COMMONWEALTH of VIRGINIA
Board of Education Agenda

Date of Meeting July 23**,** 2009 **Time:** 9 a.m.
Location: Jefferson Conference Room, 22nd Floor, James Monroe Building
101 North 14th Street, Richmond, Virginia

9:00 a.m. FULL BOARD CONVENES `

Moment of Silence

Pledge of Allegiance

Approval of Minutes of the June 25, 2009, Meeting of the Board

Public Comment

Consent Agenda

A. Final Review of Financial Report on Literary Fund

B. Final Review of Recommendations Concerning Applications for Literary Fund Loans

C. Final Review of Recommendations Concerning Literary Fund Applications

D. First Review of Proposed Revised *Guidelines and Standards of Learning for Family Life Education* as Required by the 2009 General Assembly

E. First Review of Revised *Guidelines for Awarding the Veteran Honorary High School Diploma* in Response to HB 1767 Adopted by the 2009 General Assembly

F. First Review of Proposed Board of Education Meeting Dates for 2010 Calendar Year

G. First Review of Revised Eligibility Criteria for Cost-Saving and Service-Sharing Agreements Between School Divisions in the Commonwealth of Virginia

H. First Review of Nominations to Fill Vacancies on Board of Education Advisory Committees: Advisory Committee on Adult Education and Literacy, State Special Education Advisory Committee, Virginia Advisory Committee for Career and Technical Education, Virginia Advisory Committee for the Education of the Gifted, and the Advisory Board on Teacher Education and Licensure

Action/Discussion: Board of Education Regulations

I. First Review of Proposed Guidelines for an Academic and Career Plan as Required in Section 8 VAC 20-31-140 of the *Regulations Establishing Standards for Accrediting Public Schools in Virginia*

J. First Review of Proposed Amendments to the *Regulations Governing Local School Boards and School Divisions* (8 VAC 20-720) and Repeal of the *Regulations Governing Instructional Materials – Selection and Utilization by Local School Boards* (8 VAC 20-170), *Regulations Governing Textbook Adoption State Level* (8 VAC 20-220), *Regulations Governing Textbook Adoption Local Level* (8 VAC 20-230), and *Regulations Governing Textbook Fund Management and Handling on Local Level* (8 VAC 20-270)

K. First Review of Proposed Amendments to the *Regulations Governing Local School Boards and School Divisions* (8 VAC 20-720) and Repeal of the *Rules Governing Fees and Charges* (8 VAC 20-370)

Action/Discussion Items

L. First Review of the Proposal to Establish the Governor's School @ Innovation Park (GS@IP) Serving Students from Manassas City, Manassas Park City, and Prince William County Public School Divisions

M. First Review of a Proposal to Establish a Governor's Career and Technical Academy: The Governor's Career and Technical Academy for STEM in Richmond

N. First Review of Proposed Revised Curriculum Framework for *2009 Mathematics Standards of Learning*

O. Final Review of Revisions to Criteria for the *Virginia Index of Performance*, Virginia's Incentive Program to Encourage and Recognize School Accountability Performance and Competence to Excellence

P. First Review of Updates to the Virginia Board of Education *Student Conduct Policy* Guidelines

Q. Final Review of Proposed *Guidelines for the Neighborhood Assistance Program for Education*

R. First Review of the Direct Aid to Public Education Budget for the 2010-2012 Biennium

DISCUSSION OF CURRENT ISSUES - by Board of Education Members and Superintendent of Public Instruction

EXECUTIVE SESSION

ADJOURNMENT

PUBLIC NOTICE

The Board of Education members will meet for dinner at 6:30 p.m. at the Crowne Plaza Hotel on Wednesday, July 22, 2009. Items for the Board agenda may be discussed informally at that dinner. No votes will be taken, and it is open to the public. The Board president reserves the right to change the times listed on this agenda depending upon the time constraints during the meeting.

GUIDELINES FOR PUBLIC COMMENT

1. The Board of Education is pleased to receive public comment at each of its regular monthly meetings. In order to allow the Board sufficient time for its other business, the total time allotted to public comment will generally be limited to thirty (30) minutes. Individuals seeking to speak to the Board will be allotted three (3) minutes each.

2. Those wishing to speak to the Board should contact Dr. Margaret Roberts, Executive Assistant for Board Relations at (804) 225-2924. Normally, speakers will be scheduled in the order that their requests are received until the entire allotted time slot has been used. Where issues involving a variety of views are presented before the Board, the Board reserves the right to allocate the time available so as to ensure that the Board hears from different points of view on any particular issue.

3. Speakers are urged to contact Dr. Roberts in advance of the meeting. Because of time limitations, those persons who have not previously registered to speak prior to the day of the Board meeting cannot be assured that they will have an opportunity to appear before the Board.

4. In order to make the limited time available most effective, speakers are urged to provide multiple written copies of their comments or other material amplifying their views.

Board of Education Agenda Item

Item: A. **Date:** July 23, 2009

Topic: Final Review of Financial Report on Literary Fund

Presenter: Mr. Kent C. Dickey, Assistant Superintendent for Finance

Telephone Number: (804) 225-2025 **E-Mail Address**: Kent.Dickey@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting _____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:

In accordance with the provisions of the *Code of Virginia*, Chapter 10, Section 22.1-142, the Board of Education is responsible for the management of the Literary Fund. This report reflects the status of the Literary Fund and the status of the Reserve Fund, which is in the custody of the Virginia Public School Authority (VPSA). The report also reflects the total principal of the fund, as well as cash, investments, and all short-/long-term loans in both funds.

Summary of Major Elements

Attachment A reflects the financial position of the Literary Fund as of March 31, 2009. The information presented in this report reflects the commitments against the Literary Fund as of March 31, 2009.

Attachment B reflects the currently active projects funded through the Literary Fund as of March 31, 2009.

Attachment C represents the projects that have closed and for which full payment from the Literary Fund has been made since the last Board meeting.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends approval of the financial report (including all statements) on the status of the Literary Fund as of March 31, 2009.

Impact on Resources:

As funds become available in the Literary Fund, recommendations will be made to the Board for funding priority projects and those projects at the top of the First Priority Waiting List, with the cash balance reduced as loan requests are processed.

Timetable for Further Review/Action:

The Department staff will prepare a quarterly financial report on this fund for Board approval. Information also will be presented each quarter, as part of another agenda item, regarding those projects on the two waiting lists.

Attachment A

STATEMENT OF THE FINANCIAL POSITION OF THE LITERARY FUND
(as of March 31, 2009)

Line Reference		March 31, 2009	December 31, 2008	Increase/(Decrease)
	PRINCIPAL BALANCE			
1.	Cash and investments maintained by State Treasurer	253,568,479	182,923,905	70,644,574
2.	Temporary loans received from local school boards (secured by promissory notes)	7,500,000	0	7,500,000
3.	Cash and investments in custody of Virginia Public School Authority (VPSA)	0	0	0
4.	Long-term loans in custody of Virginia Public School Authority (VPSA)	308,778,567	309,143,318	(364,751)
5.	Total Principal of Literary Fund	**569,847,046**	**492,067,223**	77,779,823
	CURRENT COMMITMENTS AGAINST LITERARY FUND REVENUE			
6.	Balance due on active projects (Attachment B)	25,091,935	41,616,998	(16,525,064)
7.	Debt service on VPSA equipment notes[1]	60,536,725	60,536,725	0
8.	Interest rate subsidy[2]	0	0	0
9.	Trigon Reserve	5,657,429	5,657,429	0
10.	Transfer for Teacher Retirement[3]	228,691,828	228,691,828	0
11.	Other Encumbrances held by Treasurer of Virginia	10,234	10,234	0
12.	Required Carry Forward Balance	64,469,470	64,469,470	0
13.	Total of Literary Fund Commitments	**384,457,620**	**400,982,684**	(16,525,064)
	FUNDS AVAILABLE FOR CURRENT COMMITMENTS AND NEW LOANS			
14.	Cash and investments maintained by State Treasurer (Line 1)	253,568,479		
15.	Less commitments against Literary Fund Revenues (Line 13)	(384,457,620)		
16.	**Balance Available to Fund New Projects Currently on Waiting List - (Additional Funds Needed to Meet Commitments)**	**(130,889,141)**		

NOTES:

[1]Chapter 781 requires $64,469,470 to be set aside for debt service on VPSA equipment notes. (Fiscal year-to-date payment of $3,932,745 in October reflected in line 7.)

[2]Chapter 781 requires $8,631,107 to be set aside for an interest rate subsidy program. (Fall Subsidy Sale completed for $8,631,106.33 and is reflected in line 6.)

[3]Chapter 781 requires $228,691,828 to be transferred from the Literary Fund to pay teacher retirement in fiscal year 2009.

Attachment B

ACTIVE LITERARY FUND PROJECTS (as of March 31, 2009)

Application Number	School Division	School	Release Date	Funds Approved for Release	Actual Funds Disbursed	Balance Due	Percent Drawn
Literary Loans							
11254	Southampton County	Riverdale Elementary	January, 2008	7,500,000	-	7,500,000	0.00%
11261	Culpeper County	New Elementary	January, 2008	7,500,000	-	7,500,000	0.00%
				$ 15,000,000	**$ -**	**$ 15,000,000**	
Subsidy Grants							
11062	Chesapeake City	Butts Road Intermediate	2001 Subsidy	85,594	(77,881)	7,713	90.99%
11098	Washington County	Holston High	2003 Subsidy	20,949	(989)	19,960	4.72%
11097	Washington County	John S. Battle High	2003 Subsidy	30,210	-	30,210	0.00%
11099	Washington County	Patrick Henry High	2003 Subsidy	30,181	-	30,181	0.00%
11100	Washington County	Valley Institute	2003 Subsidy	5,861	-	5,861	0.00%
11151	Nottoway County	Blackstone Primary	2004 Subsidy	54,632	(40,393)	14,239	73.94%
11150	Nottoway County	Crewe Primary	2004 Subsidy	191,790	(161,572)	30,218	84.24%
11181	Grayson County	Grayson Middle	2005 Subsidy	138,831	-	138,831	0.00%
11201	Portsmouth City	Park View Elementary	2006 Subsidy	1,331,227	(6,500)	1,324,727	0.49%
11210	Halifax County	Halifax Middle	2006 Subsidy	1,331,227	(1,097,125)	234,102	82.41%
11220	Halifax County	South Boston Elementary	2006 Subsidy	641,739	(227,676)	414,063	35.48%
11212	Washington County	Abingdon Elementary	2007 Subsidy	201,358	(6,500)	194,858	3.23%
11213	Washington County	High Point Elementary	2007 Subsidy	154,739	-	154,739	0.00%
11214	Washington County	Valley Institute Elementary	2007 Subsidy	123,197	-	123,197	0.00%
11215	Washington County	E. B. Stanley Middle	2007 Subsidy	149,896	-	149,896	0.00%
11228	Roanoke County	Northside High School	2007 Subsidy	798,438	-	798,438	0.00%
11258	Gloucester County	Abingdon Elementary School	2007 Subsidy	798,438	(672,361)	126,078	84.21%
11262	Wise County	Coeburn Middle School	2008 Subsidy	631,973	-	631,973	0.00%
11263	Wise County	Powell Valley Primary School	2008 Subsidy	726,322	-	726,322	0.00%
11255	Roanoke City	William Fleming High School	2008 Subsidy	1,006,140	-	1,006,140	0.00%
11272	Town of West Point	West Point High School	2008 Subsidy	64,219	(6,500)	57,719	10.12%
11273	Town of West Point	West Point Middle School	2008 Subsidy	41,984	-	41,984	0.00%
11270	Rockingham County	New Elementary School in Elkton	2008 Subsidy	999,640	-	999,640	0.00%
11271	Rockingham County	New High School in Elkton	2008 Subsidy	1,006,140	-	1,006,140	0.00%
11293	Tazewell County	Richlands Elementary School	2008 Subsidy	446,045	-	446,045	0.00%
11294	Tazewell County	Tazewell Elementary School	2008 Subsidy	483,392	-	483,392	0.00%
11295	Tazewell County	Springville Elementary School	2008 Subsidy	243,178	-	243,178	0.00%
11296	Tazewell County	North Tazewell Elementary School	2008 Subsidy	324,368	-	324,368	0.00%
11297	Tazewell County	Cedar Bluff Elementary School	2008 Subsidy	327,724	-	327,724	0.00%
				$ 27,389,431	**$ (2,297,496)**	**$ 25,091,935**	

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Attachment C

LITERARY FUND PROJECT REIMBURSEMENTS COMPLETED (as of March 31, 2009)

Application Number	School Division	School	Release Date	Funds Approved for Release	Actual Funds Disbursed	Funds Returned	Balance Due	Percent Drawn
11221	Culpeper County	Culpeper County High	January, 2008	7,500,000	(7,500,000)	-	-	100.00%
11259	Greensville County	E. W. Wyatt Middle	January, 2008	7,500,000	(7,500,000)	-	-	100.00%
				$ 15,000,000	$ (15,000,000)	$ -	$ -	
11096	Washington County	Abingdon High	2003 Subsidy	34,943	(34,943)	-	-	100.00%
11143	Franklin County	Windy Gap Elementary	2006 Subsidy	745,557	(745,557)	-	-	100.00%
11121	Henry County	G. W. Carver Elementary	2006 Subsidy	624,720	(624,720)	-	-	100.00%
11222	Henry County	Campbell Court Elementary	2006 Subsidy	706,533	(706,533)	0.10	-	100.00%
11256	Henry County	Drewry Mason Elementary	2007 Subsidy	648,523	(648,523)	-	-	100.00%
11209	New Kent County	New Kent High School	2007 Subsidy	214,640	(214,640)	-	-	100.00%
11260	Powhatan County	New Elementary School	2008 Subsidy	1,006,140	(1,006,140)	-	-	100.00%
				$ 18,981,055	$ (18,981,055)	$ 0.10	$ -	

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Board of Education Agenda Item

Item: B. **Date:** July 23, 2009

Topic: Final Review of Recommendations Concerning Applications for Literary Fund Loans

Presenter: Mr. Kent C. Dickey, Assistant Superintendent for Finance

Telephone Number: (804) 225-2025 **E-Mail Address:** Kent.Dickey@doe.virginia.gov

Origin:

_____ Topic presented for information only (no board action required)

_X_ Board review required by
_X_ State or federal law or regulation
_____ Board of Education regulation
_____ Other: _____

_X_ Action requested at this meeting _____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action

_____ Previous review/action
date _____
action _____

Background Information:

The recommendation for approval of the projects on Attachment A is in accordance with the *Code of Virginia*, Chapter 10, Section 22.1-146, which authorizes the Board of Education to make loans from the Literary Fund for the purpose of erecting, altering, or enlarging school buildings. Approval of an application constitutes the first step in a two-step process to secure a loan from the Literary Fund. The second step can occur only after Departmental receipt of final plans and specifications per Section 22.1-140 of the *Code of Virginia*, coupled with a written request to the Department for release of funds, with the latter request also requiring Board approval.

Summary of Major Elements:

Attachment A reflects one (1) application that has been reviewed by the Department. This application has met all of the Board requirements necessary to be approved for a Literary Fund loan.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends approval of the one (1) application totaling $7,500,000 (Attachment A).

Impact on Resources:

There will be no impact on the resources of the Literary Fund until a locality receives approval from the Board of Education for the release of funds, construction begins on the approved project, and a request for reimbursement is submitted and approved.

Timetable for Further Review/Action:

Recommendations similar to Attachment A will be presented to the Board on a quarterly basis as needed, if found in proper order after review by the Department.

BOARD OF EDUCATION

LITERARY FUND LOAN APPLICATIONS PRESENTED FOR APPROVAL

It is recommended that the following applications be approved:

Literary Fund #	School Division	School	Date Received	Amount	Comment
11312	Buckingham County	Dillwyn Lower Elementary School	April 27, 2009	7,500,000	Addition and Renovation (Plans Not Received)

Total: $ 7,500,000

July, 2009

Board of Education Agenda Item

Item: C. **Date:** July 23, 2009

Topic: Final Review of Recommendations Concerning Literary Fund Applications Approved for Release of Funds or Placement on a Waiting List

Presenter: Mr. Kent C. Dickey, Assistant Superintendent for Finance

Telephone Number: (804) 225-2025 **E-Mail Address**: Kent.Dickey@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action
____ Previous review/action
date _____
action _____

Background Information:

The Literary Fund regulations of the Board establish two priorities for the Literary Fund Waiting Lists. These priorities are as follows:

Priority 1: Applications from localities having a composite index less than 0.6000 and indebtedness (including the application considered for release of funds) less than $20 million to the Literary Fund (Attachment A).

Priority 2: Applications from localities having a composite index of 0.6000 or above or an indebtedness (including the application considered for release of funds) of $20 million or greater to the Literary Fund (Attachment B).

Attachment C lists the projects that have been removed from the First Priority Waiting List.

Attachment D identifies the Literary Fund applications that are available for release.

Attachment E is the Board of Education's current Approved Application List. This attachment identifies the Literary Fund applications that are approved as to form but are not included on either waiting list and are not recommended for funding.

Summary of Major Elements:

To the extent funds are available, a recommendation for initial release of funds is presented for projects currently on the First Priority Waiting List or otherwise eligible for priority funding. To the extent funds are not available, new requests for the initial release of Literary Funds cannot be approved. As a result, such requests must be deferred and placed on either the First or Second Priority Waiting List in accordance with the Literary Fund regulations.

This item consists of the four elements that require action by the Board of Education. These elements are:

1. One new project, totaling $7,500,000, listed on Attachment A is eligible for placement on the First Priority Waiting List.

2. Orange County submitted a letter dated June 30, 2009, requesting that its Middle School project be removed from the First Priority Waiting List. The school board has acquired funding from sources other than the Literary Fund for this project.

3. One new project, totaling $7,500,000, listed on Attachment E, has a Literary Fund application, which is approved as to form, but the plans have not yet been finalized. When the Department receives the plans, this project will be eligible for placement on a waiting list. Until such time, this project should remain on the Approved Application List.

4. Roanoke County submitted a letter dated April 8, 2009, requesting that the William Byrd High School project be removed from the Approved Application List. The school board has acquired funding from sources other than the Literary Fund for this project.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education approve the action described in the four elements listed under "Summary of Major Elements."

Impact on Resources:

Current Board policy provides that, upon initial release of funds, Literary Fund cash is reduced in the total amount of the approved loan to assure that cash is available as required for project completion. The disbursement of funds is based on actual invoices or other evidence of bills due and payable from the Literary Fund.

Timetable for Further Review/Action:

The staff will prepare items for the Board on these actions as needed. Based on the availability of funds, initial release of funds will be made or projects will be deferred and placed on the Waiting Lists.

VIRGINIA BOARD OF EDUCATION - LITERARY FUND FIRST PRIORITY WAITING LIST

The following projects have been placed or are recommended for placement on the First Priority Waiting List with the actions as indicated in the last column. Projects recommended for action at this meeting are presented in italics.

Priority	Date Placed on Waiting List	School Division	School	Interest Rate	Amount	Cumulative Total	Action/Status
1	July, 2007	Pulaski County	Riverlawn Elementary School	2%	7,500,000	7,500,000	Funding Deferred
2	October, 2007	Manassas Park City	Cougar Upper Elementary School	3%	7,500,000	15,000,000	Funding Deferred
3	October, 2007	Covington City	Jeter Watson Intermediate School	2%	7,500,000	22,500,000	Funding Deferred
4	October, 2007	Covington City	Edgemont Primary School	2%	7,500,000	30,000,000	Funding Deferred
5	October, 2007	Prince George County	North Elementary School	2%	7,500,000	37,500,000	Funding Deferred
6	July, 2008	Petersburg City	Robert E. Lee Elementary School	2%	6,493,700	43,993,700	Funding Deferred
7	July, 2008	Petersburg City	Walnut Hill Elementary School	2%	5,818,691	49,812,391	Funding Deferred
8	July, 2008	Norton City	Norton Elementary School	3%	7,500,000	57,312,391	Funding Deferred
9	July, 2008	Portsmouth City	Simonsdale Elementary School	2%	7,500,000	64,812,391	Funding Deferred
10	July, 2008	Lynchburg City	Sandusky Middle School	3%	7,500,000	72,312,391	Funding Deferred
11	July, 2008	Northampton County	Northampton High School	3%	7,500,000	79,812,391	Funding Deferred
12	July, 2008	Lee County	Dryden Elementary School	2%	2,300,000	82,112,391	Funding Deferred
13	July, 2008	Grayson County	West Grayson Elementary School	2%	7,500,000	89,612,391	Funding Deferred
14	October, 2008	Pittsylvania County	Tunstall High School	2%	7,500,000	97,112,391	Funding Deferred
15	October, 2008	Pittsylvania County	Chatham High School	2%	7,500,000	104,612,391	Funding Deferred
16	October, 2008	Wythe County	Rural Retreat High School	2%	7,500,000	112,112,391	Funding Deferred
17	October, 2008	Wythe County	Rural Retreat Middle School	2%	2,600,000	114,712,391	Funding Deferred
18	October, 2008	Montgomery County	New Elliston-Lafayette & Shawsville Elementary School	3%	7,500,000	122,212,391	Funding Deferred
19	January, 2009	Lexington City	Lylburn Downing Middle School	3%	7,500,000	129,712,391	Funding Deferred
20	January, 2009	Warren County	Luray Avenue Middle School	3%	7,500,000	137,212,391	Funding Deferred
21	January, 2009	Grayson County	Fries Elementary School	2%	7,500,000	144,712,391	Funding Deferred
22	January, 2009	Henry County	Fieldale Collinsville Middle School	2%	2,500,000	147,212,391	Funding Deferred
23	January, 2009	Henry County	Magna Vista High School	2%	7,200,000	154,412,391	Funding Deferred
24	January, 2009	Richmond County	Richmond County Elementary School	3%	4,250,000	158,662,391	Funding Deferred
25	January, 2009	Richmond County	Rappahannock High School	3%	250,000	158,912,391	Funding Deferred
26	April, 2009	Giles County	Giles County Technology Center	2%	7,500,000	166,412,391	Funding Deferred
27	April, 2009	Giles County	Eastern Elementary/Middle School	2%	7,500,000	173,912,391	Funding Deferred
28	April, 2009	Nottoway County	Blackstone Primary School	2%	666,667	174,579,058	Funding Deferred
29	April, 2009	Nottoway County	Crewe Primary School	2%	666,667	175,245,725	Funding Deferred
30	April, 2009	Nottoway County	Burkeville Elementary School	2%	666,666	175,912,391	Funding Deferred
31	April, 2009	Fluvanna County	Fluvanna County High School	3%	7,500,000	183,412,391	Funding Deferred

New projects to be added with funding deferred until funds are approved for release by separate action of the Board of Education

32	*July, 2009*	*Virginia Beach City*	*Great Neck Middle School*	*3%*	*7,500,000*	*190,912,391*	*Funding Deferred*

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VIRGINIA BOARD OF EDUCATION - LITERARY FUND SECOND PRIORITY WAITING LIST

The following projects have been placed or are recommended for placement on the Second Priority Waiting List with the actions as indicated in the last column. Projects recommended for action at this meeting are presented in italics.

Priority	Date Placed on Waiting List	School Division	School	Interest Rate	Amount	Cumulative Total	Action/Status	Comments
1	October, 2008	Pittsylvania County	Dan River High School	2%	7,500,000	7,500,000	Funding Deferred	
2	October, 2008	Pittsylvania County	Gretna High School	2%	7,500,000	15,000,000	Funding Deferred	

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VIRGINIA BOARD OF EDUCATION - REMOVAL FROM FIRST PRIORITY WAITING LIST

The following projects have been removed from the First Priority Waiting List with the actions as indicated in the last column.

Date Placed on Waiting List	School Division	School	Interest Rate	Amount	Cumulative Total	Action/Status
January, 2009	Orange County	Middle School	4%	7,500,000	7,500,000	Application withdrawn

July, 2009

VIRGINIA BOARD OF EDUCATION - RELEASE OF LITERARY FUNDS

It is recommended that Literary Funds be released for the following projects on the first priority waiting list.

Date Placed on Waiting List	School Division	School	Interest Rate	Amount	Cumulative Total

NO PROJECTS

July, 2009

LITERARY FUND OF VIRGINIA

APPROVED APPLICATION LIST [1]

Priority[2]	Date Placed on Application List	School Division	School	Interest Rate	Application Amount	Cumulative Total	Action/Status
1	January, 2007	Washington County	John Battle High School	3%	489,126	489,126	Pending receipt of plans
2	January, 2007	Washington County	Abingdon High School	3%	489,126	978,252	Pending receipt of plans
3	January, 2007	Washington County	Patrick Henry High School	3%	1,177,236	2,155,488	Pending receipt of plans
4	January, 2007	Washington County	Holston High School	3%	602,186	2,757,674	Pending receipt of plans
5	January, 2007	Washington County	Meadowview Elementary School	3%	1,491,288	4,248,962	Pending receipt of plans
6	January, 2007	Washington County	Wallace Middle School	3%	1,165,073	5,414,035	Pending receipt of plans
7	January, 2007	Washington County	Glade Spring Middle School	3%	1,596,000	7,010,035	Pending receipt of plans
8	April, 2008	Alleghany County	Alleghany High School	2%	7,500,000	14,510,035	Pending receipt of plans
9	January, 2009	Hopewell City	Hopewell High School	2%	7,500,000	22,010,035	Pending receipt of plans
New projects to be added to the approved application list							
10	*July, 2009*	*Buckingham County*	*Dillwyn Lower Elementary School*	*2%*	*7,500,000*	*29,510,035*	*Pending receipt of plans*

[1] Reflects only those applications not on waiting lists

[2] The William Byrd High School project, previously ranked Priority 1, has been withdrawn by Roanoke County.

Note: Per 8VAC20-100-90, applications which remain on the approved application list for three years shall be removed from the list.

Board of Education Agenda Item

Item: D. **Date:** July 23, 2009

Topic: First Review of Proposed Revised *Guidelines and Standards of Learning for Family Life Education* as Required by the 2009 General Assembly

Presenter: Dr. Cynthia A. Cave, Director of Student Services

Telephone Number: 804-225-2818 **E-Mail Address**: Cynthia.Cave@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)
_X_ Board review required by
  _X_ State or federal law or regulation
  ____ Board of Education regulation
  ____ Other: _____

_X_ Action requested at this meeting __ Action requested at future meeting: _____(Date)

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:

The Family Life Education requirements of the Board of Education were first enacted in 1987 by the General Assembly. In 1988, the Board of Education prepared a document that included Standards of Learning (SOL) Objectives and Descriptive Statements, guidelines for training individuals who will be teaching family life education, and guidelines for parent/community involvement. The 1988 guidelines were revised in 2002 to include the requirements of House Bill 1206 (benefits of adoption), in 2004 to include the requirements of House Bill 1015 (sexual assault), in 2007 to include House Bill 1916 (dating violence and the characteristics of abusive relationships), and again in 2008 to include Senate Bill 640 (mental health education and awareness).

In the 2009 Session of the Virginia General Assembly, House Bill 1746 (Pogge) and Senate Bill 827 (Smith) amended § 22.1-207.1 of the *Code of Virginia* to require that the following information be included in the Family Life Guidelines:

> The Board of Education shall develop by December 1, 1987, standards of learning and curriculum guidelines for a comprehensive, sequential family life education curriculum in grades K through 12. Such curriculum guidelines shall include instruction as appropriate

for the age of the student in family living and community relationships; the benefits, challenges, responsibilities, and value of marriage for men, women, and children, and communities; abstinence education; the value of postponing sexual activity; the benefits of adoption as a positive choice in the event of an unwanted pregnancy; human sexuality; human reproduction; dating violence; the characteristics of abusive relationships; steps to take to avoid sexual assault, and the availability of counseling and legal resources, and, in the event of such sexual assault, the importance of immediate medical attention and advice, as well as the requirements of the law; the etiology, prevention and effects of sexually transmitted diseases; and mental health education and awareness.

Also in the 2009 session, House Bill 1980 (McClellan) amended § 22.1-207.2 to require all school divisions to provide parents and guardians of students participating in a family life education program a summary to assist in understanding the program being taught in the classroom. The amendment changes the previous *Code of Virginia* language, which required the provision of a summary only upon a request from a parent or guardian. The amended section is shown below.

> Each school board shall develop and,- ~~when so requested by an individual parent or guardian of a student participating in the family life education program,~~ distribute to ~~that parent or guardian,~~ the parents or guardians of a student participating in the family life education program a summary designed to assist parents in understanding the program implemented in its school division as such program progresses and to encourage parental guidance and involvement in the instruction of the students. Such information shall reflect the curricula of the program as taught in the classroom. The school division shall include the following information on the summary:
>
> Parents and guardians have the right to review the family life education program offered by their school division, including written and audio-visual educational materials used in the program. Parents and guardians also have the right to excuse their child from all or part of family life education instruction.

Summary of Major Elements:

As shown in the attached, the *Guidelines and Standards of Learning for Family Life Education* have been revised in accordance with the 2009 legislation. See pages two and three of the guidelines section, which references *Code* § 22.1-207.2, "Right of parents to review certain materials; summaries distributed on request." See also pages ten and 12 of the guidelines. Many of the descriptive statements supporting the *Standards* objectives already reflect the new legislative requirements. Others have been amended to reflect the required age-appropriate changes in the guidelines. Revisions have also been made to align the *Standards* with the *Student Conduct Policy Guidelines.* The revised standards are listed below.

Grade Level	Amended Standards of Learning Descriptive Statements	Page
Kindergarten	K.3, K.7	16, 17
First Grade	1.12	19
Second Grade	2.5, 2.7	20, 21
Third Grade	3.1, 3.2, 3.10, 3.11	22, 23
Fourth Grade	4.7	25
Fifth Grade	5.10, 5.12	27
Sixth Grade	6.8	29
Seventh Grade	7.4, 7.7, 7.10	30, 31
Eighth Grade	8.3, 8.5, 8.6, 8.13	33, 34
Ninth Grade	9.2, 9.7, 9.14	36, 37
Tenth Grade	10.2, 10.14	38, 39
Eleventh Grade	11.1, 11.6	41
Twelfth Grade	12.8, 12.12	45

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education waive first review and adopt the revised curriculum guidelines regarding Family Life Education.

Impact on Resources:
The financial impact will be minimal. The revised document will be posted on the Virginia Department of Education's Office of Student Services Web site. School divisions will be informed of the revisions by way of a Superintendent's Memo.

Timetable for Further Review/Action:
Upon Board of Education adoption of the 2009 revised guidelines, the Virginia Department of Education will make them available to school divisions and post the guidelines on the Virginia Department of Education's Office of Student Services Web site.

Family Life Education

Board of Education Guidelines
and
Standards of Learning
for Virginia Public Schools

Commonwealth of Virginia
Department of Education
Richmond, VA 23218-2120

Revised
July 2009

FAMILY LIFE EDUCATION

Revised 2009

FAMILY LIFE EDUCATION

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CODE OF VIRGINIA
FOR FAMILY LIFE EDUCATION

CODE OF VIRGINIA FOR FAMILY LIFE EDUCATION

§22.1-207.1. Family life education.

The Board of Education shall develop by December 1, 1987, standards of learning and curriculum guidelines for a comprehensive, sequential family life education curriculum in grades K through 12. Such curriculum guidelines shall include instruction as appropriate for the age of the student in family living and community relationships; the benefits, challenges, responsibilities, and value of marriage for men, women, and children, and communities; abstinence education; the value of postponing sexual activity; the benefits of adoption as a positive choice in the event of an unwanted pregnancy; human sexuality; human reproduction; dating violence; the characteristics of abusive relationships; steps to take to avoid sexual assault, and the availability of counseling and legal resources, and, in the event of such sexual assault, the importance of immediate medical attention and advice, as well as the requirements of the law; the etiology, prevention and effects of sexually transmitted diseases; and mental health education and awareness.

All such instruction shall be designed to promote parental involvement, foster positive self concepts and provide mechanisms for coping with peer pressure and the stresses of modern living according to the students' developmental stages and abilities. The Board shall also establish requirements for appropriate training for teachers of family life education, which shall include training in instructional elements to support the various curriculum components.

For the purposes of this section, "abstinence education" means an educational or motivational component which has as its exclusive purpose teaching the social, psychological, and health gains to be realized by teenagers' abstaining from sexual activity before marriage.

(1987, c. 371; 1999, c. 422; 2002, c. 554; 2004, c. 1030; 2007, c. 32.; 2008, c.0417; 2009, c.437)

§ 22.1-207.2. Right of parents to review certain materials; summaries distributed on request.

Every parent, guardian or other person in the Commonwealth having control or charge of any child who is required by § 22.1-254 A to send such child to a public school shall have the right to review the complete family life curricula, including all supplemental materials used in any family life education program. A complete copy of all printed materials and a description of all audio-visual materials shall be kept in the school library or office and made available for review to any parent or guardian during school office hours before and during the school year. The audio-visual materials shall be made available to parents for review, upon request, on the same basis as printed materials are made available.

Each school board shall develop and~~, when so requested by an individual parent or guardian of a student participating in the family life education program,~~ distribute to ~~that parent or guardian,~~ the parents or guardians of a student participating in the family life education program a summary designed to assist parents in understanding the program implemented in its school division as such program progresses and to encourage parental guidance and involvement in the instruction of the students. Such information shall reflect the curricula of the program as taught in the classroom. The school division shall include the following information on the summary:

"Parents and guardians have the right to review the family life education program offered by their school division, including written and audio-visual educational materials used in the program. Parents and guardians also have the right to excuse their child from all or part of family life education instruction."

(1989, c. 515; 1991, cc. 139, 526; cc. 0451; 2009, cc.)

INTRODUCTION

INTRODUCTION

In 1987, §22.1-207.1 of the *Code of Virginia* was amended to direct the Board of Education to develop standards of learning and curriculum guidelines for a comprehensive, sequential family life education (FLE) curriculum in grades K through 12. From February 1987 to December 1987, individuals from public schools (including administrators and teachers), state agencies, parent groups, and not-for-profit organizations that provided family life services contributed time, resources, and expertise to help develop a report to submit to the Virginia General Assembly. The report *Family Life Education: Board of Education's Response to House Bill No. 1413* included sections on the Board of Education guidelines for setting up a required FLE program, Standards of Learning objectives and descriptive statements for grades kindergarten through 12, guidelines for training individuals that teach FLE and for involving parents and community-based organizations in the local FLE program.

The FLE program was funded by the General Assembly during its 1988 session based on the plan developed by the Board of Education and the Department of Education. The program scheduled for implementation by all school divisions during the 1989-90 school year, provided guidance to localities in developing comprehensive, age-appropriate, and sequential instruction in specific content areas. Program flexibility allowed options for the local planning teams. The program could cover grades K through 10 or K through 12, depending upon the desires of a school division. School divisions were permitted to use state-approved Standards of Learning objectives or develop their own learner objectives. Educators identified as FLE teachers participated in in-depth staff development workshops over a two-year period.

Each school division was required to appoint a community involvement team to assist in the development of the program and to promote community involvement. The Board of Education guidelines were written to assure that parents had opportunities to review the program annually and to opt their children out of all or part of the program.

During the fall and winter of school year 1992-93, the Department of Education conducted a study of the FLE program in the Virginia public schools. The study resulted from an agreement between the 1992 General Assembly and the Department of Education. A self-report survey of FLE programs was repeated in 2004 and 2006. Results again indicated compliance with mandates and policies. Of the 132 school divisions serving students in the state, 120 divisions, or 91 percent, responded to the 2006 survey. Eighty-eight percent, or 105, of school divisions surveyed in 2006 offered FLE programming.

Also in 1992, the Virginia General Assembly amended §22.1-275.1 of the *Code of Virginia* to direct local school boards to establish a school health advisory board of no more than 20 members. The legislation specified that the local board shall consist of broad-based community representation including, but not limited to, parents, students, health professionals, educators, and others. Many localities opted for their school health advisory board to also serve as the FLE community involvement team.

In September 1997, the *Regulations Establishing Standards for Accrediting Public Schools in Virginia (8 VAC 20-131-10)* were amended by the Board of Education to state that "Each school may implement the Standards of Learning for the Family Life Education program promulgated by the Board of Education or a Family Life Education program consistent with the guidelines developed by the Board of Education which shall have the goals of reducing the incidence of pregnancy and/or sexually-transmitted disease and substance abuse among teenagers."

The 1999 Virginia General Assembly amended §22.1-207.1 of the *Code of Virginia* and added "abstinence education" as a Family Life Education instructional topic to the content areas identified in 1987: "…family living and community relationships, the value of postponing sexual activity, human sexuality, human reproduction, and the etiology, prevention and effects of sexually transmitted diseases." The Virginia Department of Education and Virginia Department of Health cooperated to strengthen abstinence education staff development workshops.

House Bill 1206, passed by the 2002 Virginia General Assembly, required the Board of Education to include "the benefits of adoption as a positive choice in the event of an unwanted pregnancy" in its curriculum guidelines for a comprehensive, sequential Family Life Education curriculum. The bill also required the Board to specify that training of teachers of Family Life Education include training in instructional elements to support the various curriculum components.

House Bill 1015, passed by the 2004 Virginia General Assembly, required the Board of Education to include "steps to take to avoid sexual assault, and the availability of counseling and legal resources, and, in the event of such sexual assault, the importance of immediate medical attention and advice, as well as the requirements of the law" in its curriculum guidelines for a comprehensive, sequential Family Life Education curriculum.

House Bill 1916, passed by the 2007 Virginia General Assembly, required the Board of Education to include "dating violence and the characteristics of abusive relationships" in its curriculum guidelines for a comprehensive, sequential Family Life Education curriculum.

Senate Bill 640, passed by the 2008 Virginia General Assembly, required the Board of Education to include "mental health education and awareness" in its curriculum guidelines for a comprehensive, sequential Family Life Education curriculum.

House Bill 1746, passed by the 2009 Virginia General Assembly, required the Board of Education to include "benefits, challenges, responsibilities, and value of marriage for men, women, children, and communities" in its curriculum guidelines for a comprehensive, sequential Family Life Education curriculum.

House Bill 1980, also passed by the 2009 Virginia General Assembly, required school divisions to provide parents and guardians of students participating in a family life

education program a summary to assist in understanding the program being implemented. The summary should include the following statement: "Parents and guardians have the right to review the family life education program offered by their school division, including written and audio-visual educational materials used in the program. Parents and guardians also have the right to excuse their child from all or part of family life education instruction."

In an effort to align with the *Student Conduct Policy Guidelines*, information regarding the appropriate use of electronic devices was added to Family Life Education program.

BOARD OF EDUCATION GUIDELINES FOR FAMILY LIFE EDUCATION

BOARD OF EDUCATION GUIDELINES FOR FAMILY LIFE EDUCATION

I. The following guidelines shall be followed in the implementation of the Board of Education's approved Family Life Education program.

A. A community involvement team, or school health advisory board, shall be identified and should include individuals such as a person from the central office, an elementary school principal, a middle school principal, a high school principal, teachers, a school board member, parents, one or more members of the clergy, a member of the medical profession, and others in the community.

B. There must be evidence of broad-based community involvement and an annual opportunity for parents and others to review curriculum and instructional materials prior to the beginning of actual instruction.

C. Those individuals selected by the localities to teach the Family Life Education program shall participate in the training program sponsored by the Department of Education.

~~D. A Family Life Education leader from each grade level shall be identified to assist in training individuals who will be teaching to work with a community involvement team or school health advisory board, and to assist in program implementation and evaluation.~~

D.~~E.~~ Medical professionals ~~shall~~ may be involved, where appropriate, to help teach the content of the Family Life Education curriculum and to serve as a resource to students and to parents.

E.~~F.~~ Local training and follow-up activities shall involve the community in understanding and implementing the Family Life Education program.

F.~~G.~~ Local agencies/organizations/support systems shall be identified and used as resources for the Family Life Education program.

G. An "opt-out" procedure shall be provided to ensure communication with the parent or guardian for permission for students to be excused from all or part of the program.

H. A plan for teaching sensitive content in sex-separated classes shall be announced publicly.

I. The *Family Life Education Standards of Learning* objectives approved by the Board of Education shall be used by the local school board. However, local school divisions may reassign the grade designation of the Standards of Learning objectives within grades K-6. The grade designation for objectives within grades 7-12 may be reassigned only one grade level, up or down. Also, the program may be adopted for kindergarten through grade 10 or kindergarten through grade 12; however, local scheduling of Family Life Education shall avoid any interruption or detraction from instruction in basic skills in elementary schools or in those courses required for graduation in the secondary schools.

J. The curriculum shall include education about those sections of statutory law applicable to instructional units relating to sexual conduct and misconduct and legal provisions relating to family life. This would include using any electronic devises to convey inappropriate behaviors and/or images.

K. The curriculum shall include mental health education and awareness as applicable to instructional units relating to family life.

L. The curriculum shall include information outlining the benefits, challenges, responsibilities, and value of marriage for men, women, children and communities.

II. The following guidelines shall be followed in the implementation of the Family Life Education program developed locally.

A. The Family Life Education program developed locally shall be comprehensive and sequential and include the following content areas and may include others at the discretion of the local school board:

1. Family living and community relationships;

2. The value of postponing sexual activity until marriage (abstinence education);

3. Human sexuality;

4. Human reproduction and contraception, including the benefits of adoptions as a positive choice in the event of an unwanted pregnancy;

5. The etiology, prevention, and effects of sexually transmitted diseases;

6. Stress management and resistance to peer pressure;

7. Development of positive self-concepts and respect for others, including people of other races, religions, or origins;

8. Parenting skills;

9. Substance abuse;

10. Child abuse;

11. Prevention of sexual assault and, in the event of sexual assault, the importance of receiving immediate medical attention and advice, knowledge of the requirements of the law, and use of resources such as counseling and legal services;

12. Dating violence and the characteristics of abusive relationships including using electronic devices to convey inappropriate images and behaviors; ~~and~~

13. Mental health education and awareness; and

14. The benefits of marriage.

B. The Family Life Education program developed locally shall include and adhere to the following:

1. A community involvement team, or school health advisory board, shall be identified and should include individuals such as a person from the central office, an elementary school principal, a middle school principal, a high school principal, teachers, a school board member, parents, one or more members of the clergy, a member of the medical profession, a mental health practitioner, and others in the community.

2. There must be evidence of broad-based community involvement and an annual opportunity for parents and others to review curriculum and instructional materials prior to the beginning of actual instruction.

3. Those individuals selected by the localities to teach the local Family Life Education program shall participate in the training program sponsored by the Department of Education. The training program shall include training in instructional elements to support the various curriculum components.

4. A Family Life Education leader from each grade level shall be identified to assist in training individuals who will be teaching, to work with a community involvement team or school health advisory board, and to assist in program implementation and evaluation.

5. Medical and mental health professionals may ~~shall~~ be involved, where appropriate, to help teach the content of the Family Life Education curriculum and to serve as a resource to students and to parents.

6. Local training and follow-up activities shall involve the community in understanding and implementing the Family Life Education program.

7. Local agencies/organizations/support systems shall be identified and used as resources for the Family Life Education program.

8. An "opt-out" procedure shall be provided to ensure communication with the parent or guardian for permission for students to be excused from all or part of the program.

9. A plan for teaching sensitive content in sex-separated classes shall be announced publicly.

10. Local scheduling of Family Life Education, to include kindergarten through grade 10 or kindergarten through grade 12, shall avoid any interruption or detraction from instruction in the basic skills in the elementary schools or in those courses required for graduation in the secondary schools.

11. A local curriculum plan shall use as a reference the *Family Life Education Standards of Learning* objectives approved by the Board of Education and shall provide age-appropriate instruction in relation to students' developmental stages and abilities.

12. The curriculum shall include education about those sections of statutory law applicable to instructional units relating to sexual conduct and misconduct and legal provisions relating to family life. <u>This would include using any electronic devises to convey inappropriate behaviors and/or images</u>.

13. The curriculum shall include mental health education and awareness as applicable to instructional units relating to family life.

<u>14. The curriculum shall include information on the benefits, challenges, responsibilities, and value of marriage for men, women, children, and communities.</u>

STANDARDS OF LEARNING OBJECTIVES AND DESCRIPTIVE STATEMENTS

STANDARDS OF LEARNING OBJECTIVES AND DESCRIPTIVE STATEMENTS

KINDERGARTEN

K.1 The student will experience success and positive feelings about self.

Descriptive Statement: These experiences are provided by the teacher through the climate of the classroom environment and include, but are not limited to, experiencing success in school, effectively handling routines, experiencing self-acceptance, and acceptance from others. Parents are encouraged to reinforce these positive experiences and feelings at home. Emphasis is placed on respect for racial and ethnic differences.

K.2 The student will experience respect from and for others.

Descriptive Statement: Teachers and other adults at school actively listen to and accept feelings and opinions of the child. A classroom climate that encourages positive mental health development and protects the child from physical and emotional infringements by others is provided. The child also learns and practices courtesy and good manners.

K.3 The student will become aware of the effects of his or her behavior on others and the effects of others' behavior on himself or herself.

Descriptive Statement: The teacher uses appropriate descriptive language to explain to a child how his or her behavior affects others positively as well as negatively. The same descriptive language is used to explain to a child the effects of others' behavior on him or her. This approach is reinforced by other school personnel and parents are encouraged to continue such explanations at home. The child is introduced to the concept of privacy, especially in the use of bathroom facilities. In addition, the importance of avoiding gossip about others' personal or family problems is stressed. Concepts concerning electronic privacy, such as not sharing your name and address over the internet, are introduced.

K.4 The student will recognize that everyone is a member of a family and that families come in many forms.

Descriptive Statement: This includes a variety of family forms: traditional or two-parent families-mother, father, and children; extended families-relatives other than the immediate family living in the home; single-parent families; adoptive families; foster families; families with stepparents; and blended families-new families formed by the marriage of a man and woman with children from previous marriages. Recognition and inclusion will foster positive mental health.

K.5 The student will identify members of his or her own family.

Descriptive Statement: This refers to identifying the adult and child members of the student's family.

K.6 The student will develop an awareness of positive ways in which family members show love, affection, respect, and appreciation for each other.

Descriptive Statement: The focus is on the appropriate words and actions that promote positive mental health development. Through words and actions which convey care, protection and guidance, such as touching, listening, hugging, praising, encouraging, supporting, helping and playing, the child will understand that rules are made for safety, and protection.

K.7 The student will realize that physical affection can be an expression of friendship, of celebration, or of a loving family.

Descriptive Statement: It is important for the student to understand that appropriate expressions of affection are healthy for the individual, ~~and for~~ the family, and the community. The student will begin to understand the differences between appropriate and inappropriate expressions of affection. This understanding will foster positive mental health.

K.8 The student will recognize the elements of good and bad touches by others.

Descriptive Statement: Elements of good touches by others are identified as follows: (1) touching that can be done in front of anyone; (2) touching that is not a secret; (3) touching that makes the child feel good and not uncomfortable; (4) touching that is done to provide cleaning or medical care for the child; and (5) touching that is an expression of affection by a family member. Bad touches by others include the following: (1) touching on private parts of the body; (2) touching to be kept secret; and (3) touching that could produce bad feelings.

K.9 The student will demonstrate how to say "no" to inappropriate approaches from family members, neighbors, strangers, and others.

Descriptive Statement: This involves learning how to say "no" in a loud voice while standing up and looking directly at the person. It is important for children to know that they should tell or report such happenings to a trusted adult such as a parent, teacher, minister, grandparent, or guardian. In addition, they should understand the need to continue telling about inappropriate approaches until someone listens and responds.

K.10 The student will identify "feeling good" and "feeling bad."

Descriptive Statement: Descriptive words are used to help the child identify pleasant and unpleasant feelings. Parents are encouraged to reinforce expressions of feelings at home and to work with the teacher in a team approach to achieving this, which encourages good mental health functioning.

K.11 The student will find help safely if lost.

Descriptive Statement: Students learn their full names, addresses, telephone numbers, and how to find reliable help if lost in a mall or other public place.

FIRST GRADE

1.1 The student will experience continuing success and good feelings about self.
Descriptive Statement: The teacher continues to provide a classroom environment that fosters experiences of success in school work, in self-acceptance of body image, in the handling of routine situations, and in group activities. The student is made aware of any behavior on his or her part that causes others to have hurt feelings. Parents are encouraged to reinforce successful experiences, self-esteem, and good mental health practices at home.

1.2 The student will experience continuing respect from others.
Descriptive Statement: Teachers and other adults at school continue active listening and acceptance of the feelings and opinions of the child, providing a classroom climate that protects the child from physical, mental and emotional infringement by others. Difficult situations, such as how to handle a bully on the playground, are discussed.

1.3 The student will become aware of the effects of his or her behavior on others and the effects of others' behavior on himself or herself.
Descriptive Statement: The teacher continues to use appropriate descriptive language to explain to a child how his or her behavior affects others both positively and negatively, and how others' behavior affects him or her. The child learns to respect others and their feelings, and practices good mental health behaviors.

1.4 The student will develop an understanding of the importance of a family and of different family patterns.
Descriptive statement: The emphasis is on the need for loving parents, or other responsible adult(s) in the family, regardless of the type of family. The student advances from awareness of family forms at the kindergarten level to understanding the importance of the family and its various forms at the first-grade level. The following family patterns are included: two-parent families; extended families-relatives other than the immediate family living in the home; single-parent families; adoptive families; foster families; families with stepparent; and blended families-new families formed by the marriage of a man and woman with children from previous marriages. Recognition and inclusion will foster positive mental health.

1.5 The student will identify family members and their responsibilities in contributing to the successful functioning of the family.
Descriptive Statement: The focus is on the tasks that must be performed in order for a family to function successfully. Examples of tasks are providing food; providing shelter; providing and caring for clothing; providing money for these and other necessities; providing love and caring, including meeting the needs of elderly or physically and mentally disabled family members; and providing for fun and play.

1.6 The student will realize that human beings and other mammals have babies and that the babies can be breast-fed.
Descriptive Statement: Content associated with this objective can be found in books, magazines, films, videos, and other materials, as approved by the school division. Pets may be used to demonstrate mammalian behavior. Parents are encouraged to assist with this objective during the course of normal family activities.

1.7 The student will use correct terminology when talking about body parts and functions.

Descriptive Statement: Scientific terms such as urinate, bowel movement, penis and breast will be introduced as they occur in daily activities and are not taught directly. Parents are encouraged to reinforce correct terminology at home.

1.8 The student will express his or her feelings of happiness, sadness, and anger to the teacher.

Descriptive Statement: Teachers help children on an individual basis to recognize and express their feelings of happiness, sadness, and anger. Children are assisted in dealing appropriately with their feelings. If matters of a private nature arise, teachers are urged to contact parents so they can take a team approach to individual student problems. Positive mental health practices will be utilized.

1.9 The student will become aware of appropriate behavior to use in dealing with his or her feelings.

Descriptive Statement: The focus is on helping the child understand that feelings are different from behavior. The teacher helps the child understand that while feelings do influence behavior, each person can control his or her own behavior and the ways feelings are expressed. It is important for the teacher to help the child know that all feelings are valid. Appropriate strategies for expressing feelings include exercise, games, direct verbalization, art, music, dance, play, storytelling, and creative drama. Positive mental health practices will be utilized.

1.10 The student will experience the logical consequences of his or her behavior.

Descriptive Statement: The child needs to have the opportunity to make developmentally appropriate choices in his or her daily living and to experience the outcomes (both positive and negative) of his or her choices. The foundation for responsible decision making and positive mental health at all ages involves being allowed to learn from one's choices. Examples of appropriate choices at this grade level include choosing from a list of appropriate foods, choosing from a variety of activities and learning centers, and choosing the sequence in which learning activities are completed. An example of an appropriate consequence would be to clean up a spilled beverage rather than to be punished for this.

1.11 The student will realize that physical affection can be an expression of friendship, of celebration, or of a loving family.

Descriptive Statement: The child is reminded that appropriate expressions of affection are important for individual and family well-being and that physical affection from family members and friends usually represents good touching. The student will begin to understand the differences between appropriate and inappropriate expressions of affection and the impact on individual mental health.

1.12 The student will demonstrate strategies for responses to inappropriate approaches from family members, neighbors, strangers, and others.

Descriptive Statement: Elements of good and bad touching are reviewed, and methods of avoiding negative encounters are presented. Appropriate use of communication devices such as the phone and internet will be discussed. Children learn how to tell a trusted adult, such as a parent, teacher, minister, grandparent, or guardian, about such incidents when they occur.

SECOND GRADE

2.1 The student will recognize that everyone has strengths and weaknesses and that all persons need to be accepted and appreciated as worthwhile.

Descriptive Statement: The key idea is that all human beings are worthwhile and need to be accepted and appreciated as they are. The emphasis is on daily experiences in which children receive the message that they are worthwhile. In this environment the student is able to use his or her strengths to overcome weaknesses, to realize that not everyone has the same strengths and weaknesses, to change the things he or she can change, and to accept the things that cannot be changed. Care is taken to ensure that children view persons with a physical or mental disability as unique individuals with many strengths.

2.2 The student will realize that adults other than parents also provide care and support for children.

Descriptive Statement: Adults, other than parents, who provide care and support for children include foster parents; child-care providers; day-care teachers; extended family members; neighbors; family friends; and personnel of community support agencies, civic organizations, and religious organizations.

2.3 The student will become aware that babies grow inside the mother's body in a special place called the uterus.

Descriptive Statement: The purpose of this objective is to provide basic, age-appropriate information; to demonstrate ease or comfort in talking about reproduction-related topics; and to correct misinformation.

2.4 The student will become aware of the need to take responsibility for the effects of his or her behavior on others.

Descriptive Statement: Through daily classroom experiences, the teacher can encourage children to express appreciation for positive peer behavior such as helping, sharing, being courteous, accepting others' opinions, and showing respect for others' possessions. When hurtful behavior occurs, children can be encouraged to make restitution by helping the victim solve the problem caused by the behavior. School personnel will use positive mental health practices to resolve problem behavior.

2.5 The student will demonstrate appropriate ways of dealing with feelings.

Descriptive Statement: Pleasant feelings (for example, those associated with success and praise) and unpleasant feelings (for example, those resulting from anger, rejection, isolation, and failure) are discussed. The student will begin to understand the characteristics of appropriate and inappropriate behavior as it relates to relationships. The concept of virtual relationships will be introduced. Appropriate behavior, in response to pleasant and unpleasant feelings, is practiced in pretend situations so that these desirable strategies are available when needed in real-life situations.

2.6 The student will realize that physical affection can be an expression of friendship, of celebration, or of a loving family.

Descriptive Statement: The teacher continues to reinforce the concept that appropriate expressions of affection are healthy for the individual and for the family. The student will recognize inappropriate expressions and demonstrate skills to correct inappropriate expressions.

2.7 The student will advance in readiness to say "no" and to tell a trusted adult, such as a parent, teacher, minister, grandparent, or guardian, in private about inappropriate approaches from family members, neighbors, strangers, and others.

Descriptive Statement: This is a review of the elements of good and bad touching, including how to handle inappropriate approaches. The student will understand the differences between appropriate and inappropriate expressions of affection and behavior, including the use of electronic devices to convey such feelings.

2.8 The student will be conscious of how commercials use our emotions to make us want products.

Descriptive Statement: Children are introduced to the concept of media influences, which is developed further at higher grade levels. The students are given examples of techniques used by the media to create excitement and a desire to purchase products. Students will begin to understand how the media affects mental health issues such as self-image.

THIRD GRADE

3.1 The student will demonstrate a sense of belonging in group work and play.
Descriptive Statement: The child experiences cooperative group games and acceptance as a member of the class. This involves reciprocal helping behavior and positive mental health practices. Participation in groups such as the scouts is encouraged. Students will be introduced the appropriate and inappropriate behavior of virtual groups on the internet.

3.2 The student will express what he or she likes about himself or herself to continue developing a positive self-image.
Descriptive Statement: Expressive media (for example, exercises, games, art, music, dance, internet, and drama) are used for student expression of the capabilities, personality traits, and physical features that the child likes about himself or herself.

3.3 The student will become aware of the changes occurring in family life that affect daily living and produce strong feelings.
Descriptive Statement: Changes which occur include moving to a new home, the addition or birth of a sibling, the birth of a disabled child, death, illness, drug abuse, separation, divorce, remarriage, and children leaving home. Children are assisted in adjusting to such changes on an individual basis through the teacher-parent team approach to problem solving using positive mental health practices.

3.4 The student will give examples of healthy coping strategies for dealing with the feelings produced by changes in the family.
Descriptive Statement: An essential component is providing a clear explanation of the changes which occur in families. Healthy coping strategies include vigorous physical activity such as exercises and games; talking about feelings; reading books; and creative expressions such as writing, art, music, dance, and drama. In order to foster positive mental health, it is important that feelings be expressed openly in appropriate ways.

3.5 The student will identify external body parts associated with reproduction and elimination, using correct terms.
Descriptive Statement: External genitalia are explained, including correct scientific terms such as penis, scrotum, vaginal opening, opening of the urethra, and anus.

3.6 The student will recognize that all human beings grow and develop in a given sequence but that rates and patterns vary with individuals.
Descriptive Statement: The student's own biographical data are used to chart growth and development patterns and sequences and to demonstrate and validate individual variations in development. Students are taught to be accepting of other's differences, including physical and mental differences.

3.7 The student will become aware that both a male and a female are necessary to have a baby.
Descriptive Statement: The focus is on the concept that babies begin with a sperm and an egg, with the male providing the sperm and the female providing the egg. This is an age-appropriate introduction to reproduction and is not intended to be an explicit explanation of the sexual process.

3.8 The student will comprehend that the baby grows inside the mother's body for nine months and then is born.

Descriptive Statement: The umbilical cord and placenta are introduced. Students also learn that at the end of nine months of development, the baby leaves the mother's body through the vagina or through a surgical process known as Caesarean section. The extent of the discussion of the birth process at this point is dependent upon the students and the topics that arise.

3.9 The student will describe the types of behavior that enable him or her to gain friends or to lose friends.

Descriptive Statement: Behavior that helps children make and keep friends includes: friendly attitudes, being aware of others' feelings, sharing, using appropriate language and behavior, and accepting the attitudes and feelings of others. Behavior that causes children to lose friends includes: verbal or physical aggression; embarrassing or criticizing the friend; excluding the friend from activities; and violations of the relationship, such as lying, gossiping, cheating, stealing, and breaking promises. Behavior in groups also is discussed with emphasis on the rights and responsibilities of being a member of a group. Positive mental health practices should be utilized when discussing behaviors.

3.10 The student will practice safety rules in the home.

Descriptive Statement: This involves following up on the safety/first-aid objectives for the third-grade health curriculum and focuses on ~~telephone and door-answering safety when no adult is present.~~ appropriate use of communication devices such as the phone and internet when no adult is present. Parents are encouraged to discuss and develop safety precautions at home.

3.11 The student will demonstrate to others how to respond appropriately to good touches and how to handle inappropriate approaches from relatives, neighbors, strangers, and others.

Descriptive Statement: This is a continuing review of the elements of good and bad touches including responding appropriately both to good and to bad touches. When a good touch is welcomed by the child, he or she can respond by smiling, by returning a similar gesture, or by saying "thank you." Children also need continuing encouragement to tell a trusted adult in private about any inappropriate approaches. This includes inappropriate approaches made by way of electronic devices such as the internet or text messaging. Other responses to inappropriate approaches include saying "no," getting away from the person quickly, telling the person that he or she does not like the touch, and telling a trusted adult about the inappropriate approach.

3.12 The student will be conscious of how commercials use our emotions to make us want products.

Descriptive Statement: Children review the concept of media influences. The students are given examples of techniques used by the media to create excitement and a desire to purchase products. Students will begin to understand how the media affects mental health issues such as self-image, alcohol, tobacco and other drug use.

FOURTH GRADE

4.1 The student will be able to identify the human reproductive organs.
Descriptive Statement: Emphasis is placed on the male reproductive organs: penis, testicles, scrotum, and urethra; and on the female reproductive organs: uterus, ovaries, vagina, and fallopian tubes.

4.2 The student will identify physical changes that begin to occur during puberty.
Descriptive Statement: The individual differences in growth patterns associated with male and female sexual changes are presented. Male characteristics presented include: increased width of shoulders, increased length of arms and legs, the pituitary gland that controls physical growth through hormones, the appearance of pubic and axillary hair, and changes in the voice. Female characteristics presented include: increased width and roundness of hips, development of breasts, the pituitary gland that controls physical growth through hormones, the appearance of pubic and axillary hair, and the onset of the menstrual cycle. Emphasis is placed on the fact that the onset of sexual changes and growth patterns varies with individuals and that this is natural. Students are helped on an individual basis to avoid being fearful if they are slower to develop than their peers. The harmful effects of teenage pregnancy are discussed along with the importance of avoiding premarital sexual activity. In addition, the importance of personal hygiene in relation to these bodily changes is discussed. When problems arise, teachers and parents are encouraged to continue working together in a team approach to problem solving.

4.3 The student will develop an awareness of human fertilization and prenatal development.
Descriptive Statement: Instruction includes the uniting of the sperm and the egg and the development of the fetus inside the uterus.

4.4 The student will identify basic human emotions and effective ways of dealing with them.
Descriptive Statement: Emphasis is placed on understanding and dealing with strong emotions, both positive and negative. Students learn how to deal with joy and exuberance, as well as those emotions resulting from loss, rejection, divorce, death, illness, and moving. The student learns to manage appropriate responses to these feelings and to avoid self-destructive or abusive behavior by using positive mental health practices.

4.5 The student will develop positive reactions to his or her strengths and weaknesses.
Descriptive Statement: This includes accepting personal responsibility for successes and failures, taking pride in successes, and understanding that mistakes can result in positive learning toward success next time.

4.6 The student will become aware of the need to assume responsibility within the family and to function effectively as a family member.
Descriptive Statement: The focus is on sharing tasks within the family and helping, supporting, and communicating with family members. Special attention is given to appropriate assistance and support for and communication with family members who have physical or mental disabilities.

4.7 The student will describe the factors surrounding child abuse and child neglect.
Descriptive Statement: The terms child abuse and child neglect (including sexual abuse and electronic harassment) are explained, as well as how to protect oneself and the importance of confiding in a trusted adult such as a parent, teacher, minister, grandparent, or guardian.

4.8 The student will identify factors contributing to the use of drugs.
Descriptive Statement: Discussion includes the motivation for using alcohol, tobacco and other drugs, a need to feel "grown up," a need for peer acceptance, a "high" from the temporary effects of drugs, and/or a relief from emotional pain. Emphasis is placed on ways of dealing with one's needs and feelings without the use of drugs or other substances.

4.9 The student will recognize the dangers of substance abuse.
Descriptive Statement: The focus is on the misuse of tobacco, alcohol, and other drugs. Content includes the adverse effects of substance abuse on the individual and on the many contributing factors to family violence, sexual violence, and child abuse.

FIFTH GRADE

5.1 The student will define the structure and function of the endocrine system.
Descriptive Statement: The basic parts of the endocrine system (pituitary gland and adrenal glands) and their functions are introduced.

5.2 The student will identify the human reproductive organs in relation to the total anatomy.
Descriptive Statement: Emphasis is placed on the male reproductive organs: penis, testicles, scrotum, and urethra; and on the female reproductive organs: uterus, ovaries, vagina, and fallopian tubes. The reproductive organs are explained in relation to total human anatomy.

5.3 The student will explain how human beings reproduce.
Descriptive Statement: Instruction includes the uniting of the sperm and the egg and the development of the unborn child inside the uterus. The development of the baby at different stages is illustrated. Emphasis is placed on the consequences of premarital sexual activity. The importance of prenatal care is discussed also, as well as the profound effects of drugs on the mother and developing child.

5.4 The student will recognize the relationship between the physical changes that occur during puberty and the developing capacity for reproduction.
Descriptive Statement: Physical changes that occur during puberty are summarized. Topics included are nocturnal emissions and erections; menstruation; instability of emotions, such as mood swings during puberty; development of a positive attitude toward one's sexuality; and the relationship between changes during puberty and one's ability to conceive and bear children.

5.5 The student will realize the importance of nutrition for himself or herself and for pregnant women who need to eat nutritious foods and avoid dangerous substances while the baby is growing inside the uterus.
Descriptive Statement: This objective is incorporated into the nutrition component for the fifth-grade health curriculum.

5.6 The student will identify reasons for avoiding sexual activity prior to marriage.
Descriptive Statement: The psychological, social, and physical consequences of premarital sexual relations are discussed, as well as the benefits of postponing sexual intercourse until one is physically and emotionally mature and has a positive, committed marital relationship. The detrimental effects of premarital sex, including teenage pregnancy, infant mortality, and sexually transmitted diseases are emphasized, as well as the impact on one's reputation, self-esteem, and mental health.

5.7 The student will describe the effects of personal hygiene on one's self-concept.
Descriptive Statement: Discussion focuses on those bodily changes in puberty that require special attention to cleanliness and their relationship to a positive self-concept and acceptance from peers. Proper use of feminine hygiene products in relationship to cleanliness is included.

5.8 The student will recognize the importance of contributing to a constructive group activity.

Descriptive Statement: The teacher emphasizes the individual's contribution to accepting responsibility, how this relates to group success or failure, and how opportunities for leadership may be presented.

5.9 The student will develop an increased understanding of the roles, duties, and responsibilities of family members.

Descriptive Statement: The student can achieve this by defining the traditional and changing roles, duties, and responsibilities of family members; by preparing for the life-long adjustments required for his or her changing roles; and by describing the emotional interactions involved in being a family member. Nontraditional roles of males and females are discussed, and options for the lifelong goals of men and women are presented.

5.10 The student will examine the messages from mass media related to sexuality.

Descriptive Statement: Printed materials, advertising, television, wearing apparel, internet, movies, and music are discussed in relation to gender stereotyping and to the avoidance of sexual exploitation and sexual violence. Students will understand how the media affects mental health issues related to sexuality.

5.11 The student will develop skill in saying "no" to any social behavior or activity that he or she perceives as wrong for him or herself.

Descriptive Statement: Discussion focuses on alternatives to situations such as rude behavior, smoking, alcohol or drug use, theft, vandalism, violence, and premarital sexual relationships.

5.12 The student will recognize threatening or uncomfortable situations and how to react to them.

Descriptive Statement: These situations may include walking alone, opening doors for strangers, experiencing sexual abuse or incest, receiving obscene telephone calls or text messages, and facing dangers found in shopping malls. Ways of protecting oneself and recognizing and reporting such threats are stressed. The point is made, however, that most life situations are not threatening.

5.13 The student will explain the effects of substance abuse on the body.

Descriptive Statement: Emphasis is placed on the adverse effects of alcohol, drugs, and tobacco on the body. This information is related to physical and emotional growth during adolescence, including sexual development; to fetal development; and to any adverse effects upon the family unit.

5.14 The student will become aware of the existence of sexually transmitted diseases.

Descriptive Statement: Factual information regarding the nature of sexually transmitted diseases, including human immuno-deficiency virus (HIV)/acquired immune deficiency syndrome (AIDS), is introduced. HIV/AIDS is explained as a deadly disease. Other diseases referred to include syphilis, gonorrhea, chlamydia, and genital herpes.

SIXTH GRADE

6.1 The student will relate personal hygiene to the physical changes that occur during puberty.

Descriptive Statement: Changes during puberty are discussed in relation to the increased need for personal hygiene, for proper dental care, for frequent showering and shampooing, for the use of deodorants, for the use and disposal of pads and tampons, and for clean clothing.

6.2 The student will explain the effects of growth on development, attitudes and interests.

Descriptive Statement: The teacher provides opportunities for discussion of physical changes during puberty, group and non-group relationships, peer pressure, and boy/girl relationships. Emphasis is on the positive and normal aspects of differences among individuals.

6.3 The student will continue to identify physical and emotional changes that occur during puberty and their effects on growth and development.

Descriptive Statement: The following topics are discussed in relation to male and female changes during puberty: nocturnal emissions and erections; menstruation, masturbation; instability of emotions and ways of expressing these emotions appropriately; and approaches to developing a positive attitude toward one's sexuality.

6.4 The student will recall basic facts about sexually transmitted diseases.

Descriptive Statement: Factual information is presented regarding sexually transmitted diseases, including syphilis, gonorrhea, chlamydia, and genital herpes. Diseases of the genitalia common to adolescents that are not sexually transmitted are described so as to allay unnecessary fears (such as vaginitis, urethritis, etc.).

6.5 The student will be able to describe the etiology, effects, and transmission of the AIDS virus.

Descriptive Statement: Instruction includes factual information regarding the AIDS virus and its transmission. The medical profession should be involved in teaching this objective (and other health-related topics) to include the most up-to-date facts.

6.6 The student will summarize the process of human reproduction and the benefits of postponing premarital sexual activity.

Descriptive Statement: This is a review of the reproductive process and the advantages of delaying sexual involvement. The possible detrimental effects of premarital sexual activity for both males and females are emphasized. They include sexually transmitted diseases, unwanted pregnancy, infant mortality, and psychological (reputation, self-esteem, etc.), social, economic, mental and physical consequences.

6.7 The student will describe personal characteristics that can contribute to happiness for self and others.

Descriptive Statement: This includes self-discipline, self-esteem, independence, acceptance of reality, acceptance of others, tolerance, concern for the needs of disabled persons, loyalty, honesty, cooperation, diligence, respect for proper authority, and acceptance of responsibility for self in relation to others. The student will practice responding to situations using positive mental health practices.

6.8 The student will demonstrate increased understanding of child abuse and neglect, including emotional and sexual abuse.

Descriptive Statement: This is accomplished by defining the types of abuse, including electronic harassment, and explaining the need to report such situations to a trusted adult such as a parent, teacher, minister, grandparent, or guardian. The teacher helps students identify resources for the reporting and treatment of child abuse, sexual and family violence.

6.9 The student will become aware of community healthcare and safety agencies and their functions.

Descriptive Statement: Instruction includes the availability of community agencies providing the following services: child abuse prevention; treatment of abuse victims; mental health counseling; teenage pregnancy prevention and counseling; family planning counseling; prenatal care; substance abuse prevention and treatment and support groups; suicide prevention; prevention and treatment of sexually transmitted diseases, including HIV/AIDS; other general and specialized medical services, including the role of the family physician, local health department or community service board; police department, fire department, and other safety services; and community services provided by religious organizations. Parents are encouraged to learn about these agencies and to use their services when needed.

6.10 The student will explain the effects of substance abuse on the individual, family, school, and society.

Descriptive Statement: The effects of alcohol, tobacco, and other drugs on the individual, family, school, and society are presented with emphasis on genetic risks and fetal development, the progression of the addiction, drunken driving, physical and sexual abuse, mental health issues, family violence, and the hazards of "second-hand" smoking. Information on local community resources for obtaining help with these problems is included.

6.11 The student will evaluate the messages from mass media related to sexuality and gender stereotyping.

Descriptive Statement: Students progress from examining media messages in the fifth grade to evaluating messages from mass media related to sexuality and gender stereotyping in the sixth grade. The avoidance of sexual exploitation, sexual violence, sexual abuse (including electronic harassment) and stereotyping is stressed. Students will understand how the media affects mental health issues related to sexuality.

6.12 The student will apply decision-making skills in solving specific problems and in determining the possible outcomes of his or her decisions.

Descriptive Statement: Instruction includes the steps in the decision-making process, problem solving, and assertive communication skills. Using positive mental health practices, students relate decision-making and problem-solving skills to actual adolescent problems--their own or situations presented in case problems. The effects of decisions on lifelong goals are emphasized, and students predict the possible outcomes of decisions made. Career and other options available to men and women are stressed as choices and are identified in the decision-making process.

SEVENTH GRADE

7.1 The student will identify his or her role and relationships within the family.
Descriptive Statement: Content includes identification of personal interactions; communication skills; ways of meeting emotional, physical, and intellectual needs; and the student's contribution to the family unit. Students learn the positive benefits of personal sacrifice to support family goals and needs when such a decision is indicated.

7.2 The student will recognize the physical development of his or her sex characteristics and how they affect emotional and social growth.
Descriptive Statement: Emphasis is placed on the biological and physiological changes of early adolescence. Attention is given to such secondary sex characteristics as body growth, genital changes, hormonal secretions, the onset of menstruation, and sex-response feelings. Instruction promotes self-awareness and alleviates anxiety through factual information regarding menstruation, spontaneous erections, nocturnal emissions, masturbation, and differences in growth rates and development.

7.3 The student will realize that physical affection is not all sexual, but that it also can be an expression of friendship, of celebration, or of a loving family.
Descriptive Statement: The student learns that appropriate expressions of affection are essential for emotional, physical, and psychological health. The student will recognize the difference between appropriate and inappropriate physical affection.

7.4 The student will recognize that sexual behaviors are conscious decisions; that it is important to say "no" to premarital and inappropriate sexual relationships; and that appropriate relationships are based on mutual respect, trust, and caring.
Descriptive Statement: Sexual feelings are interpreted as normal and to be expected, but not always to be manifested in behavior. Instruction includes explanation of the differences between needs and desires, assertive skills, problem solving or conflict resolution, and alternatives. Ways to say "no" to premarital sexual relations and ways that students can support each other in saying "no" are presented. Characteristics of abusive relationships, which may also involve alcohol and other drug abuse or inappropriate use of electronic devices such as phone or internet, are addressed. In addition, the consequences of teenage pregnancy, the nature of sexually transmitted diseases, and the benefits of delaying sexual activity until marriage are reviewed.

7.5 The student will identify messages in society related to sexuality.
Descriptive Statement: The teacher guides the student in discovering and analyzing messages about sexuality found in advertising media, music and videos, television, films, printed materials, and graffiti. Messages conveyed by adults also are addressed. Students learn to recognize gender stereotyping and sexual exploitation. They are encouraged to evaluate and counteract any negative effects identified and to engage in a variety of positive activities, rather than spending too much time viewing media ~~programs~~ containing negative components. Students will demonstrate how these messages affect mental health issues related to sexuality.

7.6 The student will be aware of the consequences of preteen and teenage sexual intercourse.

Descriptive Statement: Instruction focuses on updated, factual information regarding sexually transmitted diseases, including HIV/AIDS; pelvic inflammatory disease (PID); cervical cancer; unwanted pregnancy; and discussion about reputation, guilt, and anxiety. Discussion also includes the emotional, psychological and financial implications of sexual activity and parenting before marriage. Students are guided in identifying positive aspects about themselves as reasons for avoiding risk-taking behavior. They learn also about the positive results and freedoms associated with abstinence during the preteen and teenage years.

7.7 The student will list the adverse consequences of a pregnancy in early adolescence, as well as the positive benefits of postponing pregnancy until marriage.

Descriptive Statement: Instruction includes a review of pregnancy and childbirth from previous grade levels, as well as discussion of responsibilities involved and adverse consequences encompassing the emotional, mental, physical, social, and economic impact on young parents, on their families, and on society. The nutritional implications of high-risk infants and teenage mothers also are included. The effects of an adolescent pregnancy on the student's lifelong goals and potential achievements are emphasized. The benefits of being married before having children and the effects on the family, child, and community will be discussed.

7.8 The student will describe the signs and symptoms of pregnancy.

Descriptive Statement: Instruction involves physical and psychological changes and the need for early detection of pregnancy through medical testing to ensure a healthy and successful pregnancy. Community resources for testing and/or further information are identified.

7.9 The student will develop an understanding of and responsibility for family planning.

Descriptive Statement: Content includes reasons for family planning, factors to be considered when planning a family, the role of the family physician, community resources, and methods of contraception.

7.10 The student will explain techniques for preventing and reporting sexual assault and molestation.

Descriptive Statement: Methods of handling assault and molestation, as well as prevention methods, are presented. Emphasis is placed on the importance of avoiding situations which could provide opportunities for molestation and sexual assault, including the homes and cars of acquaintances when no appropriate supervision is available. Students will practice appropriate use of the internet and text messaging. Key terms are defined. Approaches and behaviors, both in person and electronically, used by perpetrators are identified and explained. Community resources for victims of molestation and assault are identified.

7.11 The student will identify causes, symptoms, treatment, prevention, and transmission of sexually transmitted diseases, including AIDS.

Descriptive Statement: Topics include the nature, symptoms, treatment, transmission, and diagnosis of the following diseases in addition to HIV/AIDS: syphilis, gonorrhea, chlamydia, and genital herpes. In addition, myths are dispelled; for example students learn that one cannot contract a sexually transmitted disease from dirty dishes or clothing. High-risk activities, such as needle sharing, intravenous drug abuse, are discussed.

Community resources for the testing and treatment of sexually transmitted diseases are identified.

7.12 The student will identify the issues associated with friendships.
Descriptive Statement: The student accomplishes this by identifying characteristics of each type of friendship and by relating these characteristics to changes as one advances through the growth and development process. The student will identify the characteristics of healthy and unhealthy friendships and other relationships.

7.13 The student will realize the role of peers and the peer group during adolescence, and the nature and purpose of dating.
Descriptive Statement: Discussion focuses on the qualities of friendship, the importance of participating in peer groups that encourage the development of positive personal traits, and the nature of dating. Group dating is presented as a positive first step in developing romantic relationships, demonstrating appropriate and inappropriate dating behavior, utilizing positive mental health practices and fulfilling dating responsibilities.

7.14 The student will recognize contributions of various racial and ethnic groups to family life and society.
Descriptive Statement: Topics include the importance of racial and ethnic identity for families and the effects of negative stereotypes on families and individuals. Emphasis is placed on appreciation of racial and ethnic differences.

7.15 The student will increase his or her ability to listen to different points of view and to accept the rights of others to a differing point of view.
Descriptive Statement: Positive communication skills are developed to enhance relationships and to increase recognition of various points of view existing within families and society.

EIGHTH GRADE

8.1 The student will relate stages of human development to his or her own developmental level.

Descriptive Statement: The student learns that people change as they age, according to their developmental level--physically, mentally, and emotionally. Physical development and human anatomy are reviewed. Stages of mental and emotional development are presented in relation to the student's present developmental level with the goal of increasing his or her self-understanding and self-acceptance--now and in the future. Commonly accepted theories of personal development are presented as they relate to the student's own development.

8.2 The student will recognize the development of sexuality as an aspect of the total personality.

Descriptive Statement: The primary factor to be presented is the development of one's own sexual identity.

8.3 The student will become aware of the need to think through decisions and to take responsibility for them.

Descriptive Statement: The impact of present decisions on future opportunities and personal development is stressed. Instruction also includes support skills for the decision-making process--assertive communication, identification of personal conflicts, positive mental health practices, and conflict resolution. Lifelong educational, career, and personal development goals are examined in relation to present decisions and to options available to males and females at various stages of their lives. Students will discuss the impact of personal information posted on social networking sites such as MySpace, Facebook or Twitter on future goals.

8.4 The student will identify the issues associated with friendships.

Descriptive Statement: The student accomplishes this by reviewing the characteristics of appropriate and inappropriate friendships, by discussing the qualities of a good friend, and by relating the characteristics to changes as one continues to advance through the growth and development process.

8.5 The student will recognize the nature of dating during adolescence.

Descriptive Statement: Content includes the need for belonging, love, and affection, and the search for one's own identity. In addition, students examine the difference between love and infatuation and become aware that one learns about oneself from every relationship, and these experiences prepare one for the challenges and responsibilities of marriage. The student will also recognize warning signs for potentially abusive dating relationships and negative mental health practices.

8.6 The student will interpret the messages in society related to sexuality.

Descriptive Statement: Students continue to discover and analyze messages about sexuality found in advertising media, music and videos, television, films, the internet, printed materials, and graffiti. Students also determine the impact of these messages on themselves and others and review how to counteract negative effects. Positive alternatives to media immersion are discussed. Students will demonstrate how these messages affect mental health issues related to sexuality.

8.7 The student will describe strategies for saying "no" to premarital sexual relations.
Descriptive Statements: The emphasis is on strengthening self-confidence and reinforcing assertive skills and decision-making skills. Students learn why and how to say “no” to premarital sexual relations and to situations that challenge their own values, how to manage peer pressure, and how to manage their own sexual feelings.

8.8 The student will develop the coping skills needed to deal with stress.
Descriptive Statement: Students identify possible sources of stress (for example, parental, peer, and school pressures; teenage pregnancy; and fear of HIV/AIDS); and the positive and negative ways in which individuals deal with these sources of stress. The point is made, however, that stress cannot be avoided and that it is not all negative. Information is provided to counteract negative approaches to dealing with stress, such as alcohol, drugs, and suicide. Students learn positive physical and mental techniques for coping with stress (for example, exercise and sports, creative arts, religious activities and youth groups, and career-development and life-management activities).

8.9 The student will identify the stresses related to changing relationships in the home, school, and community.
Descriptive Statement: Emphasis is placed on the grief and adjustment processes associated with loss or change resulting from such circumstances as illness, a disabling condition, death, separation, divorce, loss of friendship, loss of income, or coping with substance abuse. The point is made, however, that changes may bring new opportunities to form friendships and to engage in new activities; that some relationships contain normal amounts of stress, especially in adolescents; and that stress is usually only temporary. The student will utilize positive mental health practices in stress management.

8.10 The student will analyze the issues related to teenage pregnancy.
Descriptive Statement: The physical, social, emotional, legal, financial, educational, psychological and nutritional implications of teenage pregnancy are discussed. The roles of and impact on the teenage mother and father are identified.

8.11 The student will review facts about pregnancy prevention and disease control.
Descriptive Statement: Methods of contraception are analyzed in terms of their effectiveness in preventing pregnancy and the spread of disease. Abstinence is emphasized as the only method that is 100 percent effective in preventing pregnancy and the most effective method of minimizing the possibility of contracting sexually transmitted diseases.

8.12 The student will describe the effects of alcohol and drug abuse on families and peer relationships.
Descriptive Statement: The effects of substance abuse on judgment within the peer group in terms of social and sexual behavior are analyzed. The effects of such abuse within the family also are emphasized, including family and sexual violence.

8.13 The student will identify the effects and prevention of sexual assault, rape (including "date rape"), incestuous behavior, and molestation.
Descriptive Statement: Content includes developing assertive skills, resolving conflict, avoiding risk situations and provocative behavior and dress, saying "no," and identifying other alternatives. Characteristics of dating violence, electronic harassment, and abusive relationships will be discussed. Information on referral services also is provided.

8.14 The student will recall the ways in which the AIDS virus is transmitted, and techniques for preventing this disease.

Descriptive Statement: This involves describing behaviors, including homosexuality, that put one at risk; dispelling myths regarding the transmission of the infection; and stressing abstinence and rejection of the use of illegal, intravenous drugs. The use of condoms in preventing the spread of HIV/AIDS is discussed.

NINTH GRADE

9.1 The student will trace the human growth cycle in relation to parenting skills from the prenatal period through the elderly stage.
Descriptive Statement: Information about developmental levels throughout the life cycle-prenatal, infant, toddler, pre-kindergarten, school-age, adolescent, young adult, middle-age, and elderly-is related to the complexity of childrearing and to the need for maturity before parenthood. Life-stage development is also presented to help students gain appreciation of their own development.

9.2 The student will explain the importance of the family as a basic unit of society and his or her responsibility as a member of the family.
Descriptive Statement: Topics include the function of the family, family forms, family strengths, and family influences on society. The benefits, challenges, responsibilities, and value of marriage for men, women, and children, and communities in society will be included.

9.3 The student will recognize the development of sexuality as an aspect of the total personality.
Descriptive Statement: Discussion focuses on the development of one's sexual identity. Internal and external conflicts associated with problems of sexual identity are addressed.

9.4 The student will review and apply the decision-making process.
Descriptive Statement: Students practice methods of gathering information and applying the decision-making process in practical situations. Emphasis is placed on the need for parental guidance, family and personal values, knowledge, positive mental health practices, and reason as bases for decision-making.

9.5 The student will review the nature and purposes of dating.
Descriptive Statement: Topics include understanding family guidelines, the functions of dating, and coping with the pressures experienced in dating situations. Students will discuss the signs of dating violence and physically and mentally abusive relationships. Discussion also focuses on the importance of group dating, rather than dating as a couple, in early adolescence.

9.6 The student will realize the importance of setting standards for controlling sexual behavior and of postponing sexual relations until marriage.
Descriptive Statement: The physical, emotional, social, psychological and economic consequences of premarital sexual relations continue to be emphasized along with reinforcement of assertive skills and ways to say "no" in terms that will enable the student to resist pressure from other teenagers and manage his or her own feelings and behavior.

9.7 The student will interpret the effects and prevention of sexual assault, rape (including "date rape"), incestuous behavior, and molestation.
Descriptive Statement: This is a review of the use of assertive skills, conflict resolution, avoidance of risk situations, and referral services in the community. In addition to identifying such factors, the student explains or interprets them to others. The student will demonstrate proper approaches to dealing with physically and mentally abusive relationships. The student will identify the appropriate and inappropriate use of electronic devices.

9.8 The student will relate specific information on substance abuse to each stage of the life cycle.
Descriptive Statement: Emphasis is on substance use and abuse during pregnancy, puberty, and adolescence and its general effect on daily functioning.

9.9 The student will be able to explain the process of reproduction.
Descriptive Statement: Instructional components include anatomy, physiology, conception, fertility, fetal development, childbirth, and prenatal care.

9.10 The student will demonstrate understanding of specific health issues, including the ability to conduct particular self-examinations.
Descriptive Statement: The focus is on factual information about menstruation, proper use of feminine hygiene products in relationship to cleanliness, pre-menstrual syndrome, menopause, and male- and female-specific concerns. Disease prevention through self-assessment and self-examination is reinforced with emphasis on breast and testicular self-examination.

9.11 The student will demonstrate knowledge of pregnancy prevention and disease control.
Descriptive Statement: Topics include planning for adult relationships, a review of factors to consider in planning for a family, misconceptions about contraception, a review of methods of contraception in relation to effectiveness in pregnancy prevention and disease control, and the decisions associated with contraception. Abortion is not presented as a method of birth control, but spontaneous abortion or miscarriage is explained and the risks of induced abortion are analyzed.

9. 12 The student will explain the transmission and prevention of the AIDS virus.
Descriptive Statement: This is a review of the ways in which HIV is transmitted and the techniques for preventing this disease.

9.13 The student will identify the effects of discrimination.
Descriptive Statement: The teacher helps students identify forms of discrimination including ageism, racism, and sexism and the consequences of discrimination on individual and family life. Discussion focuses on the value and importance of differences among individuals and families. The effects of discrimination on a person's mental health will also be discussed.

9.14 The student will begin to identify educational and career goals.
Descriptive Statement: Students formulate educational and career objectives. A "life goals" project provides the structure for achieving this objective and students complete activities that enable them to gain insight into the variety of personal and career options available to males and females. Students will discuss the impact of use of social networking sites, such as MySpace, Facebook and Twitter, on career goals.

TENTH GRADE

10.1 The student will determine how maturation affects adolescents.
Descriptive Statement: Emphasis is placed on the process of adolescent development as it relates to self-image, self-esteem, physiological changes, identification of human needs, constructive responses to emotions, positive mental health practices, the decision-making process, sources of values, and self-discipline.

10.2 The student will describe his or her own attitudes concerning expectations of self and interpersonal relationships.
Descriptive Statement: Appropriate friendships, dating or group activities, stages of developing relationships, assertiveness, types of love, communication, and individual and family roles are stressed. Discussion will include the expectations of virtual relationships.

10.3 The student will examine values, morals, and ethics essential to the growth and maintenance of positive human relationships.
Descriptive Statement: The universal values of honesty, trustworthiness, self-control, responsibility for self and others, and social justice are discussed as well as the development of moral and ethical systems.

10.4 The student will use the steps in the decision-making process to solve specific problems.
Descriptive Statement: Instruction deals with the six steps of the decision-making process as they relate to personal, social, and peer pressures and to media messages. These steps include: identifying the problem; listing all possible alternatives; evaluating the alternatives and their consequences based on personal and familial beliefs as well as societal values; choosing an alternative that promotes the good in self, others, and society; acting on the decision; and evaluating the results. Resources in the community that can assist in evaluating alternatives are identified.

10.5 The student will recognize the need to abstain from premarital sexual intercourse.
Descriptive Statement: Content focuses on the need to consider lifelong goals in relation to pressures for present sexual activity. Topics include readiness for parenthood, the consequences of non-marital pregnancy, the effects of sexually transmitted diseases, the impact on reputation, mental health and on present and future goals, the importance of adhering to family values, the need to complete educational plans, the burdens of financial responsibilities, and interference with future goals and job opportunities. The positive benefits of postponing sexual activity until marriage are emphasized. Students will identify personal, educational and career goals and the impact an unplanned pregnancy or sexually transmitted infection would have on these goals. In addition, abstinence continues to be emphasized as the only method that is 100 percent effective in preventing pregnancy.

10.6 The student will recognize alternatives to premarital sexual intercourse for expressing feelings and affection.
Descriptive Statement: Students are guided toward communicating feelings and affection through talking; through expressing ideas, values, and goals; through social and recreational contacts and community service; and through positive body language, caring gestures, and other positive mental health practices, rather than through premarital sexual intercourse.

10.7 The student will explain the factors to be considered in preparing for dating and marriage.

Descriptive Statement: Steps involved in relationships are identified, including friendships; dating (casual, double/group, single, blind, steady, and leading to marriage); and mate selection. Steps to developing positive, healthy relationships will also be discussed.

10.8 The student will examine factors to be considered in life-goal planning.

Descriptive Statement: Discussion includes lifelong career goals in relation to economics and continuing education, considering the possibilities of marriage and preparing for a family, and/or career development plans. Family planning, including methods of contraception, is reviewed.

10.9 The student will describe the signs and symptoms of pregnancy.

Descriptive Statement: Instruction involves physical and psychological changes and the need for early detection of pregnancy through medical testing to ensure a healthy and successful pregnancy. Community resources for testing and/or further information are identified.

10.10 The student will analyze the factors associated with a healthy pregnancy.

Descriptive Statement: Content focuses on causes of low birth weight such as smoking, poor nutrition, and use of alcohol and other drugs, as well as the effects of sexually transmitted diseases, including HIV/AIDS. Other consequences of good and poor health habits, including the importance of quality prenatal care, are stressed.

10.11 The student will explain the importance of supportive roles of the mother and father through pregnancy and birth.

Descriptive Statement: Topics for discussion include the responsibilities of each parent in relation to proper prenatal care; the effects of heredity; possible abnormal outcomes such as miscarriage, birth defects, still-birth, and premature birth; and the stages of fetal development prior to birth.

10.12 The student will describe available birthing options.

Descriptive Statement: Prepared materials on childbirth education are primary resources. Birthing alternatives, such as natural childbirth, are examined.

10.13 The student will identify the stages of the birthing process.

Descriptive Statement: The stages of the birthing process include the onset of the process and the three stages of labor and delivery--dilation, birth, and expulsion of placenta.

10.14 The student will analyze the skills and attitudes needed to become a competent parent.

Descriptive Statement: Attitudes toward parenting styles are examined. Instruction also includes various parenting strategies described by authorities. Students have opportunities to identify parenting skills they wish to develop. Students will understand the importance of the parenting responsibilities of both the mother and father. Students will understand the benefits, challenges, responsibilities, and value of marriage in parenting. The student will be able to identify community and familial support systems that are available to parents. Students will understand the positive and negative effects of parenthood on mental health.

10.15 The student will describe adjustments to be made after the birth of a child.
Descriptive Statement: The newborn child as a source of joy and love is emphasized; however, the impact on the family of caring for a newborn infant is examined, including the effects on income, educational plans, leisure time, time available for sleep, and interpersonal relationships.

10.16 The student will compile a list of community agencies and resources available to assist individuals and families.
Descriptive Statement: Examples of community resources to be listed are mental health services, social services, religious organizations, private agencies, hot lines such as violence prevention, child abuse, sexual violence and suicide, day-care centers, nursing homes, and the department of health.

10.17 The student will review the positive aspects of family life as a basic unit of society and as a means of personal development.
Descriptive Statement: Instruction includes a review of family functions and forms, with particular emphasis on family interactions. The family unit is described as a primary factor for the development of one's personality and for preparation for adulthood as either a married or a single person. The relationship of the family unit to the community and the world is stressed.

ELEVENTH GRADE

11.1 The student will evaluate individual strengths and weaknesses in relation to personal, educational, and career goals.
Descriptive Statement: Students are guided through a realistic self-assessment including working toward personal improvement, setting short- and long-term goals, formulating action plans, establishing priorities, and using school and community resources. Emphasis is placed on the variety of choices available to young women and the need for sound decision-making. The impact of social networking sites, such as MySpace, Facebook and Twitter, on goals will be discussed.

11.2 The student will relate major theories of human development to his or her own situation and/or developmental level.
Descriptive Statement: A review of the major theories of personal developmental stages is followed by analysis of each stage as it relates to the student's own development. Students are made aware that these are theories, that they are not all inclusive, and that they may or may not relate to the student's individual life.

11.3 The student will recognize advantages of abstinence from premarital sexual relations, reinforcing methods of saying "no" to undesirable behavior.
Descriptive Statement: The physical, emotional, social, psychological, and economic consequences of premarital sexual relations continue to be stressed, and students progress in development of assertive skills, including methods of saying "no" in ways that enable them to resist pressure from other teenagers and manage their own feelings and behavior.

11.4 The student will explain how television can have both positive and negative effects on the development to individuals--children, adolescents, and adults.
Descriptive Statement: Content includes types of messages conveyed on television; techniques for analyzing television programs and commercials; and strategies for evaluating television offerings according to their potential to entertain, to educate, to reinforce concepts, to guide or misguide behavior, and to promote violence. Students will demonstrate how these messages affect mental health issues.

11.5 The student will express his or her own attitude toward parenting.
Descriptive Statement: This centers on the student's own opinions about parenthood--possible reasons for becoming a parent, realistic role expectations for parenthood, and parental responsibilities. It also includes discussion of the responsibilities of parents who have children with characteristics that may be displeasing to the parent(s). Students will demonstrate the skills needed to utilize positive mental health practices in parenthood.

11.6 The student will develop skills in making parenting decisions.
Descriptive Statement: Students explore the relationship between personal and family development and planning for parenthood. They analyze the factors to be considered in family planning, such as education, career development, finances, marriage preparation and maturity.

11.7 The student will classify the major problems, issues, and decisions related to each stage of the family life cycle.
Descriptive Statement: The life cycle and how it applies to individuals and families is covered along with developmental tasks and needs of individual family members.

11.8 The student will identify parenthood options in terms of questions to be answered and decisions to be made.

Descriptive Statement: Discussion includes readiness to be a parent; family planning issues and spacing of children; choices resulting from infertility, genetic factors, and birth defects; and expenses associated with parenthood. Discussion also includes the positive aspects of parenting for the individual and for society.

11.9 The student will describe characteristics of newborn infants.

Descriptive Statement: Characteristics include physical appearance, medical tests to assess normalcy, observable infant behavior, emotional and physical needs of the child, and decisions related to circumcision.

11.10 The student will recall ways to cope with common fears and concerns regarding the care of newborn infants.

Descriptive Statement: The emphasis is on parent-child relationships, such as bonding, special care requirements, feeding schedules, stress, Sudden Infant Death Syndrome (SIDS), sleep patterns, colic, smothering, apnea, medications, illness, and breast and bottle feeding. Positive and negative effects of parenthood on mental health will be discussed.

11.11 The student will describe the adjustments family members face in the postnatal period.

Descriptive Statement: Adjustments to be considered include how the baby's needs affect other family members and their schedules. Consideration is given to the expectations of relatives and to adult needs for privacy, recreation, and time with other children. The issue of sibling rivalry is also discussed.

11.12 The student will explain the stages of growth and development in children.

Descriptive Statement: Topics included are the growth patterns of children, behavior patterns to be expected as children develop, and appropriate parent responses in reacting to and in guiding children's behavior.

11.13 The student will calculate the personal considerations and financial costs of childbearing.

Descriptive Statement: This includes the following considerations: the economic costs of raising a child, including the expenses of medical care before and after pregnancy; the costs of educating a child; the social considerations, including the investment of time and energy needed for quality child care; and the opportunity considerations, such as staying home to care for a child rather than pursuing an education or a career. This is balanced with discussion regarding the rewards of having children.

11.14 The student will identify criteria for selecting adequate child-care services.

Descriptive Statement: This is achieved by guiding the student in identifying child-care alternatives and in establishing guidelines for selecting appropriate care, considering pre-school education, after-school day care, the problems of children in self-care (“latchkey”) situations, and the need for quality and quantity of time in maintaining the physical and mental well-being of the child.

11.15 The student will analyze community resources to meet specific needs.

Descriptive Statement: This analysis focuses on community healthcare resources, employee benefits and programs, support agencies and services, sources of educational information about child care and parenting, and family planning resources.

TWELFTH GRADE

12.1 The student will describe the value of the home and family as primary sources of enrichment and personal renewal.
Descriptive Statement: Content focuses on the importance of home and family as a support system, as a nurturing influence in developing values and attitudes, and as an example or role model for the student's future home and lifestyle.

12.2 The student will analyze the effects of cultural and family patterns on individual and family development.
Descriptive Statement: Topics such as kinship, family cultural background and customs, family religious traditions, and the changing family in today's society are analyzed.

12.3 The student will describe types of adjustments and sources of conflict in interpersonal relationships.
Descriptive Statement: Students learn that adjustments in relationships are to be expected and are not all bad. Instruction also includes common problems, commitment to the relationship, communication skills, decision-making strategies, compromise, positive mental health practices and other methods of conflict resolution.

12.4 The student will explain how parental responsibilities change throughout the family life cycle.
Descriptive Statement: The following topics are reviewed: the family life cycle; family structures; cultural and religious influences on parental behavior; psychosocial developmental stages; the developmental tasks of parents and children through the life cycle; strategies for parenting; nutritional needs of family members throughout the life cycle; family roles and responsibilities at various stages; and conflict resolution.

12.5 The student will recognize problems of individuals with handicapping conditions and ways in which families can be sensitive to and make adjustments for these needs.
Descriptive Statement: The emphasis is on managing and coping with the mental, emotional and financial stress brought on by the special needs of individual family members with such conditions as chronic illness, physical, mental and emotional handicaps, and learning disabilities. The use of community resources, educational institutions, and personal skills is included.

12.6 The student will develop a plan for managing resources in the home.
Descriptive Statement: This involves developing a household budget that achieves family goals. Time and energy management and the role of personal skills also are discussed.

12.7 The student will interpret state laws that affect family life.
Descriptive Statement: Current laws in Virginia are reviewed as well as any pending legislation affecting individuals and families regarding marriage, divorce, adoption, mental health, child abuse, sexual abuse and assault, and legal responsibilities of parents.

12.8 The student will identify ways of preventing and/or coping with various types of violence.

Descriptive Statement: Content includes issues associated with dating violence, spouse abuse, sexual assault, physical and verbal child abuse, family violence, electronic harassment, and abuse of the elderly and disabled; violence prevention strategies, and identification of local support groups and agencies. Emphasis is placed on abuse as an unacceptable form of behavior that should not be tolerated. The need to report violence to appropriate authorities and agencies is presented as well as methods of reporting. Students will demonstrate the ability to seek mental health services as needed when coping with violence.

12.9 The student will analyze stress and crisis situations which affect family life.

Descriptive Statement: Stress situations and crises in the family are emphasized, particularly parental crises, death and dying, substance abuse, the termination of a marriage, role changes, job conflicts, loss of income, and serious illness. Students learn ways to prevent and manage such situations and crises and to ensure that the final outcome is positive. Students will demonstrate the ability to seek mental health services as needed when coping with violence.

12.10 The student will identify procedures and criteria for assessing community resources that deal with individual and family problems.

Descriptive Statement: Students learn how to locate community resources and how to evaluate them in selecting appropriate assistance with individual and family problems.

12.11 The student will interpret rationale for saying "no" to premarital sexual activity.

Descriptive Statement: The student progresses in assertive skills associated with saying "no" and knows the physical, emotional, social, psychological and economic implications of premarital sexual relations.

12.12 The student will prepare a plan for the fulfillment of lifelong goals.

Descriptive Statement: Each student develops a plan designed to achieve the goals previously identified and based on the self-assessment activity in the eleventh grade. The plan includes strategies for attaining personal, educational, and career goals. The student continues to be made aware of the variety of opportunities and choices available and the impact of current decisions on future goals.

GUIDELINES FOR TRAINING INDIVIDUALS WHO WILL BE TEACHING FAMILY LIFE EDUCATION

GUIDELINES FOR TRAINING INDIVIDUALS WHO WILL BE TEACHING FAMILY LIFE EDUCATION

INTRODUCTION

Individuals who teach Family Life Education (FLE) must be trained in its content, teaching strategies, use of instructional materials, assessment methods, and ways to involve parents. To ensure consistency in dealing with sensitive content and issues, a comprehensive and systematic training program is essential. The training program uses a combination of workshops and technology. The Board of Education shall establish requirements for appropriate training for teachers of FLE, which shall include training in instructional elements to support the various curriculum components. All individuals teaching FLE should participate in the state training program and follow-up activities in the region or local school division.

TRAINING PROGRAM

The Department of Education sponsored, in 1988 through 1990, a series of regional and statewide FLE training sessions and teleconferences for the divisions' FLE contact persons, grade level leaders, and teachers. The school division contact persons and grade-level leaders were responsible for determining if the program was properly implemented.

In following years, FLE in-service and staff development workshops were offered from the Department of Education on an "as requested basis." During 1996, Virginia Commonwealth University's Division of Health and Physical Education conducted a survey of local FLE staff development needs. Data were requested from five representatives in each school division (the division-level FLE contact person; an administrator or teacher from the elementary, middle, and high schools; and the special education director). The survey indicated the need for ongoing, consistent, and skill appropriate staff development opportunities on 21 specific topics. Over a two-year period, two advisory groups (including representatives of the Virginia Congress of Parents and Teachers, the Virginia Department of Health, central office administrators, teachers, higher education educators, and adolescents) provided input in developing an ongoing staff development plan partially implemented in 1997 and fully implemented in 2002.

The current FLE staff development plan is ~~primarily~~ funded through federal funds from the Centers for Disease Control and Prevention, Division of Adolescent and School Health. ~~Additional funds sometimes are provided through the Virginia Department of Health.~~ The staff development plan includes the use of 14 training modules (in manual format) to address most of the 21 requested topics, a continual broad scope and multiple-level review process, piloting of newly developed draft modules, evaluation of each module, and revisions of the training manuals. The plan also includes a multiple-level training-of-trainers program where qualified educators are identified to provide staff development workshops to FLE teachers, other classroom teachers (including special

education), instructional specialists, administrators, nurses, counselors, social workers, parents, community-based educators, and related positions. ~~Some trainers are identified as statewide mentor trainers and others are identified as local facilitators~~.

The theory-based, skills-based staff developed workshops are offered during statewide summer training sessions and at regional or local sites during the school year on an "as requested basis." Each training session is evaluated. Results of the evaluation are used to revise training manuals and instructional procedures for adults.

SUMMARY

This design provides for consistency in training personnel and implementing the FLE program. The provision for support and follow-up is based on research findings which indicate that without effective training and follow-up activities it is less likely that individuals will practice what they have been trained. The evaluation will be designed to determine, on a continuing basis, if teachers or community-based educators that work with youth use information or skills learned in their classes with children and youth. This approach to evaluation should provide useful information about the success of the program, both immediate and long-term.

GUIDELINES FOR PARENT/COMMUNITY INVOLVEMENT

GUIDELINES FOR PARENT/COMMUNITY INVOLVEMENT

INTRODUCTION

An important element in the successful implementation of a Family Life Education program is parent/community involvement. A theme that runs throughout the program is the parent/teacher team approach to Family Life Education. Because of the sensitive nature of program content, a planned approach to parent/community involvement is critical.

PLAN FOR PARENT/COMMUNITY INVOLVEMENT

In each school division that offers Family Life Education, the superintendent will identify a community involvement team, or use the school health advisory board, which should include individuals such as central office personnel, an elementary school principal, a middle school principal, a high school principal, teachers, a school board member, parents, one or more members of the clergy, a member of the medical and mental health profession, which may include a substance abuse prevention or treatment practitioner, and others in the community.

Parents and community-based personnel are encouraged to participate in statewide and local training sessions for Family Life Education.

The community involvement team or school health advisory board members will work with others in their localities to offer an ongoing plan to explain the Family Life Education program and to solicit support and involvement in its implementation.

PARENT INVOLVEMENT ACTIVITIES

Department of Education staff members provide workshops and training sessions on Family Life Education and related topics at the state leadership conference and in localities as requested. Parents participate on the statewide HIV/STD Resources Review Panel and on other planning committees as formed. One of the current 14 training modules addresses *Strengthening Parental Involvement in Family Life Education*. School and community-based personnel as well as other parents are encouraged to participate in workshops that outline the key components of Family Life Education and the role of parents in the program.

Each teacher of Family Life Education is asked to meet with parents of students involved in the program. Provision ~~should~~ must be in place for an ongoing review of local curriculum and instructional materials before they are used in the classroom. It is recommended that a resource center containing Family Life Education materials that may be checked out by parents is available in every school.

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Board of Education Agenda Item

Item: E. **Date:** July 23, 2009

Topic: First Review of Revised *Guidelines for Awarding the Veteran Honorary High School Diploma* in Response to HB 1767 Adopted by the 2009 General Assembly

Presenter: Dr. Margaret N. Roberts, Executive Assistant to the Board of Education

Telephone Number: (804) 225-2924 **E-Mail Address:** Margaret.Roberts@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting

____ Action requested at future meeting:

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date:
action:

Background Information: In recognition of the efforts and sacrifices of veterans who served in World War II and the Korean War, the 2001 and 2002 General Assembly adopted legislation to authorize the Virginia Board of Education to award the Honorary High School Diploma to veterans of World War II and the Korean War who, upon returning home after discharge, were unable to complete their high school education. The Board of Education subsequently authorized awards to be made to Vietnam War veterans; however, this provision was not specifically codified until 2009.

The 2009 General Assembly, in recognition of the service of Vietnam veterans, codified the issuance of the Veteran Honorary High School Diploma to Vietnam War veterans who served between 1959 and 1975 and who were also unable to continue their education upon returning home.

Pursuant to *§§ 2.2-3309.1, 2.2-3310, and 22.1-17.4* of the *Code of Virginia*, veterans of World War II, the Korean War, and the Vietnam War who were unable to complete their high school education may apply for a Veteran Honorary Diploma, if they were subsequently honorably discharged and meet the criteria specified by the Board of Education.

Any World War II, Korean War, or Vietnam War veteran may apply for a Veteran Honorary High School Diploma by filing with the Board of Education a written statement declaring that:

1. The veteran served in a branch of the United States Armed Forces during the years specified as follows: World War II between 1939 and 1945; Korean War between 1950 and 1953; and Vietnam War between 1959 and 1975.
2. The veteran was drafted or enlisted in the United States Armed Forces;
3. The veteran was subsequently honorably discharged; and
4. The veteran was unable to resume his or her high school education upon returning to civilian life.

The information may be submitted by the veteran, by his or her family, or by any individual or veterans' organization on behalf of the veteran. The Virginia Board of Education will issue the honorary diploma to eligible veterans upon request at any time during the year. The Board also honors requests from families for posthumous awards.

Information on the Veteran Honorary Diploma program and the process for making a request is posted prominently on the Virginia Department of Education's Web site and has been disseminated to veterans' organizations in Virginia.

Since the Veteran Honorary Diploma program began in 2001, more than 2,000 veterans have received this recognition.

The Virginia Department of Education has defined the term *veteran* to mean a person who served in the active military, naval, or air service, and who was discharged or released under conditions other than dishonorable (38 USC § 101).

Summary of Major Elements: The 2009 amendments to the *Code* require that the Board of Education's procedures be modified slightly to reflect the latest legislative changes. Thus, the public information and the application form have to be modified to reflect the following:

- The award of the Veteran Honorary Diploma to Vietnam War veterans as codified; and
- The *Code* specifically states that the veteran must have an honorable discharge from military service.

The following information is attached:

- Revised *Guidelines for Awarding the Veteran Honorary High School Diploma* showing provisions of recent legislative amendments in bold print;
- Revised honorary diploma request form showing provisions of recent legislative amendments in bold print;
- Copy of the relevant legislation authorizing the Veteran Honorary Diploma program;

Superintendent's Recommendation: The Superintendent of Public Instruction recommends that the Board of Education waive first review and adopt the revised *Guidelines for Awarding the Veteran Honorary High School Diploma* and the revised honorary diploma request form to reflect legislative changes adopted by the 2009 General Assembly.

Impact on Resources: The Honorary Diploma program is conducted using existing fiscal and administrative resources of the Virginia Department of Education.

Timetable for Further Review/Action: Upon final adoption by the Board of Education, the revised *Guidelines for Awarding the Veteran Honorary High School Diploma* and the request form will be posted on the Department of Education's Web site and broadly disseminated to appropriate veterans' organizations, community groups, and interested individuals.

DRAFT:

Guidelines for Honorary Diplomas for World War II, Korean War, and Vietnam War Veterans

Requirements of the *Code of Virginia*

Pursuant to *§§ 2.2-3309.1, 2.2-3310, and* ***22.1-17.4*** of the *Code of Virginia*, veterans of World War II, the Korean War, **and the Vietnam War** who were unable to complete their high school education may apply for a Veteran Honorary Diploma, **if they were subsequently honorably discharged** and meet the criteria specified by the Board of Education.

Any World War II, Korean War, or **Vietnam War** veteran may apply for a Veteran Honorary High School Diploma by filing with the Board of Education a written statement declaring that:

1. The veteran served in a branch of the United States Armed Forces during the years specified as follows: World War II between 1939 and 1945; Korean War between 1950 and 1953; and **Vietnam War between 1959 and 1975**;
2. The veteran was drafted or enlisted in the United States Armed Forces;
3. **The veteran was subsequently honorably discharged**; and
4. The veteran was unable to resume his or her high school education upon returning to civilian life.

The information may be submitted by the veteran, by his or her family, or by any individual or veterans' organization on behalf of the veteran. The Virginia Board of Education will issue the honorary diploma to eligible veterans upon request at any time during the year. The Board also honors requests from families for posthumous awards.

The term veteran means a person who served in the active military, naval, or air service, and who was discharged or released under conditions other than dishonorable. 38 USC § 101.(5) SB 1210, supra.(6) Id.

Virginia Board of Education Requirements

Any veteran of World War II, the Korean War, **or the Vietnam War** who is interested in receiving the Commonwealth of Virginia Veteran Honorary High School Diploma may submit the honorary diploma request form or a statement that includes the following information:

1. The veteran's full name as it should be printed on the diploma;
2. Dates of service;
3. Statement affirming that the veteran:
    a. Was drafted or enlisted in the United States Armed Forces;
    b. Was unable to complete his education upon returning to civilian life; and
    c. **Was subsequently honorably discharged from military service.**

The information may be submitted by the veteran, by his or her family, or by any veterans' organization on behalf of the veteran.

VIRGINIA BOARD OF EDUCATION

Request for Veteran Honorary High School Diploma

Any military veteran of World War II, the Korean War, **or the Vietnam War, who was subsequently honorably discharged,** may receive the Commonwealth of Virginia World War II, Korean War, **or Vietnam War** Veteran Honorary High School Diploma. If you wish to receive the Veteran Honorary High School Diploma, please complete the following information. This information may be submitted by the veteran, by his or her family, or by any individual or veterans' organization on behalf of the veteran.

Veteran's name as it is to appear on the Honorary Diploma (please print)	
Dates of active duty service	
Location of last school attended	

Type of Honorary Diploma requested (check one)

☐ World War II (1939-1945) ☐ Korean War (1950-1953) ☐ **Vietnam War (1959-1975)**

I hereby certify the above-named veteran was drafted or did enlist in the United States Armed Forces, served during the above dates, **was subsequently honorably discharged**, and was unable to resume his or her high school education upon returning to civilian life.

Signature:			Date:
Person requesting Diploma:		Telephone:	( )
Mail Diploma to:			

Return signed, completed form two weeks in advance to:

Veteran Honorary High School Diploma Program
Virginia Department of Education
P. O. Box 2120
Richmond, Virginia 23218-2120
Ph: (804) 225-2924 / Fax: (804) 225-2524
Margaret.Roberts@doe.virginia.gov

CHAPTER 66

An Act to amend and reenact §§ 2.2-3309.1, 2.2-3310, and 22.1-17.4 of the Code of Virginia, relating to certain honorary diplomas.

[H 1767]

Approved February 25, 2009

Be it enacted by the General Assembly of Virginia:

1. That §§ 2.2-3309.1, 2.2-3310, and 22.1-17.4 of the Code of Virginia are amended and reenacted as follows:

§ 2.2-3309.1. Virginia World War II Veterans Appreciation Week; Virginia Korean War Veterans Appreciation Week; honorary diplomas to be awarded under certain circumstances during such weeks.

A. In recognition of the sacrifice of the members of the United States Armed Forces who served in World War II, the first full week in September, i.e., the week that was the first full official week of peace in 1945, shall hereby be designated the Virginia World War II Veterans Appreciation Week, beginning in September 2001.

In accordance with the Board of Education's guidelines as authorized by § 22.1-17.4, any veteran of World War II may apply for a Commonwealth of Virginia World War II Veteran Honorary High School Diploma by filing with the Virginia Board of Education a statement declaring that:

1. During the years between 1939 and 1945, he served in any branch of the United States Armed Forces *and was subsequently honorably discharged*;

2. He was drafted or did enlist in the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

B. In recognition of the sacrifice of the members of the United States Armed Forces who served during the Korean War, the first full week in November shall hereby be designated the Virginia Korean War Veterans Appreciation Week, beginning in November 2002.

In accordance with the Board of Education's guidelines as authorized by § 22.1-17.4, any veteran of the Korean War may apply for a Commonwealth of Virginia Korean War Veteran Honorary High School Diploma by filing with the Virginia Board of Education a statement declaring that:

1. During the years between 1950 and 1953, he served in any branch of the United States Armed Forces *and was subsequently honorably discharged*;

2. He enlisted in or was drafted into the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

C. Upon receiving a statement in compliance with this section and § 22.1-17.4 that has been filed in accordance with its guidelines, the Board of Education shall award the veteran described in subsections A or B, a Commonwealth of Virginia World War II Veteran Honorary High School Diploma or a Commonwealth of Virginia Korean War Veteran Honorary High School Diploma, as appropriate. Such diploma shall also be delivered during Virginia World War II Veterans Appreciation Week or Virginia Korean War Veterans Appreciation Week, as appropriate.

§ 2.2-3310. Vietnam War Memorial Dedication and Veterans' Recognition Week.

A. The first full week of November of each year shall be designated as Vietnam War Memorial Dedication Week and Veterans' Recognition Week in the Commonwealth, to honor in perpetuity the men and women who have served their country as members of the armed forces during the Vietnam ~~Conflict~~ *War*.

B. In accordance with the Board of Education's guidelines as authorized by § 22.1-17.4, any veteran of the Vietnam War may apply for a Commonwealth of Virginia Vietnam War Veteran Honorary High School Diploma by filing with the Virginia Board of Education a statement declaring that:

1. During the years between 1959 and 1975, he served in any branch of the United States Armed Forces and was subsequently honorably discharged;

2. He enlisted in or was drafted into the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

C. Upon receiving a statement in compliance with this section and § 22.1-17.4 that has been filed in accordance with its guidelines, the Board of Education shall award the veteran described in subsection B a Commonwealth of Virginia Vietnam War Veteran Honorary High School Diploma. Such diploma shall also be delivered during Virginia Vietnam War Memorial Dedication and Veterans' Recognition Week in the Commonwealth.

§ 22.1-17.4. Certain honorary diplomas to be issued under specific circumstances.

A. Any veteran of World War II may apply to the Board of Education for a Commonwealth of Virginia World War II Veteran Honorary High School Diploma by filing, in compliance with Board guidelines, a statement declaring that:

1. During the years between 1939 and 1945, he served in any branch of the United States Armed Forces *and was subsequently honorably discharged*;

2. He was drafted or did enlist in the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

B. Any veteran of the Korean War may apply to the Board of Education for a Commonwealth of Virginia Korean War Veteran Honorary High School Diploma by filing, in compliance with Board guidelines, a statement declaring that:

1. During the years between 1950 and 1953, he served in any branch of the United States Armed Forces *and was subsequently honorably discharged*;

2. He enlisted in or was drafted into the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

C. Any veteran of the Vietnam War may apply to the Board of Education for a Commonwealth of Virginia Vietnam War Veteran Honorary High School Diploma by filing, in compliance with Board guidelines, a statement declaring that:

1. During the years between 1959 and 1975, he served in any branch of the United States Armed Forces and was subsequently honorably discharged;

2. He enlisted in or was drafted into the United States Armed Forces while still enrolled as a secondary school student in any school in any state or territory of the United States or any school located on or associated with a United States military base or embassy; and

3. He was unable to resume his secondary education upon returning to civilian life.

~~C~~ *D*. The Board of Education shall establish guidelines setting forth the timelines and procedures for applying for such diplomas. Upon the filing of the required statement in accordance with its guidelines, the Board of Education shall award the veteran either a Commonwealth of Virginia World War II Veteran Honorary High School Diploma, or a Commonwealth of Virginia Korean War Veteran Honorary High School Diploma, *or a Commonwealth of Virginia Vietnam War Veteran Honorary High School Diploma*. Such diplomas shall be delivered to eligible veterans during the first full week in September that has been designated, in accordance with § 2.2-3309.1, as the Virginia World War II Veterans Appreciation Week, or during the first full week in November that has been designated, in accordance with § 2.2-3309.1, as the Virginia Korean War Veterans Appreciation Week, *or during the first full week in November that has been designated, in accordance with § 2.2-3310, as Vietnam War Memorial Dedication Week and Veterans' Recognition Week in the Commonwealth.*

Board of Education Agenda Item

Item: F. **Date:** July 23, 2009

Topic: First Review of Proposed Board of Education Meeting Dates for the 2010 Calendar Year

Presenter: Dr. Margaret N. Roberts, Executive Assistant to the Board of Education

Telephone: 804/225-2924 **E-mail:** Margaret.Roberts@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- ____ State or federal law or regulation
- ____ Board of Education regulation
- _X_ Other: Board of Education Bylaws

_X_ Action requested at this meeting

___ Action requested at future meeting

Previous Review/Action:

_X_ No previous board review/action

___ Previous review/action:
date:
action:

Background Information: Section 2 of Article Three of the Bylaws of the Board of Education states the following:

> Section 2. Regular Meetings. Prior to and no later than the annual meeting (February), the Board shall adopt a tentative schedule for regular meetings for the applicable calendar year. Such schedule shall be subject to the change, alteration or adjustment by the President as he or she deems appropriate, to accommodate the operation of the Board as is necessary.

Summary of Major Elements: In recent years, the Board of Education has met monthly except for the months of August and December. Meetings are typically held on the fourth Thursday of the month, although this is not a requirement. Exceptions are the January meeting, which is held early in the month to coincide with the opening of the General Assembly session, and the November meeting, which is scheduled to avoid meeting during Thanksgiving week. The April meeting is typically a two- or three-day planning session.

In addition, the proposed dates for meetings in 2010 (shown below) are set to avoid scheduling conflicts with major professional commitments for Board of Education members and the Superintendent of Public Instruction.

In addition to the monthly business meetings, the President may call special meetings of the full Board of Education and its committees, as deemed necessary. Unless otherwise announced by the President, all Board of Education meetings will held in the Jefferson Conference Room on the 22nd floor of the James Monroe Building, 101 North 14th Street, Richmond, Virginia 23219.

The proposed meeting dates for 2010 are as follows:

Thursday, January 7, 2010
Thursday, February 25, 2010
Thursday, March 18, 2010
Wednesday-Thursday, April 21-22, 2010
Thursday, May 27, 2010
Thursday, June 24, 2010
Thursday, July 22, 2010
Thursday, September 23, 2010
Thursday, October 28, 2010
Thursday, November 18, 2010

Superintendent's Recommendation: The Superintendent of Public Instruction recommends that the Board of Education waive first review and adopt the schedule of meeting dates for the 2010 calendar year.

Impact on Resources: Funding to support the expenses related to the meetings of the Board of Education are provided from the Department of Education's general operating budget, which is appropriated by the General Assembly.

Timetable for Further Review/Action: Following adoption, the dates will be widely disseminated to local school officials, statewide organizations, and to the public. The meeting dates will also be posted on the Board of Education's Web site.

ATTACHMENT:

PROPOSED

MEETING DATES
2010 CALENDAR YEAR

Thursday, January 7, 2010

Thursday, February 25, 2010

Thursday, March 18, 2010

Wednesday-Thursday, April 21-22, 2010

Thursday, May 27, 2010

Thursday, June 24, 2010

Thursday, July 22, 2010

Thursday, September 23, 2010

Thursday, October 28, 2010

Thursday, November 18, 2010

Board of Education Agenda Item

Item: G. **Date:** July 23, 2009

Topic: First Review of Revised Eligibility Criteria for Cost-Saving and Service-Sharing Agreements between School Divisions in the Commonwealth of Virginia

Presenter: Mr. Kent C. Dickey, Assistant Superintendent for Finance

Telephone Number: (804) 225-2025 **E-Mail Address**: Kent.Dickey@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

____ No previous board review/action

_X_ Previous review/action
date July 27, 2005
action _____

Background Information:

In July 2005, as required by Section 22.1-98.2, *Code of Virginia*, the Board of Education adopted eligibility criteria and procedures for school divisions to enter into cost-saving or service-sharing agreements with contiguous school divisions, with eligible divisions receiving supplemental Basic Aid funding as provided in Section 22.1-98.2. The criteria adopted by the Board in July 2005 were consistent with the criteria set forth in Section 22.1-98.2. However, the 2008 General Assembly amended the criteria in Section 22.1-98.2, and, as a result, the Board's criteria are no longer consistent with the *Code* and need to be revised.

As amended, Section 22.1-98.2 increases the maximum number of students from 350 to 1,100 students allowed for a school division to qualify to have its state share of Basic Aid adjusted, based on a cost-sharing agreement with a neighboring school division. In addition, only those school divisions in a locality with a composite index of .6000 or greater and 65 percent or more

of its local taxes coming from real estate taxes would qualify. The state share of Basic Aid for an eligible division is adjusted based on the lower composite index of a contiguous school division involved in the cost-savings agreement.

Summary of Major Elements

Attachment A shows the amended section of the *Code of Virginia* as adopted by the 2008 General Assembly.

Attachment B is the revised eligibility criteria consistent with the *Code* that are recommended for approval by the Board of Education. Revised language is shown in italics and deleted language is shown with strikethroughs. In addition to the revised criteria, Attachment B provides the current procedures for application of the criteria to requests from eligible school divisions.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education waive first review and adopt the revised criteria as presented in Attachment B. In addition, the Superintendent requests that the Board authorize the Department of Education to make subsequent technical revisions to the criteria in order to keep them aligned with any future changes made by the General Assembly.

Impact on Resources:

Currently, only one school division (Highland County Public Schools) meets the eligibility criteria to receive supplemental Basic Aid funding in FY 2010. Additional school divisions may qualify beginning in FY 2011; however, those divisions will not be known until the Governor introduces the 2010-2012 biennial budget.

Timetable for Further Review/Action:

The Governor must approve the adjustment to the state share of Basic Aid for eligible divisions prior to the disbursement of state funds. The Department of Education must annually report to the Chairmen of the House Appropriations and the Senate Finance committees the cost savings arrangements made, and the adjusted state shares of Basic Aid approved by the Governor. No further action is required of the Board.

Attachment A

Code of Virginia

§ 22.1-98.2. Certain agreements; adjustment of state share for basic aid.

A. Any school board of a school division in which fewer than 1,100 students were included in average daily membership for the preceding school year, in a locality that has a local composite index of .6000 or greater, and has 65 percent or more of its local taxes coming from real estate taxes, as calculated by the Auditor of Public Accounts and reported annually to the Department of Education, upon entering into certain cost-savings agreements with a contiguous school division for the consolidation or sharing of educational, administrative, or support services, shall receive the state share for basic aid computed on the basis of the composite index of local ability-to-pay of the contiguous school division, calculated annually, for a period of 15 years.

The Board of Education shall develop eligibility criteria for such cost-savings and service-sharing agreements and for the adjustment of the state share for basic aid, consistent with the appropriation act.

The Governor shall approve the adjustment to the state share prior to the disbursement of funds. The Department of Education shall annually report to the Chairmen of the House Appropriations and Senate Finance Committees the cost-savings agreements made and the adjusted state shares so approved.

B. The local school board receiving the adjusted state share shall not use the additional funds received to supplant local funds appropriated for education. The adjusted state share shall be used solely for educational purposes and shall not be used to reduce local operating expenditures for public education from the prior fiscal year. However, no school division shall be required to maintain a per pupil expenditure for operations that exceeds the per pupil expenditure in the prior fiscal year. The superintendent of the school division shall inform the Superintendent of Public Instruction of the public education purpose for which these local funds shall be used.

C. This section shall not prohibit the Commonwealth from terminating or modifying any program or function under which distribution to a local school board has been made, and if so terminated or modified all obligations hereunder shall cease or be reduced in proportion with such modifications, as the case may be.

D. If any such contractual agreements between the relevant school divisions terminate prior to the end of the applicable period set forth above, the Commonwealth's obligation under this section shall cease.

E. This agreement and adjusted state payment shall be in lieu of any existing funds a locality receives from a Small School Division Assistance grant.

F. Any standard of quality set forth in this act that is not required as of June 30, 2004, and for which additional state funding is required, shall not take effect unless the state's share of funding that standard is included in the general appropriation act for the period July 1, 2004, through June 30, 2006, passed during the 2004 Session of the General Assembly and signed into law by the Governor.

(2004, c. 820; 2008, cc. 589, 705.)

Eligibility Criteria and Procedures for Supplemental Funding for School Divisions in the Commonwealth of Virginia That Enter Into Cost-Saving or Service-Sharing Agreements

Purpose

Section 22.1-98.2, *Code of Virginia,* directs the Board of Education to develop eligibility criteria for cost-saving and service-sharing agreements for school divisions that enter into such agreements with contiguous school divisions. School divisions serving fewer than ~~350~~ *1,100* students in the prior school year, *having a local composite index of .6000 or greater, and having 65 percent or more of their local taxes coming from real estate taxes* that enter into such an agreement with a contiguous school division are eligible to receive the state share for Basic Aid computed on the basis of the composite index of the contiguous school division, calculated annually, for 15 years.

The Governor must approve the adjustment to the state share for Basic Aid prior to the disbursement of funds. The Department of Education must annually report to the Chairmen of the House Appropriations and the Senate Finance Committees the cost saving arrangements made, and the adjusted state shares of Basic Aid approved by the Governor.

Definitions

Eligible school divisions: School divisions that served less than ~~350~~ *1,100* students in the prior school year, *have a local composite index of .6000 or greater, and have 65 percent or more of their local taxes coming from real estate taxes*.

Cost-saving or service-sharing agreements: A formal agreement executed between the eligible school division and one or more contiguous school divisions. This agreement must be evidenced by a written document that bears the original signatures of the superintendents of the participating school divisions. The agreement must contain sufficient information to demonstrate how the agreement meets the eligibility criteria.

Additional State Share of Basic Aid: The difference between the Basic Aid entitlement the eligible school division would normally receive and that which it would receive using the lowest composite index of a contiguous school division participating in the agreement.

Eligibility Criteria

Agreements submitted by an eligible school division to the Department of Education must be made with a contiguous school division and must demonstrate how the agreement meets the following criteria:

- evidence of one or more shared services with another school division; or,
- evidence of the savings or cost increases avoided as a result of shared services or a cooperative agreement for purchasing or other administrative practice; or,
- evidence that a savings has been achieved by contracting services with another school division.

The agreement must include a statement of assurance that it complies with all federal, state, and local laws and regulations.

Examples of agreements that may meet these criteria include, but are not limited to, those that:

1. provide for the consolidation or sharing of specialized educational services or educational support services;

2. provide for the consolidation or sharing of specialized educational facilities in instructional areas such as career and technical education;

3. identify administrative or support services that are duplicative and establish a process for the consolidation or sharing of administrative or support services;

4. provide for joint professional development services;

5. provide for the consolidation or sharing of technology applications and support;

6. provide for the consolidation or sharing of operations and maintenance and custodial services;

7. provide for shared, bulk, or volume purchasing; and

8. provide for privatization or outsourcing of support services with a contiguous school division.

Procedures

To be considered for adjusted Basic Aid funding under Section 22.1-98.2, *Code of Virginia,* a school division must submit to the Department of Education a cost or service-sharing plan with a contiguous division prior to September 1 of each fiscal year.

The content of the submitted cost or service-sharing plan must meet the above listed criteria.

Receipt of adjusted Basic Aid funding will begin after approval of the plan by the Department of Education and approval of the adjusted payment by the Governor of Virginia.

The additional Basic Aid payments will be computed for the eligible school division on the basis of full year funding using the lowest composite index of a contiguous school division participating in the agreement.

All payments of additional Basic Aid pursuant to these procedures are subject to appropriation of state funds for this purpose.

State funding of additional Basic Aid does not reduce the required local effort of the eligible school division.

References

- Section 22.1-98.2, *Code of Virginia*
- Chapter ~~951~~ *781*, ~~2005~~ *2009* Acts of Assembly

Board of Education Agenda Item

Item: H. **Date:** July 23, 2009

Topic: First Review of Nominations to Fill Vacancies on Board of Education Advisory Committees: Advisory Committee on Adult Education and Literacy, State Special Education Advisory Committee, Virginia Advisory Committee for Career and Technical Education, Virginia Advisory Committee for the Education of the Gifted, and the Advisory Board on Teacher Education and Licensure

Presenter: Dr. Margaret N. Roberts, Executive Assistant to the Board of Education

Telephone: 804/ 225-2924 **E-mail:** Margaret.Roberts@doe.virginia.gov

____ Topic presented for information only (no board action required)

____ Board review required by
- ____ State or federal law or regulation
- ____ Board of Education regulation
- X Other: Board of Education Bylaws

X Action requested at this meeting

____ Action requested at future meeting

Previous Review/Action:

X No previous board review/action

____ Previous review/action:
date:
action:

Background Information: Article Nine, Section 2 of the Board of Education's bylaws states the following:

> Advisory Committees. Advisory committees may be created by the Board for special purposes to include, but not be limited to, federal and state-mandated committees. An advisory committee shall be composed of persons who represent the views and interests of the general public and who are known to be qualified to perform their duties. Personnel of the Department of Education may be appointed to the committee, as members or as consultants. All appointments to an advisory committee shall be made by the Board upon the recommendations of the Superintendent of Public Instruction. . . .

The Board of Education's bylaws also specify the term of service in Article Sixteen, Section 4, as follows:

> **Section 4. Term of Service.** Appointments to an advisory committee shall be for a term of three years. Members of an advisory committee may be appointed to a second consecutive three-year term, but shall not be eligible to serve for more than six consecutive years . . .

The Board of Education has six advisory committees, five of which have vacancies for the three-year term of July 2009 to June 2012. The nomination process for the Student Advisory Committee is handled through a special procedure that will be conducted in the early fall.

Two advisory committees require specific categories for membership. The categories are set by the *Code of Virginia* or by state or federal regulation. In addition, the Board's bylaws permit persons to be reappointed to a second term.

Superintendent's Memo Number 128-09 dated May 8, 2009, announced the call for nominations to fill the current advisory committee vacancies. The call for nominations indicated which vacancies involved an incumbent eligible for reappointment. The call for nominations was sent to public school principals, statewide education organizations, interest groups, advocates, and individuals who had expressed interest. This information was also posted on the Board of Education's Web page. The deadline for submission was June 15, 2009.

Following the close of the nomination period, the nominations were reviewed. Those recommended for appointment or reappointment were selected based upon qualifications and on the required categories for membership (if applicable). It is important to note that every attempt was made to balance the membership by geographic region as well as gender and ethnicity.

Summary of Major Elements: The nominees recommended for appointment or reappointment to the 2009-2012 term are as follows:

<u>Advisory Board on Teacher Education and Licensure</u>

- Business Community Representative: Ms. Rena Berlin, Director of Education, Virginia Holocaust Museum
- Classroom Teacher (Middle): Ms. Kathy Heil, Mathematics Teacher, Grade 8, King George Middle School, King George County Schools
- Classroom Teacher (Secondary): Ms. Patricia McGloine, Social Studies Teacher, Princess Anne High School, Virginia Beach City Public Schools
- Higher Education (Public): Dr. Susan G. Magliaro, Director, School of Education, Virginia Tech

- Nonpublic School: Ms. Courtney Gaskins, Teacher of Special Education, Youth for Tomorrow, Bristow, Virginia

- Classroom Teacher (Elementary): Incumbent-reappointment to a second term: Ms. Dawn Rees-Blakeman, Westside Elementary School, Roanoke City Public Schools

- Higher Education (Independent): Incumbent-reappointment to a second term: Dr. Carole C. Grove, Director, Master of Arts in Teaching Program, Mary Baldwin College

- School Board Member: Incumbent-reappointment to a second term: Ms. Ann Y. Williams, Hopewell City School Board

State Special Education Advisory Committee

- Region II Parent: Mrs. Sandra Hermann, Virginia Beach

- Region III Parent: Mrs. Lori Jackson, Mathews County

- Region VII Parent: Mrs. Jackie Myal, Pulaski County

- Region VIII Parent: Mrs. Bernadette Jones, Amelia County

- Region I Parent: Mrs. Carletta Wilson, Richmond: Incumbent-reappointment to a second term

- Classroom Teacher: Ms. Melodie Henderson, Chesterfield County: Incumbent-reappointment to a second term

Advisory Committee on Adult Education and Literacy

- Ms. Elaine Callahan, Adult Education Program Manager, Henrico County Public Schools

- Ms. Betsy Mathias, Regional Adult Education Program Manager, Spotsylvania County Public Schools

- Ms. Annette Loschert, Executive Director, Literacy Volunteers of the Roanoke Valley

- Dr. Bonita Moore, Director, Adult and Community Education, Fairfax County Public Schools

- Ms. Paulette Richmond, Academic Coordinator for Adult Education, Virginia Beach City Public Schools

- Dr. Troilen Seward, Educational Consultant, Claremont, VA

Career and Technical Education Advisory Committee

- Mr. Allan R. Melton, Manager of Product Training, The Apprentice School, Northrop Grumman-Region II
- Mr. Frederick R. Norman, Owner, Commonwealth of Virginia Consulting, LLC, an Information Technology business development consulting firm-Region I
- Mrs. Lynn May, Registered Nurse-Region III
- Ms. Jane Foy, Co-host and Producer, WINA Morning News Program, Charlottesville-Region V
- Mr. Chad Ratliff, General Manager and Co-Owner of the Ratliff Group, LLC (Real Estate Investment Firm)-Region VII

Virginia Advisory Committee for the Education of the Gifted

- Ms. Patti Davis, Parent, Ashland
- Dr. Carol V. Horn, Coordinator of Gifted Programs, Fairfax County Public Schools
- Mr. Reginald Johns, Gifted Resource Teacher, Hampton City Public Schools
- Ms. Veronica Annette Kouassi, Assistant Director, Appomattox Regional Governor's School, Petersburg
- Ms. Kerri M. Wilson, VSBA Board of Directors, Harrisonburg City School Board
- Dr. Ellen Fithian, Independent Educational Consultant, Poquoson: Incumbent-reappointment to a second term
- Dr. Judith Greathouse, Coordinator of Gifted Programs, Frederick County Public Schools: Incumbent-reappointment to a second term
- Mr. Brian Pace, Director, Piedmont Governor's School: Incumbent-reappointment to a second term

Superintendent's Recommendation: The Superintendent of Public Instruction recommends that the Board of Education waive first review and adopt the list of nominees recommended for appointment to Board of Education advisory committees for the July 2009-June 2012 term.

Impact on Resources: The operating expenses and other costs associated with the meetings and functions of the Board of Education's advisory committees are provided through the Department of Education's operating funds. Where applicable, federal funds are provided to support the expenses and the work of an advisory committee.

Timetable for Further Review/Action: Department of Education staff will notify the nominees appointed to the Board of Education advisory committees so that the committee meetings for the 2009-2010 school year may be set as soon as possible.

Board of Education Agenda Item

Item: I. **Date:** July 23, 2009

Topic: First Review of Proposed Guidelines for an Academic and Career Plan as Required in Section 8 VAC 20-131-140 of the *Regulations Establishing Standards for Accrediting Public Schools in Virginia*

Presenter: Dr. Linda M. Wallinger, Assistant Superintendent for Instruction

Telephone Number: (804) 225-2034 **E-Mail Address:** Linda.Wallinger@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

____ Board review required by
- ____ State or federal law or regulation
- _X_ Board of Education regulation
- ____ Other: _____

____ Action requested at this meeting _X_ Action requested at future meeting: September 17, 2009

Previous Review/Action:

____ No previous board review/action

_X_ Previous review/action
date February 19, 2009
action Approved *Regulations Establishing Standards for Accrediting Public Schools in Virginia* (8 VAC 20-131-5 et seq.)

Background Information:
In December 2007, Governor Tim Kaine requested that the Board of Education include in its revised *Regulations Establishing Standards for Accrediting Public Schools in Virginia, (8 VAC-20-131-5 et seq)* provisions for each middle and high school student to have a personal learning plan that aligns academic and career goals with the student's course of study. On February 19, 2009, the Virginia Board of Education approved revisions to the *Regulations Establishing Standards for Accrediting Public Schools in Virginia* (8 *VAC* 20-131-5 et seq.) (Standards of Accreditation or SOA) that included a requirement for an Academic and Career Plan. The section of the *Regulations Establishing Standards for Accrediting Public Schools in Virginia* pertaining to the Academic and Career Plan reads:

8 VAC 20-131-140: College and career preparation programs and opportunities for postsecondary credit.
Beginning with the 2010-2011 academic year, all schools shall begin development of a personal Academic and Career Plan for each seventh-grade student with completion by the fall of the student's eighth-grade year. Students who transfer from other than a Virginia public school into the eighth grade shall have the Plan developed as soon as practicable following enrollment. Beginning with the 2011-2012 academic year, students who transfer into a Virginia public school after their eighth-grade year shall have an Academic and Career Plan developed upon enrollment. The components of the Plan shall include, but not be limited to, the student's program of study for high school graduation and a postsecondary career pathway based on the student's academic and career interests. The Academic and Career Plan shall be developed in accordance with guidelines established by the Board of Education and signed by the student, student's parent or guardian, and school official(s) designated by the principal. The Plan shall be included in the student's record and shall be reviewed and updated, if necessary, before the student enters the ninth and eleventh grades. The school shall have met its obligation for parental involvement if it makes a good faith effort to notify the parent or guardian of the responsibility for the development and approval of the Plan. Any personal academic and career plans prescribed by local school boards for students in grades 7-12 and in effect as of June 30, 2009, are approved to continue without further action by the Board.

Summary of Major Elements:
The *Guidelines for the Academic and Career Plan* includes:

- Purpose of Academic and Career Plans
- Academic and Career Plan Timeline
- Academic and Career Plan Template
- Components of the Academic Career Plan

A technical assistance document will be developed by the Virginia Department of Education to include a model Academic and Career Plan template that can be adapted for use by school officials working with students in academic and career preparation.

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education accept for first review the proposed *Guidelines for the Academic and Career Plan*.

Impact on Resources:
School divisions that did not have personal academic and career plans for students in grades 7 through 12 in effect by June 30, 2009, will need to begin developing and implementing such plans for seventh-grade students by the beginning of the 2010-2011 academic year.

Timetable for Further Review/Action:
Following review and final approval of the Board of Education, notification will be made to school divisions of the guidelines and their availability on the Virginia Department of Education's Web site.

Proposed

Guidelines for Academic and Career Plans

as prescribed in

Regulations Establishing Standards for Accrediting Public Schools in Virginia

8 VAC 20-131-140
College and career preparation programs and opportunities for postsecondary credit

Virginia Board of Education

July 23, 2009

Guidelines for Academic and Career Plans

Introduction

The Board of Education included in its 2009 revisions to the *Regulations Establishing Standards for Accrediting Public Schools in Virginia, (8 VAC-20-131-5 et seq)* provisions for each middle and high school student to have a personal learning plan that aligns academic and career goals with the student's course of study. On February 19, 2009, the Board adopted the revised Regulations, also known as the *Standards of Accreditation* [http://www.doe.virginia.gov/VDOE/Accountability/soafulltxt.pdf]. The section pertaining to Academic and Career Plans reads:

> *8 VAC 20-131-140: College and career preparation programs and opportunities for postsecondary credit.*
>
> Beginning with the 2010-2011 academic year, all schools shall begin development of a personal Academic and Career Plan for each seventh-grade student with completion by the fall of the student's eighth-grade year. Students who transfer from other than a Virginia public school into the eighth-grade shall have the Plan developed as soon as practicable following enrollment. Beginning with the 2011-2012 academic year, students who transfer into a Virginia public school after their eighth-grade year shall have an Academic and Career Plan developed upon enrollment. The components of the Plan shall include, but not be limited to, the student's program of study for high school graduation and a postsecondary career pathway based on the student's academic and career interests. The Academic and Career Plan shall be developed in accordance with guidelines established by the Board of Education and signed by the student, student's parent or guardian, and school official(s) designated by the principal. The Plan shall be included in the student's record and shall be reviewed and updated, if necessary, before the student enters the ninth and eleventh grades. The school shall have met its obligation for parental involvement if it makes a good faith effort to notify the parent or guardian of the responsibility for the development and approval of the Plan. Any personal academic and career plans prescribed by local school boards for students in grades 7-12 and in effect as of June 30, 2009, are approved to continue without further action by the Board.

Purpose of Academic and Career Plans

The Academic and Career Plan is designed to be a working document that maximizes student achievement by having the student accomplish goals in middle and high school that lead to postsecondary and career readiness. The Plan should be student-driven and maintained by school professionals working cooperatively to assist the student in reaching his or her goals in the most logical academic and career path.

The Academic and Career Plan should start with the end in mind. The student, parent or guardian, and school professional(s) will create a plan agreed upon by all parties to ensure everyone is focused on working toward the same goals and analyze and adjust the Plan in response to new information to meet the needs of the student.

Academic and Career Plan Timeline

Beginning with the 2010-2011 academic year, all schools shall begin development of a personal Academic and Career Plan for each seventh-grade student, with completion by the fall of the student's eighth-grade year.

Students who transfer from other than a Virginia public school into the eighth grade shall have the Plan developed as soon as practicable following enrollment. Beginning with the 2011-2012 academic year, students who transfer into a Virginia public school after their eighth-grade year shall have an Academic and Career Plan developed upon enrollment.

The Academic and Career Plan shall be signed by the student, student's parent or guardian, and school official(s) designated by the principal. The Plan will be included in the student's record and must be reviewed and updated, if necessary, before the student enters the ninth and eleventh grades. The schedule for revising the Plan may be determined by the school division. The school shall have met its obligation for parental involvement if it makes a good faith effort to notify the parent or guardian of the responsibility for the development and approval of the Plan.

Academic and Career Plan Template

The format of the Academic and Career Plan is flexible. Any personal academic and career plans prescribed by local school boards for students in grades 7-12 and in effect as of June 30, 2009, are approved to continue without further action by the Board.

A technical assistance document will be developed by the Virginia Department of Education to include a model Academic and Career Plan template that can be adapted for use by school officials working with students in academic and career preparation.

Academic and Career Plan Components

Required components of the Academic and Career Plan shall include, but not be limited to:

- The student's program of study for high school graduation that is aligned with a postsecondary career pathway and/or college entrance;
- A postsecondary career pathway based on the student's academic and career interests; and
- A signature from the student, student's parent or guardian, and school official(s) designated by the principal.

Board of Education Agenda Item

Item: J. **Date:** July 23, 2009

Topic: First Review of Proposed Amendments to the *Regulations Governing Local School Boards and School Divisions* (8 VAC 20-720) and Repeal of the *Regulations Governing Instructional Materials – Selection and Utilization by Local School Boards* (8 VAC 20-170), *Regulations Governing Textbook Adoption State Level* (8 VAC 20-220), *Regulations Governing Textbook Adoption Local Level* (8 VAC 20-230), and *Regulations Governing Textbook Fund Management and Handling on Local Level* (8 VAC 20-270)

Presenter: Ms. Anne D. Wescott, Assistant Superintendent for Policy and Communications

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Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting _____ Action requested at future meeting: _____

Previous Review/Action:

___ No previous board review/action

_X_ Previous review/action

date May 21, 2008 (textbooks) and April 24, 2008 (instructional materials)

action Approval of the Notices of Intended Regulatory Actions (NOIRA)

Background Information: The Board of Education currently has three sets of regulations governing textbooks and one set of regulations governing instructional materials. The regulations governing textbooks are: *Regulations Governing Textbook Adoption State Level* (8 VAC 20-220), *Regulations Governing Textbook Adoption Local Level*, (8 VAC 20-230), and *Regulations Governing Textbook Fund Management and Handling on Local Level*, (8 VAC 20-270). The regulations governing instructional materials are: *Regulations Governing Instructional Materials – Selection and Utilization by Local School Boards* (8 VAC 20-170). All of these regulations were adopted on or before September 1, 1980, have not been amended since that time, and are out-of-date.

During the 2008 General Assembly, three bills were passed that impact the purchasing and provision of textbooks for Virginia's public school students. These bills were HB 137, patroned by Delegate Chris Peace, HB 354, patroned by Delegate Mark Cole and SB 356, patroned by Senator John Watkins. HB 137 and SB 356 are identical and were proposed by the Department of Education. HB 354 is identical, with the addition of a provision making it possible for any private school within a school division to purchase textbooks from the local school board's contract. These bills took effect on July 1, 2008.

The purpose of this proposal is to repeal the four current regulations and amend the *Regulations Governing Local School Boards and School Divisions* by creating a section governing textbooks. The three current regulations will be repealed simultaneously with the adoption of the amendment. The amendment will also capture the requirements of the bills passed by the 2008 General Assembly.

Summary of Major Elements: The proposed regulations will capture the requirements of HB 137, HB 354 and HB 356, all passed by the 2008 General Assembly, relating to textbook purchasing. These provisions relate to the approval of textbooks, basal textbooks, contacts with textbook publishers, the distribution of textbooks and consumable materials, and the selection of instructional materials by local school divisions. In addition, a number of provisions that are unnecessary, outdated, or are no longer required by the *Code of Virginia* would be deleted.

In 8 VAC 20-720-10, the definitions section:

- The term "textbook" is defined, consistent with the definition of textbook in § 22.1-238 of the *Code of Virginia*.
- The term "instructional materials" is also defined.

In VAC 20-70-160, the instructional materials section:

- Language is added to provide parents with the right to inspect instructional materials used as a part of the educational curriculum, and the procedure for granting a request to parents for such access. This language is consistent with the federal *Protection of Pupil Rights Amendment*, 20 U. S. C. § 123h and its implementing regulation 34 CFR 98.

In 8 VAC 20-720-170, the textbooks section:

- The textbook selection process is streamlined, consistent with the 2008 legislation. School divisions purchasing textbooks approved by the Board of Education may either enter into a contract with the publisher or purchase on an as-needed basis. In accordance with § 22.1-241 of the *Code of Virginia*, the written contracts or purchase orders for textbooks approved by the Board are exempt from the *Virginia Public Procurement Act*, and the textbook price shall not exceed the lowest wholesale price at which the book or books involved in the contract are currently bid under contract anywhere in the United States.

- Local school boards may continue to use textbooks not approved by the Board of Education, provided that they adopt procedures governing the selection process. The selection process must include the appointment of an evaluation committee, notice to parents and opportunities for consideration of public comment, and the use of selection criteria approved by the local school board. Textbooks not approved by the Board of Education must be purchased in accordance with the *Virginia Public Procurement Act* or locally adopted procurement procedures or regulations that contain requirements for competitive purchasing.

- Local school divisions would be required to certify annually that the textbooks are selected and purchased in accordance with the *Code of Virginia* and these regulations.

- Language about the textbook fund that is no longer required by the *Code*, and other outdated and unnecessary provisions of the current regulations, would be repealed.

Upon passage of the new section governing textbooks, the current individual regulations would be simultaneously repealed.

Superintendent's Recommendation: The Superintendent of Public Instruction recommends that the Board of Education accept the proposed regulations for first review and authorize the Department of Education staff to proceed with the requirements of the Administrative Process Act.

Impact on Resources: The administrative impact for the review of these regulations and passage of the section governing textbooks is expected to have a minimal fiscal or administrative impact on the Department of Education and local school divisions.

Timetable for Further Review/Action: The timetable for further action will be governed by the requirements of the Administrative Process Act.

CHAPTER 720

REGULATIONS GOVERNING
LOCAL SCHOOL BOARDS AND SCHOOL DIVISIONS

8VAC 20-720-10. Definitions

"Instructional materials" means all materials, other than textbooks, used to support instruction in the classroom, including, but not limited to, books, workbooks, and electronic media.

"Textbooks" means print or electronic media for student use that serve as the primary curriculum basis for a grade-level subject or course.

8 VAC 20-720-160. Instructional materials.

A. Local school boards shall be responsible for the selection, approval, and utilization of instructional materials.

B. Local school boards shall adopt policies and criteria for the selection of instructional materials that shall include, at a minimum:

1. Instituting a policy regarding the rights of parents to inspect, upon request, any instructional materials used as part of the educational curriculum for students, and the procedure for granting a request by a parent for such access, in accordance with the *Protection of Pupil Rights Amendment*, 20 U. S. C. § 123h, and its implementing regulation, 34 CFR 98;

2. Establishing procedures for the reconsideration of challenged materials;

3. Placing special emphasis on the thorough evaluation of materials related to controversial or sensitive topics such as sex education, moral education, and religion; and

4. Including in the curriculum and scheduling options for students whose parents choose to withdraw them from class for the duration of the treatment of a sensitive or controversial topic. Parents should be required to justify their requests.

8VAC20-720-170. Textbooks

A. Textbook approval

1. The Board of Education shall have the authority to approve textbooks for use in the public schools of Virginia.

2. In approving basal textbooks for reading in kindergarten and first grade, the Board shall report to local school boards those textbooks with a minimum decodability standard based on words that students can correctly read by properly attaching speech sounds to each letter to formulate the word at 70 percent or above for such textbooks, in accordance with § 22.1-239 of the *Code of Virginia*.

3. Any local school board may use textbooks not approved by the Board provided the school board selects such books in accordance with this chapter.

B. Selection of textbooks by local school boards

Local school boards shall adopt procedures for the selection of textbooks. These procedures shall include, at a minimum, the following:

1. Appointment of an evaluation committee by the local school board to review and evaluate textbooks in one or more of the subject areas.

2. Notice to parents that textbooks under consideration for approval will be listed on the school division's Web site and made available at designated locations for review by any interested citizens. Provisions shall be made for those reviewing such textbooks to present their comments and observations, if any, to the school board through locally approved procedures. Actions which are necessary to assure appropriate consideration of citizen comments and observations shall be taken and adequate time for such consideration shall be allowed.

3. Use of selection criteria that has been approved by the local school board.

C. Purchasing Board of Education approved textbooks

1. Local school divisions shall purchase textbooks approved by the Board of Education directly from the publishers of the textbooks by either entering into written term contracts or issuing purchase orders on an as-needed basis in accordance with § 22.1-241 of the *Code of Virginia*.

2. Such written contracts or purchase orders shall be exempt from the *Virginia Public Procurement Act* (§§ 2.2-4300 et seq. of the *Code of Virginia*) and from any locally adopted regulations or procedures.

D. Purchasing non-Board of Education approved textbooks

Local school divisions shall purchase non-Board of Education approved textbooks by either entering into written contracts or issuing purchase orders on an as-needed basis in accordance with locally adopted procurement procedures or regulations that contain requirements for competitive purchasing or the *Virginia Public Procurement Act*.

E. Certifications

The division superintendent and chairperson of the local school board shall annually certify to the Virginia Department of Education that:

1. All textbooks were selected and purchased in accordance with this chapter; and

2. The price paid for each textbook was not in excess of that charged elsewhere in the United States in accordance with § 22.1-241 of the *Code of Virginia*.

The certification shall include a list of all textbooks adopted by the local school board.

CHAPTER 170

REGULATIONS GOVERNING INSTRUCTIONAL MATERIALS – SELECTION AND UTILIZATION BY LOCAL SCHOOL BOARDS

~~8VAC20-170-10. Responsibility - local school boards.~~

~~The Board of Education places with local school boards the responsibility for the selection, approval, and utilization of instructional materials.~~

~~In the selection of instructional materials, the local school board is responsible for the following:~~

1. ~~Developing local criteria for selection (the Board of Education will assist by publishing guidelines for the development of criteria);~~

2. ~~Approving materials which are consistent with instructional goals and objectives;~~

3. ~~Appointing a division evaluation committee which should include, when appropriate, parents, students, teachers, supervisors, and nonparent patrons;~~

4. ~~Providing for the examination of materials by appropriate committees and individuals (local boards may choose to exempt certain types of materials from the formal evaluation process - maps, charts, games, etc.);~~

5. ~~Providing notice to parents that books and materials under consideration for approval will be available at designated locations for review by any interested citizens. Provisions should be made for those reviewing such materials to present their comments and observations, if any, to the school board through locally approved procedures. Those actions should be taken which are necessary to assure appropriate consideration of such citizen observations and adequate time for such consideration should be allowed. Such actions might include (i) opportunity to meet with the board, or (ii) opportunity to meet with board-appointed professional committees assigned responsibility for making recommendations to the board;~~

6. ~~Requesting special assistance in the evaluation of proposed materials, if desired, from the Department of Education;~~

7. ~~Establishing procedures for the reconsideration of challenged materials;~~

8. ~~Placing special emphasis on the thorough evaluation of materials related to controversial or sensitive topics such as sex education, moral education, and religion;~~

9. ~~Including in the curriculum and schedule options for students whose parents choose to withdraw them from class for the duration of the treatment of a sensitive or controversial topic. Parents should be required to justify their requests.~~

CHAPTER 220

REGULATIONS GOVERNING TEXTBOOK ADOPTION
STATE LEVEL

~~8VAC20-220-10. Adoption period established.~~

~~Textbooks shall be adopted for a six-year period, according to a schedule to be determined by the Department of Education and approved by the Board of Education in the following areas:~~

~~1. Elementary:~~

~~a. Language and grammar;~~
~~b. Social studies;~~
~~c. Mathematics;~~
~~d. Health;~~
~~e. Dictionaries;~~
~~f. Science;~~
~~g. Reading;~~
~~h. Spelling; and~~
~~i. Handwriting.~~

~~2. Secondary:~~

~~a. Literature;~~
~~b. Speech;~~
~~c. Drama;~~
~~d. Journalism;~~
~~e. English, grammar, and composition;~~
~~f. Physical science;~~
~~g. Earth-space science;~~
~~h. Biology;~~
~~i. Chemistry;~~
~~j. Physics;~~
~~k. World history;~~
~~l. United States history;~~
~~m. United States government;~~
~~n. Economics;~~
~~o. Mathematics;~~
~~p. Health;~~
~~q. Dictionaries;~~
~~r. Sociology;~~
~~s. Geography; and~~
~~t. Foreign Languages.~~

~~8VAC20-220-20. Deletion from approved lists within adoption period; extension of contracts for adopted books.~~

~~An adopted book may be deleted from the approved list within the six-year period in accordance with statutory provisions; and contracts for certain books currently adopted as well as those which may be adopted from such areas as writing, spelling, and literature (anthologies) may be extended up to four years in accordance with statutory provisions.~~

~~8VAC20-220-30. Types of materials adopted.~~

~~Only those materials which are designed to provide basic support for the instructional program of a particular content area at an appropriate level will be adopted.~~

~~8VAC20-220-40. Wholesale prices.~~

~~Contracts with the publishers shall be made for all textbooks at the wholesale prices free on board publishers' nearest shipping point.~~

~~8VAC20-220-50. Allowance for delivery costs.~~

~~A percentage determined by the Board of Education will be added to the wholesale prices of textbooks, free on board publishers' nearest shipping point, to cover the cost of delivering the books to division school boards in Virginia.~~

~~8VAC20-220-60. Maximum retail prices.~~

~~A percentage, in addition to that mentioned above, shall be added to establish the maximum retail prices of textbooks.~~

~~8VAC20-220-70. Price adjustment requests.~~

~~At the time of adoption (December of even years), the Board of Education also will consider requests from publishers for adjustments in contract prices for materials already under contract but not involved in the current adoption.~~

CHAPTER 230

REGULATIONS GOVERNING TEXTBOOK ADOPTION
LOCAL LEVEL

~~8VAC20-230-10. Authority.~~

~~The Constitution of Virginia gives the Board of Education authority to adopt textbooks for use in the public schools of Virginia. To fulfill its duty, the Board adopts a multiple list of textbooks in each grade and subject in which basal adoptions are made. In turn, local school boards select materials to meet local needs from this multiple listing. In addition, the Code of Virginia provides that any local school board may use textbooks not approved by the board, provided the school board selects such books in accordance with regulations promulgated by the Board of Education.~~

~~8VAC20-230-20. Local adoptions of state-adopted texts.~~

~~Following the announcement of adoptions, the Board of Education authorizes a period of five to seven months in which localities may examine and select materials from the list chosen by the board. Such local adoptions are reported to the Department of Education on forms provided by the department.~~

~~8VAC20-230-30. Local adoptions of nonstate adopted material.~~

~~The Board of Education has set forth the following regulations for the selection of textbooks not on the state-adopted list:~~

1. ~~An evaluation committee shall be appointed by the school board to review and evaluate textbooks in one or more of the subject areas for which adoptions are effective beginning July 1 of odd-numbered years.~~

2. ~~The evaluation committee shall be representative of the supervisory staff of the central office, elementary or secondary school administrators or both, and classroom teachers of the subject fields in which adoptions are to be made, and shall be nondiscriminatory with respect to sex and race.~~

3. ~~Before recommending a textbook not on the state-adopted list, the committee shall first have examined and evaluated the appropriate textbooks on the state-adopted list.~~

4. ~~The evaluation committee shall submit in writing its recommendations and supporting data via the division superintendent to the school board for action in sufficient time for the adoptions by the local school boards to be effective July 1 of odd- numbered years.~~

5. ~~Criteria to be used by the evaluation committee in the review and assessment of textbooks must have the official approval of the local school board. The criteria, as approved, shall be on file in the office of the local school board.~~

6. ~~The division superintendent shall certify to the Superintendent of Public Instruction or his representative, on forms prescribed by the Department of Education, a list of all books adopted by the local school board and state that such books have been adopted in full compliance with this chapter and that information as to prices paid for such books is available upon request.~~

7. ~~Evidence shall be on file in the office of the local school board that the price charged for any textbook adopted under this chapter is not in excess of that charged elsewhere in the United States.~~

~~8VAC20-230-40. Local adoptions for materials for subject areas not included in basal adoptions.~~

~~For use in vocational classes and for other subject areas in which no material is adopted, localities may select textbooks from lists of recommended texts furnished by the Department of Education.~~

CHAPTER 270

REGULATIONS GOVERNING TEXTBOOK FUND MANAGEMENT AND HANDLING ON LOCAL LEVEL

~~8VAC20-270-10. General.~~

~~Although most school systems distribute textbooks to students on a free or rental basis, some systems still use retail sales to students. In the following sections, references to "retail sales" or "unsold textbooks on hand" refer to this type of distribution. Books are secured from publishers on a consignment basis and payment is made quarterly as the books are sold. Books not sold may be held until the end of an adoption period and returned to the publisher for credit.~~

~~Only those textbooks selected by school divisions from the list of state-adopted texts are subject to the prices and regulations set forth in contracts between the publishers having books on the adopted list and the Virginia Board of Education.~~

~~8VAC20-270-20. Establishment and designation of special fund; establishment of special bank account.~~

~~A separate fund shall be established by the school board and the chief fiscal officer of the county, city, or town (of which the school board is a part), to which shall be credited all proceeds received from the sale of textbooks in the local school system. This special fund shall be designated:~~

~~County, City, or Town of.....~~
~~School Textbook Fund~~
~~The chief fiscal officer is requested to establish a special bank account titled as follows:~~
~~County, City, or Town of.....~~
~~School Textbook Fund~~
~~By.....~~
~~(Treasurer/Director of Finance or such title as he may have.)~~

~~8VAC20-270-30. Textbook sales, receipts, and disbursements; bonds for clerk and other personnel handling funds.~~

~~The school board shall designate the clerk of the school board, who shall be bonded as provided by law, to handle the sale of textbooks. Additional personnel employed to assist the clerk in handling textbook funds shall be covered by a fidelity and faithful performance bond, a copy of which shall be filed in the school board office.~~

~~The local school board shall require the clerk to deposit intact, with the treasurer or the director of finance or in any bank designated by the chief fiscal officer, all moneys received from the sale of textbooks; and the treasurer or the director of finance, in turn, will deposit these sums to the credit of the special bank account aforementioned. When ordering payments to publishers, or the payment of any expense from the proceeds of the sale of textbooks, the county, city, or town~~

~~school board shall issue its warrant made payable to the publisher, agency, or individual to whom the payment is being made; this warrant shall be signed by the chairman of the school board and countersigned by the clerk of that board.~~

~~In each instance, each warrant shall indicate that it is payable from the school textbook fund as set forth above. All expenditures shall be approved and a warrant in payment thereof authorized by the school board in accordance with the procedure for the expenditure of regular school funds. The procedure to be followed for the disbursement of funds credited to the school textbook fund in cities shall conform to the procedure in effect for the disbursements of school funds; the only distinction being that the school board and the chief fiscal officer shall maintain a separate fund and separate bank account for the receipts and disbursements incident to the handling of textbooks.~~

~~8VAC20-270-40. Accounting and records; verification of book shipments received.~~

~~The school board shall require the clerk of the board to maintain a record of receipts and disbursements of the textbook fund and to reconcile the balance in this fund each month with the chief fiscal officer of the county, city or town. It shall also require the maintenance of a ledger account with each publisher to which will be credited the value of books received for sale and to which will be charged all payments made to the publisher on account and all transactions for exchanged and returned books. This account shall be reconciled with the reports of unsold books on hand. The invoices received from the publishers for books shipped to the school board shall be filed in separate folders by the names of publishers. Each shipment of books received shall be verified by actual count and the date and quantity of books received should be written on the invoice opposite each title and signed by the person making the count.~~

~~8VAC20-270-50. School systems having free or rental textbook systems and also selling textbooks.~~

~~In counties, cities, and towns where free or rental textbook systems are in operation in some schools and textbooks are sold to pupils in other school systems, all textbooks purchased from the publishers should be handled through the textbook fund. Books which are used for that portion of the school system from which rental or free textbooks are furnished should be purchased from the textbook fund and be paid for with a warrant drawn on the regular school operating fund or the school textbook rental fund.~~

~~8VAC20-270-60. Transfers between school operating fund and textbook fund.~~

~~If the school board makes an appropriation for the operation of the school textbook fund, a warrant should be drawn on the regular school operating fund and deposited to the credit of the school textbook fund. If the school board authorizes the use of surplus school textbook funds for general school operation, a warrant should be drawn on the textbook fund and credited to the regular school operating fund.~~

~~8VAC20-270-70. Reports and payments to publishers; unsold textbooks on hand as of June 30.~~

~~Copies of reports to publishers listing all new unsold textbooks on hand and showing balances due for all books sold as of October 15, January 15, March 31, and June 30 shall be kept by the school board. The school board shall forward the original of each periodic report, together with its remittance, directly to the publishers on the dates designated. Each report to the publisher certifying unsold textbooks on hand as of the date of the report shall be certified by the persons responsible for the handling of the textbooks and the superintendent, or some person designated by the superintendent, who shall verify the accuracy of the report by an actual count of the books on hand. Unsold textbooks on hand as of June 30 of each year shall be listed on the Virginia textbook requisition (elementary and high) for the current year.~~

~~8VAC20-270-80. Books for resale to be segregated from those owned by the school board.~~

~~Books received from the publishers for resale shall be segregated and maintained under a separate inventory control from books which are owned outright by the school board and used in a rental or a free- textbook system.~~

~~8VAC20-270-90. Responsibility for books placed in specific schools.~~

~~Where the school board finds it necessary to place books in a school for resale to pupils, the principal of the school (or other person approved by the school board) shall be required to sign a receipt listing the titles and retail sale prices of all books placed in his or her custody; the individual shall be responsible for the total value of books received and be required to account to the school board not less than quarterly in money and value of books returned equal to the total value of books receipted for by him.~~

~~8VAC20-270-100. Audits; preservation of records.~~

~~The school textbook fund shall be audited annually on order of the school board or by the governing board as a part of the overall county, city, or town audit. A copy of the audit report shall be furnished to the Board of Education. The records required by this chapter shall be preserved in the same manner as other public records.~~

~~8VAC20-270-110. Fire insurance on textbooks in stock.~~

~~The entire stock of textbooks shall be adequately covered by fire insurance and any loss shall be payable to the school board. A copy of the policy shall be filed with the school board and satisfactory proof of coverage submitted to the Board of Education.~~

~~8VAC20-270-120. Retail sales of textbooks to be for cash.~~

~~Textbooks shall be sold at retail for cash only.~~

~~8VAC20-270-130. Issuance of warrants between board meetings.~~

~~The school board may provide, by resolution, for the issuance of warrants drawn on the textbook fund in payment of amounts due publishers and for freight, or drayage falling due between meeting of the board. All such warrants shall be signed by the chairman and countersigned by the clerk of the school board and presented to the school board for approval at the next meeting following the issuance of such warrants.~~

Board of Education Agenda Item

Item: K. **Date:** July 23, 2009

Topic: First Review of Proposed Amendments to the *Regulations Governing Local School Boards and School Divisions* (8 VAC 20-720) and Repeal of the *Rules Governing Fees and Charges* (8 VAC 20-370)

Presenter: Ms. Anne D. Wescott, Assistant Superintendent for Policy and Communications

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Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting _____ Action requested at future meeting: _____

Previous Review/Action:

___ No previous board review/action

_X_ Previous review/action

date July 17, 2008

action Approval of the Notice of Intended Regulatory Action (NOIRA)

Background Information: The Board of Education's *Rules Governing Fees and Charges*, 8 VAC 20-370-10, were adopted on or before September 1, 1980, and have not been amended since that time. The purpose of this proposal is to update the regulations by repealing the current regulations governing fees charged by local school divisions and creating a new regulation that will be added as a section to the proposed *Regulations Governing Local School Boards and School Divisions*, 8 VAC 20-720-10 et seq.

Summary of Major Elements: The proposed regulation will include specific provisions regarding permissible and impermissible fees, policies for families that cannot afford the fees and permissible and impermissible actions for the failure to pay the fees. The current regulation will be repealed simultaneously with the promulgation of the new regulation.

The following changes related to policy are proposed:

- Local school boards that charge fees would be required to have a policy and a fee schedule that would be provided to parents annually and posted on the school division's Web site.

- The policy would include a provision to waive or reduce fees for economically disadvantaged students and students whose families are undergoing economic hardships.

- The policy and fee schedule would be required to be consistent across the school division.

- No fees could be charged that had not been approved by the local school division.

The following changes related to fees and charges are proposed:

- Fees may not be charged as a condition of school enrollment unless the student is not of school age or does not live within the jurisdiction (§§ 22.1-1, 22.1-3, and 22.1-5, *Code of Virginia*).

- Fees may not be charged for textbooks or textbook deposits; however, § 22.1-143, *Code of Virginia*, permits local school divisions to assess a reasonable fee for lost or damaged textbooks.

- Fees may not be charged for pupil transportation to and from school (Attorney General's Opinion dated August 29, 2007), but may be charged for the student's pro rata cost of providing for voluntary extracurricular activities (§ 22.1-176, *Code of Virginia*).

- Fees may be charged for summer school unless the summer school program is a remediation program required by the Standards of Quality (§ 22.1-253.13:1, *Code of Virginia*).

- Fees may be charged for class dues; however, class dues shall not be mandatory, and the school board must specify the kinds of programs and activities covered by class dues;

- Fees may be charged for nonmandatory services such as parking fees and locker fees (Attorney General's Opinions dated November 8, 1991 and 1964-65 Att'y Gen. Ann. Rep. 294).

- Fees may be charged for consumable materials, such as workbooks, but the local school board must have a policy to ensure that these are furnished at a reduced price or free of charge to students who are unable to afford them (§ 22.1-243, *Code of Virginia*).

- Fees may be charged for the behind the wheel portion of the driver's education program (§ 22.1-205, *Code of Virginia*).

- Fees may be charged for the preparation and distribution of official paper copies of the student's transcript, provided that the school board first provides a reasonable number of copies for free. Official electronic copies of transcripts shall be provided at no cost.

The following additional provision related to nonpayment of fees is proposed:

- A student may not be suspended or expelled for nonpayment of fees and charges.

Superintendent's Recommendation: The Superintendent of Public Instruction recommends that the Board of Education accept the proposed regulations for first review and authorize the Department of Education staff to proceed with the requirements of the Administrative Process Act.

Impact on Resources: The administrative impact for the review of these regulations and passage of the section governing fees and charges is expected to have a minimal fiscal or administrative impact on the Department of Education and local school divisions.

Timetable for Further Review/Action: The timetable for further action will be governed by the requirements of the Administrative Process Act.

CHAPTER 720

REGULATIONS GOVERNING
LOCAL SCHOOL BOARDS AND SCHOOL DIVISIONS

8VAC 20-720-80. Student fees and charges.

A. No fees or charges may be levied on any pupil by any school board unless authorized by the Board of Education or prescribed by the *Code of Virginia*.

B. Each local school board shall develop a policy in accordance with the requirements of the Standards of Quality, § 22.1-253.13:7 of the *Code of Virginia*, addressing any fees that are charged. The policy shall include the schedule of fees charged by the school division, provisions for reducing or waiving fees, and sanctions for nonpayment of fees. The policy and the fee schedule shall be provided to parents annually and posted on the school division's Web site.

C. The policy shall provide for the reduction or waiver of fees for economically disadvantaged students and students whose families are undergoing economic hardships. This shall include, but not be limited to, families receiving unemployment benefits and public assistance, including Temporary Assistance for Needy Families (TANF), food stamps, and Medicaid; foster families caring for children in foster care; and families that are homeless.

D. School divisions shall not charge any fees that have not been approved by the local school board.

E. The fee policy and the fee schedule shall be consistent throughout the school division, although there may be different fee schedules for elementary, middle, and high schools.

F. Local school boards shall not charge fees:

1. As a condition of school enrollment, except for students who are not of school-age or who do not reside within the jurisdiction, in accordance with §§ 22.1-1 and 22.1-3 of the *Code of Virginia* and as provided for in § 22.1-5 of the *Code*;

2. For instructional programs and activities, or materials required for instruction, except as specified in subsection G of this section;

3. For textbooks or textbook deposits; however, § 22.1-243 of the *Code of Virginia* permits a local school board to assess a reasonable fee or charge for lost or damaged textbooks;

4. For pupil transportation to and from school; or

5. For summer school programs or other forms of remediation required by the Standards of Quality, § 22.1-253.13:1 of the *Code of Virginia*.

G. Local school boards may charge fees for the following:

1. Nonmandatory services, such as parking fees or locker rental fees;

2. Nonmandatory extracurricular activities;

3. Class dues; however, class dues shall not be mandatory, and the school board shall specify the kinds of programs and activities covered by class dues;

4. Field trips or educationally-related programs that are not required instructional activities;

5. Deposits for musical instruments not required for instructional activities;

6. Distance learning classes for enrichment and not necessary to meet the requirements for a diploma;

7. Summer school, unless the classes are required for remediation as prescribed by the Standards of Quality, § 22.1-253.13:1 of the *Code of Virginia*;

8. Overdue or lost or damaged library books;

9. Lost or damaged textbooks, in accordance with § 22.1-243 of the *Code of Virginia*; however, textbooks shall be provided free of charge;

10. Consumable materials such as workbooks, writing books and drawing books; however, in accordance with § 22.1-243 of the *Code of Virginia*, the local school board shall develop a policy ensuring that workbooks, writing books, and drawing books are furnished to students who are unable to afford them at a reduced price or free of charge;

11. The behind the wheel portion of the driver's education program, in accordance with § 22.1-205 of the *Code of Virginia*;

12. A student's pro rata share of the cost of providing transportation for voluntary extracurricular activities, in accordance with § 22.1-176 of the *Code of Virginia*; and

13. The preparation and distribution of official paper copies of student transcripts; however, each school board shall provide a reasonable number of copies for free before a charge is levied for additional official copies. Official electronic copies of student transcripts shall be provided for free.

H. Local school boards shall not:

1. Withhold any student's scholastic report card or diploma because of nonpayment of fees and charges, in accordance with § 22.1-6 of the *Code of Virginia*; or

2. Suspend or expel a student for nonpayment of fees and charges.

I. Nothing in this chapter shall be construed to prohibit the school board of any county, city, or town from making supplies, services, or materials available to pupils at cost.

J. These regulations do not address the operation of school stores or fund raising activities where transactions are strictly voluntary.

CHAPTER 370

RULES GOVERNING FEES AND CHARGES

~~8VAC 20-370-10. Fees and charges.~~

~~No fees or charges as noted below may be levied on any pupil by any school board unless authorized by the Board of Education; further, no pupils' scholastic report card or diploma shall be withheld because of nonpayment of any such fee or charge.~~

~~Fees may be charged for:~~

1. ~~Class dues;~~

2. ~~Voluntary student activities;~~

3. ~~Night school classes;~~

4. ~~Postgraduate classes;~~

5. ~~Summer school;~~

6. ~~Rental textbooks;~~

7. ~~Musical instruments used in regularly scheduled instructional classes; and~~

8. ~~Library fees.~~

~~Nothing in this chapter shall be construed to prohibit the school board of any county, city, or town from making supplies, services, or materials available to pupils at cost. Nor is it a violation to make a charge for a field trip or an educational related program that is not a required activity.~~

~~Deposits may be required when return of the item used results in a return of the fees deposited.~~

~~This chapter is not intended to cover operations of school stores or other fund raising activities. These activities are covered by opinions of the Attorney General and certain practices which may be approved by auditors.~~

Board of Education Agenda Item

Item: L. **Date:** July 23, 2009

Topic: First Review of the Proposal to Establish The Governor's School @ Innovation Park (GS@IP) Serving Students from Manassas City, Manassas Park City, and Prince William County Public School Divisions

Presenters: Dr. Felicia D. Dyke, Director, Office of Middle and High School Instruction
Dr. Gail E. Pope, Superintendent, Manassas City Public Schools
Dr. Thomas H. DeBolt, Superintendent, Manassas Park City Public Schools
Dr. Steven L. Walts, Superintendent, Prince William County Public Schools

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Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:
In 2007, a planning group representing the school divisions of Manassas City, Manassas Park City, and Prince William County began formal study for the establishment of an Academic-Year Governor's School for gifted high school students. Within several months of the establishment of the planning committee, George Mason University became a partner in the endeavor.

In 2008, the General Assembly awarded $100,000 to Prince William County Public Schools, fiscal agent for the partnership, to begin the process of planning the program, identifying the location, and developing operational procedures for a new Governor's School. The three school divisions, along with George Mason University, have conducted a variety of studies to determine the focus, curriculum and instruction, grades, and location for a proposed Academic-Year Governor's School for the region's gifted high school students.

Summary of Major Elements:
The proposal documents the existence of an active Governing Board, the designation of a fiscal agent, the overall mission, goals and objectives, the proposed program administration, the proposed student selection criteria, and a proposed site location for The Governor's School @ Innovation Park. The document provides detailed descriptions of the program's curricular focus on environmentally-based sciences and advanced mathematics, augmented by an extensive concentration on 21st Century skills, Earth, relevant engineering practices, technology, and original research skills.

The proposal offers letters of support from business/industry, higher education, and community leaders for the program and its vision and mission.

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education waive first review and approve the proposal thus enabling the Governing Board to proceed to the 2010 General Assembly for operational funding.

Impact on Resources:
The staff at the Department of Education has reviewed the GS@IP proposal. The Department of Education distributes general funds allocated by the General Assembly to Academic-Year Governor's Schools' fiscal agents based on the individual programs' September 30th membership. Additional operating funds would need to be included in the Governor's budget in December 2009 and in the Appropriation Act for the 2010-2012 biennium. Given current funding formulas and an estimated 60 to 75 students attending from Prince William County, the approximate state funding for this program could range from $156,200 to $187,350.

Timetable for Further Review/Action:
The Governing Board of The Governor's School @ Innovation Park respectfully requests that the Virginia Board of Education expedite the processing of this request to support budget preparations by the Virginia Department of Education and the Governor for FY2011. The Governing Board is working with its legislative delegation to seek operational funds from the 2010 General Assembly in order that the program might open in September 2010. Once the funding is included in the Governor's budget, the Governing Board will need to work with the General Assembly to ensure that the funding is retained in the adopted budget.

Procedures for Initiating an Academic-Year Governor's School
Proposal Review

Name: The Governor's School @ Innovation Park

Location: Manassas City, Manassas Park City, and Prince William County Public Schools

Date of Review: June 2, 2009

REVIEW OF THE PROPOSAL

School divisions desiring to implement an Academic-Year Governor's School shall provide the Department of Education with documentation of the following:

I. The existence of an active, ongoing Governing Board of superintendents or their designees from the participating school divisions. **Page 6**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

a. The board shall include school board members and parents. **Page 6**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

b. The Governing Board shall design and administer the Governor's School program which is beyond the scope and sequence of the regular school program for gifted students. **Sections IV and V**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

c. Said Governing Board shall determine:

1. the initial location and **Pages 4 and 36**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

2. fiscal agent that is the school division in which the Governor's School is located. **Pages 7 and 37**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

II. A statement which demonstrates the need/rationale for the school. This statement should be concise and state the important reasons to have a Governor's School, separate and unique from the existing program offerings for secondary gifted students. **Page 1**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

> **a.** A statement of assurance that all school divisions in the region have been invited to participate. **Page 2**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

> **b.** A statement of assurance that all participating school divisions support the program for a minimum of three years. **Page 41**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

III. A brief description of the proposed program:

> **a.** site location - A statement of assurance that site location(s) meets program requirements. **Section II and page 36**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

> **b.** number of students **Page 40**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

> **c.** grade levels **Pages 13 and 40**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

d. general curriculum design. **Section V**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

e. recommended classification. **Page 42**

Half-day (.5) √ **5/6-day (.8333)** Full-day (1.0)

IV. A written memorandum of agreement with local businesses, industries, and institutions of higher learning. This agreement will suggest ways in which community resources will contribute to the Governor's School to broaden the scope of the students' educational experiences. **Appendix V**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

V. A statement of assurances that the Governing Board has reviewed provisions for the Administrative Procedures Guide for the Establishment of Academic Year Governor's Schools and agrees to follow the guidelines set forth in the document. **Page 6**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

VI. A statement of assurance that an ongoing Governing Board will be established to reflect current Board of Education regulations relative to jointly operated schools and programs. **Page 7**

√ **Full Documentation** ___Partial Documentation ___No Documentation

Citation:

Review of Documentation

The plan submitted by the three school divisions seeking to establish The Governor's School @ Innovation Park is detailed and offers strong evidence for the need for the program. The proposal provides detailed information about the advanced curriculum, the structure of the school day/week, and the screening, selection, and orientation of students. The Governing Board, planning committee, superintendents' executive committee, and community involvement portions of the document are well-structured, with evidence that the Governing Board will approve policies required under *Code of Virginia* §22.1-26. Joint Schools.

The Governor's School @ Innovation Park

A Proposal for the Establishment of

An Academic-Year Governor's School
Serving Manassas City, Manassas Park City, and
Prince William County Public Schools

Anticipated Opening September 2010

As approved by the
Manassas City, Manassas Park City, and
Prince William County
School Boards

Planning Committee Members

George Mason University
Prince William Campus

Ronald Carmichael
Executive Officer
Jeff Gorrell
Dean, Graduate School of Education
Richard J. Diecchio
Associate Dean for Undergraduate Programs
Lynne Schrum
Coordinator, Elementary & Secondary Education Program (Science)
Molly Grove
Director of Campus Relations

Manassas City Public Schools

Scott Albrecht
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Virginia Dwyer
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Dr. Michaelene Meyer
Deputy Superintendent Curriculum & Instruction
Dr. Barbara McGonagill
Director, Gifted/Talented and Special Programs
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CTE Department Chair, Osbourn High School
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I. Introduction

Statement of Need and Interest

The Northern Virginia region has a respected history of innovation and leadership in educational opportunities for its students. The three school divisions of Manassas City (MCPS), Manassas Park City (MPCS), and Prince William County (PWCS) have continuously espoused the need to expand opportunities for their strongest students in mathematics and science. When a Prince William County School Board member, Dr. Michael Otaigbe voiced his concern in February 2007 that students' abilities in these areas were not adequately served, his interest galvanized similar apprehension in educators in Manassas City and Manassas Park City.

Prince William County Public Schools has participated in the Thomas Jefferson High School for Science and Technology (TJHSST) program since its designation as the first Academic-Year Governor's School in the mid 1980s. However, Northern Virginia educational and employment opportunities and expectations, as well as transportation realities have changed immensely in the last 20 years. TJHSST continues to draw many PWCS students, but its numbers have declined, often as travel time has increased.

Since MCPS and MPCS did not participate in the full-day program at TJHSST, administrators from those divisions also recognized that additional opportunities in the areas of mathematics and science were needed. All three school divisions have taken part in the many national efforts to increase student achievement in K-12 science, technology, engineering, and mathematics (STEM). In response to this regional interest, the Superintendents of Manassas City, Manassas Park City and Prince William County met and agreed to explore a partial day science, technology, engineering, and mathematics (STEM) program. All three division administrators recognize that such a shared-time model offered their students the best of two communities, a community of learners where accelerated, college-level coursework designed to match their abilities and needs was balanced with their community of friends, academics, and extracurricular activities and athletics at their base high schools.

The STEM initiative with its emphasis on design and problem solving was seen as a natural vehicle to incorporate and test existing knowledge from many disciplines into new knowledge and experiences they would acquire through original research. Such "intellectually messy" problems would encourage students to function as engineers to use technology to gather and analyze data, design, test, and improve a proposed solution, and then communicate their findings to their peers.

Additionally, the division administrators recognized the opportunity this expansion offered to incorporate other significant advancements into their systems. Manassas City Public Schools had adopted tenets of the Partnership for 21st Century Schools into its program K – 12 under the leadership of Superintendent Gail Pope. Throughout the MCPS curriculum and instruction teachers and administrators were challenged to expand students use of those skills considered essential in the modern world:

- Learning and innovation skills - creativity and innovation, critical thinking, problem solving, communication and collaboration;
- Information, media, and technology skills - information literacy, media literacy, ICT (information, communications and technology) literacy; and
- Life and career skills - flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, leadership and responsibility.

An overarching concern expressed by all administrators and school board members focused on the economic opportunities available in the Manassas

City, Manassas Park City, and Prince William County region. Through collaboration with the many technologically innovative corporations located in the region, students would be able to employ their knowledge and skills while working side-by-side with engineers, designers, physicists, technicians and others on the front line of inquiry. Companies such as Lockheed Martin, BAE Systems, Aurora Flight Sciences Corporation, Georator Corporation, Northrup Grumman, and Micron have opened their doors to students and teachers to encourage the growth of student achievement and learning.

The continued growth of this region is predicated on the strength of its work force to think critically and creatively. The authors of *Understanding University Success* (Conley, 2003), a project of the Association of American Universities and the Pew Charitable Trusts, concluded that such skills may in fact be more important than specific content knowledge.

> The habits of mind include critical thinking, analytic thinking and problem solving… and an ability and desire to cope with frustrating and ambiguous learning tasks. Other critical skills include…to discern the relative importance and credibility of various sources of information; to draw inferences and reach conclusions independently; and to use technology as a tool to assist the learning process rather than as a crutch. It is not enough simply to know something; the learner must possess the ability to do something with that knowledge, whether it is to solve a problem, reach a conclusion, or present a point of view.

The need to provide more opportunity for advanced exploration of science, technology, engineering, and mathematics; the need to incorporate 21st Century Skills into the curriculum; the desire to incorporate the rich economic opportunities of the region; and the importance of building habits of mind in their students prompted the three divisions' administrators to move forward with the planning of the 19th Academic-Year Governor's School to serve Manassas City, Manassas Park City, and Prince William County.

Initial Steps

An interest in a shared-time, regional Academic-Year Governor's School came from a Prince William County School Board member in February 2007. In response to the interest, the Superintendents of Manassas City, Manassas Park and Prince William County met and agreed to explore a partial day STEM program. School division designees were appointed to begin the process in April 2007. In June 2007, the superintendents' designees met with Dr. Barbara McGonagill, then principal specialist for Gifted and Governor's Schools at the Virginia Department of Education.

In summer 2007, the service region for the proposed Academic-Year Governor's School was defined as the Prince William County area including the three school divisions found within the county. At that time, all three school divisions made commitments to participate in the development of the program.

The Governor's School @ Innovation Park (GS@IP) Planning Committee was established in July 2007. George Mason University agreed to become a partner in August 2007. With the planning committee and a university partner in place, an application for a planning grant was approved by the Manassas City, Manassas Park City, and Prince William County School Boards in November 2007. The Virginia General Assembly

> "Each year approximately 200 Prince William County students applied for admission to Thomas Jefferson High School and each year only about 20 were usually admitted. I was always wondering whatever happened to the 180 students who could not get in. They were equally motivated and smart. Whatever happened to their dreams and hopes of becoming scientists and engineers? The Governor's School @ Innovation Park will provide a place for these students to be challenged and begin the process of realizing their career goals."
>
> Dr. Michael Otaigbe
> School Board Chairman
> Prince William County Public Schools

approved the planning grant in April 2008. A request for an extension of the planning grant into the second year of the biennium was made in January 2009. (See Appendix A.) To facilitate the planning process, a consultant was hired in August 2008. (See Appendix B.)

A master time line was established by the planning committee to direct the proposal process. Initial research included visits to two existing Governor's Schools (GS) in February 2008. The planning committee visited Central Virginia GS in Lynchburg and Roanoke Valley GS in Roanoke City. On April 30, 2008, a panel of teachers, students, and the director of Mountain Vista Governor's School answered questions and offered perspectives to the committee at one planning committee meeting. At the October 14, 2008 meeting, a panel discussion with two Governor's School directors from New Horizons and Chesapeake Bay Governor's Schools was conducted. At that meeting former New Horizons director and current principal specialist for Gifted and Governor's Schools for the Virginia Department of Education, Dr. Donna Poland, provided additional information about the planning and operations processes. The visitations and panel discussion helped the planning committee envision how the GS@IP would be organized and operate. (See

Localities and Their Services

Prince William County includes three school divisions: Manassas City Public Schools, Manassas Park City Public Schools, and Prince William County Public Schools. The biggest challenge faced by the planning committee was to design a program that would provide unique experiences for all students who attend the GS@IP.

Manassas City has a student enrollment of approximately 6,200. The *Children's Engineering Initiative* is available for students in kindergarten through grade 8 as well as a gifted and talented program, K-12. While high school students who are identified as gifted have Advanced Placement (AP) or dual enrollment courses from which to select, there is limited, if any, integration across content areas. Opportunities for mentorships/internships are available informally through Career and Technical Education programs.

Manassas Park has a student enrollment of approximately 2,300. While high school students who are identified as gifted have Advanced Placement or dual enrollment courses from which to select, there is limited, if any, integration across content areas.

Manassas Park High School does offer a community service course. The intent of the course is to increase students' communication and team building skills.

Prince William County Public Schools (PWCS) has a student enrollment of approximately 73,000. Gifted Education Services are offered at all schools from kindergarten through grade twelve. In addition to gifted services, each of the ten high schools has a specialty program. These specialty programs include the following: Center for Information Technology; the Cambridge Programme; International Baccalaureate Programme; the Center for Environmental and Natural Sciences; the Biotechnology Center; the Center for International Studies and Languages; and the Center for Fine and Performing Arts. A wide variety of programs is also offered through Career and Technical Education. Air Force, Army, and Navy JROTC programs are available. All programs require an application and a possible change in high school for the selected students. PWCS students have participated in the Thomas Jefferson High School for Science and Technology (TJHSST) in Fairfax County since its inception. Fewer students have chosen to attend TJHSST since the development of the specialty programs in Prince William County Public Schools.

II. Site Location and University Partner

George Mason University Prince William Campus (GMU-PWC) has been designated by the George Mason Board of Visitors as the primary campus for the biological and life science research being conducted at Mason. In addition to the current wet laboratory space located in the three academic buildings, Occoquan, Discovery, and Bull Run Halls, the University is currently building a new 52,000 sq. ft., state-of-the-art, biomedical research laboratory (BRL), in cooperation with the National Institute of Health. Scheduled for completion in the spring of 2010, this facility will be home to several of the research efforts currently underway on campus as well as new research endeavors.

By relocating several research activities currently housed in existing labs to the BRL, Mason will have the ability to increase the number of academic/teaching laboratories, and thus expand the life science academic offerings on campus for undergraduate and graduate students. This project will also provide much needed wet laboratory space for the addition of the medical education program scheduled to begin on the Prince William Campus in fall 2010.

The College of Science is committed to building additional wet laboratory space to further expand their research programs beyond 2010. This newly planned facility is also intended to house a biotechnology (biotech) incubator facility, operated by the Mason Enterprise Center. The Mason Enterprise Center will assist emerging biotech companies as they develop and mature. With the addition of the new leased laboratory facilities, Mason plans to attract new researchers and research projects, as well as new biotech companies wanting to partner with Mason in its research efforts.

Finally, the GMU-PWC provides direct support for Mason's environmental science and life sciences research at both the Smithsonian's Conservation Research Center (CRC) in Front Royal, and Mason's Potomac Environmental Research and Education Center in Belmont Bay. Both of these centers are directly involved in environmental and conservation science research and education. Future plans call for establishing an interactive exhibit center on the Prince William Campus to showcase the research being done at both of these auxiliary sites.

The University is conveniently located in Innovation Technology Park, a 1,500-acre business and technology park targeting biotechnology, life science, and supporting industries. Anchored by George Mason University's life science campus, Innovation Technology Park has grown, since

Bull Run Hall Classroom

Occoquan Hall

opening in 1997, to become home to biotech industry leaders. This unique public-private partnership has evolved into a "university-centered" model for economic development within Prince William County. This innovative model was recognized by CoreNet Global, the world's leading professional association for corporate real estate and workplace executives serving leading multinational companies, with their top economic development leadership award in 2006. This award was jointly accepted on behalf of the George Mason University and the Prince William County Economic Development office for their continued partnership for future growth in Innovation.

During a recent speech, former Virginia Secretary of Technology, Aneesh P. Chopra said, "A key component of innovation is the presence of a four-year research institution. George Mason University's life sciences campus in Prince William and the research development projects around it are absolutely the cornerstones and foundation of the vibrant and innovative community there."

As specified more fully in the administrative aspects of this proposal, GMU-PWC will provide office space for the faculty and staff of the GS@IP. Classroom space and adequate laboratory facilities will be made available for the Academic-Year Governor's School staff and students. The proximity of the University to community resources for mentorships and internships makes it an optimal site to meet the goals of the proposed program. The GS@IP will be the only Governor's School housed as a single site on a major four-year university; this location will increase the program's capacity to shape a community of learners among its students that includes major researchers in related fields as mentors, colleagues, and instructors.

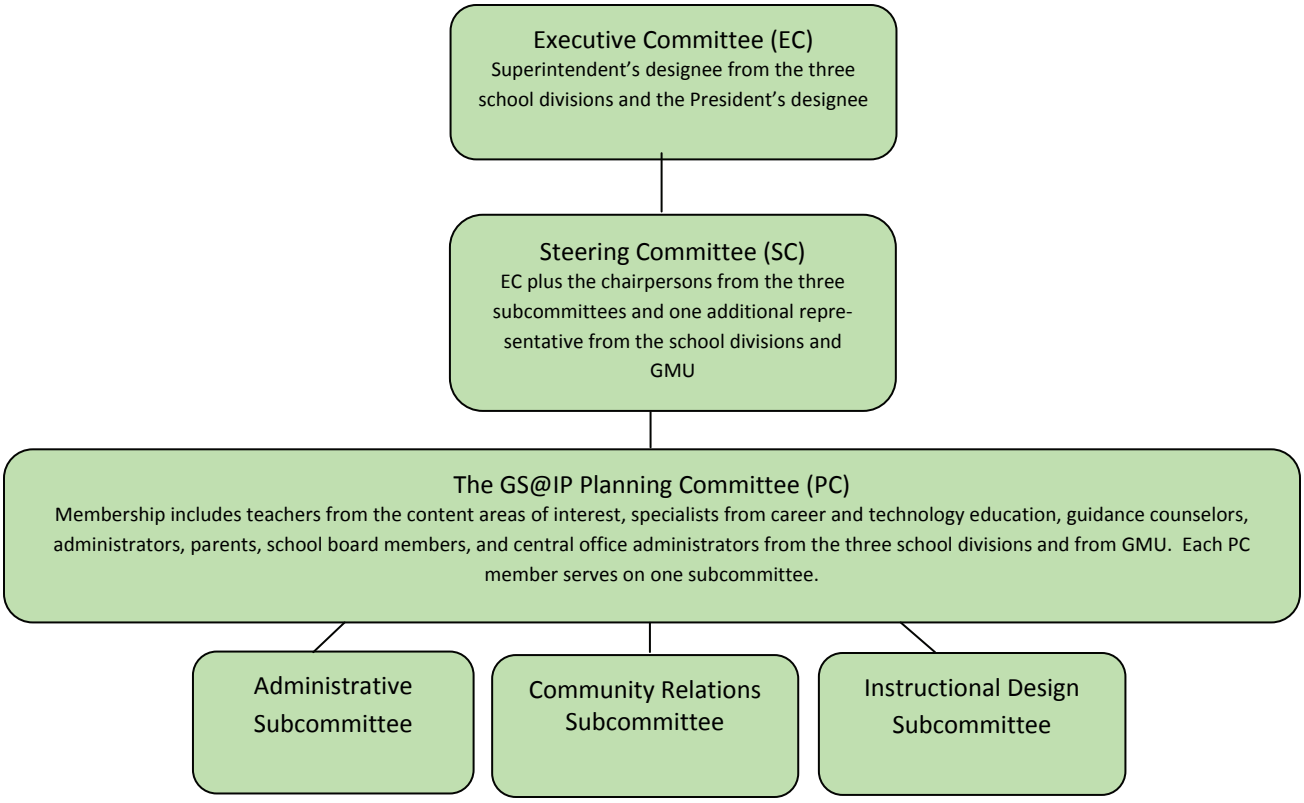
This location will ensure that no student has more than 40 minutes of travel time from his/her home base high school. These students, who possess a broad range of interests and talents, will be able to balance the opportunities afforded by a regional program for academically gifted students with the opportunities offered at their home-based high school. They can continue to be leaders in academics, fine arts, sports, Student Council Association (SCA) and other extracurricular activities, as well as to socialize with their age peers.

III. Governance and Organizational Structure

From its earliest days through the submission of this proposal, the planning for the Governor's School has been done through a tiered committee process. The GS@IP Executive Committee was composed of the superintendent's designee from each school division and a designee from George Mason University. Two additional administrators or teachers from each school division and an additional representative from George Mason University joined the Executive Committee to form the GS@IP Steering Committee. The chairperson for each of the three subcommittees was a steering committee member. The Planning Committee was composed of the Steering Committee and included school board representatives, parents, and additional content specialists from each school division, and George Mason staff. (See Appendix D.) The graphic below indicates the committee-subcommittee structure of the GS@IP Planning Committee.

Each member of the Planning Committee served on one of the three subcommittees: Instructional Design, Community Relations, or Administration. These groups carefully reviewed provisions for the *Administrative Procedures Guide for the Establishment of an Academic-Year Governor's School* and agreed to follow the guidelines set forth in the document. (See Appendix E.)

The GS@IP Planning Committee – Subcommittee Structure



The GS@IP Governing Board will be established as authorized by *§22.1-26* of the *Code of Virginia* and consistent with the regulations of the Board of Education for *Jointly Owned and Operated Programs 8VAC20-280-10 and 8VAC2-280-20*. The governing board shall be composed of two members elected or appointed from each participating school board. George Mason University will be a participating non-voting partner in the Governor's School. (See Appendix F.)

The management and administrative authority of the Governor's School shall be vested in the GS@IP Executive Committee of Superintendents composed of the division superintendents of the member school divisions, or each superintendent's duly appointed designee, and the President of George Mason University, or his/her appointed designee.

The executive committee's powers and duties shall include, but are not limited to, the following:

1. Managing, administering, and operating the Governor's School and its programs, including making personnel recommendations, subject to the authority of the Governing Board as set forth at *Virginia Code § 22.1-26* and the Regulations of the Virginia Board of Education.

2. Purchasing supplies, and purchasing, selling or disposing of equipment or appliances.

3. Preparing, with the advice and approval of the Governing Board, an annual program plan, budget, and plan for financing the operation of the Governor's School.

The Prince William County School Division shall serve as the Operational Fiscal Agent of the Governor's School. As fiscal agent PWC is responsible for the custody of the Governor's School's funds upon receipt of such funds from the Statutory Fiscal Agent, the Treasurer of Prince William County. The Operational Fiscal Agent shall arrange for the safe depository of school funds and, where necessary, see that sufficient collateral is posted to secure such funds. The Operational Fiscal Agent shall perform all duties relative to the financial affairs of the Governor's School, which the Operational Fiscal Agent is authorized and required to perform for the Prince William County Public Schools.

The governing board shall appoint a qualified director, upon recommendation of the executive committee of superintendents, who shall manage the day-to-day operations of the Governor's School. The policies and regulations of that school division serving as the fiscal agent shall govern the operation of the Governor's School, as well as any policies or regulations enacted by the governing board.

The director shall bring matters to and take direction from the executive committee of superintendents and shall make recommendations to the committee regarding programs of instruction, staffing needs, operational policies, finances, and all other matters within the purview of the committee.

A new program advisory committee, outlined more fully in the Administration section of this document, will provide perspectives on policies, curriculum, and technical areas of the Governor's School. The composition of the program advisory committee will maintain a broad representation from each of the participating partners.

IV. Mission, Vision, Purpose, and Core Values

Mission

The GS@IP students choose to engage in rigorous academic study, challenge themselves to acquire knowledge, develop understanding, think reflectively, and take intellectual and creative risks in problem solving for the benefit of Earth.

Vision

Students in the regional Governor's School will encounter a range of opportunities encouraging intellectual and academic excellence. Students will collaborate with experienced mentors in business, industry, government, and universities. As a learning community, students, teachers, and mentors will engage in analytical, creative and real-world problem solving through an integrated research model.

Purpose

The purpose of the regional Governor's School is to educate students in the related fields of science, technology, engineering, and mathematics in order to prepare them to contribute to the global community of the 21st century. The instructional design of the program integrates strands in biology, chemistry, and physics with mathematics, with concepts of engineering and technology, and with laboratory research. Learning experiences focus on real-world research with mentorship opportunities in business, industry, government, and universities.

Core Values

Learners identify personal goals and pursue challenges in a trusting and supportive environment. Decisions are made conscientiously based upon data; and such decisions are supported by a community focused on learning and teaching. (See Appendix G.)

V. Program and Curricular Design

The GS@IP, as a new member of the Virginia Academic-Year Governor's Schools, would continue that program's beliefs in accelerated learning to meet the needs of students whose remarkable abilities require specialized opportunities for growth and development. The instructional design (ID) subcommittee of the GS@IP has used the tenets of the Virginia Academic-Year Governor's School (Virginia Department of Education, 2007) as guidelines for its instructional and curricular components.

The Academic-Year Governor's School Programs shall provide educational options not available in home schools for students identified as gifted or eligible to be so designated. These programs will provide students with the following opportunities:

- *To develop their own separate identity as a community of learners,*
- *To learn and grow in an environment that nurtures the unique abilities and needs of gifted learners,*
- *To develop a positive and realistic concept of self and others,*
- *To belong to a community of learners who share interests and abilities,*
- *To learn about subjects of interest to them,*
- *To be risk-takers and decision-makers in a non-threatening environment,*
- *To provide career exploration and/or advanced classes which may help students as they prepare for college or other post-secondary opportunities, and*
- *To expand their knowledge of and interest in science and technology, the humanities, and the arts by providing interaction with community, industry, professionals, and higher education.*

Preliminary Decisions

Based on discussions held in 2007, superintendents and administrators within the three participating school divisions concluded that the greatest need for accelerated services for their high school students paralleled a STEM - science, technology, engineering, and mathematics - initiative. As presented in the opening section of this proposal, the Manassas City, Manassas Park, and Prince William County area is replete with high tech companies, both large and small. The presence and expansion of corporations from British Aerospace and Marconi Electronic Systems (BAE) to Lockheed Martin, as well as smaller enterprises like Georator to Colgan Air, offer evidence of the area's need for a replenishing pool of highly qualified, prospective employees as well as entrepreneurs and inventive leaders in these fields that rely on applied science, engineering, mathematics, and technology.

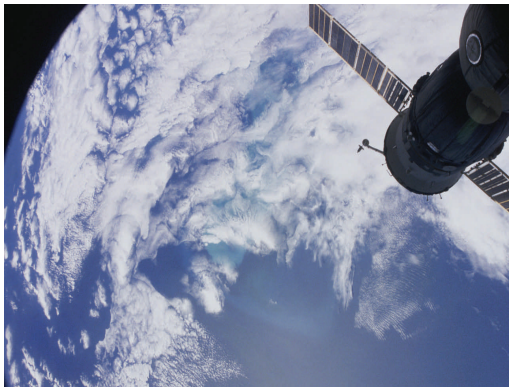
Further discussions across the divisions prompted the members of the initial planning group to outline an intensive program in science, technology, engineering, and mathematics. In summer 2007, discussions began to include representatives from GMU-PWC.

In August 2007, the newly initiated GS@IP Planning Committee began its design of the program presented in this document. The program was designed to prepare students with these opportunities:

- To acquire science and mathematics knowledge and skills commensurate with their abilities;
- To engage in the application of the relevant engineering practices, use of technology, and original research; and
- To develop their career goals and aspirations that distinguish them from their age-level peers.

Program Theme and Focus

Earth



As the ID subcommittee began its work on the theme/ focus for the program, it considered the needs of the area as well as the needs of students. Over a series of months, stakeholders held many discussions and returned time and again to the diverse use of technology found in local business and industry. Additionally, the ID subcommittee reviewed the existing specialty programs available for Prince William County Public Schools to ensure that this program met an unsatisfied need and did not jeopardize the integrity of any of those programs.

Those discussions helped the subcommittee recognize that a theme and focus of "Earth" allowed students to explore topics through integrated problem solving and research, while providing ample time to target learning to the depth required for gifted learners. (See Appendix H.)

The GS@IP program will emphasize research and problem solving around the focus "Earth." Within an interdisciplinary study, students will consider the many and varied aspects of Earth:

- How Earth and its ecosystems work,
- How organisms, especially humans, interact with Earth's life support systems/ environment; and
- How problems that affect Earth and its inhabitants are recognized and addressed.

This integrated program will capitalize on the more globalized definitions of environmental and geosciences that encompass study in the broader context of economics, social science, governmental policy, and management as they describe sustainable growth in the systems of Earth.

Curricular Goals and Instructional Objectives

Building on the noted work of researchers in curriculum design for gifted learners such as Joyce VanTassel-Baska (1993) and June Maker (1996), the ID subcommittee recommended goals and objectives for the GS@IP that respond to the qualitatively different manner in which these gifted learners optimally function.

The content selected to be used with these learners needs to be modified to (a) focus on the abstractions and concepts that unite facts and processes; (b) reflect the complex nature of knowledge from different disciplines; and (c) offer students opportunities to focus on different aspects, points of view, problems, or issues under a broader theme.

The learning processes to be used with these students need to be modified to (a) provide open-ended questions and problems where answers are marked by thorough investigation of the variables within the situation; (b) require the acquisition, use, and evaluation of information rather than the determination of a single, correct answer; (c) promote inductive reasoning and discovery or inquiry method of learning; (d) expect students to demonstrate their reasoning through evidence in a variety of forms; (e) use motivational power of freedom of choice in content, process, product, and evaluation of their work; and (f) respond to their learning rates by varying the pace and methodology of presentation of information.

The results or product expected from these learners needs to be modified to (a) be authentic and built around real problems, issues, and concerns; (b) be presented to a relevant audience with both knowledge and interest in the information conveyed; (c) be transformational, not merely summaries of the works of others; (d) reflect the variety of products that can convey students' competence and creativity; (e) offer insights into what the student has both gained from and brought to the relevant study; and (f) include relevant evaluative criteria from the teacher, the student and other stakeholders such as the mentor, expert , parents, or guardians.

Therefore, the following goals and objectives will form the foundation of the evaluative structure of learning and teaching experiences of the GS@IP.

I am pleased that the Governor's School @ Innovation Park has selected Earth and our environment as our focus. This is an excellent opportunity for tomorrow's engineers, scientists and community leaders to learn first hand the intricate cause and effect relationship that every day decisions have on generations to come. Even more importantly, the curricula of instruction is balanced so that these inter-relationships are shown daily through both instruction and hands-on learning experiences.

Scott Albrecht
School Board Vice-Chairman
Manassas City Public Schools

Goals and Objectives

Goal 1: To provide an integrated, problem-based exploration of science, technology, engineering, and mathematics commensurate with the abilities of its students and based on the core, conceptual knowledge and skills of each area.	***Objectives:*** a. To develop a sequence of integrated courses that link advanced sciences with the appropriate advanced mathematics skills; b. To align instructional opportunities across science and mathematics that require students to study, research, and collaborate as they propose solutions for relevant problems using applied engineering and technology; c. To provide opportunities that build a community of learners, as students share knowledge through collaborative research investigations; and d. To incorporate assessment of students' abilities, rates of learning, and interests into the design and modification of program goals and design.
Goal 2: To extend students' exploration and engagement into original research and application through mentorships and collaboration with experts in their selected fields of science, technology, engineering, and mathematics.	***Objectives:*** a. To extend content knowledge in mathematics and science through direct application of engineering principles and technology in a variety of settings; b. To immerse students in the application of the scientific method and field-based research; c. To engage students in active adaptation in authentic situations provided through mentorships and service learning opportunities; and d. To provide students with opportunities to explore science, technology, engineering, and mathematics within relevant issues with experts in a variety of fields.
Goal 3: To enrich students' interest in the problems facing Earth and its environment through support of their endeavors, respect for their discoveries and insights, and encouragement of their personal goals and aspirations in the fields of science, technology, engineering, and mathematics.	***Objectives:*** a. To encourage students' career aspirations through placement in relevant collaborative groups and appropriate mentorships; and b. To encourage students' appreciation for the knowledge and skills of others and their awareness of the importance of collaboration between and among public and private entities.

Strands of Study

The GS@IP program and curricular design uses the *strand approach* to allow maximum student growth and development in the sciences. Students will enter GS@IP at the junior level and select a strand based on interest and preparation that they will follow for the two-year program. Three strands – environmental biology, environmental chemistry, and environmental physics are articulated to move students through content typically experienced in the first two years of university academic study.

The marked difference between the GS@IP instructional design and that of either the traditional high school accelerated science and mathematics program or the early years of university study is a matter of the manner and depth, not simply a matter of early exposure. **While the content will be college-level, it will not be college-like.** As shown in the following graphic, the program and curricular design indicate the importance of cross-disciplinary learning and applied research and problem solving as significant foundations for deeper analytic and creative thinking. →

The GS@IP
Elements of the Instructional Design

Core science content derived from one or more GMU courses, emphasizing skill and knowledge as well as conceptual development

Correlated authentic endeavors and assessments used to ground content and skill development

Governor's School Integrated Instructional Design

Core mathematics contents selected and presented in collaboration and support with the specific science content

Research skills and analytical statistics taught collaboratively and reinforced through mentorships and field experiences which employ applied engineering

In the integrated design, science will serve as the source of problems around which the curriculum is designed. Mathematics will take a supportive role. Mathematical knowledge will be selected and aligned to support students' research. As students are assigned topics within or across their strands, the mathematics and engineering principles needed to enable their research and inquiry will spiral throughout the science content. The GS@IP program and curricular design raise the floor of learning above that offered at any of the area high schools, whether through International Baccalaureate, Advanced Placement, Cambridge International Examinations courses, or dual enrollment courses. This program is unique in two ways: first, its emphasis on the integration of science with the appropriate mathematics and principles of engineering is not found in local high schools; second, its extensive use of research and inquiry learning, and the application of skills through mentorships and service learning are similarly opportunities not available in area high schools.

The instructional design of the GS@IP strives for a different approach and perspective from either the typical high school AP course or the traditional college presentation of content. Instead, the GS@IP program is predicated on inspiring future leaders for the 21st century's global knowledge economy which is marked by the dramatic increase and availability of information, and by the increasing effect of technology on people and their relationship to the world. Table 1 on page 15 offers examples from two recommended courses that demonstrate the difference this program strives to achieve.

Manassas Park students have enjoyed dynamic teachers and learning in mathematics and science for many years. The inclusion of the Governor's School option will allow our high school students with remarkable abilities and interests in the area of research and scientific inquiry to explore topics and issues typically reserved for college students. We are excited that we are able to open new doors of discovery and investigation for students in this region using the resources and opportunities that abound in this area.

Michael Wine
School Board Chairman
Manassas Park City Schools

Table 1: Comparison of Instructional Design and Content Mastery

Content	Traditional High School/Advanced Placement Classes	Traditional College Content	The GS@IP
		Advanced Mathematical Modeling	
Trigonometry Component	The standard high school course contains a 12 – 15 week course in trigonometry with an emphasis on circular and triangle trigonometry concepts. Real world applications such as harmonic motion, sinusoidal functions, and vectors are introduced and explored, but not necessarily emphasized and assignments usually do not include "hands-on" learning.	The trigonometry component of the standard college class would not be substantially different from the traditional high school class. The primary difference would be the depth to which each topic is explored. Again, trigonometry as a tool for mathematical modeling is not emphasized and "hands-on" experiences would be limited.	In this course, circular and triangle trigonometry will be taught to the depth of the traditional college course. In addition, there will be a primary emphasis on the uses of trigonometry to model and solve real-world problems. Vector applications would be emphasized. Added trigonometry topics will include polar mathematics and parametric functions. The need to encapsulate cyclical Earth phenomena will drive the study of trigonometric functions. Whenever applicable, students will include trigonometry concepts and modeling in their science and research classes. All appropriate skills will again be employed in mentorship settings as required by the activities supervised by the mentor.
Functions Component	The usual high school pre-calculus class reviews and extends algebra concepts and techniques, provides a "library" of elementary functions and associated function concepts, practices analytic skills, and introduces calculus concepts, particularly limits. Exponential functions and logarithms are taught but not given weighted emphasis. Real-world modeling and problem solving is limited.	The course content would not differ significantly from a rigorous high school course. The primary differences would be the depth to which individual topics are explored and the difficulty of exercises and problems.	This class would include all the topics of a rigorous high school or college class. There will be an emphasis placed on modeling and solving real-world problems, particularly using exponential and logarithmic functions as models. Data for creating models will come from science and research classes. Analytic skills will be emphasized. In addition, this course will provide introductory concepts and skills in sequence and series, linear algebra, probability and statistics, combinatorics, and graph theory. The study of probability and statistics will be an outgrowth of proper professional presentation of individual research.
		Calculus 1	
Calculus	AP Calculus BC emphasizes four broad topics, limits; derivatives; integrals and their polynomial approximations; and series. In each topic, content and objectives are specifically designed to emphasize broad problem solving concepts and not necessarily applications to specific sciences or engineering fields. AP Calculus strives to present the concepts of calculus as a unified subject, emphasizing the relations among topics and concepts.	The usual first (or first two) courses in college calculus present all the topics of AP Calculus plus several additional topics, including extended methods and applications of integration, conics, polar equations, and parametrics. Many college calculus classes are now tailored to particular fields of study, i.e., "Calculus for Business." or "Calculus for Engineers."	Calculus I is designed to provide the topics and concepts associated with typical first year college/ university calculus at the honors level, usually a course distinctly different from regular Calculus I courses. In addition, problem-solving and applications will be specific to the science and research component of the GS curriculum, whenever appropriate. Calculus as a mathematical tool for modeling real-world problems will be emphasized. Based on successful completion of this course, students will be prepared for both the AP Calculus BC exam and further study in calculus.

Integrated Curriculum and Design

As previously indicated, the GS@IP curricular design allows students to choose among three strands: environmental biology, environmental chemistry, or environmental physics. Each strand features prescribed junior and senior science courses. Partnered with each science course is a mathematics course structured and presented in conjunction with the relevant scientific principles, concepts, and theories. In addition, each course integrates fundamental principles of engineering.

Beyond the integration of mathematics to support the science content, students from across the three strands will take Research Applications and Integrations (RAI-I and RAI-II) each year where students must work collaboratively. Through this dedicated cross-pollination and diverse group research projects, students will recognize the necessity of the "interdisciplinary approach" to problem solving in pursuit of viable solutions to environmental problems.

Teachers from the three science strands will work with the RAI teachers to monitor the use of and the need for additional instruction in specific scientific content to enable students to engage in active laboratory- and field-based research.

Mentorship Arrangements

The RAI teachers will monitor students' use of their knowledge and skills in mentorships in area corporations and industries. These mentorships will enable students to bring the scientific and mathematic concepts taught in the GS@IP courses into sharper relief as they are employed in business and industry.

Mentorships will serve a singularly important venue for engineering applications. Through these mentorships, students will have opportunities to work alongside and learn from practicing engineers, mathematicians, network designers, programmers, technicians, and professionals in the careers to which these students aspire. The mentorship is intended to

Engineering Applications

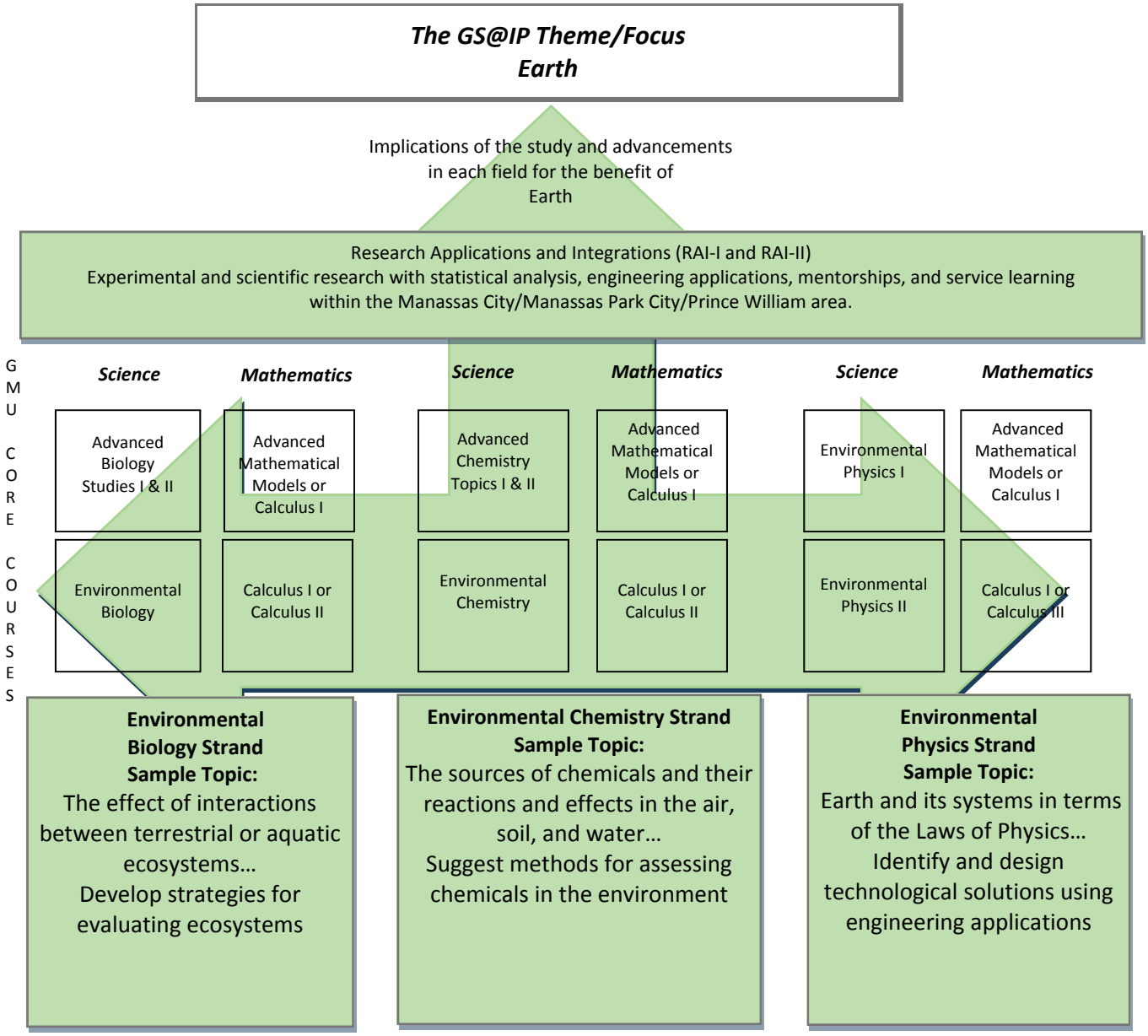
be an authentic experience, in which students become practicing members of design and engineering teams. These experiences are intended to reinforce students' acquisition of knowledge and skills, but more importantly, these are opportunities for students to gain an appreciation for the processes that make knowledge and skill useful in today's world. (See Appendix I.)

In order to determine the flow of the development of the principles of engineering across the curriculum, Appendix J Engineering Concepts Crosswalk, indicates where knowledge and skills will be introduced, developed, reinforced, and extended throughout the program.

Service Learning Components

The RAI teachers will also monitor students' engagement in service learning activities. These activities will press students to work with nonprofit and other approved organizations to adopt a task and reach a successful resolution of that task. Whether it is to build a working model of a compound machine to help third-grade students better understand the nature and function of simple machines, or to design and construct a Web page for a program in the community, students will be expected to demonstrate the use of their leadership and collaborative skills as well as their content skills and knowledge.

As indicated in the following graphic, content, process, and products are aligned with problem solving to maximize the coherence and integration of knowledge and skills.



Recommended Science Course Descriptions

Environmental Biology Strand

Advanced Biology Studies I (ABSI) – Junior Year First Semester	**Advanced Biology Studies II (ABS II) – Junior Year Second Semester**	**Senior Environmental Biology (SEBIO) – Senior Year Two Semesters**
Advanced Biology Studies I is a focused survey course with objectives that will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment for this course and its second semester counterpart will demonstrate students' conceptual reasoning regarding the nature of change within the life sciences fields.	Advanced Biology Studies II is a focused survey course with objectives that will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment builds on students' research from ABS I.	Senior Environmental Biology is a focused study of microbiology with concepts basic to viruses and prokaryotic and eukaryotic cell structure and function. Organic change will be studied from the perspective of structure, classification, physiology and distribution, with particular interest paid to the technological and medical implications of microbiotic change in our world. The course objectives will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment builds on students' research into aspects of environmental biology and the implications of microbiological changes that affect Earth.
NOTE: *For more complete information regarding each course, please review the draft individual course outlines in Appendix K.*		

Recommended Science Course Descriptions

Environmental Chemistry Strand

Advanced Chemistry Topics I (ACT I) – Junior Year First Semester	Advanced Chemistry Topics II (ACT II) - Junior Year Second Semester	Senior Environmental Chemistry (SECHEM)– Senior Year Two Semesters
Advanced Chemistry Topics I is a focused survey course with objectives that will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment for this course and its second semester counterpart will demonstrate students' conceptual reasoning regarding the study of Earth's macro and micro chemical systems.	Advanced Chemistry Topics II is a focused survey course with objectives that will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment builds on students' research from ACT I.	Senior Environmental Chemistry is a focused study of the organic chemical foundations that have paved the way for the chemical, industrial, petroleum, and biological revolutions of the past 75 years. The course objectives will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/ culminating activity/authentic assessment builds on students' research into aspects of environmental chemistry and the implications of change on Earth.

Recommended Science Course Descriptions

Environmental Physics Strand

Environmental Physics I (EPI) – Junior Year Two Semesters	Environmental Physics II (EPII) – Senior Year Two Semesters
Environmental Physics I is a physics course with major concepts integrated from the fields of engineering and geology. The course objectives will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/culminating activity/ authentic assessment will demonstrate students' conceptual reasoning regarding the physical laws of nature.	Environmental Physics II is a physics course with major concepts integrated from the fields of engineering and geology. The course objectives will be accomplished through the use of experimentation and a comprehensive laboratory component with field research utilizing advanced technologies. The culminating authentic task/culminating activity/ authentic assessment will demonstrate students' conceptual reasoning regarding advanced physical processes.

Recommended Mathematics Course Descriptions

Advanced Mathematical Models (AMM) – Junior Year Two Semesters	Calculus with Analytical Geometry I (CALC I) – Junior Year or Senior Year Two Semesters	Calculus II (CALC II) – Senior Year Two Semesters
Advanced Mathematical Models is a course in pre-calculus mathematics utilizing advanced technologies designed to support the science program and provide a thorough preparation for calculus and other advanced mathematics courses. The course will include college algebra, trigonometry with an emphasis on vectors, and a comprehensive introduction to calculus. Each topic will be taught through a problem solving approach emphasizing the student's ability to analyze, model, and solve real-world problems.	Calculus with Analytical Geometry I is a two semester calculus course using advanced technologies that includes the study of limits, derivatives, integrals, optimization, conic sections, parametrics, and vectors and their application in physical, chemical and environmental phenomenon. Each topic will be taught through a problem solving approach emphasizing the student's ability to analyze, model and solve real-world problems.	Calculus II is a two semester calculus course using advanced technologies and includes the study of partial differentiation, multiple integrals, line and surface integrals, and three-dimensional analytic geometry; and first and higher-order ordinary differential equations. Each topic will be taught through a problem solving approach emphasizing the student's ability to analyze, model and solve real-world problems.

Recommended Research Course Descriptions

Research Applications and Integrations I (RAI-I) Junior Year, Two Semesters	Research Applications and Integrations II (RAI-II) Senior Year, Two Semesters
Research Applications and Integrations I provides students with diverse opportunities to employ and evaluate their conceptual knowledge. Students will engage in service learning and field experiences through mentorships that incorporate engineering, ethics, scientific experimental design, statistical analysis, scientific literature review, and journal/technical writing. This course supports the student's work on the authentic task/ culminating activity/authentic assessment as well as independent research endeavors. Relevant advanced technologies will promote scientific literacy and communication skills. The coursework will include content comparable to AP Statistics so that students will be able to take the AP test. A major part of this course is to foster global communication and collaboration within the program strands.	Research Applications and Integrations II will continue and expand students' opportunities for small group and individual research building on the skills and experiences gained in RAI. Opportunities will continue for students to employ and evaluate their conceptual knowledge and to work collaboratively with students from other strands. Students will engage in service learning and field experiences through mentorships that incorporate engineering, ethics, scientific experimental design, statistical analysis, scientific literature review, and journal/technical writing. This course supports the student's work on the authentic task/culminating activity/ authentic assessment as well as independent research endeavors. Relevant advance technologies will promote scientific literacy and communication skills. A major focus for RAI-II will be the peer review, publication, and presentation of students' work in noted scientific journals and before organizations such as the National Consortium of Specialized Secondary Schools for Science, Mathematics, and Technology.

Curricular and Instructional Premises

The critical or distinguishing attributes of the Academic-Year Governor's Schools are not the courses to which students will have access, but instead the manner and depth in which the content, both knowledge and skills, will be presented. As content and opportunities are selected, aligned, and integrated, critical consideration must be given to the reality that these are gifted learners. Their learning is marked by the following behaviors that distinguish them from their age-level peers:

- Create new designs or ways of doing tasks
- Manipulate information
- See relationships and combine ideas
- Thrive on complexity and ambiguity
- Construct abstractions
- Need a purpose for what they are doing
- Draw inferences
- Focus on the journey of learning

Noting these differences in learning behaviors, curriculum and instruction for these students will be modified to ensure that both support students' intellectual and social/emotional growth and development. Governor's School staff will use these premises to guide their work as instructional strategies and opportunities are developed and as curriculum is drafted and revised.

1. The principles of differentiation for curriculum/instruction for gifted students are embedded in all coursework. These principles include the requirement that
   - Content is approached conceptually, using relevant problems, issues, and concerns as the frame of reference for the selection and use of information and activities;
   - Integrated curricula from mathematics and science are presented and reinforced through applications incorporating relevant technology and engineering principles;
   - Content selection is made with a respect for the interests and abilities of the student;
   - Tasks and assignments require abstract reasoning at the analysis, synthesis, and evaluative levels of processing;
   - Tasks promote students' independent and self-directed use of research methods and materials through the use of choice in a variety of aspects of each major assignment;
   - The curriculum and assessment rely on complex tasks that allow students to challenge existing ideas, to produce new ideas, and to develop new techniques, materials, and solutions to wide-ranging problems;
   - Students work collaboratively across strands to encourage self understanding as well as to foster appreciation for the strengths and capabilities of others; and
   - Students engage in meta-cognitive evaluation of their own work and abilities based on multiple criteria. →

(National/State Leadership Training Institute for the Gifted/Talented, 1978)

2. Coursework requires students to complete classroom/laboratory as well as extension activities that involve mentorships, service learning, and field research.

3. Coursework throughout the two years requires a level of technological training that includes
    - Extensive use of spreadsheets;
    - Extensive use of graphic presentation software;
    - Extensive use of databases for the collection and analysis of raw data;
    - Extensive use of Geographic Information Systems (GIS), Global Positioning System (GPS), and other data collection devices; and
    - Extensive use of interactive whiteboard and other presentation tools.

4. Coursework is problem-based, relying on the scientific method and research for alternatives and solutions. In all situations, coursework will be built on prevalent technologies, relevant engineering applications, 21st century skills, and market-driven forces and expectations.

5. Assessment of coursework is a collaborative endeavor involving the student and his/her goals for the specific task, the expectations of the teacher, expectations of George Mason University's collaborative teachers, and the students' mentors or field supervisors.

6. Instruction provided at the GS@IP is qualitatively and quantitatively different from instruction offered to highly able and motivated science, technology, engineering, and mathematics students in high schools in Manassas City, Manassas Park City, and Prince William County.

7. Professional development in the design, instruction, and assessment for problem-based, authentic instruction will be provided continuously to all instructors and teachers working in this model and will provide components upon which their work with students is evaluated.

George Mason University's Continuous Curriculum And Instruction Collaboration

Faculty and administrators from GMU-PWC were brought into the planning process and, as the extended timeline indicates, the collaboration between the GS@IP faculty and GMU faculty will increase following the approval of the program by the Virginia Board of Education. Building upon the instructional design recommended by the ID subcommittee, the GS@IP-GMU faculty will develop more detailed syllabi and other supporting documentation for each course.

As the following table indicates, extensive collaboration and document development will occur following Virginia Board of Education approval and continue periodically as the program is implemented.

Table 2: The GS@IP—GMU Curriculum Collaboration

Date	Group	Activities	Outcomes
May 2009	ID subcommittee and representatives from the provost's office	Review initial instructional design and discuss expectations for dual enrollment credit and the required supporting documents	Revision of extended timeline Meeting agenda and minutes
September 2009		Confirmation of approval of program by the Virginia Board of Education	
December 2009	GMU provost's representatives	Determination of which GMU personnel will work directly with faculty to develop more detailed materials Initial list of points of concern regarding recommended course descriptions and draft course outlines	List of GMU personnel with contact information Initial written review
January 2010	Director is appointed	Discussions will begin regarding facilities, faculty selection, and curriculum	Meeting agenda and minutes
March 2010	GS director and GMU curriculum group	Schedule of meetings between April and June to finalize documents to support request for dual enrollment credit from GMU	Calendar, locations, objectives
April – May 2010	GS faculty and GMU faculty	Syllabi development sessions; documents to support dual enrollment credit for the MOU with GMU	Syllabi MOU support

The planning committee recognizes the critical importance of working closely with the appropriate administrators and faculty from GMU to ensure that information and documentation are developed to enable the university to determine whether dual enrollment credit may be provided for specific courses offered by the GS@IP.

Traditionally, the three school divisions have used Northern Virginia Community College, and typically one semester (.5) of high school credit translated into three semester hours of community college credit. The initiation of this program will not change any existing dual enrollment agreements these divisions have with Northern Virginia Community College. While GS students may take these dual enrollment courses, they are not part of the GS requirements. The regional governing board will include in its MOU with GMU the specific number of dual enrollment credits GS students will earn for specific courses.

As the instruction and program design subcommittee worked through course development, two premises served as the core of assumptions.

- Each course offered has, at its core, critical concepts from developmentally appropriate science, mathematics, or research content with engineering applications.

- To ensure the depth of content and experience and integration of disciplines, significant concepts and applications from more advanced GMU courses were woven into the science, mathematics, engineering, and research applications courses. The scope of content does not purport to deliver a complete inventory of concepts, skills, and theories within those advanced courses.

The ID subcommittee limited its consideration of GMU dual enrollment course credit to freshman- and sophomore-level courses in science and mathematics with limited exposure to courses that carry a 300-level label. A proposed correlation chart is provided in Appendix L indicating initial thoughts on the articulation of the GS@IP high school credits and GMU science and mathematics undergraduate credit.

In addition to GMU validation of semester credit for courses presented at the GS@IP, GMU instructors will be involved in the development of the individual courses. Selected instructors and other personnel will be involved in the design of content, integration of laboratory and field experiences, and the expectations for examinations.

In subsequent years, GMU instructors and the GS@IP faculty will continue this collaboration through a variety of formal mechanisms in the administrative components. Through the director's planning committee and departmental advisory committees, GMU instructors will have opportunities to provide insights into the course content, instructional design, and student research and engineering applications assessment. GMU instructors will also be involved during development of the annual course evaluative survey and summary of data collected. This information will be used formatively to monitor and adjust the content presented to the GS@IP students.

As part of the first year of study in an effort to ensure consistent depth of coverage, the GS@IP students may take corresponding semester examinations from the GMU course for which they are acquiring credit. Results of examinations may be used in the evaluation and revision of the instruction and content for future years.

Standards of Learning

Since the courses that students will take at the GS@IP are predicated on their completion of mathematics past Algebra II and science beyond introductory biology, chemistry, or earth science, these end-of-course examinations will have been taken at the base middle or high school before these students enter the GS@IP. Remaining end-of-course or other Standards of Learning assessment components will be taken at the student's home base high school in accordance with the testing schedule of the school division.

Examinations for College Credit

The GS@IP planning committee recognizes the importance that colleges/universities, parents, and students place on the acquisition of Advanced Placement (AP), Advanced International Certificate of Education (AICE) and International Baccalaureate Diploma (IBD) credits in high school. While the course design for this program is substantially different from the course of study in accelerated mathematics and science courses in traditional high schools, the GS@IP curriculum will provide students with the depth of knowledge and skills expected to pass such externally moderated examinations for college credit in selected areas. To assist students in preparing for selected AP, AICE, and IBD examinations, specifically in biology, calculus, chemistry, physics, and statistics, preparatory sessions will be sponsored by the Governor's School, after school hours, to review the format of these timed examinations for college credit.

Correlation with School Division's Programs for the Gifted

The directors and supervisors of programs for the gifted will serve on one or more of the director's planning and advisory committees. Through those regularly scheduled meetings and through additional discussions, the directors/supervisors of programs for the gifted will be involved in decisions regarding, but not limited to, the program application process, timeline, selection criteria, and evaluation of process; design and evaluation of curriculum and instruction; professional development of teachers/mentors/researchers and others who work directly with the GS@IP students; program evaluation and modification; communications including Web pages and printed materials; and instructional provisions and modifications based on feedback from home base high schools and parents. (See Appendix M.)

Current Services for Gifted/Talented Students

As is required for submission of a proposal for a new Academic-Year Governor's School, the proposed curriculum and instructional design must be significantly different from those programs available in the base high schools for school divisions' gifted students. The program outlined in this section differs significantly from the program in Manassas City and Manassas Park. In those two school divisions, students identified as gifted are directed toward AP or dual enrollment opportunities within the standard course of study. However, there is limited, if any, integration across content areas. Occasionally overlapping units of study in science and mathematics lead to opportunities for more advanced inquiry and study, however, individual or small group research across science strands is not available.

In Manassas City, mathematics content emphasizes advancing students' knowledge and comprehension of concepts and skills in a traditional hierarchical approach. Honors and AP courses are typically more differentiated than are the regular sections of mathematics courses. However, honors and AP do not respond to the specific need for acceleration and differentiation for the school divisions' most advanced students.

In Manassas City, scientific research opportunities are limited to laboratory experiments with limited additional field study using those resources in immediate proximity to each campus. A student internship program is available as part of the career education assignment at Osbourn High School. The internship is rarely used by advanced students and it is not integrated into the science and mathematics programs. It does not emphasize individual and small group, collaborative field-based research. Service learning is supported at Osbourn High School through its peer mentoring program.

Manassas Park City similarly offers advanced mathematics through Calculus 2. The division also provides limited research opportunities through its laboratory science courses. It offers a community service course at its high school that requires students to work in either a school or nonprofit setting to offer assistance to clients/students and staff/teachers, but it does not offer any type of mentorship program.

Prince William County Public Schools has a comprehensive program of advanced mathematics through Calculus AB and BC as well as International Baccalaureate Diploma (IBD) and Cambridge (AICE) accelerated mathematics options. Within its specialty programs, research endeavors are targeted toward the focus of the school. For example, students in the biotechnology program at Osbourn Park High School conduct research in the school and area laboratory settings in the areas of biology, chemistry, physics, and environmental science. In this program, concepts of biology and chemistry are integrated, but are not necessarily integrated with mathematics or with any type of engineering application. A limited number of mentorship opportunities are available. Service learning is a component of all PWC specialty programs as noted in the division's *High School Program Opportunities* brochure.

In addition, all PWC high schools have a seminar program for identified gifted students. This program is designed to help students make cross-curricular connections between and among disciplines.

Summer Boot Camp

Students entering the Academic-Year Governor's School from any of the area high schools will need to be supported as they move from the more traditional programs to a model built on connections. The proposed design expects students to make connections across content areas and to demonstrate collaboration and teamwork skills similar to those found in the fields of study they may pursue after graduation. Due to the nature of the boot camp program, it will be included in the school calendar and all students will be expected to attend.

It is important, therefore, that teachers and students have an opportunity to become acquainted with the various facets of the program design. Teachers will need to assess skills to determine whether individual students have the requisite knowledge for Advanced Mathematics Models or for Calculus I with Analytical Geometry. Additionally, students' skills in technology use will similarly need to be assessed. This program will require extensive knowledge of spreadsheet and database software. Opportunities to work with both kinds of software in advance of the start of class will enable the professional staff to determine how much reinforcement is needed within in the formal classroom presentation. Students will have conducted laboratory research at their respective high schools, but few will have been placed in the position to recognize a problem, analyze the variables within the problem, and then design, conduct, and communicate their findings regarding the initial problem. Most importantly, few of these students will have had the opportunity to work extensively with other students with similarly deep and intense interests in environmental sciences and research devoted to the study of environmental science.

The one week Summer Boot Camp will provide its new class with these opportunities:

1. Familiarize students with the nature and purpose of GS@IP;
2. Familiarize students with the GMU-PWC facilities;
3. Allow teachers to determine which level of mathematics is appropriate for each student;
4. Acquaint students with the research design to be used throughout the two-year program;
5. Acquaint students with the nature of problem-based learning;
6. Acquaint students with spreadsheet and database software and other important technology;
7. Acquaint students with the expectations of the mentorship and the service learning components;
8. Allow staff and administrators to monitor and adjust the structure of the program based on the students selected to attend the program; and
9. Allow students, faculty, and staff to build a community of learners that will share the GMU-PWC environment for the next two years.

"The proposed regional Academic-Year Governor's School's emphasis on science, technology, engineering, and mathematics is a positive step forward in Virginia's efforts to ensure the availability of a highly skilled, technically proficient workforce to meet the future needs of businesses like Lockheed Martin."

Denise Saiki, Vice President & General Manager
Lockheed Martin—MS2 Undersea Systems

VI. Student Selection and Criteria

Student selection for the GS@IP is an open, multi-faceted process. Any student from the three participating school divisions who feels he or she has the foundation to succeed in the program is encouraged to review the application process and selection criteria and apply through his or her school division.

The process of selecting students relies heavily on the work of many researchers in the field of assessment. These researchers conclude that optimum recognition of giftedness and advanced learning capabilities are indicated by students' insistent need to understand the overarching concepts, unifying themes, and coherent view of knowledge, themselves, and the world.

Critical Tenets of Selection

1. Once an application has been submitted for consideration, the student will be evaluated on the total collection of elements required in the application. No student will be removed from consideration through the use of a "cut score" on a single item, test, or measure.
2. Students deserve the optimal opportunity to demonstrate their exceptional reasoning skills in science, technology, engineering, and mathematics. The application process will be marked by its consistent, appropriate, and fair selection, use, and evaluation of materials and process.

Selection Criteria

Aptitude

Students who will be successful in this integrated and research-based program will require an exceptional aptitude for the core elements of science, technology, engineering, and mathematics. Such knowledge is typically assessed using instruments that determine a student's verbal/linguistic and non-verbal/quantitative reasoning capabilities. A variety of aptitude measures currently exist that have been valid and reliable in the assessment of verbal and nonverbal reasoning. The selection process will include data from current, valid, and reliable aptitude measures.

Achievement

The assessment of achievement is critical to the determination of students who will be successful in this rigorous program. Achievement may be assessed in many fashions: Grade point average, teacher recommendations, norm-referenced measures, work samples or demonstrations, etc. Regardless of the method of evidence of achievement, students selected will be expected to demonstrate previous achievement in the core elements of science, technology, engineering, and mathematics. →

While grades are indicative of student achievement, researchers increasingly cite examples of randomness across grading methods and criteria from classroom to classroom. Attempting to standardize grades as a reliable criterion across school divisions is made increasingly difficult as labels such as honors, AP, Cambridge, and GT enter as variants of instructional design. Students may also include a recommendation from a relevant third professional (nonimmediate or extended family member) of the individual student's choice.

A variety of nationally norm-referenced achievement measures currently exist that have been found valid and reliable in assessing student learning in the fields of science and mathematics.

Portfolios have become increasingly important in the assessment of aptitude, achievement, motivation, persistence, and interest. Through a collection of items, reviewers representing each school division are able to determine the extent to which work demonstrates the student's (a) above grade- and age-level reasoning, insights, and perspectives; (b) effective organization and communication using materials and resources in clever and unique ways; (c) complex and intricate nature of the student's learning; (d) in-depth understanding of the problem, task, or idea; (e) research pursued in consideration of the problem, task, or idea; and (f) high interest, perseverance, and motivation brought to assigned and independently selected tasks. The selection process will include data from a portfolio of prescribed as well as independently selected materials.

Personal Characteristics

Students who will be successful in this problem-based, inquiry-driven learning environment must be self-motivated, risk-taking, questioning, perceptive, and capable of communicating their research process and conclusions in a well-reasoned, coherent manner to a variety of audiences. Essays on specific topics will allow reviewers insights in the maturity and preparedness of applicants for this program. The selection process will include evaluation of students' timed and controlled responses to prescribed essay questions.

Sample Application and Timeline

A sample application with criteria is provided for review in Appendix N. Applications will be evaluated annually to determine the effectiveness of the individual elements. A part of the application's evaluation process is the student's success in the program.

Applications will be modified as needed; however, once an application has been released to the public for submission for selection of student, no changes shall be made to it during that established timeline for submission. Timelines for the submission of application, testing, and submission of other elements may not be shortened once they have been approved by the regional governing board, posted on the GS@IP Web page, or distributed through the participating school divisions.

VII. Administration

Administration Subcommittee

The administrative subcommittee was composed of principals from high schools in the three localities, counselors from Manassas City and Manassas Park City, and representatives from George Mason University. Those members worked through the following requirements:

- Administration and Staff
  - Staff Allocation
  - Credentials and Qualifications
  - Recruitment
- Advisory Committee(s)
- Calendar
- Code of Conduct
- Evaluation
- Facilities
- Fiscal Agent
  - Insurance Verification
  - Memorandum of Understanding (MOU) with GMU
  - Required Material and Equipment Support
- Grading Process
- Transportation

Administration and Staff

Staffing Allocations

The staff and administration required to support the initial program design will include the following personnel:

- Director
- Administrative Assistant
- Biology Teacher
- Chemistry Teacher
- Physics Teacher
- Mathematics Teacher

In order to ensure the successful and efficient opening of the program in September 2010, the executive committee supports the hiring of the director immediately. The recruitment for that position will begin in September 2009, upon the approval of the proposal by the Virginia Board of Education.

With an initial student population estimated between 75-90 students, the four content teachers would provide instruction along with a teaching director the first year. This level of staffing would equate to a student-teacher ratio in classes of 15:1, as suggested in the Academic-Year Governor's School evaluation criteria. It is imperative that at least one teacher from the core subjects have an engineering and research background.

Credentials and Qualifications

Qualifications for the **program director** include the following expectations:

- Master's degree in educational leadership or curriculum and instruction;
- Endorsements in administration and gifted education or special needs;
- Teaching experience with gifted/high ability students;
- Demonstrated experience working with students on alternative projects, mentorship programs, or independent study proposals;
- Budget and master schedule experience;
- Supervision of instruction experience, evaluation of veteran teachers offering advanced curricula;
- Leadership and communication skills as an ambassador for this program, the ability to write and represent the program effectively;
- Program planning and implementation;
- Experience working with business and industry to develop mentorship opportunities;
- Program monitoring and evaluation; and
- Ability to organize and draw inferences from data.

Qualifications for the **program faculty** include the following expectations as well as those expectations that GMU has for its adjunct instructional staff:

- Master's degree in the content area to be taught;
- Endorsement in gifted education;
- Demonstrated teaching experience with gifted/high ability students;
- Demonstrated experience working with students on alternative projects, mentorship programs, or independent study proposals;
- Demonstrated experience in an integrated curricular design working collaboratively with school-based and nonschool-based resource and personnel;
- Demonstrated experience with problem-based curricula emphasizing research;
- Demonstrated verbal, written, and digital communication skills; and
- Ability to organize and draw inferences from data.

Recruitment

The fiscal agent will be responsible for the recruitment and personnel concerns associated with all staff members. The fiscal agent will prepare all job descriptions in conjunction with the Superintendents' Executive Committee and subsequently with the program director.

Advertisements for the program director's position will be announced through the following media following the approval of the proposal by the Virginia Board of Education in September 2009:

- *Washington Post*
- *Education Week*
- Manassas City, Manassas Park City, and Prince William County Public School divisions, George Mason University, and Governor's School Web sites
- National Association for Gifted Children
- Association for Supervision and Curriculum Development
- Virginia Association for Supervision and Curriculum Development
- Virginia Association of Secondary School Principals

The Superintendents' Executive Committee will organize interviews, inviting membership from subcommittee chairs and co-chairs. If necessary, the interview committee will select two or three finalists and will forward those names to the executive committee for final interviews.

The program director will participate in job fairs as part of the recruitment efforts and will work in conjunction with the Prince William County Public Schools Office of Human Resources to ensure that all documents needed for the hiring of faculty and staff are properly prepared and that timelines are followed appropriately. All positions will be posted in three feeder division human resources offices.

Timeline for Hiring Program Director	
September 2009	Advertisement of position
October 2009	Application cut off
November 2009	Applicant screening
December 2009	Recommendation forwarded to Manassas City, Manassas Park and Prince William County Public School Boards for approval
January 2010	Director begins work at George Mason University-Prince William Campus

Advertisements for the program faculty positions will be announced through the following media following the approval of specific job descriptions by the Superintendents' Executive Committee:

- *Washington Post*
- *Education Week*
- Manassas City, Manassas Park, and Prince William County Public School division, George Mason University, and Governor's School Web sites
- National Association for Gifted Children
- Association for Supervision and Curriculum Development
- Virginia Association for Supervision and Curriculum Development
- Virginia and national associations for science, mathematics, problem-based curriculum, and mentorship endeavors

Staffing allocations for subsequent years will be determined by the Superintendents' Executive Committee with approval made by the regional governing board.

Advisory Committee(s)

Formulated to mirror a principal's advisory committee, the program advisory committee will initially meet quarterly and serve in an advisory capacity to the Governor's School. The committee does not have decision-making capacity.

The members of the advisory committee shall include representatives from the following stakeholders (organizational responsibilities)

- Director (chair)
- George Mason University Administrative coordinator and/or curriculum coordinator (GMU's interests)
- Deputy and/or assistant superintendents for curriculum and instruction (program continuity within divisions)
- Curriculum specialists representing science, technology, engineering, and mathematics, (content integrity)
- Directors/supervisors of gifted education (instructional integrity)
- Guidance counselors (home base high school liaison)
- Parent (parental perspectives)
- Student (student perspectives)
- Business Representatives (business/ industry perspectives)

The program director will have the authority to reorganize the advisory committee format to maximize its effectiveness. While the membership may be expanded as the program changes over time, the initial membership must be included in any subsequent reorganization.

Calendar

In an effort to maximize the program director's time in the first year of the program's operation, the administrative subcommittee recommends that the GS@IP follow the school calendar of the fiscal agent, Prince William County Public Schools.

While some holidays overlap across the three divisions and with George Mason University, not all holidays or other special activities days align. For that reason, the Academic-Year Governor's School calendar for 2010-2011 will be adopted when the Prince William County Public Schools' calendar is approved by its school board. Contracts for employees for the GS@IP will be written to reflect fall, winter, and spring breaks as well as teacher professional development days for the county.

Subsequent calendars for GS@IP will incorporate the array of Advanced Placement, Cambridge, International Baccalaureate, and Standards of Learning assessment/testing schedules for the three divisions. All student applications, other printed information, and the GS@IP Web page will reflect that students are expected to attend classes in alignment with Prince William County school openings and closing, regardless of the calendar/closing of their school divisions.

Code of Conduct

In an effort to maximize the program director's time in the first year of the program's operation, the administrative subcommittee recommends that the GS@IP adopt the Code of Conduct for students from the fiscal agent, Prince William County Public Schools. Students will be informed that while on buses from their respective school divisions, their respective Codes of Conduct are in effect.

Subsequent revisions to the Code of Conduct shall be reviewed by the executive committee, prior to approval by the regional governing board. The Code of Conduct shall be included as an element of the evaluation of the program.

Daily Schedule

Both the members of the ID and the administrative subcommittees were involved in discussions with staff from GMU regarding the most advantageous daily schedule for the GS@IP students. GMU staff recommended that the GS@IP students attend classes in the morning, when more classrooms and laboratories were available. With that in mind, the ID subcommittee developed the following weekly schedule as the skeleton around which more detailed planning could proceed once the director and faculty were hired. Table 3 indicates the arrangement of classes to meet the expectations outlined in the program and curricular design. →

Table 3: Weekly Schedule of Classes

Period	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Period 1 105 minutes 7:30 – 9:15	Science/Math	Juniors - Mentorship Day	Juniors – RAI-I	Science/Math	Science/Math
Break 9:15 – 9:30					
Period 2 105 minutes 9:30 – 11:15	Math/Science			Math/Science	Math/Science
Service Learning	90 minutes per week				

The two dominant classes would be periods 1 and 2, both 105 minutes in length. Science teachers felt this was adequate time to present concepts and to utilize the appropriate technology and laboratory settings. Tuesdays and Wednesdays would be devoted to either mentorship activities at area businesses or industries and more focused, concentrated research within the RAI-I class where their science and mathematics knowledge and skills will be integrated into applied engineering and technology-based research. On those days, all teachers would be engaged in observations of students at their mentorship sites or would be working with small groups supporting their research in GMU laboratories, supervising field-based research, or in other research-related endeavors. All students would be required to document 90 minutes of service learning per week through logs and reports to the RAI-I teacher.

With this schedule, students in the GS@IP are in active, accelerated learning for more than 19 hours of the 27.5 contact hours offered in Virginia high schools. GS@IP will spend 69 percent of their school week in programs developed singularly for their intellectual needs.

Evaluation

In an effort to maximize the program director's time in the first year of the program's operation, the administrative subcommittee recommends that the GS@IP adopt the instructional personnel evaluation for the fiscal agent, Prince William County Public Schools.

The program director will submit to the Superintendent's Executive Committee evaluation documents, including pre-planning forms, mid-year evaluations, and final evaluations in accordance with the timeline issued by the Office of Human Resources.

Subsequent revisions to the instructional personnel evaluation process shall be reviewed by the executive committee, prior to approval by the regional governing board. Those revisions may include provisions to evaluate veteran teachers through alternative methods. Such alternatives may include longitudinal projects that incorporate data collection; as well as leadership in program evaluation, community-based instructional programs, curriculum development, and professional development.

The program director will develop an annual evaluation process that will seek information and data to monitor the program's effectiveness. That process will include the collection of data regarding the quality of the instructional design, the curriculum, the instructional staff, and the supporting components – mentorship, field research, and service learning. Data will be collected from all stakeholders who are included as members on the advisory committee as well as staff and faculty of the three school divisions, George Mason University, mentors, and service learning contacts.

Benchmarks for the evaluation of the program will be drawn from the Academic-Year Governor's School Evaluation Rubrics, available from the Virginia Department of Education, as well as elements from the National Consortium of Specialized Secondary Schools for Mathematics, Science, and Technology and other evaluation criteria from accelerated programs for gifted students.

Summary data and conclusions as well as recommendations for programmatic changes will be presented annually to the executive committee and the school boards of the three participating divisions as part of the program director's annual report. This information will also be provided to other audiences as deemed appropriate by the executive committee.

Facilities

Based on information from the ID subcommittee, the administrative subcommittee provided George Mason University with an outline of the amount and kinds of space needed to support the program in the first year. During the first year, 2010-2011, classes will be split between the Occoquan and Bull Run buildings. The following spaces are available at the GMU-PWC for the first year of the program:

- Office space for the director, an administrative assistant, four to six instructional staff
- Four classrooms with built in LCD, laptop/ Internet connections, supporting digital and video technologies, and technology access for students' laptops at their desks;
- One wet-prep laboratory and one dry-prep laboratory;
- Computer laboratory access as GMU students through the open laboratories for all students as well as in each classroom; and
- Storage space will be allocated within existing laboratories and in the office space.

In 2011 and subsequent years, the program will have access to additional classroom and laboratory space as another building in the adjacent Innovation Park opens. At that time, additional classrooms, laboratories, and storage areas will be assigned to the GS@IP.

Fiscal Agent

The Executive Committee of the planning committee designated Prince William County Public Schools as the fiscal agent to receive the planning grant authorized by the 2008 General Assembly. In subsequent discussions, it was agreed that the county would continue to function as the fiscal agent for the Academic-Year Governor's School. A formal agreement indicating the relationship among the three school divisions and George Mason University is included in Appendix F.

As the fiscal agent, Prince William County will secure all needed insurance and documentation. All budgetary issues and procedures will follow Prince William County Public Schools' timeline and specifications. In all areas of the budget, Prince William County Schools' personnel will oversee the activities of the program director and all areas of the GS program at George Mason University.

In February 2009, the school boards of Manassas City, Manassas Park City, and Prince William County signed an agreement outlining their commitment to participate in and fund the operation of the GS@IP. In fiscal year 2010, all three school divisions have allocated funds in their budgets to support the administrative costs of hiring and equipping the director. The signed memorandum of understanding establishes Prince William County Public Schools as the fiscal agent of the program.

Following approval by the Virginia Board of Education, the fiscal agent will sign a memorandum of understanding (MOU) with George Mason University that will define the following terms:

- Facilities to which the GS@IP have sole use;
- Classrooms, laboratory space, storage space, and other meeting space that the GS@IP will share with other GMU faculty, staff, and students and the expectations that govern shared space;
- Required equipment and materials
  - Computers for faculty and staff
  - Laptops for students
  - Phone
  - Fax machine
  - Copier
  - Office Furniture (desks, chairs, file cabinets, etc.)
  - Office Supplies (ink, toner, paper, etc.)
  - Server for e-mail and/or network
  - Textbooks
  - Shared lab equipment (beakers, laboratory burners, etc.)
  - Miscellaneous
- Student access to support facilities such as the library, computer laboratories, field sites, etc.;
- Student and staff parking arrangements;
- Student and staff designation as GMU students and staff;
- Cost for dual enrollment hours credit and transcripts;
- Access and reporting expectations for grades for dual enrollment classes;
- Articulation between high school and GMU course credits;
- Provisions for the safety and security of students under the age of 18 on the GMU-PWC campus; and
- Ancillary support (Web site, technology, resources, supplies, equipment, maintenance, and custodial support) that will be provided by the University for the GS@IP.

Grading Process

Governor's School courses will be graded on a numeric scale with scores ranging from 0-100. Semester scores will be reported numerically to the school divisions and converted to the corresponding letter grade and grade point equivalency used in each respective division. The determination of whether the Governor's School courses will carry weighted credit will remain a local decision.

For purposes of the GMU transcript, all semester grades will be reported using the existing corresponding letter grade and grade point equivalency in practice at the time the courses are taken. All decisions regarding grade point averages for courses reported on the GMU transcript remain under the auspices of the Board of Visitors of George Mason University.

Transportation

Transportation will remain the responsibility of the individual school division. Both Manassas and Manassas Park will provide transportation for their students from Osbourn and Manassas Park High Schools, respectively. Students will arrive at their high schools in time to be transported to the GMU-PWC.

Manassas and Manassas Park school divisions have developed contingency plans to transport each other's students in a variety of situations.

Prince William County Public Schools will provide transportation for its students through one of the following options:

- From their home base high schools using existing bus routes;
- From their home base high schools using student transportation; or
- From express stops for specialty programs.

Student transportation to and from mentorship endeavors will be the responsibility of the student and his or her parents. Support will be provided to arrange carpools for students at the same mentorship sites. Students for whom transportation to mentorship sites cannot be provided by parents or through carpooling arrangements will be given priority assignment to mentorship sites within close proximity to the GMU-PWC campus or at sites adjacent in Innovation Technology Park. This was discussed in several planning sessions by various subcommittees. (See Appendix O.)

VIII. Community Relations

The Community Relations subcommittee served as the spokesperson for GS@IP during the planning process. The co-chairs of the subcommittee hold positions within GMU and PWC that establish them as community resource contacts.

The focus of the Community Relations subcommittee was to speak to a wide variety of potential stakeholders about the GS@IP. By communicating with potential stakeholders throughout the planning process, the subcommittee sought to strengthen the prospective involvement and participation among the communities the program will serve. Among the groups that received information about the GS@IP are CORE2 (Consortium of Regional Employers and Educators), Speak Up Manassas Toastmasters, Prince William County Greater Manassas Chamber of Commerce, Manassas Rotary Club, Leadership Prince William and companies such as Micron, Aurora Flight Sciences Corporation, and Lockheed Martin. In addition, the Prince William County Greater Manassas Chamber of Commerce dedicated one of its Insight Series evening meetings to the topic of the Regional Governor's School to help get more information out to the community. (See Appendix P.) At this March 5, 2009 meeting, parents, students, and other interested persons provided important suggestions and comments regarding the critical aspects of the proposed program. (See Appendix Q.)

Several articles have appeared in regional publications about the GS@IP. The subcommittee developed an initial brochure for parents, students, and other interested parties in the three school divisions. Copies of the articles and brochure are included in Appendix R.

The Web site for GS@IP will be a part of the CAPSTONE project, sponsored by the instructional technology department of GMU. Through CAPSTONE, seniors create a Web site for an area nonprofit organization that meets its specific needs and purposes. While it is still under development, the Web site will serve as a major communication vehicle for the GS@IP. The design template can be seen in Appendix S.

In an attempt to involve students from the three school divisions into the planning process, a logo/name contest was held. The planning committee made the final selection for the logo (See Appendix T.) The executive committee and superintendents selected the name for the GS@IP which was presented for approval by each of the school boards.

The Community Relations subcommittee agendas and minutes may be found in Appendix U.

The Community Relations subcommittee collected petitions and letters of support from area business, industry, and civic organizations. (See Appendix V.)

IX. Proposed Budget

Each school division has committed to provide start-up funds for hiring a Director in January 2010. The planning committee proposed the January hiring so that there is sufficient time for hiring staff and working with George Mason to assure the facility and curriculum are ready for students. The proposed budget for start-up is included in Appendix W.

Based on a projected total enrollment of 75-90 eleventh-grade students from three participating school divisions, the proposed budget for 2010-2011 is included in Appendix X.

X. School Division's Assurances of Support

Table 3: Initial School Division Student Membership

School Division	Year One	Year Two	Year Three
Manassas City	10	20	25
Manassas Park City	5	10	12
Prince William County	60-75	120-150	130-160
Total	75-90	150-180	167-197

Each school division has committed to the GS@IP for an initial three-year period. The table above reflects the number of students projected to participate in the GS@IP for the first year, 2010-2011 as 11th graders. In years two and following, the student population will include juniors and seniors.

XI. Conclusion

The appendices provide complete documentation to support this proposal. The three school divisions, Manassas City, Manassas Park and Prince William request your immediate consideration and approval of this proposal for the GS@IP for opening in the fall of 2010, as a five-sixth day continuous program pending legislative financial support.

Appendices

A.	Planning Grant Information
B.	Consultant Information
C.	Master Timeline
D.	Roster of committee members and minutes
E.	Committee Roles and Responsibilities
F.	Governance Agreement
G.	Core Values
H.	Instructional Design Subcommittee Minutes
I.	Graphic Overview of Concepts, Skills, Applications Integration
J.	Engineering Concepts Crosswalk
K.	Course Outlines
l.	Chart for Dual Enrollment
M.	Gifted Resolutions
N.	Student Application
O.	Administration Subcommittee Minutes
P.	Insight Series Information
Q.	March 5, 2009 Participant Feedback
R.	Articles and Brochures
S.	Web Site
T.	Logo Contest
U.	Community Relations Subcommittee Minutes
V.	Petitions and Support Information
W.	Start-Up Budget
X.	Proposed Budget for 2010-2011
Y.	Works Cited

Board of Education Agenda Item

Item: M **Date:** July 23, 2009

Topic: First Review of a Proposal to Establish a Governor's Career and Technical Academy: The Governor's Career and Technical Academy for STEM in Richmond

Presenter: Dr. Lois A. Williams, STEM Coordinator
Dr. Yvonne Brandon, Superintendent, Richmond City Public Schools

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(804) 780- 7704 ybrandon@richmond.k12.va.us

Origin:

____ Topic presented for information only (no board action required)

____ Board review required by
____ State or federal law or regulation
____ Board of Education regulation
_X_ Other: Process for Initiating a Governor's Career and Technical Academy Approved by the Board of Education on November 29, 2007

_X_ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:
Virginia's Governor's Career and Technical Academies are programs designed to expand options for the general student population to acquire science, technology, engineering and mathematics (STEM) literacy and other critical skills, knowledge and credentials that will prepare them for high-demand, high-wage and high-skill careers. Partnerships establishing academies must include at least one public school division, business and industry, and postsecondary education.

On November 29, 2007, the Board of Education approved the criteria to establish a Governor's Career and Technical Academy. Subsequently, on March 19, 2008, the Board approved the standards for the Governor's Career and Technical Education Exemplary Standards Awards Program, in which all Career and Technical Academies must participate.

Currently, there are eight Governor's Career and Technical Academies in Virginia. They are located in Arlington County, Halifax County, Loudoun County, The New Horizons Regional Center in Hampton City, The Pruden Center for Industry and Technology in Suffolk City, Russell County, Stafford County and Chesterfield County.

As required by the Board of Education, the State Council of Higher Education in Virginia (SCHEV) has reviewed the attached proposal and recommends that the Board approve the proposal. Staff at the Virginia Department of Education (DOE) have also reviewed the proposal in the context of the Board's criteria. An executive summary of the proposal is contained in Attachment A. Attachments B and C contain the reports from the reviews by SCHEV and the DOE. Attachment D contains the complete proposal.

Summary of Major Elements:
The focus of the Governor's Career and Technical Academy for STEM in Richmond is to offer Richmond City Public Schools' students a solid education in science, technology, engineering and mathematics along with the critical skills needed to succeed in a digital, global economy. Work force readiness opportunities and a rigorous academic and technical program of study in two career pathways (Engineering and Technology and Therapeutic Services) will prepare students for a full range of postsecondary opportunities (two- and four-year colleges), formal employment training, apprenticeships, and the military. The career pathway programs have been designed to lead students to opportunities in high-skill, high-wage, and high-demand employment areas.

Students in each pathway will participate in several middle school and summer program components to help prepare them for admission into the Academy's high school program. The Engineering and Technology Pathway will teach students the key elements and skills of engineering and technology-based careers by immersing them in rigorous engineering problems. The Therapeutic Services Pathway will focus on Sports Medicine and Emergency Medical Services. An Academy partnership with Virginia Commonwealth University (VCU) will enable students to shadow VCU sports trainers to learn how to care for and help athletes prevent injuries. Students will also participate in a variety of academic and extracurricular activities conducted by the School of Engineering at VCU and the School of Engineering, Science and Technology at Virginia State University. All students will have the opportunity to take dual enrollment courses from J. Sargeant Reynolds Community College and earn multiple licenses and certifications.

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education waive first review and approve the proposal to establish the Governor's Career and Technical Academy for STEM in Richmond.

Impact on Resources:
Funding must be provided at the local level.

Timetable for Further Review/Action:
The Governor's Career and Technical Academy for STEM in Richmond will be in operation for the beginning of the 2009-2010 academic year.

Attachment A

The Governor's Career and Technical Academy for STEM in Richmond
Executive Summary
July 23, 2009

Partnership Members:	Richmond City Public Schools; Virginia Commonwealth University; Virginia State University; J. Sargeant Reynolds Community College; James Madison University; Old Dominion University; Science Museum of Virginia; Timmons Group, Inc.; MathScience Innovation Center; U-Turn Sports Performance Academy; YMCA-North Richmond; Center for Educational Learning Technology (CELT); Dr. Gregory Pleasants-Parham Road Internal Medicine; Black Data Processing Associates; Jacqueline Johnson-Curl, D.D.S.; Quastar, LLC; Ronald A. Williams, LTD (electronic and technology resources); Virginia Sports Medicine & Physical Therapy; Richmond Area Program for Minorities in Engineering; Johnson Controls, Inc.; and ECPI College of Technology
Lead Entity:	Richmond City Public Schools
Fiscal Agent:	Richmond City Public Schools
Contact Person:	Ms. Cozette G. McIntyre Grants Manager 804-780-7791 cmcintyr@richmond.k12.va.us
Academy Location:	Governor's Career and Technical Academy for STEM in Richmond Richmond Technical Center 2020 Westwood Avenue Richmond, Virginia 23230
Number Students:	In year one, a total of forty-five slots will be allocated for rising eighth-grade student admission. This will allow thirty students in the Engineering and Technology pathway and fifteen students in the Therapeutic Services pathway. Each year the Academy will add an additional forty-five students. The potential for enrollment is 180 students in year four.
Career Pathways:	Engineering and Technology Therapeutic Services
Academy Goals and Description:	The major goal of the Academy is to raise student aspirations and attract more students to postsecondary education in preparation for technical careers, especially targeting students who might otherwise have settled for a curriculum that did not prepare them well for postsecondary education or work. Partnerships and collaborations will provide a program that will support and engage students in a variety of middle school, pre-Academy and summer experiences designed to help them to achieve in a rigorous high school component.

Highlights of the Program:

An Academy "community of learners" will be established through collaboration with partners in higher education, nonprofit organizations, and businesses. Students within the district will have the opportunity to master core academic courses from any high school and also attend the Academy.

Additional highlights of the program are:

- Rigorous, hands-on and project-based coursework;
- Cross-disciplinary, hands-on professional development for teachers;
- Academic support during the summer and academic year including interactive seminars covering communication, organization, negotiation, and decision-making skills;
- Work force readiness opportunities;
- Career and college development activities for students beginning in eighth grade to include personalized Academic and Career Plans, college tours, and exposure to college students and professionals; and
- Parent and community involvement recruited through a variety of forums to present information and collect feedback.

The State Council of Higher Education for Virginia

Review of Governor's Career and Technical Academy Proposal

Name of Lead Entity on Proposal: Richmond Public Schools

Date of Review: June 18,2009

The State Council of Higher Education for Virginia recommends approval of the Governor's Career and Technical Education Academy for STEM in Richmond as a Governor's Career and Technical Academy.

Daniel LaVista — 6-17-09

Dr. Daniel LaVista
Executive Director
State Council for Higher Education

Date

State Council of Higher Education for Virginia

Governor's Career and Technical Academies Postsecondary Curriculum Review Checklist

Academy Name	Collaborating Partners	Total Funds Requested	Allocated Funds for Postsecondary Component
Governor's Career and Technical Academy for STEM in Richmond	Richmond Public Schools, VCU, JSRCC, (Others—see proposal)	None	NA

Criteria

Category 1: Postsecondary Accreditation and Approvals

YES/NO

YES Postsecondary institution is appropriately accredited

NA Proposed postsecondary program has specialized accreditation, if applicable

YES Proposed postsecondary program is SCHEV and/or VCCS approved

NO Proposed postsecondary program will be seeking SCHEV and /or VCCS approval

Category 2: Governor's Career and Technical Academy Requirements

YES/NO

YES **Evidence of a partnership with a postsecondary institution, business, or industry, and demonstrated roles for each entity**

YES **Offers at least one career pathway in a field identified by a statewide authority or organization as a strategic growth area for Virginia**

YES **Offers at least one career pathway addressing regional and local work force demand in a high-wage, high skill field identified by employers and work force officials**

YES **At least one of the two career pathways is in a STEM-related field**

Category 3: Postsecondary/Business Component Requirements

YES/NO

YES **Provides opportunities for students to earn industry credentials or state licensure, associate or baccalaureate degrees, and college credit for work-based experiences**

YES **Articulates with baccalaureate programs or to higher levels of training or professional credentialing**

YES **Demonstrates P-16 integration including curriculum development with high school, college, and university faculty (desired)**

Includes college faculty as adjunct faculty of the academy (desired)

YES **Provides opportunities for students to participate in work-based experiences**

Category 4: Academic Quality

YES/NO

YES **Requires appropriate postsecondary faculty qualifications**

YES **Requires faculty to hold industry certification, where necessary**

YES **Planned professional development for faculty and administrators**

YES **Planned systematic program and learning outcomes assessment**

Category 5: Administration and Funding

<u>YES/NO</u>

YES Funding is sufficient to support effective administrative and operational needs including materials, administrative personnel, and facilities

YES Funding is sufficient to sustain faculty salaries, curriculum development costs, and instructional materials and delivery

YES Facilities possess the necessary physical attributes to deliver the instructional program (classroom space, technology, labs, equipment)

COMMENTS

The proposed program is comprehensive and integrated, meeting the criteria outlined by SCHEV. It is well written and has an effective plan for the efficient utilization of resources.

Virginia Department of Education
Governor's Career and Technical Academy
Proposal Review Checklist

Final Review

Title of Proposal: The Governor's Career and Technical Academy for STEM in Richmond

Lead Entity for Proposal: Richmond City Public Schools

Date of Review: June 5, 2009

Virginia Department of Education
Governor's Career and Technical Academy
Proposal Review Checklist

I. Partnership Capacity

Partnerships desiring to implement a Governor's Career and Technical Academy shall provide the Department of Education with evidence of the following:

Criteria	Documentation			Comments
	Full	Partial	None	
A. An active, ongoing planning committee, including a list of members and signed certifications from each that they are willing and able to serve in that capacity. At a minimum, members must represent K-12 education (superintendent or designee), higher education, and business and industry. All partners must be represented on the committee.		X		3/17/09 A few signatures were missing from the planning committee.
	X			6/5/09 All signatures are included.
B. An Advisory Board, including a list of members and signed certifications from each that they are willing and able to serve in that capacity.		X		3/17/09 A few signatures were missing from the Advisory Board.
	X			6/5/09 All business partners are represented on the Advisory Board.
C. A written memorandum of agreement among school divisions, local businesses, postsecondary institutions, and any other partners that outlines ways in which community resources will contribute to the Governor's Career and Technical Academy to broaden the scope of students' educational experiences.		X		3/17/09 A few business partner signatures were missing.
	X			6/5/09 All signatures are included.

Criteria	Documentation			Comments
	Full	Partial	None	
D. A statement of assurances that the Governor's Career and Technical Academy Planning Committee has reviewed provisions of *Administrative Procedures Guide for the Establishment of Governor's Career and Technical Academies* and agrees to follow the guidelines set forth in the document (see appendix).	X			
E. A statement of assurances that, if				

Criteria	Documentation			Comments
	Full	Partial	None	
applicable, an ongoing Governing Board will be established to reflect current Board of Education regulations relative to jointly operated schools and programs.				Not applicable.
Comments: 3/17/09 The review committee suggested a few more partners could be used to support the engineering pathway. 6/5/09 Richmond City Public Schools has included additional partners in each pathway.				

II. Need/Rationale for the Academy

Partnerships desiring to implement a Governor's Career and Technical Academy shall provide the Department of Education with evidence of the following:

Criteria	Documentation			Comments
	Full	Partial	None	
A. Demonstration of the need/rationale for the Academy. This statement should be concise and state the major reasons to have a Governor's Career and Technical Academy, including need at the state, local and/or regional levels.	X			Need is well documented.
B. A description of the enhanced or additional offerings in science, technology, engineering, and/or mathematics (STEM) that will meet the need described above.	X			
C. A fiscal agent that is a public entity, including a certification that the entity is willing and able to serve in that capacity.	X			
Comments:				

III. Program Description

Each Governor's Career and Technical Academy planning committee shall develop cooperatively with local school divisions, business, community, and higher education partners and have available for review and dissemination, a program description that includes:

A. A statement of program goals addressing the following criteria:

Criteria	Documentation			Comments
	Full	Partial	None	
1. Rigorous academic content in career and technical instruction;	X			
2. An emphasis on STEM career pathways;	X			
3. Individualized high school plans to ensure course selections that are aligned with students' transition and career goals after high school;	X			
4. Evidence that graduates will complete a college and work readiness curriculum, minimally at the level specified for Commonwealth Scholars Course of Study (State Scholars Core) with the possibility of pre-approved substitution of equivalent courses where there may be more relevant course selections for a particular career pathway;	X	X		3/17/09 The Commonwealth Scholars Course of Study requirements are only partially fulfilled at this time. 6/5/09 The Commonwealth Scholars Course of Study requirements are met.
5. Evidence that graduates will qualify for the Technical and/or the Advanced Technical Diplomas; and	X			
6. Incorporation of Virginia's Workplace Readiness Skills.	X			
Comments:				

A statement of program objectives and performance measures to:

Criteria	Documentation			Comments
	Full	**Partial**	**None**	
1. Improve academic achievement of Academy students;	X			
2. Increase completion of dual enrollment courses;	X			
3. Provide workplace readiness experiences for students through strong partnerships with businesses;	X			
4. Increase high school graduation rates;	X			
5. Reduce dropout rates;	X			
6. Increase enrollment and retention in postsecondary education;	X			
7. Increase the proportion of students completing a college and work place ready curriculum in high school;	X			
8. Reduce the proportion of students requiring remediation in college;	X			
9. Increase the number of industry certifications awarded to high school students; and	X			
10. Increase the number of graduates employed in high-wage, high-demand and high-skill careers.	X			
Comments: 3/17/09 All program objectives need to identify baseline data collection. 6/5/09 Baseline objectives have been identified.				

B. A brief description of the proposed program, including:

Criteria	Documentation			Comments
	Full	Partial	None	
1. Site location;	X			
2. Number of students to be served;	X			
3. Grade levels;	X			
4. General curriculum design;	X			
5. List of courses to be delivered;	X			
6. Description of how/where the courses will be delivered. Courses may be delivered on a high school, technical center or community college campus, online, or in other innovative ways; and	X			
7. Designation of full-day or part-day, academic-year program.	X			
Comments:				

B. Evidence of participation in the Governor's Exemplary Standards Award Program for Career and Technical Education

	Documentation			Comments
	Full	Partial	None	
	X			
Comments: Statement of intent is included.				

C. Program and course descriptions

E.1. At least two well-articulated career pathways must be included that meet the following criteria:

Criteria	Documentation			Comments
	Full	Partial	None	
Pathway #1: Engineering				
a. Must include opportunities to earn industry credentials, postsecondary certificates, diplomas or associate degrees while in high school and pursue additional industry credentials and academic degrees at the associate, bachelor's and graduate levels. These pathways may be in the same or different career clusters.	X			
b. Must be in a field identified by a statewide authority or organization, such as the Virginia Economic Development Partnership or the Virginia Research and Technology Advisory Commission, as a strategic growth area for Virginia. Examples include biosciences, information technology, automotive technology and motor sports, as well as modeling and simulation and nanotechnology **or**	X			
c. Must address regional and local work force demand in a high-wage, high-skill field as identified by employers and work force officials.				Fulfilled statewide requirement
d. At least one pathway must be in a STEM-related field. This career pathway should drive the innovative capacity of the region and/or state.	X			
Comments:				

Criteria	Documentation			Comments
	Full	Partial	None	
Pathway #2: Therapeutic Services				
a. Each career pathway must include opportunities to earn industry credentials, postsecondary certificates, diplomas or associate degrees while in high school and pursue additional industry credentials and academic degrees at the associate, bachelor's and graduate levels. These pathways may be in the same or different career clusters.	X			
b. Must be in a field identified by a statewide authority or organization, such as the Virginia Economic Development Partnership or the Virginia Research and Technology Advisory Commission, as a strategic growth area for Virginia. Examples include biosciences, information technology, automotive technology and motor sports, as well as modeling and simulation and nanotechnology, or	X			
c. Must address regional and local work force demand in a high-wage, high-skill field as identified by employers and work force officials.				This pathway addresses a statewide need.
d. Of the two pathways described, at least one must be in a STEM-related field. This career pathway should drive the innovative capacity of the region and/or the state.	X			The engineering pathway fulfills this requirement.

Criteria	Documentation			Comments
	Full	Partial	None	
e. Additional career pathways may address one of the areas described above, or an area identified by the partnership as an area of interest, growth, or expansion for students in the service area of the Academy.				Not applicable.
Comments: The Therapeutic Services pathway is quite exciting as the focus of this pathway is sports medicine. This is a first for the Academies and offers exciting opportunities for internships for the students.				

E.2 List of all requirements for successful program completion.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

E.3 Academy graduates must achieve one or more of the following benchmarks:

Criteria	Documentation			Comments
	Full	Partial	None	
a. Earn one or more industry certifications or state occupational licenses, and/or demonstrate competencies on an assessment instrument recognized by postsecondary institutions such as CLEP examinations, collaboratively designed or mutually approved end-of-course tests, college placement tests, or student portfolios reviewed by a team of college and high school faculty; **or**	X			
b. Earn at least 9 transferable college credits as defined in the Early College Scholars program (includes dual enrollment, AP and other options); **or**	X			This is an option in the Therapeutic Services pathway.
c. Earn an Associate Degree.			X	Not required.

Criteria	Documentation			Comments
	Full	Partial	None	
Comments:				

E.4 Significant work-based experience must be included representing additional instruction or training beyond the classroom such as:

Criteria	Documentation			Comments
	Full	Partial	None	
a. Cooperative Education; or	X			
b. Internships; or	X			
c. Job Shadowing; or	X			
d. Mentorships; or	X			
e. Project-based learning; or	X			
f. Service learning; or				
g. A combination of the above.				
Comments: One internship opportunity describes students shadowing sports trainers on the field during VCU football games to observe procedures directly.				

C. Length of program and daily schedule: Governor's Career and Technical Academies are defined by program content, not by the location or delivery system of courses. Evidence of the following must be submitted:

Criteria	Documentation			Comments
	Full	Partial	None	
Designation of full-day or part-day, academic-year program.	X			
Comments:				

D. Assurance from the fiscal agent that operating funds and facilities are available to support the Governor's Career and Technical Academy and are adequate to meet the needs of the program

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

E. Materials and equipment to be provided to accomplish program goals and objectives.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments: Perkins funds will be used.				

F. Evidence of an internal evaluation process to effect program improvement, including:

Criteria	Documentation			Comments
	Full	Partial	None	
1. A review of the Academy's policies, procedures, and outcomes;	X			RCPS has an internal review mechanism that will be used.
2. A review of the program design and instructional delivery;	X			
3. Consideration of feedback from students, staff, parents, the community, and partnership members; and	X			
4. Annual collection and reporting of data to the Department of Education related to student achievement, goal achievement, and other indicators.	X			
Comments:				

IV. Administrative Procedures

Each Governor's Career and Technical Academy must develop and maintain procedures developed cooperatively with participating partners. There should be evidence of procedures in the four areas that follow.

A. Partnerships - The role of business and industry, public school divisions, and postsecondary institutions in the partnership. The role of work force and economic development entities should also be included if they are among the partners.

	Documentation			Comments
	Full	Partial	None	
	X			

Comments:

B. Student recruitment, selection criteria, and admissions.

	Documentation			Comments
	Full	Partial	None	
	X			

Comments:
The student application and teacher scoring rubric are both included in the appendices.

C. Code of student conduct and attendance.

	Documentation			Comments
	Full	Partial	None	
	X			

Comments:

D. Transportation provided by the school division or consortium that is in compliance with all applicable federal and state regulations.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

E. Staff recruitment, selection, and assignment - The Governor's Career and Technical Academy shall hire staff members who meet the Virginia teacher licensure requirements and/or postsecondary faculty qualifications. Where applicable, they must have industry-specific education with training and experience, including industry certification.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

F. Staff development - The program will provide appropriate staff training in addition to staff planning time.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

G. Staff evaluation – Staff will be evaluated according to the human resources policies of the agency or institution employing Academy personnel.

	Documentation			Comments
	Full	Partial	None	
	X			
Comments:				

H. Parent, student and community involvement

Criteria	Documentation			Comments
	Full	Partial	None	
1. Preparation for entering the Academies should begin by eighth grade.	X			Many summer programs for middle school students, both existing and newly created, will be used to prepare students.
2. Students, parents, teachers, and counselors should work collaboratively to: a. Complete career interest inventories;	X			
b. Prepare academic and career plans outlining an intended course of study in high school;	X			
c. Review multiple postsecondary pathways and the steps required to pursue them;	X			
d. Participate in career assessments to identify areas students should strengthen to qualify for their selected pathways; and	X			Several tools were mentioned including Virginia Wizard.
e. Discuss available diplomas, seals, and other recognitions including admission to specialized programs such as Governor's Academies.	X			

I. Documentation of insurance, budget, and other fiscal information

	Documentation			Comments
	Full	**Partial**	**None**	
Insurance	X			
Budget (from appendix)	X			
Budget Narrative	X			
Other				
Comments:				

Attachment D

The Governor's Career and Technical Academy for STEM in Richmond

Proposal Submitted to
The Virginia Department of Education
By
Richmond City Public Schools
July 23, 2009

Governor's Career and Technical Academy for STEM in Richmond

Richmond City Public Schools

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Governor's Career and Technical Academy for STEM in Richmond
Richmond City Public Schools

Introduction

The focus of the Governor's Career and Technical Academy for STEM in Richmond is to offer Richmond City Public Schools' (RCPS) students a solid education in science, technology, engineering and mathematics (STEM) along with the critical skills needed to succeed in a digital, global economy. A rigorous academic and technical program of study in two career pathways (Engineering and Technology and Therapeutic Services) will prepare students for a full range of postsecondary opportunities, formal employment training, apprenticeships, and the military. The career pathway programs have been designed to lead students to opportunities in high-skill, high-wage, and high-demand employment areas.

Currently RCPS has career and technical education pathways in place. However, this Academy will raise the standards by moving the Engineering and Technology and the Therapeutic Services Pathways to four-year programs from one-, two- and three-year completion programs. In addition, new courses are being added to both pathways and Project Lead The Way will be introduced to the Engineering and Technology Pathway.

Academy coursework, professional development for teachers, academic support for students, career, and college development activities along with parent and community involvement are designed to create a sustainable, STEM community of learners.

Students in each pathway will participate in middle school and summer program components to prepare them to enter the Academy and excel in the high school program.

The Engineering and Technology Pathway will teach students the key elements and skills of engineering and technology-based careers by immersing them in rigorous engineering problems. The Therapeutic Services Pathway will focus on Sports Medicine and Emergency Medical Services.

The Academy and its programs are the result of collaboration across RCPS content areas and strong partnerships with area businesses, the MathScience Innovation Center, the Science Museum of Virginia, and J. Sargeant Reynolds Community College.

Rationale/Need

Richmond is the capital of Virginia and serves as the cultural, financial, and business center of a rapidly growing metropolitan area. Richmond is considered one of the nation's preferred locations for corporate headquarters. Many local companies native to Richmond have regional, national and global markets. In 2008, *Forbes Magazine* placed Virginia first in the nation as the best site for business for the third year in a row. Forbes' index is based on a combination of business climate, labor, regulatory environment, economic climate, growth prospects, and quality of life.

The challenge for RCPS and Academy partners is to ensure that all students have the opportunity to share in, and are not excluded from, the strong, thriving, metropolitan economy. The Governor's Career and Technical Academy for STEM in Richmond is dedicated to reversing the trend of what has been depicted as a national tragedy—the underachievement and isolation of a growing low-income population.

In 2003, RCPS began making significant strides in raising student state mandated test scores and has increased the number of formerly low-performing schools to schools that are now fully accredited. In 2008, for the third consecutive year, every RCPS high school was fully accredited. The percentage of schools earning full accreditation reached a record high of 87.5 percent meeting the Standards of Learning (SOL) benchmark scores in English, mathematics, history and science. Two additional schools were granted conditional accreditation, which increases the district's accreditation rate to 91.7 percent. These accomplishments can be attributed to committed leadership, dedicated teachers and a host of initiatives and endeavors that include a concentrated instructional program in middle school mathematics and a newly implemented reading program on the secondary level featuring both remediation and content area strategies.

Establishment of the Academy is one of the commitments that RCPS has made to better serve the needs of students and their families, many of whom are part of a phenomenon known as the cycle of poverty. In the cycle, generations of a family remain economically poor. Lack of education is one of the critical factors perpetuating the cycle. Seventy-four percent of RCPS students qualify for free and reduced lunch, representing the second highest percentage in Virginia where the average is 33.32 percent. United States census data (2000) indicate that 48 percent of Richmond households are in the $0-$29,999 income category compared to 18 percent in neighboring Chesterfield County and 25 percent in Henrico County. Thirty-two percent of the

total city population is under the age of 18 and 52 percent are female heads of households with children under the age of five.

The Academy is designed to meet the work force needs of emerging and existing businesses and industries in Virginia. The Academy's program will help students develop "21st Century skills in the context of rigorous, content-based, academic study. Teachers will engage students in authentic, intellectually stimulating and challenging work that motivates them to work hard, collaborate in meaningful ways, build a variety of skills, and conduct research to accomplish their goals." (Literacy in the Digital Age, the North Central Regional Educational Laboratory and the Metiri Group, 2003)

Engineering and Technology Pathway

Engineering and Technology is a STEM pathway that will provide students with a variety of employment options and postsecondary opportunities. In 2007, the Virginia Office of the Secretary of Technology reported that there was an impending technology boom. "Tech jobs, wages, and exports are all on the rise…if these trends continue, next year Virginia will become the state with the highest concentration of tech workers in the nation." "Engineers are needed to design and build new systems while Engineering Technologists will design and build new components." (Greg Poersch, AeA Cyberstates 2006 Report)

The U.S. Bureau of Labor Statistics has projected a need for 160,000 more engineering positions over the ten-year period between 2006 and 2016. This 11 percent increase does not include the replacement of many retiring engineers. It is predicted that more than half of the country's engineers are nearing retirement. The need for environmental engineers in Virginia in 2012 is 2,402, a 49.56 percent change requiring 273 replacements and 796 openings due to growth. (Virginia Workforce Council, Workforce Development Blueprint, 2002, "Specific Occupations with the Largest Percent Increase in Employment, 2002-2012)

The Virginia Workforce Commission reports that growth plus replacement needs for engineers are estimated to average about 193 openings per year from 2004-2014. Of these estimated 193 openings per year, 54.9 percent are due to growth (new positions) and 45.1 percent are due to the replacements of workers leaving the occupation. This compares with all occupations in Virginia statewide where 42.9 percent of annual openings are due to growth and 57.1 percent of annual openings are due to the replacement of workers leaving these occupations. The employment of

engineers is expected to grow about as fast as the average for all occupations over the next decade, but growth will vary by specialty. Environmental engineers should experience the fastest growth, while civil engineers should see the largest employment increase.

Long-Term Occupational Employment Projections-Engineering Source: Virginia Workforce Connection; Projections Team/Micro Matrix System (2002)				
Occupation	**2014 Projected Employment**	**Total Annual Average Openings**	**Annual Average Openings due to Growth**	**Annual Average Openings due to Replacement**
Civil Engineering Technicians	2,906	99	48	51
Electronics Engineers (except computers)	7,767	276	153	123
Mechanical Engineers	8,118	311	122	189
Industrial Engineers	4,572	171	80	91

National earnings reported in May 2006, by the U.S. Bureau of Labor Statistics are shown in the following tabulations:

Engineering Technicians	
Aerospace engineering and operations technicians	$53,300
Electrical and electronic engineering technicians	$50,660
Industrial engineering technicians	$46,810
Mechanical engineering technicians	$45,850
Electro-mechanical technicians	$44,720
Civil engineering technicians	$40,560
Environmental engineering technicians	$40,560

Civil Engineering Technicians	
Local government	$45,800
Architectural services	$42,310
Engineering services	$41,180
State government	$35,870
Testing laboratories	$31,800

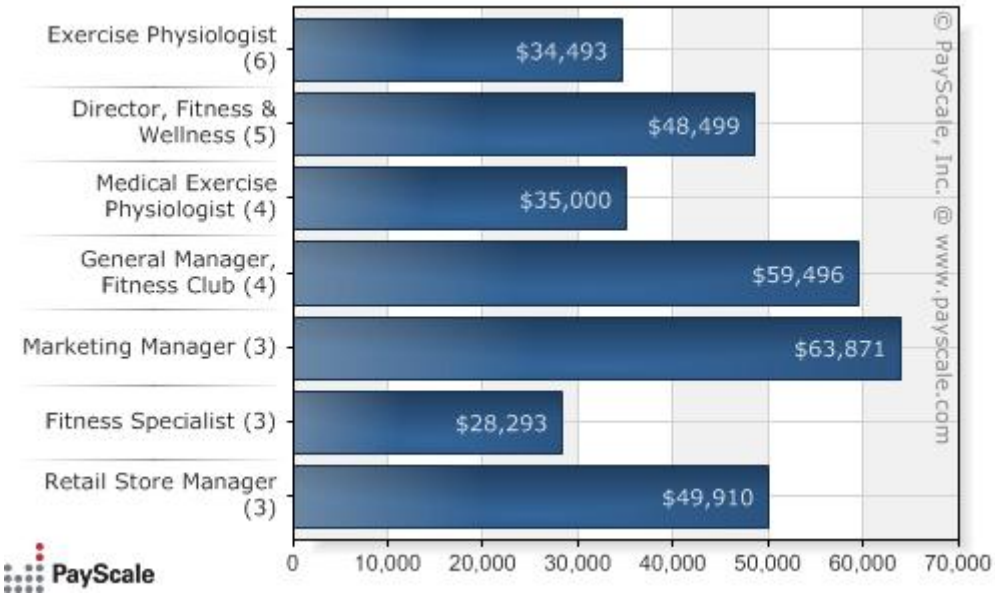
Therapeutic Services Pathway

The focus of the Therapeutic Services Pathway is providing instruction to prepare students to enter the fields of sports medicine and emergency medical services. Sports medicine is a broad, emerging field comprising the sciences related to the care, treatment and prevention of sports-related injuries. The completion of courses in emergency medical services is a requirement for studies in sports medicine and exercise science at four-year institutions. The exercise science concentration prepares students to serve in a variety of fitness, health and conditioning programs in corporate, commercial, university and clinical settings. Career paths include research, exercise physiology, corporate fitness, cardiopulmonary rehabilitation, strengthening and conditioning, and wellness.

The U.S. Department of Labor predicts that eight of the twenty careers with the highest demand for employees in the next decade will be in the health care sector. Nearly 80 million Americans born between 1946 and 1964 are living longer. This population is expected to place a demand on the services of physical therapy, exercise, nutrition and wellness professionals.

Employment as personal fitness trainers, nutrition and fitness specialists or health club instructors are options for Academy students after high school and during their pursuit of a two-year degree. According to information compiled by the U.S. Bureau of Labor Statistics, personal trainers and exercise instructors generally earn a salary of $25,470 per year.

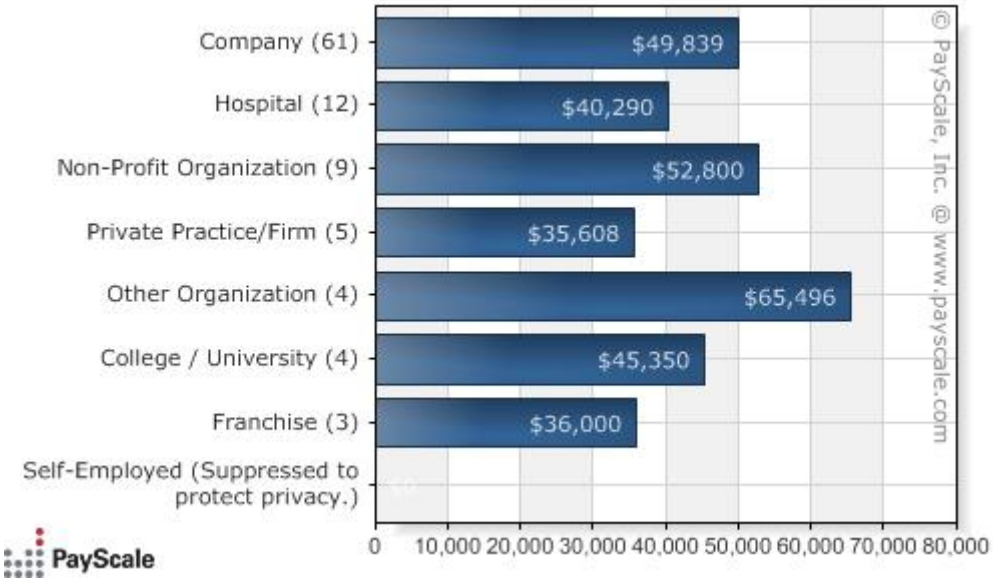
Median Salary by Job - Degree: Exercise Physiology (United States)



Occupations for exercise scientists include teachers, designers of exercise and rehabilitation plans, and nutrition, exercise and health researchers. A bachelor's or master's degree in Exercise Physiology or a related field is required. U.S. Bureau of Labor Statistics expects overall employment for exercise scientists to grow by almost 30 percent between the years 2006 and 2016. The greatest number of positions will be in physical therapy, personal training and exercise physiology.

In 2006, the median salary for all exercise scientists was around $66,000 a year. Research scientists may earn salaries of over $90,000 a year depending on their academic qualifications.

Median Salary by Employer Type - Degree: Exercise Physiology (United States)



Exercise physiologists assess a client's overall physiological health using medical records, tests and observations. The information is then used to create a therapeutic program to improve the client's overall health and well-being. Most entry-level physiologists must have a bachelor's degree in exercise science or a related field. The employment outlook for physiologists, reported by the U.S. Bureau of Labor Statistics, predicts growth in nursing care facilities and outpatient facilities that cater to the disabled to grow faster. The median annual salary for physiologists is $34,990.

Certified Athletic Trainers (CAT) are medical experts in preventing, recognizing, managing and rehabilitating injuries that result from physical activity. These trainers can help athletes avoid unnecessary medical treatment and disruption of normal daily life. In cooperation with physicians and other allied health personnel, the athletic trainer functions as a vital member of athletic health-care teams in secondary schools, colleges, universities, sports medicine clinics, professional sports programs and other health care settings. Salaries in this field vary widely depending upon the level of education, employment setting, and experience. According to the 2005 National Athletic Trainer's Association salary survey, average salaries for CATs ranged from $28,495- $63,568.

Specific Occupations with Largest Percent Increases in Employment, Virginia, 2002-2012 Source: Virginia Workforce Council, Work force Development Blueprint 2020						
Occupational Title	**Employment Est. 2002**	**Employment Proj. 2012**	**Percent Change**	**Openings Replacements**	**Openings Growth**	**Openings Total**
Physical Therapists Aides	916	1,456	58.95 %	153	540	693
Physical Therapists Assistants	1,229	1,918	56.06 %	205	689	894
Fitness Trainers and Aerobics Instructors	5,196	7,880	51.66 %	1,192	2,684	3,876
Physical Therapists	2,987	4,303	44.06 %	294	1,316	1,610

Foundation for Implementation

Richmond City Public Schools (RCPS) and Richmond Technical Center (RTC) staff toured established academies in Virginia to prepare for planning and implementing the Governor's Career and Technical Academy for STEM in Richmond.

This RCPS/RTC Planning Team played an integral role in the planning and development of the Academy. See Appendix A for a list of team members. The team attended the Virginia Department of Education's "From Vision to Practice Conference: Growing SySTEMic Literacy Across the Content Areas" in 2008 in Richmond, Virginia. The conference served as a stimulus for gaining RCPS broad-based support and collaboration across the content areas. The team met with potential partners, helped to develop student selection criteria, and reviewed curriculum resulting in course alignment and course sequences through dual enrollment and Advanced Placement.

The team also reviewed the success and effectiveness of like-minded programs within the RCPS district such as Open High School, Richmond Community High School and Franklin Military Academy. Open High School is a fully accredited alternative high school that offers smaller classes,

a more informal experience and a broader range of curriculum offerings. The school's name and founding principles are based on the belief that valid learning experiences can, and do, occur outside of the traditional classroom setting. The entire community with all its human and material resources should be made into a learning laboratory. Courses are held on-site and at selected locations in the metropolitan area. Richmond Community High School provides an accelerated, college preparatory curriculum for students from low economic backgrounds who show strong promise for academic excellence. The curriculum at Community is distinguished by an in-depth focus on high-level thinking and problem solving skills. The Richmond Community and Open High Schools were ranked in 2008 among the nation's "best" schools by U.S. News and World Report magazine and School Evaluation Services, a K-12 education data research and analysis business operated by Standard and Poor's. Franklin Military Academy is an alternative high school created to offer a structured environment of academics, military and public safety training. It is a special initiative that provides high school learning centers for students who are strongly motivated and wish to have a distinctive educational experience in a small school environment of focused learning, guided by a team of mentor teachers, military and public safety partners, as well as an education-to-careers curriculum.

Consultations with RCPS principals and school counselors were held during the planning phase. Both groups have expressed enthusiasm and support for recommending students for participation in the Academy.

The Governor's Career and Technical Academy for STEM in Richmond will build upon the various experiences of RCPS students and teachers by creating opportunities to expand options to acquire STEM literacy and other critical knowledge, skills and credentials that will prepare them for high-demand, high-wage and high-skill careers.

RCPS students participate in a variety of programs focused on providing exposure to science, technology, engineering and mathematics. Since 2005, Altria and the University of Richmond have sponsored the "Math and Science Investigators" (MSI) program. MSI has provided a rigorous academic achievement program for one hundred rising eighth- and ninth-grade students for five weeks during the summer. These students participate in career exploration, field trips and mentoring during the academic year and the summer. Course offerings include: Earth Science, Biology, Chemistry, Algebra I and II, Geometry, Research I and II, Content Literacy I, II and III and Independent Research.

Approximately one hundred ninth-grade students from four RCPS schools participated in a Johns Hopkins Mathematics Program in the summer of 2008 and will participate in the summer of 2009. The goal of the program is to help students pass Algebra I.

In 2008, ten students in grades 4-6 from George Mason Elementary School participated in a Summer Enrichment Day Camp conducted by Virginia Commonwealth University (VCU) Medical Center's Division of Health Careers/Education and Special Services for Students. The program is also a partnership with the Science Museum of Virginia's Outreach Department and receives funding support from the Howard Hughes Medical Institute. The four-week program consist of hands-on workshops, field trips, daily mathematics and reading tutorials, swimming, art and other activities focused on science and health. The program will be offered again in the summer of 2009.

RCPS students in grades 6-8 have participated in the National Science Foundation (NSF)-Advanced Technological Education Program/J. Sargeant Reynolds Community College (JSRCC) "Pathways to Teaching" middle school camp since 2006. The program was funded by a NSF grant and is now sponsored by JSRCC. This summer enrichment program consists of three classes that provide students with information on teaching careers in mathematics, science and technology education. The curriculum is participatory and allows students to experience learning about careers through an applied approach.

In addition to STEM-related programs, all ninth-grade RCPS students participate in a year-long freshman seminar course. This Johns Hopkins University course is focused on equipping entering freshmen with multiple tools for success and achievement in high school. The curriculum stresses social skills, human relations, team building and cooperative learning. The Holland Inventory Six Personality/Career Types is also administered.

The success of these programs has created an eligible pool of potential Academy students. Many are prepared for the challenges of rigorous studies and others are motivated and have a keen interest in pursuing STEM-related careers. Parents of these students also have an expectation that the investment of student time and energy in these extracurricular activities will distinguish and prepare them for opportunities in higher education and high-wage employment. All of these opportunities for students help establish a strong foundation on which to develop the Governor's Career and Technical Academy for STEM in Richmond. Appendix B provides a timeline for activities that support the Academy.

Partner Capacity

Throughout the years, Richmond City Public Schools (RCPS), J. Sargeant Reynolds Community College (JSRCC), Virginia Commonwealth University (VCU), Virginia State University (VSU), the Science Museum of Virginia (SMV) and the MathScience Innovation Center (MSIC) have collaborated in distinct and significant ways. These collaborations have included the development of student science and mathematics projects, course development, and professional development for teachers.

Both VSU and RCPS are charged with public missions to provide access, serve and educate a general population of students who choose to enter their institutions. This public mission includes a RCPS commitment "to move from competence to excellence" and VSU's mission to "elevate our standing within the Commonwealth of Virginia and the nation, in our effort to ensure the quality education all citizens deserve and seek."

VSU's School of Engineering, Science and Technology is committed to providing a dynamic and stimulating learning environment where a combination of classroom instruction and laboratory work prepares students for the global nature of the engineering, science and mathematics professions. The School houses undergraduate programs in:

- Computer Engineering;
- Manufacturing Engineering;
- Electronics Engineering;
- Mechanical Engineering; and
- Industrial and Logistical Engineering.

These programs educate students to become professionals able to adapt to societal change, to communicate effectively and to be highly trainable. Students benefit from a curriculum that features in-depth major courses and substantial training in mathematics, physical sciences, social sciences and the humanities.

VSU will serve as an Academy partner by providing engineering and technology professional development for teachers. VSU will also sponsor school year and summer programs for students. Plans are underway to offer Engineering and Technology academy students a two-credit course in the VSU Engineering Technology program.

Another partner, Richmond Area Program for Minorities in Engineering (RAPME) is a local nonprofit organization, officially incorporated in July 1978, with ten industry sponsors and

a goal to achieve greater diversity in science and engineering. RAPME was formed to encourage minority middle and high school students to consider science and engineering as a profession. This mission aligned with the national effort to alleviate the underrepresentation of minorities in all engineering professions. RAPME is an exemplary program of collaborative efforts that brings together three partner institutions: Virginia State University, Virginia Commonwealth University, and J. Sargeant Reynolds Community College. They share the passion, experience, and knowledge to set strategic directions to establish, sustain, and improve the RAPME feeder system across the science and engineering disciplines. RAPME will reserve fifteen openings in its summer institute for eligible Academy Engineering and Technology pathway students in grades 8-12.

The MathScience Innovation Center is a forty-two-year-old nonprofit organization dedicated to futuristic mathematics and science education for K-12 teachers and students. Formed in 1966 as the Mathematics and Science Center, the organization was recently renamed as part of its expanded leadership role, including trend analysis, professional development of educators, innovative student programs and advocacy of futuristic programs. Its *2015 Vision* focuses on implementing new programs in engineering, fractal geometry, nanotechnology, environmental modeling and distance learning. According to Dr. Julia Cothron, Executive Director of the MathScience Innovation Center, “There is a global talent war; for the United States to compete, engineering must be further incorporated into the sciences.”

The MathScience Innovation Center will work as an Academy partner to provide professional development for teachers and hands-on activities for students. Plans are underway to develop a three-day workshop on vertical team teaching and a two-week summer camp experience for students.

The Science Museum of Virginia (SMV) is a long-standing partner and training provider for RCPS. The Museum is a premier center for hands-on science education and is a one-stop resource center for K-12 science teachers, designed to enrich the quality of science education. The RCPS-SMV partnership has initiated a variety of programs supporting teachers, students and their parents. Extensive professional development for teachers has helped to increase student achievement. The partnership’s Standards of Learning (SOL) Enrichment program began as a program specifically created to address the needs of students and elementary school teachers in RCPS.

SMV's programs, hands-on activities, laboratories, teacher resources, and summer camp experiences will be infused into the Academy's summer and school year program. The SMV will collaborate with the VCU School of Education to provide workshops in Therapeutic Exercise and Engineering for Alternative Energy for core academic teachers and Academy instructors.

The VCU School of Engineering and the Department of Health and Human Performance (HHP) share a commitment to admitting more Richmond area students into their programs. Pre-Academy and Academy students in the Therapeutic Services Pathway will participate in a variety of VCU Health Careers pipeline programs. The primary goal of these programs is to offer minority and disadvantaged students assistance in planning careers in health care throughout their middle, high school, undergraduate and professional years. Students will also visit the Department's Exercise Physiology Laboratory and the Sports Medicine Research Laboratory.

The VCU Department of Health and Human Performance will also provide job-shadowing opportunities for Therapeutic Services Pathway students. All pathway students will have the opportunity to shadow VCU sports trainers. These trainers are contracted by RCPS to provide athletic services for RCPS sports teams at five high schools. During these experiences, students will learn how to care for and help athletes prevent injuries that occur during practices and competitions. Students will also have the opportunity to shadow VCU sports trainers during VCU athletic events.

The VCU Engineering Department will provide activities during the academic year for students in grades 8-12 including a full-day information workshop with sessions on completing college applications, interview skills, etc. Also provided are workshops offered by the National Society of Black Engineers (NSBE) and VCU engineering alumni. They will also sponsor a recognition ceremony for the Academy's Engineering and Technology students upon completion of the twelfth grade.

Academy partners, U-Turn Sports Performance Academy, Timmons Group, Jacqueline Johnson-Curl, D.D.S., Black Data Processing Associates, Quastar, LLC, ECPI College of Technology, and Ronald A. Williams, LTD, will participate in career fairs, provide job-shadowing experiences and offer tours of their facilities for students.

These partners have been consulted during the planning stages of the Academy and will also serve as members of the Advisory Board. See Appendix C for a listing of Planning Committee Members and Appendix D for a listing of Advisory Board Members and the Memoranda of Agreement.

Articulation Agreements

In 2007, the Academy Planning Committee began developing activities in collaboration with the Richmond Technical Center's (RTC) principal, career coordinator, teachers of engineering and health-related courses, and grants management staff. This initial committee expanded to include sports medicine staff from VCU, a physical therapist and owner of a physical therapy business, a representative of the RTC/CTE Advisory Council, an engineer and owner of an engineering firm, RCPS director of instruction, and RCPS instructional specialists for science, mathematics, technology/trade and industry education, health/medical science, marketing education, health and physical education, history, career and technical education and guidance.

Initial commitment forms, entitled "Memorandum of Agreement", "Partner Identification Form" and "Planning Committee Agreement", have all been re-titled as the development of the Academy has continued. Ultimately, all persons have committed to sharing their knowledge, skills and talents for the development of the Academy by participating in planning meetings with the entire group or in smaller subsets.

RCPS has long-term partnerships with local colleges and universities, including Virginia Commonwealth University (VCU), Virginia State University (VSU), Old Dominion University (ODU), and J. Sargeant Reynolds Community College (JSRCC). RCPS teachers have engaged in professional development and students have participated in school, summer and Saturday programs in these partnerships.

Students have taken dual enrollment courses at JSRCC as agreed upon in articulation agreements since 1997. See Appendix E for the current contract. Deans from the School of Mathematics and Science and School of Nursing and Allied Health are members of the Academy's Advisory Board.

Numerous planning consultations for the development of the Academy have occurred with representatives from higher education. Dr. John Ritz, Old Dominion University, has

provided considerable information and training regarding Project Lead the Way for Engineering and Technology pathway teachers.

The planning committee met at VSU with faculty from the School of Engineering. Dr. Keith Williamson, Associate Professor, and Chair, Engineering and Technology, brought staff to RTC to help plan for the Academy. Dr. Williamson pledged to provide professional development for Academy teachers, campus tours for students, and summer enrichment opportunities for students in the RAPME Program, under the direction of Dr. Gymama Slaughter. An initial meeting with Dr. Acevedo, Professor and Chair, Health and Human Performance at VCU, was extremely helpful in defining the scope of the Therapeutic Services pathway. He also pledged the involvement of Alan Freedman, Director of Clinical Experiences for the Athletic Training Education Program, Department of Exercise Science. Mr. Freedman has agreed to provide professional development for teaching staff, job-shadowing experiences with athletic trainers for Academy students and continued involvement as a planning committee and advisory board member.

Valuable input from Kevin Harris, Director, VCU Diversity Access Programs, Health Careers/Education and Special Services for Students, has strengthened the program development of the Academy's Therapeutic Services pathway. Mr. Harris and his staff have pledged their support in the implementation of the Academy, specifically the Therapeutic Services pathway. The focus of the Diversity Access Program is to encourage minority student participation in health careers through an array of enrichment programs and services. Mr. Harris has pledged support of this pipeline of programs to enhance Academy activities and to provide RCPS students with exposure to health careers as early as fourth grade.

Richmond Technical Center principal, career coordinator, faculty, and the instructional specialist for dual enrollment met with JSRCC staff to confirm approved dual enrollment courses and Academy teacher qualifications. JSRCC staff included: Dr. Robert Heinz, Interim Dean of Engineering and Manufacturing; Joel Adler, Interim Dean of Allied Health; and Tracey Banks, Coordinator of Dual Enrollment. RCPS staff included: Nelson Colbert, RCPS Coordinator, Dual Enrollment; Erlene Carter-Dabney, RTC Guidance Counselor; and Mauricee Holmes, RTC Principal.

Dr. Oris Griffin, Associate Professor, Office of Special Assistant to the President, James Madison University, led an enrichment program to help encourage and prepare RCPS students

for postsecondary education. Dr. Griffin has pledged her involvement and assistance in developing and providing professional development for Academy teachers and campus tours for Academy students.

Numerous businesses have expressed interest in future involvement in the Academy and will be consulted and included in the Academy's implementation. For example, Brandon Ream, Director of Physical Therapy and co-owner of Virginia Sports Medicine and Physical Therapy, has served as a consultant and provided valuable insight in planning the Academy. Mr. Ream has pledged job-shadowing experiences for students and teachers. Melvin Flemming, Jr., Project Designer, Timmons Group, Inc., has also been a valuable asset as consultant in the planning and development of the Academy.

Mr. Raymond Cousins, RTC/CTE Advisory Chairman and Work force Development Consultant has been an active and committed member of the Academy's Planning Committee. The RTC/CTE Advisory Council has agreed to pay the student scholarship fee for Academy students' participation in the RAPME Summer Enrichment Program. Jim Donahue, Account Executive, Public Sector, K-12, Virginia Building Efficiency for Johnson Control, has been a valuable contributor to the development of the Academy. Johnson Control, an engineering company in close proximity to RTC, has agreed to provide student mentoring and internships, job shadowing for students and teachers in its simulation lab, and workshops for staff and students. Dr. Laurie Keating, Vice-President of Technology Research and Planning for the Center for Educational Learning Technology (CELT) Corporation, has agreed to provide guidance to the RCPS Information Technology Department for the installation of software and hardware for the Academy.

All partners have agreed to serve as presenters for career fairs, mock job interviews, presentations and role models for students. All members of the Academy planning committee, RTC/ CTE Advisory Council, CTE Advisory Board, and Academy advisory board have agreed to serve as full partners in the development and implementation of the Academy.

Parent, Student, and Community Involvement

The Academy will actively seek parent and community involvement. Research conducted, compiled and presented by two of the nation's foremost authors on parent

involvement shows that students with involved parents, no matter what their income or background are more likely to:

- Earn higher grades and test scores, and enroll in higher-level programs;
- Be promoted, pass their classes and earn credits;
- Attend school regularly;
- Have better social skills, show improved behavior and adapt well to school; and
- Graduate and go on to postsecondary education.

(*A New Wave of Evidence: The Impact of School, Family, and Community Connections on Student Achievement*, by Anne T. Henderson and Karen L. Mapp; Austin, TX: Southwest Educational Development Laboratory, 2002)

The community also plays a distinct role in providing support for both parents and students. The RCPS Office of School Community Partnerships has been created to develop, promote and assist in the coordination of collaborative efforts between schools and the business, faith and civic communities. This is an effort to create and foster relationships beneficial to RCPS and to the community at large. These partnerships help students connect with a larger world outside of their community. Students benefit from the care and enthusiasm resulting from healthy interactions of volunteers from other cultures, races, and income groups. Students are able to benefit from the support and resources of adults other than their parents, teachers and principals. This type of positive interaction nurtures positive self-esteem and combats negative, anti-social behavior.

RCPS will recruit parent and community involvement for the Academy through a variety of forums presenting information on the purpose and goals of the Academy, career options and the required academic preparation for each pathway. Information will be provided to dispel myths and biases towards pathway occupations, encouraging the participation and enrollment of females and other minorities.

Beginning in middle school, students will develop Academic and Career Plans to ensure that course selections are aligned with their academic and career goals after the Academy. Planning will include input and review from parents.

Tours of the RTC facility along with classroom observations and demonstrations will be provided to the community to recruit partnerships and to promote the Academy pathways. The Academy and its two pathways will be showcased at Career Fair presentations to the community

and business professionals. Brochures will be developed and provided at presentations to RCPS PTA/PTO meetings. Conversations have been initiated with a business partner for the development of a pro bono marketing plan that will disseminate information about the Academy.

Presentations and training for RCPS middle school counselors and teachers will be held to increase the quality of information presented during counseling sessions to educate students and parents.

Program Description

The Governor's Career and Technical Academy for STEM in Richmond will offer RCPS students a rigorous academic and technical program of study in two career pathways (Engineering and Technology and Therapeutic Services). Courses will emphasize in-depth understanding, connect new ideas to prior knowledge, encourage exploration, and help students construct meaning from course content. A plan of study for each pathway is included in Appendix F. Each plan of study shows the level of academic rigor required for program completion. This includes meeting the requirements of the Commonwealth Scholars Course of Study, the Standard Technical Diploma and the Advanced Technical Diploma.

The pathways are a combination of academic and technical study that will integrate classroom and real-world learning. Middle, high school and summer program components will employ hands-on, project-based instruction. Academy coursework, teacher professional development, academic support, career and college development activities, along with parent and community involvement will create a STEM community of learners.

The Project Lead the Way (PLTW) curriculum will be integrated into the Academy's Engineering and Technology pathway program of studies. PLTW is modeled after introductory engineering courses taught at the university level. The Therapeutic Services pathway will provide instruction that will focus on emergency medical services and an introduction to sports medicine. Additional health-related pathways will be considered for development and expansion of the Academy.

The Academy will prepare students for a full range of postsecondary opportunities, formal employment training, apprenticeships, the military and high-skill, high-wage, high-demand employment.

Summer enrichment activities and mathematics classes will provide students with the information, instruction and support needed to help them to realize their full potential and achieve at a high level.

A program component, “Camp Confidence” has been designed to help students to develop problem-solving and decision-making skills. These skills will be addressed in interactive seminars convened twice per month during the school year. Parents will also be expected to attend a minimum of four sessions. In addition to these seminars, activities will be offered that will support the learning and development of students outside of the classroom. (Appendix G)

Students pursuing the Engineering and Technology pathway will need a strong background in mathematics. RCPS offers a mathematics summer school program. These summer courses will be presented to Academy students and parents in academic advisement sessions as options to support the achievement of academic and career goals. Four courses are designed for rising sixth-, seventh- and eighth-graders. The courses will serve as acceleration for some students and an intervention/remediation for other students at risk of failing the SOL exams.

Goal Statement

There is compelling evidence suggesting that by the fifth grade, students have developed the conceptual framework necessary to understand vocational preparation requirements and that by the sixth or seventh grade, students may have already begun adjusting both their aspirations and their expectations downward. (“Children’s Perceptions of Vocational Preparation Requirements”, Anne E. Blackhurst, Richard W. Auger and Kay Herting-Wahl ASCA Professional School Counseling, 2003)

The Academy and its partners are committed to developing a program that will support and engage students in a variety of middle school and summer experiences designed to help them to achieve in a rigorous high school component.

The Academy goal is to raise student aspirations and attract more students to postsecondary education in preparation for technical careers, especially targeting students who might otherwise have settled for a curriculum that did not prepare them well for postsecondary education or work.

Therapeutic Services Pathway

The Therapeutic Services pathway will provide students the opportunity to understand the relationship of their studies of the complexities of life science and biology to careers in the health care industry. The academic program, along with hands-on activities, interaction with mentors, and job shadowing, will provide students with projects designed to increase their critical thinking skills, and abilities to observe and discover. Students will learn how to collect and assess data, make interpretations and communicate their findings.

Students will visit the VCU Exercise Physiology Laboratory and Sports Medicine Research Laboratory providing opportunities to make connections between studies and real-life work experiences.

Collaboration with the VCU Center on Health Disparities will provide programming from its *Pipeline to the Health Careers Program* to address the needs of middle school, minority and disadvantaged students. Approximately 80 percent of the RCPS school population receives free or reduced lunches (a commonly used indicator of poverty). The ethnic breakdown of RCPS students is: African American: 21,408, Asian: 178; Hawaiian: 2; Hispanic: 884; Native American: 13; White: 1,730; Unspecified: 11; Total: 24,226 (January 2009)

The VCU Department of Health and Human Performance will provide job-shadowing opportunities for Therapeutic Services pathway students. Fifteen students will shadow VCU sports trainers who are contracted by RCPS to provide athletic services for RCPS sports teams at five high schools. During these experiences students will learn how to care for and help athletes prevent injuries that occur during practices and competitions. In addition, students will have the opportunity to shadow VCU sports trainers during VCU athletic events.

Students can take up to four JSRCC dual enrollment courses for a total of thirteen credits along with the following license and certifications in the Therapeutic Services pathway:

<u>Certification, Licensure, Assessment</u>

Medical Terminology

- VA Workplace Readiness Assessment (NOCTI)
- IC3 Certification (Certiport)

Emergency Medical Technician I, II and III

- VA Workplace Readiness Assessment (NOCTI)
- IC3 Certification (Certiport)

- EMS First Responder Certification (VDHOEM)
- Emergency Medical Technician (VDHOEM)
- Cardiopulmonary Resuscitation (CPR)

Completion of Academy courses will enable students to pursue associate degree programs at J. Sargeant Reynolds Community College and undergraduate studies in Health and Human Performance Program (Exercise Science) at Virginia Commonwealth University.

Middle School Component

The Therapeutic Services pathway middle school component is designed as a pre-Academy experience for students; courses are not required for Academy admissions. The following three courses will be offered to rising sixth-, seventh- and eighth-grade students during the academic year at their middle schools.

Sixth grade:

- **Family and Consumer Sciences Exploratory (VDOE 8208)** This eighteen-week course provides a foundation for managing individual, family, career, and community roles and responsibilities. In FACS Exploratory I, students focus on areas of individual growth such as personal goal achievement, responsibilities within the family, and accountability for personal safety and health. They also explore and practice financial management, clothing maintenance, food preparation, positive and caring relationships with others, and self-assessment as related to career exploration. Students apply problem-solving and leadership skills as they progress through the course. Mathematics, science, English, social sciences, fine arts, and technology are integrated throughout the course.

Seventh grade:

- **Keyboarding (VDOE 6150)** This eighteen-week course is designed for middle school students to develop and enhance touch skills for entering alphabetic, numeric, and symbol information on a keyboard. Students compose and produce personal, educational, and professional documents.
- **Make it Your Business (VDOE 6111).** This eighteen-week course is design, establish, and operate a small group or class business, producing a service or product that meets an identified school or community need. Emphasis is placed on the introduction and application of business terminology, basic entrepreneurship concepts, and fundamental

business principles. Basic academic skills (mathematics, science, English, and history/social science) are integrated into this course.

Eighth grade:

- **Computer applications (VDOE 6617)** This eighteen-week course is designed for students to develop or review correct keyboarding techniques and gain a basic knowledge of word processing, spreadsheet, database, graphics, and telecommunications applications. Students demonstrate an understanding of computer concepts through application of knowledge. Students learn to use software packages and local and worldwide network communications systems.

- **Career Investigations I (VDOE 9070)** Phase I career program that prepares students to be "career investigators." To obtain the title, students must assess their roles in society, identify their roles as workers, analyze their personal assets, complete a basic exploration of career clusters and select career fields or occupations for further study, and secure a career investigator (job shadowing) position with a local employer.

All middle school students will have an opportunity to select the career and technical education courses to enhance their interest in health and sciences careers. Through each middle school CTE course, students and parents will be able preview the Therapeutic Services pathway for high school.

Summer School Component

Middle school students interested in the Therapeutic Services pathway will be offered a wide range of summer, pre- Academy experiences that will provide exposure to health care careers and professionals. VCU's Summer Enrichment Day Camp will provide students (grades six and seven) with hands-on exposure to the health field including medicine, dentistry, occupational therapy, pharmacy, life sciences and healthy lifestyles.

VCU's Medical Center JR (MCJR) Project Health Careers Early Learning Program will provide interactive workshops for eighth grade students and their parents. These ninety-minute workshops will address topics such as: academic preparation, financial aid planning, community service, and goal setting.

Plans are underway to develop a two- week camp experience for students that will be conducted by the MathScience Innovation Center. The camp will be modeled after Powhatan County Public School's first ever engineering camp. The camp will target rising ninth and tenth graders. The program will consist of daily design challenges, field trips to construction sites and engineering companies, team building activities, problem-solving activities, and guest speakers from NASA. Students will attend the program from Monday to Thursday, 9 a.m.-1 p.m. Field trips will be held each Friday.

Students will also benefit from a variety of field trips to area hospitals, fire stations, airport, and YMCA.

High School Component

JSRCC dual enrollment courses will be offered to students and taught at the Academy located on the Richmond Technical Center campus.

Therapeutic Services Pathway Curriculum Design (All courses required for graduation from Academy pathway except keyboarding)
Keyboarding Applications (VDOE 6152)
Medical Terminology (VDOE 8383)
Medical Terminology HLT 143 (3 Credits)
Introduction to Health and Medical Sciences (VDOE 7555)
Medical Terminology HLT 144
Human Anatomy and Physiology (VDOE 4330)
Nutrition and Wellness (VDOE 5147)
Emergency Medical Technician I (VDOE 8333)

Therapeutic Services Pathway **Curriculum Design** (continued)
Emergency Medical Technician EMS 111 (6 credits)
Emergency Medical Technician II (VDOE 8334)
Emergency Medical Technician EMS 120 (1 credit)
Emergency Medical Technician III (VDOE 8335)
Sports Medicine I (VDOE 7660)
Sports Medicine II (VDOE 7662)

Course Descriptions

Course descriptions are as follows:

Medical Terminology (VDOE 8383) covers word building and term comprehension in a scientific manner for the accurate description of the human body.

Medical Terminology (HLT 143 and 144) provides an understanding of medical abbreviations and terms includes the study of prefixes, suffixes, word stems, and technical terms with emphasis on proper spelling, pronunciation, and usage. Emphasizes more complex skills and techniques in understanding medical terminology.

Introduction to Health and Medical Sciences (VDOE 7555) is an introductory course designed for potential Certified Nursing Assistant (CNA) students. This course introduces students to a variety of health care careers and develops basic skills required in all health and medical sciences. It is designed to help students understand the key elements of our health care system and examine and match one's skills with nursing careers.

Human Anatomy and Physiology (VDOE 4330) provides an explanation of the chemical and physical phenomena underlying the structure and function of systems of the human body. Identifies, explains functions of chemical networking of the various body parts in relation to the total system. In addition, this course provides detailed explanations of the functions of the human

body not covered in biology and develops basic knowledge of physiology as represented by the latest advances.

Nutrition and Wellness (VDOE 5147) Students focus on making choices that promote wellness and good health; analyzing relationships between psychological and social needs and food choices; choosing foods that promote wellness, obtaining and storing food for self and family; preparing and serving nutritious meals and snacks; selecting and using equipment for food preparation; and identifying strategies to promote optimal nutrition and wellness in society. Teachers reinforce the basic skills of mathematics, science, and communication, throughout the content.

Emergency Medical Technician I, II and III (VDOE 8333, 8334 and 8335) Students will focus on the role and responsibilities of emergency rescue workers, basic medical terminology, and health care skills that include first aid, cardiopulmonary resuscitation; aseptic technique, and related anatomy and physiology and disease knowledge. Instruction also emphasizes proper care and use of common emergency equipment and safe methods for lifting moving and transporting injured persons. Supervised, on-the-job and patient care experiences are part of the instructional program.

Emergency Medical Technician (EMS 111 and EMS 120) are courses needed to prepare students for certification as a Virginia and/or National Registry EMT-Basic. Includes aspects of pre-hospital basic life support as defined by the Virginia Office of EMS curriculum for Emergency Medicine Technician Basic Lecture and Laboratory and is a component of the JSRCC Emergency Medical Services-Paramedic Associate of Applied Science degree program.

Sports Medicine I and II (VDOE7660, 7662) is designed to provide students with a strong foundation in the field of sports medicine/athletic training. Students will develop skills in assessment, care, and evaluation of an athlete's injury or illness; advise athletes on the proper use of equipment; plan and implement comprehensive athletic injury and illness preventative programs; and develop training programs and routines designed to improve athletic performance.

In addition to coursework, students will visit the VCU Exercise Physiology Laboratory and Sports Medicine Research Laboratory. The Exercise Physiology Laboratory contains equipment related to both applied physiology and biochemistry applications. It is a 1,400 sq. ft. human performance laboratory, 200 sq. ft. biochemistry and blood preparation laboratory, 800 sq. ft. body composition laboratory, a 2,000 sq. ft. exercise room, and three 120 sq. ft. office spaces. The

laboratory contains equipment related to both applied physiology and biochemistry applications.

Students will also visit the VCU Sports Medicine Research Laboratory (SMATR) for exposure to research opportunities for all levels of students ranging from secondary to doctoral studies. The laboratory is a 1,400 sq. ft. facility with an additional 200 sq. ft. of quiet space for testing. The general focus of the SMATR laboratory is lower extremity injury with emphases on anatomical, biomechanical, and factors contributing to injury. Current research activities are focused on factors contributing to functional ankle instability. The lab is accessible year-round, and includes state of the art instrumentation for assessment of human neuromuscular performance, joint laxity, and postural stability.

High School Summer Programs

The high school summer component consists of the following programs:

- Youth Health Services Corps – The program provides leadership training and placement for students in community service agencies providing heath care to vulnerable, underserved populations.
- VCU Medical Center Junior Volunteers – Junior volunteers assist staff, patients, and their families during one or two summer sessions in July or August. This program gives students an insider's view of careers in health care.
- Camp Confidence – summer leadership program that exposes students to the Virginia Workplace Readiness Skills.

Engineering and Technology Pathway

The hallmark of the Academy's Engineering and Technology pathway program is a curriculum that is designed to make mathematics and science relevant. Students will learn how to become productive members of teams and also how to communicate effectively.

The Project Lead the Way (PLTW) curriculum will be integrated into the Academy's Engineering and Technology pathway program of studies. PLTW is modeled after introductory engineering courses taught at the university level. By engaging in hands-on, real-world projects, students will learn how the skills they are learning in the classroom can be applied in everyday life. This approach used by PLTW is known as activities-based, project-based and problem-based (APPB) instruction. Students also learn how to define problems, set timelines, become leaders,

team members and problem solvers.

Instructors will teach students the key elements and skills of engineering and technology-based careers by immersing them in rigorous engineering problems. The pathway course of study is an activity-oriented curriculum designed as explorations and inquiries in mathematics, science, and technology. Principles and concepts are taught that will focus on showing, not telling students how to use engineering skills to solve everyday problems.

Students will have the opportunity to take five JSRCC dual enrollment courses totaling fourteen credits and earn the following certifications, licensure and assessments:

Certification, Licensure, Assessment

Principles of Engineering

- Pre-Engineering Assessment (NOCTI)
- VA Workplace Readiness Assessment and IC3 Certification (Certiport)

Introduction of Engineering Design

- Pre-Engineering Assessment (NOCTI)
- VA Workplace Readiness Assessment (NOCTI) IC3 Certification (Certiport)

Digital Electronics

- Pre-Engineering Assessment (NOCTI)
- VA Workplace Readiness Assessment (NOCTI) and IC3 Certification (Certiport)

Digital Visualization

- Pre-skill Assessment for Mastercam Certification (NOCTI)
- VA Workplace Readiness Assessment (NOCTI) and IC3 Certification
- AutoCAD Certifications (Brainbench)
- Autodesk Application Certification Program (Autodesk)
- Brainbench Web Design and Development Certification (Brainbench)
- Certified SolidWorks Professional (SolidWorks Corporation)

Engineering Drawing and Design

- Pre- Engineering Assessment (NOCTI)
- VA Workplace Readiness Assessment (NOCTI) and IC3 Certification
- AutoCAD Certification (Brainbench)
- Autodesk Application Certification Program (Autodesk)
- Brainbench Web Design and Development Certifications (Brainbench)

- Certified Solidworks Professional (SolidWorks Corporation)

Architectural Drawing and Design; Advanced Architectural Drawing and Design

- AutoCAD Certification (Brain Bench)
- Autodesk Application Certification Program (Autodesk)
- Brainbench Web Design and Development Certifications (Brainbench)
- Certified SolidWorks Professional (SolidWorks Corporation)
- Pre- Skills Assessment for Mastercam Certification (NOCTI)
- VA Workplace Readiness Assessment (NOCTI) and IC3 Certification (Certiport)

Middle School Component

The Engineering and Technology pathway middle school component is designed as a pre-Academy experience for students. Courses are not required for Academy admissions. The following two courses will be offered to rising sixth- and seventh-grade students during the academic year.

Sixth grade:

- **Introduction to Technology (VDOE 8483)** This nine-week course will introduce students to the basic elements of all technology, including processes, energy, information, and people. Students will explore up to four systems of technology, including construction, transportation, communication, and production/manufacturing. Students will relate the impact of technology on society, environment, and culture to future consequences and decisions.

Seventh grade:

- **Inventions and Innovations (RCPS 5431)** During this eighteen-week course, students will make models of significant inventions that have advanced society. After studying these developments, they will explore contemporary technological problems facing them, their community, or the world, and apply systematic procedures to invent new products or innovations as solutions.

Thirty eighth-grade students will have the opportunity to take Project Lead the Way "Gateway to Technology" courses. Currently, only two middle schools are contracted to offer the program. Future plans are to phase in one to two middle schools per year.

Gateway to Technology Project Lead The Way	
Design and Modeling	Students use geometry, problem solving, teamwork, and project management skills to design and develop product prototypes
The Magic of Electrons	Students are engaged in relevant, hands-on projects; students unravel the mysteries of digital circuitry
The Science of Technology	Students apply scientific principles and concepts of simple machines and energy to solve real world problems
Automation and Robotics	Students design and build automated systems, incorporate the principles of electrons, physics, robotics to gain an enriched understanding of the contemporary mechanical world

Students interested in pre-Academy experiences can also take the Technological Systems course. Technological Systems (VDOE 8463) is an eighteen-week course where students combine resources into systems, realizing technology as a system. By simulating systems and assessing their impacts, students gain insight into how to approach the problems and opportunities of a technological world in a broad sense. Students will also explore occupational areas and educational programs for technology-oriented careers.

Summer Component

Summer experiences are designed to be both rigorous and engaging. Mathematics is an integral part of engineering and is a required subject for those pursuing studies in the Engineering and Technologies pathway. The Summer Mathematics Program will provide a means of acceleration for some students and intervention/remediation for other students at risk of failing the SOL examinations.

Richmond City Public Schools Summer Mathematics Program

Course	Purpose
Advanced Mathematics I **(Grade 6)**	The course provides an avenue for single or double acceleration for students who achieve a qualifying score on the ARDT, receive teacher recommendations, have an average mathematics grade of 'B,' successfully complete the Advanced Mathematics Summer Program and receive a qualifying score. These students will be taught the curriculum for one to two grade levels above their current grade level. Students will also take the appropriate Virginia Standards of Learning exam for the curriculum received, resulting in students completing either Algebra I or geometry in eighth grade.
Advanced Mathematics II (Grade 7)	The course provides an avenue for single or double acceleration for students who achieve a qualifying score on the ARDT, receive teacher recommendations, have an average mathematics grade of 'B,' successfully complete the Advanced Mathematics Summer Program and receive a qualifying score. These students will be taught the curriculum for one to two grade levels above their current grade level. Students will also take the appropriate Virginia Standards of Learning exam for the curriculum received, resulting in students completing either Algebra I or geometry in eighth grade.
Accelerated Mathematics – Grade 6	The course provides an avenue for students who are performing below grade level on a few Standards of Learning (SOL). The condensed, grade-level curriculum is correlated to the state standards. Every lesson uses manipulatives to guide students to discover mathematics concepts and engage in problem solving.
Algebra Readiness Summer (Grades 7 and 8)	The course prepares students for success in algebra. It is designed to provide mathematics intervention for students at-risk of failing the Standards of Learning test as demonstrated by their individual performance on the Algebra Readiness Diagnostic Test (ARDT).
Advanced Mathematics II **(Grade 8)**	The course provides an avenue for single or double acceleration for students who achieve a qualifying score on the ARDT, receive teacher recommendations, have an average mathematics grade of 'B,' successfully complete the Advanced Mathematics Summer Program and receive a qualifying score. These students will be taught the curriculum for one to two grade levels above their current grade level. Students will also take the appropriate Virginia Standards of Learning exam for the curriculum received, resulting in students completing either Algebra I or geometry in eighth grade.
Accelerated Mathematics – (Grade 7)	The course provides an avenue for students who are performing below grade level on a few Standards of Learning. The condensed, grade-level curriculum is correlated to the state standards. Every lesson uses manipulatives to guide students to discover mathematics concepts and engage in problem solving.

Engineering and Technology Pathway Program Summer Component		
Grade	**Project**	**Focus**
Eighth Grade (fifteen slots reserved for eligible Academy students)	RAPME Summer Institute	The Institute is a three- to five-week academic program whereby students will be provided with career information, options and requirements. Students will participate in engineering related classroom projects and visit local area engineering firms to view firsthand, the work of engineers. Seminars conducted by practicing engineers in various occupations will also be provided.
Eighth Grade	Virtual Worlds Summer Program	Teams of students will create their own virtual (three dimensional multiuser) worlds (computer graphic exhibits) using computer software. Students will receive support and guidance from undergraduate VCU students within the virtual universe. (Appendix H))

High School Component

All ninth-grade students are eligible for admission into the Academy. The PLTW program will be phased in so that it is available to students as they advance to the next grade level. Students will take two, ninety-minute classes every other day.

Engineering and Technology Pathway Program Curriculum Design
Course
(PLTW) Introduction to Engineering Design VDOE 8439
Digital Visualization VDOE 8459
Digital Visualization VDOE 8459
(PLTW) Principles of Engineering VDOE 8441
(PLTW) Principles of Engineering VDOE 8441
(PLTW) Digital Electronics VDOE 8440
(PLTW) Digital Electronics VDOE 8440
(PLTW) Introduction to Engineering Design VDOE 8439
Architectural Drawing and Design VDOE 8437
Computer Aided Drafting I DE/DRF 231
Advanced Architectural Drawing and Design VDOE 8492
Computer Aided Drafting II DE/DRF 232
Engineering Design and Development VDOE 8443 (PLTW)
Engineering Graphics DE/EGR 110
Introduction to Engineering Design DE/EGR 123
Introduction to Engineering and Engineering Methods DE/EGR 124

Course Descriptions

All of the following courses are required for Academy graduation from the Engineering and Technology Pathway:

Introduction to Engineering Design (VDOE 8439) uses a design development process while enriching skills; students create and analyze models using specialized computer software.

Digital Visualization (VDOE 8459) Students gain experiences related to computer animation by solving problems involving 3-D object manipulation, story boarding, texture mapping, lighting concepts and environmental geometry. They produce animations that include interdisciplinary projects related to science, engineering, and the entertainment industry. A major emphasis is placed on the production of a portfolio that showcases examples of student's original work.

Principles of Engineering (VDOE 8441) explores technology systems and manufacturing processes, addressing the social and political consequences of technological change.

Digital Electronics (VDOE 8440) teaches applied logic through work with electronic circuitry; which students also construct actual applications and test for functionality.

Architectural Drawing and Design (VDOE 8437) teaches students principles of architecture and increases their understanding of working drawings and construction techniques. Students use computer-aided drawings and design (CADD) equipment and established standards or codes to prepare models for presentation.

Engineering Design and Development (VDOE 8443) consists of small teams of students spending the year solving a problem of their own choosing. The teams apply principles developed in the four preceding foundation courses. Students employ skills and knowledge to brainstorm possibilities, research current patents and regulations, construct a working model, test the model in real-life situations (or simulation); document their designs, and present and defend the design to a panel of experts comprised of Academy Partners and Advisory Board members.

Engineering Graphics (DE/EGR 110) (3 credits) presents theories and principles of orthographic projection. Studies multiview, pictorial drawings and sketches, geometric construction, sectioning, lettering, tolerancing, dimensioning, and auxiliary projections. Studies the analysis and graphic presentation of space relationships of fundamental geometric elements, points, lines, planes and solids; includes instruction in computer-aided drafting.

Introduction to Engineering Design (DE/EGR 123) (2 credits) introduces the fundamental knowledge and experience needed to understand the engineering design process through the

basics of electrical, computer, and mechanical systems. Includes the completion of a project in which a specific electromechanical robot kit will be analyzed, assembled, and operated. Students will present project results orally and in writing.

Introduction to Engineering and Engineering Methods (DE/EGR 124) (3 credits) introduces the engineering profession, professionalism, and ethics; covers problem presentation, engineering calculations, digital computer applications, word processing, worksheets, programming in FORTRAN or C++ and elementary numerical methods.

Computer Aided Drafting I (DE/DRF 231) (3 credits) teaches computer-aided drafting concepts and equipment. Develops a general understanding of components and operating a typical CAD system. Lecture and laboratories.

Computer Aided Drafting II (DE/DRF 232) (3 credits) teaches advanced operation in computer-aided drafting. Lecture and laboratories are included.

Academic Year Activities

The VCU Engineering Department will conduct the following academic year, extracurricular activities for Engineering and Technology pathway students:

The VCU Engineering Department Partnership Activities	
Activity	**Format**
Introduction to Engineering and Chemical Engineering	Two hands-on activities to be held during the fall semester for eighth-grade students (1/2 days)
Computer Science and Biomedical Engineering	Two hands-on activities for ninth-grade students (1/2 days)
Electrical Engineering (Circuits Lab) and Computer Engineering (Clean Room)	Two hands-on activities for tenth-grade students (1/2 days)
VCU Tour and a VCU Engineering Information Session	A full day session for eleventh-grade students
The VCU Engineering Department Partnership Activities	
Activity	**Format**
Mechanical Engineering	Half day, a hands-on activity for twelfth-grade

	students
The VCU Engineering Expo (Senior VCU students display their Senior Design projects which range from robotics to the redesign of roller coaster seats to blimps)	Academy students will be invited to attend. Held annually in April
Résumé writing, interview skills, and scholarship application preparation workshop	Session conducted for twelfth-grade students by the National Society of Black Engineers (NSBE) and VCU Engineering alumni
Recognition ceremony	Academy graduates, parents, partners, faculty and staff will attend.

Academy Completion Requirements

Academy completion will be determined by the following criteria:

- Commonwealth Scholars requirements;
- Advanced Studies Diploma, Technical or Advanced Technical Diploma;
- A minimum of fourteen transferable dual enrollment credit for Engineering and Technology Pathway students;
- A minimum of ten transferable dual enrollment credits for Therapeutic Services Pathway students;
- One or more CTE credentials approved by the Virginia Department of Education; and
- Successfully pass the Virginia's Workplace Readiness Skills Assessment.

Work-based Experiences

The VCU Department of Health and Human Performance will provide job shadowing for Therapeutic Services pathway students. All students will shadow VCU sports trainers who are contracted by RCPS to provide athletic services for RCPS sports teams at five high schools. During these experiences, students will learn how to help athletes prevent injuries that occur during practices and competitions. In addition, students will have the opportunity to shadow VCU sports trainers during VCU athletic events.

Therapeutic Services pathway students will also participate in the following career development experiences:

- VCU Volunteers Youth Health Services Corp will provide students with leadership training and placement for students in community service agencies providing health care to vulnerable, underserved populations; and
- VCU ACEe will provide students with clinical experiences and first-hand knowledge about medical careers.

Engineering and Technology pathway students will participate in the Richmond Area Program for Minorities in Engineering (RAPME) Summer Institute. RAPME will provide students with opportunities to engage in engineering related classroom projects and visit local area engineering firms. Students will participate in job shadowing at Academy partner firms Ronald Williams, LTD, and the Timmons Group. Seminars conducted by practicing engineers in various occupations will also be provided.

Career and College Development Activities

RCPS sixth-grade students will work closely with their school counselors to develop student portfolios. Eighth-grade students interested in pursuing studies at the Academy will be required to work collaboratively with parents and guidance counselors to prepare an Academic and Career Plan outlining an intended course of study.

Career Cruising, an interactive, online career resource will be used by school counselors to help students move seamlessly through the career exploration and planning process. Students will use *Career Matchmaker* and *My Skills* as tools to provide feedback to understand how careers relate to their skills and interests. Students' Academic and Career Plans will be fully integrated with the *Career Cruising* guidance system. Students will be able to create a personalized four-year high school education plan and develop résumés. Comprehensive detailed information, including a national database of postsecondary schools will provide students, parents and counselors with information on admissions and expenses.

Completion of career interest inventories will be documented in student portfolios. Kuder's Assessment or Virginia Wizard, Explorer, PreACT, PSAT scores, SAT scores, and other tools that help identify skills, interests, aptitudes and academic abilities will also be included. Career interest inventories and their findings will be used to engage parents, students, teachers, and counselors in a collaborative career planning process.

Academic and Career Plans will be updated annually for counseling sessions with parents and students prior to course selection for the next school year. Students will be encouraged to review their plans twice a year.

An Academy Course Selection Guide will serve as a directory for parents and students. The guide will provide general information about the Academy, course offerings and graduation requirements. School counselors will use the guide to help students make decisions such as balancing Advanced Placement and dual enrollment courses.

Length of Program and Daily Schedule

The following chart depicts the schedule of Academy high school students on an odd and even schedule.

Odd Calendar Days:	
High School	
7:15 a.m.- 7:25 a.m.	Homeroom
7:25 a.m. - 8:50 a.m.	Block One-Core Subject (Period One)
8:55 a.m. - 10:25 a.m.	Block Two-Core Subject (Period Three)
RTC	
10:30 a.m. - 10:55 a.m.	Commute to RTC
11:05 a.m.	Student Arrival
11:10 a.m. - 2:10 p.m.	Therapeutic Services Pathway Course Or Engineering and Technology Pathway Course
Even Calendar Days	
High School	
7:15 a.m. - 7:25 a.m.	Homeroom
7:25 a.m.- 8:50 a.m.	Block One-Core Subject (Period Two)
8:55 a.m.- 10:25 a.m.	Block Two-Core Subject (Period Four)
10:30 a.m.- 10:55 a.m.	Commute to RTC
11:05 a.m.	Student Arrival
11:10 a.m.- 2:10 p.m.	Therapeutic Services Pathway Course Or Engineering and Technology Pathway Course

Number of Students and Grade Levels

The potential for enrollment in the Academy is 180 students in year four. Forty-five openings will be allocated for rising eighth-grade students during the first year, allowing for fifteen students in the Therapeutic Services pathway and thirty in the Engineering and Technology pathway. Each year the Academy will add an additional forty-five students.

Site Locations and Course Delivery

The Academy will be located in the RCPS Richmond Technical Center (RTC). It serves RCPS high school students during the day and adults in the evening (approximately 12 percent are from surrounding counties).

RTC is fully accredited and currently offers 42 Career and Technical Education (CTE) programs (69 courses) in five clusters: personal/business services; transportation and manufacturing; construction; technology and communication; and medical services. RTC also offers 13 dual enrollment courses, 14 honors courses, two diploma seals, and 86 credential opportunities.

Transportation

Students will be transported to and from the Richmond Technical Center to RCPS schools by RCPS school buses. Students will also be transported to any postsecondary site (JSRCC, VSU) to attend classes, field trips and summer programs and returned back to their schools. All trips will be approved by the students' parents and/or guardians. Transportation provided by the school division will be in compliance with all applicable federal and state regulations.

Student Recruitment, Selection Criteria, and Admissions

Students interested in the Academy will be offered a variety of summer experiences. The experiences are designed as a pipeline for the Academy and anyone can apply. Students will be recruited based upon their grades, motivation, interest, and teacher recommendations.

The following information and activities will be developed and targeted to all students, parents, teachers, and counselors at RCPS middle schools as follows:

1. PTA meeting presentations to include:

- An overview of the Academy;
- Forecast of the healthcare and engineering industries;
- Benefits of attending the Academy, dual enrollment credits, postsecondary education and a career and technical education; and
- Question and answer session.

2. School-based "Parent's Night" presentations to include:
   - An overview of the Academy;
   - Information concerning Academy requirements (admission, graduation); and
   - Benefits of the Academy - scholarships, postsecondary education, career and technical education, industry certifications, job outlook, and potential earnings.
3. Presentations to RCPS staff and faculty in elementary and secondary schools to include:
   - An overview of the Academy;
   - Course curriculum and delivery;
   - Forecast of the healthcare and engineering industries;
   - Benefits of attending an Academy, dual enrollment credit, college credit, postsecondary education and career and technical education; and
   - Question and answer session.
4. Counselor Institute workshops
   - Workshops held with all RCPS counselors to provide information concerning the Academy, admission requirements, curriculum and career pathways, career and technical education, diplomas, dual enrollment credits, industry certifications and assessments.

In year one, approximately forty-five students will be admitted into the Academy. Rising ninth graders will be invited to apply for admission into the Academy. The selection criteria are based on a scoring rubric. Completion of a student application is one of the requirements. A selection committee to include partners will review the data and interview the applicants. See Appendix I.

Students will be admitted to the Academy based on the selection criteria as defined. In addition, all eighth-grade students must pass the JSRCC placement test for dual enrollment. Students must also meet with middle or high school counselors to develop an individualized high

school plan. The meeting is designed to ensure that course selections are aligned with a student's transition and career goals beyond the Academy.

Performance Measures

The focus of the Governor's Career and Technical Academy for STEM in Richmond is to offer students a solid, rigorous education in science, technology, engineering, and mathematics along with the critical skills needed to succeed in a digital, global economy. Two career pathways will prepare students for a full range of postsecondary opportunities, formal employment training, apprenticeships, and the military. Each pathway has been designed to lead students to opportunities in high-skill, high-wage, and high-demand employment areas.

The Academy goal is to raise student aspirations and attract more students to postsecondary education in preparation for technical careers especially targeting students who might otherwise have settled for a curriculum that did not prepare them well for postsecondary education or work.

Accomplishment of this goal will require the Academy's leadership to continually improve the curriculum, school climate, instruction, parent and community relations, and staff professional development. Baseline data will be established along with a process for the collection of data.

The Academy will establish baseline data during the 2009-2010 school year on the following measures:

a. Improve academic achievement of Academy students by three percent;
b. Increase the number of Academy student completions of dual enrollment courses with a grade "C" or better by three percent;
c. Increase the number of relevant workplace readiness experiences for Academy students through strong partnerships with businesses by five percent;
d. Increase the number of students who graduate from high school through Academy participation by three percent;
e. Reduce the number of Academy student dropouts by three percent;
f. Increase enrollment and retention in postsecondary education by one percent;
g. Increase the proportion of Academy students completing a college and workplace ready curriculum in high school by three percent;
h. Reduce the proportion of Academy students requiring remediation in college by one percent;
i. Increase the number of industry certifications awarded to Academy students by two percent; and

j. Increase the number of Academy graduates employed in high-wage, high-demand and high-skill careers by three percent.

Internal Evaluation Process

Richmond City Public Schools' *Program Accountability, Review, Monitoring, and Evaluation* (PARME) Plan will be used for collecting, reviewing and analyzing data pertaining to the Academy's policies, procedures, program design, instructional delivery and outcomes for annual reporting to the Virginia Department of Education. Reporting will also include specific student outcomes such as academic and goal achievement.

There are three components to this plan: the program logic model, the comprehensive evaluation component, and the monitoring component. The program logic model provides ongoing opportunities for stakeholders (feedback from students, staff, parents, teachers, the community and partnership members) to collect, review, and analyze program data on a regular basis to understand how, why, and for whom the program works. This process will be a collaborative endeavor, one in which evaluators, program managers/staff, as well as other stakeholders work together to design and implement the evaluation. The monitoring component will address the need to provide decision makers with program-related data summaries on an ongoing basis. Data collected will be used for program improvement.

Specifically, collaborative evaluation teams will be formed to design and conduct a process evaluation of the implementation of the Academy. These teams will also implement and monitor participant progress on the Academy performance measures, design and conduct participant surveys, and collect, analyze, and report student course grades, attendance, and test scores.

Materials and Equipment

Materials, supplies, and equipment needed for instruction and to accomplish pathway program goals and objectives have been determined and are included in the budget and budget narrative.

Sustainability of Academy

Richmond City Public Schools, in establishing the Academy, is increasing the rigor of the existing pathways for engineering and Technology and Therapeutic Services which are currently supported though Carl Perkins funds. Richmond City Public Schools will continue to devote these funds to the expanded program in the Academy.

Administrative Procedures

The Governor's Career and Technical Academy for STEM in Richmond will maintain procedures that are developed cooperatively with participating partners and follow the provisions of the Governor's Exemplary Standards Award Program for Career and Technical Education. Appendices J and K provide statements of support and assurance, respectively.

Governor's Exemplary Standards Award Program for Career and Technical Education

The Governor's Career and Technical Academy for STEM in Richmond will follow the provisions of the *Administrative Procedures Guide for the Establishment of Governor's Career and Technical Academies.* Richmond City Public Schools and its Academy partners will ensure participation in the Governor's Exemplary Standards Award Program for Career and Technical Education.

Academy Coordination

A coordinator will be hired to oversee, manage and direct the daily operations of the Academy. The coordinator will be responsible for:

- Developing and maintaining strong partner relationships with the community;
- Convening Advisory Board meetings and providing support for their activities;
- Promotion of the Academy and its programs to all stakeholders and potential partners; and
- Coordination of the Academy activities, field trips, etc.

The coordinator will work closely with the RCPS Coordinator for Research and Evaluation for the collection, compilation and reporting of program assessment data. The coordinator will report directly to the principal of the Richmond Technical Center. Clerical support will be provided.

Code of Student Conduct and Attendance

All students in the Academy must adhere to the Code of Student Conduct as set forth by Richmond City Public Schools and the Richmond Technical Center. In addition, students attending dual enrollment courses must adhere to the code of conduct as set forth by the Virginia Community College System. Due to the rigor of the curriculum, it is extremely important that students attend all class sessions.

Staff Recruitment, Selection, and Assignment

Recruitment for the selection and assignment of Academy staff will be conducted to hire personnel with required certifications (where applicable) and who meet Virginia teacher licensure requirements and/or postsecondary faculty qualifications. All dual enrollment courses will be taught by teachers meeting the Virginia Community College System's academic qualifications.

Staff Development

Academy staff have primary responsibility for the vision and accomplishment of Academy goals. However, learning for all stakeholders will be necessary to develop the Academy to the desired state of a "community of learners". Five learning disciplines will be used as a model to achieve goals and to establish a culture of learning: (1) personal mastery, (2) mental models, (3) team learning, (4) shared vision, and (5) systems thinking. (Schools that Learn, Senge et al. 2000)

Cross disciplinary teams will be developed to research and develop a staff development model that will sustain and support collaborative approaches for providing instruction to achieve positive student outcomes.

Annual school orientations will be held throughout the division to present an overview of the Academy's goals and purposes and will serve as the foundation for specific trainings at the elementary, middle and high school level.

The MathScience Innovation Center will develop and conduct a workshop on vertical team teaching and two weeks of summer professional development for core academic teachers and Academy instructors in each pathway. Topics for the summer sessions include nanotechnology, which will address the interests of Therapeutic Services Pathway teachers. Nanotechnology is the result of innovations in microscopy that allow humans to visualize, manipulate, and create substances at the nanoscale. This four-pronged program will include attendance at a summer institute, creation of a model lesson, implementation of classroom lessons and an educational project. Anticipated outcomes of the training are the eventual integration of nanotechnology topics into the middle and high school mathematics and science courses.

The topic selected for a given summer session will address the interests of Engineering and Technology pathway teachers. This session is also a four-pronged program that will include attendance at a summer institute, creation of a model lesson, implementation of classroom lessons and an educational project. The program will provide information for teachers to learn how to work as a member of a team to implement innovative teacher and student programs and explore new fields in engineering along with ways to connect emerging knowledge to the curriculum.

The Science Museum of Virginia (SMV) will collaborate with the VCU School of Education to provide the following for core academic teachers and Academy instructors in each pathway:

- Therapeutic Exercise: The focus of the sessions will be to aquaint teachers with the proper use of therapeutic exercise in the treatment and rehabilitation of athletic injuries in physically active individuals (includes the use of therapeutic exercise in the treatment of groin, thigh, hip, knee, lower leg, ankle, foot, shoulder, elbow, wrist, hand, finger and back injuries in physically active individuals), and basic nutrition requirements. Sessions will be led by educators at the athletic training faculty through the VCU School of Education.
- Engineering for Alternative Energy: The sessions will be held at SMV where three alternative energy demonstration projects are located. Teachers will have the opportunity to see and test geothermal, wind, solar photovoltaic, and solar thermal systems functioning under operating conditions. These projects are designed as demonstrations of working alternative energy systems: the New Energy Virginia outdoor exhibit, (geothermal loop, wind turbine, photovoltaic array with grid connection), the Solar Decathlon House (with 500 ft. deep geothermal well, 8.6 KW photovoltaic array and award winning solar design), and the Energy Performance. A hands-on, problem solving introduction to alternative energy will be provided. Teachers will learn the applications, effectiveness and efficiency of emerging energy technologies and receive teaching materials appropriate for high school technology students. Sessions will be led by educators at the Science Museum of Virginia. Opportunities will be made available for mentored student projects during the summer or school year over the course of the program.

Among the requirements of the school division agreement with PLTW is that each teacher be provided with a laptop and software that meet PLTW specifications. Each teacher must agree to become PLTW certified within two years and commit to continuous improvement. RCPS will support these requirements,

A core training PLTW summer institute will provide a two week experience conducted by practicing classroom teachers and university faculty. Classroom instruction, partnered with independent assignments, is designed to prepare teachers to teach the PLTW curriculum. A PLTW conference for guidance counselors will also be provided.

Additional professional development activities will be developed during the Academy's implementation with James Madison University and the VCU Health and Human Performance Department.

Staff Evaluation

Staff will be evaluated according to the human resources policies of Richmond City Public Schools.

Documentation of insurance and other fiscal information

RCPS shall keep in full force student malpractice blanket liability insurance covering students in the amount of $2,000,000 per occurrence and $5,000,000 in the aggregate.

V. Budget Narrative

Governor's Career and Technical Academy for STEM in Richmond

Direct Costs:	
Personnel:	
Program Coordinator (Part-time 50%) $35 per hour x 20 hours per week x 48 weeks	$33,600
Stipends: Teachers participating in RCPS training for Engineering and Therapeutic Health Pathways 4 Teachers x $3,000 per Teacher	$12,000
Clerical Support: $12 per hour (Student Rate x 10 hours per week x 48 weeks	$5,760
Tutors: To assist students who are experiencing academic difficulties $21 per hour x 360 hours estimated	$7,560
Summer Camp (2010): Teachers for instruction of Per-Engineering or Therapeutic Health 2 Teachers x $2,000 per Teacher	$4,000
TOTAL	**$62,920**

Employee Benefits:	
Fringe Benefits calculated on the total salaries of $62,920	$6,707
TOTAL	**$6,707**

Purchased Contractual Services:	
Project Lead the Way (PLTW):	
Annual upgrade of the software which will cover the following:	
AutoCAD® Architecture, AutoCAD®	
Inventor® Professional, Autodesk® Design Review, Revit® Architecture,	
AutoCAD® Revit MEP, AutoCAD® Civil 3D®, and 3ds Max Design.	
This annual subscription is for unlimited installations at the Richmond Technical Center (RTC)	$3,995
Complete installation and configuration conducted by an Autodesk Certified Technician which includes:	
Autodesk product activation and authorization	
Computer system maintenance to optimize performance	
Resolve conflicts with computer protection/security software	
Update drivers/configure output devices	
Provide instructor with software orientation	
One-year unlimited toll-free telephone/e-mail support	$5,395
Dual Enrollment:	
Cost of courses for students participating in dual enrollment courses at J. Sargeant Reynolds Community College (JSRCC)	
15 Students in Therapeutic Health x $267 per course x 3 courses = $12,015	
15 Students in Engineering x $267 per course x 3 courses = $12,015	$24,030
SMV/VCU Workshops:	
Therapeutic Exercise Workshops for teachers with cost to include:	
SMV/VCU personnel cost, materials/supplies, and administrative cost $4,577	$4,577
Engineering for Alternative Energy Workshops for teachers; cost to include:	
SMV personnel cost, materials/supplies, and administrative cost $7,130	$7,130
Career Cruising:	
$1,000 x 16 Schools (8 middle and 8 high schools)	$16,000
TOTAL	**$61,127**

Staff Development:	
Project Lead the Way (PLTW): Staff Development is an integral component of PLTW and instructors participating in the program will receive training three times a year, which will cost the division $6,000 and includes: • two days of on-site professional development training which will be held on divisionwide staff development days. The training will be customized to meet the specific needs of each PLTW teacher. • mandatory summer professional development for three participating teachers seeking certification as PLTW instructors.	$6,000
Professional Development Training:	
Conferences:	
NATA Symposium $1,500 x 2 Instructors	$3,000
EMS Symposium $1,500 x 2 Instructors	$3,000
Teacher Licensure $1,500 x 2 Instructors	$3,000
EMT Instructor update (yearly) $50 x 2 Instructors	$100
TOTAL	**$15,100**

Supplies:	
Dual Enrollment: Cost of college textbooks to be used by students participating in dual enrollment courses at J. Sargeant Reynolds Community College 15 students in Therapeutic Health x 3 classes x $150 per textbook (cost of average college textbook) = $6,750 15 students in Engineering x 3 classes x $150 per textbook (cost of average college textbook) = $6,750	$13,500
Parental Involvement: Materials, supplies, and refreshments to be provided at a variety of forums for parents to learn about Academy's admission and completion requirements for students and expectation for parent involvement	$1,000
Printing: Development of brochures to be provided for RCPS PTA/PTO meetings and other venues	$1,000
Refreshments: Food/drinks for events such as:	
Field trips	$450
Confidence camp	$1,000
Graduation Ceremony	$250
Career Fair Presentation:	

Materials and supplies needed for presentation to showcase the Academy and its two pathways	$1,000
Certification/Licensure for students	$6,907
Office Supplies:	
Supplies for operation of Academy	$3,500
Therapeutic Health	
Sports Medicine Course Supplies	$16,827
Course: Intro to Engineering Design	
Project Lead the Way:	
First year implementation of two courses (Intro to Engineering and Principles of Engineering) and the (Gateway to Technology) units:	
Course: Intro to Engineering Design	
Equipment and Supplies	$665
Consumables	$1,104
Course: Principles of Engineering	
Equipment and Supplies	$19,271
Consumables	$309
Course: Gateway to Technology	
Equipment and Supplies	$14,162
Consumables	$630
TOTAL	**$81,575**

Travel:	
Dual Enrollment:	
Cost of transportation for students participating in dual enrollment courses at J. Sargeant Reynolds Community College (JSRCC)-students will be transported from Richmond Technical Center (RTC) to JSRCC	
$89 (mileage and driver) per day x 2 days per week x 16 week course	$2,848
Field Trips:	
Engineering Pathway Program	
Travel from RTC to the following:	
VCU School of Engineering, Richmond, VA	
Old Dominion University, Norfolk, VA	
Stihl Corporation, Virginia Beach, VA	
Wyeth Corporation, Richmond, VA	
Infineon, Richmond, VA	
King's Dominion, Doswell, VA	

Estimated cost of field trips $1.92 per mile x 510 miles + $24.86 per hour x 45 hours	$2,088
Therapeutic Health Pathway Program Travel from RTC to the following: Chesterfield Fire Station #15, Chesterfield, VA Chesterfield Airport, Chesterfield, VA Richmond Ambulance Authority, Richmond, VA Henrico Fire Station #7, Henrico County, VA Richmond Fire Station #10, Richmond, VA VCU Health Systems, Richmond, VA VCU Sports Medicine, Richmond, VA Henrico Doctors Hospital – Parham, Richmond, VA VCU-Lifevac, Richmond, VA Chippenham Sports Medicine, Richmond, VA VCU Training Room, Richmond, VA YMCA-North, Richmond, VA $1.92 per mile x 155 miles + $24.86 per hour x 64 hours	$1,889
Summer Program: Student transportation to RTC from all middle schools: Bus 1 - $1.92 per mile x 14 miles x 20 days + $24.86 x 2 hours per day x 20 days Bus 2 - $1.92 per mile x 24 miles x 20 days + $24.86 x 2 hours per day x 20 days Bus 3 - $1.92 per mile x 14 miles x 20 days + $24.86 x 2 hours per day x 20 days	$4,980
TOTAL	**$11,805**

Equipment:	
Laptop w/accessories – Coordinator	$1,262
Printer – Coordinator	$405
TOTAL	**$1,667**

DIRECT COSTS TOTAL IN-KIND:	
Staff Development:	
Professional Development for Staff	$1,500
TOTAL	**$1,500**

Internal Services:	
Supervision and Monitoring	$4,500
Planning Committee/Advisory Board	$6,500
TOTAL	**$11,000**

Summer Component Activities:	
Academic Support for Students: Summer courses available for students pursuing the engineering pathway (based on the average cost per the last three years)	
Mathematics Summer School	
Personnel Cost	$74,696
Materials/Supplies	$14,256
Advanced Mathematics	
Personnel Cost	$24,899
Materials/Supplies	$4,140
VDOE Algebra Readiness Summer Program	
Personnel Cost	$24,899
Materials/Supplies	$369
TOTAL	**$143,259**

Travel:	
Transportation to Academy:	
Outreach, i.e., Parent night presentation, counselor institutes	$6,000
TOTAL	**$6,000**
IN-KIND TOTAL	**$161,759**

Budget Summary

A.	**Direct Costs**	**General Funds and Carl Perkins**	**In-Kind (Contributions or assistance in a form other than money. Equipment, materials, or services or recognized value that are offered in lieu of cash)**	**Total**
1.	Personnel	$62,920		$62,920
2.	Employee Benefits	$6,707		$6,707
3.	Purchased/Contractual Service	$61,127		$61,127
4.	Internal Services		$11,000	$11,000
5.	Staff Development	$15,000	$1,500	$17,000
6.	Summer Component Activities		$143,259	$143,259
7.	Travel	$11,805	$6,000	$17,805
8.	Contractual Services			
9.	Materials and Supplies	$81,579		$81,579
10.	Equipment	$1,667		$1,667
11.	Educational Software			
B.	**Indirect Costs**			
1.	Miscellaneous			
	TOTAL	**$234,506**	**$161,759**	**$396,265**

Appendix A: Richmond City Public Schools and Richmond Technical Center Planning Team

Governor's Career and Technical Academy for STEM in Richmond Richmond City Public Schools/Richmond Technical Center (RTC) Planning Team		
Staff Name	**Title**	**Role**
James Carson	Technical Education Cluster Teacher (RTC)	Developed Engineering and Technology Program
Nelson Colbert	Dual Enrollment Coordinator A/P Coordinator/Retired Science Instructional Specialist	Reviewed curriculum for course alignment, course sequences through Advanced Placement and Dual Enrollment; Student selection criteria; Academy Completion; Met with Partners
Erlene Carter-Dabney	School Counselor (RTC)	Developed course selection guide; reviewed curriculum for course alignment, course sequences
Helena Easter	Science Instructional Specialist	Reviewed curriculum for course alignment, course sequences; Student selection criteria; Academy completion: Met with Partners
Herman Edwards	School Counselor (RTC)	Developed course selection guide; reviewed curriculum for course alignment, course sequences
N. Mauricee Holmes	Principal, Richmond Technical Center (RTC)	Developed pathways, recruited and collaborated with partners, reviewed curriculum for course alignment, course sequences through Advanced Placement and Dual Enrollment; Student selection criteria; Academy Completion; planning and advisory membership
Roger James	Health Sciences Cluster Leader and Instructor (RTC)	Developed Therapeutic Services Program; Student selection criteria; Academy Completion; met with partners
Deborah Kyles	Instructional Specialist, Marketing/Family and Consumer Science	Reviewed curriculum for course alignment, course sequences; Student selection criteria; Academy completion

Victoria Oakley	Director of Instruction	Reviewed curriculum for course alignment, course sequences; student selection criteria; Academy completion; met with partners
Cozette McIntyre	Grants Manager	Reviewed curriculum for course alignment, course sequences; student selection criteria; Academy Completion; met with partners; proposal development; coordination with VDOE
Beverly Mountain	Instructional Specialist, Guidance Services	Reviewed curriculum for course alignment, course sequences; Student selection criteria; Academy Completion; met with partners
Darlene Smith	Instructional Specialist, Business, and ICTS-Telecommunications	Reviewed curriculum for course alignment, course sequences; student selection criteria; Academy completion; met with partners
Jorge Valenzuela	Technology Education and Trade and Industry Specialist	Reviewed curriculum for course alignment, course sequences; student selection criteria; Academy completion; met with partners; PLTW coordination
Audrey Vosburg	Grant Writer	Developed proposal
Kenya Wallach	Mathematics Instructional Specialist	Reviewed curriculum for course alignment, course sequences; Developed summer mathematics programs; Academy completion; met with partners
Charles B. Watson	Career Experiences Coordinator (RTC)	Developed Engineering and Technology Program; reviewed curriculum for course alignment, course sequences; student selection criteria; Academy completion; coordination of partnerships

Appendix B: Program Implementation Timeline

Governor's Career and Technical Academy for STEM in Richmond Academy Implementation Timeline NOTE: * denotes programs new to RCPS beginning in the summer of 2009	
ACTIVITIES	**DATE**
Hire a part-time coordinator for the program (Mr. Charles Watson, Career Coordinator, will serves as acting coordinator until the new coordinator is hired)	August 2009
Recruit students Meetings with counselors and principals	March-May 2009
Advisory Council Meeting (quarterly)	May 2009
Summer Professional Development for Teachers PLTW Summer Institute (two weeks)* PLTW School Counselors Conference (middle and high school counselors)* Two weeks of MSIC teacher training ("Engineering" and "Nanotechnolgy" each)* Science Museum of Virginia	July–August 2009
Summer Experiences for Students: ▪ Camp Confidence for students and parents* ▪ VCU Summer Enrichment Day Camp (6th and 7th graders)* ▪ VCU Medical Center Project Health Careers Early Learning Program for 8th graders and parents* ▪ MSIC Camp (five weeks) ▪ VCU Youth Health Services CoRPS (10th graders)* ▪ VCU Project ACEe (11th and 12th graders)* ▪ VCU Acceleration Program* ▪ RCPS Summer Mathematics Program ▪ RAPME ▪ Virtual Worlds (8th graders)*	June–August 2009
Meet with Community Partners	August 2009
Academy Orientation and Open House for Parents, Partners	August/September 2009
Academic year begins VCU Engineering Department Partnership Activities	September 2009 September 2009
Advisory Council Meeting	January 2010
Recruit Students for year two of the program	March 2010-April 2010
Academy Orientation Meeting for Parents and incoming Students (year two)	June 2010
Summer Sessions for Students	June 2010-July 2010
Program Closeout/ Reporting	June 2010-August 2010

Appendix C: Planning Committee

Planning Committee Members The Governor's Career and Technical Academy for STEM in Richmond 2008-2009		
Member	**Title**	**Affiliation**
Jerry Browder	Staff, Carl Perkins Project	Richmond City Public Schools
James Carson	Technology Instructor	Richmond Technical Center
Earlene Carter-Dabney	Counselor, Guidance	Richmond Technical Center
Nelson Colbert	Dual Enrollment Coordinator/AP Coordinator	Richmond City Public Schools
Dr. Julia M. Cothron	Executive Director	MathScience Innovation Center
Raymond Cousins	Consultant Chair of RTC CTE Advisory Council	Work force Investment Act Consultant
Helena Easter	Science Instructional Specialist	Richmond City Public Schools
Herman Edwards	Counselor, Guidance	Richmond Technical Center
Melvin R. Fleming, Jr.	Senior Project Designer Civil Engineering Consultant	Timmons Group, Inc.
Kavansa Gardner	Director, IT	Richmond City Public Schools
Kevin Harris	Director, Diversity Access Programs Division of Health Careers/Education and Special Services for Students, Medical Center	Virginia Commonwealth University MCV Campus
N. Mauricee Holmes	Principal	Richmond Technical Center
Roger N. James	Health Sciences Cluster Leader	Richmond Technical Center
William James	Instructional Specialist/Health and Physical Education	Richmond City Public Schools
Deborah Kyles	Family Consumer Science, Marketing Education and Health and Medical Sciences Specialist	Richmond City Public Schools

Member	Title	Affiliation
Cozette McIntyre	Grants Manager	Richmond City Public Schools
Beverly Mountain	Instructional Specialist, Guidance	Richmond City Public Schools
Victoria Oakley	Director of Instruction	Richmond City Public Schools
Dr. Gymama Slaughter	Executive Director Richmond Area Program for Minorities in Engineering (RAPME)	Virginia State University
Darlene Smith	Business Instructional Specialist	Richmond City Public Schools
Jorge Valenzuela	Technology Education and Trade and Industry Specialist	Richmond City Public Schools
Audrey Vosburg	Grants Writer	Richmond City Public Schools
Kenya Wallach	Math Instructional Specialist	Richmond City Public Schools
Charles B. Watson	Career Experiences Coordinator	Richmond Technical Center
Ronald Williams	Business Owner (software and laboratory equipment)	Ronald A. Williams, LTD
Willie Williams	Retired Technical Trainer for Philip Morris	Volunteer
Dr. Keith Williamson	Associate Professor and Chair of Engineering and Technology	Virginia State University

Planning Committee Agreement

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Education Academy for STEM in Richmond. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the Academy
5. Assist in the dual enrollment process to establish courses at the high school level as dual enrollment courses.

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Terry D. Browder
Print

October 3, 2008
Date

Terry D. Browder
Signature

Planning Committee Agreement

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JAMES CARSON, JR. — Print

3/9/09 — Date

Signature

Planning Committee Agreement

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Evelene Carter-Dabney
Print

March 9, 2009
Date

Evelene Carter-Dabney
Signature

Planning Committee Agreement

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Nelson L. Colbert
Print

10/3/08
Date

Nelson L. Colbert
Signature

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance (Sports Medicine) and Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist the curriculum coordinator in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance (Sports Medicine) and Engineering Systems.

Mathscience Innovation Center — 10/31/08
Date

Judith M. Cothran, Ed.D — 10/31/08
Executive Director

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

RAYMOND C COUSINS, JR — 9/5/09

Print — Date

Signature

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Helena Easter
Print

10-3-08
Date

Helena Easter
Signature

Planning Committee Agreement

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Herman W. Edwards, Jr.
Print

3/9/09
Date

Herman W. Edwards, Jr.
Signature

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

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4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

_____ 8/13/08
Date

_____ _____

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

KAVANSA GARDNER
Print

10/8/08
Date

Signature

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance (Sports Medicine) and Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

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4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance (Sports Medicine) and Engineering Systems.

Th. G. Nam — 10/29/08
Date

Kevin Harris

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

N. Mauricee Holmes — 3/9/09

Print — Date

N. Mauricee Holmes

Signature

Planning Committee Agreement

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NAKIA JAMES
Print

3/9/09
Date

Signature

Planning Committee Agreement

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William Tamer
Print

12/10/08
Date

William Tamer
Signature

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Deborah D. Kyles
Print

December 4, 2008
Date

Deborah D. Kyles
Signature

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Cozetta G. McIntyre
Print

10/3/07
Date

Cozetta G. McIntyre
Signature

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Beverly S. Mountain
Print

10-15-08
Date

Beverly S. Mountain
Signature

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Victoria S. Oakley
Print

October 2, 2008
Date

Victoria S. Oakley
Signature

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

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4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

Dr. Gymama Slaughter
Executive Director, RAPME

10/7/2008
Date

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement

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By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Darlene Smith
Print

10/15/2008
Date

Darlene M Smith
Signature

Planning Committee Agreement

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Jorge Valenzuela
Print

10/24/09
Date

Signature

Planning Committee Agreement

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Education Academy for STEM in Richmond. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the Academy
5. Assist in the dual enrollment process to establish courses at the high school level as dual enrollment courses.

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

Audrey Vosburg
Print

10-3-07
Date

Audrey Vosburg
Signature

Grant Writer
Richmond Public Schools

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist the curriculum coordinator in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

Kenya Wallach
RPS Math Instructional Specialist
Richmond Public Schools

July 30, 2008
Date

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Education Academy for STEM in Richmond. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the Academy
5. Assist in the dual enrollment process to establish courses at the high school level as dual enrollment courses.

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Education Academy for STEM in Richmond.

CHARLES B. WATSON
Print

March 9, 2009
Date

Charles B Watson
Signature

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist the curriculum coordinator in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

Ronald A. Williams 7-29-08

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist the curriculum coordinator in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

Willie Williams

Willie L. Williams
Retired – Philip Morris Technical Trainer

8/07/08
Date

_____ _____

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Planning Committee Agreement
Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems

The Planning Committee is an integral component of the establishment and implementation of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems. As a member of the Planning Committee, I will:

1. Assist in the development of academy goals and objectives
2. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
3. Assist the curriculum coordinator in the alignment of course objectives to the competency based education
4. Assist in the evaluation of the programs, courses and overall operation of the academy
5. Assist in the dual enrollment process to establish each course at the high school level as a dual enrollment course*

By signing this agreement, I certify that I am a willing participant and supporter in the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems.

10/7/2008
Date

Dr. Keith Williamson
VSU, Associate Professor and Chair
Engineering & Technology

*This will be articulated between the community colleges and the high school dual enrollment coordinator.

Appendix D: Advisory Board and Memoranda of Agreements

Advisory Board
The Governor's Career and Technical Academy for STEM in Richmond
2008-2009

Member	Affiliation
Kevin G. Adams Student Activity Director John Marshall High School	Richmond City Public Schools
Joel Adler Interim Dean, School of Nursing and Allied Health	J. Sargeant Reynolds Community College
Nelson Colbert Dual Enrollment Coordinator/AP Coordinator	Richmond City Public Schools
Dr. Judith Cothron Executive Director	MathScience Innovation Center
Raymond Cousins Consultant Chair of RTC Advisory Council	Work force Investment Act Consultant
Jelani Dandles Outreach Coordinator	U-Turn Sports Performance Academy
Harinder S. Dhindsa, MD, MPH Emergency Physician, Director of Division of EMS	Virginia Commonwealth University
Charles Farina Regional Manager	Johnson Controls
Melvin R. Fleming, Jr. Senior Project Designer/Civil Engineering	Timmons Group, Inc.
Alan D. Freedman, MED, ATC Director of Clinical Experiences Athletic Training Education Program	Virginia Commonwealth University
Dr. Oris Griffin Associate Professor	James Madison University

Member	Affiliation
David Hagen Museum Scientist	Science Museum of Virginia
Chris Hicks Community Development Director	YMCA North Richmond
Deirdre Johnson Health Sciences Program Assistant Office of Health Careers/Education and Special Services for Students	Virginia Commonwealth University
Jacqueline Johnson-Curl, D.D.S. Dentist	Jacqueline Johnson-Curl, D.D.S. Family Dentistry
Dr. Laurie Keating Vice President Technology Research and Planning	Center for Educational Learning Technology (CELT)
Thomas P. Loughran, MD Medical Director of VCU Sports Medicine Center	Virginia Commonwealth University
Eugene Maurakis Director of Science Education	Science Museum of Virginia
Dr. Roland Moore Dean, School of Mathematics and Science	J. Sargeant Reynolds Community College
Victoria Oakley Director, Department of Instruction	Richmond City Public Schools
Dr. Lorraine Parker Associate Professor Computer Science Department	Virginia Commonwealth University
Dr. Gregory Pleasants Physician	Parham Road Internal Medicine
Jackie Pryor President	Black Data Processing Associates

Member	Affiliation
Vaughn Quash Owner/Proprietor	Quastar, LLC
Stefanie Ramsey Department Head	Richmond City Public Schools
C. Brandon Ream, MPT, CSCS Director of Physical Therapy	Virginia Sports Medicine and Physical Therapy
Renee Reid, MD Emergency Physician Director of Quality Assurance Division	Virginia Commonwealth University
Dr. John M. Ritz Professor and Chair Occupational and Technical Studies	Old Dominion University
Dr. Gymana Slaughter Executive Director	Richmond Area Program for Minorities in Engineering (RAPME) Virginia State University
Ron Tracey Campus Director	ECPI College of Technology
Ronald A. Williams President	Ronald A. Williams, LTD Electronic and Technology Resources
Willie L. Williams Retired Technical Trainer Philip Morris USA	Volunteer
Dr. Keith Williamson Associate Professor Chair of Engineering and Technology	Virginia State University

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools' (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with critical skills needed to succeed in a digital, global economy. A rigorous academic and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two- and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high-skill, high-wage, high-demand employment areas.

RTC/RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service-learning opportunities.
3. Provide or assist in the procurement of instructional and professional development resources.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.
7.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools-Richmond Technical Center.
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers;
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

Partner — Date: 26 May 09

Kevin G. Adams, Athletic Director
John Marshall High School

N. Maurice Holmes — Date: 5-26-09

CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM In Richmond Public Schools- Richmond Technical Center

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with the critical skills needed to succeed in a digital, global economy. A rigorous academic and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two- and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high - skill, high – wage, high- demand employment areas

RTC/RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
3. Provide or assist in the procurement of instructional and professional development resources.
4. Assist in the development and implementation of strategies for teacher professional development programs.
5. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
6. Assist in developing and implementing strategies for the recruitment and enrollment of non- traditional and minority students.
7. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

.RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the **Governor's Career and Technical Academy For STEM in Richmond Public Schools- Richmond Technical Center**
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, **graduate students for fellowship teaching and/or guest lecturers**
4. Conduct on-going evaluation of the Academy to make sure that the delivery methods and outcomes are consistent with the program's vision and purpose.

Interim Dean, School of Nursing & Allied Health
J S Reynolds
Partner — Date: 4-14-09

N. Maurice Johnson
CTE Academy — Date: 4-14-09

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with the critical skills needed to succeed in a digital, global economy. A rigorous academy and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two-and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high – skill, high- wage- demand employment areas.

RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Nelson Colbert
AP/Dual Enrollment Coordinator

6/2/09
Date

N. Maurice Holmes/cut.
Principal, CTE Academy

6-2-09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with the critical skills needed to succeed in a digital global economy. A rigorous academy and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two-and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high – skill, high- wage- demand employment areas.

RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Executive Director — June 2, 2009
Date

Maxascience Innovation Center

N. Maurice Holmes/CT — 6-2-09
Principal, CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Education Academy for STEM in Richmond

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified Governor's Career and Technical Academy for Health and Human Performance Engineering Systems partners for the purpose of serving as the steering and program development committee for the establishment of the Governor's Career and Technical Academy for Health and Human Performance (Sports Medicine) and Engineering Systems.

The major focus of this Academy is on inspiring students with the qualities of creativity, innovation, inquisitiveness, and concernment to address the healthcare needs and the development of devices and procedures that solve medical and health-related problems. The Academy will provide instruction ranging from health care terminology, sports medicine careers to the principles and transfers of technology, and the engineering design, testing and manufacturing of devices, apparatus, and equipment used in the healthcare industry.

RTC/RPS PARTNERS AGREE TO:

1. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
2. Provide guidance in the development of the curriculum and course offerings;
3. Provide work-base learning experiences that would include but not limited to cooperative education, job shadowing, project-based learning, internships and service learning opportunities when appropriate for students; and
4. Assist in the evaluation of the programs, courses and overall operation of the academy

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems;
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, **graduate students for fellowship teaching and/or guest lecturers**
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

3/5/09
Date

N. Maurice Holmes 3/5/09

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools' (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with critical skills needed to succeed in a digital, global economy. A rigorous academic and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two- and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high-skill, high-wage, high-demand employment areas.

RTC/RPS PARTNERS AGREE TO: *

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service-learning opportunities.
3. Provide or assist in the procurement of instructional and professional development resources.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.
7.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools-Richmond Technical Center.
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers;
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

** [signature] * — Partner U-TURN — 5-26-09 Date

N. Maurice Holmes — 5-26-09

CTE Academy — Date

*Willingness to explore developing activities.
**Please see attached addendum.

U-TURN

May 26, 2009

Addendum:
U-TURN will agree to the contents of the attached document contingent upon receiving more details within the next 2 years on the Governor's Career and Technical Academy For STEM. Further details are included but not limited to: U-TURN's time commitment, financial needs, and staff requirements.

Warmest Regards,

Jelani Dandles
Director of Outreach
U-TURN Sports Performance Academy

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with the critical skills needed to succeed in a digital, global economy. A rigorous academy and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two-and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high – skill, high- wage- demand employment areas.

RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

MD — 6/2/09
Date

Harinder Dhindsa
Harinder S. Dhindsa, MD, MPH
Director, Division of EMS, Dept. of Emergency Medicine

Principal, CTE Academy — 6/4/09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems Partners

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified Governor's Career and Technical Academy for Health and Human Performance Engineering Systems partners for the purpose of serving as the steering and program development committee for the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering System.

The major focus of this Academy is on inspiring students with the qualities of creativity, innovation, inquisitiveness and concernment to address the healthcare needs and the development of devices and procedures that solve medical and health-related problems. The Academy will provide instruction ranging from health care terminology, sports medicine careers to the principles and transfers of technology, and the engineering design, testing and manufacturing of devices, apparatus, and equipment used in the healthcare industry.

PARTNERS AGREE TO:

1. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
2. Depending upon the availability of resources, Johnson Controls, Inc., will make reasonable efforts to provide guidance in the development of the curriculum and course offerings;
3. Depending upon the availability of resources, Johnson Controls, Inc., will make reasonable efforts to provide work-based learning experiences that would include but not limited to cooperative education, job shadowing, project-based learning, internships and service learning opportunities when appropriate for students; and
4. Assist in the evaluation of the programs, courses and overall operation of the Academy

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems;
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the Academy.

Chas J Farina - RSM
Johnson Controls, Inc.
Partner

5/27/09
Date

N. Maurice Holmes /CT.
CTE Academy

5-27-09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified partner for the purpose of establishment, implementation and sustainability of the Academy. The focus of the Governor's Career and Technical Education Academy for STEM in Richmond is to offer Richmond Public Schools (RPS) students a solid education in science, technology, engineering and mathematics (STEM), along with the critical skills needed to succeed in a digital, global economy. A rigorous academy and technical program of study in two career pathways will prepare students for a full range of postsecondary opportunities (two-and four year colleges), formal employment training, apprenticeships, and the military. Each pathway, Engineering and Therapeutic Services, has been designed to lead students to opportunities in high – skill, high- wage- demand employment areas.

RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Melvin R. Fleming
Timmons Group

6/2/09
Date

N. Maurice Holmes
Principal, CTE Academy

6/3/09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

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RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
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RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Alan D. Freedman — 6/3/09
Alan D. Freedman, Director — Date
Clinical Experiences, Athletic Training Education
Virginia Commonwealth University

Maurice Hall — 6/4/09
Principal, CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM

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RTC/RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service-learning opportunities.
3. Provide or assist in the procurement of instructional and professional development resources.
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7.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the **Governor's Career and Technical Academy for STEM in Richmond Public Schools-Richmond Technical Center.**
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, **graduate students for fellowship teaching and/or guest lecturers;**
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

Oris J. Griffin — Partner — May 27, 2009 — Date

Maurice Holmes — CTE Academy — 5/27/09 — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

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1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for STEM in Richmond Public Schools at the Richmond Technical Center
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Paul B Hagan
Museum Scientist
Science Museum of Virginia

June 2, 2009
Date

N. Maurice Holmes Jr.
Principal, CTE Academy

6-2-09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
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For STEM

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May 26, 2009
Date

Partner
Chris Hicks, Community Development Director
YMCA North Richmond

5/26/09
Date

CTE Academy

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Deidre A. Johnson — 6·3·09
Deidre A. Johnson
Virginia Commonwealth University
Date

N. Maurice Holmes — 6-3-09
Principal, CTE Academy
Date

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Jacqueline Johnson Clark DRS — 5/26/09
Partner — Date

N. Maurice Hilliard — 5/26/09
CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems Partners

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified Governor's Career and Technical Academy for Health and Human Performance Engineering Systems partners for the purpose of serving as the steering and program development committee for the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering System.

The major focus of this Academy is on inspiring students with the qualities of creativity, innovation, inquisitiveness, and concernment to address the healthcare needs and the development of devices and procedures that solve medical and health-related problems. The Academy will provide instruction ranging from health care terminology, sports medicine careers to the principles and transfers of technology, and the engineering design, testing and manufacturing of devices, apparatus, and equipment used in the healthcare industry.

PARTNERS AGREE TO:

1. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
2. Provide guidance in the development of the curriculum and course offerings;
3. Provide work-base learning experiences that would include but not limited to cooperative education, job shadowing, project-based learning, internships and service learning opportunities when appropriate for students; and
4. Assist in the evaluation of the programs, courses and overall operation of the academy

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems;
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, **graduate students for fellowship teaching and/or guest lecturers**
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

Laurie Keating, Ed D — 5/27/2009
Date

Maurice Holman — 5/27/09

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems Partners
Date: 8/5/08

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified Governor's Career and Technical Academy for Health and Human Performance Engineering Systems partners for the purpose of serving as the steering and program development committee for the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering System.

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VCU 8/5/08

Dr. Thomas P. Loughran, M.D. 7/08/08
Medical Director of VCU Sports Medicine Center

N. Maurice Holmes/CT 8/5/08

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EUGENE G. MAURAKIS
DIR. SCIENCE EDUCATION
SCIENCE MUSEUM of VA.

2 June 2009
Date

N. Maurice Holmes/CT.
Principal, CTE Academy

6-2-09
Date

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Ed.D — 5/27/09
Partner — Date

Maurice Holmes — 5/27/09
CTE Academy — Date

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Victoria D. Oddy
Director of Instruction

June 2, 2009
Date

N. Maurice Holmes, CT.
Principal, CTE Academy

6-2-09
Date

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Between
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L. M. Parker — 6/3/09
L. M. Parker
VCU Computer Science
Date

N. Maurine Holmes/CT — 6/3/09
Principal, CTE Academy
Date

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Partner	5/26/09 Date
N Maurice Hobby CTE Academy	5/26/09 Date

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Partner
Black Data Processing Associates

5/26/09
Date

Maurice Holmes/Cyber

CTE Academy

5/26/09
Date

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Vaughn Quash — 5-26-09

Partner — Date

Quastar, LLC

CTE Academy — Date

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6/4/09
Date

Principal, CTE Academy

6/4/09
Date

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C. Brandon Ream — 5/27/09
Partner — Date

Maurice Johnson — 5/27/09
CTE Academy — Date

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1. Ass st in the development and implementation of strategies for teacher professional development programs.
2. Pro ide or assist in the procurement of instructional and professional development resources.
3. Pro ide work-based learning experiences that will include but are not limited to cooperative education, job sha owing, project-based learning, internships, mentoring and service learning opportunities.
4. Sha e Academy information with other business leaders and organizations to recruit additional partners and spo sors.
5. Ass st in developing and implementing strategies for the recruitment and enrollment of non-traditional and mi rity students.
6. Pro ide information to be used for reporting and evaluation of programs, courses and the overall operation of the Ac demy.

RICHMO D TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Co rdinate the curriculum development of the Governor's Career and Technical Academy for STEM in Ri mond Public Schools at the Richmond Technical Center
2. Of r courses related to healthcare and engineering sciences;
3. Hi certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Co duct on-going evaluation of the academy to make sure that the delivery methods and outcomes are co stent with program's vision and purpose.

Renee Reid M.D
Renee Reid, M.D.
Emergency Physician

6/2/09
Date

Principal, TE Academy

6/4/09
Date

Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

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RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
2. Provide or assist in the procurement of instructional and professional development resources.
3. Provide work-based learning experiences that will include but are not limited to cooperative education, job shadowing, project-based learning, internships, mentoring and service learning opportunities.
4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

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2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, graduate students for fellowship teaching and/or guest lecturers
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

John M. Ritz — 6-3-09
John Ritz, Ph.D — Date
Professor and Chair, Old Dominion University
Occupational and Technical Studies

R. Maurice Harris — 6/3/09
Principal, CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
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Gymama Slaughter, Phd
Professor, Virginia State University
Director, RAPME

6/2/09
Date

N. Maurice Holmes
Principal, CTE Academy

6/3/09
Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical Center/Richmond Public Schools
And
The Governor's Career and Technical Academy
For Health and Human Performance Engineering Systems Partners
Date:_____

The Richmond Technical Center/Richmond Public Schools hereby enters into this Memorandum of Agreement with the identified Governor's Career and Technical Academy for Health and Human Performance Engineering Systems partners for the purpose of serving as the steering and program development committee for the establishment of the Governor's Career and Technical Academy for Health and Human Performance Engineering System.

The major focus of this Academy is on inspiring students with the qualities of creativity, innovation, inquisitiveness, and concernment to address the healthcare needs and the development of devices and procedures that solve medical and health-related problems. The Academy will provide instruction ranging from health care terminology, sports medicine careers to the principles and transfers of technology, and the engineering design, testing and manufacturing of devices, apparatus, and equipment used in the healthcare industry.

PARTNERS AGREE TO:

1. Identify the needs of the healthcare, engineering and related services industries of the state of Virginia;
2. Provide guidance in the development of the curriculum and course offerings;
3. Provide work-base learning experiences that would include but not limited to cooperative education, job shadowing, project-based learning, internships and service learning opportunities when appropriate for students; and
4. Assist in the evaluation of the programs, courses and overall operation of the academy

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

1. Coordinate the curriculum development of the Governor's Career and Technical Academy for Health and Human Performance Engineering Systems;
2. Offer courses related to healthcare and engineering sciences;
3. Hire certified instructors, **graduate students for fellowship teaching and/or guest lecturers**
4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcome are consistent with the program's vision and purpose of the academy.

Ron Tracey
Campus Director ~~of Technology~~
ECPI ~~Technical~~ College of Technology

Date 8/7/08

N. Maurice Holmes/CT.

8/7/08

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

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RTC/ RPS PARTNERS AGREE TO:

1. Assist in the development and implementation of strategies for teacher professional development programs.
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4. Share Academy information with other business leaders and organizations to recruit additional partners and sponsors.
5. Assist in developing and implementing strategies for the recruitment and enrollment of non-traditional and minority students.
6. Provide information to be used for reporting and evaluation of programs, courses and the overall operation of the Academy.

RICHMOND TECHNICAL CENTER/RICHMOND PUBLIC SCHOOLS AGREES TO:

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4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Ronald Williams — 6-4-2009
Ronald Williams, LTD — Date

N. Maurice — 6/4/09
Principal, CTE Academy — Date

MEMORANDUM OF AGREEMENT
Between
Richmond Technical/Richmond Public Schools
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Willie Williams, Technical Trainer
Retired-Pilip Morris

June 2, 2009
Date

N. Maurice Johnson
Principal, CTE Academy

6/3/09
Date

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Between
Richmond Technical/Richmond Public Schools
And
The Governor's Career and Technical Academy
For STEM in Richmond Public Schools at the Richmond Technical Center

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2. Offer courses related to healthcare and engineering sciences;
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4. Conduct on-going evaluation of the academy to make sure that the delivery methods and outcomes are consistent with program's vision and purpose.

Keith Williamson, PH.d
Assoc. Professor & Chair
Virginia State Unversity

6-2-2009
Date

Principal, CTE Academy

6/3/09
Date

Appendix E: Dual Enrollment Contract

Dual Enrollment Contract
2009 - 2011
Between
J. Sargeant Reynolds Community College
and
Richmond City Public Schools

The purpose of this agreement is to set out the terms and conditions upon which courses will be offered under the "Virginia Plan for Dual Enrollment Between Virginia Public Schools and Community Colleges" established by the Secretary of Education, the VCCS Chancellor, and the Superintendent of Public Instruction in January 2005. The purpose of this offering is to allow high school students to take college-level courses and receive both college credit and high school credit towards graduation.

Each party does hereby agree to the following:

1. Under this agreement, J. Sargeant Reynolds Community College (College) will make available college-level courses to students of Richmond City Public Schools (School Division) for the 2009 – 2010 and 2010 – 2011 academic years.

   The courses to be offered will be established in advance of each academic year for the fall and spring semesters by mutual agreement of both parties.

   This agreement is tentative until registration for the course(s) is completed and is subject to adequate student enrollment as determined by the College. The College and School Division reserve the right, by mutual agreement of both parties, to cancel any class sections or add sections in advance of each academic year.

2. Tuition & Fees

   Rates for tuition will be in accordance with rates established by the State Board for Community Colleges and in effect at the time the classes begin. Fees will be in accordance with fees established by the State Board for Community Colleges and the J. Sargeant Reynolds Community College Board for the applicable term.

   If the School Division assumes responsibility for the payment of tuition and fees for the student, the School Division will, prior to registration, identify the students to be sponsored, including the students' full names, student identification number, and college course prefix and number. The College will issue an invoice to the School Division after the census date, which is designated as the end of the period when students may add or drop the class without penalty. Full tuition and fees are due for students who do not drop their classes by the drop deadline (census date). Payment is due from the School Division within thirty (30) days of the date of the invoice.

   If the student is responsible for payment of tuition and fees, payment is due at registration. Payment may be made by check, MasterCard, Visa, Discover, or cash.

3. Textbooks

   The College determines the textbooks used in dual enrollment courses. The provision of all dual enrollment course textbooks is the responsibility of the student, unless the School Division elects to provide textbooks. Required textbooks will be available for purchase from the college's bookstore.

4. Payment for Other Services

   Payment or reimbursement for other costs and services will be determined by written mutual consent of the School Division and the College.

Revised 5-6-2009 TCB

5. Faculty

a. Selection

(1) Authority to Select/Hire

The selection and supervision of instructional faculty for all community college courses covered by this agreement will be the responsibility of the College and shall meet the requirements of Title 22.1, Chapter 15, Article 2 of the Code of Virginia as amended. The School Division may recommend qualified teachers who are interested in teaching in the dual enrollment program to the College for consideration. Each faculty member teaching in the dual enrollment program shall be a member of the college's full- or part-time faculty or an employee of the school division.

(2) Dual enrollment course faculty must meet the minimum credential requirements set forth by Form VCCS-29 (Attachment 1) and the Southern Association of Colleges and Schools.

b. Payment

If the instructor for dual enrollment course(s) is employed full time by the school division and the course(s) are part of the assigned teaching workload, the College will reimburse the School Division for the services of its employee in lieu of direct compensation to the faculty member. Reimbursement will be made based on the college's actual adjunct faculty per credit hour rate times the number of credits of the course(s) taught. The actual adjunct faculty per credit hour rate will be calculated annually based on the prior year's actual adjunct expenditures. Reimbursement will occur no later than the end of the semester of the course.

If, however, the College employs an instructor that is not affiliated with the School Division, the College will compensate the faculty member directly. Payment of faculty salaries will be in accordance with the Virginia Community College System approved adjunct faculty rates depending on qualifications of the instructor. Payment will occur no later than the end of the semester of the course.

c. Faculty Responsibilities

Instructors will be expected to conform to college policies, including but not limited to, preparing course syllabi, verifying class rosters, reporting student progress to the college, taking attendance, and providing final grades at the end of the semester.

All faculty teaching dual enrollment courses will be required to attend faculty orientation and other in-service programs as agreed upon by both parties.

6. Students

a. Selection and Eligibility to Participate in Dual Enrollment Program

(1) In order to be eligible to participate in the Dual Enrollment Program, high school students must be high school juniors or seniors, have permission of their parent or guardian, be recommended by their high school principal (or designee) to cross register, and meet course prerequisites. High school freshmen and sophomores will be considered on a case by case basis as noted in 6.a.(3) below.

(2) Students must meet admission and course placement requirements of the college. Requirements for admission include the completion of an application for admission to the college, course request

forms, residency forms, and the completion and receipt of satisfactory scores on the college's placement tests when required.

(3) Exceptions to the policies established in 6.a.(1) and 6.a.(2) regarding student eligibility may be made on a case-by-case basis with the approval of the School Division superintendent and the College president.

7. College Administrative Responsibilities

a. The College, through its instructor(s), will provide the appropriate School Division officials with progress reports on each student as agreed by the contracting School Division and College. Release of progress reports by the College shall be conditional upon receipt of a proper authorization for the release of grades by the College to the School Division conforming to the requirements of the US DOE FERPA regulations. At the conclusion of each college academic term, the student will receive a college grade for each course in which he/she was registered and such grades will become part of the student's permanent college record.

b. A record will be maintained by the College for each student in the Dual Enrollment Program as a part of the permanent college record maintained by the college's Admissions and Records office. Transcripts will be sent to colleges/universities upon student request.

c. The College will provide a minimum of 800 minutes of instruction (to include testing and evaluation) for each lecture credit or lab contact hour per semester to school division students enrolled in college courses under this agreement.

8. High School Administrative Responsibilities

The School Division will verify enrollments in each class section, and instructors will report grades to the College within a prescribed period of time, according to mutually agreed-upon procedures. The School Division shall not establish dual enrollment classes with a "mix" of dual enrollment and non-dual enrollment students.

9. Award of Credit

College and high school credit shall be awarded to the participating high school student upon successful completion of the course.

10. Course Standards

a. Course Equivalency, Evaluation, and Assessment

Assessment has long been recognized in Virginia as an important aspect of an effective instructional program. In this spirit, all dual enrollment arrangements developed and implemented under the auspices of the Virginia Plan for Dual Enrollment shall include a formal mechanism for evaluation. The College has the responsibility to ensure that all dual enrollment courses taught are equivalent to other instruction offered by the college, specifically in terms of course objectives, components of the syllabi, level and rigor of content, evaluation of students, textbooks, student outcomes and assessment and faculty evaluation.

b. Modifications of Policies

Modifications of on-campus policies, procedures, and rules appropriate to the high school setting may be agreed to by the parties in writing before each term begins.

c. Student Performance

The College reserves the right to: (1) advise the student, parents, and school division that the student does not have sufficient skills or abilities to continue in the courses selected after the first semester, or (2) determine that a student cannot enroll in a subsequent course.

11. Agreement Contacts

Contact persons for this agreement are:

- the School Division: _____
- the School: _____
- the College: Director of Outreach and Recruitment, 804-523-5935
  Vice-President of Finance and Administration, 804-523-5132

12. Transferability

Normally, academic courses intended for transfer with a grade of "C" or above will transfer to institutions of higher education. However, no guarantee can be made regarding transferability to all colleges and universities. Community college occupational/technical course credits earned are applicable to specific curricula and are intended to prepare students for employment in those areas. While some of these courses may be accepted for transfer, students should be advised to consult with transfer institutions in order to determine if their courses will be accepted for transfer.

13. The College reserves the right to enroll other students when courses are offered on campus or sites not at the high school.

14. Each party will be responsible for liability coverage of its employees and agents in fulfilling its responsibilities under this agreement, to the extent authorized by law.

15. If either party wishes to terminate this agreement, a written notice must be provided within 90 days of the requested termination date. Termination will not take place until dual enrollment courses in progress are completed.

16. The College or the School Division shall not unlawfully discriminate on the basis of race, nationality, ethnicity, religion, gender, age, or disability in any undertaking pursuant to this agreement.

17. Nothing herein shall be construed as a waiver of the sovereign immunity of the Commonwealth of Virginia or the assumption of any liability contrary to the laws and statutes of Virginia.

Signatures:

Gary L. Rhodes, President
J. Sargeant Reynolds Community College

Date: 5/7/09

Yvonne Brandon, Superintendent
Richmond City Public Schools

Date: 5/7/09

Revised 5-6-2009 TCB

Appendix F: Academy Plan(s) of Study

Governor's Career and Technical Academy for STEM in Richmond
Plan of Study

Student Name: _____
School: _____
Date: _____

Cluster: Science, Technology, Engineering, and Mathematics

Pathway: Engineering and Technology

This Career Pathway Plan of Study serves as a guide, along with other career planning materials, as learners continue on a career path. Courses listed within this plan are only recommended and individualized to meet each learner's educational and career goals.

EDUCATION LEVELS	GRADE	English/ Language Arts	Mathematics	Science	Social Studies/ Science	Other Required Courses Recommended Electives Learner Activities	Recommended Career and Technical Courses Source: Administrative Planning Guide www.doe.virginia.gov/VDOE/ Instruction/CTE/apg/	Occupations Relating to This Pathway: www.doe.virginia.gov/VDOE/ Instruction/CTE/careerclusters/ www.careerclusters.org www.cteresource.org/cpg/
MIDDLE	6	6 English 6H English 7A English	6 Mathematics 6H Mathematics 7A Mathematics	6 Science 6H Science 7A Life Science	6 U.S. History I 6H US History I	Keyboarding Comp. Applications Exploratory Foreign Language	Introduction to Technology (VDOE 8482)	Occupations Requiring Less than a Baccalaureate Degree: ▪ Civil Engineering Technicians • Electrical and Electronic Technicians • Industrial Engineering Technicians • Environmental Engineering Technicians • Electro-mechanical Technicians • Aerospace Engineering and Operations Technicians
	7	7 English 7H English 8A English	7 Mathematics 7H Mathematics 7A Mathematics 8A Pre Algebra 9A Algebra I (VDOE 3130)	7 Life Science 7H Life Science 8A Physical Science	7 US History II 7H US History II	Foreign Language Keyboarding Computer Solutions Health and Physical Education	Inventions and Innovations (VDOE -8464)	
	8	8 English 8H English 9A English (VDOE 1130)	8 Pre Algebra 8H Pre Algebra 9A Algebra I (VDOE 3130) 10A Geometry (VDOE 3143)	8 Physical Science 8H Physical Science 9A Earth Science (VDOE 4210) 10A Biology (VDOE 4310)	8 Civics and Economics 8H Civics and Economics	Foreign Language Keyboarding Applications (VDOE 6152) 1 CR Health and Physical Education	Technological Systems (VDOE 8462) Career Investigations (VDOE 9070) "Gateway to Technology Program": Project Lead the Way (PLTW) -Science and Technology (9wks) -Design and Modeling (9wks) -Magic of Electrons (9wks) -Automation and Robotics (9wks)	

SECONDARY	9	9 English (VDOE 1130) 9H English (VDOE 1130) 10A English (VDOE 1140)	9 Integrated Math I (VDOE 3131) 9 Integrated Math II (VDOE 3132) 9 Algebra I (VDOE 3130) 9H Algebra I (VDOE 3130) 10A Geometry (VDOE 3143) 11A Algebra II/ Trig (VDOE 3137)	Integrated Science I (VDOE 4211) Earth Science (VDOE 4210) H Earth Science (VDOE 4210) Biology (VDOE 4310) 10A Biology (VDOE 4310)	World Geography (VDOE 2210) H World Geography (VDOE 2210) World History and Geography I to 1500 AD (VDOE 2341) H World History and Geography I to 1500 AD (VDOE 2341)	Foreign Language 9 Health and Physical Education (VDOE 7300) Keyboarding Applications (VDOE 6152) 1 CR 10 Health and Physical Education (VDOE 7400)	Pathway to Engineering Program PLTW Principles of Engineering (VDOE 8441), 1CR or Introduction to Engineering Design, (VDOE 8439) 1CR and Digital Visualization (VDOE 8459) 1 CR	Occupations Requiring a Baccalaureate Degree • Civil Engineer • Mechanical Engineer • Industrial Engineer • Electrical Engineer • Electronic Engineer • Aerospace Engineer • Computer Hardware Engineer • Environmental Engineer • Nuclear Engineer • Chemical Engineer • Materials Engineer • Agricultural Engineer • Biomedical Engineer

	10	10 English (VDOE 1140) 10H English (VDOE 1140) 11A English (VDOE 1150)	9 Integrated Math II (VDOE 3132) 10 Geometry I (VDOE 3144) 10 Geometry II (VDOE 3145) 10 Geometry (VDOE 3143) 10H Geometry (VDOE 3143) 11A Algebra II (VDOE 3135) 11A Algebra II/ Trig (VDOE 3137) 12A Math Analysis (VDOE 3162)	Integrated Science II (VDOE 4311) Biology (VDOE 4310) Biology Part I (VDOE 4300) Biology Part II (VDOE 4301) H Biology (VDOE 4310) Chemistry (VDOE 4410) 11A Chemistry (VDOE 4410)	World History and Geography I to 1500 AD (VDOE 2341) H World History and Geography to 1500 AD (VDOE 2341) World History and Geography II to 1500 AD to Present (VDOE 2341) H World History and Geography II to 1500 AD to Present (VDOE 2341)	Foreign Language Fine Arts Elective AP Fine Arts Courses	Principles of Engineering (VDOE 8441),1CR or Introduction to Engineering Design,(VDOE 8439) 1 CR and Digital Electronics (VDOE 8440) 1 CR	
Career Assessment: Explorer, Pre-ACT and Career Cruising								

	11	11 English (VDOE 1150) 11H English (VDOE 1150) 12A English (VDOE 1160) 13AP English Literature (VDOE 1195) 13AP English Language (VDOE 1195) College Composition I (DE/ENG 111) 3CR (VDOE 1195) College Composition II (DE/ ENG 112) 3CR (VDOE 1195)	10 Geometry II (VDOE 3145) 10 Geometry (VDOE 3143) 11 Algebra II (VDOE 3135) 11H Algebra II (VDOE 3135) 11 Algebra II/ Trig (VDOE 3137) 12A Math Analysis (VDOE 3162) 13AP Statistics (VDOE 3192) 13AP Calculus (VDOE 3177) Pre Calculus (DE/ MTH 163) 3CR VDOE 3162 Calculus I (DE/ MTH 173) 5CR (VDOE 3162) Calculus II (DE/ MTH 174) 5CR (VDOE 3162)	Integrated Science III (VDOE 4311) 13AP Biology (VDOE 4370) Biology I (DE/ BIO 101) 4CR (VDOE 4370) Biology II (DE/BIO 102) 4CR (VDOE 4370) Chemistry (VDOE 4410) H Chemistry (VDOE 4410) A Physics (VDOE 4510) 13AP Physics (VDOE 4570)	VA and US History I (VDOE 2361) VA and US History II (VDOE 2362) VA and US History (VDOE 2360) H VA and US History (VDOE 2360) 13AP US History (VDOE 2319) 13AP European History (VDOE 2399)		Architectural Drawing and Design (VDOE 8437) 2 CR and Computer Aided Drafting I (DE/ DRF 231) 3CR Advanced Architectural Drawing and Design (VDOE 8492) 2CR and Computer Aided Drafting II (DE/ DRF 232) 3CR	<u>Occupations Requiring an Advanced Degree</u> • Aerospace Engineer • Aeronautical Engineer • Astronautical Engineer • Chemical Engineer • Civil Engineer • Computer Engineer • Electrical Engineer • Industrial Engineer • Manufacturing Engineer • Mechanical Engineer

	12	12 English (VDOE 1160) 12H English VDOE 1160 13AP English Literature (VDOE 1195) 13AP English Language (VDOE 1195) College Composition I (DE/ ENG 111) 3CR (VDOE 1195) College Composition II (DE/ ENG 112) 3CR (VDOE 1195)	11 Algebra II (VDOE 3135) 11 Algebra II/ Trig (VDOE 3137) 12 Math Analysis (VDOE 3162) 13AP Statistics (VDOE 3192) 13AP Calculus (VDOE 3177) Pre Calculus (DE/ MTH 163) 3CR (VDOE 3162) Calculus I (DE/ MTH 173), 5CR (VDOE 3162) Calculus II (DE/ MTH 174), 5CR (VDOE 3162)	13AP Chemistry (VDOE 4410) 13AP Biology (VDOE 4370) Biology I (DE/ BIO 101) 4CR (VDOE 4370) Biology II (DE/ BIO 102) 4CR (VDOE 4370) Physics (VDOE 4510) A Physics (VDOE 4510) 13AP Physics (VDOE 4570)	VA and US Government (VDOE 2360) H VA and US Government (VDOE 2360) 13AP VA and US Government (VDOE 2445) 13AP European History (VDOE 2399)		Engineering Design and Development (VDOE 8443) 2CR And Engineering Graphics (DE/ EGR 110) 3CR Introduction to Engineering Design (DE/ EGR 123), 2CR Introduction to Engineering and Engineering Methods (DE/ EGR 124), 3CR	

High school courses in the pathway are coded: A=Accelerated; AP= Advanced Placement; CR= Credit; H=Honors; DE= Dual Enrollment; VC=Verified Credit

List related certifications/credentials approved by VDOE and offered locally:
AutoCAD Certifications
Virginia Workplace Readiness Assessment (NOCTI) and IC³ Certification
Pre-Engineering Assessment (NOCTI)
Occupational Safety Health and Administration (OSHA)

Additional Learning Opportunities:
CTSO Organization(s): ☐ SkillsUSA and ☒ TSA

Work-Based Learning:
☒ Career Research ☒ Student Apprenticeship ☒ Mentorship
☒ Job Shadowing ☒ Service Learning Project

Postsecondary Placement Assessments: COMPASS and SAT II

College Entrance Exams: ACT and SAT I

POST SECONDARY

POSTSECONDARY PROGRAMS RELATED TO THIS CAREER PATHWAY

Pathway	Associate Degree, College Certificate, or Apprenticeship	Bachelor's Degree	Postgraduate Degree
Engineering and Technology	J. Sargeant Reynolds Community College	Virginia State University Bachelor's of Science	Virginia Commonwealth University Masters of Science Doctoral Degree

College: J Sargeant Reynolds Community College – Associate Degree in Engineering School Division(s): Richmond City Public Schools

Postsecondary:

POSTSECONDARY - COMMUNITY COLLEGE or APPRENTICESHIP - Determined Locally

Semester	English	Science	Mathematics	Social Studies	Required Courses or Recommended Electives			
POSTSECONDARY PLAN OF STUDIES INCLUDES POSTSECONDARY ACADEMIC, CTE, AND OTHER ELECTIVE COURSES APPROPRIATE FOR AN ASSOCIATE DEGREE.								
Year 1 1st Semester	College Composition I	College Chemistry I	Calculus with Analytic Geometry I	Introduction to Engineering and Engineering Methods	College Success Skills	Personal Wellness Elective		
Year 1 2nd Semester	College Composition II	Introduction to Engineering Design or Engineering Graphics	Engineering Mechanics-Statics or Engineering Elective	Personal Wellness Elective	Calculus w/ Analytic Geometry II	Humanities Elective		
Year 2 1st Semester	University Physics	Engineering Elective	Vector Calculus	Engineering Economy or Engineering Elective	Social / Behavioral Science Elective			
Year 2 2nd Semester	Engineering Elective	Fine Arts Elective	Social / Behavioral Science Elective	University Physics II	Ordinary Differential Equations			

College courses offered locally in the high school for college credit are coded: A=Accelerated; CR= Credit; H=Honors; DE= Dual Enrollment; VC=Verified Credit

Related Industry Certifications Available:

AutoCAD Certifications
Occupational Safety Health and Administration (OSHA)

Additional Suggested Learning Opportunities: Student Organizations: Society of Women Engineers, Richmond Area Program form Minorities in Engineering, Vocational Education Careers of America, National Society of Black Engineers, National Technical Association

Work-Based Learning:
☒ Cooperative Education ☒ Internship ☒ Mentorship
☒ Job Shadowing ☒ Service Learning Project ☐ Registered Apprenticeship

UNIVERSITY

University/College: Virginia State University – B.S. Degree in Mechanical Engineering

Degree or Major: B.S. Degree in Mechanical Engineering

Number of Articulated CC Credits: 60

Notes:

Governor's Career and Technical Academy for STEM in Richmond
Plan of Study

Cluster: Health Sciences Pathway: Therapeutic Services

Student Name: _____
School: _____
Date: _____

This Career Pathway Plan of Study serves as a guide, along with other career planning materials, as learners continue on a career path. Courses listed within this plan are only recommended and individualized to meet each learner's educational and career goals.

EDUCATION LEVELS	GRADE	English/ Language Arts	Mathematics	Science	Social Studies/ Science	Other Required Courses Recommended Electives Learner Activities	Recommended Career and Technical Courses	Occupations Relating to This Pathway
	6	6English 6H English 7A English	6Mathematic s 6H Mathematics 7A Mathematics	6 Science 6H Science 7A Life Science	6 US History I 6H US History 1	Keyboarding Comp. Applications Exploratory Foreign Language	Family & Consumer Sciences Exploratory	Occupations Requiring Less than a Degree: Clinical Medical Assistant EMT/Paramedic ER Technician Exercise Instructor Nursing Assistant Orthopedic Technician Personal Trainer Physical Therapist/Assistant Radiology Technician Respiratory Therapist Occupations Requiring a Baccalaureate Degree Athletic Trainer Employee Fitness Director Exercise Physiologist Occupational Therapist Recreation Therapist Sports Nutritionist Sports Psychologists Surgical Technician

MIDDLE	7	7 English 7H English 8A English	7 Mathematics 7H Mathematics 7A Mathematics 8A Pre Algebra 9A Algebra I (VDOE 3130)	7 Life Science 7H Life Science 8A Physical Science	7 US History II 7H US History II	7 Health and Physical Education	Keyboarding (VDOE 6150) Make it Your Business (VDOE 6111-18)
	8	8 English 8H English 9A English (VDOE 1130)	8 Pre Algebra 8H Pre Algebra 9A Algebra I (VDOE 3130) 10A Geometry (VDOE 3143)	8 Physical Science 8H Physical Science 9A Earth Science (VDOE 4210) 9A Biology (VDOE 4310)	8 Civics/ Economics 8H Civics/ Economics	8 Health and Physical Education	Computer Applications (VDOE 6617) Career Investigations I (VDOE 9070)
Career Assessment: Virginia Wizard and Career Cruising							
SECONDARY	9	9 English (VDOE 1130) 9H English (VDOE 1130) 10A English (VDOE 1140)	9 Integrated Math I (VDOE 3131) 9 Integrated Math II (VDOE 3132) 9 Algebra I (VDOE 3130) 9H Algebra I (VDOE 3130) 10A Geometry (VDOE 3143) 11A Algebra II/ Trig (VDOE 3137)	Integrated Science I (VDOE 4211) Earth Science (VDOE 4210) H Earth Science (VDOE 4210) Biology (VDOE 4310) 10A Biology (VDOE 4310)	World Geography (VDOE 2210) H World Geography (VDOE 2210) World History and Geography I to 1500 AD (VDOE 2341) H World History and Geography to 1500 AD (VDOE 2341)	Foreign Language Health and Physical Education (VDOE 7300)	Keyboarding Applications (VDOE 6152) 1CR Introduction to Health and Medical Sciences (VDOE 7555) 1CR Medical Terminology (VDOE 8383) 1CR and Medical Terminology (DE/ HLT 143) 3CR

	10	10 English (VDOE 1140) 10H English (VDOE 1140) 11A English (VDOE 1150)	9 Integrated Math II (VDOE 3132) 10 Geometry I (VDOE 3144) 10 Geometry II (VDOE 3145) 10 Geometry (VDOE 3143) 10H Geometry (VDOE 3143) 11A Algebra II (VDOE 3135) 11A Algebra II/ Trig (VDOE 3137) 12A Math Analysis (VDOE 3162)	Integrated Science II （VDOE 4311) Biology（VDOE 4310) Biology Part I （VDOE 4300) Biology Part II （VDOE 4301) H Biology（VDOE 4310) Chemistry（VDOE 4410) 11A Chemistry （VDOE 4410)	World History and Geography I to 1500 AD（VDOE 2341) H World History and Geography to 1500 AD （VDOE 2341) World History and Geography II to 1500 AD to Present （VDOE 2341) H World History and Geography II to 1500 AD to Present （VDOE 2341)	Foreign Language Health and Physical Education (VDOE 7400)	Human Anatomy and Physiology （VDOE 4330) 1CR Nutrition and Wellness (VDOE 5147) 1CR	

	11	11 English (VDOE 1150) 11H English (VDOE 1150) 12A English (VDOE 1160) 13AP English Lit (VDOE 1195) 13AP English Language (VDOE 1195) College Composition I (DE/ ENG 111) 3CR (VDOE 1195) College Composition II (DE/ ENG 112) 3CR (VDOE 1195)	10 Geometry II (VDOE 3145) 10 Geometry (VDOE 3143) 11 Algebra II (VDOE 3135) 11H Algebra II (VDOE 3135) 11 Algebra II/ Trig (VDOE 3137) 12A Math Analysis (VDOE 3162) 13AP Statistics (VDOE 3192) 13AP Calculus (VDOE 3177) Pre Calculus (DE/ MTH 163) 3CR, (VDOE 3162) Calculus I (DE/ MTH 173) 5CR (VDOE 3162) Calculus II (DE/ MTH 174) 5CR (VDOE 3162)	Integrated Science III (VDOE 4411) Biology I (DE/ BIO101,) 4CR (VDOE 4370 Biology II (DE/BIO 102) 4CR (VDOE 4370) Chemistry (VDOE 4410) H Chemistry (VDOE 4410) Chemistry I (DE/ CHM 101) 4CR (VDOE 4470) Chemistry II (DE/ CHM 102) 4CR (VDOE 4470) A Physics (VDOE 4510) AP Biology (VDOE 4370) 13AP Physics (VDOE 4570)	VA and US History I (VDOE 2361) VA and US History II (VDOE 2362) VA and US History (VDOE 2360) H VA and US History (VDOE 2360) 13AP US History (VDOE 2319) 13AP European History (VDOE 2399)	Foreign Language	Emergency Medical Technician I (VDOE 8333) 2CR Emergency Medical Technician II (VDOE 8334) 2CR Emergency Medical Technician III (VDOE 8335) 1CR Emergency Medical Technician (DE/ EMS 111) 6CR Emergency Medical Technician (DE/EMS 120) 1CR	

	12	12 English (VDOE 1160) 12H English (VDOE 1160) 13AP English Literature (VDOE 1195) 13AP English Language (VDOE 1195) College Composition I (DE/ ENG 111) 3CR (VDOE 1195) College Composition II (DE/ ENG 112) 3CR (VDOE 1195)	11 Algebra II (VDOE 3135) 11 Algebra II/ Trig (VDOE 3137) 12 Math Analysis (VDOE 3162) 13AP Statistics (VDOE 3192) 13AP Calculus (VDOE 3177) Pre Calculus (DE/ MTH 163) 3CR (VDOE 3162) Calculus I (DE/ MTH 173) 5CR (VDOE 3162) Calculus II (DE/ MTH 174) 5CR (VDOE 3162)	13AP Biology (VDOE 4370) Biology I (DE/ BIO 101) 4CR (VDOE 4370) Biology II (DE/BIO 102) 4 CR (VDOE 4370) 13AP Chemistry (VDOE 4410) ChemistryI (DE/ CHM 101) 4 CR VDOE 4470 Chemistry II (DE/ CHM 102) 4 CR (VDOE 4470) Physics (VDOE 4510) A Physics (VDOE 4510) 13AP Physics (VDOE 4570)	VA and US Government (VDOE 2360) H VA and US Government (VDOE 2360) 13AP VA and US Government (VDOE 2445) 13AP European History (VDOE 2399)	Foreign Language	Sports Medicine (VDOE 7660) 2CR Sports Medicine II (VDOE 7662) 2CR	

High school courses in the pathway are coded: A=Accelerated; AP= Advanced Placement; CR= Credit; H=Honors; DE= Dual Enrollment; VC=Verified Credit

List related certifications/credentials approved by VDOE and offered locally: Workplace Readiness Assessment (NOCTI) and IC3 Certification Emergency Medical Technician EMS First Responder Cardiopulmonary Resuscitation (CPR)	Additional Learning Opportunities: Student Organizations: National Athletic Trainers Association, American College of Sports Medicine, National Association of Emergency Medical Technicians, Health Occupations Students of America Work-Based Learning: Job Shadowing, Coordinated Internship, Student Apprenticeship, Mentorship , Cooperative Learning
Postsecondary Placement Assessments: COMPASS and SAT	**College Entrance Exams**: ACT, SAT I and SAT II

POSTSECONDARY	POSTSECONDARY PROGRAMS RELATED TO THIS CAREER PATHWAY			
	Pathway	Associate Degree, College Certificate, or Apprenticeship	Bachelor's Degree	Postgraduate Degree

School of Nursing Allied Health	J. Sargeant Reynolds Community College	*Virginia Commonwealth University* *Bachelor's of Science*	Virginia Commonwealth University Masters of Science Doctoral Degree

College: **J. Sargeant Reynolds Community College** School Division(s): Richmond City Public Schools

Postsecondary Placement Assessments: COMPASS and SAT II

POSTSECONDARY - COMMUNITY COLLEGE or APPRENTICESHIP - Determined Locally

Semester	English	Mathematics	Science	Social Studies	Required Courses or Recommended Electives			
POSTSECONDARY PLAN OF STUDIES INCLUDES POSTSECONDARY ACADEMIC, CTE, AND OTHER ELECTIVE COURSES APPROPRIATE FOR AN ASSOCIATE DEGREE.								
Year 1 1st Semester		Math 120	Health Science NAS 161	SDV 100 College Success Skills	EMS 112 EMT I Or EMS 111 EMT Basic	EMS 113 EMT II	EMS 120 EMT Basic Clinical	
Year 1 2nd Semester	English 111 College Composition		Health Science II NAS 162		EMS 1561 Introduction to Advanced Life Support	EMS 170 ALS Internship	EMS 153 ALS – Trauma Care	Social / Behavioral Science Elective
Year 2 1st Semester			ITE 115 Introduction to Computer Applications and Concepts		EMS 155 ALS – Medical Care	EMS 159 ALS - Special Populations	EMS 172 ALS Clinical Internship II	EMS 173 ALS Clinical Field Internship II
Year 2 2nd Semester			Personal Wellness Elective		EMS 205 Advanced Pathophysiology	EMS 207 Advanced Patient Assessment	EMS 242 Clinical Internship II EMS 243 Field Internship II	EMS 201 EMS Professional Dev.
College courses offered locally in the high school for college credit are coded: DE (Dual Enrollment) and/or VC (Validated Credit)								

Related Industry Certifications Available:
Emergency Medical Technician
EMS First Responder
Cardiopulmonary Resuscitation (CPR)

Additional Suggested Learning Opportunities:
Work-Based Learning:
Cooperative Education Internship Mentorship Job Shadowing

Appendix G: Camp Confidence

"Camp CONFIDENCE" * at the Governor's Career and Technical Academy for STEM in Richmond

Theme: **"**Preparation Meets Opportunity**"**

Purpose: To increase students' knowledge to be successful in a variety of career paths

Rationale: To eliminate barriers to students' successful entry into careers

Format: Interactive **s**eminars will be offered twice monthly covering "life skills" to help students with problem-solving and decision-making. Parents will be expected to attend four sessions. Parent sessions will also focus on financial planning for postsecondary education. Internal and external sources will be used to facilitate seminars.

Seminar Topics:

Communication Skills

Organizational Skills

Negotiation Skills

Financial Fitness and Budgeting

Individuality/Uniqueness

Determination

Education

Networking

Competence

Etiquette

Related topics: stress management, appropriate attire for the workplace, time management, leadership development, research and evaluation, travel/exchange programs.

Supportive Activities:

- Toastmasters for Youth Development;
- Challenge Discovery for team building;
- College campus visits; and
- Visits for cultural enrichment, i.e., museums, and positive leisure/social activities.

Reference: developed by CgM 2009

Appendix H: Virtual Worlds Program

Governor's Career and Technical Academy for STEM in Richmond

Richmond City Public Schools, Richmond VA

VIRTUAL WORLDS

"**Virtual Worlds,"** is an interactive computer based communication program through which teams of students collaborate with a teacher coach, and student mentors at Virginia Commonwealth University in Richmond VA, and Cornell University in Ithaca NY, in order to build their own 3D multiuser computer graphics exhibits. Within these exhibits, students and educators can interact to learn about interesting topics and interactive forums. Students gain beneficial tools by working through the innovative medium of virtual worlds. Students learn and utilize technology literacy, science literacy, history, mathematical principles, contemporary forms of research, as well as valuable team skills through working with college students and peers.

The following statements offer brief insight into what SciCentr and SciFair are as presented on the Cornell University SciCentr Virtual Worlds Web site.

"SciCentr is an online science museum of 3D, multiuser exhibits featuring basic science and contemporary research, especially projects at Cornell University. Some exhibits are framed as galleries, some as games, and others as interactive laboratories. In these exhibits, students and educators can interact to learn about interesting topics ranging from wave science to genetics."

"SciFair is a science communication program through which teams of teens collaborate with student mentors at Cornell University to build their own exhibits. Students gain the tools for working with the innovative medium of virtual worlds (technology literacy), as well as science literacy and valuable team skills through working with college students and peers."

Richmond City Public Schools is in the process of acquiring a virtual universe (computer server) that is comparable to the virtual universe at Cornell University, and will be utilized in accordance with the SciCentr and SciFair programs. This will enable Richmond City Public Schools to host and manage the program with all middle and high schools.

The Governor's Career and Technical Academy for STEM at the Richmond Technical Center is a complimentary match for the virtual worlds program. Students from both middle schools and high schools will be able to learn how to create their own virtual worlds using virtual worlds software, and receive mentoring and guidance from undergraduate and graduate students from VCU through mentoring, after school programming, and summer virtual institutes offered by Richmond City Public Schools and hosted at VCU. The approach for this program is to introduce students who have little or no experience using this technology, to the fields of mathematics, computer science, and computer engineering, according to the state's Standards of Learning through the use of virtual worlds' software.

The targeted grade levels for the program in middle schools will be grades 6-8, and in high schools grades 9-12. The learning objectives will include, but not be limited to:

- exposing middle school students to new methodologies of computer technology and software development;
- teaching students how to use computers and the Internet to conduct research;
- introducing students to the fields of computer science, computer engineering, software development, and technological pathways;
- teaching students how to work together as teams;

- encouraging high school students and middle school students to mutually mentor one another and share the science of virtual worlds and gain the benefits of student interaction;
- working and interacting with undergraduate computer science majors at Virginia Commonwealth through the University's School of Computer Science and School of Engineering via online and in world mentoring to create a direct connection with higher education; and
- encouraging students to pursue venues of higher education in fields of science, technology, engineering, and mathematics.

Teachers at Richmond Technical Center have begun the training required to provide instruction that will likely appear as “gaming” to students. Expanded professional development opportunities for teachers are being discussed with Virginia Commonwealth University’s Computer Science Department.

Appendix I: Academy Student Application and Selection Scoring Rubric

Governor's Career and Technical Academy for Pre-Engineering and Health and Human Performance Academy Student Application 2009-2010

Application materials must be submitted or postmarked on or before school deadlines to receive priority consideration.

First Name_____ Middle Name_____ Last Name_____

Address_____

City_____ State_____ Zip_____

Phone_____ Cell or Message_____ E-Mail_____

Student ID Number_____ Age_____ Date of Birth_____

School currently attending (Name, City, State): _____

_____

Date Application submitted: _____

Class level at time of planned enrollment: (circle one) **Freshman** **Sophomore** **Junior** **Senior**

Overall Grade Point Average: _____ Science Grade Point Average: _____

Mathematics Grade Point Average: _____

List all related Mathematic Courses w/Grades: _____

_____

_____

List all related Science Courses w/Grades: _____

_____

_____

Signature of Applicant_____

Signature of Parent(s)_____

Academy Student Selection Rubric					
Factors	**Rating Scale (1-5) 5 is highest and 1 is the lowest**				
	5	4	3	2	1
Application					
Overall GPA					
Science GPA					
Math GPA					
Interest Inventory Assessment					
Essay					
Interview					
Referral Letter					
*Summer Program (extra credit)					
*Attendance					

- Application
  - (5) Signed, without any misspelled words and no omissions
  - (4) Signed with one or two misspelled words and no omissions
  - (3) Signed with one or two misspelled words and one omission
  - (2) Signed with more than two misspelled words and two omissions
  - (1) Signed with more than three misspelled words and more than two omissions
- Overall GPA
  - (5) Overall “A” average according to RCPS grade system
  - (4) Overall “B” average according to RCPS grade system
  - (3) Overall “C” average according to RCPS grade system
  - (2) Overall “D” average according to RCPS grade system
  - (1) Overall “F” average according to RCPS grade system
- Science GPA
  - (5) Overall “A” average according to RCPS grade system
  - (4) Overall “B” average according to RCPS grade system
  - (3) Overall “C” average according to RCPS grade system
  - (2) Overall “D” average according to RCPS grade system

  - (1) Overall “F” average according to RCPS grade system

- Math GPA
  - (5) Overall “A” average according to RCPS grade system
  - (4) Overall “B” average according to RCPS grade system
  - (3) Overall “C” average according to RCPS grade system
  - (2) Overall “D” average according to RCPS grade system
  - (1) Overall “F” average according to RCPS grade system
- Interest Inventory Assessment
  - (5) STEM appears in the top three clusters
  - (4) STEM appears in the top five clusters
  - (3) STEM appears in the top seven clusters
  - (2) STEM appears in the top nine ranking according to interest
  - (1) STEM appears in the top ten ranking according to interest
- Essay
  - (5) Addresses topic fully, written using 50-100 words, no misspelled words, and no incorrect punctuation errors.
  - (4) Addresses topic fully, written using 50-100 words, no more than two misspelled words, and not more than two incorrect punctuation errors.
  - (3) Addresses topic fully, written using 50-100 words, no more than three misspelled words, and not more than three incorrect punctuation errors.
  - (2) Somewhat addresses the topic, written 50-100 words, no more than three misspelled words and not more than three incorrect punctuation errors.
  - (1) Very little addresses the topic, or written using less than 50 or more than 100 words, or more than three misspelled words and more than three punctuation errors.
- Interview
  - (5) Responds to all questions satisfactorily
  - (4) Responds to most of the questions satisfactorily
  - (3) Responds to some of the questions satisfactorily
  - (2) Responds to a few of the questions satisfactorily

  - (1) Responds to two or less questions satisfactorily

- Referral Letter (from Science and/or Mathematics Educator)
  - (5) Very highly recommended
  - (4) Highly recommended
  - (3) Satisfactorily recommended
  - (2) Somewhat recommended
  - (1) Recommended with reservations
- Summer Program (extra credit can be given for attending a summer program that covers any of the components of STEM) (more detailed information will be provided)
- Attendance
  - (5) Perfect Attendance for the last semester
  - (4) No more than 2 unexcused days missed during the last semester
  - (3) No more than 4 unexcused days missed during the last semester
  - (2) No more than 6 unexcused days missed during the last semester
  - (1) More than 6 unexcused days missed during the last semester.

Appendix J: Statement(s) of Support

RICHMOND PUBLIC SCHOOLS
Office of the Superintendent

301 North Ninth Street • Richmond, Virginia 23219 • (804) 780-8320 • FAX (804) 780-4122

YVONNE W. BRANDON, Ed.D.
Superintendent

March 9, 2009

Statement of Support for the Governor's CTE Academy for STEM in Richmond

As Superintendent of Richmond Public Schools, I wholeheartedly support and enthusiastically endorse the creation of the Governor's Career and Technical Education Academy for Science, Technology, Engineering and Mathematics (STEM) at the Richmond Technical Center (RTC). The location of STEM at one of the region's leading technology and career training facilities is an appropriate choice and logical linkage.

As head of the city's public school system, I can guarantee that the Academy will receive the essential support necessary to ensure its success. In fact, Richmond Public Schools, along with the administration and staff at RTC, will gladly assist with faculty training, classroom and laboratory design, and community partnerships.

Of course, locating the Academy at the Richmond Technical Center will most benefit our students. Indeed, they are my primary reason for requesting that the Academy be located in Richmond. An important component of the district's overall plan to make Richmond one of the nation's leading urban school systems is our 21st Century Workforce Preparedness Initiative. Simply put, we want the graduates of Richmond Public Schools to be equipped with the knowledge and skills required for postsecondary education or successful entry into the workforce. These are the only outcomes we deem acceptable for our students. By locating the Governor's Career and Technical Education Academy at the Richmond Technical Center, you will greatly assist in our achieving these goals.

Yvonne W. Brandon, Ed.D.
Superintendent

RICHMOND PUBLIC SCHOOLS

Richmond Technical Center
2020 Westwood Avenue
Richmond, Virginia 23230-4198
Telephone (804) 780-6237 Fax (804) 780-6061

Statement of Support for the Governor's CTE Academy for STEM in Richmond:

As the principal of the Richmond Technical Center (RTC) for the past eight years, I am committed, along with the faculty and staff, to provide a nurturing and innovative educational environment for our students. The establishment of the Governor's Career and Technical Education Academy in STEM at RTC will provide additional options for students to pursue.

An essential component of the Governor's Career and Technical Academy for Science, Technology, Engineering and Mathematics (STEM) is support from the school in which the program will be held. As principal of the Richmond Technical Center, I will:

1. Select well-trained and prepared faculty for the Academy
2. Assist in the evaluation of the programs, courses and the overall operation of the Academy
3. Design classroom and laboratory space for instruction
4. Create an environment that is conducive for learning
5. Collaborate and Partner with businesses and other community agencies
6. Collaborate and Partner with both community and four year colleges
7. Assist in the approval of dual enrollment courses for certain identified courses at the high school level, and
8. Assist in preparing students for post-secondary experiences in the workplace, technical school or college.

By signing this statement, I certify that I am a willing supporter in the establishment of the Governor's Career and Technical Education Academy for Science, Technology, Engineering and Mathematics in Richmond.

N. Maurice Holmes

N. Maurice Holmes

February 27, 2009

"In accordance with federal laws, the laws of the Commonwealth of Virginia and the policies of the School Board of the City of Richmond, Richmond Public Schools does not discriminate on the basis of sex, race, color, age, religion, disabilities or national origin in the provision of employment and services. The Richmond Public Schools operates equal opportunity and affirmative action programs for students and staff. The Richmond Public Schools is an equal opportunity/affirmative action employer. The Section 504 Coordinator is Mr. Harley Tomey, Richmond Public Schools, 301 North Ninth Street, Richmond, Virginia 23219, (804) 780-7911. The ADA Coordinator is Ms. Aisha Shamburger, 2015 Seddon Way, 1st Floor, Richmond, VA 23230-4117 (804) 780-6211. The Title IX Officer is Mrs. Angela C. Lewis, Richmond Public Schools, 301 North Ninth Street, Richmond, Virginia 23219, (804) 780-7716." The United States Department of Education's Office of Civil Rights may be contacted also at P.O. Box 14620, Washington, D.C. 20044-4420. Telephone: 202-208-2545

Raymond Cousins
RTC CTE Advisory Council, Chair
Richmond Technical Center
2020 Westwood Avenue
Richmond, VA 23230
804-780-6237

February 23, 2009

Statement of Support for the Governor's CTE Academy in STEM in Richmond:

As Chair of the Richmond Technical Center Career and Technical Education Advisory Council (RTC CTE), it gives me great pride to share the enthusiastic participation of the Advisory Council and our role to model the educational, business, professional and community service behaviors at the Richmond Technical Center.

As an Advisory Council we are governed by one committed guiding purpose, to enrich the lives of students, staff and the community at Richmond Technical Center (RTC). We have a strong advisory council with varying levels of expertise that resonates into passionate business acumen. Our council is committed to supporting the goals and ideals of Richmond Public Schools and RTC students in the following arenas:

- Assist the Administration in developing and implementing broad career and technical education programs for the school year;
- Work with designated staff members in planning and evaluating career and technical education programs in the school;
- Facilitate communication and cooperation between the school, the citizens, organizations, industries and institutions of the community; and,
- Address the student body on topics, which will inspire students to pursue career and technical education careers.

These commitments have rendered great success with the RTC CTE Advisory Council Annual Golf Tournament and Scholarship Fundraiser affording the opportunity for students to earn scholarship dollars to purse college degrees. Each year the RTC CTE Advisory Council hosts a Business Partners Event where the business community as well as public leaders and educators collaborate and share best practices focused on enriching the lives of RTC students, their families and communities. Mock Job Interviews in the spring and fall of each year embraces the business and technical acumen of RTC CTE Advisory Council Members and their employers to role model the professional behavior of what is expected and equally demanded in life after high school. Whether our students are preparing for college, employment or the armed services, members of the RTC CTE Advisory council lends countless volunteer hours in working with the students of RTC to give them a realistic vision of what a future could be.

Through a determined commitment to promote financial literacy one of our RTC CTE Corporate Sponsors was recognized as a Regional Department of Education Award Winner in 2007. The advisory council partners with the RTC Clusters in their respective disciplines and assists teachers and staff in culminating the classroom with the workforce. Students get an opportunity

to do job shadowing, internships, and mentoring opportunities at RTC CTE Advisory Council places of employment and community involvement.

The RTC CTE Advisory Council attends the City of Richmond's School Board and City Council meetings and works very closely with Central Office Administration. Advisory Council members are present for the installation of RTC officers for student organization; serves as host/hostess at the Skills USA Competition; and speaks at the School Board Finance and Budget Committee meeting to discourage the elimination of budget cuts in the CTE classroom. The council attends and participates in many educational and community events.

We invite you and your staff to attend RTC Annual Awards Night Recognition Ceremony where students and their families celebrate the career and technical achievements of an entire school year's hard work, determination and perseverance. These ceremonies year-over-year will tug at your heart and if you are an educator or have been affected by an educator you are thankful for the thankless and selfless acts they do every day to make sure that our students become outstanding citizens.

Raymond Cousins

RTC CTE Advisory Council, Chair

Appendix I—Statement of Support

VATPDC
Virginia Applied Technology & Professional Development Center

Old Dominion University
Frank Batten College of Engineering & Technology
www.eng.odu.edu

OLD DOMINION UNIVERSITY **PH: 757.683.5505**
4111 Monarch Way, Ste 106 **Fax: 757.683.5509**

Norfolk, Virginia 23508 *www.vatpdc.com*

March 15, 2009

Mrs. Maurice Holmes
Prinicpal
Richmond Technical Center
2020 Westwood Ave
Richmond, VA 23230-4198

Dear Mrs. Holmes:

I am pleased to submit this letter in support of the Richmond Public Schools' Richmond Technical Center's application for the Virginia Department of Education, Office of Career and Technical Education Services, grant to establish a Project Lead The Way (PLTW) program. Project Lead The Way offers a four-year sequence of courses which, when combined with college preparatory mathematics and science courses in high school, introduces students to engineering and engineering technology prior to entering college. The grant will be used to establish a state of the art Project Lead The Way laboratory. We endorse the course work which will include Introduction to Engineering Design, Principles of Engineering, Digital Electronics, Engineering Design and Development and Civil Engineering and Architecture or Computer Integrated Manufacturing.

Old Dominion University is committed to partner with Richmond Public Schools' Richmond Technical Center to implement a partnership for the purpose of increasing the number of students interested in engineering related careers while improving students' academic knowledge and technical abilities. This collaborative project will focus on strengthening STEM (Science, Technology, Engineering and Math) foundations in high school students using a combination of activities-based, project –based, and problem-based (APPB) learning. Our organization supports this goal.

This letter of support documents Old Dominion University's commitment to our partnership with Richmond Public Schools for the specific purpose of increasing the number of students

interested in careers in engineering and engineering technology fields. This support is demonstrated by submitting this letter of support and may include the possibility of providing mentors for students in their junior and senior engineering courses, speaking engagements for the students and /or providing engineers to serve on a panel of outside reviewers to evaluate student senior projects at the end of the school year.

Sincerely,

Jerry B. Robertson, P.E.
National Affiliate Director – Virginia PLTW
Executive Director, VATPDC

Appendix K: Statement of Assurance

Assurance

Richmond Public Schools will serve as the fiscal agent for the implementation and development of the Governor's Career and Technical Academy for Pre- Engineering and Health & Human Performance (Sports Medicine).

Richmond Public Schools will assure that all operating funds and facilities available will be used to support the Academy and is adequate to meet the needs of the program.

Dr. Yvonne W. Brandon	Interim Superintendent	October 31, 2008
Name (Print)	Title	Date
Signature		10/31/08 Date

Board of Education Agenda Item

Item: N. **Date:** July 23, 2009

Board of Education Agenda Item

Topic: First Review of Proposed Revised Curriculum Framework for 2009 *Mathematics Standards of Learning*

Presenter: Dr. Linda M. Wallinger, Assistant Superintendent for Instruction

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Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____
- ____ Action requested at this meeting _X_ Action requested at future meeting: After public comment

Previous Review/Action:

____ No previous board review/action

_X_ Previous review/action
Date February 19, 2009
Action Board of Education adopted the 2009 *Mathematics Standards of Learning*.

Background Information:
New academic content *Mathematics Standards of Learning* were developed in 1995 and revised in 2001. The *Standards of Quality* require the Board of Education to review the *Standards of Learning* on a regular schedule. The *Mathematics Standards of Learning* were scheduled for review in 2009. As a result, on March 19, 2008, the Board approved a plan to complete the review and revision of these standards and the companion Curriculum Framework during 2009.

On February 19, 2009, the Board approved the 2009 *Mathematics Standards of Learning*. In accordance with the plan, the Department of Education took the following steps to produce a draft of the proposed revised Curriculum Framework for the 2009 *Mathematics Standards of Learning* for the Board's first review:

- Selected a review committee that consisted of individuals solicited from school divisions as well as other stakeholder groups to participate in the process;
- Met with the review committee during May 2009;
- Developed a draft of the proposed revised Curriculum Framework for the 2009 *Mathematics Standards of Learning*.

Summary of Major Elements:
The Virginia Department of Education has developed the attached draft of the proposed revised Curriculum Framework for the 2009 *Mathematics Standards of Learning* (Attachment A).

The major elements of the attached proposed revised Curriculum Framework for the 2009 *Mathematics Standards of Learning* include:

- Specificity and clarity of the scope and intent of each of the 2009 *Mathematics Standards of Learning*;
- Instructional focus for each strand in each grade K-8;
- Growth in the level at which content is presented and increased rigor in each of the six strands in K-8;
- Evidence of the path through K-7 to Algebra I;
- Continued growth from the Patterns, Functions, and Algebra strand in K-8 through Algebra I; Algebra, Functions, and Data Analysis; and Algebra II; and
- Increased emphasis on probability and statistics at the high school level in alignment with recommendations from Achieve, the College Board, ACT, and other organizations and current documents.

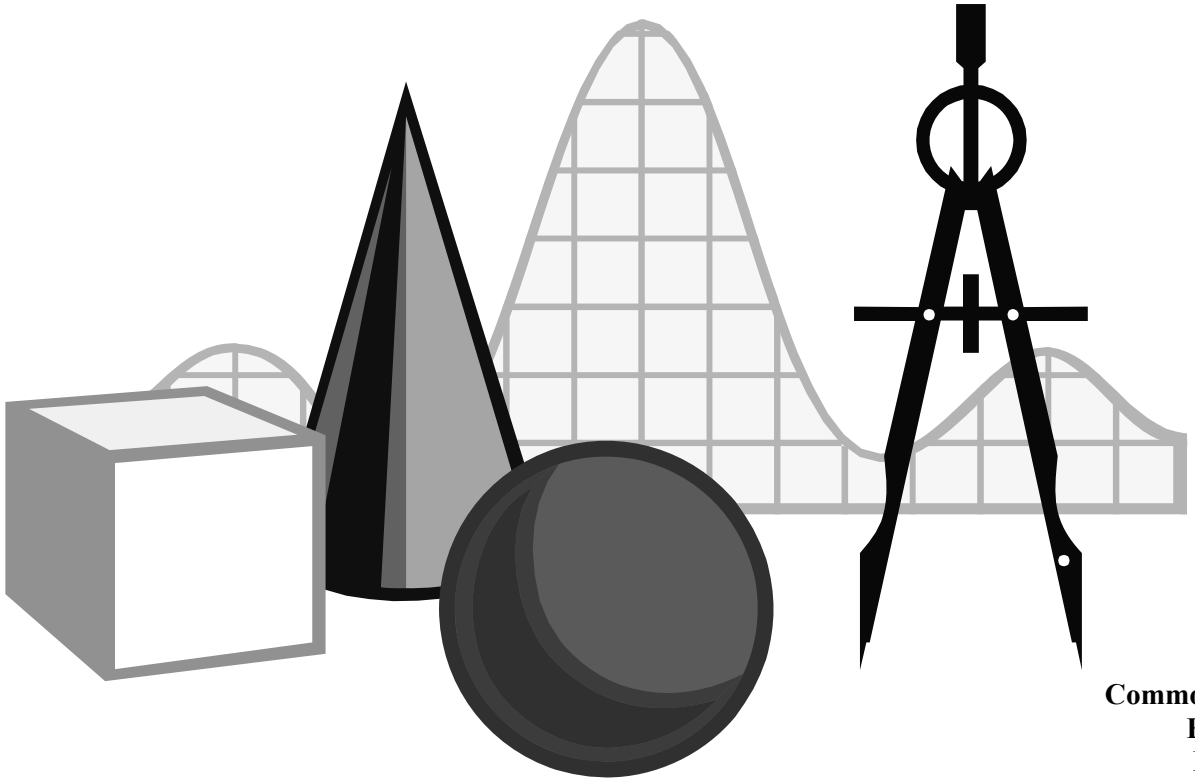
Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education accept for first review the proposed revised Curriculum Framework for the 2009 *Mathematics Standards of Learning*.

Impact on Resources:
This responsibility can be absorbed by the agency's existing resources at this time.

Timetable for Further Review/Action:
Following the Board of Education's acceptance of the 2009 *Mathematics Standards of Learning* Curriculum Framework for first review, notification and availability will be made on the Virginia Department of Education's Web site. The 2009 *Mathematics Standards of Learning* Curriculum Framework work plan calls for public comment, final review, and adoption by the Board of Education in 2009.

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Kindergarten



Commonwealth of Virginia
Board of Education
Richmond, Virginia
Draft July 23, 2009

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Acknowledgements
The Virginia Department of Education wishes to express sincere thanks to Deborah Kiger Bliss who assisted in the development of the *2009 Mathematics Standards of Learning* Curriculum Framework.

NOTICE TO THE READER

The Virginia Department of Education does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities.

The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, ~~simple~~ fractions, number relationships ("more than," "less than," and "~~as many as~~ equal to"), and the effects of ~~simple~~ single-step and multistep computations ~~operations on numbers (fact families)~~. These learning experiences should allow students to engage actively in a variety of problem solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

K.1 The student, given two sets, each containing 10 or fewer concrete objects, will identify and describe one set as having more, fewer, or the same number of members as the other set, using the concept of one-to-one correspondence.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A set is a collection of distinct elements or items. • A one-to-one correspondence exists when two sets have an equal number of items. • Strategies for developing the concept of one-to-one matching involve set comparisons without counting. Hands-on experiences in matching items between two sets by moving, touching, and aligning objects, using one-to-one correspondence, enable visual as well as kinesthetic comparisons of the number of items in the two sets. • Students can also ~~use the strategy of~~ count~~ing~~ to make comparisons between two sets without matching the sets, using one-to-one correspondence. • Students are generally familiar with the concept of *more*, but have had little experience with the term *less*. It is important to use the terms together to build an understanding of their relationship. For example, when asking which group has more, follow with which group has less and vice versa.	**All students should** • Understand how quantities relate to each other, which leads to an understanding of how numbers are related to each other.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Match each member of one set with each member of another set, using the concept of one-to-one correspondence to compare the number of members between sets, where each set contains 10 or fewer objects. • Compare and describe two sets of 10 or fewer objects, using the terms *more, fewer,* and *the same*. • Given a set of objects, construct a second set which has more, fewer or the same number of objects.

K.2 The student, given a set containing 15 or fewer concrete objects, will
a) tell how many are in the set by counting the number of objects orally;
b) write the numeral to tell how many are in the set; and
c) select the corresponding numeral from a given set of numerals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Counting involves two separate skills: verbalizing the list of standard number words in order ("one, two, three,…") and connecting this sequence with the objects in the set being counted, using one-to-one correspondence. Association of number words with collections of objects is achieved by moving, touching, or pointing to objects as the number words are spoken. Objects may be presented in random order or arranged for easy counting. • Kinesthetic involvement (e.g., tracing the numbers, using tactile materials, such as sand, sandpaper, carpeting, or finger paint) facilitates the writing of numerals. • Articulating the characteristics of each numeral when writing numbers has been found to reduce the amount of time it takes to learn to write numerals. • Zero (0) is both a number and a digit. As a number, it plays a central role in mathematics as the additive identity of the integers, real numbers, and many other algebraic structures. As a digit, zero is used as a placeholder in systems. • *Conservation of number* and *cardinality principle* are two important milestones in development to attaching meaning to counting. • The cardinality principle refers to the concept that the last counted number describes the total amount of the counted set. It is an extension of one-to-one correspondence.	**All students should** • Read and write numerals from 0 through ~~10~~ 15. • Understand that the total number of objects can be found by counting. • Understand that the last counted number describes the total amount in the set. • Understand that if the set is empty, it has 0 elements. • Understand that changing the spatial arrangement of a set of objects does not change the total amount of the set.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count orally the number of objects in a set containing ~~10~~ 15 or fewer concrete objects, using one-to-one correspondence, and identify the corresponding numeral. • Identify written numerals from 0 through ~~10~~ 15 represented in random order. • Select the numeral from a given set of numerals that corresponds to a set of ~~10~~ 15 or fewer concrete objects. • Write the numerals from 0 through ~~10~~ 15. • Write a numeral that corresponds to a set of ~~10~~ 15 or fewer concrete objects. • Construct a set of objects that corresponds to a given numeral, including an empty set.

K.2 The student, given a set containing 15 or fewer concrete objects, will
a) tell how many are in the set by counting the number of objects orally;
b) write the numeral to tell how many are in the set; and
c) select the corresponding numeral from a given set of numerals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Conservation of number is the understanding that the number of objects remains the same when they are rearranged spatially.		

K.3 The student, given an ordered set of ten objects and/or pictures, will indicate the ordinal position of each object, first through tenth, and the ordered position of each object.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Understanding the cardinal and ordinal meanings of numbers is necessary to quantify, measure, and identify the order of objects. • An ordinal number is a number that names the place or position of an object in a sequence or set (e.g., first, third). *Ordered position*, *ordinal position*, and *ordinality* are terms that refer to the place or position of an object in a sequence or set. • The ordinal position is determined by where one starts in an ordered set of objects or sequence of objects. • The ordinal meaning of numbers is developed by identifying and verbalizing the place or position of objects in a set or sequence (e.g., the student's position in line when students are lined up alphabetically by first name).	**All students should** • Use ordinal numbers to describe the ~~order~~ position of objects in a sequence.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the ordinal positions first~~, second, and third~~ through tenth using ordered sets of ~~three~~ ten concrete objects and/or pictures of such sets presented from – left-to-right; – right-to-left; – top-to-bottom; and/or – bottom-to-top.

K.4 The student will

a) count forward to 100 and backward from 10;
b) identify one more than a number and one less than a number; and
c) count by fives and tens to 100.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Counting skills are essential components of the development of number ideas; however, they are only one of the indicators of the understanding of numbers. • Counting forward by rote advances the child's development of sequencing. Students should count the natural numbers 1, 2, 3, 4,…. These are not to be confused with the whole numbers that begin with the integer zero. • Counting backward by rote lays the foundation for subtraction. Students should count backward beginning with 10, 9, 8,… through …3, 2, 1, 0. • Counting forward and backward leads to the development of counting on and counting back. • The patterns developed as a result of skip counting are precursors for recognizing numeric patterns, functional relationships, and concepts underlying money, time telling, and multiplication. Powerful models for developing these concepts include, but are not limited to, counters, hundred chart, and calculators. • Skip counting by fives lays the foundation for reading a clock effectively and telling time to the nearest five minutes, counting money, and developing the multiplication facts for five. • Skip counting by tens is a precursor for use of place value, addition, counting money, and multiplying by multiples of 10.	**All students should** • Use the correct oral counting sequence in both forward and backward counting situations. • Understand that skip counting can be used to count a collection of objects. • Describe patterns in skip counting and use those patterns to predict the next number or numbers in the skip counting sequence. • Understand that numeric relationships include one more than, one less than, two more than, two less than, etc. • Understand benchmarks of five and ten.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count forward from ~~1~~ 0 to ~~30~~ 100. • Count backward from 10 to ~~1~~ 0. • Recognize the relationship of one more than and one less than a number using objects (i.e., five and one more is six; and one less than ten is nine). • Group ~~30~~ 100 or fewer objects together into sets of fives or tens and then count them by fives or by tens. • ~~Investigate and recognize the pattern of counting by fives and tens, using 30 or fewer concrete objects.~~ • Investigate and recognize the pattern of counting by fives ~~and tens~~ to ~~30~~ 100, using a ~~calculator~~ variety of tools. • Investigate and recognize the pattern of counting by ~~fives and~~ tens to ~~30~~ 100, using a ~~calculator~~ variety of tools.

K.4 The student will

a) count forward to 100 and backward from 10;
b) identify one more than a number and one less than a number; and
c) count by fives and tens to 100.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Calculators can be used to display the numeric patterns that result from skip counting. ~~Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. For example, when skip counting by fives, press 5 + 5 = = =… to produce 5, 10, 15,….~~		

K.5 The student will identify the parts of a set and/or region that represent fractions for halves and fourths.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A fraction is a way of representing part of a whole (as in a region/area model) or part of a group (as in a set model). • In each fraction model, the parts must ~~be equal (i.e., each pie piece must~~ have the same area~~)~~. ~~In problems with fractions, a whole is broken into equal-size parts and reassembled into one whole.~~ • The fractional parts of a set model are subsets of an equal number. For example, in a set of ten cubes, each half would be a subset of five cubes. • Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions furthers this development (e.g., *thirds* means "three equal parts of a whole" or $\frac{1}{3}$ represents one of three ~~equal-size~~ parts of equal size when a pizza is shared among three students).	**All students should** • Understand that fractional parts are equal shares of a whole region or a whole set. • Understand that the fraction name (*half*, *fourth*) tells the number of equal parts in the whole. • Understand that the fraction name (*half*, *fourth*) of the set model is a subset of the whole set with equal numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize fractions as representing parts of equal size of a whole. • Given a region, identify half and/or a fourth of the region. • Given a set, identify half and/or a fourth of the set.

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling ~~and~~, discussing, and recording a variety of problem situations. This approach ~~to~~ helps students ~~move~~ transition from the concrete to the representation to the symbolic ~~the abstract~~ ~~and~~ in order to develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, multiplication, division ~~facts~~ and related facts ~~families~~;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions ~~and decimals~~.

K.6 The student will model adding and subtracting whole numbers, using up to 10 concrete objects.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Whole numbers are 0, 1, 2, 3, 4, 5, 6, and so on. • Addition is the process of combining or joining sets. • Subtraction can be viewed as a ~~"~~taking away~~"~~ or ~~"~~separating~~"~~ process or as the difference between two sets. • Counting on from the larger set to determine the sum of the combined sets is a strategy for finding a sum. • Counting backward from the larger set to determine the difference between two sets is a strategy for subtraction. • Number relationships, including the following, help students develop strategies for adding and subtracting. – Instant recognition of the amount in a set of objects that are arranged in a familiar pattern such as the dots on number cubes – One more than, one less than, two more than, two less than	**All students should** • Understand that addition j~~oins~~ means putting things ~~objects~~ together and that subtraction is the inverse of addition and means ~~separates~~ to separate ~~objects~~ things out.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Combine two sets with known quantities in each set, and count the combined set using up to 10 concrete objects, to determine the sum, where the sum is not greater than 10 ~~concrete objects~~. • Given a set of 10 or fewer concrete objects, ~~Remove~~ remove, ~~"~~take away,~~"~~ or separate part of ~~a~~ the set ~~from a given set to~~ and determine the result ~~of subtraction~~.

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

K.7 The student will recognize a penny, nickel, dime, and quarter and will determine the value of a collection of pennies and/or nickels whose total value is 10 cents or less.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Involvement in varied activities such as physically manipulating coins and making comparisons about their sizes, colors, and values is prerequisite to the skills of coin recognition and valuation. • Counting money helps students gain an awareness of consumer skills and the use of money in everyday life. • A variety of classroom experiences in which students manipulate physical models of money and count forward to determine the value of a collection of coins are important activities to ensure competence with using money. • ~~Establishing a one-to-one correspondence between the number names and the objects in a set of coins (pennies and/or nickels) is essential for an accurate count.~~ • Students need experiences to develop the concept that a nickel has a value of five cents even though it is one object.	**All students should** • Develop common referents for identifying pennies, nickels, dimes, and quarters. • Understand the value of a collection of coins whose value is 10 cents or less.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe the properties/characteristics (e.g., color, relative size) of a penny, nickel, dime, and quarter. • Identify a penny, nickel, dime, and quarter. • Identify that a nickel is the same value as five pennies. • Count a randomly placed collection of pennies and/or nickels (or models of pennies and/or nickels) whose value is 10 cents or less, and determine the value of the collection.

K.8 The student will identify the instruments used to measure length (ruler), weight (scale), time (clock: digital and analog; calendar: day, month, and season), and temperature (thermometer).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Many experiences in measuring physical objects, using nonstandard and standard units of measure, help to develop an intuitive understanding of measurement and will help students connect a tool with its purpose in measuring. • Selecting from among various measuring instruments and determining which can be used to solve various real-life problems are introduced at this level. • A precursor to connecting tools to a type of measurement is an introduction to the concepts of length, weight, time, and temperature.	**All students should** • Identify an appropriate measuring tool for a given unit of measure.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a ruler as an instrument to measure length. • Identify different types of scales as instruments to measure weight. • Identify different types of clocks (analog and digital) as instruments to measure time. • Identify the components of a calendar, including days, months, and seasons. • Identify different types of thermometers as instruments used to measure temperature.

K.9 The student will tell time to the hour, using analog and digital clocks.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Many experiences in relating time on the hour to daily routines and school schedules (e.g., catching the bus, lunch time, recess time, and resource time) help students develop personal referents for time. • Making sense of telling time to the nearest hour is reinforced when students recognize the positions of the hands on an analog clock and identify the corresponding time to the hour.	**All students should** • Apply an appropriate technique, depending on the type of clock, to determine time to the nearest hour.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Tell time on an analog clock to the hour. • Tell time on a digital clock to the hour.

K.10 The student will compare two objects or events, using direct comparisons or nonstandard units of measure, according to one or more of the following attributes: length (shorter, longer), height (taller, shorter), weight (heavier, lighter), temperature (hotter, colder). Examples of nonstandard units include foot length, hand span, new pencil, paper clip, and block.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Length is the distance ~~along a line or figure from one point to another~~ between two points. • Height is the vertical length of a perpendicular to its base. • Weight is a measure of the heaviness of an object. • Temperature is the degree of hotness or coldness of an object (e.g., a body) or environment. • Students need to identify the attribute that they are measuring (e.g., length, height, weight, temperature) before they begin to measure. • ~~Extensive opportunities~~ Multiple hands-on experiences are needed to gain the ability to compare the attributes of objects.	**All students should** • Compare and order objects according to their attributes. • Develop an understanding of measuring with nonstandard and standard units of measure. • Recognize attributes (length, height, weight, temperature) that can be measured.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and describe lengths of two objects (as shorter or longer), using direct comparison or nonstandard units of measure (e.g., foot length, hand span, new pencil, paper clip, block). • Compare and describe heights of two objects (as taller or shorter), using direct comparison or nonstandard units of measure (e.g., book, hand span, new pencil, paper clip, block). • Compare and describe weights of two objects (as heavier or lighter), using direct comparison or nonstandard units of measure (e.g., book, cubes, new pencil, paper clip, block). • Compare and describe temperatures of two objects or environment (as hotter or colder), using direct comparison.

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of ~~shapes~~ figures and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent ~~two- and three-dimensional~~ plane and solid ~~shapes~~ figures through drawing, block constructions, dramatization, and verbal language.

The focus of instruction at this level is on

- observing, identifying, describing, comparing, contrasting and investigating ~~three-dimensional~~ solid objects and their ~~two-dimensional~~ faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, contrasting, sorting, and classifying ~~shapes~~ figures; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to ~~these shapes~~ figures but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.

K.11 The student will

a) identify, describe, and trace plane geometric figures (circle, triangle, square, and rectangle); and

b) compare the size (larger, smaller) and shape of plane geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An important part of the geometry strand in grades K through 2 is the naming and describing of ~~shapes~~ figures. Children move from their own vocabulary and begin to incorporate conventional terminology as the teacher uses geometric terms. • A plane geometric figure is any ~~two-dimensional~~ plane, closed ~~shape~~ figure. Circles and polygons are examples of plane geometric figures. • Presentation of triangles, rectangles, and squares should be made in a variety of spatial orientations so that students do not develop the common misconception that triangles, rectangles, and squares must have one side parallel to the bottom of the page on which they are printed. • The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., "I know it's a rectangle because it looks like a door, and I know	**All students should** • Use their knowledge of ~~two-dimensional~~ plane figures to help them systematically represent and describe their world. • ~~Develop an understanding of the shapes of geometric figures by using various methods.~~ • Identify the characteristics of plane geometric figures (circle, triangle, square, and rectangle). • Compare the size and shape of plane geometric figures by using strategies to sort and/or group and begin to refine the vocabulary used to explain their strategies.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a circle, triangle, square, and rectangle. • Describe the ~~properties~~ characteristics of triangles, squares, and rectangles, including number of sides and number of ~~corners~~ angles. • Describe a circle using terms such as round and curved. • ~~Draw~~ Trace a circle, triangle, square, and rectangle. • Compare and group plane geometric figures (circle, triangle, square, and rectangle) according to their relative sizes (larger, smaller). • Compare and group plane geometric figures (circle, triangle, square, and rectangle) according to their shapes. • Distinguish between examples and nonexamples of identified geometric figures.

K.11 The student will

a) identify, describe, and trace plane geometric figures (circle, triangle, square, and rectangle); and

b) compare the size (larger, smaller) and shape of plane geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
that a door is a rectangle.”) – **Level 2: Analysis.** Properties are perceived, but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., “I know it’s a rectangle because it is closed; it has four sides and four right angles.”). • A polygon is a geometric figure that – has sides that are ~~straight~~ line segments; – is simple (its sides do not cross); – is closed; and – is two-dimensional (~~it~~ lies in a plane). • A triangle is a polygon with three angles and three sides. Children should be shown different types of triangles such as equilateral, isosceles, scalene, right, acute, and obtuse; however, they are not expected to name the various types. • A quadrilateral is a polygon with four sides. • A rectangle is a quadrilateral with four right angles. • A square is a rectangle with all four sides of equal length. • A circle is a closed curve with all points in one plane and the same distance from a fixed point (the center). • Early experiences with comparing and sorting ~~shapes~~ figures assist students in analyzing the characteristics ~~and properties of two-dimensional geometric shapes~~ of plane geometric figures. • Attribute blocks, relational attribute blocks, ~~power blocks~~, and tangrams are among the		

K.11 The student will

a) identify, describe, and trace plane geometric figures (circle, triangle, square, and rectangle); and

b) compare the size (larger, smaller) and shape of plane geometric figures (circle, triangle, square, and rectangle).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
manipulatives that are particularly appropriate for sorting and comparing size. – Clay, straws, and paper and scissors are several manipulatives that are appropriate for constructing geometric figures.		

K.12 The student will describe the location of one object relative to another (above, below, next to) and identify representations of plane geometric figures (circle, triangle, square, and rectangle) regardless of their positions and orientations in space.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Representations of circles, squares, rectangles, and triangles can be found in the students' environment at school and at home. Students should have opportunities to identify/classify things in their environment by the type of ~~shape~~ figures those things represent. • Children are often confused when a ~~shape~~ figure such as a square is rotated: they frequently refer to the rotated square as a diamond. Clarification needs to be ongoing — i.e., a square is a square regardless of its location in space; there is no such geometric ~~shape~~ figure as a diamond. • ~~Geometric manipulatives that can be used to combine plane geometric figures to create familiar shapes are~~ ~~– tangrams;~~ ~~– attribute blocks;~~ ~~– pattern blocks;~~ ~~– power blocks;~~ ~~– relational attribute blocks; and~~ ~~– transformations (slides, flips, turns) on shapes, which can be applied to change the orientation of the shape.~~	**All students should** • ~~Use a variety of skills that relate to direction, distance, and position in space in order to enhance their navigation skills.~~ • Understand that objects can have different orientations in space.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify pictorial representations of a circle, triangle, square, and rectangle, regardless of their position and orientation in space. • Describe the location of one object relative to another, using the terms *above*, *below*, and *next to*.

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible, unlikely, equally likely, more likely,* and *certain.*

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

K.13 The student will gather data by counting and tallying.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are pieces of information collected about people or things. The primary purpose of collecting data is to answer questions. • Tallying is a method for gathering information. Tally marks are used to show how often something happens or occurs. Each tally mark represents one occurrence. Tally marks are clustered into groups of five, with four vertical marks representing the first four occurrences and the fifth mark crossing the first four on a diagonal to represent the fifth occurrence. • When data are presented in an organized manner, students can describe the results of their investigation (i.e., identifying parts of the data that have special characteristics, including categories with the greatest, the least, or the same number of responses). • In the process of gathering data, students make decisions about what is relevant to their investigation (e.g., when collecting data on their classmates' favorite pets, deciding to limit the categories to common pets). • When students begin to collect data, they recognize the need to categorize, which helps develop the understanding of "things that go together." Categorical data are used when constructing ~~pictorial~~ picture graphs and bar graphs.	**All students should** • Pose questions and gather data. • Understand how data are collected and presented in an organized manner by counting and tallying.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Gather~~ Use counting and tallying to gather data on ~~given~~ categories identified by ~~counting and tallying~~ the teacher and/or student (e.g., favorites, number of days of various types of weather during a given month, types of pets, types of shoes).

K.14 The student will display gathered data in object graphs, picture graphs, and tables, and will answer questions related to the data.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Object graphs are graphs that use concrete materials to represent the categorical data that are collected (e.g., cubes stacked by the month, with one cube representing the birthday month of each student). • ~~Pictorial~~ Picture graphs are graphs that use pictures to show and compare information. ~~A key is often used to indicate what each picture represents (e.g., one picture of a dog represents five dogs).~~ • Tables are an orderly arrangement of data in which the data are arranged in columns and rows in an essentially rectangular format. Tables may be used to display some type of numerical relationship or organized lists (e.g., input/output functions, tables showing one candy costs five cents and two candies cost 10 cents). • Students represent data to convey results of their investigations at a glance, using concrete objects, pictures, and numbers to give a "picture" of the organized data. • When data are displayed in an organized manner, children can describe the results of their investigations. • Graphs can be used to make connections between mathematics and social studies and/or science (e.g., job areas and the different people that work in these areas: health — doctors and nurses; education — teachers and principals). • Statements representing an analysis and interpretation of the characteristics of the data in	**All students should** • Understand that data can be represented using concrete objects, pictures, and graphs. • Understand that different types of representations emphasize different things about the same data. • Understand that picture graphs use pictures to show and compare information; object graphs use concrete materials to represent categorical data; and tables can be used to show an orderly arrangement of data in columns and rows. • Answer questions related to the gathered data from object graphs, picture graphs, and tables. • Relate their ideas about the data to concepts such as part-part-whole and number relationships.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Display data by arranging concrete objects into organized groups to form a simple object graph. • Display gathered data, using ~~pictorial representations of the data~~ pictures to form a simple ~~pictorial~~ picture graph (e.g., a picture graph of the types of shoes worn by students on a given day). • Display ~~information~~ gathered data in tables, either in rows or columns ~~(e.g., a table showing the number of bunnies in one column and the number of ears the bunnies have in another or a table showing the time schedule for classroom activities)~~. • Answer questions related to the gathered data displayed in object graphs, picture graphs, and tables by: – Describing the categories of data and the data as a whole (e.g., the total number of responses) and its parts. – Identifying parts of the data that represent numerical relationships, including categories with the greatest, the least, or the same.

K.14 The student will display gathered data in object graphs, picture graphs, and tables, and will answer questions related to the data.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
the graph (e.g., similarities and differences, least and greatest, the categories, and total number of responses) should be asked.		

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns ~~in the real world~~. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to Algebra.

K.15 The student will sort and classify objects according to attributes.

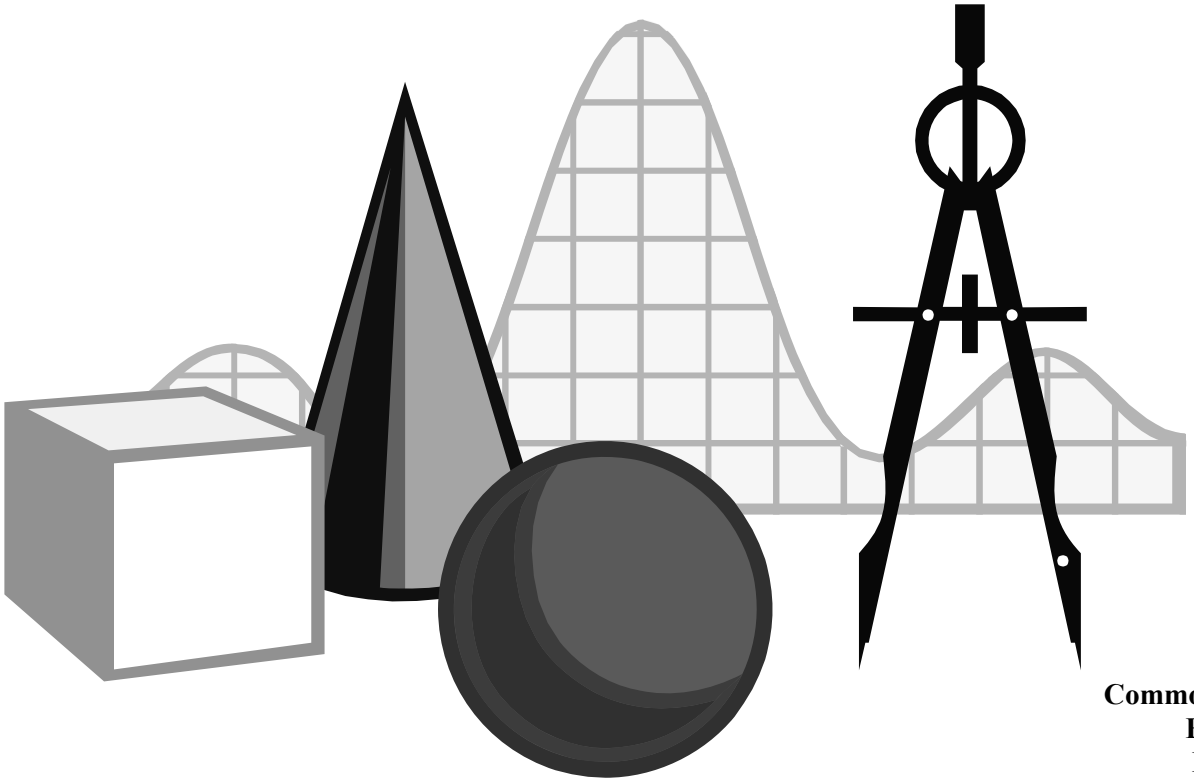
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• To classify is to arrange or organize a set of materials according to a category or attribute (a quality or characteristic ~~of a thing~~). • General similarities and differences among objects are easily observed by children entering kindergarten, who are able to focus on any one attribute. The teacher's task is to move students toward a more sophisticated understanding of classification in which two or more attributes connect or differentiate sets, such as those found in nature (e.g., leaves with different colors and different ~~shapes~~ figures).	**All students should** • Understand that the same set of objects can be sorted and classified in different ways.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Sort objects into appropriate groups (categories) based on one attribute~~, such as size, shape, or color~~. • Classify sets of objects into ~~three~~ groups (categories) of one attribute ~~(e.g., for size — small, medium, and large)~~. • Label attributes of a set of objects that has been sorted. • Name multiple ways to sort a set of objects.

K.16 The student will identify, describe, and extend repeating patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Pattern recognition is a fundamental cornerstone of mathematics, particularly algebra. • In a repeating pattern, the core of the pattern is the string of elements that repeats. By identifying the core, students demonstrate their understanding of the pattern. • Students should recognize that the sound pattern 'snap, clap, snap, clap' is the same in form as the color pattern 'red, blue, red, blue'. • Pattern recognition and the extension of the pattern allows students to make predictions. • The simplest types of patterns are repeating patterns. The patterns can be oral, such as the refrain in "Old MacDonald's Farm" ("e-i-e-i-o"), or physical with clapping and snapping patterns, or combinations of both, such as is found in songs like the "Hokey Pokey." In each case, students need to identify the basic unit of the pattern and repeat it. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. • Sample repeating patterns (repeating the ~~basic~~ core ~~unit)~~ are – ABABABAB; – ABCABC; – AABBAABBAABB; – AABAAB; – AABCAABC; and – ABACABAC.	**All students should** • Understand that patterns are a way to recognize order and organize their world and to predict what comes next in an arrangement. • Understand that the sound pattern 'snap, clap, snap, clap' is the same in form as the color pattern 'red, blue, red, blue'.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Observe and identify the basic repeating pattern (core) found in repeating patterns of common objects, sounds, and movements that occur in ~~real-life~~ practical situations~~, where there are four or fewer elements in the basic repeating pattern~~. • ~~Describe~~ Identify the ~~basic repeating pattern~~ core ~~found~~ in a repeating pattern~~, where there are four or fewer elements in the basic repeating pattern~~. • Extend a repeating pattern by adding at least two repetitions to the pattern. • Create a repeating pattern. • Compare similarities and differences between patterns.

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 1



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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, ~~simple~~ fractions, number relationships ("more than," "less than," and "~~as many as~~ equal to"), and the effects of ~~simple~~ single-step and multistep computations ~~operations on numbers (fact families)~~. These learning experiences should allow students to engage actively in a variety of problem solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

1.1 The student will

a) count from 0 to 100 and write the corresponding numerals; and

b) group a collection of up to 100 objects into tens and ones and write the corresponding numeral to develop an understanding of place value.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• There are three developmental levels of counting: – rote sequence; – one-to-one correspondence; and – the cardinality of numbers. • Counting involves two separate skills: verbalizing the list of standard number words in order ("one, two, three,…") and connecting this sequence with the items in the set being counted, using one-to-one correspondence. Association of number words with collections of objects is achieved by moving, touching, or pointing to objects as the number words are spoken. • The last number stated represents the number of objects in the set. This is known as the cardinality of the set. • Rote counting is a prerequisite skill for the understanding of addition, subtraction, and the ten-to-one concept of place value. • Articulating the characteristics of each numeral when writing numbers has been found to reduce the amount of time it takes to learn to write numerals. • The number system is based on a pattern of tens where each place has ten times the value of the place to its right. This is known as the ten-to-one concept of place value. • Opportunities to experience the relationships among tens and ones through hands-on experiences with manipulatives are essential to developing the ten-to-one place value concept of	**All students should** • Associate oral number names with the correct numeral and set of objects. • Understand that 1 and 10 are special units of numbers (e.g., 10 is 10 ones, but it is also 1 ten). • Understand the ten-to-one relationship of ones and tens (10 ones equals 1 ten). • Understand that numbers are written to show how many tens and how many ones are in the number. • Understand that groups of tens and ones can be used to tell how many.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count by rote from ~~1~~ 0 to 100, using the correct name for each numeral. • Use the correct oral counting sequence to tell how many objects are in a set. • Write numerals correctly. • Write each numerals ~~for the numbers 1 to 100~~ from 0 to 100. • Read two-digit numbers when shown a numeral, a Base-10 model of the number, or a pictorial representation of the number. • Identify the (ones, tens) of each digit in a two-digit numeral (e.g., The of the 2 in the number 23 is tens. The value of the 2 in the number 23 is 20). • Group a collection of objects into sets of tens and ones. Write the numeral that corresponds to the total number of objects in a given collection of objects that have been grouped into sets of tens and ones.

1.1 The student will

a) count from 0 to 100 and write the corresponding numerals; and

b) group a collection of up to 100 objects into tens and ones and write the corresponding numeral to develop an understanding of place value.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
our number system and to understanding the value of each digit in a two-digit number. Ten-to-one trading activities with manipulatives on place value mats provide excellent experiences for developing the understanding of the places in the ~~b~~Base-10 system. • Models that clearly illustrate the relationships among tens and ones are physically proportional (e.g., the tens piece is ten times larger than the ones piece). • Providing students with opportunities to model two-digit numbers expressed with groups of ones and tens will help students understand the ideas of trading, regrouping, and equality. • Recording the numeral when using physical and pictorial models leads to an understanding that the position of each digit in a numeral determines the size of the group it represents.		

1.2 The student will count forward by ones, twos, fives, and tens to 100 and backward by ones from 30.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The patterns developed as a result of skip counting are precursors for recognizing numeric patterns, functional relationships, and concepts underlying money, time telling, and multiplication. Powerful models for developing these concepts include counters, number line, hundred chart, and calculators. • Skip counting by twos supports the development of the concept of even numbers. • Skip counting by fives lays the foundation for reading a clock effectively and telling time to the nearest five minutes, counting money, and developing the multiplication facts for five. • Skip counting by tens is a precursor for use of place value, addition, counting money, and multiplying by multiples of 10. • Counting backward by rote lays the foundation for subtraction. Students should count backward beginning with ~~20, 19, 18~~, 30, 29, 28, … through …3, 2, 1, 0. • Calculators can be used to reinforce skip counting. ~~Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. For example, when skip counting by twos, press 2 + 2 = = =… to produce 2, 4, 6, 8, 10,…; or when skip counting by fives, press 5 + 5 = = =… to produce 5, 10, 15,….~~	**All students should** • Understand that collections of objects can be grouped and skip counting can be used to count the collection. • Describe patterns in counting by ones (both forward and backward) and skip counting and use those patterns to predict the next number in the counting sequence.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count by ones, twos, fives, and tens to 100, using concrete objects, such as counters, connecting cubes, pennies, nickels, and dimes. • Demonstrate a one-to-one correspondence when counting by ones with concrete objects or representations. • Skip count orally by twos, fives and tens to 100 starting at various multiples of 2, 5, or 10. • Count backward by ones from ~~20~~ 30.

1.3 The student will identify the parts of a set and/or region that represent fractions for halves, thirds, and fourths and write the fractions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A fraction is a way of representing part of a whole set or a whole region. • In a set fraction model, students need opportunities to make fair shares. For example, when sharing a set of 12 markers with three friends, each person would have one-third of the whole set. Also, each element of the set, no matter its size, is considered to be an equal share of the whole. • In an area fraction model, ~~In each fraction model, the parts must be equal (i.e., each pie piece must have the same area). In problems with fractions,~~ a whole is broken into equal-size parts and reassembled into one whole. • The words *denominator* and *numerator* are not required at this grade, but the concepts of part and whole are required for understanding of a fraction. • At this level, students ~~should not be~~ are expected to first understand the part-whole relationship (e.g., three out of four equal parts) before being expected to recognize or use symbolic representations for fractions (e.g., $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$)~~,~~ ~~until they understand the part-whole relationship~~. • Students should have opportunities to make connections and comparisons among fraction representations by connecting concrete or pictorial representations with spoken representations (e.g., "one-half," "one out of two equal parts", or "two-thirds", "two out of three equal parts" and "one half is more than one	**All students should** • Understand that a fraction represents a part of a whole. • Understand that fractional parts are equal shares of a whole. • Understand that the fraction name (*half*, *third*, *fourth*) tells the number of equal parts in the whole.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Represent a whole to show it having two equal parts and identify one half ($\frac{1}{2}$), and two halves ($\frac{2}{2}$). • Represent a whole to show it having three equal parts and identify one third ($\frac{1}{3}$), two thirds ($\frac{2}{3}$) and three thirds ($\frac{3}{3}$). • Represent a whole to show it having four equal parts and identify one fourth ($\frac{1}{4}$), two fourths ($\frac{2}{4}$), three fourths ($\frac{3}{4}$) and four fourths ($\frac{4}{4}$). • Identify and model ~~one-half and one-fourth~~ halves, thirds, and fourths of a whole, using the set model (e.g., connecting cubes and counters), and region/area models (e.g., pie pieces, pattern blocks, geoboards, paper folding, and drawings)~~; and measurement models (e.g., cuisenaire rods, connecting cubes, fraction strips, drawings)~~. • Name and write fractions represented by drawings or concrete materials for halves, thirds, and fourths. • Represent a given fraction using concrete materials, pictures, and symbols for halves, thirds, and fourths. For example, write the symbol for one-fourth, and represent it with concrete materials and pictures.

1.3 The student will identify the parts of a set and/or region that represent fractions for halves, thirds, and fourths and write the fractions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
fourth of the same whole" ~~but not $\frac{1}{2}$~~). • Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions (e.g., *thirds* means "three equal parts of a whole" ~~or $\frac{1}{3}$ represents one of three equal-size parts when a pizza is shared among three students~~) furthers this development.		

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from ~~real-life~~ practical experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling ~~and~~, discussing, and recording a variety of problem situations. This approach ~~to~~ helps students ~~move~~ transition from the concrete to the representation to the symbolic ~~the abstract~~ ~~and~~ in order to develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, multiplication, division ~~facts~~ and related facts ~~families~~;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions ~~and decimals~~.

1.4 The student, given a familiar problem situation involving magnitude, will

a) select a reasonable order of magnitude from three given quantities: a one-digit numeral, a two-digit numeral, and a three-digit numeral (e.g., 5, 50, 500); and

b) explain the reasonableness of the choice.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Magnitude refers to the size of a set. • Exploring ways to estimate the number of objects in a set, based on appearance, (e.g., clustering, grouping, comparing) enhances the development of number sense. • To estimate means to find a number that is close to the exact amount. When asking for an estimate, teachers might ask, "*about* how much?" or "*about* how many?" or "Is this about 10 or about 50?" • Students should be provided opportunities to estimate a quantity, given a benchmark of 10 and/or 100 objects.	**All students should** • Develop an understanding of the order of magnitude (size) of whole numbers and use this knowledge to estimate quantities.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Select a reasonable order of magnitude for a given set from three given quantities: a one-digit numeral, a two-digit numeral, and a three-digit numeral (e.g., 5, 50, and 500 jelly beans in jars) in a familiar problem situation. • Given a familiar problem situation involving magnitude, explain why a particular estimate was chosen as the most reasonable from three given quantities: a one-digit numeral, a two-digit numeral, and a three-digit numeral.

1.5 The student will recall basic addition facts with sums to 18 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Associate the terms *addition*, *adding*, and *sum* with the concept of joining or combining. • Associate the terms *subtraction*, *subtracting*, *minus*, and *difference* with the process of "taking away" or separating (i.e., removing a set of objects from the given set of objects, finding the difference between two numbers, or comparing two numbers). • Provide practice in the use and selection of strategies. Encourage students to develop efficient strategies. Examples of strategies for developing the basic addition and subtraction facts include – counting back; – "one-more-than," "two-more-than" facts; – "one-less-than," "two-less-than" facts; – "doubles" to recall addition facts (e.g., 2 + 2 =__; 3 + 3 =__); – "near doubles" [e.g., 3 + 4 = (3 + 3) + 1 = __]; – "make-ten" facts (e.g., at least one addend of 8 or 9); – "think addition for subtraction" (e.g., for 9 – 5 = __, think "5 and what number makes 9?"); – use of the commutative property, without naming the property (e.g., 4 +3 is the same as 3 + 4); – use of ~~fact families~~ related facts (e.g., 4 + 3 = 7 , 3 + 4 = 7, 7 – 4 = 3, and 7 – 3 = 4); – use of the zero property (e.g., 4 + 0 = 4), without naming the property but saying, "When you add zero to a number, you always get the original number." – use patterns to make sums (e.g., 0 + 5 = 5, 1 + 4 = 5, 2 + 3 = 5, etc.) – Manipulatives should be used initially to develop an understanding of addition and subtraction facts ~~and to engage students in meaningful memorization~~. Rote recall of the facts is often	**All students should** • Develop an understanding of the addition and subtraction relationship. • Develop addition and subtraction strategies for fact recall. • Develop fluency with basic number combinations for addition and subtraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify + as a symbol for addition, ~~and~~ – as a symbol for subtraction, and = as a symbol for equality. • Recall and state orally the basic addition facts for sums with two addends to ~~10~~ 18 or less and the corresponding subtraction facts. • Recall and write the basic addition facts for sums to ~~10~~ 18 or less and the corresponding subtraction facts, when addition or subtraction problems are presented in either horizontal or vertical written format.

1.5 The student will recall basic addition facts with sums to 18 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
achieved through constant practice and may come in a variety of formats, including presentation through flash cards, practice sheets, and/or games. – Students should first master facts to 10 and then master facts to 18.		

1.6 The student will create and solve one-step story and picture problems using basic addition facts with sums to 18 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The problem solving process is enhanced when students – create their own story problems; and – model word problems, using manipulatives, ~~or drawings~~ representations, or number sentences/equations. • Students should ~~be exposed to~~ experience a variety of problem types related to addition and subtraction, including – join and separate problems (action involved); join (for example: Sam had 8 pennies. Tom gave him 3 more. How many pennies does Sam have now? separate (for example: Sam had 11 pennies. He gave 3 to Tom. How many pennies does Sam have now?) – part-part-whole problems (no action involved); missing part (for example: There are 8 marbles. Five are shown. How many are missing?) – classification problems (for example: Jane had 12 hats. Only three of the hats are blue. How many are not blue?) – comparison problems (for example: Bill is 7 years old. Alice is 4 years old. How much younger is Alice than Bill?).	**All students should** • Understand various meanings of addition and subtraction in a variety of situations. • Understand that creating and solving problems involves the use of addition and/or subtraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Interpret and solve oral or written story and picture problems involving one-step solutions, using basic addition and subtraction facts (sums to ~~10~~ 18 or less and the corresponding subtraction facts). • Identify a correct number sentence to solve an oral or written story ~~or~~ and picture problem, selecting from among basic addition and subtraction facts.

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

1.7 The student will

a) identify the number of pennies equivalent to a nickel, a dime, and a quarter; and

b) determine the value of a collection of pennies, nickels, and dimes whose total value is 100 cents or less.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Many experiences with coins help students develop an understanding of money, such as – drawing pennies to show the value of a given coin (e.g., a nickel, a dime, or a quarter); – playing store and purchasing classroom objects, using play money (pennies); – representing the value of a nickel, a dime, and a quarter, using pennies; and – trading the equivalent value of pennies for a nickel, a dime, and a quarter, using play money. • Counting money helps students gain an awareness of consumer skills and the use of money in everyday life. • A variety of classroom experiences in which students manipulate physical models of money and count forward to determine the value of a collection of coins are important activities to ensure competence with counting money. • Establishing a one-to-one correspondence between the number names and the items in a set of coins (pennies, nickels, or dimes) is essential for an accurate count. • The last number stated represents the value of a collection of coins being counted. This is known as the cardinality of the set.	**All students should** • Develop an understanding of exchanging the appropriate number of pennies for a nickel, a dime, or a quarter. • <u>Develop an understanding of place value by skip counting a collection of coins by ones, fives, and tens.</u>	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the value of a nickel, a dime, and a quarter in terms of pennies. • Recognize the characteristics of pennies, nickels, and dimes (e.g., color, size). • Count by ones to determine the ~~total~~ value of a collection of pennies whose total value is 100 cents or less. • Count by fives to determine the ~~total~~ value of a collection of nickels whose total value is 100 cents or less. • Count by tens to determine the ~~total~~ value of a collection of dimes whose total value is 100 cents or less. • <u>Count by ones, fives, and tens to determine the value of a collection of pennies and nickels, pennies and dimes, and nickels and dimes whose total value is 100 cents or less.</u> • <u>Count by ones, fives, and tens to determine the value of a collection of pennies, nickels, and dimes whose total value is 100 cents or less.</u> • ~~Identify the value of a collection of pennies, nickels, and dimes, whose total value is 100 cents or less.~~

1.8 The student will tell time to the half-hour, using analog and digital clocks.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Many experiences using clocks help students develop an understanding of the telling of time to the half-hour, including – identifying the parts of an analog clock (minute and hour hands); – demonstrating a given time to the half-hour, using a model clock; – writing correct digital time to the half-hour; and – relating time on the half-hour to daily routines and school schedules (e.g., the times of TV programs, bedtime, resource time, lunch time, recess time).	**All students should** • Understand how to tell time to the half-hour, using an analog ~~or~~ and digital clock. • Understand the concepts of a.m., p.m., minutes, and hours. • Understand that there are sixty minutes in an hour.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Tell time shown on an analog clock to the half-hour. • Tell time shown on a digital clock to the half-hour. • Match a written time to the time shown on a digital ~~or~~ and analog clock to the half-hour.

1.9 The student will use nonstandard units to measure length, weight/mass, and volume.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The process of measurement involves selecting a unit of measure, comparing the ~~object to be measured to the~~ unit to the object to be measured, counting the number of times ~~the object can be measured by~~ the unit is used to measure the object, and arriving at an approximate total number of units. • Premature use of instruments or formulas leaves children without the understanding necessary for solving measurement problems. • When children's initial explorations of length, weight/mass, and volume involve the use of nonstandard units, they develop some understanding about the need for standard measurement units for length, weight/mass, and volume especially when they communicate about these measures.	**All students should** • Understand that measurement involves comparing an attribute of an object to the same attribute of the unit of measurement (e.g., the length of a cube measures the length of a book. The weight/mass of the cube measures the weight/mass of the book. The volume of the cube measures the volume of a book). • Understand how to measure length, weight/mass, and volume using various nonstandard units of measurement.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Measure the length of objects, using various nonstandard units (e.g., connecting cubes, paper clips, erasers). • Measure the weight/mass of objects, using a balance scale with various nonstandard units (e.g., paper clips, bean bags, cubes). • Measure the volume of objects, using various nonstandard units (e.g., connecting cubes, blocks, rice, water).

1.10 The student will compare, using the concepts of more, less, and equivalent,
a) the volumes of two given containers; and
b) the weight/mass of two objects, using a balance scale.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimation is a commonly used strategy to compare the volumes of two containers. • Determining the volume of a container by counting the number of nonstandard units (e.g., a spoonful, or scoopful~~, or teacupful~~ of concrete material, such as jelly beans, sand, water, or rice) that can be held by the container is a precursor to comparing volumes. • A variety of activities that focus on directly comparing the volume of objects leads to an understanding of volume. • The level of difficulty in measuring volume can be increased by varying and mixing the sizes of the containers (e.g., using short, wide containers as well as tall, narrow containers). • Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • Balance scales are instruments used for weighing. A balance scale usually has a beam that is supported in the center. On each side of the beam are two identical trays. When the trays hold equal weights, the beam is level, and	**All students should** • Understand how to fill containers with objects to determine their volume and compare the volumes of two containers. • Understand that a balance ~~beam~~ scale can be used to compare the weights of two objects using the terms more, less, or equivalent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare the volumes of two containers to determine if the volume of one is ~~greater than~~ more, less ~~than~~, or ~~the same as~~ equivalent to the other, using nonstandard units of measure (e.g., a spoonful~~,~~ or scoopful~~, or teacupful~~). • Compare the volumes of two containers to determine if the volume of one is ~~greater than~~ more, less ~~than~~, or ~~the same as~~ equivalent to the other by pouring the contents of one container into the other. • Compare the weight/mass of two objects, using the terms *lighter, heavier*, or *the same*, using a balance scale. The pan containing less weight/mass will rise and the pan containing more weight/mass will fall. If the objects are of equivalent weight/mass, the two pans will balance.

1.10 The student will compare, using the concepts of more, less, and equivalent,
a) the volumes of two given containers; and
b) the weight/mass of two objects, using a balance scale.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
the scale is "balanced."- • Physically measuring the weights of objects, using a balance scale, helps students develop an intuitive idea of what it means to say something is "lighter," "heavier," or "the same." • Experience estimating the weights of two objects (one in each hand) using the terms lighter, heavier, or the same promotes an understanding of the concept of balance.		

1.11 The student will use calendar language appropriately (e.g., names of the months, *today, yesterday, next week, last week*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Time is a unit of measure.~~ • ~~Real-life~~ Practical situations are appropriate to develop a sense of the interval of time between events (e.g., Boy Scout meetings occur every week on Monday: there is a week between meetings). • The calendar is a way to represent ~~measure~~ units of time (e.g., days, weeks, and months). • Using a calendar develops the concept of day as a 24-hour period rather than a period of time from sunrise to sunset.	**All students should** • Understand how to use a calendar as a way to measure time.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Read a calendar to locate a given day or date. • Identify the months of the year. • Identify the seven days in a week. • Determine the days/dates before and after a given day/date (e.g., yesterday, today, tomorrow). • Determine the date that is a specific number of days or weeks in the past or in the future from a given date, using a calendar. • Identify specific dates (e.g., the third Monday in a given month).

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of ~~shapes~~ figures and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent ~~two- and three-dimensional~~ plane and solid ~~shapes~~ figures through drawing, block constructions, dramatization, and verbal language.

The focus of instruction at this level is on

- observing, identifying, describing, comparing, contrasting and investigating ~~three-dimensional~~ solid objects and their ~~two-dimensional~~ faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, contrasting, sorting, and classifying ~~shapes~~ figures; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these ~~shapes~~ figures but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

1.12 The student will identify and trace, describe, and sort plane geometric figures (triangle, square, rectangle, and circle) according to number of sides, vertices, and right angles.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A plane geometric figure is any two-dimensional closed ~~shape~~ figure. Circles and polygons are examples of plane geometric figures. • The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., "I know it's a rectangle because it looks like a door, and I know that a door is a rectangle"). – **Level 2: Analysis.** Properties are perceived, but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., "I know it's a rectangle because it is closed; it has four sides and four right angles, and opposite sides are parallel."). • Students should have experiences with various plane geometric polygons. – Triangles could be equilateral, right,	**All students should** • Develop strategies to sort and/or group plane geometric figures and refine the vocabulary used to explain their strategies.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe a circle. • ~~Draw~~ Trace triangles, squares, rectangles, and circles. • Describe triangles, squares, and rectangles by the number of sides, ~~corners, and square corners~~ vertices, and right angles. • Sort plane geometric figures into appropriate subsets (categories) based on characteristics (number of sides, vertices, angles, curved, etc.). • Identify the name of the ~~shape~~ geometric figure when given information about the number of sides, ~~corners, and/or square corners~~ vertices, and right angles.

1.12 The student will identify and trace, describe, and sort plane geometric figures (triangle, square, rectangle, and circle) according to number of sides, vertices, and right angles.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
obtuse, acute, etc. – Quadrilaterals could be rectangles, squares, trapezoids, rhombi, etc. • A vertex is the point at which two line segments, lines, or rays meet to form an angle. • A polygon is a plane geometric figure which – has sides that are ~~straight~~ line segments; – is simple (its sides do not cross); – is closed; and – is two-dimensional (~~it~~ lies in a plane). • A triangle is a polygon with three angles and three sides. • A quadrilateral is a polygon with four sides. • A rectangle is a quadrilateral with four right angles. • A square is a rectangle with four sides of equal length. • A circle is a closed curve with all points in one plane and the same distance from a fixed point (the center). • Presentation of triangles, rectangles, and squares should be made in a variety of spatial orientations so that students do not develop the common misconception that triangles, rectangles, and squares must have one side parallel to the bottom of the page on which they are printed.		

1.13 The student will construct, model, and describe objects in the environment as geometric shapes (triangle, rectangle, square, and circle) and explain the reasonableness of each choice.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Representations of circles, squares, rectangles, and triangles can be found in the students' environment at school and at home. Students should have opportunities to identify/classify things in the~~ir~~ environment by the type of ~~shape~~ figure those things represent. • Children are often confused when a ~~shape~~ figure such as a square is rotated: they frequently refer to the rotated square as a diamond. Clarification needs to be ongoing — i.e., a square is a square regardless of its location in space; there is no such geometric ~~shape~~ figure as a diamond. • Translations (~~slides~~ translations, ~~flips~~ reflections, and ~~turns~~ rotation) can be used to change the location of objects. • Building geometric and spatial capabilities fosters enthusiasm for mathematics while providing a context to develop spatial sense. • Polygons can be constructed using other polygons (e.g., six equilateral triangles can be used to construct a hexagon, a triangle can be added to a rectangle to create a pentagon, etc.)	**All students should** • Understand that geometric figures are integral parts of ~~his/her~~ the environment. • Use familiarity with the figure, structure, and location to develop spatial reasoning.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct plane geometric figures. • Identify models of representations of circles, squares, rectangles, and triangles in the environment at school and home and tell why they represent those ~~shapes~~ figures. • Describe representations of circles, squares, rectangles, and triangles in the environment and explain the reasonableness of the choice ~~(e.g., "I know it's a rectangle because it looks like a door, and I know that a door is a rectangle.")~~.

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible, unlikely, equally likely, more likely,* and *certain.*

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

1.14 The student will investigate, identify, and describe various forms of data collection (e.g., recording daily temperature, lunch count, attendance, favorite ice cream), using tables, picture graphs, and object graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Students' questions about the physical world can often be answered by collecting data and observing the results. • Data are information collected about people or things. The primary purpose of collecting data is to answer questions. • After generating questions, students decide what information is needed and how it can be collected. • The collection of the data often leads to new questions to be investigated. • The entire process broadens children's views of mathematics and its usefulness. • Data collection could involve voting, informal surveys, tallying, and charts. • Surveys, which are data-collecting tools that list choices, should have a limited number of questions at the primary grades. • Tallying is a method for gathering information. Tally marks are used to show how often something happens or occurs. Each tally mark represents one occurrence. Tally marks are clustered into groups of five, with four vertical marks representing the first four occurrences and the fifth mark crossing the first four on a diagonal to represent the fifth occurrence.	**All students should** • Understand how data can be collected and presented in an organized manner. • Understand that data gathered and analyzed from observations and surveys can have an impact on our everyday lives.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate various forms of data collection, including counting and tallying, informal surveys, observations, and voting. • Identify and describe various forms of data collection in ~~his or her world~~ practical situations (e.g., recording daily temperature, lunch count, attendance, and favorite ice cream.)

1.15 The student will interpret information displayed in a picture or object graph, using the vocabulary *more, less, fewer, greater than, less than,* and *equal to*.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Statistics is used to describe and interpret with numbers the world around us; it is a tool for problem solving. • Students' questions about everyday life can often be answered by collecting and interpreting data. • Organized data provides a clearer picture for interpretation. Data may be described in object graphs and picture graphs. • Picture graphs are graphs that use pictures to show and compare information. ~~A key is often used to indicate what each picture represents (e.g., one picture of a dog represents five dogs).~~ • Object graphs are graphs that use concrete materials to represent the categorical data that are collected (e.g., cubes stacked by the month, with one cube representing the birthday month of each student). • Interpretation of the data could lead to additional questions to be investigated.	**All students should** • Understand that picture graphs use pictures to represent and compare data while object graphs use concrete objects to represent and compare data. • Understand that data can be analyzed and interpreted, using the terms *more*, *less*, *fewer*, *greater than*, *less than*, and *equal to*.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Demonstrate the meaning of the terms *more*, *less*, *fewer*, *greater than*, *less than*, and *equal to*, using concrete materials.~~ • Compare one category to another in a graph, indicating which has more or which has less, or which is equal to. • Interpret information displayed in object graphs and picture graphs, using the words *more*, *less*, *fewer*, *greater than*, *less than*, and *equal to*. • Find answers to questions, using graphs (e.g., "Which category has more?" ~~"Which category has less"~~, "How many more?", and "How many in all?").

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns ~~in the real world~~. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to Algebra.

1.16 The student will sort and classify concrete objects according to one or more attributes, including color, size, shape, and thickness.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Sorting, classifying, and ordering objects facilitate work with patterns, geometric ~~shapes~~ figures, and data. • To classify is to arrange or organize a set of materials according to a category or attribute (a quality or characteristic ~~of a thing~~). • General similarities and differences among items are easily observed by primary students, who can begin to focus on more than one attribute at a time. During the primary grades, the teacher's task is to move students toward a more sophisticated understanding of classification in which two or more attributes connect or differentiate sets, such as those found in nature (e.g., leaves with different colors and different ~~shapes~~ figures).	**All students should** • Understand the same set of objects can be sorted and classified in different ways.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Sort and classify objects into appropriate subsets (categories) based on one or two attributes, such as size, ~~shape~~ geometric figure, color, or thickness.

1.17 The student will recognize, describe, extend, and create a wide variety of growing and repeating patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Patterns allow children to recognize order, ~~to~~ generalize, and ~~to~~ predict. • Patterning should include – reproducing a given pattern, using manipulatives; – recording a pattern with pictures or symbols; – transferring a pattern into a different form or different representation (e.g., blue–blue–red to an AAB repeating pattern); and – analyzing patterns in ~~the real world~~ practical situations (e.g., calendar, seasons, days of the week). • The simplest types of patterns are repeating patterns. The part of the pattern that repeats is the core. The patterns can be oral, such as the refrain in "Old MacDonald's Farm" ("e-i-e-i-o"), or physical with clapping and snapping patterns, or combinations of both, such as is found in songs like the "Hokey Pokey." In each case, students need to identify the basic unit of the pattern and repeat it. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. • Growing patterns are more difficult for students to understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns in both arithmetic and geometric formats. • Create an arithmetic number pattern. Sample numeric patterns are 6, 9, 12, 15, 18,.. ; (repeating numeric pattern);	**All students should** • Understand that patterns are a way to recognize order, to organize their world, and to predict what comes next in an arrangement. • Recognize and state the core of a pattern. • Analyze how both repeating and growing patterns are generated.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize the pattern in a given rhythmic, color, ~~shape~~ geometric figure, or numerical sequence. • Describe the pattern in a given rhythmic, color, ~~shape~~ geometric figure, or numerical sequence in terms of the core (the part of the sequence that repeats). • Extend a pattern, using manipulatives, geometric figures, numbers, or calculators. • Transfer a pattern from one form to another. • Create a repeating or growing pattern, using manipulatives, geometric figures, numbers, or calculators (e.g., the growing patterns 2, 3, 2, 4, 2, 5, 2, 6, 2, …). • ~~Create an arithmetic number pattern, using a calculator (e.g., when skip counting by fives, use the constant feature on the calculator by pressing 5 + 5 = = = … to produce the pattern 5, 10, 15, 20, …).~~

1.17 The student will recognize, describe, extend, and create a wide variety of growing and repeating patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
5, 7, 9, 11, 13, … (repeating numeric pattern); and 1, 2, 4, 7, 11, 16, … (growing numeric pattern). • In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation ~~(turn)~~ is the result of turning a figure around a point or a vertex, and reflection ~~(flip)~~ is the result of flipping a figure over a line.		

1.18 The student will demonstrate an understanding of equality through the use of the equal sign.

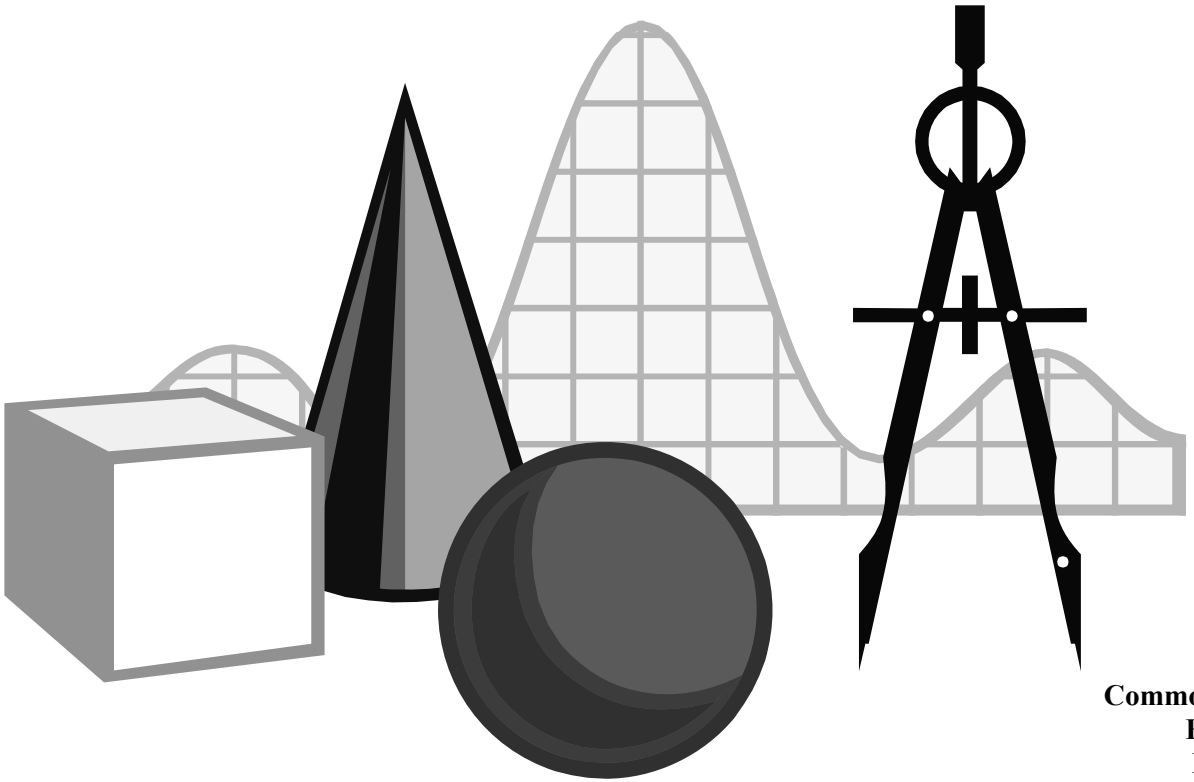
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Equality can be shown by measuring with a balance scale or a number balance. • Manipulatives such as rods, connecting cubes, and counters can be used to model equations. • Equations are not equal. Equations have expressions of equal value on both sides. • An equation must be balanced. There must be the same amount on each side of the equal sign. (e.g., 5 + 3 = 5 + 3). • A common misunderstanding is that the equal sign always means the answer. The equal sign can represent an equality. • Equations should be shown in many different forms (e.g., 6 = 6, 4 + 2 = 6, 5 + 1 = 4 + 2, 6 = 4 + 2, 4 = 6 - 2). • Inequalities such as 5 < 4 + 3 are not equations. Equations must have the equal sign. • It is important for children to understand that the expression 3 + 5 is another representation of eight. • The equal sign is used when two representations name the same number, 5 + 3 = 10 - 2. These two expressions in the equation represent the same number, eight. • Equations should be routinely modeled in conjunction with story problems. • Solving missing addend problems and stories helps with the understanding of equality and the equal sign (e.g., There are four red birds in the tree. Some black birds fly to the tree. Now there	**All students should** • Understand that the equal sign means "is the same as" or "another name for" or "equal in value". • Understand that equality represents a balance concept. Both sides of the equation balance because they are equal (they have the same value).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the equality (=) symbol. • Recognize that the equations 4 + 2 = 2 + 4 and 6 + 1= 4 + 3 represent expressions of equal value. • Model an equation that represents an expression of equal value. • Identify equivalent values (e.g., 3 = 3, 4 + 3 = 8 - 1, 7 = 2 + 5, etc.).

1.18 The student will demonstrate an understanding of equality through the use of the equal sign.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
are six birds in the tree. How many black birds flew to the tree? 4+__ =6)		

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 2



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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, ~~simple~~ fractions, number relationships ("more than," "less than," and "~~as many as~~ equal to"), and the effects of ~~simple~~ single-step and multistep computations ~~operations on numbers (fact families)~~. These learning experiences should allow students to engage actively in a variety of problem solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The number system is based on a simple pattern of tens where each place has ten times the value of the place to its right. • Opportunities to experience the relationships among hundreds, tens, and ones through hands-on experiences with manipulatives are essential to developing the ten-to-one place value concept of our number system and to understanding the value of each digit in a three-digit number. Ten-to-one trading activities with manipulatives on place value mats provide excellent experiences for developing the understanding of the places in the ~~b~~Base-10 system. • Models that clearly illustrate the relationships among hundreds, tens, and ones are physically proportional (e.g., the tens piece is ten times larger than the ones piece). • Students need to understand that 10 and 100 are special units of numbers (e.g., 10 is 10 ones, but it is also 1 ten). • Flexibility in thinking about numbers is critical. For example, 123 is 123 ones; or 1 hundred, 2 tens, and 3 ones; or 12 tens and 3 ones. • Rounding is finding the nearest easy-to-use number (e.g., the nearest 10) for the situation at hand. • Number lines are useful tools for developing the concept of rounding to the nearest ten. ~~Students can use the strategy of identifying a number on a~~	**All students should** • Understand the ten-to-one relationship of ones, tens, and hundreds (10 ones equals 1 ten; 10 tens equals 1 hundred). • Understand that numbers are written to show how many hundreds, tens, and ones are in the number. • Understand that rounding gives a close, easy-to-use number to use when an exact number is not needed for the situation at hand. • Understand that a knowledge of place value is essential when comparing numbers. • Understand the relative magnitude of numbers by comparing numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Demonstrate the understanding of the ten-to-one relationships among ones, tens, and hundreds, using manipulatives (e.g., beans and cups, ~~b~~Base-10 blocks, bundles of 10 ~~Popsicle~~ sticks). • Determine the place value of each digit in a three-digit numeral presented as a pictorial representation (e.g., a picture of ~~b~~Base-10 blocks) or as a physical representation (e.g., actual ~~b~~Base-10 blocks). • Write numerals, using a ~~b~~Base-10 model or picture. • Read three-digit numbers when shown a numeral, a ~~b~~Base-10 model of the number, or a pictorial representation of the number. • Identify the place value (ones, tens, hundreds) of each digit in a three-digit numeral. • Determine the value of each digit in a three-digit numeral (e.g., in 352, the 5 represents 5 tens and its value is 50). • Round two-digit numbers to the nearest ten. • Compare two numbers between 0 and 999 represented pictorially or with concrete objects (e.g., ~~b~~Base-10 blocks), using the words *greater than, less than* or *equal to*.

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~number line and finding the multiple of ten that is closest to the identified number.~~ Rounding to the nearest ten using a number line is done as follows: – Locate the number on the number line. – Identify the two tens the number comes between. – Determine the closest ten. – If the number in the ones place is 5 (halfway between the two tens), round the number to the higher ten. • ~~A strategy~~ Once the concept for rounding numbers using a number line is developed, the procedure for rounding numbers to the nearest ten is as follows: – Look one place to the right of the digit in the place you wish to round to. – If the digit is less than 5, leave the digit in the rounding place as it is, and change the digit to the right of the rounding place to zero. – If the digit is 5 or greater, add 1 to the digit in the rounding place and change the digit to the right of the rounding place to zero. • A procedure for comparing two numbers by examining place value may include the following: – Line up the numbers by place value lining up the ones. – Beginning at the left, find the first place value where the digits are different. – Compare the digits in this place value to determine which number is greater (or which is less). – Use the appropriate symbol > or < or words *greater than* or *less than* to compare the numbers in the order in which they are		

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
presented. – If both numbers are the same, use the symbol = or the words *equal to*. • Mathematical symbols (>, <) used to compare two unequal numbers are called *inequality symbols*.		

2.2 The student will

a) identify the ordinal positions first through twentieth, using an ordered set of objects; and

b) write the ordinal numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Understanding the cardinal and ordinal meanings of numbers is necessary to quantify, measure, and identify the order of objects. • An ordinal number is a number that names the place or position of an object in a sequence or set (e.g., first, third). *Ordered position*, *ordinal position*, and *ordinality* are terms that refer to the place or position of an object in a sequence or set. • The ordinal position is determined by where one starts in an ordered set of objects or sequence of objects (e.g., left, right, top, bottom). • The ordinal meaning of numbers is developed by identifying and verbalizing the place or position of objects in a set or sequence (e.g., a student's position in line when students are lined up alphabetically by first name). • Ordinal position can also be emphasized through sequencing events (e.g., months in a year or sequencing in a story). • Cardinality can be compared with ordinality when comparing the results of counting. There is obvious similarity between the ordinal number words *third* through *twentieth* and the cardinal number words *three* through *twenty.*	**All students should** • Use ordinal numbers to describe the position of an object in a sequence or set.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count an ordered set of objects, using the ordinal number words *first* through *twentieth*. • Identify the ordinal positions first through twentieth, using an ordered set of objects. • Identify the ordinal positions first through twentieth, using an ordered set of objects presented in lines or rows from – left to right; – right to left; – top to bottom; and – bottom to top. • Write 1st, 2nd, 3rd, through 20th in numerals.

2.3 The student will

a) identify the parts of a set and/or region that represent fractions for halves, thirds, fourths, sixths, eighths, and tenths;
b) write the fractions; and
c) compare the unit fractions for halves, thirds, fourths, sixths, eighths, and tenths.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The whole should be defined. • A fraction is a way of representing part of a whole (as in a region/area model) or part of a group (as in a set model). • In each fraction model, the parts must be equal (i.e., each pie piece must have the same area; the size of each chip in a set must be equal). In problems with fractions, a whole is broken into equal-size parts and reassembled into one whole. • The denominator ~~(bottom number)~~ tells how many equal parts are in the whole or set. The numerator ~~(top number)~~ tells how many of those parts are being described. • Students should have opportunities to make connections among fraction representations by connecting concrete or pictorial representations with spoken or symbolic representations. • Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions (e.g., *thirds* means "three equal parts of a whole" or $\frac{1}{3}$ represents one of three equal-size parts when a pizza is shared among three students) will further this development. • A unit fraction is one in which the numerator is one. • Using models when comparing unit fractions will	**All students should** • Understand that fractional parts are equal shares of a whole or a whole set. • Understand that the fraction name (*half*, *fourth*) tells the number of equal parts in the whole. • Understand that when working with unit fractions, the larger the denominator, the smaller the part and therefore the smaller the fraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize fractions as representing equal-size parts of a whole. • Identify the fractional parts of a whole or a set for $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$, and $\frac{1}{10}$. • Identify the fraction names (halves, thirds, fourths, sixths, eighths, tenths) for the fraction notations $\frac{1}{2}$, $\frac{1}{3}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$, and $\frac{1}{10}$. • Represent fractional parts of a whole for ~~$\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$, and $\frac{1}{10}$~~. halves, thirds, fourths, sixths, eighths, tenths using – region/area models (e.g., pie pieces, pattern blocks, geoboards); – sets (e.g., chips, counters, cubes); and – measurement models (e.g., fraction strips, ~~cuisenaire~~ rods, connecting cubes). • Compare unit fractions ($\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}$, and $\frac{1}{10}$) using the words *greater than*, *less than* or *equal to* and the symbols (>, <, =).

2.3 The student will

a) identify the parts of a set and/or region that represent fractions for halves, thirds, fourths, sixths, eighths, and tenths;
b) write the fractions; and
c) compare the unit fractions for halves, thirds, fourths, sixths, eighths, and tenths.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
assist in developing the concept that the larger the denominator the smaller the piece; therefore, $\frac{1}{3} > \frac{1}{4}$.		

2.4 The student will

a) count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10;
b) count backward by tens from 100; and
c) recognize even and odd numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The patterns developed as a result of grouping and/or skip counting are precursors for recognizing numeric patterns, functional relationships, and concepts underlying money, time telling, multiplication, and division. Powerful models for developing these concepts include counters, hundred chart, and calculators. • Skip counting by twos supports the development of the concept of even numbers. • Skip counting by fives lays the foundation for reading a clock effectively and telling time to the nearest five minutes, counting money, and developing the multiplication facts for five. • Skip counting by tens is a precursor for use of place value, addition, counting money, and multiplying by multiples of 10. • Calculators can be used to display the numeric patterns resulting from skip counting. Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. ~~For example, when skip counting by twos, press 2 + 2 = = = … to produce 2, 4, 6, 8, 10, …; or when skip counting by fives, press 5 + 5 = = = … to produce 5, 10, 15, ….~~ • Odd and even numbers can be explored in different ways (e.g., dividing collections of objects into two equal groups or pairing objects).	**All students should** • Understand that collections of objects can be grouped and skip counting can be used to count the collection. • Describe patterns in skip counting and use those patterns to predict the next number in the counting sequence. • Understand that the starting point for skip counting by 2 does not always begin at 2. • Understand that the starting point for skip counting by 5 does not always begin at 5. • Understand that the starting point for skip counting by 10 does not always begin at 10. • Understand that every counting number is either even or odd.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine patterns created by counting by twos, fives, and tens on a hundred chart. • Skip count by twos, fives, and tens to 100, using manipulatives, a hundred chart, mental mathematics, a calculator, and/or paper and pencil. • Skip count by twos, fives, and tens to 100~~, using the constant feature on the calculator~~. • Count backward by tens from 100. • ~~Group objects by threes.~~ • ~~Group objects by fours.~~ • Use objects to determine whether a number is odd or even.

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling ~~and~~, discussing, and recording a variety of problem situations. This approach ~~to~~ helps students ~~move~~ transition from the concrete to the representation to the symbolic ~~the abstract~~ ~~and~~ in order to develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, multiplication, division ~~facts~~ and related facts ~~families~~;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions ~~and decimals~~.

2.5 The student will recall addition facts with sums to 20 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Associate the terms *addition, adding,* and *sum* with the concept of joining or combining. • Associate the terms *subtraction, subtracting, minus*, and *difference* with the process of "taking away" or separating (i.e., removing a set of objects from the given set of objects, finding the difference between two numbers, or comparing two numbers). • Provide practice in the use and selection of strategies. Encourage students to develop efficient strategies. Examples of strategies for developing the basic addition and subtraction facts include – counting on; – counting back; – "one-more-than," "two-more-than" facts; – "one-less-than," "two-less-than" facts; – "doubles" to recall addition facts (e.g., 2 + 2 =__; 3 + 3 =__); – "near doubles" [e.g., 3 + 4 = (3 + 3) + 1 = __]; – "make-ten" facts (e.g., at least one addend of 8 or 9); – "think addition for subtraction," (e.g., for 9 – 5 = __, think "5 and what number makes 9?"); – use of the commutative property, without naming the property (e.g., 4 +3 is the same as 3 + 4); – use of related facts ~~families~~ (e.g., 4 + 3 = 7 , 3 + 4 = 7, 7 – 4 = 3, and 7 – 3 = 4); – use of the zero property (e.g., 4 + 0 = 4), without naming the property but saying, "When you add zero to a number, you always get the original number." • Manipulatives should be used initially to develop an understanding of addition and subtraction facts and to engage students in meaningful memorization.	**All students should** • Understand that addition involves combining and subtraction involves separating. • Develop fluency in recalling ~~basic~~ facts for addition and subtraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Recall and write the basic addition facts for sums to 18 or less and the corresponding subtraction facts.~~ • Recall and write the basic addition facts for sums to ~~18~~ 20 or less and the corresponding subtraction facts, when addition or subtraction problems are presented in either horizontal or vertical written format.

2.5 The student will recall addition facts with sums to 20 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
Rote recall of the facts is often achieved through constant practice and may come from a variety of formats, including presentation through flash cards, practice sheets, and/or games.		

2.6 The student, given two whole numbers whose sum is 99 or less, will
a) estimate the sum; and
b) find the sum, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimation is a number sense skill used instead of finding an exact answer. When an actual computation is not necessary, an estimate will suffice. • Rounding is one strategy used to estimate. • Estimation is also used before solving a problem to check the reasonableness of the sum when an exact answer is required. • By estimating the result of an addition problem, a place value orientation for the answer is established. • Strategies for mentally adding two-digit numbers ~~mentally~~ include student-invented strategies, making-ten, partial sums and counting on, among others. – partial sums: 56 + 41 = __ 50 + 40 = 90 6 + 1 = 7 90 + 7 = 97 – counting on: 36 + 62 = __ 36 + 60 = 96 96 + 2 = 98 • Addition means to combine or join quantities. • The ~~standard algorithm for addition is~~ terms used in addition are 23 → *addend* + 46 → *addend* 69 → *sum* • Strategies for adding two-digit numbers can include, but are not limited to, using a hundreds chart, number line, and invented strategies.	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in practical situations when exact answers are not required or needed. • Understand that estimation skills are also valuable in determining the reasonableness of the sum when solving for the exact answer is needed. • Understand that addition is used to join groups in practical situations when exact answers are needed. • Develop flexible methods of adding whole numbers by combining numbers in a variety of ways to find the sum, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Regroup 10 ones for 1 ten, using ~~b~~Base-10 models, when finding the sum of two whole numbers whose sum is 99 or less. • Estimate the sum of two whole numbers whose sum is 99 or less and recognize whether the estimation is reasonable. • ~~Determine~~ Find the sum of two whole numbers whose sum is 99 or less, using ~~b~~Base-10 models, such as ~~b~~Base-10 blocks and bundles of tens. • Solve problems presented vertically or horizontally that require finding the sum of two whole numbers whose sum is 99 or less, using paper and pencil. • Solve problems, using mental computation strategies, involving addition of two whole numbers whose sum is 99 or less.

2.6 The student, given two whole numbers whose sum is 99 or less, will

a) estimate the sum; and

b) find the sum, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Building an understanding of the algorithm by first using concrete materials and then a do-and-write approach connects it to the written form of the algorithm. • The traditional algorithm for two-digit numbers is contrary to the natural inclination to begin with the left-hand number. • Regrouping is used in addition when a sum in a particular place value is 10 or greater.		

2.7 The student, given two whole numbers, each of which is 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimation is a number sense skill used instead of finding an exact answer. When an estimate is needed, the actual computation is not necessary. • Rounding is one strategy used to estimate. • Estimation is also used before solving a problem to check the reasonableness of the sum when an exact answer is required. • ~~Giving an estimate of~~ By estimat~~e~~ing the result of a subtraction problem, ~~establishes~~ a place value orientation for the answer is established. • Subtraction is the inverse operation of addition and is used for different reasons: – to remove one amount from another; – to compare one amount to another; and – to find the missing quantity when the whole quantity and part of the quantity are known. • Three terms often used ~~to discuss~~ in subtraction are *minuend* → 98 *subtrahend* → – 41 *difference* → 57 • Regrouping is a process of renaming a number to make subtraction easier. • An understanding of the subtraction algorithm should be built by first using concrete materials and then employing a do-and-write approach (i.e., use the manipulatives, then record what you have done). This connects the activity to the written form of the algorithm. • Mental computational strategies for subtracting two-	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in practical situations when exact answers are not required or needed. • Understand that estimation skills are also valuable in determining the reasonableness of the difference when solving for the exact answer is needed. • Understand that subtraction is used in practical situations when exact answers are needed. • Develop flexible methods of subtracting whole numbers to find the difference, by combining numbers in a variety of ways, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Regroup 1 ten for 10 ones, using ~~b~~Base-10 models, such as ~~b~~Base-10 blocks and bundles of tens. • Estimate the difference of two whole numbers each 99 or less and recognize whether the estimation is reasonable. • ~~Determine~~ Find the difference of two whole numbers each 99 or less, using ~~b~~Base-10 models, such as ~~b~~Base-10 blocks and bundles of tens. • Solve problems presented vertically or horizontally that require finding the difference between two whole numbers each 99 or less, using paper and pencil. • Solve problems, using mental computation strategies, involving subtraction of two whole numbers each 99 or less.

2.7 The student, given two whole numbers, each of which is 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
digit numbers might include – lead-digit or front-end strategy: 56 – 21 = __ 50 – 20 = 30 6 – 1 = 5 30 + 5 = 35 – counting up: 87 – 25 = __ 20 + 60 = 80 5 + 2 = 7 60 + 2 = 62 or 87 – 25 = __ 25 + 60 = 85 85 + 2 = 87 60 + 2 = 62 or 87 – 25 = __ 25 + 2 = 27 27 + 60 = 87 2 + 60 = 62 – partial differences: 98 – 41 = __ 90 – 40 = 50 8 – 1 = 7 50 + 7 = 57. • Strategies for subtracting two-digit numbers may include using a hundreds chart, number line, and invented strategies.		

2.8 The student will create and solve one- and two-step addition and subtraction problems, using data from simple tables, picture graphs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Problem solving means engaging in a task for which a solution or a method of solution is not known in advance. Solving problems using data and graphs offers a natural way to connect mathematics to practical situations. • The ability to retrieve information from simple charts and picture graphs is a necessary prerequisite to solving problems. • An example of an approach to solving problems is Polya's four-step plan: – Understand: Retell the problem. – Plan: Decide what the operation is. – Solve: Write a number sentence. – Look back: Does the answer make sense? • The problem solving process is enhanced when students – create their own story problems; and – model word problems, using manipulatives or drawings.	**All students should** • Develop strategies for solving practical problems. • Enhance problem solving skills by creating their own problems.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the appropriate data and the operation needed to solve an addition or subtraction problem where the data are presented in a simple table, picture graph, or bar graph. • Solve addition and subtraction problems requiring a one- or two-step solution, using data from simple ~~charts~~ tables, picture graphs, bar graphs, and everyday-life situations. • Create a one- or two-step addition or subtraction problem using data from simple tables, picture graphs, and bar graphs whose sum is 99 or less . ~~For subtraction, the difference will be between two whole numbers each 99 or less.~~

2.9 The student will recognize and describe the related facts that represent and describe the inverse relationship between addition and subtraction.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition and subtraction are inverse operations, that is, one undoes the other: 3 + 4 = 7 7 – 3 = 4 7 – 4 = 3 4 + 3 = 7 • For each addition fact, there is a related subtraction fact. • Developing strategies for solving missing-addends problems and the missing part of subtraction facts ~~(e.g., 7 __ = 3)~~ builds an understanding of the link between addition and subtraction. To solve 9 – 5 = __, think 5 + __ = 9. • Demonstrate joining and separating sets to investigate the relationship between addition and subtraction.	**All students should** • Understand how addition and subtraction relate to one another.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the missing number in a number sentence (e.g., 3 + __ = 5 or __+ 2 = 5; 5 – __ = 3 or 5 – 2 = __). • Write the related facts for a given addition or subtraction fact (e.g., given 3 + 4 = 7, write 7 – 4 = 3 and 7 – 3 = 4).

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

2.10 The student will

a) count and compare a collection of pennies, nickels, dimes, and quarters whose total value is $2.00 or less; and

b) correctly use the cent symbol (¢), dollar symbol ($), and decimal point (.).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The money system used in the United States consists of coins and bills based on ones, fives, and tens, making it easy to count money. • The dollar is the basic unit. • Emphasis is placed on the verbal expression of the symbols for cents and dollars (e.g., $0.35 and 35¢ are both read as "thirty-five cents"; $3.00 is read as "three dollars"). • Money can be counted by grouping coins and bills to determine the value of each group and then adding to determine the total value. • The most common way to add amounts of money is to "count on" the amount to be added.	**All students should** • Understand how to count and compare a collection of coins and one-dollar bills whose total value is $2.00 or less. • Understand the proper use of the cent symbol (¢), dollar sign ($), and decimal point (.).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify all coins and a one-dollar bill, recording the value, using the cent symbol (¢), dollar symbol ($), and decimal point (.).~~ • Determine the value of a collection of coins and one-dollar bills whose total value is $2.00 or less. • Compare the values of two sets of coins and one-dollar bills (each set having a total value of $2.00 or less), using the terms *greater than, less than*, or *equal to*. • Simulate everyday opportunities to count and compare a collection of coins and one-dollar bills whose total value is $2.00 or less. • Use the cent (¢) and dollar ($) symbols and decimal point (.) to write a value of money which is $2.00 or less.

2.11 The student will estimate and measure
a) length to the nearest centimeter and inch;
b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and
c) liquid volume in cups, pints, quarts, gallons, and liters.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A clear concept of the size of one unit ~~(one inch or one centimeter)~~ is necessary before one can measure to the nearest unit. • Knowledge of the exact relationships within the metric or U.S. Customary system of measurement for measuring liquid volume, such as 4 cups to a quart, is not required at this grade level. • Practical experiences measuring liquid volume, using a variety of actual measuring devices (e.g., containers for a cup, pint, quart, gallon, and liter), will help students build a foundation for estimating liquid volume with these measures. • The experience of making a ruler can lead to greater understanding of using one. • Proper placement of a ruler when measuring length (i.e., placing the end of the ruler at one end of the item to be measured) should be demonstrated. • ~~Perimeter is the distance around any two-dimensional shape and is found by adding the measures of the sides.~~ • ~~Linear metric measurement is based on the meter (a base-10 system) and includes centimeters.~~ • ~~Linear standard measurement is based on the foot and includes inches.~~ • ~~A polygon is a simple closed figure lying on a plane, such as a triangle or square. "Simple" means that the lines do not cross.~~ • Weight and mass are different. Mass is the amount	**All students should** • Understand that centimeters/inches are units used to measure length. • Understand how to estimate ~~linear measures and how to use a ruler to~~ and measure to determine a linear measure to the nearest centimeter and inch. • Understand that pounds/ounces and kilograms/grams are units used to measure weight/mass. • Understand how to use a scale to determine the weight/mass of an object and use the appropriate unit for measuring weight/mass. • Understand that cups, pints, quarts, gallons, and liters are units used to measure liquid volume. • Understand how to use measuring devices to determine liquid volume in both metric and customary units. • ~~Understand how to compare measures.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify an inch as a U.S. customary unit for measuring length.~~ • Estimate and measure the length of various line segments and objects to the nearest inch and centimeter. • ~~Identify a centimeter as a metric unit for measuring length.~~ • ~~Estimate and measure the length of various line segments and objects to the nearest centimeter.~~ • ~~Measure each side of a variety of concrete polygons and add them to determine the distance around the polygon (its perimeter).~~ • ~~Determine the distance around a polygon (its perimeter), given the measurements of the sides in centimeters or inches.~~ • ~~Identify pound as the U.S. customary units for measuring weight.~~ • ~~Identify kilogram as a metric unit for measuring mass.~~ • Estimate and then measure the weight/mass of ~~familiar~~ objects to the nearest pounds/ounces and kilograms/grams, using a scale. • ~~Estimate and then measure the weight/mass of familiar objects to the nearest kilogram, using a scale.~~

2.11 The student will estimate and measure

a) length to the nearest centimeter and inch;

b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and

c) liquid volume in cups, pints, quarts, gallons, and liters.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • ~~Mass is more difficult for young children to understand than length.~~ • A balance is a scale for measuring mass. To determine the mass of an object by using a two-pan balance, first level both sides of the balance by putting standard units of mass on one side to counterbalance the object on the other; then find the sum of the standard units of mass required to level the balance. • Benchmarks of common objects need to be established for one pound and one kilogram ~~(e.g., the mass of a math book is about one kilogram).~~ Practical experience measuring the mass of familiar objects helps to establish benchmarks. • Pounds and kilograms are not compared at this level. • The terms *cups, pints, quarts, gallons*, and *liters* are introduced as terms used to describe the liquid volume of everyday containers. • The exact relationship between a quart and a liter is not expected at this level.		• ~~Identify the metric and U.S. customary units for~~ Estimate and measure ~~measuring~~ liquid volume in ~~(e.g.,~~ cups, pints, quarts, gallons, and liters~~)~~. • ~~Compare customary and metric units of liquid volume (e.g., cups to quarts, liters to quarts), using actual measuring devices and the concepts of *more, less*, and *equivalent*.~~

2.12 The student will tell and write time to the nearest five minutes, using analog and digital clocks.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Telling time requires reading a clock. The position of the two hands on an analog clock is read ~~with the little hand indicating the hour and the long hand indicating the number of minutes after or before an hour~~ to tell the time. A digital clock shows the time by displaying the time in numbers which are read as the hour and minutes. • ~~Time is a unit of measure.~~ • The use of a demonstration clock with gears ensures that the positions of the hour hand and the minute hand are precise at all times. • The face of an analog clock can be divided into 4 equal parts, called *quarter hours*, of 15 minutes each.	**All students should** • Apply an appropriate technique to determine time to the ~~quarter hour~~ nearest five minutes, using analog and digital clocks. • Demonstrate an understanding of counting by fives to predict five minute intervals when telling time to the nearest five minutes.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Show, ~~and~~ tell, and write time to the ~~quarter hour~~ nearest five minutes, using an ~~model~~ analog and digital clock. • ~~Write the time indicated on a digital clock to the nearest quarter hour.~~ • ~~Write the time indicated on an analog clock to the nearest quarter hour.~~ • Match a written time to a time shown on a clock face to the ~~quarter hour~~ nearest five minutes.

2.13 The student will

a) determine past and future days of the week; and

b) identify specific days and dates on a given calendar.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The calendar is a way to represent ~~measure~~ units of time (e.g., days, weeks, and months). • Using a calendar develops the concept of day as a 24-hour period rather than a period of time from sunrise to sunset. • Practical situations are appropriate to develop a sense of the interval of time between events (e.g., Boy Scout meetings occur every week on Monday: there is a week between meetings).	**All students should** • Understand how to use a calendar as a way to measure time.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Read a calendar to locate a given day or date.~~ • ~~Identify the seven days in a week.~~ • Determine the days/dates before and after a given day/date. • Determine the ~~date~~ day that is a specific number of days or weeks in the past or in the future from a given date, using a calendar. • Identify specific days and dates (e.g., the third Monday in a given month or what day of the week does May 11 fall on).

2.14 The student will read the temperature on a Celsius and/or Fahrenheit thermometer to the nearest 10 degrees.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The symbols for degrees in Celsius (°C) and degrees in Fahrenheit (°F) should be used to write temperatures. • Celsius and Fahrenheit temperatures should be related to everyday occurrences by measuring the temperature of the classroom, the outside, liquids, body temperature, and other things found in the environment. • Estimating and measuring temperatures in the environment in Fahrenheit and Celsius require the use of real thermometers. • A physical model can be used to represent the temperature determined by a real thermometer.	**All students should** • Understand how to measure temperature in Celsius and Fahrenheit with a thermometer.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Read temperature to the nearest 10 degrees from real Celsius and Fahrenheit thermometers and from physical models (including pictorial representations) of such thermometers.

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of ~~shapes~~ figures and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent ~~two- and three-dimensional~~ plane and solid ~~shapes~~ figures through drawing, block constructions, dramatization, and verbal language.

The focus of instruction at this level is on

- observing, identifying, describing, comparing, contrasting, and investigating ~~three-dimensional~~ solid objects and their ~~two-dimensional~~ faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, contrasting, sorting, and classifying ~~shapes~~ figures; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these ~~shapes~~ figures but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

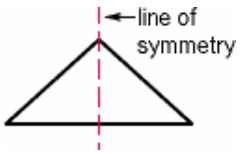
The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

2.15 The student will

a) draw a line of symmetry in a figure; and

b) identify and create figures with at least one line of symmetry.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A figure ~~or shape~~ is symmetric along a line when one-half of the figure is the mirror image of the other half. • A line of symmetry divides a symmetrical figure, object, or arrangement of objects into two parts that are congruent if one part is reflected ~~(flipped)~~ over the line of symmetry.  • Children learn about symmetry through hands-on experiences with geometric ~~shapes~~ figures and the creation of geometric pictures and patterns. ~~while playing with shapes.~~ • Guided explorations of the study of symmetry by using mirrors, miras, paper folding, and pattern blocks will enhance students' understanding of the attributes of symmetrical ~~shapes~~ figures. • While investigating symmetry, children move ~~shapes~~ figures, such as pattern blocks, intuitively, thereby exploring transformations of those ~~shapes~~ figures. A transformation is the movement of a figure — either a translation, rotation, or reflection. A translation ~~(slide)~~ is the result of sliding a figure in any direction; rotation ~~(turn)~~ is the result of turning a figure around a point or a vertex; and reflection ~~(flip)~~ is the result of flipping a figure over a line.	**All students should** • Develop strategies to determine whether or not a figure has at least one ~~a~~ line of symmetry. • Develop strategies to create figures with at least one line of symmetry. • Understand that some figures may have more than one line of symmetry.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify ~~and create~~ figures ~~that are symmetrical along a line~~ with at least one line of symmetry, using various concrete materials. • Draw ~~the~~ a line~~(s)~~ of symmetry — horizontal, vertical, and diagonal — in a figure. • ~~Identify and demonstrate a line of symmetry in an object or an arrangement of objects.~~ • ~~Investigate~~ Create figures with at least one line of symmetry using various concrete materials ~~using~~ (e.g., paper ~~folding~~, mirrors/miras, pattern blocks, wax paper, or tracing paper).

2.16 The student will identify, describe, compare, and contrast plane and solid geometric figures (circle/sphere, square/cube, and rectangle/rectangular prism).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., "I know it's a rectangle because it looks like a door, and I know that a door is a rectangle."). – **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., "I know it's a rectangle because it is closed; it has four sides and four right angles, and opposite sides are parallel."). • An important part of geometry is naming and describing ~~shapes~~ figures in two-dimensions (plane ~~shapes~~ figures) and three-dimensions (solid ~~shapes~~ figures). • A vertex is a point where two or more line segments, lines, or rays meet to form an angle. • An angle is two rays that share an endpoint. • Plane figures are two-dimensional figures formed by lines that are curved, straight, or a combination of both. They have angles and edges.	**All students should** • Understand the differences between plane and solid figures while recognizing the inter-relatedness of the two. • Understand that a solid figure is made up of a set of plane figures.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine similarities and differences between related plane and solid ~~shapes~~ figures (e.g., circle/sphere, square/cube, rectangle/rectangular ~~solid~~ prism, using models and cutouts. • Trace faces of solid ~~shapes~~ figures (e.g., cube and rectangular solid) to create the set of plane figures related to the solid ~~shape~~ figure. • Identify and describe plane and solid figures (e.g., circle/sphere, square/cube, and rectangle/rectangular ~~solid~~ prism), according to the number and shape of their faces, edges, and vertices using models. • Compare and contrast plane and solid geometric ~~shapes~~ figures (e.g., circle/sphere, square/cube, and rectangle/rectangular ~~solid~~ prism) according to the number and shape of their faces (sides, bases), edges, vertices, and ~~corners~~ angles.

2.16 The student will identify, describe, compare, and contrast plane and solid geometric figures (circle/sphere, square/cube, and rectangle/rectangular prism).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The identification of ~~two-~~plane and ~~three-dimensional~~ solid figures is accomplished by working with and handling objects. • Tracing faces of solid figures is valuable to understanding the set of plane figures related to the solid figure (e.g., cube and rectangular prism). • A circle is a closed curve in a plane with all its points the same distance from the center. • A sphere is a ~~three-dimensional (~~solid~~)~~ figure with all of its points the same distance from its center. • A square is a rectangle with four sides of equal length. • A rectangular prism is a solid in which all six faces are rectangles. A rectangular prism has 8 vertices and 12 edges. • A cube is a ~~three-dimensional (~~solid~~)~~ figure with six congruent, square faces. All edges are the same length. A cube has 8 vertices and 12 edges. It is a rectangular prism. • A rectangle is a plane figure with four right angles. A square is a rectangle. • ~~A square pyramid is a three-dimensional (solid) figure that has a square base and whose other faces are triangles that share a common vertex.~~ • ~~A cylinder is a three-dimensional (solid) figure with two congruent, parallel circular surfaces joined by a curved surface.~~ • ~~A cone is a three-dimensional (solid), pointed figure that has a flat, round base (usually a circle) that is joined to a vertex by a curved surface.~~		

2.16 The student will identify, describe, compare, and contrast plane and solid geometric figures (circle/sphere, square/cube, and rectangle/rectangular prism).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The edge is the line segment where two faces of a ~~three-dimensional~~ solid figure ~~meet~~ intersect. • A face is a polygon that serves as one side of a ~~three-dimensional~~ solid figure (e.g., a square is a face of a cube). • ~~A corner is the point at which three or more edges meet.~~ • A base is a special face of a ~~three-dimensional (~~solid~~)~~ figure. • The relationship between plane and solid geometric figures, such as the square and the cube or the rectangle and the rectangular ~~solid,~~ prism helps build the foundation for future geometric study of faces, edges, angles, and vertices.		

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible, unlikely, equally likely, more likely,* and *certain.*

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

2.17 The student will use data from experiments to construct picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The purpose of a graph is to represent data gathered to answer a question. • ~~Picture and bar graphs are created to communicate the data collected.~~ • Picture graphs are graphs that use pictures to show and compare information. ~~A key should be used to indicate what the picture symbol represents (e.g., one picture of a sneaker represents five sneakers in a graph of shoe types).~~ • Pictographs are graphs that use symbols/pictures to show and compare information. A student can be represented as a stick figure in a pictograph. A key should be used to indicate what the picture symbol represents (e.g., one picture of a sneaker represents five sneakers in a graph of shoe types).– • Bar graphs are used to compare counts of different categories (categorical data). Using grid paper may ensure~~s~~ more accurate graphs. – A bar graph uses parallel, horizontal or vertical bars to represent counts for several categories. One bar is used for each category, with the length of the bar representing the count for that category. – There is space before, between, and after the bars. – The axis displaying the scale that represents the count for the categories should extend one increment above the greatest recorded piece of data. Second grade students should be collecting data that are recorded in increments of whole numbers, usually multiples of 1 or 2. – Each axis should be labeled, and the graph should be given a title.	**All students should** • Understand that data may be generated from experiments. • Understand how data can be collected and organized in picture graphs, pictographs, ~~or~~ and bar graphs. • Understand that picture graphs use pictures to show and compare data. • Understand that pictographs use a symbol/representation of an object, person, etc. • Understand that bar graphs can be used to compare categorical data.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Organize data from experiments, using lists, tables, objects, pictorial representations, tally marks, and charts, in order to construct a graph. • Read the information presented horizontally and vertically on ~~a simple~~ picture graphs, pictographs, ~~or~~ and bar graphs. • Collect no more than 16 pieces of data to answer a given question. • Represent data from experiments by constructing ~~a simple~~ picture graphs, pictographs, ~~or~~ and bar graphs. • Label the axes on a bar graph, limiting the number of categories (categorical data) to four and the increments to multiples of whole numbers (e.g., multiples of 1, 2, or 5). • Label the axes on a picture graph and pictograph, limiting the number of categories to four and including a key where appropriate. • ~~Interpret information from simple picture and bar graphs by writing at least one statement that covers one or both of the following:~~ ~~– Describe the categories of data and the data as a whole (e.g., the total number of responses).~~ ~~– Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same.~~ • ~~Select the best interpretation of a graph from a set of possible interpretations of the graph.~~

2.17 The student will use data from experiments to construct picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
– ~~Statements representing an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences, least and greatest, the categories, and total number of responses) should be written.~~ • ~~When data is displayed in an organized manner, the results of investigations can be described, and the questions posed can be answered.~~		

2.18 The student will use data from experiments to predict outcomes when the experiment is repeated.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A spirit of investigation and experimentation should permeate probability instruction, where students are actively engaged in investigations and have opportunities to use manipulatives. • Investigation of experimental probability is continued through informal activities, such as dropping a two-colored counter (usually a chip that has a different color on each side), using a multicolored spinner (a circular spinner that is divided equally into two, three, four or more equal "pie" parts where each part is filled with a different color), using spinners with numbers, or rolling random number generators (dice). • Probability is the chance of an event occurring (e.g., the probability of landing on a particular color when flipping a two-colored chip is $\frac{1}{2}$, representing one of two possible outcomes). • An event is a possible outcome in probability. Simple events include the possible outcomes when tossing a coin (heads or tails), when rolling a random number generator (a number cube or a die where there are six equally likely outcomes and the probability of one outcome is $\frac{1}{6}$), or when spinning a spinner. • If all the outcomes of an event are equally likely to occur, the probability of an event is equal to the number of favorable outcomes divided by the total number of possible outcomes: the probability of the event = $\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$.	**All students should** • Understand that data may be generated from experiments. • ~~Understand and apply basic concepts of probability.~~ • Understand that the likelihood of an event occurring is to ~~determine~~ predict the probability of it happening.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Conduct probability experiments, using multicolored spinners, colored tiles, or number cubes and use the data from the experiments to predict outcomes if the experiment is repeated. • Record the results of probability experiments, using tables, charts, and tally marks. • Interpret the results of probability experiments (e.g., the two-colored spinner landed on red 5 out of 10 times). • Predict which of two events is more likely to occur if an experiment is repeated.

2.18 The student will use data from experiments to predict outcomes when the experiment is repeated.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• At this level, students need to understand only this fractional representation of probability (e.g., the probability of getting heads when flipping a coin is $\frac{1}{2}$). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *as likely as unlikely*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring. Activities should include practical examples.		

2.19 The student will analyze data displayed in picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Statements that represent an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences, least and greatest, the categories, and total number of responses) should be discussed with students and written. • When data ~~is~~ are displayed in an organized manner, the results of investigations can be described, and the questions posed can be answered.	**All students should** • Understand how to read the key used in a graph to assist in the analysis of the displayed data. • Understand how to interpret data in order to analyze it. • Understand how to analyze data in order to answer the questions posed, make predictions, and generalizations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Interpret~~ Analyze information from simple picture graphs, pictographs, and bar graphs by writing at least one statement that covers one or both of the following: – Describe the categories of data and the data as a whole (e.g., the total number of responses). – Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same. • Select the best analysis of a graph from a set of possible analyses of the graph.

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns ~~in the real world~~. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to Algebra.

2.20 The student will identify, create, and extend a wide variety of patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Identifying and extending patterns is an important process in mathematical thinking. • Analysis of patterns in the real world (e.g., patterns on a butterfly's wings, patterns on a ladybug's shell) leads to the analysis of mathematical patterns such as number patterns and geometric patterns. • Reproduction of a given pattern in a different manifestation, using symbols and objects, lays the foundation for writing numbers symbolically or algebraically. • The simplest types of patterns are repeating patterns. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. • Growing patterns are more difficult for students to understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns in both arithmetic and geometric formats. • In numeric patterns, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Sample numeric patterns include – 6, 9, 12, 15, 18, …; (growing numeric pattern); – 5, 7, 9, 11, 13, … (repeating numeric pattern); and – 1, 2, 4, 7, 11, 16, … (growing numeric pattern). • In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation ~~(turn)~~ is the result of turning a	**All students should** • Understand patterns are a way to recognize order and to predict what comes next in an arrangement. • Analyze how both repeating and growing patterns are generated.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a growing and/or repeating pattern from a given geometric or numeric sequence. • Predict the next number, geometric figure, symbol, picture, or object in a given pattern. • Extend a given pattern, using numbers, geometric figures, symbols, pictures, or objects. • Create a new pattern, using numbers, geometric figures, pictures, symbols, or objects. • Recognize the same pattern in different manifestations.

2.20 The student will identify, create, and extend a wide variety of patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
figure around a point or a vertex, and reflection ~~(flip)~~ is the result of flipping a figure over a line.		

2.21 The student will solve problems by completing numerical sentences involving the basic facts for addition and subtraction. The student will create story problems, using the numerical sentences.

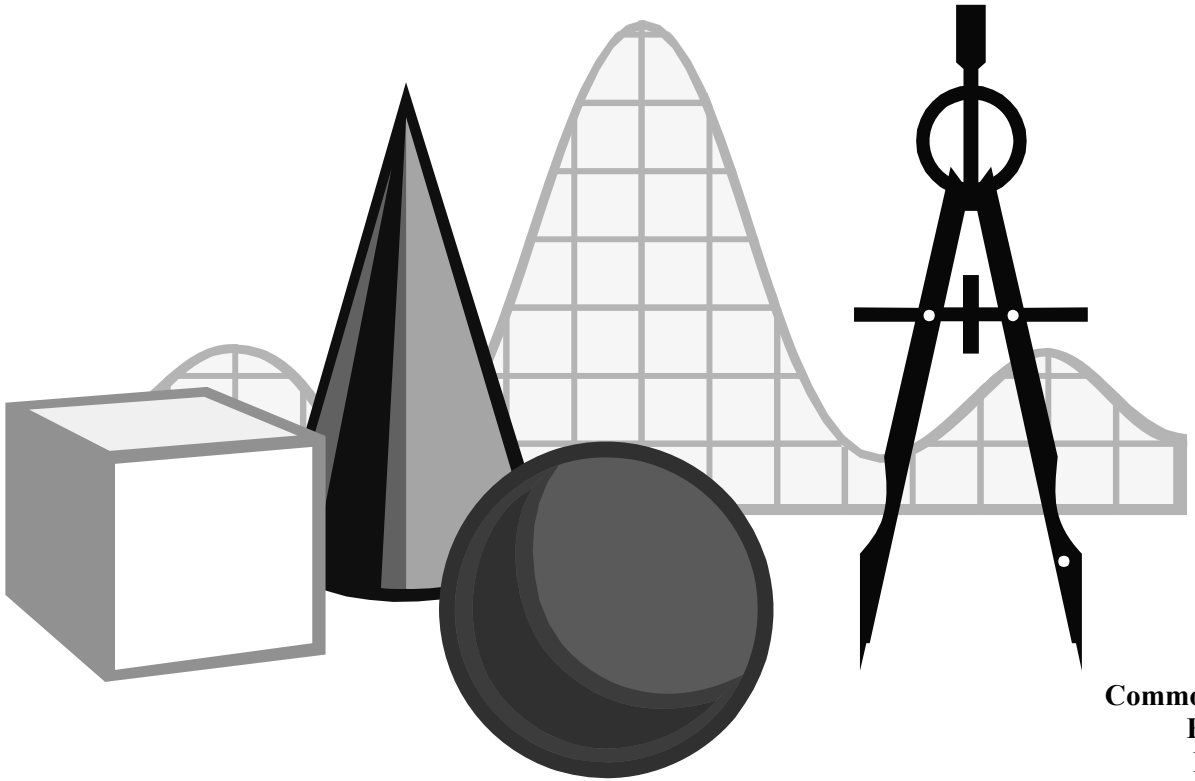
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Recognizing and using patterns and learning to represent situations mathematically are important aspects of primary mathematics. • Discussing what a word problem is saying and writing a number sentence are precursors to solving word problems. • The patterns formed by related basic facts facilitate the solution of problems involving a missing addend in an addition sentence or a missing part (subtrahend) in a subtraction sentence. • Making mathematical models to represent simple addition and subtraction problems facilitates their solution. • By using story problems and numerical sentences, students begin to explore forming equations and representing quantities using variables. • Students can begin to understand the use of a symbol (e.g., __, ?, or ☐) to represent an unknown quantity.	**All students should** • Use mathematical models to represent and understand quantitative relationships. • Understand various meanings of addition and subtraction and the relationship between the two operations. • Understand how to write missing addend and missing subtrahend sentences.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve problems by completing a numerical sentence involving the basic facts for addition and subtraction (e.g., 3 + __ = 7, or 9 – __ = 2). • Create a story problem for a given numerical sentence.

2.22 The student will demonstrate an understanding of equality by recognizing that the symbol = in an equation indicates equivalent quantities and the symbol ≠ indicates that quantities are not equivalent.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The = symbol means that the values on either side are the same (balanced). • The ≠ symbol means that the values on either side are not the same (not balanced). • In order for students to develop the concept of equality, students need to see the = symbol used in various locations (e.g., 3 + 4 = 7 and 5 = 2 + 3).	**All students should** • Understand that the equal symbol means equivalent (same as) quantities. • The inequality symbol (≠) means not equivalent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the equality (=) and inequality (≠) symbols. • Identify equivalent values and equations. (e.g., 8 = 8 and 8 = 4 + 4) • Identify nonequivalent values and equations. (e.g., 8 ≠ 9 and 4 + 3 ≠ 8) • Identify and use the appropriate symbol to distinguish between equal and not equal quantities. (e.g., 8 + 2 7 + 3 and 1 + 4 6 + 2)

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 3



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Board of Education
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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, ~~simple~~ fractions, number relationships ("more than," "less than," and "~~as many as~~ equal to"), and the effects of ~~simple~~ single-step and multistep computations ~~operations on numbers (fact families)~~. These learning experiences should allow students to engage actively in a variety of problem solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

3.1 The student will

a) read and write six-digit numerals and identify the place value and value of each digit;
b) round whole numbers, 9,999 or less, to the nearest ten, hundred, and thousand; and
c) compare two whole numbers between 0 and 9,999, using symbols (>, <, or =) and words (*greater than, less than*, or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The structure of the ~~b~~Base-10 number system is based upon a simple pattern of tens, where each place is ten times the value of the place to its right. This is known as a ten-to-one place value relationship. • The structure of the ~~b~~Base-10 blocks is based on the ten-to-one place value relationship (e.g., 10 ~~cubes~~ units make a long, 10 longs make a flat, 10 flats make a ~~big~~ cube). • Place value refers to the value of each digit and depends upon the position of the digit in the number. In the number 7,864, the eight is in the hundreds place, and the value of the 8 is eight hundred. • Flexibility in thinking about numbers — or "decomposition" of numbers (e.g., 12,345 is 123 hundreds, 4 tens, and 5 ones) — is critical and supports understandings essential to multiplication and division. • Whole numbers may be written in a variety of formats: – Standard: 123,456; – Written: one hundred twenty-three thousand, four hundred fifty-six; and – Expanded: (1 × 100,000) + (2 × 10,000) + (3 × 1,000) + (4 × 100) + (5 × 10) + (6 × 1). • Numbers are arranged into groups of three places called *periods* (ones, thousands, millions, and so on). Places within the periods repeat (hundreds,	**All students should** • Understand that knowledge of place value is essential when comparing numbers. • Understand the relationships in the place value system, where each place is ten times the value of the place to its right. • Understand that rounding gives an estimate to use when exact numbers are not needed for the situation. • Understand the relative magnitude of numbers by comparing numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate and identify the place and value for each digit in a six-digit numeral, using ~~b~~Base-10 manipulatives (e.g., ~~b~~Base-10 blocks). • Use the patterns in the place value system to read and write numbers. • Read six-digit numerals orally. • Write six-digit numerals that are stated verbally or written in words. • Round a given whole number, 9,999 or less, to the nearest ten, hundred, and thousand. • Solve problems, using rounding of numbers, 9,999 or less, to the nearest ten, hundred, and thousand. • Determine which of two whole numbers between 0 and 9,999 is greater. • Determine which of two whole numbers between 0 and 9,999 is less. • Compare two whole numbers between 0 and 9,999, using the symbols >, <, or =. • Use the terms *greater than, less than*, and *equal to* when comparing two whole numbers.

3.1 The student will

a) read and write six-digit numerals and identify the place value and value of each digit;
b) round whole numbers, 9,999 or less, to the nearest ten, hundred, and thousand; and
c) compare two whole numbers between 0 and 9,999, using symbols (>, <, or =) and words (*greater than, less than*, or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
tens, ones). ~~The base-10 blocks of shapes repeat every period (e.g., cube – long – flat, big cube – big long – big flat).~~ Commas are used to separate the periods. Knowing the place value and period of a number helps students find the value of a digit~~s~~ in any number as well as read and write numbers. • To read a whole number through the hundred thousands place, – read the ~~number~~ digits to the first comma; – say the name of the period (e.g., "thousands"); ~~and~~ then – read the last three digits, but do not say the name of the ones period. • Reading and writing large numbers should be related to numbers that have meanings (e.g., numbers found in the students' environment). Concrete materials, such as ~~b~~Base-10 blocks ~~and bundles of sticks,~~ may be used to represent whole numbers through thousands. Larger numbers may be represented ~~by symbol cards~~ on place value charts. • Rounding is one of the estimation strategies ~~and~~ that is often used to assess the reasonableness of a solution or to give ~~a rough idea~~ an estimate of an amount. • Students should explore reasons for estimation, using ~~real-life~~ practical experiences, and use rounding to solve ~~real-life~~ practical situations. • The concept of rounding may be introduced through the use of a number line. When given a number to round, locate it on the number line. Next, determine		

3.1 The student will

a) read and write six-digit numerals and identify the place value and value of each digit;
b) round whole numbers, 9,999 or less, to the nearest ten, hundred, and thousand; and
c) compare two whole numbers between 0 and 9,999, using symbols (>, <, or =) and words (*greater than, less than*, or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
the multiple of ten, hundred, or thousand it is between. Then identify to which it is closer. • A procedure for rounding numbers to the nearest ten, hundred, or thousand is as follows: – Look one place to the right of the digit to which you wish to round. – If the digit is less than 5, leave the digit in the rounding place as it is, and change the digits to the right of the rounding place to zero. – If the digit is 5 or greater, add 1 to the digit in the rounding place, and change the digits to the right of the rounding place to zero. • A procedure for comparing two numbers by examining may include the following: – Line up the numbers by place value by lining up the ones. – Beginning at the left, find the first place value where the digits are different. – Compare the digits in this place value to determine which number is greater (or which is less). – Use the appropriate symbol > or < or the words *greater than* or *less than* to compare the numbers in the order in which they are presented. – If both numbers are the same, use the symbol = or the words *equal to*.		

3.2 The student will recognize and use the inverse relationships between addition/subtraction and multiplication/division to complete basic fact sentences. The student will use these relationships to solve problems.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition and subtraction are inverse operations, as are multiplication and division~~; that is, one undoes the other~~. • In building thinking strategies for subtraction, an emphasis is placed on connecting the subtraction fact to the related addition fact. The same is true for division, where the division fact is tied to the related multiplication fact. Building fact sentences helps strengthen this relationship. • Addition and subtraction should be taught concurrently in order to develop understanding of the inverse relationship. • Multiplication and division should be taught concurrently in order to develop understanding of the inverse relationship.	**All students should** • Understand how addition and subtraction are related. • Understand how multiplication and division are related.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use the inverse relationships between addition/subtraction and multiplication/division to solve related basic fact sentences. For example, 5 + 3 = 8 and 8 – 3 = __; 4 × 3 = 12 and 12 ÷ 4 = __. • Write three related basic fact sentences when given one basic fact sentence for addition/subtraction and for multiplication/division. For example, given 3 × 2 = 6, ~~write~~ solve the related facts __× 3 = 6, 6 ÷ 3 = __, and 6 ÷ __ = 3.

3.3 The student will

a) name and write fractions (including mixed numbers) represented by a model;
b) model fractions (including mixed numbers) and write the fractions' names; and
c) compare fractions having like and unlike denominators, using words and symbols (>, <, or =).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A fraction is a way of representing part of a whole (as in a region/area model or a measurement model) or part of a group (as in a set model). Fractions are used to name a part of one thing or a part of a collection of things. • In each ~~fraction~~ area/region and length/measurement model, the parts must be equal-sized (congruent) ~~(i.e., each pie piece must have the same area; the size of each chip in a set must be equal; the measures such as the red Cuisenaire rod or the connecting cube must be equal)~~. Wholes are ~~broken~~ divided or partitioned into equal-sized parts. ~~and reassembled into wholes~~. In the set model, each member of the set is an equal part of the set. The members of the set do not have to be equal in size. • The denominator ~~(bottom number)~~ tells how many equal parts are in the whole or set. The numerator ~~(top number)~~ tells how many of those parts are being ~~described~~ considered. • ~~Students should have~~ Provide opportunities to make connections among fraction representations by connecting concrete or pictorial representations with oral language and symbolic representations. • Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions (e.g., *thirds* means "three	**All students should** • Understand that the whole must be defined. • Understand that the denominator tells the number of equal parts ~~in~~ that represent a whole. • Understand that the numerator is a counting number that tells how many equal size parts are being considered. • Understand that the value of a fraction is dependent on both the number of parts in a whole (denominator) and the number of those parts being considered (numerator).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Name and write fractions ~~and~~ (including mixed numbers) represented by ~~drawings or concrete materials~~ a model ~~for~~ to include halves, thirds, fourths, eighths, and tenths. • ~~Represent a given fraction or mixed number, and write the fractions' names using~~ Use concrete materials~~,~~ and pictures~~, and symbols~~ to model ~~for~~ at least halves, thirds, fourths, eighths, and tenths. ~~For example, write the symbol for one-fourth, and represent it with concrete materials and pictures.~~ • Compare fractions using the terms greater than, less than, or equal to and the symbols (<, >, and =). Comparisons are made between fractions with both like and unlike denominators, using concrete materials and pictures.

3.3 The student will

a) name and write fractions (including mixed numbers) represented by a model;
b) model fractions (including mixed numbers) and write the fractions' names; and
c) compare fractions having like and unlike denominators, using words and symbols (>, <, or =).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
equal parts of a whole," $\frac{1}{3}$ represents one of three equal-size parts when a pizza is shared among three students, or *three-fourths* means "three of four equal parts of a whole") furthers this development. • Comparing unit fractions (a fraction in which the numerator is one) builds a mental image of fractions and the understanding that as the number of pieces of a whole increases, the size of one single piece decreases (e.g., $\frac{1}{5}$ of a bar is smaller than $\frac{1}{4}$ of a bar). • Comparing fractions to a benchmark on a number line (e.g., close to 0, less than $\frac{1}{2}$, exactly $\frac{1}{2}$, greater than $\frac{1}{2}$, or close to 1) facilitates the comparison of fractions when using concrete materials or pictorial models.		

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling ~~and~~, discussing, and recording a variety of problem situations. This approach ~~to~~ helps students ~~move~~ transition from the concrete to the representation to the symbolic ~~the abstract~~ ~~and~~ in order to develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, multiplication, division ~~facts~~ and related facts ~~families~~;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions ~~and decimals~~.

3.4 The student will estimate solutions to and solve single-step and multistep problems involving the sum or difference of two whole numbers, each 9,999 or less, with or without regrouping.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition is the combining of quantities; it uses the following terms: *addend* → 423 *addend* → + 246 *sum* → 669 • Subtraction is the inverse of addition; it yields the difference between two numbers and uses the following terms: *minuend* → 7,698 *subtrahend* → – 5,341 *difference* → 2,357 • An algorithm is a step-by-step method for computing. • An example of an approach to solving problems is Polya's four-step plan: – Understand: Retell the problem; read it twice; take notes; study the charts or diagrams; look up words and symbols that are new. – Plan: Decide what operation(s) and sequence of steps to use to solve the problem. – Solve: Follow the plan and work accurately. If the first attempt does not work, try another plan. – Look back: Does the answer make sense? • Knowing whether to find an exact answer or to make an estimate is learned through practical experiences in recognizing which is appropriate. • When an exact answer is required, opportunities to ~~practice~~ explore ~~recognizing~~ whether the answer can be determined mentally or must involve paper and pencil or calculators help students select the correct	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in ~~real-life~~ practical situations when exact answers are not required or needed. • Understand that estimation skills are also valuable in determining the reasonableness of the sum or difference when solving for the exact answer is needed. • Develop and use strategies to estimate whole number sums and differences ~~and~~ to ~~judge~~ determine the reasonableness of ~~such estimations~~ an exact answer. • Develop flexible methods of adding whole numbers by combining numbers in a variety of ways, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine whether an estimate or an exact answer is an appropriate solution for practical addition and subtraction problem~~s~~ situations involving single-step and multistep problems. • Determine whether to add or subtract in practical problem situations. • Estimate the sum or difference of two whole numbers, each 9,999 or less when an exact answer is not required. • Add or subtract two whole numbers, each 9,999 or less. • ~~Estimate and~~ ~~find~~ Solve practical problems involving the sum of two whole numbers, each 9,999 or less, with or without regrouping, using calculators, paper and pencil, or mental computation in practical problem situations. • ~~Estimate and~~ Solve practical problems involving the difference of two whole numbers, each 9,999 or less, with or without regrouping, using calculators, paper and pencil, or mental computation in practical problem situations. • Solve single-step and multistep problems involving the sum or difference of two whole numbers, each 9,999 or less, with or without regrouping.

3.4 The student will estimate solutions to and solve single-step and multistep problems involving the sum or difference of two whole numbers, each 9,999 or less, with or without regrouping.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
approach. • Determining whether an estimate is appropriate and using a variety of strategies to estimate requires experiences with problem situations involving estimation. • There are a variety of mental mathematics strategies for each basic operation, and opportunities to practice these strategies give students the tools to use them at appropriate times. For example, with addition, mental mathematics strategies include – Adding 9: add 10 and subtract 1; and – Making 10: for column addition, look for numbers that group together to make 10. • Using ~~b~~Base-10 materials to model and stimulate discussion about a variety of problem situations helps students understand regrouping and enables them to move from the concrete to the abstract. Regrouping is used in addition and subtraction algorithms. ~~When adding, if the sum in a place is 10 or more, place value is used to regroup the sums so that there is just one digit in each place. When subtracting, if the number in a place is not enough to subtract from, regrouping is required.~~ • Conceptual understanding begins with concrete experiences. Next, the children must make connections that serve as a bridge to the symbolic. One strategy used to make connections is representations, such as drawings, diagrams, tally marks, graphs, or written comments. • ~~A certain amount of practice is necessary to develop fluency with computational strategies for multidigit numbers; however, the practice must be motivating and systematic if students are to develop fluency in~~		

3.4 The student will estimate solutions to and solve single-step and multistep problems involving the sum or difference of two whole numbers, each 9,999 or less, with or without regrouping.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~computation, whether mental, with manipulative materials, or with paper and pencil.~~		

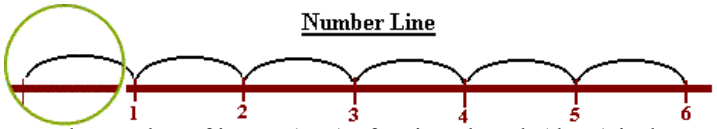
3.5 The student will recall multiplication facts through the twelves table, and the corresponding division facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The development of computational fluency relies on quick access to ~~basic~~ number facts. • A certain amount of practice is necessary to develop fluency with computational strategies; however, the practice must be motivating and systematic if students are to develop fluency in computation, whether mental, with manipulative materials, or with paper and pencil. • Strategies to learn the multiplication facts through the ~~nines~~ twelves table include an understanding of multiples/skip counting, properties of zero and one as factors, ~~square numbers~~, pattern of nines, commutative property, and related facts ~~families (the two related multiplication and two division problems)~~. • In order to develop and use strategies to learn the multiplication facts through the ~~nines~~ twelves table, students should use concrete materials, hundred chart, and mental mathematics. • ~~Multiplication is a shortcut for adding same-size groups.~~ To extend the understanding of multiplication, three models may be used: – The equal-sets or equal-groups model lends itself to sorting a variety of concrete objects into equal groups and reinforces repeated addition or skip counting. – The array model, consisting of rows and columns (e.g., 3 rows of 4 columns for a 3-by-4 array) helps build the commutative property. – The length model (e.g., a number line) also reinforces repeated addition or skip counting.	**All students should** • Develop fluency with ~~basic~~ number combinations for multiplication and division. • Understand that multiplication is repeated addition. • Understand that division is the inverse of multiplication. • Understand that patterns and relationships exist in the ~~basic~~ facts. • Understand that number relationships can be used to learn and retain the ~~basic~~ facts.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recall and state the multiplication and division facts through the ~~nines~~ twelves table. • Recall and write the multiplication and division facts through the ~~nines~~ twelves table.

3.6 The student will represent multiplication and division, using area, set, and number line models, and create and solve problems that involve multiplication of two whole numbers, one factor 99 or less and the second factor 5 or less.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The multiplication and division facts through the ~~nines~~ twelves tables should be modeled. • Multiplication is a shortcut for repeated addition. The terms associated with multiplication are listed below: *factor* → 54 *factor* → × 3 *product* → 162 • Creating real-life problems and solving them facilitates the connection between mathematics and everyday experiences (e.g., area problems). • The use of ~~b~~Base-10 blocks and repeated addition can serve as a model. For example, ~~17 × 4~~ 4 × 12 is read as four sets consisting of one rod and ~~seven~~ two units. The sum is renamed as ~~six~~ four rods and eight units or ~~68~~ 48. This can be thought of as ~~(10 + 7) × 4 = (10 × 4) + (7 × 4)~~ ~~40 + 28 = 40 + (20 + 8)~~ ~~(40 + 20) + 8 = 68. (SET)~~ 12 + 12 + 12 + 12 = (SET) • The use of ~~b~~Base-10 blocks and the array model can be used to solve the same problem. A rectangle array that is one rod and ~~seven~~ two units long by four units wide is formed. The area of this array is represented by 4 ~~longs~~ rods and ~~2~~8 units. ~~and can be thought of as~~ ~~(10 + 7) × 4 = (10 × 4) + (7 × 4)~~ ~~40 + 28 = 40 + (20 + 8)~~ ~~(40 + 20) + 8 = 68.~~ ~~(AREA)~~ • The number line model can be used to solve a multiplication problem such as 3 × 4. This is represented on the number	**All students should** • Understand ~~various~~ the meanings of multiplication and division. • Understand the ~~effects~~ models used to represent ~~of~~ multiplying and dividing whole numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model multiplication, using area, ~~and~~ set, and number line models. • Model division, using area, ~~and~~ set, and number line models. • Solve multiplication problems, using the ~~standard~~ multiplication algorithm, where one factor is 99 or less and the second factor is 5 or less. • Create and solve word problems involving multiplication, where one factor is 99 or less and the second factor is 5 or less.

3.6 The student will represent multiplication and division, using area, set, and number line models, and create and solve problems that involve multiplication of two whole numbers, one factor 99 or less and the second factor 5 or less.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
line by three jumps of four. • The number line model can be used to solve a division problem such as 6 ÷ 3 and is represented on the number line by noting how many jumps of three go from 6 to 0.  The number of jumps (two) of a given length (three) is the answer to the question. • An algorithm is a step-by-step method for computing.		

3.7 The student will add and subtract proper fractions having like denominators of 12 or less.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A proper fraction is a fraction whose numerator is ~~smaller~~ less than ~~its~~ the denominator. A proper fraction is ~~another name for~~ a fraction ~~between zero and~~ that is always less than one. • An improper fraction is a fraction whose numerator is greater than or equal to the denominator. An improper fraction is a fraction that is equal to or greater than one. • An improper fraction can be expressed as a mixed number. A mixed number is written as a whole number and a proper fraction. • The ~~concepts~~ strategies of addition and subtraction applied to fractions are the same as ~~these concepts~~ the strategies applied to whole numbers. • Reasonable answers to problems involving addition and subtraction of fractions can be established by using benchmarks such as 0, $\frac{1}{2}$, and 1. For example, $\frac{3}{5}$ and $\frac{4}{5}$ are each greater than $\frac{1}{2}$, so their sum is greater than 1. • Concrete materials and pictorial models representing area/regions (circles, squares, and rectangles), length/measurements (fraction bars and strips), and sets (counters) can be used to add and subtract fractions having like denominators of ~~10~~ 12 or less.	**All students should** • Understand that a proper fraction is a fraction whose numerator is smaller than its denominator. • Understand that an improper fraction is a fraction whose numerator is greater than or equal to the denominator and is one or greater than one. • Understand that an improper fraction can be expressed as a whole number or a mixed number. • Understand that a mixed number is written as a whole number and a proper fraction. • Understand that computation with fractions uses the same ~~concepts~~ strategies as whole number computation.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Demonstrate a fractional part ~~(halves, thirds, fourths, eighths, and tenths)~~ of a whole, using – region/area models (e.g., pie pieces, pattern blocks, geoboards, drawings); – set models (e.g., chips, counters, cubes, drawings); and – measurement models (e.g., nonstandard units such as ~~cuisenaire~~ rods, connecting cubes, and drawings). • Name and write fractions and mixed numbers represented by drawings or concrete materials ~~for halves, thirds, fourths, eighths, and tenths~~. • Represent a given fraction or mixed number, using concrete materials, pictures, and symbols~~, for halves, thirds, fourths, eighths, and tenths~~. For example, write the symbol for one-fourth and represent it with concrete materials and/or pictures. • Add and subtract with proper fractions having denominators of ~~10~~ 12 or less, using concrete materials and pictorial models representing area/regions (circles, squares, and rectangles), length/measurements (fraction bars and strips), and sets (counters).

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

3.8 The student will determine, by counting, the value of a collection of bills and coins whose total value is $5.00 or less, compare the value of the bills and coins, and make change.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The value of a collection of coins and bills can be determined by counting on, beginning with the highest value, and/or by grouping the coins and bills. • A variety of skills can be used to determine the change after a purchase, including – counting on, using coins and bills, i.e., starting with the amount to be paid (purchase price), counting forward to the next dollar, and then counting forward by dollar bills to reach the amount from which to make change; and – mentally calculating the difference.	**All students should** • Understand that a collection of coins and bills has a value that can be counted. • Understand how to make change from $5.00 or less.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count the value of collections of coins and bills up to $5.00. • Compare the values of two sets of coins or bills, up to $5.00, using the terms *greater than, less than*, and *equal to*. • Make change from $5.00 or less.

3.9 The student will estimate and use U.S. Customary and metric units to measure

a) length to the nearest $\frac{1}{2}$ inch, inch, foot, yard, centimeter, and meter;

b) liquid volume in cups, pints, quarts, gallons, and liters;

c) weight/mass in ounces, pounds, grams, and kilograms; and

d) area and perimeter.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • The concept of a standard measurement unit is one of the major ideas in understanding measurement. Familiarity with standard units is developed through hands-on experiences of comparing, estimating, measuring, and constructing. • Benchmarks of common objects need to be established for each of the specified units of measure (e.g., the mass of a mathematics book is about one kilogram). Practical experience measuring the mass of familiar objects helps to establish benchmarks and facilitates the student's ability to estimate measures. • One unit of measure may be more appropriate than another to measure an object, depending on the size of the object and the degree of accuracy desired. • Correct use of measurement tools is essential to understanding the concepts of measurement. • Perimeter is the distance around any two-dimensional	**All students should** • Understand how to estimate measures of length, liquid volume, ~~and~~ weight/mass, area and perimeter. • Understand how to determine the actual measure of length, liquid volume, ~~and~~ weight/mass, area and perimeter. • Understand that perimeter is a measure of the distance around a polygon. • Understand that area is a measure of square units needed to cover a surface.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify and use the following units of length: centimeters, meters, part of an inch, inches, feet, and yards, centimeters, and meters.~~ • ~~Identify and use the following units of liquid volume: cups, pints, quarts, gallons, and liters.~~ • ~~Identify and use the following units of weight/mass: ounces, pounds, grams, and kilograms.~~ • Estimate and ~~then measure~~ use U.S. Customary and metric units to measure lengths of objects to the nearest ~~centimeter, and meter,~~ ~~and the nearest~~ $\frac{1}{2}$ of an inch, inch, foot, ~~and~~ yard, centimeter, and meter. • ~~Estimate and then measure lengths of~~ Determine the actual measure of length using U.S. Customary and metric units to measure objects to the nearest ~~centimeter and meter,~~ ~~and the nearest~~ $\frac{1}{2}$ of an inch, foot, ~~and~~ yard, centimeter, and meter. • Estimate and ~~then measure~~ use U.S. Customary and metric units to measure the weight/mass of objects to the nearest ounce, ~~and~~ pound, ~~and the nearest~~ gram, and kilogram. • Determine the actual measure of weight/mass using

3.9 The student will estimate and use U.S. Customary and metric units to measure

a) length to the nearest $\frac{1}{2}$ inch, inch, foot, yard, centimeter, and meter;

b) liquid volume in cups, pints, quarts, gallons, and liters;

c) weight/mass in ounces, pounds, grams, and kilograms; and

d) area and perimeter.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~shape~~ figure and is found by adding the measures of the sides. • Area is a two-dimensional measure and is therefore measured in square units. • Area is the number of square units needed to cover a figure, or more precisely, it is the measure in square units of the interior region of a two-dimensional figure.		U.S. Customary and metric units to measure the weight/mass of objects to the nearest ounce, ~~and~~ pound, ~~and the nearest~~ gram, and kilogram. • Estimate and ~~then measure~~ use U.S. Customary and metric units to measure liquid volume to the nearest cup, pint, quart, gallon, and liter. • Determine the actual measure of liquid volume using U.S. Customary and metric units to measure to the nearest cup, pint, quart, gallon, and liter. • Estimate and use U.S. Customary and metric units to measure area and perimeter. • Determine the actual measure of area or perimeter using U.S. Customary and metric units.

3.10 The student will

a) measure the distance around a polygon in order to determine perimeter; and

b) count the number of square units needed to cover a given surface in order to determine area.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A polygon is a closed plane figure composed of at least three line segments that do not cross. None of the sides are curved. • Perimeter is a measure of the distance around a polygon and is found by adding the measures of the sides. • Area is a measure of square units needed to cover a surface. Area may be determined by counting the number of square units on a given surface. • Opportunities to explore the concepts of perimeter and area should involve hands-on experiences (e.g., placing tiles (units) around a polygon and counting the number of tiles to determine its perimeter and filling or covering a polygon with cubes (square units) and counting the cubes to determine its area).	**All students should** • Understand the meaning of a polygon as a closed figure with at least three sides. None of the sides are curved and there are no intersecting lines. • Understand that perimeter is a measure of the distance around a polygon. • Understand how to determine the perimeter by counting the number of units around a polygon. • Understand that area is a measure of square units needed to cover a surface. • Understand how to determine the area by counting the number of square units.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Measure each side of a variety of ~~concrete~~ polygons and add them to determine the ~~distance around~~ perimeter of ~~the~~ each polygon (its perimeter). • Determine the area of a given surface ~~on grid paper~~ by estimating and then counting the number of square units needed to cover the surface.

3.11 The student will

a) tell time to the nearest minute, using analog and digital clocks; and

b) determine elapsed time in one-hour increments over a 12-hour period.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Telling time is applying reading skills to a clock face.~~ • While digital clocks make reading time easy, it is necessary to ensure that students understand that there are sixty minutes in an hour. • Use of a demonstration clock with gears ensures that the positions of the hour hand and the minute hand are precise when time is read. • Students need to understand that time has passed or will pass. • Elapsed time is the amount of time that has passed between two given times. • ~~Use of a~~ Elapsed time should be modeled and ~~demonstration~~ demonstrated using geared analog clocks ~~with gears ensures that the positions of the hour hand and the minute hand are precise when time is read~~ and timelines. • ~~While digital clocks make reading time easy, i~~ It is necessary to ensure that students understand that there are sixty minutes in an hour when using analog and digital clocks. • Elapsed time can be found by counting on from the beginning time to the finishing time. – Count the number of whole hours between the beginning time and the finishing time. For example, to find the elapsed time between 7 a.m. and 10 a.m., students can count on to find the difference between the times (7 and 10), so the total elapsed time is 3 hours.	**All students should** • Apply appropriate techniques to determine time to the nearest ~~five-minute interval~~ minute, using analog and digital clocks. • Understand how to determine elapsed time in one-hour increments over a 12-hour period.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Tell time to the ~~hour, half-hour, quarter-hour, nearest five-minute interval, and~~ nearest minute, using analog and digital clocks. • Match the times shown on analog and digital clocks to written times. • When given the beginning time and ending time, determine the elapsed time in one-hour increments. • Determine the elapsed time in one-hour increments within a 12-hour period (times do not cross between a.m. and p.m.). • Solve practical problems in relation to time that has elapsed.

3.12 The student will identify equivalent periods of time, including relationships among days, months, and years, as well as minutes and hours.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The knowledge that a year has $365 + \frac{1}{4}$ days will help students understand the necessity of adding a full day every fourth year, called a *leap year*. • The use of a calendar facilitates the understanding of time relationships between days and months, days and weeks, days and years, and months and years. Recognize that students need to know the relationships, such as if there are 24 hours in one day, how many hours are in three days? If the date is January 6, what date would it be in two weeks? How many weeks are in March, April, and May? • The use of an analog clock facilitates the understanding of time relationships between minutes and hours and hours and days.	**All students should** • Understand the relationship that exists among periods of time, using calendars, and clocks.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify equivalent relationships observed in a calendar, including the number of days in a given month, the number of days in a week, the number of days in a year, and the number of months in a year. • Identify the number of minutes in an hour and the number of hours in a day.

3.13 The student will read temperature to the nearest degree from a Celsius thermometer and a Fahrenheit thermometer. Real thermometers and physical models of thermometers will be used.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimating and measuring temperatures in the environment in Fahrenheit and Celsius require the use of real thermometers. • A physical model can be used to represent the temperature determined by a real thermometer. • The symbols for degrees in Celsius (°C) and degrees in Fahrenheit (°F) should be used to write temperatures. • Celsius and Fahrenheit temperatures should be related to everyday occurrences by measuring the temperature of the classroom, the outside, liquids, body temperature, and other things found in the environment.	**All students should** • Understand how to measure temperature in Celsius and Fahrenheit with a thermometer.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Read temperature to the nearest degree from real Celsius and Fahrenheit thermometers and from physical models (including pictorial representations) of such thermometers.

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of ~~shapes~~ figures and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent ~~two- and three-dimensional~~ plane and solid ~~shapes~~ figures through drawing, block constructions, dramatization, and verbal language.

The focus of instruction at this level is on

- observing, identifying, describing, comparing, contrasting and investigating ~~three-dimensional~~ solid objects and their ~~two-dimensional~~ faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, contrasting, sorting, and classifying ~~shapes~~ figures; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these ~~shapes~~ figures but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

3.14 The student will identify, describe, compare, and contrast characteristics of plane and solid geometric figures (circle, square, rectangle, triangle, cube, rectangular prism, square pyramid, sphere, cone, and cylinder) by identifying relevant characteristics, including the number of angles, vertices, and edges, and the number and shape of faces, using concrete models.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., "I know it's a rectangle because it looks like a door, and I know that the door is a rectangle."). – **Level 2: Analysis**. Properties are perceived, but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., "I know it's a rectangle because it's closed, it has four sides and four right angles, and opposite sides are parallel."). • A plane geometric figure is any two-dimensional closed ~~shape~~ figure. Circles and polygons are examples of plane geometric figures. • Three-dimensional figures are called *solid figures* or simply *solids*. Solids enclose a region of space. The interior of both plane and solid figures are not part of the figure. Solids are classified by the	**All students should** • Understand how to identify and describe plane and solid geometric figures by using relevant characteristics. • ~~Understand how to describe plane or solid using characteristics more precise ways to describe shapes by focusing on characteristics and the specialized vocabulary associated with these shapes and characteristics.~~ • Understand the similarities and differences between ~~two-dimensional (~~plane~~)~~ and ~~three-dimensional (~~solid~~)~~ figures ~~while recognizing the commonalties of the two~~.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify by name, models, and pictures of plane geometric figures (circle, square, rectangle, and triangle) and solid geometric figures (cube, rectangular ~~solid~~ prism, square pyramid, sphere, cone, and cylinder). • Identify and describe plane geometric figures by counting the number of sides, ~~corners, and square corners, and~~ angles, the number and shape of faces, vertices, and edges. • Identify and describe ~~geometric solids~~ solid geometric figures by counting the number of ~~corners, square corners~~ angles, vertices, and edges, and by the number and shape~~s~~ of ~~the~~ faces. • C~~lassify, compare~~ Compare and contrast characteristics of plane and solid geometric figures (e.g., circle/sphere, square/cube, triangle/square pyramid, and rectangle/rectangular ~~solid~~ prism), ~~using corners, square corners,~~ by counting the number of sides, angles, vertices, ~~faces, and~~ edges, and the number and shape of faces. • Compare and contrast characteristics of ~~three-dimensional (~~solid~~)~~ ~~shapes~~ geometric figures (i.e., cube, rectangular ~~solid~~ prism, square pyramid, sphere, cylinder, and cone) to similar objects in everyday life (e.g., a party hat is like a cone). • ~~Identify and name cubes, rectangular solids~~

3.14 The student will identify, describe, compare, and contrast characteristics of plane and solid geometric figures (circle, square, rectangle, triangle, cube, rectangular prism, square pyramid, sphere, cone, and cylinder) by identifying relevant characteristics, including the number of angles, vertices, and edges, and the number and shape of faces, using concrete models.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
types of surfaces they have. These surfaces may be flat, curved, or both. • The study of geometric figures must be active, using visual images and concrete materials. • Access to a variety of concrete tools such as graph paper, pattern blocks, geoboards, and geometric solids is greatly enhanced by computer software tools that support exploration. • Opportunity must be provided for building and using geometric vocabulary to describe ~~two-dimensional (~~plane~~)~~ and ~~three-dimensional (~~solid~~)~~ ~~shapes~~ figures. • ~~It is appropriate at this level to refer to "square corner." However, teachers should begin to introduce the term *right angle* for square corner as well.~~ • A cube is a ~~three-dimensional~~ solid figure with six congruent square faces and with every edge the same length. A cube has 8 ~~corners~~ vertices and 12 edges. • A cylinder is a ~~three-dimensional~~ solid figure formed by two congruent parallel circles joined by a curved surface. • A cone is a ~~three-dimensional,~~ solid, pointed figure that has a flat, round ~~base~~ face (usually a circle) that is joined to a vertex by a curved surface. • A rectangular ~~solid~~ prism is a ~~three-dimensional~~ solid figure in which all six faces are rectangles with three pair of parallel congruent opposite faces.		~~(prisms), square pyramids, spheres, cylinders, and cones by their appearance.~~ • ~~Identify and describe cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones according to the number and shape of their faces (sides, bases), edges, and corners and the number of angles and vertices.~~ • Identify ~~properties~~ characteristics of ~~three-dimensional (~~solid~~)~~ geometric ~~shapes~~ figures (cylinder, cone, cube, square pyramid, and rectangular prism).- • ~~Analyze and compare properties of three-dimensional (solid) geometric shapes (cylinder, cone, cube, square pyramid, and rectangular prism).~~

3.14 The student will identify, describe, compare, and contrast characteristics of plane and solid geometric figures (circle, square, rectangle, triangle, cube, rectangular prism, square pyramid, sphere, cone, and cylinder) by identifying relevant characteristics, including the number of angles, vertices, and edges, and the number and shape of faces, using concrete models.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A sphere is a ~~three-dimensional~~ solid figure with all of its points the same distance from its center. • A square pyramid is a ~~three-dimensional~~ solid figure ~~whose base is a~~ with one square face and ~~whose other faces are triangles~~ four triangular faces that share a common vertex. • A face is a polygon that serves as one side of a ~~three-dimensional~~ solid figure (e.g., a square is a face of a cube). • An angle is formed by two rays h~~aving~~ with a common endpoint. This endpoint is called the *vertex*. Angles are found wherever lines ~~and line segments~~ intersect. An angle can be named in three different ways by using – three letters to name, in this order, a point on one ray, the vertex, and a point on the other ray; – one letter at the vertex; or – a number written inside the rays of the angle. • An edge is the line segment where two faces of a ~~three-dimensional~~ solid figure ~~meet~~ intersect. • ~~A corner is the point at which three or more edges meet.~~ • Students should be reminded that a ~~concrete three-dimensional~~ solid geometric object, even when called a "solid," may actually be hollow rather than solid.		

3.15 The student will identify and draw representations of points, line segments, rays, angles, and lines.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A point is an exact location in space. It has no length or width. Usually, a point is named with a capital letter. • A line is a collection of points going on and on in both directions. It has no endpoints. When a line is drawn, at least two points on it can be marked and given capital letter names. The line can also be named with a single, lower-case letter. Arrow~~head~~s must be drawn to show that the line goes on in both directions infinitely. • A line segment is part of a line. It has two endpoints and includes all the points between those endpoints. The endpoints are used to name a line segment. • A ray is part of a line. It has one endpoint and continues on and on in one direction. • An angle is formed by two rays having a common endpoint. This endpoint is called the *vertex*. Angles are found wherever lines and line segments intersect. An angle can be named in three different ways by using – three letters to name, in this order, a point on one ray, the vertex, and a point on the other ray; – one letter at the vertex; or – a number written inside the rays of the angle. • Angle rulers may be particularly useful in developing the concept of an angle.	**All students should** • Understand that line segments and angles are fundamental components of noncircular, plane polygons. • Understand that a line segment is a part of a line having two end points and that it contains all the points between those two endpoints. • Understand that points make up a line. • Understand that a line continues indefinitely in two opposite directions. • Understand that a ray is part of a line with one endpoint and continues indefinitely in only one direction. • Understand that an angle is formed by two rays having a common endpoint.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify ~~and locate~~ examples of ~~a~~ points, line segments, rays, ~~and~~ angles, and lines. • Draw representations of points, line segments, rays, ~~and~~ angles, and lines, using a ruler or straightedge.

3.16 The student will identify and describe congruent and noncongruent plane figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Congruent plane figures are figures having exactly the same size and shape. Noncongruent plane figures are figures that are not exactly the same size and shape. Opportunities for exploring figures that are congruent and/or noncongruent can best be accomplished by using physical models. • ~~A figure or shape is symmetrical when one-half of the figure is the mirror image of the other half. Opportunities for exploring symmetry in figures can best be accomplished by using physical models.~~ • ~~A line of symmetry divides a symmetrical figure, object, or arrangement of objects into two parts that are congruent if one part is reflected (flipped) over the line of symmetry.~~ • ~~While investigating symmetry, students move shapes, such as pattern blocks, intuitively, thereby exploring transformations of those shapes. A transformation is the movement of a figure — either a translation, rotation, or reflection. A translation (slide) is the result of sliding a figure in any direction; a rotation (turn) is the result of turning a figure around a point or a vertex; and a reflection (flip) is the result of flipping a figure over a line.~~ • Have students identify figures that are congruent or noncongruent by using direct comparisons and/or tracing procedures.	**All students should** • Understand that congruent ~~shapes~~ plane figures match exactly. • Understand that noncongruent plane figures do not match exactly. • Understand that congruent plane figures remain congruent even if they are in different spatial orientations. • Understand that noncongruent plane figures remain noncongruent even if they are in different spatial orientations. • ~~Understand that symmetrical figures can be divided into two halves that are the mirror image of each other.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Locate examples of symmetrical figures, and verify their symmetry by using tracing procedures.~~ • ~~Determine if given figures have a line or lines of symmetry (vertical, horizontal, diagonal), using tracing procedures.~~ • ~~Locate~~ Identify examples of congruent and noncongruent figures. ~~and verify~~ Verify their congruenc~~y~~e by laying one on top of the other using drawings or models. • Determine ~~if given~~ and explain why plane figures are congruent ~~and~~ or noncongruent, using tracing procedures.

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible, unlikely, equally likely, more likely,* and *certain.*

The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

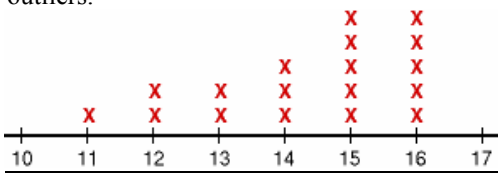
3.17 The student will

a) collect and organize data, using observations, measurements, surveys, or experiments;
b) construct a line plot, a picture graph, or a bar graph to represent the data; and
c) read and interpret the data represented in line plots, bar graphs, and picture graphs and write a sentence analyzing the data.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Investigations involving data should occur frequently and relate to students' experiences, interests, and environment. • Formulating questions for investigations is student-generated at this level. For example: What is the ~~favorite~~ cafeteria lunch preferred by students in the class when four lunch menus are offered? • The purpose of a graph is to represent data gathered to answer a question. • Bar graphs are used to compare counts of different categories (categorical data). Using grid paper ensures more accurate graphs. – A bar graph uses parallel, horizontal or vertical bars to represent counts for ~~several~~ categories. One bar is used for each category, with the length of the bar representing the count for that category. – There is space before, between, and after the bars. – The axis displaying the scale representing the count for the categories should extend one increment above the greatest recorded piece of data. Third grade students should collect data that are recorded in increments of whole numbers, usually multiples of 1, 2, 5, or 10. – Each axis should be labeled, and the graph should be given a title. – Statements representing an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences,	**All students should** • Understand how ~~gathered~~ data can be collected and organized. • Understand that data can be displayed in different types of graphs depending on the ~~questions to be answered~~ data. • Understand how to construct a line plot, picture graph, or bar graph. • Understand that data sets can be interpreted and analyzed to ~~provide different kinds of information~~ draw conclusions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Formulate questions to investigate. • Design data investigations to answer formulated questions, limiting the number of categories for data collection to four. • Collect data, using surveys, polls, questionnaires, scientific experiments, and observations. • Organize data and construct a bar graph on grid paper representing 16 or fewer data points for no more than four categories. • Label bar graphs with a title, a description of each axis, and a key where appropriate. Limit increments on the numerical axis to whole numbers representing multiples of 1, 2, 5, or 10. • Read the information presented on a simple bar or picture graph (e.g., the title, the categories, the description of the two axes, the key). • Analyze and interpret information from picture and bar graphs, with up to 30 data points and up to 8 categories, by writing at least one sentence. • Construct a line plot with no more than 30 data points. • ~~Read information presented in line plots.~~ • ~~Analyze and interpret~~ Read, interpret and analyze

3.17 The student will

a) collect and organize data, using observations, measurements, surveys, or experiments;
b) construct a line plot, a picture graph, or a bar graph to represent the data; and
c) read and interpret the data represented in line plots, bar graphs, and picture graphs and write a sentence analyzing the data.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
least and greatest, the categories, and total number of responses) should be written. • ~~Line plots show the spread of data. To construct a line plot,~~ ~~– draw a number line on grid paper (The scale of numbers should include the greatest value and the least value in a set of numbers.);~~ ~~– for each piece of data, draw an *x* above the corresponding number; and~~ ~~– title the plot.~~ • A line plot shows the frequency of data on a number line. Line plots are used to show the spread of the data and quickly identify the range, mode, and any outliers.  • When data are displayed in an organized manner, the results of the investigations can be described and the posed question answered. • Recognition of appropriate and inappropriate statements begins at this level with graph interpretations.		information from line plots~~, with data points limited to 16,~~ by writing at least one statement. • Describe the categories of data and the data as a whole (e.g., data were collected on four ~~types~~ ways to cook or prepare ~~of~~ eggs — scrambled, fried, hard boiled, and egg salad — eaten by students). • Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same (e.g., most students prefer scrambled eggs). • Select a correct interpretation of a graph from a set of interpretations of the graph, where one is correct and the remaining three are incorrect. For example, a bar graph containing data on four ~~types~~ ways to cook or prepare ~~of~~ eggs — eaten by students shows that more students prefer scrambled eggs. A correct answer response, if given, would be that more students prefer scrambled eggs than any other ~~type of eggs~~ way to cook or prepare eggs.

3.18 The student will investigate and describe the concept of probability as chance and list possible results of a given situation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A spirit of investigation and experimentation should permeate probability instruction, where students are actively engaged in explorations and have opportunities to use manipulatives. • Investigation of experimental probability is continued at this level through informal activities using two-colored counters, spinners, and random number generators (number cubes). • Probability is the chance of an event occurring. • The probability of an event occurring is the ratio of desired outcomes to the total number of possible outcomes. If all the outcomes of an event are equally likely to occur, the probability of the event = $\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$. • The probability of an event occurring is represented by a ratio between 0 and 1. An event is "impossible" if it has a probability of 0 (e.g., the probability that the month of April will have 31 days). An event is "certain" if it has a probability of 1 (e.g., the probability that the sun will rise tomorrow morning). • When a probability experiment has very few trials, the results can be misleading. The more times an experiment is done, the closer the experimental probability comes to the theoretical probability (e.g., a coin lands heads up half of the time). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring. Activities should include real-life examples.	**All students should** • Investigate, ~~U~~understand, and apply basic concepts of probability. • Understand that probability is the chance of an event happening.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Define probability as the chance that an event will happen. • List all possible outcomes for a given situation (e.g., heads and tails are the two possible outcomes of flipping a coin). • ~~Identify the possible outcomes for a common event, using terms such as *impossible*, *unlikely*, *equally likely*, *likely*, and *certain*.~~ • Identify the degree of likelihood of an outcome occurring using terms such as *impossible*, *unlikely*, *equally likely*, *likely*, and *certain*.

3.18 The student will investigate and describe the concept of probability as chance and list possible results of a given situation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• For any event, such as flipping a coin, the equally likely things that can happen are called *outcomes*. For example, there are two equally likely outcomes when flipping a coin: the coin can land heads up, or the coin can land tails up. • A sample space represents all possible outcomes of an experiment. The sample space may be organized in a list, table, or chart.		

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns ~~in the real world~~. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to Algebra.

3.19 The student will recognize and describe a variety of patterns formed using numbers, tables, and pictures, and extend the patterns, using the same or different forms.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Exploring patterns requires active physical and mental involvement. • The use of materials to extend patterns permits experimentation or trial-and-error approaches that are almost impossible without them. • Reproduction of a given pattern in a different representation, using symbols and objects, lays the foundation for writing numbers symbolically or algebraically. • The simplest types of patterns are repeating patterns. In each case, students need to identify the basic unit of the pattern and repeat it. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. • Growing patterns are more difficult for students to understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns in both arithmetic and geometric formats. • Sample numeric patterns include –6, 9, 12, 15, 18, …; –1, 2, 4, 7, 11, 16, …; –2, 4, 8, 16, 32, …; and –1, 5, 25, 125, 625, …. • In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation ~~(turn)~~ is the result of turning a figure around a point or a vertex, and reflection ~~(flip)~~ is the result of flipping a figure over a line.	**All students should** • Understand that numeric and geometric patterns can be expressed in words or symbols. • Understand the structure of a pattern and how it grows or changes. • Understand that mathematical relationships exist in patterns. • Understand that patterns can be translated from one representation to another.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize repeating and growing numeric and geometric patterns (e.g., skip counting, addition tables, and multiplication tables). • Describe repeating and growing numeric and geometric patterns formed using ~~concrete objects~~, numbers, tables, and/or pictures, using the same or different forms. • Extend repeating and growing ~~numeric and geometric~~ patterns of numbers or figures ~~formed~~ using concrete objects, numbers, tables, and/or pictures~~, using the same or different forms~~.

3.19 The student will recognize and describe a variety of patterns formed using numbers, tables, and pictures, and extend the patterns, using the same or different forms.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Sample geometric patterns include – O Δ O O Δ Δ O O O Δ Δ Δ …; and – □□ □ □□ □ …. • A table of values can be analyzed to determine the pattern that has been used, and that pattern can then be used to find the next value.		

3.20 The student will

a) investigate the identity and the commutative properties for addition and multiplication; and

b) identify examples of the identity and commutative properties for addition and multiplication.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Investigating arithmetic operations with whole numbers helps students learn about several different properties of arithmetic relationships. These relationships remain true regardless of the numbers. • The commutative property for addition states that changing the order of the addends does not affect the sum (e.g., 4 + 3 = 3 + 4). Similarly, the commutative property for multiplication states that changing the order of the factors does not affect the product (e.g., 2 × 3 = 3 × 2). • The identity property for addition states that if zero is added to a given number, the sum is the same as the given number. The identity property of multiplication states that if a given number is multiplied by one, the product is the same as the given number. • A number sentence is an equation with numbers (e.g., 6 + 3 = 9; or 6 + 3 = 4 + 5).	**All students should** • Understand that mathematical relationships can be expressed using number sentences. • Understand the identity property for addition. • Understand the identity property for multiplication. • Understand the commutative property of addition. • Understand the commutative property of multiplication. • Understand that quantities on both sides of an equal~~s~~ sign must be equal. • Understand that quantities on both sides of the not equal sign are not equal and are not balanced .	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate the identity property for addition and determine that when the number zero is added to another number or another number is added to the number zero, that number remains unchanged. Examples of the identity property for addition is 0 + 2 = 2; 5 + 0 = 5. • Investigate the identity property for multiplication and determine that when the number one is multiplied by another number or another number is multiplied by the number one, that number remains unchanged. Example of the identity property for multiplication is 1 x 3 = 3; 6 x 1 = 6. • The commutative property for addition is an order property. Changing the order of the addends does not change the sum (5 + 4 = 9 and 4 + 5 = 9). • The commutative property for multiplication is an order property. Changing the order of the factors does not change the product (2 × 3 = 3 × 2) . • Recognize that the equal~~s~~-sign (=) relates equivalent quantities. • Recognize that the not equal sign (≠) relates nonequivalent quantities. • Write number sentences to represent equivalent mathematical relationships (e.g., ~~4 · 3 = 2 · 6~~ 4 x 3 = 14 - 2).

3.20 The student will

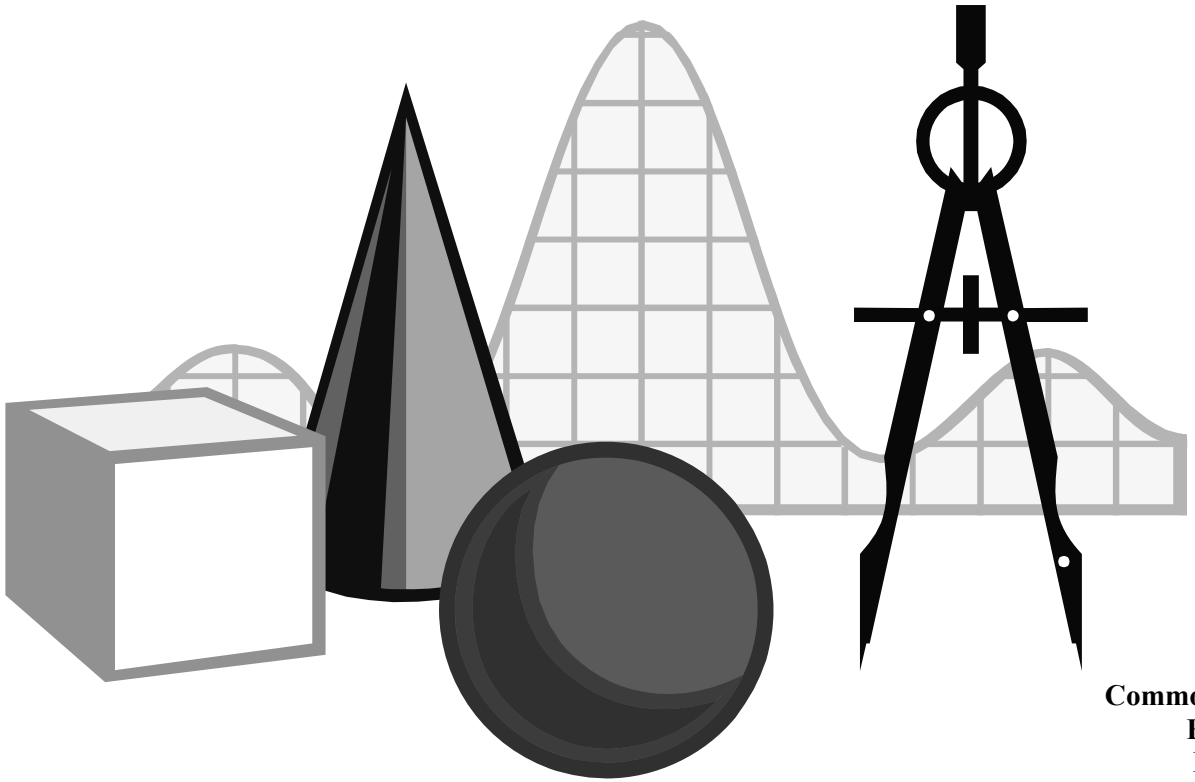
a) investigate the identity and the commutative properties for addition and multiplication; and

b) identify examples of the identity and commutative properties for addition and multiplication.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
		• Identify examples of the identity and commutative properties for addition and multiplication. • Identify number sentences that show appropriate use of the equal~~s~~ sign and the not equal sign. $6 \times 8 \neq 36 - 4$ $123 \neq 132$ $18 + 4 + 2 \neq 24 \div 6$ $36 - 14 = 11 \times 2$ $49 - 0 = 7 \times 7$

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 4



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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Mathematics instruction in grades 4 and 5 should continue to foster the development of number sense, especially with decimals and fractions. Students with good number sense understand the meaning of numbers, develop multiple relationships and representations among numbers, and recognize the relative magnitude of numbers. They should learn the relative effect of operating on whole numbers, fractions, and decimals and learn how to use mathematical symbols and language to represent problem situations. Number and operation sense continues to be the cornerstone of the curriculum.

The focus of instruction at grades 4 and 5 allows students to investigate and develop an understanding of number sense by modeling numbers, using different representations (e.g., physical materials, diagrams, mathematical symbols, and word names). Students should develop strategies for reading, writing, and judging the size of whole numbers, fractions, and decimals by comparing them, using a variety of models and benchmarks as referents (e.g., $\frac{1}{2}$ or 0.5). Students should apply their knowledge of number and number sense to investigate and solve problems.

4.1 The student will

a) identify orally and in writing the place value for each digit in a whole number expressed through millions;

b) compare two whole numbers expressed through millions, using symbols (>, <, or =); and

c) round whole numbers expressed through millions to the nearest thousand, ten thousand, and hundred thousand.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The structure of the ~~b~~Base-10 number system is based upon a simple pattern of tens, in which the value of each place is ten times the value of the place to its right. • Place value refers to the value of each digit and depends upon the position of the digit in the number. For example, in the number 7,864,352, the eight is in the hundred thousands place, and the value of the 8 is eight hundred thousand or 800,000. • Whole numbers may be written in a variety of formats: – Standard: 1,234,567 – Written: one million, two hundred thirty-four thousand, five hundred sixty-seven – Expanded: (1 × 1,000,000) + (2 × 100,000) + (3 × 10,000) + (4 × 1,000) + (5 × 100) + (6 × 10) + (7 × 1) • Numbers are arranged into groups of three places called *periods* (ones, thousands, millions, …). Places within the periods repeat (hundreds, tens, ones). Commas are used to separate the periods. Knowing the place value and period of a number helps students find values of digits in any number as well as read and write numbers. • Reading and writing large numbers should be ~~related to numbers that have~~ meaning~~s~~ful for students. Experiences can be provided that relate	**All students should** • Understand the relationships in the place value system in which the value of each place is ten times the value of the place to its right. • Use the patterns in the place value system to read and write numbers. • Understand that reading place value correctly is essential when comparing numbers. • Understand that rounding gives a close number to use when exact numbers are not needed for the situation at hand. • Develop strategies for rounding.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify and communicate, both orally and in written form, the placed value for each digit in whole numbers expressed through the one millions place. • Read whole numbers through the one millions place that are presented in standard format, and select the matching number in written format. • Write whole numbers through the one millions place in standard format when the numbers are presented orally or in written format. • Identify and use the symbols for *greater than*, *less than*, and *equal to*. • Compare two whole numbers expressed through the one millions, using symbols >, <, or =. • Round whole numbers expressed through the one millions place to the nearest thousand, ten thousand, and hundred-thousand place.

4.1 The student will

a) identify orally and in writing the place value for each digit in a whole number expressed through millions;
b) compare two whole numbers expressed through millions, using symbols (>, <, or =); and
c) round whole numbers expressed through millions to the nearest thousand, ten thousand, and hundred thousand.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
practical situations (e.g., numbers found in the students' environment including population, number of school lunches sold statewide in a day, etc.). Concrete materials such as ~~b~~Base-10 blocks and bundles of sticks may be used to represent whole numbers through thousands. Larger numbers may be represented by ~~symbol~~ digit cards and place value charts. • Mathematical symbols (>, <) used to compare two unequal numbers are called *inequality symbols*. • A procedure for comparing two numbers by examining place value may include the following: – ~~Line up the numbers by place value by lining up the ones.~~ – ~~Beginning at the left, find the first place value where the digits are different.~~ – Compare the digits in ~~this place value~~ the numbers to determine which number is greater (or which is less). – Use a number line to identify the appropriate placement of the numbers based on the place value of the digits. – Use the appropriate symbol > or < or words *greater than* or *less than* to compare the numbers in the order in which they are presented. – If both numbers ~~are the same~~ have the same value, use the symbol = or words *equal to*.		

4.1 The student will

a) identify orally and in writing the place value for each digit in a whole number expressed through millions;
b) compare two whole numbers expressed through millions, using symbols (>, <, or =); and
c) round whole numbers expressed through millions to the nearest thousand, ten thousand, and hundred thousand.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A strategy for rounding numbers to the nearest thousand, ten thousand, and hundred thousand is as follows: – Use a number line to determine the rounded number (e.g., when rounding 4,367,925 to the nearest thousand, identify the 'thousands' the number would fall between on the number line, then determine the thousand that the number is closest to): 4,367**,000** ? 4,368**,000** ←——————→ – Look one place to the right of the digit to which you wish to round. – If the digit is less than 5, leave the digit in the rounding place as it is, and change the digits to the right of the rounding place to zero. – If the digit is 5 or greater, add 1 to the digit in the rounding place and change the digits to the right of the rounding place to zero.		

4.2 The student will

a) compare and order fractions and mixed numbers;
b) represent equivalent fractions; and
c) identify the division statement that represents a fraction.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Rational numbers should be explained as any number that can be written as a fraction (e.g., $\frac{2}{1}$, $\frac{2}{3}$, $7\frac{1}{4}$).~~ • A fraction is a way of representing part of a whole (as in a region/area model or a measurement model) or part of a group (as in a set model). A fraction is used to name a part of one thing or a part of a collection of things. • In ~~each~~ the area/region and length/measurement fraction models, the parts must be equal ~~(i.e., each pie piece must have the same area; the size of each chip in a set must be equal; the measures such as the colored multi-length rods, or the parts in a fraction strip must be equal)~~. In the set model, the elements of the set do not have to be equal (i.e., "What fraction of the class is wearing the color red?"). • The denominator ~~(bottom number)~~ tells how many equal parts are in the whole or set. The numerator ~~(top number)~~ tells how many of those parts are being counted or described. • When fractions have the same denominator, they are said to have "common denominators" or "like denominators." Comparing fractions with like denominators involves comparing only the numerators.	**All students should** • Develop an understanding of fractions as parts of unit wholes, as parts of a collection, and as locations on a number line. • Use models, benchmarks, and equivalent forms to judge the size of fractions. • Recognize that a whole divided into nine equal parts has smaller parts than if the whole had been divided into five equal parts. • Recognize and generate equivalent forms of commonly used fractions and decimals. • Understand the division statement that represents a fraction. • Understand that the more parts the whole is divided into, the smaller the parts (e.g., $\frac{1}{5} < \frac{1}{3}$).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify, model, and compare fractions and mixed numbers through twelfths, using~~ ~~– region/area models (e.g., fraction circles, pattern blocks, geoboards, color tiles, graph paper);~~ ~~– set models (e.g., two-sided counters, chips); and~~ ~~– measurement models (e.g., cuisenaire rods, unifix cubes, fraction strips, number lines).~~ • Compare and order fractions having denominators of 12 or less, using manipulative models and drawings, such as region/area models (e.g., fraction circles, pattern blocks, geoboards, color tiles, graph paper, drawings); set models (e.g., two-sided counters, chips, drawings); and measurement models (e.g., colored, multilength rods, linking cubes, fraction strips, rulers/number lines, drawings). • Compare and order fractions with like denominators by comparing number of parts (numerators) (e.g., $\frac{1}{5} < \frac{3}{5}$). • Compare and order fractions with like numerators and unlike denominators by comparing the size of the parts (e.g., $\frac{3}{9} < \frac{3}{5}$). • Compare and order fractions having unlike denominators of 12 or less by comparing the fractions to benchmarks

4.2 The student will

a) compare and order fractions and mixed numbers;
b) represent equivalent fractions; and
c) identify the division statement that represents a fraction.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Strategies for comparing fractions having unlike denominators may include – comparing fractions to familiar benchmarks (e.g., 0, $\frac{1}{2}$, 1); – finding equivalent fractions, using manipulative models such as fraction strips, number lines, fraction circles, ~~cuisenaire~~ rods, pattern blocks, ~~unifix~~ cubes, ~~b~~Base-10 blocks, tangrams, ~~or~~ graph paper, or a multiplication chart and patterns; and – finding a common denominator by finding the least common multiple (LCM) of both denominators and then rewriting each fraction as an equivalent fraction, using the LCM as the denominator. • A variety of fraction models should be used to expand students' understanding of fractions and mixed numbers: – Region/area models: a surface or area is subdivided into smaller equal parts, and each part is compared with the whole (e.g., fraction circles, pattern blocks, geoboards, grid paper, color tiles). – Set models: the whole is understood to be a set of objects, and subsets of the whole make up fractional parts (e.g., counters, chips). – Measurement models: similar to area models but lengths instead of areas are compared		(e.g., 0, $\frac{1}{2}$ or 1) to determine their relationships to the benchmarks or by finding a common denominator. • Use the symbols >, <, and = to compare the numerical value of fractions having denominators of 12 or less. • ~~Represent fractions for halves, fourths, fifths, and tenths as decimals through thousandths, using concrete objects (e.g., demonstrate the relationship between the fraction $\frac{1}{4}$ and its decimal equivalent 0.25).~~ • ~~Relate fractions to decimals, using concrete objects (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, money [coins]).~~ • ~~Identify and represent~~ Represent equivalent fractions through twelfths, using region/area models, set models, and measurement models. • Identify the division statement that represents a fraction (e.g., $\frac{3}{5}$ means the same as 3 divided by 5).

4.2 The student will

a) compare and order fractions and mixed numbers;
b) represent equivalent fractions; and
c) identify the division statement that represents a fraction.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
(e.g., fraction strips, ~~cuisenaire~~ rods, ~~unifix~~ cubes, number lines, rulers). • A mixed number has two parts: a whole number and a fraction. • Equivalent fractions name the same amount. Students should use a variety of models to identify different names for equivalent fractions. • Students should focus on finding equivalent fractions of familiar fractions such as halves, thirds, fourths, sixths, eighths, tenths, and twelfths. • Decimals and fractions represent the same relationships; however, they are presented in two different formats. The decimal 0.25 is written as $\frac{1}{4}$. ~~Decimal numbers are another way of writing fractions. The base-10 models concretely relate fractions to decimals (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, money).~~ When presented with the fraction $\frac{3}{5}$, the division expression representing a fraction is written as 3 divided by 5.		

4.3 The student will

a) read, write, represent, and identify decimals expressed through thousandths;
b) round decimals to the nearest whole number, tenth, and hundredth;
c) compare and order decimals; and
d) given a model, write the decimal and fraction equivalents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The structure of the ~~b~~Base-10 number system is based upon a simple pattern of tens, where each place is ten times the value of the place to its right. This is known as a ten-to-one place value relationship. • Understanding the system of tens means that ten tenths represents one whole, ten hundredths represents one tenth, ten thousandths represents one hundredth. • A decimal point separates the whole number places from the places that are less than one. Place values extend infinitely in two directions from a decimal point. A number containing a decimal point is called a *decimal number* or simply a *decimal*. • To read decimals, – read the whole number to the left of the decimal point, if there is one; – read the decimal point as "and"; – read the digits to the right of the decimal point just as you would read a whole number; and – say the name of the place value of the digit in the smallest place. • Any decimal less than 1 will include a leading zero (e.g., 0.125). • Decimals may be written in a variety of forms: – Standard: 26.537 – Written: twenty-six and five hundred thirty-seven thousandths	**All students should** • Understand the place value structure of decimals and use this structure to read, write, and compare decimals. • Understand that decimal numbers can be rounded to an estimate when exact numbers are not needed for the situation at hand. • Understand that decimals are rounded in a way that is similar to the way whole numbers are rounded. • Understand that decimals and fractions represent the same relationship; however, they are presented in two different formats. • Understand that models are used to show decimal and fraction equivalents.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate the ten-to-one place value relationship for decimals through thousandths, using ~~b~~Base-10 manipulatives (e.g., place value mats/charts, decimal squares, ~~b~~Base-10 blocks, money). • Represent and identify decimals expressed through thousandths, using ~~b~~Base-10 manipulatives, pictorial representations, ~~calculators~~, and numerical symbols (e.g., relate the appropriate drawing to 0.05). • Identify and communicate, both orally and in written form, the , position and value, of a decimal through thousandths. For example, in 0.385, the 8 is in the hundredths place and has a value of 0.08) • Read and write decimals expressed through thousandths, using ~~b~~Base-10 manipulatives, drawings, ~~calculators~~, and numerical symbols. ~~Any decimal less than 1 will include a leading zero (e.g., 0.125).~~ • Round decimals to the nearest whole number, tenth, and hundredth. • Compare and order the value of ~~two~~ decimals, using the symbols >, <, =. • Represent fractions for halves, fourths, fifths, and tenths as decimals through ~~thousandths~~ hundredths,

4.3 The student will

a) read, write, represent, and identify decimals expressed through thousandths;
b) round decimals to the nearest whole number, tenth, and hundredth;
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d) given a model, write the decimal and fraction equivalents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
– Expanded: $(2 \times 10) + (6 \times 1) + (5 \times 0.1) + (3 \times 0.01) + (7 \times 0.001)$. • Decimals and fractions represent the same relationships; however, they are presented in two different formats. Decimal numbers are another way of writing fractions. The ~~b~~Base-10 models concretely relate fractions to decimals (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, money). • The procedure for rounding decimal numbers is similar to the procedure for rounding whole numbers. • A strategy for rounding decimal numbers to the nearest tenth and hundredth is as follows: – Look one place to the right of the digit you want to round to. – If the digit is 5 or greater, add 1 to the digit in the rounding place, and drop the digits to the right of the rounding place. – If the digit is less than 5, leave the digit in the rounding place as it is, and drop the digits to the right of the rounding place. • Different strategies for rounding decimals include: – Use a number line to locate a decimal between two numbers. For example, 18.83 is closer to 18.8 than to 18.9. – Compare the digits in ~~this~~ the numbers to determine which number is greater (or which is less). – Compare the value of decimals, using the symbols >, <, = (e.g., 0.83 > 0.8 or 0.19 < 0.2). – Order the value of decimals, from least to greatest and		using concrete objects (e.g., demonstrate the relationship between the fraction $\frac{1}{4}$ and its decimal equivalent 0.25). • Relate fractions to decimals, using concrete objects (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, decimal circles, money [coins]). • Write the decimal and fraction equivalent for a given model (e.g., $\frac{1}{4} = 0.25$ or $0.25 = \frac{1}{4}$)

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b) round decimals to the nearest whole number, tenth, and hundredth;
c) compare and order decimals; and
d) given a model, write the decimal and fraction equivalents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
greatest to least (e.g., 0.83, 0.821, 0.8) • Decimal numbers are another way of writing fractions (halves, fourths, fifths, and tenths). The ~~b~~Base-10 models concretely relate fractions to decimals (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, decimal circles money). • Provide a fraction model (halves, fourths, fifths, and tenths) and ask students for its decimal equivalent. • Provide a decimal model and ask students for its fraction equivalent (halves, fourths, fifths, and tenths).		

Computation and estimation in grades 4 and 5 should focus on developing fluency in multiplication and division with whole numbers and should begin to extend students' understanding of these operations to work~~ing~~ with ~~fractions and~~ decimals. Instruction should focus on computation activities that enable students to model, explain, and develop reasonable proficiency with basic facts and algorithms. These proficiencies are often developed as a result of investigations and opportunities to develop algorithms. Additionally, opportunities to develop and use visual models, benchmarks, and equivalents, to add and subtract with common fractions, and to develop computational procedures for the addition and subtraction of decimals are a priority for instruction in these grades.

Students should develop an understanding of how whole numbers, fractions, and decimals are written and modeled; an understanding of the meaning of multiplication and division, including multiple representations (e.g., multiplication as repeated addition or as an array); an ability to identify and use relationships between operations to solve problems (e.g., multiplication as the inverse of division); and the ability to use (not identify) properties of operations to solve problems [e.g., 7×28 is equivalent to $(7 \times 20) + (7 \times 8)$~~, or $(7 \times 30) - (7 \times 2)$]~~.

Students should develop computational estimation strategies based on an understanding of number concepts, properties, and relationships. Practice should include estimation of sums and differences of common fractions and decimals, using benchmarks (e.g., $\frac{2}{5} + \frac{1}{3}$ must be less than 1 because both fractions are less than $\frac{1}{2}$). Using estimation, students should develop strategies to recognize the reasonableness of their computations. Additionally, students should enhance their ability to select an appropriate problem solving method from among estimation, mental mathematics, paper-and-pencil algorithms, and the use of calculators and computers. With activities that challenge students to use this knowledge and these skills to solve problems in many contexts, students develop the foundation to ensure success and achievement in higher mathematics.

4.4 The student will

a) estimate sums, differences, products, and quotients of whole numbers;
b) add, subtract, and multiply whole numbers;
c) divide whole numbers, finding quotients with and without remainders; and
d) solve single-step and multistep addition, subtraction, and multiplication problems with whole numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A sum is the result of adding two or more numbers. • A difference is the amount that remains after one quantity is subtracted from another. • An estimate is a number close to an exact ~~amount~~ solution. An estimate tells about how much or about how many. • Different strategies for estimating include using compatible numbers to estimate sums and differences and using front-end estimation for sums and differences. – Compatible numbers are numbers that are easy to work with mentally. Number pairs that are easy to add or subtract are compatible. When estimating a sum, replace actual numbers with compatible numbers (e.g., 52 + 74 can be estimated by using the compatible numbers 50 + 75). When estimating a difference, use numbers that are close to the original numbers. Tens and hundreds are easy to subtract (e.g., 83 – 38 is close to 80 – 40). – The front-end strategy for estimating is computing with the front digits. Front-end estimation for addition can be used even when the addends have a different number	**All students should** • Develop and use strategies to estimate whole number sums and differences and to judge the reasonableness of such results. • Understand that addition and subtraction are inverse operations. • Understand that division is the operation of making equal groups or equal shares. When the original amount and the number of shares are known, divide to find the size of each share. When the original amount and the size of each share are known, divide to find the number of shares. • Understand that multiplication and division are inverse operations. • Understand various representations of division and the terms used in division are *dividend*, *divisor*, and *quotient*. dividend ÷ divisor = quotient quotient divisor)dividend • Understand how to solve single-step and multistep problems using whole number	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Estimate whole number sums, ~~and~~ differences, products, and quotients ~~using rounding, front-end strategies, and compatible number strategies. Describe the method of estimation used~~. • Refine estimates by adjusting the final amount, using terms such as *closer to, between*, and *a little more than*. • Determine the sum or difference of two whole numbers, each 999,999 or less, in vertical and horizontal form with or without regrouping, using paper and pencil, and using a calculator. • Estimate and find the products of two whole numbers when one factor has two digits or fewer and the other factor has three digits or fewer, using paper and pencil and calculators. • Estimate and find the quotient of two whole numbers, given a one-digit divisor and a two- or three-digit dividend. • Solve single-step and multistep problems using whole number operations. • Verify the reasonableness of sums, differences, products, and quotients of whole numbers using estimation.

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a) estimate sums, differences, products, and quotients of whole numbers;
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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
of digits. The procedure requires the addition of the values of the digits in the greatest of the smallest number. For example: 2367 → 2300 243 → 200 + 1186 → + 1100 3600 • Front-end or leading-digit estimation always gives a sum less than the actual sum; however, the estimate can be adjusted or refined so that it is closer to the actual sum. • Addition is the combining of quantities; it uses the following terms: *addend* → 45,623 *addend* → + 37,846 *sum* → 83,469 • Subtraction is the inverse of addition; it yields the difference between two numbers and uses the following terms: *minuend* → 45,698 *subtrahend* → – 32,741 *difference* → 12,957 • Before adding or subtracting with paper and pencil, addition and subtraction problems in horizontal form should be rewritten in vertical	operations.	

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
form by lining up the places vertically. • Using ~~b~~Base-10 materials to model and stimulate discussion about a variety of problem situations helps students understand regrouping and enables them to move from the concrete to the pictorial, to the abstract. Regrouping is used in addition and subtraction algorithms. In addition, when the sum in a place is 10 or more, is used to regroup the sums so that there is only one digit in each place. In subtraction, when the number (minuend) in a place is not enough from which to subtract, regrouping is required. • A certain amount of practice is necessary to develop fluency with computational strategies for multidigit numbers; however, the practice must be meaningful, motivating, and systematic if students are to develop fluency in computation, whether mentally, with manipulative materials, or with paper and pencil. • Calculators are an appropriate tool for computing sums and differences of large numbers, particularly when mastery of the algorithm has been demonstrated.		

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c) divide whole numbers, finding quotients with and without remainders; and
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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The terms associated with multiplication are *factor* → 376 *factor* → × 23 *product* → 8,648 • One model of multiplication is repeated addition. • Another model of multiplication is the "Partial Product" model. 24 × 3 12 ← Multiply the ones: 3 × 4 = 12 + 60 ← Multiply the tens: 3 × 20 = 60 72 • Another model of multiplication is the "Area Model" (which also represents partial products) and should be modeled first with Base-10 blocks. (e.g., 23 x 68) • Students should continue to develop fluency with single-digit multiplication facts and their related division facts. • Calculators should be used to solve problems that require tedious calculations. • Estimation should be used to check the reasonableness of the product. Examples of estimation strategies include the following:		

4.4 The student will

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c) divide whole numbers, finding quotients with and without remainders; and
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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
– The front-end method: multiply the front digits and then complete the product by recording the number of zeros found in the factors. It is important to develop understanding of this process before using the step-by-step procedure. $\begin{array}{r} 523 \\ \underline{\times 31} \end{array} \rightarrow \begin{array}{r} 500 \\ \underline{\times 30} \\ 15{,}000 \end{array}$ – This is $3 \times 5 = 15$ with 3 zeros. – Compatible numbers: replace factors with compatible numbers, and then multiply. Opportunities for students to discover patterns with 10 and powers of 10 should be provided. $\begin{array}{r} 64 \\ \underline{\times 11} \end{array} \rightarrow \begin{array}{r} 64 \\ \underline{\times 10} \end{array}$ • Division is the operation of making equal groups or equal shares. When the original amount and the number of shares are known, divide to find the size of each share. When the original amount and the size of each share are known, divide to find the number of shares. Both situations may be modeled with ~~b~~Base-10 manipulatives. • Multiplication and division are inverse operations. • Terms used in division are *dividend, divisor*, and *quotient.*		

4.4 The student will

a) estimate sums, differences, products, and quotients of whole numbers;
b) add, subtract, and multiply whole numbers;
c) divide whole numbers, finding quotients with and without remainders; and
d) solve single-step and multistep addition, subtraction, and multiplication problems with whole numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
dividend ÷ divisor = quotient quotient divisor)dividend • Opportunities to invent division algorithms help students make sense of the algorithm. Teachers should teach division by various methods such as repeated multiplication and subtraction (partial quotients) before teaching the traditional long division algorithm.		

4.5 The student will

a) determine common multiples and factors, including least common multiple and greatest common factor;

b) add and subtract fractions having like and unlike denominators that are limited to 2, 3, 4, 5, 6, 8, 10, and 12, and simplify the resulting fractions, using common multiples and factors;

c) add and subtract with decimals; and

d) solve single-step and multistep practical problems involving addition and subtraction with fractions and with decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A factor of a number is an integer that ~~divides evenly into that number~~ has a remainder of zero. • A factor of a number is a divisor of the number. • A multiple of a number is the product of the number and any natural number. • A common factor of ~~two or more numbers~~ a number is a divisor that all of the numbers share. • The least common multiple of two or more numbers is the smallest common multiple of the given numbers. • The greatest common factor of two or more numbers is the largest of the common factors that all of the numbers share. • Students should investigate addition and subtraction ~~of~~ with fractions, using a variety of models (e.g., fraction circles, fraction strips, rulers, ~~unifix~~ linking cubes, pattern blocks). • When adding or subtracting with fractions having like denominators, add or subtract the numerators and use the same denominator. Write the answer in simplest form using common multiples and factors. • When adding or subtracting with fractions having unlike denominators, rewrite them as fractions with a common denominator. The least common multiple (LCM) of the	**All students should** • Understand and use common multiples and common factors for simplifying fractions. • Develop and use strategies to estimate addition and subtraction involving fractions and decimals. • Use visual models to add and subtract with fractions and decimals.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find common multiples and common factors of two numbers. • Determine the least common multiple and greatest common factor of two numbers. • Use least common multiple and/or greatest common factor to find a common denominator for two fractions. • Add and subtract with fractions having like denominators ~~of 12 or less, using concrete materials, pictorial representations, and paper and pencil~~ whose denominators are limited to 2, 3, 4, 5, 6, 8, 10, and 12, and simplify the resulting fraction using common multiples and factors. • Add and subtract with fractions having unlike denominators ~~of 12 or less, using concrete materials pictorial representations and paper and pencil~~ whose denominators are limited to 2, 3, 4, 5, 6, 8, 10, and 12, and simplify the resulting fraction using common multiples and factors. • Solve problems that involve adding and subtracting with fractions having like and unlike denominators ~~of~~

4.5 The student will

a) determine common multiples and factors, including least common multiple and greatest common factor;

b) add and subtract fractions having like and unlike denominators that are limited to 2, 3, 4, 5, 6, 8, 10, and 12, and simplify the resulting fractions, using common multiples and factors;

c) add and subtract with decimals; and

d) solve single-step and multistep practical problems involving addition and subtraction with fractions and with decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
unlike denominators is a common denominator (LCD). Write the answer in simplest form using common multiples and factors. • Addition and subtraction of decimals may be explored, using a variety of models (e.g., 10-by-10 grids, number lines, money). • For decimal computation, the same ideas developed for whole number computation may be used, and these ideas may be applied to decimal s, giving careful attention to the placement of the decimal point in the solution. • Lining up tenths to tenths, hundredths to hundredths, etc. helps to establish the correct placement of the decimal. • Fractions may be related to decimals by using models (e.g., 10-by-10 grids, decimal squares, money).		~~12 or less.~~ whose denominators are limited to 2, 3, 4, 5, 6, 8, 10, and 12, and simplify the resulting fraction using common multiples and factors. • Add and subtract with decimals through thousandths, using concrete materials, pictorial representations, and paper and pencil. • Solve single-step and multistep problems that involve adding and subtracting with fractions and decimals through thousandths.

Students in grades 4 and 5 should be actively involved in measurement activities that require a dynamic interaction between students and their environment. Students can see the usefulness of measurement if classroom experiences focus on measuring objects and estimating measurements. Textbook experiences cannot substitute for activities that utilize measurement to answer questions about real problems.

The approximate nature of measurement deserves repeated attention at this level. It is important to begin to establish some benchmarks by which to estimate or judge the size of objects. ~~The intent is for students to make "ballpark" comparisons and *not* to memorize conversion factors between U.S. Customary and metric units. To fully understand these ballpark comparisons, students must be actively engaged in the process of measurement.~~

Students use standard and nonstandard, age-appropriate tools to measure objects. Students also use age-appropriate language of mathematics to verbalize the measurements of length, weight/mass, liquid volume, area, temperature, and time.

The focus of instruction should be an active exploration of the real world in order to apply concepts from the two systems of measurement (metric and U.S. Customary), to measure perimeter, weight/mass, liquid volume/capacity, area, temperature, and time. Students continue to enhance their understanding of measurement by using appropriate tools such as rulers, balances, clocks, and thermometers. The process of measuring is identical for any attribute (i.e., length, weight/mass, liquid volume/capacity, area): choose a unit, compare that unit to the object, and report the number of units.

4.6 The student will

a) estimate and measure weight/mass and describe the results in U.S. Customary and metric units as appropriate; and

b) identify equivalent measurements between units within the U.S. Customary system (ounces, pounds, and tons) and between units within the metric system (grams and kilograms).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes depending on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • Balances are appropriate measuring devices to measure weight in U.S. Customary units (ounces, pounds) and mass in metric units (grams, kilograms). • Practical experience measuring the mass of familiar objects helps to establish benchmarks and facilitates the student's ability to estimate weight/mass. • ~~Students may use familiar benchmarks to make ballpark comparisons, such as~~ ~~– 1 ounce is about 28 grams (a slice of bread weighs about 1 ounce);~~ ~~– 1 nickel has the mass of about 5 grams; and~~ ~~– 1 kilogram is a little more than 2 pounds (a textbook has a mass of about 1 kilogram).~~ • Students should estimate the mass/weight of everyday objects (e.g., foods, pencils, book bags, shoes), using appropriate metric or U.S. Customary units.	**All students should** • Use benchmarks to estimate and measure weight/mass. • Identify equivalent measures between units within the U.S. Customary and between units within the metric measurements.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine an appropriate unit of measure (e.g., ounce, pound, ton, gram, kilogram) to use when measuring everyday objects in both metric and U.S. Customary units. • Measure objects in both metric and U.S. Customary units (e.g., ounce, pound, ton, gram, or kilogram) to the nearest appropriate measure, using a variety of measuring instruments. • Record the mass of an object including the appropriate unit of measure (e.g., 24 grams). • ~~Estimate conversions between U.S. Customary and metric units, using ballpark comparisons, such as~~ ~~– 1 ounce is about 28 grams;~~ ~~– 1 nickel has the mass of about 5 grams; and~~ ~~– 1 kilogram is a little more than 2 pounds.~~

4.7 The student will

a) estimate and measure length, and describe the result in both metric and U.S. Customary units; and

b) identify equivalent measurements between units within the U.S. Customary system (inches and feet; feet and yards; inches and yards; yards and miles) and between units within the metric system (millimeters and centimeters; centimeters and meters; and millimeters and meters).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Length is the distance along a line or figure from one point to another. • U.S. Customary units for measurement of length include inches, feet, yards, and miles. Appropriate measuring devices include rulers, yardsticks, and tape measures. Metric units for measurement of length include millimeters, centimeters, meters, and kilometers. Appropriate measuring devices include centimeter rulers, meter sticks, and tapes. • Practical experience measuring the length of familiar objects helps to establish benchmarks and facilitates the student's ability to estimate length. • ~~Students may use familiar benchmarks to make ballpark comparisons, such as~~ ~~– 1 inch is about 2.5 centimeters (the diameter of a quarter is about 1 inch);~~ ~~– 1 meter is a little longer than 1 yard (a doorway is about a yard in width); and~~ ~~– 1 mile is slightly farther than 1.5 kilometers, or 1 kilometer is slightly farther than half a mile.~~ • Students should estimate the length of everyday objects (e.g., books, windows, tables) in both metric and U.S. Customary units of measure. • When measuring with U.S. Customary units,	**All students should** • Use benchmarks to estimate and measure length. • Understand how to convert units of length between the U.S. Customary and metric systems, using ballpark comparisons. • Understand the relationship between U.S. Customary units and the relationship between metric units.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine an appropriate unit of measure (e.g., inch, foot, yard, mile, millimeter, centimeter, and meter) to use when measuring everyday objects in both metric and U.S. Customary units. • Estimate the length of everyday objects (e.g., books, windows, tables) in both metric and U.S. Customary units of measure. • Measure the lengths of objects in both metric and U.S. Customary units, measuring to the nearest inch ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$), foot, yard, mile, millimeter, centimeter, or meter, and record the length including the appropriate unit of measure (e.g., 24 inches). • Compare estimates of the length of objects with the actual measurement of the length of objects. • Identify equivalent measures of length between units within the U.S. Customary measurements and between units within the metric measurements. • ~~Estimate conversions between the U.S. Customary and metric units, using ballpark comparisons, such as~~ ~~– 1 inch is about 2.5 centimeters;~~

4.7 The student will

a) estimate and measure length, and describe the result in both metric and U.S. Customary units; and

b) identify equivalent measurements between units within the U.S. Customary system (inches and feet; feet and yards; inches and yards; yards and miles) and between units within the metric system (millimeters and centimeters; centimeters and meters; and millimeters and meters).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
students should be able to measure to the nearest part of an inch ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$), inch, foot, or yard.		~~– 1 meter is a little longer than 1 yard;~~ ~~– 1 mile is slightly farther than 1.5 kilometers; and~~ ~~– 1 kilometer is slightly farther than half a mile.~~

4.8 The student will

a) estimate and measure liquid volume and describe the results in U.S. Customary units; and

b) identify equivalent measurements between units within the U.S. Customary system (cups, pints, quarts, and gallons).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• U.S. Customary units for measurement of liquid volume include cups, pints, quarts, and gallons. ~~Metric units for measurement of liquid volume include milliliters and liters~~. • The measurement of the object must include the unit of measure along with the number of iterations. • Students should measure the liquid volume of everyday objects in ~~both metric and~~ U.S. Customary units, including cups, pints, quarts, gallons, ~~milliliters, and liters~~, and record the volume including the appropriate unit of measure (e.g., 24 gallons). • Practical experience measuring liquid volume of familiar objects helps to establish benchmarks and facilitates the student's ability to estimate liquid volume. • ~~Students may use familiar benchmarks to make ballpark comparisons, such as 1 quart is a little less than 1 liter, and 1 liter is a little more than 1 quart.~~ • Students should estimate the liquid volume of containers in ~~both metric and~~ U.S. Customary units to the nearest cup, pint, quart, and gallon~~, milliliter, or liter~~.	**All students should** • Use benchmarks to estimate and measure volume. • ~~Understand how to convert units of volume~~ Identify equivalent measurements between units within the U.S. Customary ~~and metric~~ systems~~, using ballpark comparisons~~.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine an appropriate unit of measure (cups, pints, quarts, gallons~~, milliliters, or liters~~) to use when measuring liquid volume in ~~both metric and~~ U.S. Customary units. • Estimate the liquid volume of containers in ~~both metric and~~ U.S. Customary units of measure to the nearest cup, pint, quart, and gallon~~, milliliter, or liter~~. • Measure the liquid volume of everyday objects in both metric and U.S. Customary units, including cups, pints, quarts, and gallons~~, milliliters, and liters~~, and record the volume including the appropriate unit of measure (e.g., 24 gallons). • Identify equivalent measures of volume between units within the U.S. Customary system ~~and metric measurements~~. • ~~Estimate conversion between U.S. Customary and metric units, using ballpark comparisons, such as 1 quart is a little less than 1 liter, and 1 liter is a little more than 1 quart.~~

4.9 The student will determine elapsed time in hours and minutes within a 12-hour period.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Elapsed time is the amount of time that has passed between two given times. • Elapsed time should be modeled and demonstrated using analog clocks and timelines. • Elapsed time can be found by counting on from the beginning time to the finishing time. – Count the number of whole hours between the beginning time and the finishing time. – Count the remaining minutes. – Add the hours and minutes. For example, to find the elapsed time between 10:15 a.m. and 1:25 p.m., count 10 minutes; and then, add 3 hours to 10 minutes to find the total elapsed time of 3 hours and 10 minutes.	**All students should** • Understanding the "counting on" strategy for determining elapsed time in hour and minute increments over a 12-hour period from a.m. to a.m. or p.m. to p.m.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the elapsed time in hours and minutes within a 12-hour period. (times can cross between a.m. and p.m. times). • Solve practical problems in relation to time that has elapsed.

The study of geometry helps students represent and make sense of the world. At the fourth- and fifth-grade levels, reasoning skills typically grow rapidly, and these skills enable students to investigate geometric problems of increasing complexity and to study how geometric terms relate to geometric properties. Students develop knowledge about how geometric ~~shapes~~ figures relate to each other and begin to use mathematical reasoning to analyze and justify properties and relationships among ~~shapes~~ figures.

Students discover these relationships by constructing, drawing, measuring, comparing, and classifying geometric ~~shapes~~ figures. Investigations should include explorations with everyday objects and other physical materials. Exercises that ask students to visualize, draw, and compare ~~shapes~~ figures will help them not only to develop an understanding of the relationships, but to develop their spatial sense as well. ~~Discussing ideas, conjecturing, and testing hypotheses precede the development of more formal summary statements.~~ In the process, definitions become meaningful, relationships among figures are understood, and students are prepared to use these ideas to develop informal arguments.

Students investigate, identify, and draw representations and describe the relationships between and among points, lines, line segments, rays, and angles. Students apply generalizations about lines, angles, and triangles to develop understanding about congruence, other lines such as parallel and perpendicular ones, and classifications of triangles. ~~Students also explore coordinate geometry, using the coordinate plane to describe points in the first quadrant.~~

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)
- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking Algebra.)

4.10 The student will

a) identify and describe representations of points, lines, line segments, rays, and angles, including endpoints and vertices; and

b) identify representations of lines that illustrate intersection, parallelism, and perpendicularity.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A point is ~~an exact~~ a location in space. It has no length, ~~or~~ width, or height. A point is usually named with a capital letter. • A line is a collection of points going on and on infinitely in both directions. It has no endpoints. ~~A line is a collection of points going on and on infinitely in both directions. It has no endpoints.~~ When a line is drawn, at least two points on it can be marked and given capital letter names. ~~The line can also be named with a single, lower-case letter~~. ~~Arrowheads~~ Arrows must be drawn to show that the line goes on in both directions infinitely. • A line segment is part of a line. It has two endpoints and includes all the points between those endpoints. To name a line segment, name the endpoints (e.g., "the line segment AB"). • A ray is part of a line. It has one endpoint and continues ~~on and on~~ infinitely in one direction. To name a ray, say the name of its endpoint first and then say the name of one other point on the ray. • Two rays that have the same endpoint form an angle. This endpoint is called the *vertex*. Angles are found wherever lines and line segments intersect. An angle can be named in three different ways by using – three letters to name, in this order, a point on one ray, the vertex, and a point on the other ray;	**All students should** • Understand that points, lines, line segments, ~~and~~ rays, and angles, including endpoints and vertices are fundamental components of noncircular geometric figures. • Understand that the shortest distance between two points on a flat surface is a line segment. • Understand that lines in a plane either intersect or are parallel. Perpendicularity is a special case of intersection. • Identify ~~real-world~~ practical situations that illustrate parallel, intersecting, and perpendicular lines.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Differentiate among a point, line, line segment, and ray by using the definitions to compare.~~ • ~~Investigate and describe~~ Identify and describe ~~the relationships between and among~~ representations of points, lines, line segments, ~~and~~ rays, and angles, including endpoints and vertices. • Understand that lines in a plane can intersect or are parallel. Perpendicularity is a special case of intersection. • Identify practical situations that illustrate parallel, intersecting, and perpendicular lines.

4.10 The student will

a) identify and describe representations of points, lines, line segments, rays, and angles, including endpoints and vertices; and

b) identify representations of lines that illustrate intersection, parallelism, and perpendicularity.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
– one letter at the vertex; or – a number written inside the rays of the angle. • Intersecting lines ~~are lines that cross and~~ have one point in common. • Perpendicular lines are special intersecting lines that form right angles ~~(square corners)~~ where they intersect. • Parallel lines are lines that lie ~~on the same flat~~ in the same place ~~surface (plane) and never cross~~ and do not intersect. Parallel lines are always the same distance apart and do not share any points. • Students should explore intersection, parallelism, and perpendicularity in both two and three dimensions. For example, students should analyze the relationships between the edges of a cube. Which ~~line segments~~ edges are parallel? Which are perpendicular? What plane contains the upper left edge and the lower right edge of the cube? Students can visualize this by using the classroom itself to notice the lines formed by the intersection of the ceiling and walls, of the floor and wall, and of two walls.		

4.11 The student will

a) investigate congruence of plane figures after geometric transformations, such as reflection, translation, and rotation, using mirrors, paper folding, and tracing; and

b) recognize the images of figures resulting from geometric transformations, such as translation, reflection, and rotation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.) – **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.) – **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusion are understood, but the role and significance of deduction is not	**All students should** • ~~Understand that two-dimensional (plane) figures are unique in their defining properties.~~ • ~~Understand that three-dimensional (solid) figures are unique in their defining properties~~. • Understand the meaning of the term *congruent*. • Understand how to identify congruent ~~shapes~~ figures. • Understand that the orientation of figures does not affect congruency or noncongruency.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify and describe the properties of squares, rectangles, triangles, parallelograms, rhombi, and circles.~~ • ~~Identify and describe the properties of spheres, cubes, and rectangular solids (prisms).~~ • ~~Identify congruent and noncongruent figures.~~ • ~~Analyze and compare the properties of~~ ~~– circles and spheres; squares and cubes; and~~ ~~– rectangles and rectangular solids (prisms).~~ • Recognize the congruence of plane figures resulting from geometric transformations such as translation, reflection, and rotation,using mirrors, paper folding and tracing.

4.11 The student will

a) investigate congruence of plane figures after geometric transformations, such as reflection, translation, and rotation, using mirrors, paper folding, and tracing; and

b) recognize the images of figures resulting from geometric transformations, such as translation, reflection, and rotation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking algebra.) • ~~A polygon is a two-dimensional geometric figure which has straight sides and can be described as simple and closed.~~ • ~~A triangle is a polygon with three angles and three sides.~~ • ~~A quadrilateral is a polygon with four sides.~~ • ~~A rectangle is a quadrilateral with four right angles.~~ • ~~A square is a rectangle with four sides of equal length.~~ • ~~A circle is a closed curve with all points in one plane and equidistant from a fixed point (the center).~~ • Congruent figures are figures having exactly the same size and shape. Opportunities for exploring figures that are congruent and/or noncongruent can best be accomplished by using physical models. • ~~A cube is a three-dimensional solid with six congruent square faces and every edge the same length. A cube has 6 faces and 12 edges.~~ • ~~A cylinder is a three-dimensional object formed by two congruent parallel circles joined by a curved surface (usually a solid or hollow object~~		

4.11 The student will

a) investigate congruence of plane figures after geometric transformations, such as reflection, translation, and rotation, using mirrors, paper folding, and tracing; and

b) recognize the images of figures resulting from geometric transformations, such as translation, reflection, and rotation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~shaped like a can).~~ • ~~A cone is a solid, pointed figure having a flat, round base (usually a circle) that is joined to a vertex by a curved surface.~~ • ~~A rectangular solid (prism) is a three-dimensional figure in which all six faces are rectangles with three pair of parallel, congruent opposite faces.~~ • ~~A square pyramid is a solid whose base is a square and whose faces are triangles that share a common vertex.~~ • ~~A sphere is a three-dimensional object with all of its points the same distance from the center.~~ • A translation ~~(slide)~~ is a transformation in which an image is formed by moving every point on a figure the same distance in the same direction. • A reflection ~~(flip)~~ is a transformation in which a figure is flipped over a line called the *line of reflection*. All corresponding points in the image and preimage are equidistant from the line of reflection. • A rotation ~~(turn)~~ is a transformation in which an image is formed by turning its preimage about a point. • The resulting figure of a translation, reflection, or rotation is congruent to the original figure.		

4.12 The student will
a) define polygon; and
b) identify polygons with 10 or fewer sides.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A polygon is a ~~two-dimensional~~ closed plane geometric figure ~~which has straight sides and can be described as simple and closed~~ composed of at least three line segments that do not cross. None of the sides are curved. • A triangle is a polygon with three angles and three sides. • A quadrilateral is a polygon with four sides. • A rectangle is a quadrilateral with four right angles. • A square is a rectangle with four sides of equal length. • A trapezoid is a quadrilateral with exactly one pair of parallel sides. • A parallelogram is a quadrilateral with both pairs of opposite sides parallel. • A rhombus is a quadrilateral with 4 congruent sides. • A pentagon is a 5-sided polygon. • A hexagon is a 6-sided polygon. • A heptagon is a 7-sided polygon. • An octagon is an 8-sided polygon. • A nonagon is a 9-sided polygon. • A decagon is a 10-sided polygon.	**All students should** • Identify polygons with 10 or fewer sides in everyday situations. • Identify polygons with 10 or fewer sides in multiple orientations (rotations, reflections, and translations of the polygons).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to** • Define and identify properties of polygons with 10 or fewer sides. • Identify polygons by name with 10 or fewer sides in multiple orientations (rotations, reflections, and translations of the polygons)

Students entering grades 4 and 5 have explored the concepts of chance and are able to determine possible outcomes of given events. Students have utilized a variety of random generator tools, including random number generators (number cubes), spinners, and two-sided counters. In game situations, students are able to predict whether the game is fair or not fair. Furthermore, students are able to identify events as likely or unlikely to happen. Thus the focus of instruction at grades 4 and 5 is to deepen their understanding of the concepts of probability by

- ~~developing the continuum of terms to include *impossible*, *unlikely*, *equally likely*, *possible*, and *certain*;~~
- offering opportunities to set up models simulating ~~real-life~~ practical events;
- engaging students in activities to enhance their understanding of fairness; and
- engaging students in activities ~~imbued~~ that instill ~~with~~ a spirit of investigation and exploration and providing students with opportunities to use manipulatives.

The focus of statistics instruction is to assist students with further development and investigation of data collection strategies. Students should continue to focus on

- posing questions;
- collecting data and organizing this data into meaningful graphs, charts, and diagrams based on issues relating to ~~real-world~~ practical experiences;
- interpreting the data presented by these graphs;
- answering descriptive questions (“How many?” “How much?”) from the data displays;
- identifying and justifying comparisons (“Which is the most? Which is the least?” “Which is the same? Which is different?”) about the information;
- comparing their initial predictions to the actual results; and
- writing a few sentences to communicate to others their ~~analysis and~~ interpretation of the data.

Through a study of probability and statistics, students develop a real appreciation of data analysis methods as powerful means for decision making.

4.13 The student will

a) predict the likelihood of an outcome of a simple event; and

b) represent probability as a number between 0 and 1, inclusive.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A spirit of investigation and experimentation should permeate probability instruction, where students are actively engaged in explorations and have opportunities to use manipulatives. • Probability is the chance of an event occurring. • The probability of an event occurring is the ratio of desired outcomes to the total number of possible outcomes. If all the outcomes of an event are equally likely to occur, the probability of the event = $\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$. • The probability of an event occurring is represented by a ratio between 0 and 1. An event is "impossible" if it has a probability of 0 (e.g., the probability that the month of April will have 31 days). An event is "certain" if it has a probability of 1 (e.g., the probability that the sun will rise tomorrow morning). • When a probability experiment has very few trials, the results can be misleading. The more times an experiment is done, the closer the experimental probability comes to the theoretical probability (e.g., a coin lands heads up half of the time). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *as likely as unlikely*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring.	**All students should** • Understand and apply basic concepts of probability. • Describe events as likely or unlikely and discuss the degree of likelihood, using the terms *certain*, *likely*, *equally likely*, *unlikely*, and *impossible*. • Predict the likelihood of an outcome of a simple event and test the prediction. • Understand that the measure of the probability of an event can be represented by a number between 0 and 1, inclusive.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model and determine all possible outcomes of a given simple event where there are no more than ~~12~~ 24 possible outcomes, using a variety of manipulatives, such as coins, number cubes, and spinners. • Conduct experiments to determine the probability of an event occurring for a given number of trials (no more than ~~12~~ 25 trials), using manipulatives (e.g., the number of times "heads" occurs when flipping a coin 10 times; the chance that when the names of 12 classmates are put in a shoebox, a name that begins with *D* will be drawn). • Write the probability of a given simple event as a fraction, where the total number of possible outcomes is ~~12~~ 24 or fewer. • Identify the likelihood of an event occurring and relate it to its fractional representation (e.g., impossible/0; equally likely/$\frac{1}{2}$; certain/1). • Set up a probability number line showing that a number can be represented between 0 and 1, inclusively. • Determine the outcome of an event that is least likely to occur (less than half) or most likely to occur (greater than half) when the number of possible outcomes is 24 or less.

4.13 The student will

a) predict the likelihood of an outcome of a simple event; and

b) represent probability as a number between 0 and 1, inclusive.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
Activities should include ~~real-life~~ practical examples. • For ~~any~~ an event such as flipping a coin, the equally likely things that can happen are called *outcomes*. For example, there are two equally likely outcomes when flipping a coin: the coin can land heads up, or the coin can land tails up. • For another event such as spinning a spinner that is one-third red and two-thirds blue, the two outcomes, red and blue, are not equally likely. This is an unfair spinner (since it is not divided equally), therefore, the outcomes are not equally likely.		

4.14 The student will collect, organize, display, and interpret data from a variety of graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data analysis helps describe data, recognize patterns or trends, and make predictions. • Investigations involving ~~real-world~~ practical data should occur frequently, and data can be collected through brief class surveys or through more extended projects taking many days. • Students formulate questions, predict answers to questions under investigation, collect and represent initial data, and consider whether the data answer the questions. • Line graphs are used to show how two continuous variables are related. Line graphs ~~are~~ may be used to show how one variable changes over time. If this one variable is not continuous, then a broken line is used. By looking at a ~~single~~ line graph, it can be determined whether the variable is increasing, decreasing, or staying the same over time. – The values along the horizontal axis represent continuous data on a given variable, usually some measure of time (e.g., time in years, months, or days). The data presented on a line graph is referred to as "continuous data," as it represents data collected over a continuous period of time. – The values along the vertical axis are the scale and represent the frequency with which those values occur in the data set. The values should represent equal increments of multiples of whole numbers, fractions, or decimals, depending upon the data being collected. The scale should	**All students should** • Understand the difference between representing categorical data and representing numerical data. • Understand that line graphs show change over time (numerical data). • Understand that bar graphs should be used to compare counts of different categories (categorical data). • Understand how data displayed in bar and line graphs can be interpreted so that informed decisions can be made.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Collect data, using, for example, observations, measurement, surveys, scientific experiments, polls, or questionnaires. • Organize data into a chart or table. • Construct and display data in bar graphs, labeling one axis with equal whole number increments of 1 or more (numerical data) (e.g., multiples of 5, 10, or 100) and the other axis with categories related to the title of the graph (categorical data) (e.g., swimming, fishing, boating, and water skiing as the categories of "Favorite Summer Sports"). • Construct and display data in line graphs, labeling the vertical axis with equal whole number increments of 1 or more and the horizontal axis with continuous data commonly related to time (e.g., hours, days, months, years, and age). Line graphs will have no more than ~~four~~ 10 identified points along a continuum for continuous data. For example, growth charts showing age versus height place age on the horizontal axis (e.g., 1 month, 2 months, 3 months, and 4 months). • Title the given graph or identify the title in a given graph and label the axes. • ~~Analyze information~~ Interpret data from simple line and bar graphs by describing the characteristics of the data and the data as a whole (e.g., the category with the greatest/least, categories with the same number of responses, similarities and differences, the total number).

4.14 The student will collect, organize, display, and interpret data from a variety of graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
extend one increment above the greatest recorded piece of data. – Each axis should be labeled, and the graph should be given a title. – A line graph tells whether something has increased, decreased, or stayed the same with the passage of time. Statements representing an analysis and interpretation of the characteristics of the data in the graph should be included (e.g., trends of increase and/or decrease, and least and greatest). • Bar graphs should be used to compare counts of different categories (categorical data). Using grid paper ensures more accurate graphs. – A bar graph uses parallel, horizontal or vertical bars to represent counts for several categories. One bar is used for each category, with the length of the bar representing the count for that category. – There is space before, between, and after the bars. – The axis that displays the scale representing the count for the categories should extend one increment above the greatest recorded piece of data. Fourth-grade students should collect data that are recorded in increments of whole numbers, usually multiples of 1, 2, 5, or 10. – Each axis should be labeled, and the graph should be given a title. – Statements representing an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences, least and greatest, the		Data points will be limited to ~~20~~ 30 and categories to ~~4~~ 8. • Interpret the data to answer the question posed, and compare the answer to the prediction (e.g., "The summer sport preferred by most is swimming, which is what I predicted before collecting the data."). • Write at least one sentence to describe the analysis and interpretation of the data, identifying parts of the data that have special characteristics, including categories with the greatest, the least, or the same. • ~~Select from among four choices a correct analysis of the data presented in a bar or line graph. For example, given a line graph showing the number of soccer players (in millions) in the U.S. over the time period 1980 to 2000 in five-year intervals, select the correct answer response that relates to the graphs, such as, "The greatest increase in number of soccer players occurred between 1985 and 1990."~~

4.14 The student will collect, organize, display, and interpret data from a variety of graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
categories, and total number of responses) should be written.		

Students entering grades 4 and 5 have had opportunities to identify patterns within the context of the school curriculum and in their daily lives, and they can make predictions about them. They have had opportunities to use informal language to describe the changes within a pattern and to compare two patterns. Students have also begun to work with the concept of a variable by describing mathematical relationships in open number sentences~~, and they have begun to solve simple equations with one unknown~~.

The focus of instruction is to help students develop a solid use of patterning as a problem solving tool. At this level, patterns are represented and modeled in a variety of ways, including numeric, geometric, ~~graphic,~~ and algebraic formats. Students develop strategies for organizing information more easily to understand various types of patterns and functional relationships. They ~~analyze~~ interpret the structure of patterns by exploring and describing patterns that involve change, and they begin to generalize these patterns. By ~~analyzing~~ interpreting mathematical situations and models, students begin to represent these, using symbols and variables to write "rules" for patterns, to describe relationships and algebraic properties, and to represent unknown quantities.

4.15 The student will recognize, create, and extend numerical and geometric patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Most patterning activities should involve some form of concrete materials to make up a pattern. • Students will identify and extend a wide variety of patterns, including rhythmic, geometric, graphic, numerical, and algebraic. The patterns will include both growing and repeating patterns. • Reproduction of a given pattern in a different representation, using symbols and objects, lays the foundation for writing the relationship symbolically or algebraically. • Tables of values should be analyzed for a pattern to determine ~~what element comes next~~ the next value.	**All students should** • Understand that patterns and functions can be represented in many ways and described using words, tables, graphs, and symbols.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe geometric and numerical patterns, using tables, symbols, or words. • Create geometric and numerical patterns, using concrete materials, number lines, tables, and words. • Extend geometric and numerical patterns, using concrete materials, number lines, tables, and words.

4.16 The student will

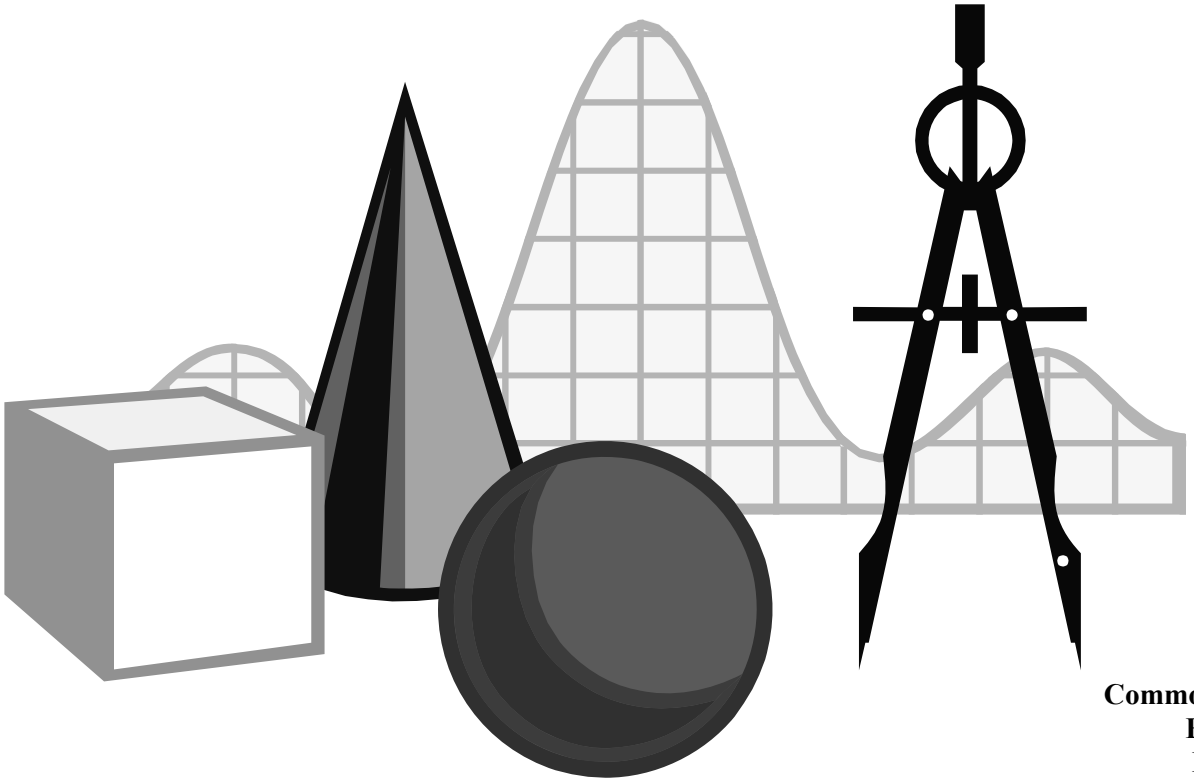
a) recognize and demonstrate the meaning of equality in an equation; and

b) investigate and describe the associative property for addition and multiplication.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Investigating arithmetic operations with whole numbers helps students learn about several different properties of arithmetic relationships. These relationships remain true regardless of the numbers. • The commutative property for addition states that changing the order of the addends does not affect the sum (e.g., 4 + 3 = 3 + 4). Similarly, the commutative property for multiplication states that changing the order of the factors does not affect the product (e.g., 2 × 3 = 3 × 2). • The associative property for addition states that the sum stays the same when the grouping of addends is changed [e.g., 15 + (35 + 16) = (15 + 35) + 16]. The associative property for multiplication states that the product stays the same when the grouping of factors is changed [e.g., 6 × (3 × 5) = (6 × 3) × 5].	**All students should** • Understand that mathematical relationships can be expressed using equations. • Understand that quantities on both sides of an equation must be equal. • Understand that the associative property for addition means you can change the groupings of three or more addends without changing the sum. • Understand that the associative property for multiplication means you can change the groupings of three or more factors without changing the product.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize and demonstrate that the equals sign (=) relates equivalent quantities in an equation. • Write ~~number sentences~~ an equation to represent equivalent mathematical relationships (e.g., 4 × 3 = 2 × 6). • ~~Identify number sentences~~ Recognize and demonstrate ~~that show~~ appropriate use of the equals sign in an equation. • Investigate and describe the associative property for addition as (6 + 2) + 3= 6 + (2 + 3). • Investigate and describe the associative property for multiplication as (3 x 2) x 4 = 3 x (2 x 4).

MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 5



Commonwealth of Virginia
Board of Education
Richmond, Virginia
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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Mathematics instruction in grades 4 and 5 should continue to foster the development of number sense, especially with decimals and fractions. Students with good number sense understand the meaning of numbers, develop multiple relationships and representations among numbers, and recognize the relative magnitude of numbers. They should learn the relative effect of operating on whole numbers, fractions, and decimals and learn how to use mathematical symbols and language to represent problem situations. Number and operation sense continues to be the cornerstone of the curriculum.

The focus of instruction at grades 4 and 5 allows students to investigate and develop an understanding of number sense by modeling numbers, using different representations (e.g., physical materials, diagrams, mathematical symbols, and word names). Students should develop strategies for reading, writing, and judging the size of whole numbers, fractions, and decimals by comparing them, using a variety of models and benchmarks as referents (e.g., $\frac{1}{2}$ or 0.5). Students should apply their knowledge of number and number sense to investigate and solve problems.

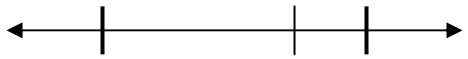
5.1 The student, given a decimal through thousandths, will round to the nearest whole number, tenth, or hundredth.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The structure of the ~~b~~Base-10 number system is based upon a simple pattern of tens in which each place is ten times the value of the place to its right. This is known as a ten-to-one place value relationship. • A decimal point separates the whole number places from the places less than one. Place values extend infinitely in two directions from a decimal point. A number containing a decimal point is called a *decimal number* or simply a *decimal*. • To read decimals, – read the whole number to the left of the decimal point, if there is one; – read the decimal point as "and"; – read the digits to the right of the decimal point just as you would read a whole number; and – say the name of the place value of the digit in the smallest place. • Decimals may be written in a variety of forms: – Standard: 23.456 – Written: Twenty-three and four hundred fifty-six thousandths – Expanded: $(2 \times 10) + (3 \times 1) + (4 \times 0.1) + (5 \times 0.01) + (6 \times 0.001)$ • To help students identify the ten-to-one place value relationship for decimals through thousandths, use ~~b~~Base-10 manipulatives, such as place value mats/charts, decimal squares, ~~b~~Base-10 blocks, and money. • Decimals can be rounded to the nearest whole number, tenth or hundredth in situations when exact numbers are not needed.	**All students should** • ~~Understand the place-value structure of decimals and use this structure to read, write, and compare decimals.~~ • Understand that decimals are rounded in a way that is similar to the way whole numbers are rounded. • Understand that decimal numbers can be rounded to ~~an~~ estimate when exact numbers are not needed for the situation at hand.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify the place values for each digit in decimals through thousandths.~~ • ~~Read decimal numbers through thousandths from written words or place-value format.~~ • ~~Write decimal numbers through thousandths from written words or from decimal numbers presented orally.~~ • Round decimal numbers to the nearest whole number, tenth or hundredth. • ~~Identify the symbols for the terms *greater than*, *less than*, and *equal to*.~~ • ~~Compare the value of two decimal numbers through thousandths, using the symbols >, <, or =.~~

5.1 The student, given a decimal through thousandths, will round to the nearest whole number, tenth, or hundredth.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~A~~ Strategies for rounding decimal numbers to the nearest whole number, tenth and hundredth ~~is~~ are as follows: – Look one place to the right of the digit to which you wish to round. – If the digit is less than 5, leave the digit in the rounding place as it is, and change the digits to the right of the rounding place to zero. – If the digit is 5 or greater, add 1 to the digit in the rounding place and change the digits to the right of the rounding place to zero. – ~~If the digit is 5 or greater, add 1 to the digit in the rounding place and change the digits to the right of the rounding place to zero.~~ • A procedure for comparing two decimals by examining place value may include the following: – Line up the decimal numbers at their decimal points. – Beginning at the left, find the first place value where the digits are different. – Compare the digits in this place value to determine which number is greater (or which is less). – Use the appropriate symbol > or < or the words *greater than* or *less than* to compare the numbers in the order in which they are presented. – If both numbers are the same, use the symbol = or words *equal to*. Two numbers can be compared by examining place value and/or using a number line. – Create a number line that shows the decimal that is to be rounded.		

5.1 The student, given a decimal through thousandths, will round to the nearest whole number, tenth, or hundredth.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The position of the decimal will help children conceptualize the number's placement relative for rounding. An example is to round 5.747 to the nearest hundredth:  5.74 5.747 5.75		

5.2 The student will

a) recognize and name fractions in their equivalent decimal form and vice versa; and

b) compare and order fractions and decimals in a given set from least to greatest and greatest to least.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Students should recognize, name, and focus on finding equivalent decimals of familiar fractions such as halves, fourths, fifths, eighths, and tenths. • Students should be able to determine equivalent relationships between decimals and fractions with denominators up to 12. • To help students compare the value of two decimals through thousandths, use manipulatives, such as place value mats/charts, 10-by-10 grids, decimal squares, ~~b~~Base-10 blocks, meter sticks, number lines, and money. • ~~A procedure for comparing two decimals by examining may include the following:~~ ~~– Line up the decimal numbers at their decimal points.~~ ~~– Beginning at the left, find the first place value where the digits are different.~~ ~~– Compare the digits in this place value to determine which number is greater (or which is less).~~ ~~– Use the appropriate symbol > or < or the words *greater than* or *less than* to compare the numbers in the order in which they are presented.~~ ~~– If both numbers are the same, use the symbol = or words *equal to*.~~ ~~Two numbers can be compared by examining place value and/or using a number line.~~ • Decimals and fractions represent the same relationships; however, they are presented in two different formats. Decimal numbers are another	**All students should** • Understand the relationship between ~~commonly used~~ fractions and their decimal form and vice versa. • Understand that fractions and decimals can be compared and ordered from least to greatest and greatest to least.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Represent fractions (halves, fourths, fifths, eighths, and tenths) in their equivalent decimal form and vice versa. • ~~Represent decimals in their equivalent fraction form (halves, fourths, fifths, eighths, and tenths).~~ • ~~Determine~~ Recognize and name equivalent relationships between decimals and fractions with denominators up to 12. • ~~Order~~ Compare and order from least to greatest and greatest to least a given set of no more than five numbers written as decimals, ~~and as~~ fractions, and mixed numbers with denominators of 12 or less.

5.2 The student will

a) recognize and name fractions in their equivalent decimal form and vice versa; and

b) compare and order fractions and decimals in a given set from least to greatest and greatest to least.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
way of writing fractions. Base-10 models (e.g., 10-by-10 grids, meter sticks, number lines, decimal squares, money) concretely relate fractions to decimals and vice versa.		

5.3 The student will

a) identify and describe the characteristics of prime and composite numbers; and

b) identify and describe the characteristics of even and odd numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A prime number is a natural number that has exactly two different factors, one and the number itself. • A composite number is a natural number that has more than two different factors. • The number 1 is neither prime nor composite because it has only one factor, itself. • The prime factorization of a number is a representation of the number as the product of its prime factors. For example, the prime factorization of 18 is $2 \times 3 \times 3$. • ~~Zero is not a natural number. Although it has an infinite number of factors, it is neither prime nor composite.~~ • Prime or composite numbers can be represented by rectangular models or rectangular arrays on grid paper. A prime number can be represented by only one rectangular array (e.g., 7 can ~~only~~ be represented by a 7×1 and a 1 x 7). A composite number can always be represented by more than ~~one~~ two rectangular arrays (e.g., 9 can be represented by a 9×1, a 1 x 9, or a 3×3). • Divisibility rules are useful tools in identifying prime and composite numbers. • Students should use manipulatives (e.g., Base-10 blocks, cubes, tiles, hundreds board, etc.) to explore and categorize numbers into groups of odd or even. • Students should use rules to categorize numbers	**All students should** • Understand and use the unique characteristics of certain sets of numbers, including prime, composite, even, and odd numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify ~~which numbers are~~ prime ~~for~~ numbers less than or equal to 50. • Identify ~~which numbers are~~ composite ~~for~~ numbers less than or equal to 50. • Explain orally and in writing why a number is prime or composite. • Identify which numbers are even or odd. • Explain and demonstrate with manipulatives, pictorial representations, oral language, or written language why a number is even or odd.

5.3 The student will

a) identify and describe the characteristics of prime and composite numbers; and

b) identify and describe the characteristics of even and odd numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
into groups of odd or even. Rules can include: – An odd number does *not* have 2 as a factor or is *not* divisible by 2. – The sum of two even numbers is even. – The sum of two odd numbers is even. – The sum of an even and an odd is odd. – Even numbers have an even number or zero in the ones place. – Odd numbers have an odd number in the ones place. – An even number has 2 as a factor or is divisible by 2.		

Computation and estimation in grades 4 and 5 should focus on developing fluency in multiplication and division with whole numbers and should begin to extend students' understanding of these operations to work~~ing~~ with ~~fractions and~~ decimals. Instruction should focus on computation activities that enable students to model, explain, and develop reasonable proficiency with basic facts and algorithms. These proficiencies are often developed as a result of investigations and opportunities to develop algorithms. Additionally, opportunities to develop and use visual models, benchmarks, and equivalents, to add and subtract with common fractions, and to develop computational procedures for the addition and subtraction of decimals are a priority for instruction in these grades.

Students should develop an understanding of how whole numbers, fractions, and decimals are written and modeled; an understanding of the meaning of multiplication and division, including multiple representations (e.g., multiplication as repeated addition or as an array); an ability not only to identify but to use relationships between operations to solve problems (e.g., multiplication as the inverse of division); and the ability to use (not identify) properties of operations to solve problems [e.g., 7×28 is equivalent to $(7 \times 20) + (7 \times 8)$~~, or $(7 \times 30) - (7 \times 2)$~~].

Students should develop computational estimation strategies based on an understanding of number concepts, properties, and relationships. Practice should include estimation of sums and differences of common fractions and decimals, using benchmarks (e.g., $\frac{2}{5} + \frac{1}{3}$ must be less than 1 because both fractions are less than $\frac{1}{2}$). Using estimation, students should develop strategies to recognize the reasonableness of their computations. Additionally, students should enhance their ability to select an appropriate problem solving method from among estimation, mental mathematics, paper-and-pencil algorithms, and the use of calculators and computers. With activities that challenge students to use this knowledge and these skills to solve problems in many contexts, students develop the foundation to ensure success and achievement in higher mathematics.

5.4 The student will create and solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division with and without remainders of whole numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An example of an approach to solving problems is Polya's four-step plan: – Understand: Retell the problem; read it twice; take notes; study the charts or diagrams; look up words and symbols that are new. – Plan: Decide what operation(s) to use and what sequence of steps to use to solve the problem. – Solve: Follow the plan and work accurately. If the first attempt doesn't work, try another plan. – Look back: Does the answer make sense? • Estimation gives a rough idea of an amount. Strategies such as front-end, rounding, and mental computation may be used to estimate addition, subtraction, multiplication, and division of whole numbers. • Examples of problems to be solved by using estimation strategies are encountered in shopping for groceries, buying school supplies, budgeting allowance, and sharing the cost of a pizza or the prize money from a contest. • Estimation can be used to check the reasonableness of the results. • ~~Terms used in multiplication are~~ ~~*factor* → 376~~ ~~*factor* → × 23~~ ~~*product* → 8,648~~	**All students should** • Understand the meaning of mathematical operations and how these operations relate to one another when creating and solving single-step and multistep word problems.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Select appropriate methods and tools from among paper and pencil, estimation, mental computation, and calculators according to the context and nature of the computation in order to compute with whole numbers. • Create single-step and multistep problems involving the operations of addition, subtraction, multiplication, and~~/or~~ division with and without remainders of whole numbers, using ~~real-life~~ practical situations. • Estimate the sum, difference, product, and quotient of whole number computations. • Solve single-step and multistep problems involving addition, subtraction, multiplication, and division with and without remainders of whole numbers, using paper and pencil, mental computation, and calculators in which – sums, differences, and products will not exceed five digits; – multipliers will not exceed two digits; – divisors will not exceed two digits; or – dividends will not exceed four digits. • Use two or more operational steps to solve a multistep problem. Operations can be the same or different.

5.5 The student will

a) find the sum, difference, product, and quotient of two numbers expressed as decimals through thousandths (divisors with only one nonzero digit); and

b) create and solve single-step and multistep practical problems involving decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition and subtraction ~~with~~ of decimals may be investigated using a variety of models (e.g., 10-by-10 grids, number lines, money). • Decimal computation uses similar procedures as those developed for whole number computation and applies them to decimal place values, giving careful attention to the placement of the decimal point in the solution. • Multiplication of decimals follows the same procedure as multiplication of whole numbers. The only difference is that a decimal point must be correctly placed in the product giving careful attention to the placement of the decimal point in the solution. • The product of decimals is dependent upon the two factors being multiplied. ~~Factors Products~~ ~~tenths × tenths = hundredths~~ ~~tenths × hundredths = thousandths~~ ~~hundredths × hundredths = ten-thousandths~~ ~~tenths × thousandths = ten-thousandths~~ • In cases where an exact product is not required, the product of decimals can be estimated using strategies for multiplying whole numbers, such as front-end and compatible numbers, or rounding. In each case, the student needs to determine where to place the decimal point to ensure that the product is reasonable. • Division is the operation of making equal groups	**All students should** • Use similar procedures as those developed for whole number computation and apply them to decimal place values, giving careful attention to the placement of the decimal point in the solution. • Select appropriate methods and tools from among paper and pencil, estimation, mental computation, and calculators according to the context and nature of the computation in order to compute with decimal numbers. • Understand the various meanings of *division* and its effect on whole numbers. • Understand various representations of division, i.e., dividend ÷ divisor = quotient quotient divisor)dividend $\frac{\text{dividend}}{\text{divisor}}$ = quotient.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine an appropriate method of calculation to find the sum, difference, and product of two numbers expressed as decimals through thousandths, selecting from among paper and pencil, estimation, mental computation, and calculators. • Estimate to find the number that is closest to the sum, difference, and product of two numbers expressed as decimals through thousandths. • Find the sum, difference, and product of two numbers expressed as decimals through thousandths, using paper and pencil. • Find the sum, difference, and product of two numbers expressed as decimals through thousandths, using mental computation. • Find the sum, difference, and product of two numbers expressed as decimals through thousandths, using calculators. • Use estimation to check the reasonableness of a sum, difference, and product. • Create and solve single-step and multistep problems. • A multistep problem needs to incorporate two or more operational steps (operations can be the same or different). • Determine the quotient, given a dividend expressed as a decimal through thousandths (and no ~~annexing~~ adding of

5.5 The student will

a) find the sum, difference, product, and quotient of two numbers expressed as decimals through thousandths (divisors with only one nonzero digit); and

b) create and solve single-step and multistep practical problems involving decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
or shares. When the original amount and the number of shares are known, divide to find the size of each share. When the original amount and the size of each share are known, divide to find the number of shares. Both situations may be modeled with ~~b~~Base-10 manipulatives. • The fair-share concept of decimal division can be modeled, using manipulatives (e.g., ~~b~~Base-10 blocks). • Division ~~of~~ with decimals is performed the same way as division of whole numbers. The only difference is the placement of the decimal point in the quotient. • The quotient can be estimated, given a dividend expressed as a decimal through thousandths (and no ~~annexing~~ ~~of~~ adding of zeros to the dividend during the division process) and a single-digit divisor. • Estimation can be used to check the reasonableness of a quotient. • Division is the inverse of multiplication; therefore, multiplication and division are inverse operations. • Terms used in division are *dividend, divisor*, and *quotient.* dividend ÷ divisor = quotient quotient divisor)dividend • There are a variety of algorithms for division such		zeros to the dividend during the division process) and a single-digit divisor. ~~All dividends should be evenly divisible by the divisor.~~

5.5 The student will

a) find the sum, difference, product, and quotient of two numbers expressed as decimals through thousandths (divisors with only one nonzero digit); and

b) create and solve single-step and multistep practical problems involving decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
as repeated multiplication and subtraction. Experience with these algorithms may enhance understanding of the traditional long division algorithm. • A multistep problem needs to incorporate no more than two operational steps (operations can be same or different).		

5.6 The student will solve single-step and multistep practical problems involving addition and subtraction with fractions and mixed numbers and express answers in simplest form.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A fraction can be expressed in simplest form (simplest equivalent fraction) by dividing the numerator and denominator by their greatest common factor. • A fraction is in simplest form when its numerator and denominator have no common factors other than 1. • Fractions having like denominators means the same as fractions having common denominators. • Equivalent fractions name the same amount. To find equivalent fractions, multiply or divide the numerator and denominator by the same nonzero number. • Addition and subtraction with fractions and mixed numbers can be modeled using a variety of concrete materials and pictorial representations as well as paper and pencil. • To add, subtract, and compare fractions and mixed numbers, it often helps to find the least common denominator. The least common denominator (LCD) of two or more fractions is the least common multiple (LCM) of the denominators. • To add or subtract with fractions having the same or like denominators, add or subtract the numerators and write in simplest form. • To add or subtract with fractions that do not have the same denominator, first find equivalent fractions with the least common denominator. Then add or subtract and write the answer in simplest form.	**All students should** • Develop and use strategies to estimate and compute addition and subtraction of fractions. • Understand the concept of least common multiple and least common denominator as they are important when adding and subtracting fractions. • Understand that a fraction is in simplest form when its numerator and denominator have no common factors other than 1.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Add and subtract~~ Solve single-step and multistep practical problems involving addition and subtraction with fractions having like and unlike denominators. Denominators should be limited to 12 or less, and answers should be expressed in simplest form. • ~~Add and subtract~~ Solve single-step and multistep practical problems involving addition and subtraction with mixed numbers having like and unlike denominators, with and without regrouping. Denominators should be limited to 12 or less, and answers should be expressed in simplest form. • Use estimation to check the reasonableness of a sum or difference.

5.6 The student will solve single-step and multistep practical problems involving addition and subtraction with fractions and mixed numbers and express answers in simplest form.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A mixed number has two parts: a whole number and a fraction. • To add or subtract with mixed numbers, students may use a number line, draw a picture, rewrite fractions with like denominators, or rewrite mixed numbers as fractions.		

5.7 The student will evaluate whole number numerical expressions, using the order of operations limited to parentheses, addition, subtraction, multiplication, and division.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An expression, like a phrase, has no equal sign. • Expressions are simplified by using the order of operations. • The order of operations defines the computation order to follow in simplifying an expression. • The order of operations is as follows: – First, complete all operations within grouping symbols. If there are grouping symbols within other grouping symbols, do the innermost operation first. – Second, evaluate all exponential expressions. – Third, multiply and/or divide in order from left to right. – Fourth, add and/or subtract in order from left to right.	**All students should** • Understand that the order of operations describes the order to use to simplify expressions containing more than one operation. • ~~Select appropriate strategies and tools to simplify expressions.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Simplify expressions by using the order of operations in a demonstrated step-by-step approach. • Find the value of numerical expressions, using the order of operations~~, mental mathematics, and appropriate tools. Exponents are limited to positive values. Fractions are limited to having denominators of 12 or less. Decimals are limited to the thousandth place~~. • Given an expression involving more than one operation, describe which operation is completed first, which is second, etc.

Students in grades 4 and 5 should be actively involved in measurement activities that require a dynamic interaction among students and their environment. Students can see the usefulness of measurement if classroom experiences focus on measuring objects and estimating measurements. Textbook experiences cannot substitute for activities that utilize measurement to answer questions about real problems.

The approximate nature of measurement deserves repeated attention at this level. It is important to begin to establish some benchmarks by which to estimate or judge the size of objects. ~~The intent is for students to make "ballpark" comparisons and *not* to memorize conversion factors between U.S. Customary and metric units. To fully understand these ballpark comparisons, students must be actively engaged in the process of measurement.~~

Students use standard and nonstandard, age-appropriate tools to measure objects. Students also use age-appropriate language of mathematics to verbalize the measurements of length, weight/mass, liquid volume, area, temperature, and time.

The focus of instruction should be an active exploration of the real world in order to apply concepts from the two systems of measurement (metric and U.S. Customary), to measure perimeter, weight/mass, liquid volume/capacity, area, temperature, and time. Students continue to enhance their understanding of measurement by using appropriate tools such as rulers, balances, clocks, and thermometers. The process of measuring is identical for any attribute (i.e., length, weight/mass, liquid volume/capacity, area): choose a unit, compare that unit to the object, and report the number of units.

5.8 The student will

a) find perimeter, area, and volume in standard units of measure;
b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation;
c) identify equivalent measurements within the metric system;
d) estimate and then measure to solve problems, using U.S. Customary and metric units; and
e) choose an appropriate unit of measure for a given situation involving measurement using U.S. Customary and metric units.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Perimeter is the distance around an object. It is a measure of length. Area is the number of square units needed to cover a surface. Volume is a measure of capacity. • To find the perimeter of any polygon, add the lengths of the sides. • Students should label the perimeter or area with the appropriate unit of linear or square measure. • Area is the number of square units needed to cover a surface or figure. • ~~Students should investigate the area of a square, rectangle, and triangle by using manipulatives (e.g., tiles, geoboards, graph paper).~~ • Students should investigate, using manipulatives, to discover the formulas for the area of a square, rectangle, and right triangle; and volume of a rectangular solid. – Area of a rectangle = Length × Width – Area of a square = Side × Side – Area of a right triangle = $\frac{1}{2}$ Base × Height – Volume of a rectangular solid = Length x Width x Height	**All students should** • Understand the concepts of perimeter, ~~and~~ area, and volume. • Understand and use appropriate units of measure for perimeter, ~~and~~ area, and volume. • Understand the difference between using perimeter, area, and volume in a given situation. • Understand how to select a measuring device and unit of measure to solve problems involving measurement.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the perimeter of a polygon, with or without diagrams, when – the lengths of all sides of a polygon that is not a rectangle or a square are given; – the length and width of a rectangle are given; or – the length of a side of a square is given. • Estimate and determine the perimeter of a polygon, and area of a square, rectangle, and right triangle following the parameters listed above, using only whole number measurements given in metric or U.S. Customary units, and record the solution with the appropriate unit of measure (e.g., 24 square inches). • Estimate and determine the area of a square, with or without diagrams, when the length of a side is given. • Estimate and determine the area of a rectangle, with or without diagrams, when the length and width are given. • Estimate and determine the area of a right triangle, with or without diagrams, when the base and the height are given. • Differentiate ~~between~~ among the concepts of area, perimeter, and volume.

5.8 The student will

a) find perimeter, area, and volume in standard units of measure;
b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation;
c) identify equivalent measurements within the metric system;
d) estimate and then measure to solve problems, using U.S. Customary and metric units; and
e) choose an appropriate unit of measure for a given situation involving measurement using U.S. Customary and metric units.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Length is the distance along a line or figure from one point to another. • U.S. Customary units for measurement of length include inches, feet, yards, and miles. Appropriate measuring devices include rulers, yardsticks, and tape measures. Metric units for measurement of length include millimeters, centimeters, meters, and kilometers. Appropriate measuring devices include centimeter rulers, meter sticks, and tapes. • When measuring with U.S. Customary units, students should be able to measure to the nearest part of an inch ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$), foot, <u>or</u> yard~~, or mile~~. • Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight that an object changes is dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • Appropriate measuring devices to measure mass in U.S. Customary units (ounces, pounds) and metric units (grams, kilograms) are balances.		• Describe ~~real-life~~ <u>practical</u> situations where area, perimeter, and volume are appropriate measures to use, and justify their choices orally or in writing. • Identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation. • Develop a procedure for finding the volume of a rectangular solid. • Determine the volume of a rectangular solid using manipulatives (e.g., cubes) or pictorial representations. • Solve problems involving measurement by selecting an appropriate measuring device and a U.S. Customary or metric unit of measure for the following: – length: part of an inch ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$), inches, feet, yards, ~~miles,~~ millimeters, centimeters, meters, and kilometers; – weight: ounces, pounds, and tons; – mass: grams and kilograms; – liquid volume: cups, pints, quarts, gallons, milliliters, and liters; – area: square units; and – temperature: Celsius and Fahrenheit units. • Estimate the conversion of Celsius and Fahrenheit units relative to familiar situations: – Water freezes at 0°C and 32°F. – Water boils at 100°C and 212°F.

5.8 The student will

a) find perimeter, area, and volume in standard units of measure;
b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation;
c) identify equivalent measurements within the metric system;
d) estimate and then measure to solve problems, using U.S. Customary and metric units; and
e) choose an appropriate unit of measure for a given situation involving measurement using U.S. Customary and metric units.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• U.S. Customary units to measure liquid volume (capacity) include cups, pints, quarts, and gallons. Metric units to measure liquid volume (capacity) include milliliters and liters. • Temperature is measured using a thermometer. The U.S. Customary unit of measure is degrees Fahrenheit; the metric unit of measure is degrees Celsius. • Practical experience measuring familiar objects helps students establish benchmarks and facilitates students' ability to use the units of measure to make estimates.		– Normal body temperature is about 37°C and 98.6°F.

5.9 The student will identify and describe the diameter, radius, chord, and circumference of a circle.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A circle is a set of points on a flat surface (plane) with every point equidistant from a given point called the *center*. • A chord is a line segment connecting any two points on a circle. Students will benefit from understanding that a chord goes from one side of the circle to the other, but does not need to pass through the center. • A diameter is a chord that goes through the center of a circle. The diameter is two times the radius. A radius is a segment from the center of a circle to any point on the circle. Two radii end-to-end form a diameter of a circle. • Circumference is the distance around or perimeter of a circle. The circumference is about 3 times larger than the diameter of a circle.	**All students should** • ~~Identify the parts of a circle.~~ • Understand that a diameter is a line segment that goes through the center of the circle. • Understand the relationship between the measures of diameter and radius and the relationship between the measures of radius and circumference. • Understand that a radius is a line segment that extends between the center and the circumference of the circle. • Understand that a chord is a line segment that extends between any two unique points of a circle. The diameter is also a special chord that goes through the center of a circle. • Understand that the circumference is the distance around the circle. Perimeter is the measure of the circumference.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify and describe the diameter, radius, chord, and circumference of a circle. • Describe the relationship between – diameter and radius~~; and~~, – diameter and chord; and – radius and circumference. • ~~Identify the diameter, radius, chord, and circumference of a given circle.~~ • The length of the diameter of a circle is twice the length of the radius.

5.10 The student will determine an amount of elapsed time in hours and minutes within a 24-hour period.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Elapsed time is the amount of time that has passed between two given times. • Elapsed time can be found by counting on from the beginning time to the finishing time. – Count the number of whole hours between the beginning time and the finishing time. – Count the remaining minutes. – Add the hours and minutes. For example, to find the elapsed time between 10:15 a.m. and 1:25 p.m., count on as follows: – from 10:15 a.m. to 1:15 p.m., count 3 hours; – from 1:15 p.m. to 1:25 p.m., count 10 minutes; and then – add 3 hours to 10 minutes to find the total elapsed time of 3 hours and 10 minutes.	**All students should** • Understand that elapsed time can be found by counting on from the beginning time to the finishing time.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine elapsed time in hours and minutes within a 24-hour period.

5.11 The student will measure right, acute, obtuse, and straight angles.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Angles are measured in degrees. There are up to 360 degrees in an angle. A degree is $\frac{1}{360}$ of a complete rotation of a full circle. There are 360 degrees in a circle. • To measure the number of degrees in an angle, use a protractor or an angle ruler. • A right angle measures exactly 90°. • An acute angle measures less than 90°. • An obtuse angle measures greater than 90° but less than 180°. • A straight angle measures exactly 180°. • Before measuring an angle, students should first compare it to a right angle to determine whether the measure of the angle is less than or greater than 90°. • Students should understand how to work with a protractor or angle ruler as well as available computer software to measure and draw angles and triangles. • ~~A right triangle has one right angle.~~ • ~~An obtuse triangle has one obtuse angle and two acute angles.~~ • ~~An acute triangle has three acute angles.~~	**All students should** • Understand how to measure ~~and draw~~ acute, right, ~~and~~ obtuse, and straight angles. • ~~Understand how to identify a triangle as either acute, right, or obtuse.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the appropriate tools (e.g., protractor and straightedge or angle ruler as well as available software) used to measure and draw angles and triangles. • ~~Draw right, acute, and obtuse angles, using appropriate tools.~~ • Measure right, acute, straight, and obtuse angles, using appropriate tools, and identify their measures in degrees. • ~~Measure the angles of right, acute, and obtuse triangles, using appropriate tools, and identify their measures in degrees.~~

The study of geometry helps students represent and make sense of the world. At the fourth- and fifth-grade levels, reasoning skills typically grow rapidly, and these skills enable students to investigate geometric problems of increasing complexity and to study how geometric terms relate to geometric properties. Students develop knowledge about how geometric ~~shapes~~ figures relate to each other and begin to use mathematical reasoning to analyze and justify properties and relationships among ~~shapes~~ figures.

Students discover these relationships by constructing, drawing, measuring, comparing, and classifying geometric ~~shapes~~ figures. Investigations should include explorations with everyday objects and other physical materials. Exercises that ask students to visualize, draw, and compare ~~shapes~~ figures will help them not only to develop an understanding of the relationships, but to develop their spatial sense as well. ~~Discussing ideas, conjecturing, and testing hypotheses precede the development of more formal summary statements.~~ In the process, definitions become meaningful, relationships among figures are understood, and students are prepared to use these ideas to develop informal arguments.

Students investigate, identify, and draw representations and describe the relationships between and among points, lines, line segments, rays, and angles. Students apply generalizations about lines, angles, and triangles to develop understanding about congruence, other lines such as parallel and perpendicular ones, and classifications of triangles. ~~Students also explore coordinate geometry, using the coordinate plane to describe points in the first quadrant.~~

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)
- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking Algebra.)

5.12 The student will classify
a) angles as right, acute, obtuse, or straight; and
b) triangles as right, acute, obtuse, equilateral, scalene, or isosceles.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A right angle ~~is an angle that forms a square corner. A right angle~~ measures exactly 90°. • ~~An acute angle forms an angle less than a right angle.~~ An acute angle measures greater than 0° but less than 90°. • ~~An obtuse angle forms an angle greater than a right angle.~~ An obtuse angle measures greater than 90° but less than 180°. • A straight angle forms an angle that measures exactly 180°. • A right triangle has one right angle. • An obtuse triangle has one obtuse angle. • An acute triangle has three acute angles (or no angle measuring 90° or greater). • A scalene triangle has no congruent sides. • An isosceles triangle has two congruent sides. • To facilitate the exploration of relationships, ask students whether a right triangle can have an obtuse angle. Why or why not? Can an obtuse triangle have more than one obtuse angle? Why or why not? What type of angles are the two angles other than the right angle in a right triangle? What type of angles are the two angles other than the obtuse angle in an obtuse triangle?	**All students should** • Understand that ~~triangles~~ angles can be classified ~~by the measures of their angles.~~ as right, acute, obtuse, or straight according to their measures. • Understand ~~how to identify~~ that a triangle can be classified as either ~~acute,~~ right, acute, or obtuse according to the measure of its largest angle. • Understand that a triangle can be classified as equilateral, scalene, or isosceles according to the number of sides with equal length.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Classify angles as right, acute, straight, ~~and~~ or obtuse. • Classify triangles as right, acute, ~~and~~ or obtuse. • Classify triangles as equilateral, scalene, or isosceles.

5.13 The student, using plane figures (square, rectangle, triangle, parallelogram, rhombus, and trapezoid), will
a) develop definitions of these plane figures; and
b) investigate and describe the results of combining and subdividing plane figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A triangle is a polygon with three sides. Triangles may be classified according to the measure of their angles, i.e., right, acute, or obtuse. Triangles may also be classified according to the measure of their sides, i.e., scalene (no sides congruent), isosceles (at least two sides congruent) and equilateral (all sides congruent). • A quadrilateral is a polygon with four sides. • A parallelogram is a quadrilateral in which both pairs of opposite sides are parallel. Properties of a parallelogram include the following: – A diagonal (a segment that connects two vertices of a polygon but is not a side) divides the parallelogram into two congruent triangles. – The opposite sides of a parallelogram are congruent. – The opposite angles of a parallelogram are congruent. – The diagonals of a parallelogram bisect each other. • A rectangle is a parallelogram with four right angles. Since a rectangle is a parallelogram, a rectangle has the same properties as those of a parallelogram. • A square is a rectangle with four congruent sides. Since a square is a rectangle, a square has all the properties of a rectangle and of a parallelogram. • A rhombus is a parallelogram with four congruent sides. Opposite angles of a rhombus are congruent. Since a rhombus is a parallelogram,	**All students should** • ~~Understand that the defining properties and symmetry of various plane figures are unique.~~ • Understand that simple plane figures can be combined to make more complicated figures and that complicated figures can be subdivided into simple plane figures.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to** • ~~Recognize and~~ ~~identify the properties of~~ Develop definitions for squares, rectangles, triangles, parallelograms, rhombi, ~~kites~~ and trapezoids. • ~~Describe the properties of squares, rectangles, triangles, parallelograms, rhombi, kites and trapezoids.~~ • ~~Analyze the properties of squares, rectangles, triangles, parallelograms, rhombi, kites and trapezoids.~~ • ~~Identify congruent, non-congruent, and similar figures~~. • Investigate and ~~Describe~~ describe the results of combining and subdividing ~~shapes~~ plane figures. • ~~Identify and describe a line of symmetry.~~ • ~~Recognize the images of figures resulting from geometric transformations such as translation, reflection, or rotation.~~

5.13 The student, using plane figures (square, rectangle, triangle, parallelogram, rhombus, and trapezoid), will
a) develop definitions of these plane figures; and
b) investigate and describe the results of combining and subdividing plane figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
the rhombus has all the properties of a parallelogram. • A trapezoid is a quadrilateral with exactly one pair of parallel sides. The parallel sides are called *bases,* and the nonparallel sides are called *legs*. If the legs have the same length, then the trapezoid is an isosceles trapezoid. • ~~A kite is a quadrilateral with two distinct pairs of adjacent congruent sides.~~ • Two or more figures can be combined to form a new ~~shape~~ figure. Students should be able to identify the figures that have been combined. • The region of ~~A~~ a polygon may be subdivided into two or more regions that represent figures. Students should understand how to divide the region of a polygon into familiar figures.		

Students entering grades 4 and 5 have explored the concepts of chance and are able to determine possible outcomes of given events. Students have utilized a variety of random generator tools, including random number generators (number cubes), spinners, and two-sided counters. In game situations, students are able to predict whether the game is fair or not fair. Furthermore, students are able to identify events as likely or unlikely to happen. Thus the focus of instruction at grades 4 and 5 is to deepen their understanding of the concepts of probability by

- ~~developing the continuum of terms to include *impossible*, *unlikely*, *equally likely*, *possible*, and *certain*;~~
- offering opportunities to set up models simulating ~~real-life~~ practical events;
- engaging students in activities to enhance their understanding of fairness; and
- engaging students in activities ~~imbued~~ that instill ~~with~~ a spirit of investigation and exploration and providing students with opportunities to use manipulatives.

The focus of statistics instruction is to assist students with further development and investigation of data collection strategies. Students should continue to focus on

- posing questions;
- collecting data and organizing this data into meaningful graphs, charts, and diagrams based on issues relating to ~~real-world~~ practical experiences;
- interpreting the data presented by these graphs;
- answering descriptive questions (“How many?” “How much?”) from the data displays;
- identifying and justifying comparisons (“Which is the most? Which is the least?” “Which is the same? Which is different?”) about the information;
- comparing their initial predictions to the actual results; and
- writing a few sentences to communicate to others their ~~analysis and~~ interpretation of the data.

Through a study of probability and statistics, students develop a real appreciation of data analysis methods as powerful means for decision making.

5.14 The student will make predictions and determine the probability of an outcome by constructing a sample space.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Probability is the chance of an event occurring. • The probability of an event occurring is the ratio of desired outcomes to the total number of possible outcomes. If all the outcomes of an event are equally likely to occur, the probability of the event = number of favorable outcomes / total number of possible outcomes. • The probability of an event occurring is represented by a ratio between 0 and 1. An event is "impossible" if it has a probability of 0 (e.g., the probability that the month of April will have 31 days). An event is "certain" if it has a probability of 1 (e.g., the probability that the sun will rise tomorrow morning). • When a probability experiment has very few trials, the results can be misleading. The more times an experiment is done, the closer the experimental probability comes to the theoretical probability (e.g., a coin lands heads up half of the time). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *as likely as unlikely*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring. Activities should include ~~real-life~~ practical examples. • For any event such as flipping a coin, the equally likely things that can happen are called *outcomes*. For example, there are two equally likely outcomes when flipping a coin: the coin can land heads up, or the coin can land tails up. • A sample space represents all possible outcomes of an experiment. The sample space may be organized in a ~~list~~, chart~~,~~ or tree diagram. • Tree diagrams ~~are drawn to~~ show all ~~of the~~ possible	**All students should** • Understand ~~and apply~~ that the basic concepts of probability can be applied to make predictions of outcomes of simple experiments. • Understand that a sample space represents all possible outcomes of an experiment. • ~~Understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct a sample space, using a tree diagram to identify all possible outcomes of a single event an outcome. • Construct a sample space, using a list or chart to represent all possible outcomes of a single event. • ~~Determine~~ Predict and determine the probability of ~~a single event~~ an outcome by constructing a sample space. The sample space ~~when the~~ will have a total ~~number~~ of 12 or less possible outcomes ~~is 12 or less~~. • ~~Create a problem statement involving probability based on information from a given problem situation. Students will not be expected to solve the problem.~~

5.14 The student will make predictions and determine the probability of an outcome by constructing a sample space.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~combinations (~~outcomes~~)~~ in a sample space. The Fundamental ~~c~~Counting ~~p~~Principle ~~tells~~ describes how to find the number of outcomes when there ~~is more than one way to put things together~~ are multiple choices. For example, how many different outfit combinations can you make from 2 shirts (red and blue) and 3 pants (black, white, khaki)? The sample space displayed in a tree diagram would show that there are $2 \times 3 = 6$ (~~counting principle~~ Fundamental Counting Principle) outfit combinations: red-black; red-white; red-khaki; blue-black; blue-white; blue-khaki). • A spinner with eight equal-sized sections is equally likely to land on any one of the sections, three of which are red, three green, and two yellow. Have students write a problem statement involving probability, such as, "What is the probability that the spinner will land on green?"		

5.15 The student, given a problem situation, will collect, organize, and interpret data in a variety of forms, using stem-and-leaf plots and line graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The emphasis in all work with statistics should be on the analysis and the communication of the analysis, rather than on a single correct answer. Data analysis should include opportunities to describe the data, recognize patterns or trends, and make predictions. • Statistical investigations should be active, with students formulating questions about something in their environment and finding quantitative ways to answer the questions. • Investigations can be brief class surveys or more extended projects taking many days. • Through experiences displaying data in a variety of graphical representations, students learn to select an appropriate representation. • ~~Bar graphs are used to compare counts of different categories (categorical data).~~ – ~~A bar graph uses either horizontal or vertical bars to represent counts for several categories. One bar is used for each category, with the length of the bar representing the count for that category.~~ – ~~There is space before, between, and after the bars.~~ – ~~The axis displaying the scale representing the count for the categories should extend one increment above the greatest recorded piece of data. Fifth-grade students should collect data that is recorded in increments of multiples of whole numbers, decimals, and fractions.~~ – ~~Each axis should be labeled, and the graph should have a title.~~	**All students should** • ~~Understand that bar graphs compare categorical data, stem-and-leaf plots list data in a meaningful array, and line graphs show changes over time.~~ • Understand how to interpret ~~propose and justify conclusions and predictions that are based on~~ ~~displays of~~ collected and organized data. • Understand that ~~bar graphs compare categorical data,~~ stem-and-leaf plots list data in a meaningful array~~,~~ and line graphs show changes over time.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Collect data, using observations (e.g., weather), measurement (e.g., shoe sizes), surveys (e.g., ~~favorite television shows~~ hours watching television), or experiments (e.g., plant growth). • Organize the data into a chart or table. • ~~Construct bar graphs, labeling one axis with equal whole number or decimal increments and the other axis with attributes of the topic (categorical data) (e.g., skiing, basketball, ice hockey, skating, and sledding as the categories of "Favorite Winter Sports"). Bar graphs will have no more than six categories.~~ • Display data in line graphs~~, bar graphs,~~ and stem-and-leaf plots. • Construct line graphs, labeling the vertical axis with equal whole number, decimal, or fractional increments and the horizontal axis with continuous data commonly related to time (e.g., hours, days, months, years, and age). Line graphs will have no more than six identified points along a continuum for continuous data (e.g., the decades: 1950s, 1960s, 1970s, 1980s, 1990s, and 2000s). • Construct a stem-and-leaf plot to organize and display data, where the stem is listed in ascending order and the leaves are in ascending order, with or without commas between leaves. • Title the given graph or identify the title. • Interpret the data ~~to compare the answer to the prediction~~ in a variety of forms (e.g., orally or in written form.)

5.15 The student, given a problem situation, will collect, organize, and interpret data in a variety of forms, using stem-and-leaf plots and line graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
– ~~Statements representing an analysis and interpretation of the characteristics of the data (e.g., similarities and differences, mode, and least and greatest) in the graph should be included.~~ • Line graphs are used to show how two continuous variables are related. Line graphs ~~are~~ may be used to show how one variable changes over time. If one variable is not continuous, then a broken line is used. By looking at a ~~single~~ line graph, it can be determined whether the variable is increasing, decreasing, or staying the same over time. – The values along the horizontal axis represent continuous data on a given variable, usually some measure of time (e.g., time in years, months, or days). The data presented on a line graph is referred to as "continuous data" because it represents data collected over a continuous period of time. – The values along the vertical axis are the scale and represent the frequency with which those values occur in the data set. The values should represent equal increments of multiples of whole numbers, fractions, or decimals depending upon the data being collected. The scale should extend one increment above the greatest recorded piece of data. – Each axis should be labeled and the graph should have a title. – A line graph tells whether something has increased, decreased, or stayed the same with the passage of time. Statements representing an analysis and interpretation		• ~~Write a few sentences to describe the interpretation of the data.~~

5.15 The student, given a problem situation, will collect, organize, and interpret data in a variety of forms, using stem-and-leaf plots and line graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
of the characteristics of the data in the graph should be included (e.g., trends of increase and/or decrease, and least and greatest). A broken line is used if the data collected is not continuous data (such as test scores); a solid line is used if the data is continuous (such as height of a plant). • Stem-and-leaf plots allow the exact values of data to be listed in a meaningful array. Data covering a range of 25 numbers are best displayed in a stem-and-leaf plot and are utilized to organize numerical data from least to greatest, using the digits of the greatest to group data. – The data is organized from least to greatest. – Each value should be separated into a stem and a leaf [e.g., two-digit numbers are separated into stems (tens) and leaves (ones)]. – The stems are listed vertically from least to greatest with a line to their right. The leaves are listed horizontally, also from least to greatest, and can be separated by spaces or commas. Every value is recorded regardless of the number of repeats. – A key is often included to explain how to read the plot.		

5.16 The student will

a) describe mean, median, and mode as measures of center;
b) describe mean as fair share;
c) find the mean, median, mode, and range of a set of data; and
d) describe the range of a set of data as a measure of variation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Statistics is the science of conducting studies to collect, organize, summarize, analyze, and draw conclusions from data. • A measure of center is a value at the center or middle of a data set. Mean, median, and mode are measures of center. • The mean, median, and mode are three of the various ways that data can be analyzed. • ~~The mean is the numerical average of the data set and is found by adding all the values in the set and dividing the sum by the number of values.~~ Mean represents a fair share concept of the data. Dividing the data constitutes a fair share. This is done by equally dividing the data points. The arithmetic way is to add all of the data points then divide by the number of data points to determine the average or mean. • The median is the piece of data that lies in the middle of the set of data arranged in order. • The mode is the piece of data that occurs most frequently in the data set. There may be one, more than one, or no mode in a data set. Students should order the data from least to greatest so they can better find the mode. • The range is the spread of a set of data. The range of a set of data is the difference between the greatest and least values in the data set. It is determined by subtracting the s~~mallest~~ least	**All students should** • Understand that mean, median, and mode are described as measures of center. • Understand that mean, median, and mode are three of the various ways that data can be measured. • Understand that mean as fair share is described as equally dividing the data set or the data set has already been divided equally. • ~~Understand that the mean is the numerical average of a data set; the median is the number in the middle of a set of data; the mode is the piece of data that occurs most often; and the range is the spread of a set of data.~~ • Understand how to ~~determine~~ find the mean, median, and mode~~, and range~~ of a set of data as measures of center. • Understand ~~what the number tells them about the data, and they need to see those~~ values in the context of other characteristics of the data in order to best describe or analyze the results.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Calculate~~ Describe and find the mean of a group of numbers representing data from a given context as a measure of center. • ~~Determine~~ Describe and find the median of a group of numbers representing data from a given context as a measure of center. • ~~Determine~~ Describe and find the mode of a group of numbers representing data from a given context as a measure of center. • Describe mean as fair share. • ~~Determine~~ Describe and find the range of a group of numbers representing data from a given context as a measure of variation.

5.16 The student will

a) describe mean, median, and mode as measures of center;
b) describe mean as fair share;
c) find the mean, median, mode, and range of a set of data; and
d) describe the range of a set of data as a measure of variation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
number in the data set from the ~~largest~~ greatest number in the data set. An example is ordering test scores from least to greatest: 73, 77, 84, 87, 89, 91, 94. The greatest score in the data set is 94 and the least score is 73, so the least score is subtracted from the greatest score or 94 - 73 = 21. The range of these test scores is 21. • Students need to learn more than how to identify the mean, median, mode, and range of a set of data. They need to build an understanding of what the number tells them about the data, and they need to see those values in the context of other characteristics of the data in order to best describe or analyze the results.		

Students entering grades 4 and 5 have had opportunities to identify patterns within the context of the school curriculum and in their daily lives, and they can make predictions about them. They have had opportunities to use informal language to describe the changes within a pattern and to compare two patterns. Students have also begun to work with the concept of a variable by describing mathematical relationships in open number sentences. ~~and they have begun to solve simple equations with one unknown.~~

The focus of instruction is to help students develop a solid use of patterning as a problem solving tool. At this level, patterns are represented and modeled in a variety of ways, including numeric, geometric, ~~graphic~~ and algebraic formats. Students develop strategies for organizing information more easily to understand various types of patterns and functional relationships. They ~~analyze~~ interpret the structure of patterns by exploring and describing patterns that involve change, and they begin to generalize these patterns. By ~~analyzing~~ interpreting mathematical situations and models, students begin to represent these, using symbols and variables to write "rules" for patterns, to describe relationships and algebraic properties, and to represent unknown quantities.

5.17 The student will describe the relationship found in a number pattern and express the relationship.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- There are an infinite number of patterns.
- The simplest types of patterns are repeating patterns. In such patterns, students need to identify the basic unit of the pattern and repeat it.
- Growing patterns are more difficult for students to understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns in both numerical and geometric formats.
- Sample numerical patterns are
  6, 9, 12, 15, 18, …;
  5, 7, 9, 11, 13, …;
  1, 2, 4, 7, 11, 16, …;
  2, 4, 8, 16, 32, …; ~~and~~
  32, 30, 28, 26, 24…; and
  1, 5, 25, 125, 625, ….
- An expression, like a phrase, has no equal sign.
- When the pattern data are graphed in a T-table, an expression can represent that data. An example is:

X	Y
6	9
9	12
12	15
15	18

This example defines the relationship as $x + 3$.

- ~~In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation (turn) is the result~~

ESSENTIAL UNDERSTANDINGS

All students should

- Understand that patterns and functions can be represented in many ways and described using words, tables, ~~graphs,~~ and symbols.
- Understand the structure of a pattern and how it grows or changes using concrete materials and calculators.
- Understand that mathematical relationships exist in patterns.
- Understand that an expression uses symbols to define a relationship.
- Understand that expressions can be numerical or variable or a combination of numbers and variables.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Describe numerical and geometric patterns formed by using concrete materials and calculators.
- ~~Express~~ Describe the relationship found in ~~numerical and geometric~~ patterns, using words, tables, ~~graphs, or a mathematical sentence~~ and symbols to express the relationship.

5.17 The student will describe the relationship found in a number pattern and express the relationship.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~of turning a figure around a point or a vertex, and reflection (flip) is the result of flipping a figure over a line.~~ • Expressions are simplified by using the order of operations. • A verbal quantitative expression involving one operation can be represented by a variable expression that describes what is going on. Numbers are used when they are known; variables are used when the numbers are unknown. For example, "a full box of cookies and four extra" can be represented by $b + 4$; "three full boxes of cookies" by $3b$; "a full box of cookies shared among four" by $\frac{b}{4}$. • A mathematical expression contains a variable or a combination of variables, numbers, and operation symbols and represents a mathematical relationship. An expression cannot be solved.		

5.18 The student will

a) investigate and describe the concept of variable;
b) write an open sentence to represent a given mathematical relationship, using a variable;
c) model one-step linear equations in one variable, using addition and subtraction; and
d) create a problem situation based on a given open sentence, using a single variable.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A variable is a symbol that can stand for an~~y~~ ~~one of a~~ unknown ~~set of~~ number~~s~~ or ~~other~~ object~~s~~. • ~~A variable is a quantity that can have different values. Any letter can be used as a variable.~~ • A variable expression is like a phrase: as a phrase does not have a verb, so an expression does not have an equals sign (=). • A verbal ~~quantitative~~ expression involving one operation can be represented by a variable expression that describes what is going on. Numbers are used when they are known; variables are used when the numbers are unknown. For example, "a full box of cookies and four extra" can be represented by $b + 4$; "three full boxes of cookies" by $3b$; "a full box of cookies shared among four" by $\frac{b}{4}$. • An open sentence ~~is a mathematical sentence~~ contains~~ing~~ a variable and an equals sign (=). For example, the sentence, "A full box of cookies and four extra equal 24 cookies." can be written as $b + 4 = 24$, where b stands for the number of cookies in one full box. "Three full boxes of cookies equal 60 cookies." can be written as $3b = 60$. • ~~An~~ Another example of an open sentence is ~~a mathematical sentence containing a variable. It also contains an equals sign (=). For example~~, $b + 3 = 23$ and represents the answer to the word problem, "How many cookies are in a box if the box plus three	**All students should** • Understand that a variable is a symbol that can stand for ~~any member of a set of numbers~~ an unknown number or object. • Understand that a variable expression is a variable or combination of variables, numbers, and symbols that represents a mathematical relationship. • Understand that verbal ~~quantitative~~ expressions can be translated to variable expressions. • Understand that an open sentence has ~~is a mathematical sentence with~~ a variable and an equal sign (=). • Understand that problem situations can be expressed as open sentences.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe the concept of a variable (presented as boxes, letters, or other symbols) as a representation of an unknown quantity. • ~~Use a variable expression to represent a given verbal expression involving one operation (e.g., "5 more than a number" can be represented by $x + 5$).~~ • Write an open sentence with addition, subtraction, multiplication, or division, using a variable to represent a missing number. • Create and write a word problem to match a given open sentence with a single variable and one operation.

5.18 The student will

a) investigate and describe the concept of variable;
b) write an open sentence to represent a given mathematical relationship, using a variable;
c) model one-step linear equations in one variable, using addition and subtraction; and
d) create a problem situation based on a given open sentence, using a single variable.

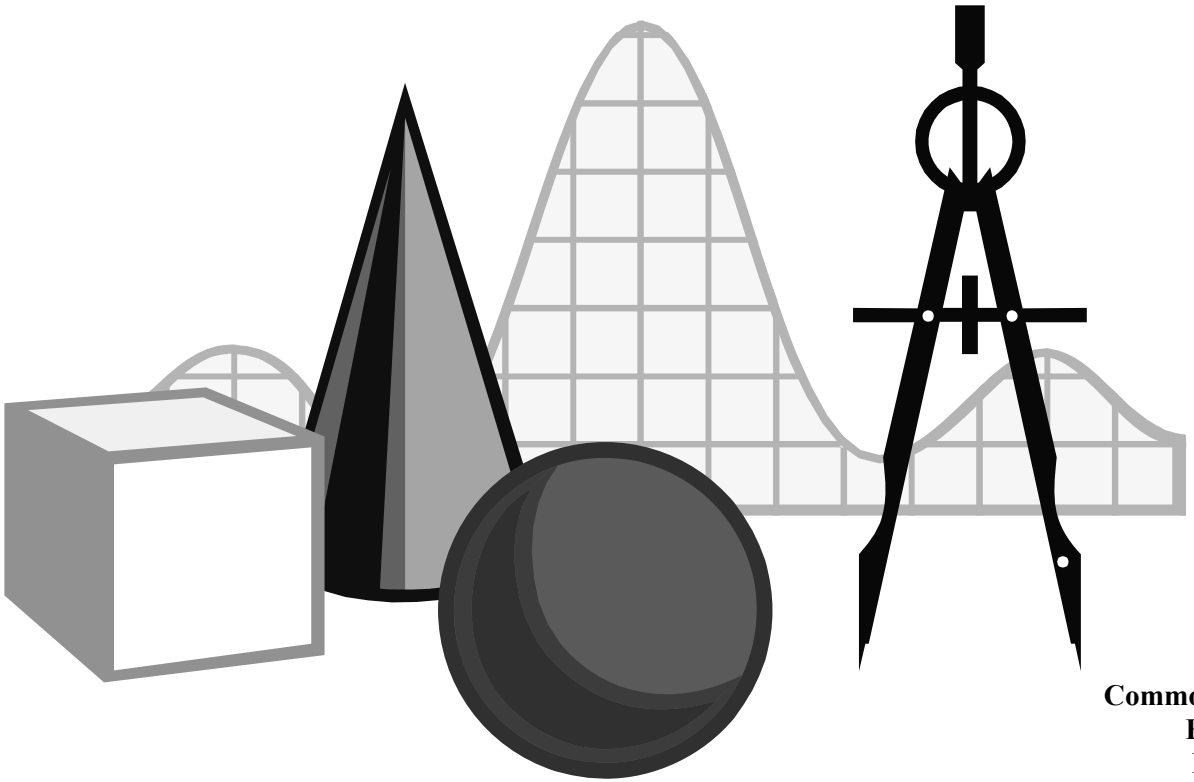
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
more equals 23 cookies, where *b* stands for the number of cookies in the box? • At this level, discuss how the symbol × used to represent multiplication can often be confused with the variable *x*. Students can minimize this confusion by using parentheses [e.g., 4(*x*) = 20 or 4x = 20] or a small dot raised off the line to represent multiplication [4 • x = 20]. • By using story problems and numerical sentences, students begin to explore forming equations and representing quantities using variables. • An open sentence containing a variable is neither true nor false until the variable is replaced with a number.		

5.19 The student will investigate and recognize the distributive property of multiplication over addition.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The distributive property states that multiplying a sum by a number gives the same result as multiplying each addend by the number and then adding the products (e.g., 3(4 + 5) = 3 x 4 + 3 x 5, 5 x (3 + 7) = (5 x 3) + (5 x 7); or (2 x 3) + (2 x 5) = 2 x (3 + 5). • The distributive property can be used to simplify expressions (e.g., 5 x 19 = 5(20-1) =100-5 = 95; or 5 x 19 = 5(10 + 9) = 50 + 45 = 95).	**All students should** • Understand that using the distributive property with whole numbers helps with understanding mathematical relationships. • Understand when and why the distributive property is used. • Understand that the distributive property states that multiplying a sum by a number gives the same result as multiplying each addend by the number and then adding the products.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate and recognize the distributive property of whole numbers, limited to multiplication over addition using diagrams and manipulatives. • Investigate and recognize an equation that represents the distributive property, when given several whole number equations, limited to multiplication over addition.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Grade 6



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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students in the middle grades focus on mastering rational numbers. Rational numbers play a critical role in the development of proportional reasoning and advanced mathematical thinking. The study of rational numbers builds on the understanding of whole numbers, fractions, and decimals developed by students in the elementary grades. Proportional reasoning is the key to making connections to most middle school mathematics topics.
- Students develop an understanding of integers and rational numbers by using concrete, pictorial, and abstract representations. They learn how to use equivalent representations of fractions, decimals, and percents and recognize the advantages and disadvantages of each type of representation. Flexible thinking about rational number representations is encouraged when students solve problems.
- Students develop an understanding of the properties of operations on real numbers through experiences with rational numbers and by applying the order of operations.
- Students use a variety of concrete, pictorial, and abstract representations to develop proportional reasoning skills. Ratios and proportions are a major focus of mathematics learning in the middle grades.

6.1 The student will describe and compare data, using ratios, and will use appropriate notations, such as $\frac{a}{b}$, *a* to *b*, and *a*:*b*.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A ratio is a comparison of any two quantities ~~and conveys an idea that cannot be expressed as a single number~~. A ratio is used to represent ~~a variety of~~ relationships within ~~a set~~ and between ~~two~~ sets. • A ratio can compare part of a set to the entire set (part-whole comparison). • A ratio can compare part of a set to another part of the same set (part-part comparison). • A ratio can compare part of a set to a corresponding part of another set (part-part comparison). • A ratio can compare all of a set to all of another set (whole-whole comparison). • The order of the quantities in a ratio is directly related to the order of the quantities expressed in the relationship. For example, if asked for the ratio of the number of cats to dogs in a park, the ratio must be expressed as the number of cats to the number of dogs, in that order. • A ratio can be written using ~~a~~ fraction form ($\frac{2}{3}$), a colon (2:3), or the word *to* (2 to 3). • A ratio is a multiplicative comparison of two numbers, measures, or quantities. • All fractions are ratios and vice versa. • Ratios may or may not be written in simplest form.	~~**All students should**~~ • ~~Understand that a ratio is a comparison of two quantities.~~ • ~~Understand that ratios can be represented in more than one way.~~ • What is a ratio? A ratio is a comparison of any two quantities. A ratio is used to represent relationships within and between sets.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe a relationship within a set by comparing part of the set to the entire set. • Describe a relationship between two sets by comparing part of one set to a corresponding part of the other set. • Describe a relationship between two sets by comparing all of one set to all of the other set. • Describe a relationship within a set by comparing one part of the set to another part of the same set. • Represent ~~the~~ a verbal relationship that makes a comparison by using the notations $\frac{a}{b}$, *a*:*b*, and *a to b.* • Create a relationship in words for a given ratio expressed symbolically.

6.1 The student will describe and compare data, using ratios, and will use appropriate notations, such as $\frac{a}{b}$, *a* to *b*, and *a*:*b*.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Ratios can compare two parts of a whole. • Rates can be expressed as ratios. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/		

6.2 The student will

a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• *Percent* means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*. • A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100 (e.g., $30\% = \frac{30}{100} = \frac{3}{10} = 0.3$). • Percents can be expressed as fractions with a denominator of 100 (e.g., $75\% = \frac{75}{100} = \frac{3}{4}$). • Percents can be expressed as decimal (e.g., $38\% = \frac{38}{100} = 0.38$). • ~~A~~ Some fractions can be rewritten as ~~an~~ equivalent fractions with ~~a~~ denominators of ~~100~~ powers of 10, and~~, thus~~, ~~as a~~ can be represented as decimals or percents (e.g., $\frac{3}{5} = \frac{60}{100} = 0.60 = 60\%$). • Decimals, fractions, and percents can be represented using concrete materials (e.g., ~~b~~Base-10 blocks, number lines, decimal squares, or grid paper). • Percents ~~should~~ can be represented by drawing ~~a~~ shaded regions on ~~a 10-by-10~~ grids or number lines to represent ~~a~~ given percents. • Percents are used in real life for taxes, sales, data description, and data comparison.	~~**All students should**~~ • ~~Understand that percent is a way of representing fractions and decimals.~~ • ~~Understand that a number can be written as a fraction, decimal, or percent.~~ • ~~Understand that percent is a method of standardization that is efficient because each number is always based on 100ths hundredths.~~ • ~~Understand that percents are used in real life applications to compare or describe data.~~ • What is the relationship among fractions, decimals and percents? Any number that can be written as a fraction can be expressed as a decimal or a percent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Recognize that *percent* means "out of 100" or *hundredths*, using the percent symbol (%).~~ • Identify the decimal and percent equivalents for ~~halves, thirds, fourths, fifths, and tenths~~ numbers written in fraction form. • Represent fractions, decimals and percents on a number line. • Describe orally and in writing the equivalent relationships among decimals, percents, and fractions that have denominators that are factors of 100. • Draw a shaded region on a ~~10-by-10~~ grid to represent a given percent. • Represent in decimal, fraction, and/or percent form a given shaded region of a ~~10-by-10~~ grid. • Compare two decimals through thousandths ~~by representing the decimals with decimal~~ using manipulatives ~~or~~ , ~~picture~~ pictorial representations, ~~or by using place-value charts~~ number lines, or the symbols $<, \leq, \geq, .>$, or =. • ~~Compare two whole numbers by representing the numbers with concrete objects or picture~~

6.2 The student will

a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Fractions, decimals and percents are equivalent forms representing a given number. • The decimal point is a symbol that indicates the location of the ones place and all other subsequent s in the decimal system. • The decimal point separates the whole number amount from the part of a number that is less than one. • The symbol • can be used in Grade 6 in place of X to indicate multiplication. • ~~Decimals can be represented and compared, using decimal manipulatives, drawings, pictures, or symbols.~~ • ~~Fractions can be represented and compared by using fraction manipulatives, drawings, pictures, or symbols.~~ • Strategies using 0, $\frac{1}{2}$ and 1 as benchmarks can be used to compare fractions. • When comparing two fractions, use $\frac{1}{2}$ as a benchmark. Example: Which is greater, $\frac{4}{7}$ or $\frac{3}{9}$? $\frac{4}{7}$ is greater than $\frac{1}{2}$ because 4, the numerator,		~~representations~~ or by using the symbols <, ≤, >, ≥, or =. • Compare two fractions with denominators of 12 or less ~~by representing the fractions with fraction~~ using manipulatives ~~or picture~~ , pictorial representations, number lines or ~~by using~~ the symbols <, >, ≤, ≥ or =. • Order no more than 3 fractions, decimals and/or percents (decimals through thousandths, fractions with denominators of 12 or less), in ascending or descending order.

6.2 The student will

a) investigate and describe fractions, decimals and percents as ratios;
b) identify a given fraction, decimal or percent from a representation;
c) demonstrate equivalent relationships among fractions, decimals, and percents; and
d) compare and order fractions, decimals, and percents.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
represents more than half of 7, the denominator. The denominator tells the number of parts that make the whole. $\frac{3}{9}$ is less than $\frac{1}{2}$ because 3, the numerator, is less than half of 9, the denominator, which tells the number of parts that make the whole. Therefore, $\frac{4}{7} > \frac{3}{9}$. • When comparing two fractions close to 1, use distance from 1 as your benchmark. Example: Which is greater, $\frac{6}{7}$ *or* $\frac{8}{9}$? $\frac{6}{7}$ is $\frac{1}{7}$ away from 1 whole. $\frac{8}{9}$ *is* $\frac{1}{9}$ away from 1 whole. Since $\frac{1}{7} > \frac{1}{9}$, then $\frac{6}{7}$ is a greater distance away from 1 whole than $\frac{8}{9}$ so $\frac{8}{9} > \frac{6}{7}$. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/ under computation and estimation.		

6.3 The student will

a) identify and represent integers;
b) order and compare integers; and
c) identify and describe absolute value of integers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Integers are the set of whole numbers and their opposites. • Positive integers are greater than zero. • Negative integers are less than zero. • Zero is an integer that is neither positive nor negative. • A negative integer is always less than a positive integer. • When comparing two negative ~~numbers~~ integers, the negative ~~number~~ integer that is closer to zero is greater. • An integer and its opposite are the same distance from zero on a number line. For example, the opposite of 3 is -3. • The absolute value of a number is the distance of a number from zero on the number line regardless of direction. Absolute value is represented as $\lvert -6 \rvert = 6$. • On a conventional number line, a smaller number is always located to the left of a larger number (e.g., -7 lies to the left of -3, thus $-7 < -3$; 5 lies to the left of 8 thus 5 is less than 8).	~~All students should~~ • ~~Understand how to identify, represent, order, and compare integers.~~ • What role do negative integers play in practical situations? Some examples of the use of negative integers are found in temperature (below 0), finance (owing money), below sea level. There are many other examples. • How does the absolute value of an integer compare to the absolute of its opposite? They are the same because an integer and its opposite are the same distance from zero on a number line.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify an integer represented by a point on a number line. • Represent integers on a number line. • Compare and order integers using a number line. • Compare integers, using the mathematical symbols <, >, and =. • Identify and describe the absolute value of an integer.

6.4 The student will demonstrate multiple representations of multiplication and division of fractions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Using manipulatives to build conceptual understanding and using pictures and sketches to link concrete examples to the symbolic enhance students' understanding of operations with fractions and help students connect the meaning of whole number computation to fraction computation. • Multiplication and division of fractions can be represented with arrays, paper folding, repeated addition, repeated subtraction, fraction strips, pattern blocks and area models. • When multiplying a whole by a fraction such as 3 x $\frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole. • When multiplying a fraction by a fraction such as $\frac{2}{3} \bullet \frac{3}{4}$, we are asking for part of a part. • When multiplying a fraction by a whole number such as $\frac{1}{2}$ x 6, we are trying to find a part of the whole. • ~~Using an area model assists with students' developing understanding of multiplication and division of fractions.~~ • For measurement division, the divisor is the number of groups. You want to know how many are in each of those groups . Division of fractions can be explained as how many of a given divisor are	• When multiplying fractions, what is the meaning of the operation? When multiplying a whole by a fraction such as 3 x $\frac{1}{2}$, the meaning is the same as with multiplication of whole numbers: 3 groups the size of $\frac{1}{2}$ of the whole. When multiplying a fraction by a fraction such as $\frac{2}{3} \bullet \frac{3}{4}$, we are asking for part of a part. When multiplying a fraction by a whole number such as $\frac{1}{2}$ x 6, we are trying to find a part of the whole. • What does it mean to divide with fractions? For measurement division, the divisor is the number of groups and the quotient will be the number of groups in the dividend. Division of fractions can be explained as how many of a given divisor are needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$ the question is, "How many $\frac{2}{3}$ make $\frac{1}{4}$?" For partition division the divisor is the size of the group, so the quotient answers the question, "How much is the whole?" or "How much for one?"	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Demonstrate the concepts of multiplication and division of fractions. • Demonstrate multiplication and division of fractions using multiple representations including, but not limited to, arrays, paper folding, fractions strips, pattern blocks and area models. • Discover and then model algorithms for multiplying and dividing with fractions using appropriate representations.

6.4 The student will demonstrate multiple representations of multiplication and division of fractions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
needed to equal the given dividend. In other words, for $\frac{1}{4} \div \frac{2}{3}$, the question is, "How many $\frac{2}{3}$ make $\frac{1}{4}$?" • For partition division the divisor is the size of the group, so the quotient answers the question, "How much is the whole?" or "How much for one?" Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#nns		

6.5 The student will investigate and describe concepts of positive exponents and perfect squares.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In exponential notation, the base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In 8^3, 8 is the base and 3 is the exponent. • A power of a number represents repeated multiplication of the number by itself (e.g., $8^3 = 8 \times 8 \times 8$ and is read "8 to the third power"). • Any real number other than zero raised to the zero power is 1. Zero to the zero power (0) is undefined. • ~~Patterns in place-value charts provide visual meaning of exponents: $10^3 = 1000$, $10^2 = 100$, $10^1 = 10$.~~ • Perfect squares are the numbers that result from multiplying any whole number by itself (e.g., $36 = 6 \times 6 = 6^2$). • Perfect squares can be represented geometrically as the areas of squares the length of whose sides are whole numbers (e.g., 1×1, 2×2, or 3×3). This can be modeled with grid paper, tiles, geoboards and virtual manipulatives.	~~**All students should**~~ • ~~Understand that a power of a number is repeated multiplication of that number by itself.~~ • ~~Understand that squaring a number and taking a square root of a number are inverse operations.~~ • What does exponential form represent? Exponential form is a short way to write repeated multiplication of a common factor such as 5 x 5 x 5 x 5 = 5^4. • What is the relationship between perfect squares and a geometric square? A perfect square is the area of a square where side length is a whole number.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize and describe patterns with exponents by using a calculator. • Recognize and describe patterns of perfect squares not to exceed 20^2, by using grid paper, square tiles and calculators. • ~~Recognize and describe patterns with square roots and squares by using squares, grid paper, and calculators~~. • Recognize powers of ten by examining patterns in a place value chart: $10^4 = 10{,}000$, $10^3 = 1000$, $10^2 = 100$, $10^1 = 10$, $10^0 = 1$.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring meaning to why procedures work and make sense.
- Students develop and refine estimation strategies and develop an understanding of when to use algorithms and when to use calculators. Students learn when exact answers are appropriate and when, as in many life experiences, estimates are equally appropriate.
- Students learn to make sense of the mathematical tools they use by making valid judgments of the reasonableness of answers.
- Students reinforce skills with operations with whole numbers, fractions, and decimals through problem solving and application activities.

6.6 The student will

a) multiply and divide fractions and mixed numbers; and

b) estimate solutions and then solve single and multistep practical problems that involve addition, subtraction, multiplication and division of fractions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Simplifying fractions to ~~their~~ simplest form assists with uniformity of answers ~~and concepts~~. • ~~Equivalent forms are needed to perform the operations of addition and subtraction with fractions.~~ • Addition and subtraction are inverse operations as are ~~M~~ multiplication and division. ~~are inverse operations.~~ • ~~Rewriting an improper fraction as a mixed numeral assists with uniformity of answers and concepts.~~ • ~~There is implied addition of the whole number part and the fractional part in mixed numerals.~~ • ~~Using manipulatives to build conceptual understanding and using pictures and sketches to link concrete examples to the symbolic enhance students' understanding of operations with fractions and help students connect the meaning of whole number computation to fraction computation.~~ • It is helpful to use estimation to develop computational strategies. For example, $2\frac{7}{8} \cdot \frac{3}{4}$ is about $\frac{3}{4}$ of 3, so the answer is between 2 and 3. • ~~It is helpful for students to simplify before they multiply fractions, using the commutative property of multiplication to reduce fractions to simplest form before multiplying.~~	~~**All students should**~~ • How are multiplication and division of fractions and multiplication and division of whole numbers alike? ~~Understand that f~~ Fraction computation uses the same ideas as whole number computation, applying those concepts to fractional parts. • What is the role of estimation in solving problems? ~~Use e~~ Estimation ~~to~~ helps determine the reasonableness of answers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Simplify fractional answers to simplest form.~~ • Multiply and divide with fractions and mixed numbers. Answers may be expressed in simplest form. • Solve single and multistep practical problems that involve addition and/or subtraction with fractions and mixed numbers, with and without regrouping, that include like and unlike denominators of 12 or less ~~and express answers in simplest form~~. Answers may be expressed in simplest form. • Solve single and multistep practical problems that involve multiplication and/or division with fractions and mixed numbers that include denominators of 12 or less ~~and express answers in simplest form~~. Answers may be expressed in simplest form.

6.7 The student will solve single and multistep practical problems involving addition, subtraction, multiplication and division of decimals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Estimation is an essential skill used to make sense of the placement of the decimal point in performing operations on decimals and for checking the decimal point's correct placement.~~ • Different strategies can be used to estimate the result of computations and judge the reasonableness of the result. For example: What is an approximate answer for 2.19 ÷ 0.8? The answer is around 2 because 2 ÷ 1 = 2. • Understanding the placement of the decimal point is very important when finding quotients of decimals. Examining patterns with successive decimals provides meaning, such as dividing the dividend by 6, by 0.6, by 0.06, and by 0.006. • Solving multistep problems in the context of real-life situations enhances interconnectedness and proficiency with estimation strategies. • Examples of ~~real-life~~ practical situations solved by using estimation strategies include shopping for groceries, buying school supplies, budgeting an allowance, deciding what time to leave for school or the movies, and sharing a pizza or the prize money from a contest. • ~~A consumer application problem is defined as the type of problem that is normally encountered in daily living, such as problems related to money, travel, work, recreation, and home life.~~ • ~~A budget may be kept for short or long periods of time. Students may keep a short-term budget to enable the purchase of an expensive item or a long-term budget to facilitate a long-term spending plan~~	~~**All students should**~~ • ~~Be able to produce an approximate answer for a given problem.~~ • ~~Understand that an estimated answer helps validate the reasonableness of a computed answer.~~ • What is the role of estimation in solving problems? Estimation gives a reasonable solution to a problem when an exact answer is not required. If an exact answer is required, estimation allows you to know if the calculated answer is reasonable.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Solve multistep practical problems involving decimals by using estimation strategies and checking for the reasonableness of results.~~ • ~~Given a dividend expressed as a decimal through thousandths and a divisor expressed as a decimal to thousandths with exactly one non-zero digit, find the quotient.~~ • ~~Given a dividend expressed as a decimal through thousandths and a divisor expressed as a decimal to thousandths with more than one non-zero digit, find the quotient by using a calculator.~~ • Solve single and multistep practical problems involving addition, subtraction, multiplication and division ~~of~~ with decimals expressed to thousandths with no more than two operations.

6.8 The student will evaluate whole number numerical expressions, using the order of operations.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The order of operations is a convention that defines the computation order to follow in simplifying an expression. • The order of operations is as follows: – First, complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols, do the innermost operation first. – Second, evaluate all exponential expressions. – Third, multiply and/or divide in order from left to right. – Fourth, add and/or subtract in order from left to right. * Grouping symbols include parentheses ( ), brackets [ ] and the division bar -. • The power of a number represents repeated multiplication of the number (e.g., $8^3 = 8 \cdot 8 \cdot 8$). The base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In the example, 8 is the base, and 3 is the exponent. • Any number, except 0, raised to the zero power is 1. Zero to the zero power is undefined. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#nns	~~All students should~~ • What is the significance of the order of operations? ~~Understand that the~~ The order of operations ~~describes~~ prescribes the order to use to simplify expressions containing more than one operation. It ensures that there is only one correct answer.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Simplify expressions by using the order of operations in a demonstrated step-by-step approach. The expressions should be limited to positive values and not include braces or absolute value. • Find the value of numerical expressions, using order of operations, mental mathematics, and appropriate tools. Exponents are limited to positive values.

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- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop the measurement skills that provide a natural context and connection among many mathematics concepts. Estimation skills are developed in determining length, weight/mass, liquid volume/capacity, and angle measure. Measurement is an essential part of mathematical explorations throughout the school year.
- Students continue to focus on experiences in which they measure objects physically and develop a deep understanding of the concepts and processes of measurement. Physical experiences in measuring various objects and quantities promote the long-term retention and understanding of measurement. Actual measurement activities are used to determine length, weight/mass, and liquid volume/capacity.
- Students examine perimeter, area, and volume, using concrete materials and practical situations. Students focus their study of surface area and volume on rectangular prisms, cylinders, pyramids, and cones.

6.9 The student will make ballpark comparisons between the U.S. Customary System of measurement and the metric system.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Making sense of various units of measure is an essential life skill, requiring reasonable estimates of what measurements mean, particularly in relation to other units of measure. – 1 inch is about 2.5 centimeters. – 1 foot is about 30 centimeters. – 1 meter is a little longer than a yard, or about 40 inches. – 1 mile is slightly farther than 1.5 kilometers. – 1 kilometer is slightly farther than half a mile. – 1 ounce is about 28 grams. – 1 nickel has the mass of about 5 grams. – 1 kilogram is a little more than 2 pounds. – 1 quart is a little less than 1 liter. – 1 liter is a little more than 1 quart. – Water freezes at 0°C and 32°F. – Water boils at 100°C and 212°F. – Normal body temperature is about 37°C and 98°F. – Room temperature is about 20°C and 70°F. • ~~Multiple experiences with using nonstandard and standard units of measure to measure physical objects help students develop an intuitive understanding of size.~~ • Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight*, as shown by the questions: "How much does it weigh?" versus "What is its mass?"	~~**All students should**~~ • ~~Understand that there is a structured relationship between and among units of measure for length, area, weight/mass, and volume in the metric and U.S. Customary systems.~~ • What is the difference between weight and mass? ~~Understand that w~~ Weight and mass are different. Mass is the amount of matter in an object. Weight is the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. • ~~Understand that measures are determined by quantitative comparison to a standard unit.~~ • How do you determine which units to use at different times? Units of measure are determined by the attributes of the object being measured. ~~Understand that m~~ Measures of length are expressed in linear units, measures of area are expressed in square units, and measures of volume are expressed in cubic units. ~~Understand that u~~ • Why are there two different measurement systems? Measurement systems are conventions invented by different cultures to meet their needs. The U.S. Customary System is the preferred method in the United States. The metric system is the preferred system worldwide.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Compare and convert units of measure for length, area, weight/mass, and volume within the U.S. Customary system and the metric system.~~ • Estimate the conversion of units of length, ~~area,~~ weight/mass, and volume between the U.S. Customary system and the metric system by using ballpark comparisons. Ex: 1 L ≈ 1qt. Ex: 4L ≈ 4 qts. • ~~Determine the most appropriate unit of measure for a given situation.~~ • Estimate measurements by comparing the object to be measured against a benchmark. • ~~Solve measurement problems by estimating and determining length, using standard and nonstandard units of measure.~~ • ~~Solve measurement problems by estimating and determining weight/mass, using standard and nonstandard units of measure~~. • ~~Solve measurement problems by estimating and determining area, using standard and nonstandard units of measure~~. • ~~Solve measurement problems by estimating and determining liquid volume/capacity, using standard and nonstandard units of measure.~~

6.9 The student will make ballpark comparisons between the U.S. Customary System of measurement and the metric system.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Chunking or benchmarks are strategies used to make measurement estimates.~~ • ~~Chunks of length, such as a window's length, can be used to estimate the length of a classroom wall~~. • ~~Benchmarks, such as the two-meter height of a standard doorway, can be used to estimate height.~~ • The degree of accuracy of measurement required is determined by the situation. • Whether to use an underestimate or an overestimate is determined by the situation. • Physically measuring objects along with using visual and symbolic representations improves student understanding of both the concepts and processes of measurement. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#measurement		

6.10 The student will

a) define pi (π) as the ratio of the circumference of a circle to its diameter;
b) solve practical problems involving circumference and area of a circle given the diameter or radius;
c) solve practical problems involving area and perimeter; and
d) describe and determine the volume and surface area of a rectangular prism.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The perimeter of a polygon is the measure of the distance around the polygon. • The area of a closed curve is the number of nonoverlapping square units required to fill the region enclosed by the curve. • The perimeter of a square whose side measures s is 4 times s ($P = 4s$), and its area is side times side ($A = s^2$). • The perimeter of a rectangle is the sum of twice the length and twice the width [$P = 2l + 2w$, or $P = 2(l + w)$], and its area is the product of the length and the width ($A = l \times w$). • ~~Experiences in using a variety of measuring devices and making real measurements promote an understanding of measurements and the formulas associated with measurements.~~ • Experiences in deriving the formulas for area and perimeter, using manipulatives such as tiles, one-inch cubes, adding machine tape, graph paper, geoboards, or tracing paper, promote an understanding of the formulas and facility in their use. • The value of pi (π) is the ratio of the circumference of a circle to its diameter. • The ratio of the circumference to the diameter of a	~~**All students should**~~ • ~~Understand the attributes of polygons and the use of measures to determine area and perimeter.~~ • ~~Understand the derivation of formulas related to area and perimeter of polygons and how to determine which is used in problem situations.~~ • ~~Select the appropriate approximation for pi (π) when solving problems~~. • ~~Understand the derivation of pi and formulas for finding circumference and area of a circle.~~ • What is the relationship between the circumference and diameter of a circle? The circumference of a circle is about 3 times the measure of the diameter. • What is the difference between area and perimeter? Perimeter is the distance around the outside of a figure while area is the measure of the amount of space enclosed by the perimeter. • What is the relationship between area and surface area? Surface area is calculated for a three-dimensional figure. It is the sum of the areas of the surfaces that make up the three-dimensional figure.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Determine if a problem situation involving polygons of four or fewer sides represents the application of perimeter or area.~~ • Apply formulas to solve practical problems involving area and perimeter of triangles and rectangles. • Derive an approximation for pi (3.14 or $\frac{22}{7}$) by gathering data and comparing the circumference to the diameter of various circles, using concrete materials or computer models. • Find the circumference of a circle by substituting a value for the diameter or the radius into the formula $C = \pi d$ or $C = 2\pi r$. • Find the area of a circle by using the formula $A = \pi r^2$. • ~~Determine the circumference and/or area of a circle, using various tools.~~ • Create and solve problems that involve finding the circumference and/or area of a circle when given the diameter or radius.

6.10 The student will

a) define pi (π) as the ratio of the circumference of a circle to its diameter;
b) solve practical problems involving circumference and area of a circle given the diameter or radius;
c) solve practical problems involving area and perimeter; and
d) describe and determine the volume and surface area of a rectangular prism.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
circle is a constant value, pi (π), which can be approximated by measuring various sizes of circles. • The fractional approximation of pi generally used is $\frac{22}{7}$. • The decimal approximation of pi generally used is 3.14. • The circumference of a circle is computed using $C = \pi d$ or $C = 2\pi r$, where d is the diameter and r is the radius of the circle. • The area of a circle is computed using the formula $A = \pi r^2$, where r is the radius of the circle. • The surface area of a rectangular prism is the sum of the areas of all six faces (SA = 2lw + 2lh + 2wh). • The volume o a rectangular prism is computed by multiplying the area of the base, B, (length x width) by the height of the prism (V = lwh or B=Bh). Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#measurement		• Solve problems that require finding the surface area of a rectangular prism, given a diagram of the prism with the necessary dimensions labeled. • Solve problems that require finding the volume of a rectangular prism given a diagram of the prism with the necessary dimensions labeled.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students expand the informal experiences they have had with geometry in the elementary grades and develop a solid foundation for the exploration of geometry in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.
- Students learn geometric relationships by visualizing, comparing, constructing, sketching, measuring, transforming, and classifying geometric figures. A variety of tools such as geoboards, pattern blocks, dot paper, patty paper, miras, and geometry software provides experiences that help students discover geometric concepts. Students describe, classify, and compare plane and solid figures according to their attributes. They develop and extend understanding of geometric transformations in the coordinate plane.
- Students apply their understanding of perimeter and area from the elementary grades in order to build conceptual understanding of the surface area and volume of prisms, cylinders, pyramids, and cones. They use visualization, measurement, and proportional reasoning skills to develop an understanding of the effect of scale change on distance, area, and volume. They develop and reinforce proportional reasoning skills through the study of similar figures.
- Students explore and develop an understanding of the Pythagorean Theorem. Mastery of the use of the Pythagorean Theorem has far-reaching impact on subsequent mathematics learning and life experiences.

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking Algebra.)
- **Level 4: Deduction.** Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. Students should be able to supply reasons for steps in a proof. (Students should transition to this level before taking Geometry.)

6.11 The student will

a) identify the coordinates of a point in a coordinate plane; and

b) graph ordered pairs in a coordinate plane.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In a coordinate plane, the coordinates of a point are typically represented by the ordered pair (x, y), where x is the first coordinate and y is the second coordinate. However, any letters may be used to label the axes and the corresponding ordered pairs. • ~~The first coordinate of a point is its distance from the vertical number line along a horizontal line.~~ • ~~The second coordinate of a point is its distance from the horizontal number line along a vertical line.~~ • ~~In a plane, a point can be located by its distances from two intersecting perpendicular number lines. The distance from one line is measured along a line parallel to the other line.~~ • The quadrants of a coordinate plane are the four regions created by the two intersecting perpendicular number lines. Quadrants are named in counterclockwise order. The signs on the ordered pairs for quadrant I are (+,+); for quadrant II, (–,+); for quadrant III, (–, –); and for quadrant IV, (+,–). • In a coordinate plane, the origin is the point at the intersection of the x-axis and y-axis; the point (0,0). • For all points on the x-axis, the y-coordinate is 0. • For all points on the y-axis, the x-coordinate is 0. ~~When a point lies on the y-axis, the x-coordinate is always 0.~~	~~**All students should**~~ • Can any given point be represented by more than one ordered pair? ~~Understand that t~~ The coordinates of a point define its unique location in a coordinate plane. Any given point is defined by only one ordered pair. • In naming a point in the plane, does the order of the two coordinates matter? Yes. The first coordinate tells the location of the point to the left or right of the y-axis and the second point tells the location of the point above or below the x-axis. Point (0, 0) is at the origin.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify and label the axes of a coordinate plane. • Identify and label the quadrants of a coordinate plane. • Identify the quadrant or axis in which a ~~an ordered pair~~ point is positioned by examining the ~~ordered pair~~ coordinates (ordered pair) of the point. • Graph ordered pairs in the four quadrants and on the axes of a coordinate plane. • Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane.

6.12 The student will determine congruence of segments, angles, and polygons.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Congruent figures have exactly the same size and the same shape. • Noncongruent figures may have the same shape but not the same size. • The symbol for congruency is ≈. • The ~~matching or~~ corresponding angles of congruent polygons have the same measure, and the ~~matching or~~ corresponding sides of congruent polygons have the same measure. • The ~~direct comparison~~ determination of ~~congruent or noncongruent~~ the congruence or noncongruence of two figures can be accomplished by placing one figure on top of the other or by comparing the measurements of ~~measuring~~ all sides and angles. • Construction of congruent line segments, angles, and polygons helps students understand congruency.	~~**All students should**~~ • ~~Understand the meaning of congruence.~~ • Given two congruent figures, what inferences can be drawn about how the figures are related? The figure will have exactly the same size and shape. Corresponding angles will have the same measure and corresponding sides will have the same length.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Characterize polygons as congruent and noncongruent according to the measures of their sides and angles. • Determine the congruence of segments, angles, and polygons ~~by direct comparison,~~ given their attributes.

6.13 The student will describe and identify properties of quadrilaterals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A quadrilateral is a closed planar (two-dimensional) figure with four sides that are line segments. • A parallelogram is a quadrilateral whose opposite sides are parallel and congruent. • For all parallelograms, both pairs of opposite sides and both pairs of opposite angles are congruent. • Parallelograms have special characteristics (such as both pairs of opposite sides are parallel and congruent) that are true for any parallelogram. • A rectangle is a parallelogram with four right angles. • Rectangles have special characteristics (such as diagonals are perpendicular bisectors) that are true for any rectangle. • A square is a rectangle with four congruent sides or a rhombus with four right angles. • A rhombus is a parallelogram with four congruent sides. • A trapezoid is a quadrilateral with exactly one pair of parallel sides. • A trapezoid with congruent, nonparallel sides is called an isosceles trapezoid. • A kite is a quadrilateral with two pairs of adjacent congruent sides. One pair of opposite angles is congruent. • Quadrilaterals can be sorted according to common attributes, using a variety of materials. • Quadrilaterals can be classified by the number of	~~**All students should**~~ • Can a figure belong to more than one subset of quadrilaterals? Any figure that has the attributes of more than one subset of quadrilaterals can belong to more than one subset. For example, rectangles have opposite sides of equal length. Squares have all 4 sides of equal length thereby meeting the attributes of both subsets.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Sort and classify polygons as quadrilaterals, parallelograms, rectangles, trapezoids, kites, rhombi, and squares based on their properties. Properties include number of parallel sides, angle measures and number of congruent sides. • Identify the sum of the measures of the angles of a quadrilateral as 360°.

6.13 The student will describe and identify properties of quadrilaterals.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
parallel sides: a parallelogram, rectangle, rhombus, and square each have two pairs of parallel sides; a trapezoid has only one pair of parallel sides; other quadrilaterals have no parallel sides. • Quadrilaterals can be classified by the measures of their angles: a rectangle has four 90° angles; a trapezoid may have none, one, or two 90° angles. • Quadrilaterals can be classified by the number of congruent sides: a rhombus has four congruent sides; a square, which is a rhombus with four right angles, also has four congruent sides; a parallelogram and a rectangle each have two pairs of congruent sides. • A square is a special type of both a rectangle and a rhombus, which are special types of parallelograms, which are special types of quadrilaterals. • The sum of the measures of the angles of a quadrilateral is 360°. • A chart ~~or~~ , graphic organizer or Venn Diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#geometry		

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- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop an awareness of the power of data analysis and probability by building on their natural curiosity about data and making predictions.
- Students explore methods of data collection and use technology to represent data with various types of graphs. They learn that different types of graphs represent different types of data effectively. They use measures of ~~central tendency~~ center and dispersion to analyze and interpret data.
- Students integrate their understanding of rational numbers and proportional reasoning into the study of statistics and probability.
- Students explore experimental and theoretical probability through experiments and simulations by using concrete, active learning activities.

6.14 The student, given a problem situation, will
a) construct circle graphs;
b) draw conclusions and make predictions using circle graphs: and
c) compare and contrast graphs which present information from the same data set.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• To collect data for any problem situation, an experiment can be designed, a survey can be conducted, or other data-gathering strategies can be used. The data can be organized, displayed, analyzed, and interpreted to answer the problem. • ~~Data can be discrete or continuous.~~ • Different types of graphs are used to display different types of data. – Bar graphs use categorical (discrete) data (e.g., months or eye color). – Line graphs use continuous data (e.g., temperature and time). – Circle graphs show a relationship of the parts to a whole. • All graphs include a title, and data categories should have labels. • A scale should be chosen that is appropriate for the data. • A key is essential to explain how to read the graph. • A title is essential to explain what the graph represents. • Data are analyzed by describing the various features and elements of a graph. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#statistics	~~**All students should**~~ • ~~Understand that data can be displayed in a variety of graphical representations.~~ • ~~Select and use appropriate statistical methods to analyze data.~~ • ~~Understand that different types of representations can tell different things about the same data.~~ • What type of data are best presented in a circle graph? Circle graphs are best used for data showing a relationship of the parts to the whole.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Collect data sets of no more than 20 items by using tally sheets, surveys, observations, questionnaires, interviews, and polls.~~ • ~~Organize data by using lists, charts, and tables.~~ • ~~Organize and display data in bar and line graphs, displaying the information as clearly as possible by using increments of whole numbers, fractions, and decimals rounded to the nearest tenth.~~ • Collect, ~~O~~organize and display data in circle graphs by depicting information as fractional. ~~parts that are limited to halves, fourths, and eighths.~~ • Draw conclusions and make predictions about data presented in a circle graph. • Compare and contrast data presented in a circle graph with the same data represented in other graphical forms studied in the previous grade level. • ~~Decide which type of graph is appropriate for a given situation.~~ ~~– Bar graphs are used to display categorical (discrete) data.~~ ~~– Line graphs are used to display continuous data.~~

6.15 The student will

a) describe mean as balance point; and

b) decide which measure of center is appropriate for a given purpose.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Measures of ~~central tendency~~ center are types of averages for a data set. They represent numbers that ~~best~~ describe a data set. Mean, median, and mode are measures of ~~central tendency~~ center that are useful for describing the average for different situations. – Mean works well for sets of data with no very high or low numbers. – Median is a good choice when data sets have a couple of values much higher or lower than most of the others. – Mode is a good descriptor to use when the set of data has some identical values. • The mean is the numerical average of the data set and is found by adding the numbers in the data set together and dividing the sum by the number of data pieces in the set. • In grade 5 mathematics, mean is defined as fair-share. • Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point. • Defining mean as balance point is a prerequisite for understanding standard deviation. • The median is the middle value of a data set in ranked order. If there are an odd number of pieces of data, the median is the middle value in ranked	~~**All students should**~~ • ~~Understand that measures of central tendency are types of averages for a data set.~~ • ~~Understand that mean, median, and mode are measures of central tendency that are useful for describing data in different situations.~~ • ~~Understand that the range describes the spread of a set of data.~~ • What does the phrase "measure of center" mean? This is a collective term for the 3 types of averages for a set of data – mean, median and mode. • What is meant by mean as balance point? Mean can be defined as the point on a number line where the data distribution is balanced. This means that the sum of the distances from the mean of all the points above the mean is equal to the sum of the distances of all the data points below the mean. This is the concept of mean as the balance point.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the mean for a set of data. • Describe the three measures of ~~central tendency~~ center and a situation in which each would best represent a set of data. • Identify and draw a number line that demonstrates the concept of mean as balance point for a set of data.

6.15 The student will

a) describe mean as balance point; and

b) decide which measure of center is appropriate for a given purpose.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
order. If there is an even number of pieces of data, the median is the numerical average of the two middle values. • The mode is the piece of data that occurs most frequently. If no value occurs more often than any other, there is no mode. If there is more than one value that occurs most often, all these most-frequently-occurring values are modes. When there are exactly two modes, the data set is bimodal. – ~~For 2, 3, 4, 5, 5, 6, 7, 8, 8, 8, 9, 11, the mode is 8.~~ – ~~For 2, 3, 4, 5, 5, 5, 7, 8, 8, 8, 9, 11, the modes are 5 and 8 (bimodal).~~ – ~~For 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 17, there is no mode.~~ • ~~The range is the difference between the greatest and least values in a set of data and shows the spread in a set of data.~~		

6.16 The student will

a) compare and contrast dependent and independent events; and

b) determine probabilities for dependent and independent events.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The probability of an event occurring is equal to the ratio of desired outcomes to the total number of possible outcomes (sample space). • The probability of an event occurring can be represented as a ratio or the equivalent fraction, decimal, or percent. • The probability of an event occurring is a ratio between 0 and 1. – A probability of 0 means the event will never occur. – A probability of 1 means the event will always occur. • A simple event is one event (e.g., pulling one sock out of a drawer and examining the probability of getting one color). • Events are independent when the outcome of one has no effect on the outcome of the other. For example, rolling a number cube and flipping a coin are independent events. • Events are dependent when the outcome of one event is influenced by the outcome of the other. For example, when drawing two marbles from a bag, *not* replacing the first after it is drawn affects the outcome of the second draw. • The probability of two independent events is found by using the following formula: P(A and B) = P(A) • P(B)	~~**All students should**~~ • ~~Understand that a probability can be expressed as a ratio, decimal, or percent~~. • How can you determine if a situation involves dependent or independent events? Events are independent when the outcome of one has no effect on the outcome of the other. Events are dependent when the outcome of one event is influenced by the outcome of the other.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast dependent and independent events. • Determine the probability of two dependent events. • Determine the probability of two independent events.

6.16 The student will

a) compare and contrast dependent and independent events; and

b) determine probabilities for dependent and independent events.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The probability of two dependent events is found by using the following formula: P(A and B) = P(A) ● P (B after A)		

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

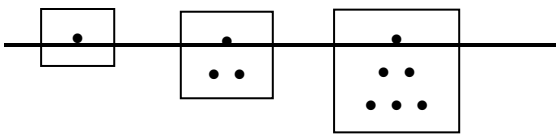
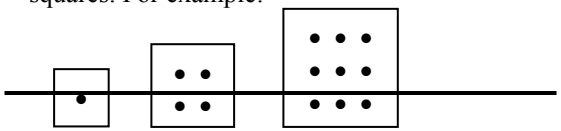
Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students extend their knowledge of patterns developed in the elementary grades and through life experiences by investigating and describing functional relationships.
- Students learn to use algebraic concepts and terms appropriately. These concepts and terms include *variable, term, coefficient, exponent, expression, equation, inequality, domain*, and *range*. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
- Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
- Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.

6.17 The student will identify and extend geometric and arithmetic sequences.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Numerical patterns may include linear and exponential growth, perfect squares, triangular and other polygonal numbers, or Fibonacci numbers. • Arithmetic and geometric sequences are types of numerical patterns. • In the numerical pattern of an arithmetic sequence, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Sample numerical patterns are 6, 9, 12, 15, 18, …; and 5, 7, 9, 11, 13, …. • In geometric number patterns, students must determine what each number is multiplied by to obtain the next number in the geometric sequence. This multiplier is called the *common ratio*. Sample geometric number patterns include 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and 80, 20, 5, 1.25, … • Strategies to recognize and describe the differences between terms in numerical patterns include, but are not limited to, examining the change between consecutive terms, ~~looking for prime numbers,~~ and finding common factors. An example is the pattern 1, 2, 4, 7, 11, 16,… • ~~Strategies to recognize and describe geometric patterns include, but are not limited to, examining flips, slides, turns, growth, and symmetry. Rotation (turn) is the result of turning a figure around a point or a vertex. Translation (slide) is the result of sliding a figure in any direction within a plane. Dilatation (scale increase or decrease) is the result of enlarging or shrinking a figure by a scale amount. Reflection~~	~~**All students should**~~ • ~~Understand that mathematical patterns can be represented in various forms, geometrically or numerically.~~ • ~~Understand that patterns regularly occur in everyday life.~~ • ~~Understand that patterns can be recognized, extended, or generalized~~. • ~~Understand that numerical patterns may involve adding or multiplying by the same number.~~ • ~~Understand that geometric patterns may involve shape, size, angles, transformations of shapes, and growth.~~ • What is the difference between an arithmetic and a geometric sequence? While both are numerical patterns, arithmetic sequences are additive and geometric sequences are multiplicative.	~~**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to**~~ • Investigate and apply strategies to recognize and describe the change between terms in numerical patterns. • Investigate and apply strategies to recognize and describe geometric patterns. • Describe verbally and in writing the relationships between consecutive terms in a numerical or geometric pattern. • Extend and apply numerical and geometric patterns to similar situations. • ~~Create~~ Using a table as an organizing tool, extend numerical and geometric ~~patterns~~ sequences by using a given rule or mathematical relationship. • ~~Describe numerical and geometric patterns, including triangular numbers.~~ • Compare and contrast arithmetic and geometric sequences. • Identify the common difference for a given arithmetic sequence. • Identify the common ratio for a given geometric sequence.

6.17 The student will identify and extend geometric and arithmetic sequences.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~(flip) is the result of flipping a figure over a line.~~ • ~~The first five triangular numbers are 1, 3, 6, 10, and 15. A triangular number can be represented geometrically as a certain number of dots arranged in a triangle, with one dot in the first (top) row and each succeeding lower row having one more dot that the row above it. To find the next triangular number, a new row is added to an existing triangle, and total number of dots counted. Students should make the connection between the number of new dots in the triangle and the corresponding triangular number. Triangular numbers can be represented as a growing pattern of triangles.~~  • ~~A square number can be represented geometrically as the number of dots in a square array. Square numbers are perfect squares and are the numbers that result from multiplying any whole number by itself (e.g., 36 = 6 × 6). Square numbers (1, 4, 9, 16, …) can be represented as a growing pattern of squares. For example:~~  • ~~The possible number of patterns is infinite.~~ • ~~The simplest types of patterns are repeating patterns. In such patterns, students need to identify the basic unit of the pattern and repeat it.~~ • ~~Growing patterns are more difficult for students to~~		

6.17 The student will identify and extend geometric and arithmetic sequences.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns both in numerical and geometric formats.~~		

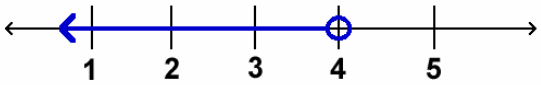
6.18 The student will solve one-step linear equations in one variable, involving whole number coefficients and positive rational solutions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A one-step linear equation is an equation that requires one operation to solve. • A term is a number, variable, product, or quotient in an expression of sums and/or differences. In $7x^2 + 5x - 3$, there are three terms, $7x^2$, $5x$, and 3. • A coefficient is the numerical factor in a term. For example, in the term $3xy^2$, 3 is the coefficient; in the term z, 1 is the coefficient. • Positive rational solutions are limited to whole numbers and positive fractions and decimals. • An equation is a mathematical sentence stating that two expressions are equal. • A variable is a symbol (placeholder) used to represent an unspecified member of a set.	~~**All students should**~~ • ~~Understand that physical objects can be used to represent and solve algebraic equations.~~ • ~~Understand that in an equation, the equal sign indicates that the value on the left side of the sign is the same as the value on the right side.~~ • When solving an equation, why is it necessary to perform the same operation on both sides of an equal sign? ~~Understand that to~~ To maintain equality, an operation performed on one side of an equation must be performed on the other side.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to** • Represent a one-step equation, using a variety of concrete materials such as colored chips ~~on an equation mat~~, ~~algebra tiles~~, algeblocks or weights on a balance scale. • Solve a one-step equation by demonstrating the steps algebraically. • Use the following algebraic terms appropriately: *equation*, v*ariable, term,* and *coefficient*. • ~~Identify examples of equations, variables, terms, and coefficients.~~

6.19 The student will investigate and recognize
a) the identity properties for addition and multiplication;
b) the multiplicative property of zero; and
c) the inverse property for multiplication.

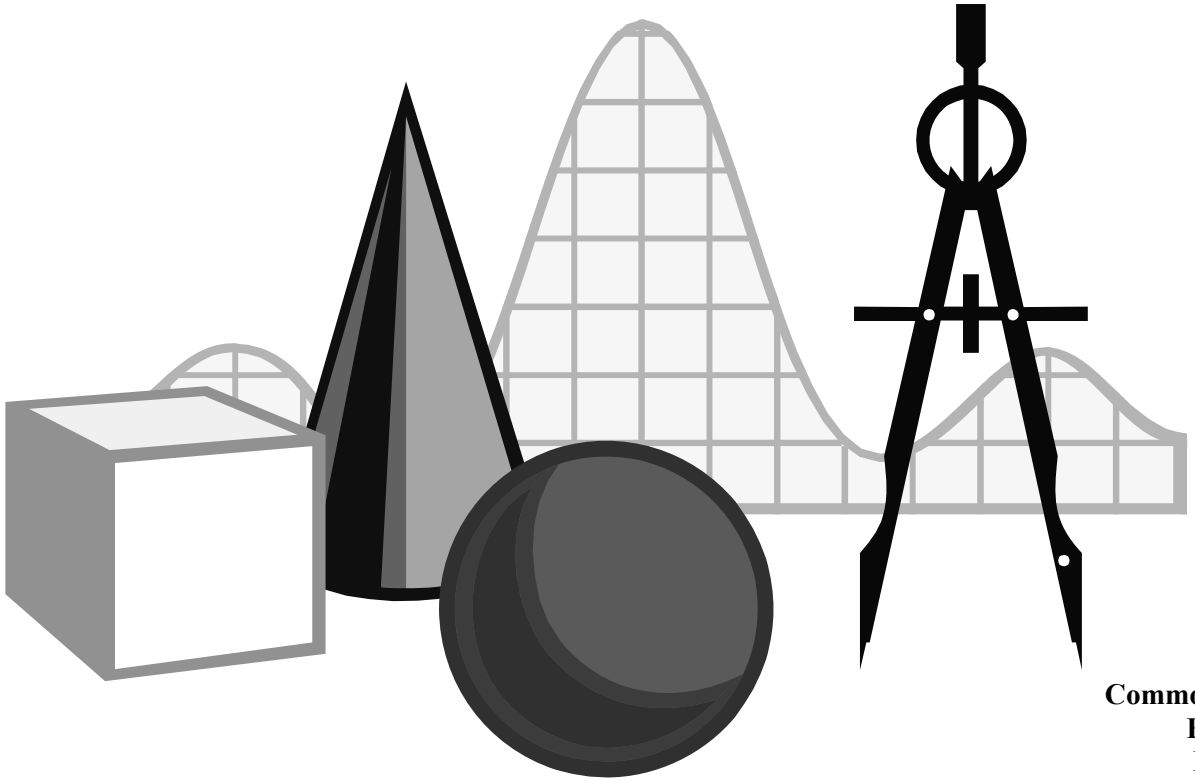
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Identity elements are numbers that combine with other numbers without changing the other numbers. The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division. • The additive identity property states that the sum of any real number and zero is equal to the given real number (e.g., $5 + 0 = 5$). • The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., $8 \cdot 1 = 8$). • Inverses are numbers that combine with other numbers and result in identity elements. • The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., $4 \cdot \frac{1}{4} = 1$). • Zero has no multiplicative inverse. • The multiplicative property of zero states that the product of any real number and zero is zero. • Division by zero is not a possible arithmetic operation. Division by zero is undefined. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#nns	~~**All students should**~~ • ~~Understand that using the properties of operations with real numbers helps with understanding mathematical relationships.~~ • ~~Understand how to use these properties when computing.~~ • How are the identity properties for multiplication and addition the same? Different? For each operation the identity elements are numbers that combine with other numbers without changing the value of the other numbers. The additive identity is zero (0). The multiplicative identity is one (1).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the real number equation that represents each property of operations with real numbers, when given several real number equations. • ~~Explore the properties of real numbers, using diagrams and manipulatives~~. • Test the validity of properties by using examples of the properties of operations on real numbers. • ~~Identify the property of operations with real numbers that is illustrated by a real number equation.~~ NOTE: The commutative, associative and distributive properties are taught in previous grades.

6.20 The student will graph inequalities on a number line.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Inequalities using the < or > symbols are represented on a number line with an open circle on the number and a shaded line over the solution set. Ex: x < 4  • Inequalities using the ≤ *or* ≥ symbols are represented on a number line with a closed circle on the number and shaded line in the direction of the solution set. • The solution set to an inequality is the set of all numbers that make the inequality true. • It is important for students to see inequalities written with the variable before the inequality symbol and after. For example x > -6 and 7 > y.	~~**All students should**~~ • Does the order of the elements in an inequality matter? Yes, the order does matter. For example, x > 5 is not the same relationship as 5 > x. However, x > 5 is the same relationship as 5 < x.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections and representation to** • Given a simple inequality with integers, graph the relationship on a number line. • Given the graph of a simple inequality with integers, represent the inequality two different ways using the symbols <, >, ≤ *and* ≥ .

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Grade 7



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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students in the middle grades focus on mastering rational numbers. Rational numbers play a critical role in the development of proportional reasoning and advanced mathematical thinking. The study of rational numbers builds on the understanding of whole numbers, fractions, and decimals developed by students in the elementary grades. Proportional reasoning is the key to making connections to most middle school mathematics topics.
- Students develop an understanding of integers and rational numbers by using concrete, pictorial, and abstract representations. They learn how to use equivalent representations of fractions, decimals, and percents and recognize the advantages and disadvantages of each type of representation. Flexible thinking about rational number representations is encouraged when students solve problems.
- Students develop an understanding of the properties of operations on real numbers through experiences with rational numbers and by applying the order of operations.
- Students use a variety of concrete, pictorial, and abstract representations to develop proportional reasoning skills. Ratios and proportions are a major focus of mathematics learning in the middle grades.

7.1 The student will

a) investigate and describe the concept of negative exponents for powers of ten;
b) determine scientific notation for numbers greater than zero;
c) compare and order fractions, decimals, percents and numbers written in scientific notation;
d) determine square roots; and
e) identify and describe absolute value for rational numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Negative exponents for powers of 10 are used to represent numbers between 0 and 1. (e.g., $10^{-3} = \frac{1}{10^3} = 0.001$). • Negative exponents for powers of 10 can be investigated through patterns such as: $10^2 = 100$ $10^1 = 10$ $10^0 = 1$ $10^{-1} = \frac{1}{10^1} = \frac{1}{10} = 0.1$ • ~~Fractions, decimals, and percents are three different representations of the same number. Some numbers also can be represented in scientific notation.~~ • A number followed by a percent symbol (%) is equivalent to that number with a denominator of 100 (e.g., $\frac{3}{5} = \frac{60}{100} = 0.60 = 60\%$). • Scientific notation is used to represent very large or very small numbers. • A number written in scientific notation is the product of two factors — a decimal greater than or equal to 1 but less than 10, and a power of 10	~~**All students should**~~ • ~~Understand that a number can be represented as a decimal, fraction, percent, and/or in scientific notation.~~ • ~~Develop strategies to compare, order, and determine equivalency among fractions, decimals, and percents.~~ • ~~Understand real-life uses of scientific notation.~~ • When should scientific notation be used? Scientific notation should be used whenever the situation calls for use of very large or very small numbers. • How are fractions, decimals and percents related? Any rational number can be represented in fraction, decimal and percent form. • What does a negative exponent mean when the base is 10? A base of 10 raised to a negative exponent represents a number between 0 and 1. • How is taking a square root different from squaring a number? Squaring a number and taking a square root are inverse operations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize powers of 10 with negative exponents by examining patterns. • Write a power of 10 with a negative exponent in fraction and decimal form. • Represent a number in fraction, decimal, and percent forms. ~~Fractions will have denominators of 12 or less.~~ • Compare, order, and determine equivalent relationships among fractions, decimals, and percents. Decimals are limited to the thousandths place, and percents are limited to the tenths place. Ordering is limited to no more than 4 numbers. • Write a number greater than ~~10~~ 0 in scientific notation. • Order no more than 3 numbers greater than 0 written in scientific notation. • Compare~~, order,~~ and determine equivalent relationships between numbers larger than ~~10~~ 0 written in scientific notation. • ~~Compare very large numbers, using scientific notation.~~

7.1 The student will

a) investigate and describe the concept of negative exponents for powers of ten;
b) determine scientific notation for numbers greater than zero;
c) compare and order fractions, decimals, percents and numbers written in scientific notation;
d) determine square roots; and
e) identify and describe absolute value for rational numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
(e.g., $3.1 \times 10^5 = 310{,}000$ and $2.85 \times 10^{-4} = 0.000285$). • ~~Decimals, fractions, and percents can be compared using concrete materials (e.g., base ten blocks, decimal squares, and grid paper).~~ • Equivalent relationships among fractions, decimals, and percents can be determined by using manipulatives (e.g., fraction bars, ~~base ten~~ Base-10 blocks, fraction circles, graph paper, number lines and calculators). • A square root of a number is a number which, when multiplied by itself, produces the given number (e.g., $\sqrt{121}$ is 11 since 11 x 11 = 121) • The square of a number can be represented geometrically as the length of a side of the square. • The absolute value of a number is the distance from 0 on the number line regardless of direction. (e.g., $\left\lvert \frac{-1}{2} \right\rvert = \frac{1}{2}$)	~~**All students should**~~ • Why is the absolute value of a number positive? The absolute value of a number represents distance from zero on a number line regardless of direction. Distance is positive.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Order no more than five numbers written as fractions, decimals, percents, and numbers larger than 10 written in~~ scientific ~~notation in ascending (least to greatest) or descending (greatest to least) order.~~ • Determine the square root of a perfect square less than or equal to 400. • Demonstrate absolute value using a number line. • Determine the absolute value of a rational number.

7.2 The student will describe and represent arithmetic and geometric sequences using variable expressions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In the numeric pattern of an arithmetic sequence, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. • In geometric sequences, students must determine what each number is multiplied by in order to obtain the next number in the geometric sequence. This multiplier is called the *common ratio*. Sample geometric sequences include – 2, 4, 8, 16, 32, …; 1, 5, 25, 125, 625, …; and – 80, 20, 5, 1.25, …. • A variable expression can be written to express the relationship between two consecutive terms of a sequence. (e.g.: 3, 6, 9, 12… If n represents a number in this sequence, the next term in the sequence can be determined using the variable expression: n + 3) (e.g.: 1, 5, 25, 125… If n represents a number in the sequence, the next term in the sequence can be determined by using the variable expression 5n.)	~~**All students should**~~ • When are variable expressions used? Variable expressions can express the relationship between two consecutive terms in a sequence.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Analyze situations to discover a variety of patterns~~. • Analyze numeric and geometric sequences to discover a variety of patterns. • Identify the common difference in an arithmetic sequence. • Identify the common ratio in a geometric sequence. • Given an arithmetic or geometric sequence, write a variable expression to describe the relationship between two consecutive terms in the sequence.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring meaning to why procedures work and make sense.
- Students develop and refine estimation strategies and develop an understanding of when to use algorithms and when to use calculators. Students learn when exact answers are appropriate and when, as in many life experiences, estimates are equally appropriate.
- Students learn to make sense of the mathematical tools they use by making valid judgments of the reasonableness of answers.
- Students reinforce skills with operations with whole numbers, fractions, and decimals through problem solving and application activities.

7.3 The student will

a) model addition, subtraction, multiplication and division of integers; and

b) add, subtract, multiply, and divide integers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The set of integers is the set of whole numbers and their opposites (e.g., … –3, –2, –1, 0, 1, 2, 3, …). • Integers are used in ~~real-life~~ practical situations, such as temperature changes (above/below zero), balance in a checking account (deposits/withdrawals), and changes in altitude (above/below sea level). • Concrete experiences in formulating rules for adding and subtracting integers should be explored by examining patterns using calculators, along a number line and using manipulatives, such as two-color counters, or by using algeblocks. • Concrete experiences in formulating rules for multiplying and dividing integers should be explored by examining patterns with calculators, along a number line and using manipulatives, such as two-color counters, or by using algeblocks. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/# under computation. For additional information on using Algeblocks, go to http://www.vdoe.whro.org/A_Blocks05/index.html	~~**All students should**~~ • ~~Develop and apply strategies involving mathematical operations with integers.~~ • ~~Understand how problems in daily life can be represented and solved by using integers.~~ • The sums, differences, products and quotients of integers are either positive or negative. How can this be demonstrated? This can be demonstrated through the use of patterns and models.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model addition, subtraction, multiplication and division of integers using pictorial representations of concrete manipulatives. • Add, subtract, multiply and divide integers . • ~~Formulate rules for adding integers.~~ • ~~Formulate rules for subtracting integers.~~ • ~~Formulate rules for multiplying integers.~~ • Formulate rules for dividing integers. • Simplify numerical expressions involving addition, subtraction, multiplication and/or division of integers using order of operations. • Solve practical problems involving addition, subtraction, multiplication, and division with integers.

7.4 The student will solve single and multistep practical problems using proportional reasoning.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A proportion is a statement of equality between two ratios. • ~~A common property relates the numerators of the two ratios, and another common property relates the denominators of the two ratios. For example, both numerators relate to one property, such as length, while both denominators relate to another property, such as width. Alternatively, both numerators could relate to scale lengths, while both denominators relate to actual lengths.~~ • ~~The dimensions of a scale model are proportional to the corresponding dimensions of the object (e.g., a blueprint of a house floor plan is proportional to the actual dimensions of the floor).~~ • A proportion can be written as $\frac{a}{b} = \frac{c}{d}$, • $a:b = c:d$, or a is to b as c is to d. • A proportion can be solved by finding the product of the means and the product of the extremes. For example, in the proportion $a:b = c:d$, a and d are the extremes and b and c are the means. If values are substituted for a, b, c, and d such as 5:12 = 10:24, then the product of extremes (5×24) is equal to the product of the means (12×10). • In a proportional situation, both quantities increase or decrease together. • In a proportional situation, two quantities increase multiplicatively. Both are multiplied by the same factor. • A proportion can be solved by finding equivalent fractions.	~~**All students should**~~ • ~~Understand that a proportion is an equation showing that two ratios are equal.~~ • ~~Understand how to set up a proportion, given the relationship between two items.~~ • What makes two quantities proportional? ~~Understand that when t~~ Two quantities are proportional, when a change in one quantity corresponds to a predictable change in the other. • ~~Understand that proportions are useful in solving many types of problems.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write proportions that represent equivalent relationships between two sets. • Solve a proportion to find a missing term. • ~~Apply proportions to solve problems that involve percents.~~ • Apply proportions to solve practical problems. Calculators may be used. • Apply proportions to convert units of measurement between the U.S. Customary System and the metric system. Calculators may be used. • Apply proportions to solve practical problems, including scale drawings. Scale factors shall have denominators no greater than 12 and/or decimals no less than tenths. Calculators may be used. • Using 10% as a benchmark, mentally compute 5%, 10%, 15% or 20% in a practical situation such as tips, tax and discounts. • Solve problems involving tip, tax, and discounts. Limit problems to only one percent computation per problem.

7.4 The student will solve single and multistep practical problems using proportional reasoning.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~There is a distinction between a proportion and the idea of equivalent fractions. Equivalent fractions are symbols for the same quantity or amount and they represent the same rational number in different forms.~~ • A rate is a special ratio that always has a denominator of 1. Examples of rates include miles/hour and revolutions/minute. A rate compares measures of different types. • Proportions are used in everyday contexts, such as speed, recipe conversions, scale drawings, map reading, reducing and enlarging, comparison shopping, and monetary conversions. • Proportions can be used to convert between measurement systems. For example: if 2 inches is about 5 cm, how many inches are in 16 cm? – $\frac{2inches}{x} = \frac{5cm}{16cm}$ • A percent is a special ratio in which the denominator is 100. • Proportions can be used to represent percent problems as follows: $\frac{percent}{100} = \frac{part}{whole}$		

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop the measurement skills that provide a natural context and connection among many mathematics concepts. Estimation skills are developed in determining length, weight/mass, liquid volume/capacity, and angle measure. Measurement is an essential part of mathematical explorations throughout the school year.
- Students continue to focus on experiences in which they measure objects physically and develop a deep understanding of the concepts and processes of measurement. Physical experiences in measuring various objects and quantities promote the long-term retention and understanding of measurement. Actual measurement activities are used to determine length, weight/mass, and liquid volume/capacity.
- Students examine perimeter, area, and volume, using concrete materials and practical situations. Students focus their study of surface area and volume on rectangular prisms, cylinders, pyramids, and cones.

7.5 The student will

a) describe volume and surface area of cylinders;
b) solve practical problems involving the volume and surface area of rectangular prisms and cylinders; and
c) describe how changing one measured attribute of a rectangular prism affects its volume and surface area.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The area of a rectangle is computed by multiplying the lengths of two adjacent sides. • The area of a circle is computed by squaring the radius and multiplying that product by π ($A = \pi r^2$, where $\pi = 3.14$ or $\frac{22}{7}$). • A rectangular prism can be represented on a flat surface as a net that contains six rectangles — two that have measures of the length and width of the base, two others that have measures of the length and height, and two others that have measures of the width and height. The surface area of a rectangular prism is the sum of the areas of all six faces ($SA = 2lw + 2lh + 2wh$). • A cylinder can be represented on a flat surface as a net that contains two circles (bases for the cylinder) and one rectangular region whose length is the circumference of the circular base and whose width is the height of the cylinder. The surface area of the cylinder is the area of the two circles and the rectangle ($SA = 2\pi r^2 + 2\pi rh$). • The volume of a rectangular prism is computed by multiplying the area of the base, B, (length times width) by the height of the prism ($V = lwh = Bh$). • The volume of a cylinder is computed by multiplying the area of the base, B, (πr^2) by the height of the cylinder ($V = \pi r^2 h = Bh$). • There is a direct relationship between changing one	~~**All students should**~~ • ~~Understand how to apply volume and surface area in real-life situations.~~ • ~~Understand the derivation of formulas related to volume and surface area of polygons.~~ • How are volume and surface area related? Volume is a measure of the amount a container holds while surface area is the sum of the areas of the surfaces on the container. • How does the volume of a rectangular prism change when one of the attributes is increased? There is a direct relationship between the volume of a rectangular prism increasing when the length of one of the attributes of the prism is changed by a scale factor.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine if a practical problem involving a rectangular prism or cylinder represents the application of volume or surface area. • ~~Develop a procedure and formula for finding~~ Find the surface area of a rectangular prism. • Solve practical problems that require finding the surface area of a rectangular prism. • ~~Develop a procedure and formula for finding~~ Find the surface area of a cylinder. • Solve practical problems that require finding the surface area of a cylinder. • ~~Develop a procedure and formula for finding~~ Find the volume of a rectangular prism. • Solve practical problems that require finding the volume of a rectangular prism. • Find the volume of a cylinder. • Solve practical problems that require finding the volume of a cylinder. • Describe how the volume of a rectangular prism is affected when one measured attribute is multiplied by a scale factor. Problems will be limited to changing attributes by scale factors only.

7.5 The student will

a) describe volume and surface area of cylinders;
b) solve practical problems involving the volume and surface area of rectangular prisms and cylinders; and
c) describe how changing one measured attribute of a rectangular prism affects its volume and surface area.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
measured attribute of a rectangular prism by a scale factor and its volume. For example, doubling the length of a prism will double its volume. This direct relationship does not hold true for surface area. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#geometry		

7.6 The student will determine if plane figures – quadrilaterals and triangles – are similar and write proportions to express the relationships between corresponding sides of similar figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Two polygons are similar if corresponding (matching) angles are congruent and the lengths of corresponding sides are proportional. • Congruent polygons have the same size and shape. • Congruent polygons are similar polygons for which the ratio of the corresponding sides is 1:1. • Similarity statements can be used to determine corresponding parts of similar figures such as: $\Delta ABC \approx \Delta DEF$ <A corresponds to <D $\overline{AB}$ corresponds to $\overline{DE}$ • The traditional notation for marking corresponding angles is to use a curve on each angle. Denote which angles correspond with the same number of curved lines. For example, if <A corresponds to <B , then both angles will be marked with the same number of curved lines. • Corresponding sides are denoted with the same number of hatch lines on each corresponding side. For example, a side on a polygon with 2 hatch marks corresponds to the side with 2 hatch marks on a similar polygon. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#geometry	~~All students should~~ • ~~Understand that similar geometric figures have the same shape but may have different sizes~~. • ~~Understand how ratios and proportions can be used to determine the length of something that cannot be measured directly~~ • How do polygons that are similar compare to polygons that are congruent? Congruent polygons have the same size and shape. Similar polygons have the same shape, and corresponding angles between the similar figures are congruent. However, the lengths of the corresponding sides are proportional. All congruent polygons are considered similar with the ratio of the corresponding sides being 1:1.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify corresponding sides and corresponding angles of similar figures using the traditional notation of curved lines for the angles and hatch marks on the sides. • Write proportions to express the relationships between the lengths of corresponding sides of similar figures. • ~~Examine congruence of corresponding angles and proportionality of corresponding sides to d~~ Determine if quadrilaterals or triangles are similar~~.~~ by examining congruence of corresponding angles and proportionality of corresponding sides. • Given two similar figures, write similarity statements using symbols such as $\Delta ABC \approx \Delta DEF$, <A corresponds to <D, and $\overline{AB}$ corresponds to $\overline{DE}$.

In the middle grades, the focus of mathematics learning is to

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- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students expand the informal experiences they have had with geometry in the elementary grades and develop a solid foundation for the exploration of geometry in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.
- Students learn geometric relationships by visualizing, comparing, constructing, sketching, measuring, transforming, and classifying geometric figures. A variety of tools such as geoboards, pattern blocks, dot paper, patty paper, miras, and geometry software provides experiences that help students discover geometric concepts. Students describe, classify, and compare plane and solid figures according to their attributes. They develop and extend understanding of geometric transformations in the coordinate plane.
- Students apply their understanding of perimeter and area from the elementary grades in order to build conceptual understanding of the surface area and volume of prisms, cylinders, pyramids, and cones. They use visualization, measurement, and proportional reasoning skills to develop an understanding of the effect of scale change on distance, area, and volume. They develop and reinforce proportional reasoning skills through the study of similar figures.
- Students explore and develop an understanding of the Pythagorean Theorem. Mastery of the use of the Pythagorean Theorem has far-reaching impact on subsequent mathematics learning and life experiences.

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking Algebra.)
- **Level 4: Deduction.** Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. Students should be able to supply reasons for steps in a proof. (Students should transition to this level before taking Geometry.)

7.7 The student will compare and contrast the following quadrilaterals based on properties: parallelogram, rectangle, square, rhombus, and trapezoid.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A quadrilateral is a closed plane (two-dimensional) figure with four sides that are line segments. • A parallelogram is a quadrilateral whose opposite sides are parallel and congruent. Opposite angles of a parallelogram are congruent. • A rectangle is a parallelogram with four right angles. The diagonals of a rectangle are the same length and bisect each other. • A square is a rectangle with four congruent sides whose diagonals are perpendicular. ~~or~~ A square is a rhombus with four right angles. • A rhombus is a parallelogram with four congruent sides whose diagonals bisect each other and intersect at right angles. • A trapezoid is a quadrilateral with exactly one pair of parallel sides. • A trapezoid with congruent, nonparallel sides is called an *isosceles trapezoid*. • Quadrilaterals can be sorted according to common attributes, using a variety of materials. • A chart, ~~or~~ graphic organizer, or Venn diagram can be made to organize quadrilaterals according to attributes such as sides and/or angles. • For all parallelograms, both pairs of opposite sides and both pairs of opposite angles are congruent. • Parallelograms have special characteristics (such as both pairs of opposite sides are parallel and congruent) that are true for any parallelogram. • ~~Rectangles~~ Squares have special characteristics	~~**All students should**~~ • ~~Understand that quadrilaterals can be classified according to the attributes of their sides and/or angles.~~ • ~~Understand that a quadrilateral can belong to one or more subsets of the set of quadrilaterals.~~ • Why can some quadrilaterals be classified in more than one category? ~~Understand that e~~ Every quadrilateral in a subset has all of the defining attributes of the subset. For example, if a quadrilateral is a rhombus, it has all the attributes of a rhombus. However, if that rhombus also has the additional property of 4 right angles, then that rhombus is also a square.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast attributes of the following quadrilaterals: parallelogram, rectangle, square, rhombus, and trapezoid. • Identify the classification(s) to which a quadrilateral belongs, using deductive reasoning and inference. • ~~Classify quadrilaterals, using deductive reasoning and inference.~~

7.7 The student will compare and contrast the following quadrilaterals based on properties: parallelogram, rectangle, square, rhombus, and trapezoid.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
(such as diagonals are perpendicular bisectors) that are true for any ~~rectangle~~ square. Additional resources on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#geometry		

7.8 The student, given a polygon in the coordinate plane, will represent transformations — reflections, dilations, rotations, and translations — by graphing in the coordinate plane.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A rotation of a geometric figure is a turn of the figure around a fixed point. The point may or may not be on the figure. The fixed point is called the *center of rotation*. • A translation of a geometric figure is a slide of the figure in which all the points on the figure move the same distance in the same direction. • A reflection is a transformation that reflects a figure across a line in the plane. • A dilation is a transformation that changes the shape of a figure by changing the distance of all the points in the figure from a specific line. The distance is changed by a multiplicative factor. • The image of a polygon is the resulting polygon after the transformation. The preimage is the polygon before the transformation.	~~**All students should**~~ • ~~Understand that the size or shape of a figure does not change by a translation or rotation.~~ • How does the transformation of a figure affect the size, shape and position of that figure? Translations, rotations and reflections do not change the size or shape of a figure. A dilation of a figure and the original figure are similar. ~~Understand that~~ Reflections, translations and rotations usually change the position of the figure.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the coordinates of the image of a ~~polygon~~ right triangle or rectangle that has been translated either vertically or horizontally. • Identify the coordinates of the image of a right triangle or rectangle that has been rotated 90° or 180° about the origin. • Identify the coordinates of the image of a right triangle or a rectangle that has been reflected over the x- or y-axis. • Identify the coordinates of a right triangle or rectangle that has been dilated. The center of the dilation will be the origin. • Sketch the image of a ~~polygon~~ right triangle or rectangle translated vertically or horizontally. • Sketch the image of a right triangle or rectangle that has been rotated 90° or 180° about the origin. • Sketch the image of a right triangle or rectangle that has been reflected over the x- or y-axis. • Sketch the image of a dilation of a right triangle or rectangle limited to a scale factor of $\frac{1}{4}$, $\frac{1}{2}$, 2, 3 or 4.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop an awareness of the power of data analysis and probability by building on their natural curiosity about data and making predictions.
- Students explore methods of data collection and use technology to represent data with various types of graphs. They learn that different types of graphs represent different types of data effectively. They use measures of ~~central tendency~~ center and dispersion to analyze and interpret data.
- Students integrate their understanding of rational numbers and proportional reasoning into the study of statistics and probability.
- Students explore experimental and theoretical probability through experiments and simulations by using concrete, active learning activities.

7.9 The student will investigate and describe the difference between the experimental and theoretical probability of an event.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Theoretical probability of an event is the expected probability and can be found with a formula. • Theoretical probability of an event = number of possible favorable outcomes / total number of possible outcomes. • The experimental probability of an event is determined by carrying out a simulation or an experiment. • The experimental probability = number of times desired outcomes occur / number of trials in the experiment. • In experimental probability, as the number of trials increases, the experimental probability gets closer to the theoretical probability (Law of Large Numbers).	~~**All students should**~~ • ~~Understand the meaning of theoretical probability.~~ • ~~Understand the difference between theoretical and experimental probability.~~ • What is the difference between the theoretical and experimental probability of an event? Theoretical probability of an event is the expected probability and can be found with a formula. ~~Understand that~~ The experimental probability of an event is determined by carrying out a simulation or an experiment. ~~Understand that i~~ In experimental probability, as the number of trials increases, the experimental probability gets closer to the theoretical probability.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the theoretical probability of an event. • Describe changes in the experimental probability as the number of trials increases. • Investigate and describe the difference between the probability of an event found through simulation versus the theoretical probability of that same event.

7.10 The student will determine the probability of compound events using the Fundamental (Basic) Counting Principle.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The Fundamental (Basic) Counting Principle is a computational procedure to determine the number of possible ~~arrangements~~ outcomes of several ~~objects~~ events. It is the product of the number of ~~ways~~ outcomes for each ~~object~~ event that can be chosen individually (e.g., the possible ~~arrangements~~ outcomes or outfits of four shirts, two pants, and three shoes is 4 · 2 · 3 or 24). • Tree diagrams are used to illustrate possible outcomes of events. They can be used to support the Fundamental (Basic) Counting Principle. • A compound event combines two or more simple events. For example, a bag contains 4 red, 3 green and 2 blue marbles. What is the probability of selecting a green and then a blue marble?	~~**All students should**~~ • What is the Fundamental Counting Principle? ~~Understand that t~~ The Fundamental (Basic) Counting Principle is a computational procedure used to determine the number of possible ~~arrangements (combinations or~~ outcomes~~)~~ of several ~~objects~~ events. • What is the role of the Fundamental Counting Principle in determining the probability of compound events? The Fundamental Counting Principle is used to determine the number of outcomes of each event. It is the product of the number of outcomes for each event that can be chosen individually.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compute the number of possible ~~arrangements~~ outcomes ~~of no more than three types of objects~~ by using the Fundamental (Basic) Counting Principle. • Determine the probability of a compound event containing no more than 2 events.

7.11 The student, given data in a practical situation, will
a) construct and analyze histograms; and
b) compare and contrast histograms with other types of graphs presenting information from the same data set.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- All graphs tell a story and include a title and labels that describe the data.
- A histogram is a form of bar graph in which the categories are consecutive and equal intervals. The length or height of each bar is determined by the number of data elements frequency falling into a particular interval.
- A frequency distribution shows how often an item, a number, or range of numbers occurs. It can be used to construct a histogram.

STUDENTS WHO READ GARFIELD

Age Group	Tally	Frequency	Cumulative Frequency
7-10	𝍸 II	7	7
11-14	𝍸 II	7	14 ← 7 + 7
15-18	III	3	17 ← 14 + 3
19-22	III	3	20 ← 17 + 3

- ~~Inferences, conjectures, and predictions are based on careful data analysis.~~
- Comparisons, predictions and inferences are made by examining characteristics of a data set displayed in a variety of graphical representations to draw conclusions.
- The information displayed in different graphs may be examined to determine how data are or are not related, ascertaining differences between characteristics (comparisons), trends that suggest what new data might be like (predictions), and/or

ESSENTIAL UNDERSTANDINGS

~~**All students should**~~

- ~~Understand that graphs tell a story.~~
- ~~Understand that data can be displayed in a variety of graphical representations.~~
- ~~Select and use appropriate statistical methods to analyze data.~~
- ~~Understand that different types of graphs can be used to represent the same data in a variety of ways~~
- What type of data are most appropriate to display in a histogram?
  Numerical data that can be characterized using consecutive intervals are best displayed in a histogram.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Collect, analyze, display, and interpret a data set ~~of no more than 20 items,~~ using histograms. For collection and display of raw data, limit the data to 20 items.
- ~~Organize data not exceeding 20 items into tables and/or graphs that provide a clear representation of dispersion or convergence of the data.~~
- Determine patterns and relationships within data sets (e.g., trends).
- Make inferences, conjectures, and predictions based on analysis of a set of data. Raw data displayed should not exceed 20 items.
- Compare and contrast histograms with line plots, circle graphs, and stem and leaf plots presenting information from the same data set.

7.11 The student, given data in a practical situation, will

a) construct and analyze histograms; and

b) compare and contrast histograms with other types of graphs presenting information from the same data set.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
"what could happen if" (inference). • ~~Methods of collecting and analyzing data are factors in determining the validity of any inferences or arguments based on the data.~~		

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct through active learning experiences a more advanced understanding of mathematics;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students extend their knowledge of patterns developed in the elementary grades and through ~~life~~ practical experiences by investigating and describing functional relationships.
- Students learn to use algebraic concepts and terms appropriately. These concepts and terms include *variable, term, coefficient, exponent, expression, equation, inequality, domain*, and *range*. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
- Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
- Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.

7.12 The student will represent relationships with tables, graphs, rules, and words.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~A function is a rule that pairs exactly one element of a set with one and only one element of another set. An example of a function is that which relates the sum, *s*, of the measures of the interior angles of a polygon to the number, *n*, of sides:~~ ~~$s = (n - 2) \cdot 180$.~~ • Rules that relate elements in two sets can be represented by word sentences, equations, tables of values, graphs, or illustrated pictorially.	~~**All students should**~~ • ~~Understand that patterns in mathematics are often represented by using a rule that relates elements in one set to elements in another set.~~ • What are the different ways to represent the relationship between two sets of numbers? ~~Understand that r~~ Rules that relate elements in two sets can be represented by word sentences, equations, tables of values, graphs or illustrated pictorially.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Represent a variety of patterns, using tables, graphs, rules, and words, in order to investigate and describe functional relationships.~~ • ~~Generalize a variety of patterns.~~ • Given a function in words, represent the function as an equation. • Given an equation that represents a relation, write a table of values. • Given a table of values, write an equation that represents a relation. • Graph in a coordinate plane ordered pairs that are represented on a table.

7.13 The student will

a) write verbal expressions as algebraic expressions and sentences as equations and vice versa; and

b) evaluate algebraic expressions for given replacement values of the variables.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An expression is a name for a number. • An expression that contains a variable is a variable expression. • An expression that contains only numbers is a numerical expression. • A verbal expression is a word phrase (e.g., "the sum of two consecutive integers"). • A verbal sentence is a complete word statement (e.g., "The sum of two consecutive integers is five."). • An algebraic expression is a variable expression that contains at least one variable (e.g., $2x - 5$). • An algebraic equation is a mathematical statement that says that two expressions are equal (e.g., $2x + 1 = 5$). • ~~Key words in translating verbal expressions/ sentences to algebraic expressions/equations may include words and their translations such as: *is* to =, *of* to *multiplication*, *more than* to +, *less than* to −, *increased by* to +, and *decreased by* to −.~~ • To evaluate an algebraic expression, substitute a given replacement value for a variable and apply the order of operations. For example, if a = 3 and b = -2 then 5a + b can be evaluated as: 5(3) + (-2)=15 + (-2)=13.	~~**All students should**~~ • How can algebraic expressions and equations be written? ~~Understand that w~~ Word phrases and sentences can be used to represent~~ed as~~ algebraic expressions and equations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write verbal expressions as algebraic expressions. Expressions will be limited to no more than 2 operations. • Write verbal sentences as algebraic equations. Equations will contain no more than 1 variable term. • Translate algebraic expressions and equations to verbal expressions and sentences. Expressions will be limited to no more than 2 operations. • Identify examples of expressions and equations. • Apply the order of operations to evaluate expressions for given replacement values of the variables. Limit the number of replacements to no more than 3 per expression.

7.13 The student will

a) write verbal expressions as algebraic expressions and sentences as equations and vice versa; and

b) evaluate algebraic expressions for given replacement values of the variables.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
Additional information on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#nns		

7.14 The student will

a) solve one- and two-step linear equations in one variable; and

b) solve practical problems requiring the solution of one- and two-step linear equations.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An equation is a mathematical sentence that states that two expressions are equal. • A one-step equation is defined as an equation that requires the use of one operation to solve (e.g., $x + 3 = -4$). • ~~A one-step inequality is defined as an inequality that requires the use one operation to solve (e.g.,~~ • ~~$x - 4 > 9$).~~ • The inverse operation for addition is subtraction, and the inverse operation for multiplication is division. • A two-step equation is defined as an equation that requires the use of two operations to solve. E.g., $2x + 1 = -5$ $\frac{x-7}{3} = 4$	~~**All students should**~~ • ~~Understand that different words have specific and different meanings to describe algebraic relationships.~~ • When solving an equation, why is it important to perform identical operations on each side of the equal sign? An operation that is performed on one side of an equation must be performed on the other side to maintain equality.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Apply the following algebraic terms appropriately: *equation, inequality*, and *expression*.~~ • ~~Identify examples of equations, inequalities, and expressions.~~ • Represent and demonstrate steps on solving one- and two-step equations in one variable using concrete materials, pictorial representations and algebraic sentences. • Solve practical problems that require the solution of a one-or two-step linear equation.

7.15 The student will

a) solve one-step inequalities in one variable; and

b) graph solutions to inequalities on the number line.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A one-step inequality is defined as an inequality that requires the use of one operation to solve (e.g., $x - 4 > 9$). • The inverse operation for addition is subtraction, and the inverse operation for multiplication is division. • When both expressions of an inequality are multiplied or divided by a negative number, the inequality symbol reverses (e.g., $-3x < 15$ is equivalent to $x > -5$). • Solutions to inequalities can be represented using a number line.	~~**All students should**~~ • ~~Understand that an operation that is performed on one side of an equation must be performed on the other side to maintain equality.~~ • ~~Understand procedures for solving inequalities.~~ • ~~Understand that when both expressions are multiplied or divided by a negative number, the inequality symbol reverses~~. • How are the procedures for solving equations and inequalities the same? The procedures are the same except for the case when an inequality is multiplied or divided on both sides by a negative number. Then the inequality sign is changed from less than to greater than, or greater than to less than. • How is the solution to an inequality different from that of a linear equation? In an inequality, there can be more than one value for the variable that makes the inequality true.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Represent and demonstrate steps in solving equations in one variable, using concrete materials, pictorial representations, and algebraic sentences.~~ • Represent and demonstrate steps in solving inequalities in one variable, using concrete materials, pictorial representations, and algebraic sentences. • ~~Translate one-step word problems and practical problems into algebraic equations and solve them.~~ • Graph solutions to inequalities on the number line.

7.16 The student will apply the following properties of operations with real numbers:
a) the commutative and associative properties for addition and multiplication;
b) the distributive property;
c) the additive and multiplicative identity properties;
d) the additive and multiplicative inverse properties; and
e) the multiplicative property of zero.

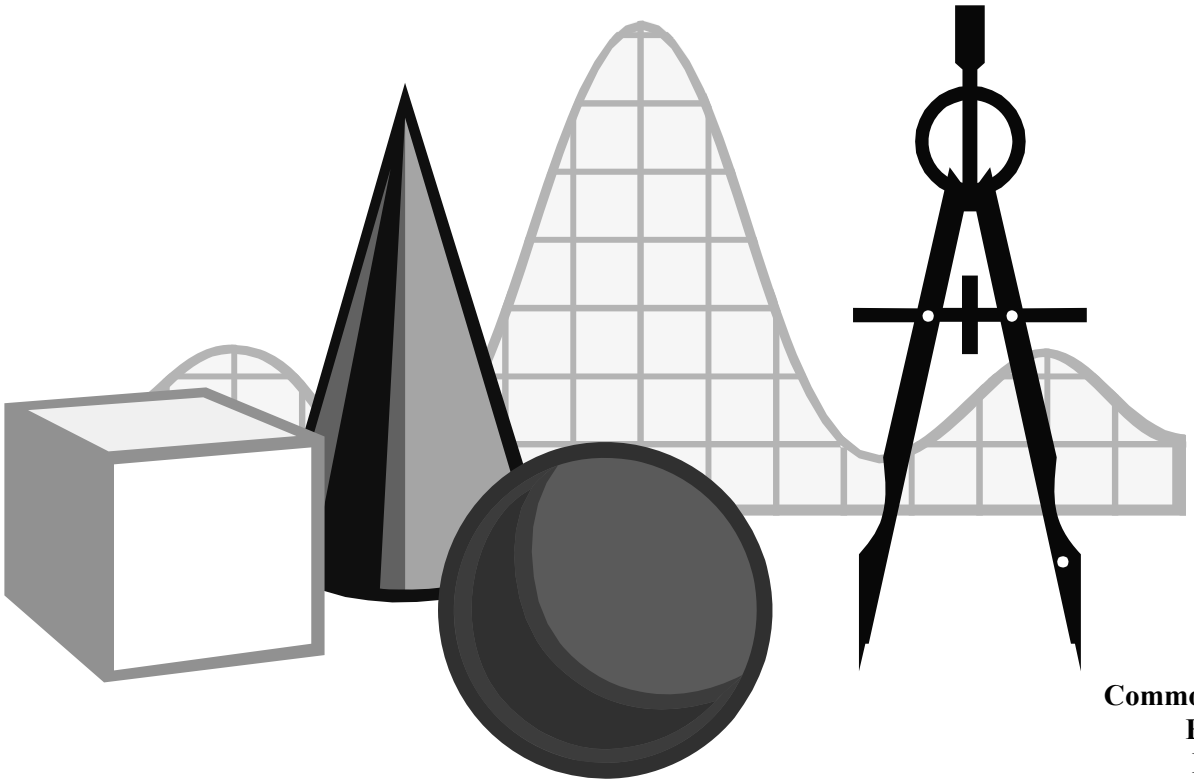
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The commutative property for addition states that changing the order of the addends does not change the sum (e.g., 5 + 4 = 4 + 5). • The commutative property for multiplication states that changing the order of the factors does not change the product (e.g., 5 · 4 = 4 · 5). • The associative property of addition states that regrouping the addends does not change the sum [e.g., 5 + (4 + 3) = (5 + 4) + 3]. • The associative property of multiplication states that regrouping the factors does not change the product [e.g., 5 · (4 · 3) = (5 · 4) · 3]. • Subtraction and division are neither commutative nor associative. • The distributive property states that the product of a number and the sum (or difference) of two other numbers equals the sum (or difference) of the products of the number and each other number [e.g., 5 · (3 + 7) = (5 · 3) + (5 · 7), or 5 · (3 – 7) = (5 · 3) – (5 · 7)]. • Identity elements are numbers that combine with other numbers without changing the other numbers. The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division. • The additive identity property states that the sum of	~~**All students should**~~ • Why is it important to apply properties of operations when simplifying expressions? ~~Understand that u~~ Using the properties of operations with real numbers helps with understanding mathematical relationships. • ~~Understand how to use these properties when computing.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify the real number equation that represents each property of operations with real numbers, when given several real number equations.~~ • ~~Explore the properties of real numbers, using diagrams and manipulatives.~~ • ~~Test the validity of properties by using examples of the properties of operations on real numbers.~~ • ~~Identify the property of operations with real numbers that is illustrated by a real number equation~~. • Identify properties of operations used in simplifying expressions. • Apply the properties of operations to simplify expressions.

7.16 The student will apply the following properties of operations with real numbers:
a) the commutative and associative properties for addition and multiplication;
b) the distributive property;
c) the additive and multiplicative identity properties;
d) the additive and multiplicative inverse properties; and
e) the multiplicative property of zero.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
any real number and zero is equal to the given real number (e.g., 5 + 0 = 5). • The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., 8 · 1 = 8). • Inverses are numbers that combine with other numbers and result in identity elements [e.g., 5 + (–5) = 0; $\frac{1}{5} \cdot 5 = 1$]. • The additive inverse property states that the sum of a number and its additive inverse always equals zero [e.g., 5 + (–5) = 0]. • The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., $4 \cdot \frac{1}{4} = 1$). • Zero has no multiplicative inverse. • The multiplicative property of zero states that the product of any real number and zero is zero. • Division by zero is not a possible arithmetic operation. Division by zero is undefined. Additional information on this topic can be found at http://www.doe.virginia.gov/VDOE/middle-math-strategies/#nns		

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Grade 8



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Board of Education
Richmond, Virginia
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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students in the middle grades focus on mastering rational numbers. Rational numbers play a critical role in the development of proportional reasoning and advanced mathematical thinking. The study of rational numbers builds on the understanding of whole numbers, fractions, and decimals developed by students in the elementary grades. Proportional reasoning is the key to making connections to most middle school mathematics topics.
- Students develop an understanding of integers and rational numbers by using concrete, pictorial, and abstract representations. They learn how to use equivalent representations of fractions, decimals, and percents and recognize the advantages and disadvantages of each type of representation. Flexible thinking about rational-number representations is encouraged when students solve problems.
- Students develop an understanding of the properties of operations on real numbers through experiences with rational numbers and by applying the order of operations.
- Students use a variety of concrete, pictorial, and abstract representations to develop proportional reasoning skills. Ratios and proportions are a major focus of mathematics learning in the middle grades.

8.1 The student will

a) simplify numerical expressions involving positive exponents, using rational numbers, order of operations, and properties of operations with real numbers; and

b) compare and order decimals, fractions, percents, and numbers written in scientific notation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• *Expression* is a word used to designate any symbolic mathematical phrase that may contain numbers and/or variables. Expressions do not contain ~~an~~ equal or inequality signs. • The set of rational numbers ~~is~~ includes the set of all numbers that can be expressed as fractions in the form $\frac{a}{b}$ where *a* and *b* are integers and *b* does not equal zero (√25, ¼ -2.3, 75%, 4.59$\overline{59}$. • A rational number is any number that can be written in fraction form. • A numerical expression contains only numbers and the operations on those numbers. • Expressions are simplified using the order of operations and the properties for operations with real numbers, i.e., associative, commutative, and distributive and inverse properties. • The order of operations, a mathematical convention, is as follows: Complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols (embedded), do the innermost operation first. Evaluate all exponential expressions. Multiply and/or divide in order from left to right. Add and/or subtract in order from left to right. *Grouping symbols include parentheses ( ), brackets [ ], braces { }, the absolute value $\lvert\ \rvert$, division/fraction bar −, and the square root symbol √.	~~**All students should**~~ • ~~Understand that any real number can be shown represented on a number line~~. • What is the role of the order of operations when simplifying numerical expressions? The order of operations ~~describes~~ prescribes the order to use to compute with rational numbers. • How does the different ways rational numbers can be represented help us compare and order rational numbers? ~~Understand that n~~Numbers can be represented as decimals, fractions, percents, and in scientific notation. It is often useful to convert numbers to be compared and/or ordered to one representation (e.g., fractions, decimals or percents). • What is a rational number? A rational number is any number that can be written in fraction form. • When are numbers written in scientific notation? Scientific notation is used to represent very large and very small numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Simplify numerical expressions containing: 1) exponents (where the base is a rational number and the exponent is a positive whole number); 2) fractions, decimals, integers and/or square roots of perfect squares; and/or 3) grouping symbols (no more than 2 embedded grouping symbols). Order of operations and properties of operations with real numbers should be used. • Compare and order no more than five fractions, decimals, percents, and numbers written in scientific notation using positive and/or negative exponents. Ordering may be in ascending or descending order.

8.1 The student will

a) simplify numerical expressions involving positive exponents, using rational numbers, order of operations, and properties of operations with real numbers; and

b) compare and order decimals, fractions, percents, and numbers written in scientific notation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A power of a number represents repeated multiplication of the number. For example, $(-5)^4$ means $(-5) \cdot (-5) \cdot (-5) \cdot (-5)$. The base is the number that is multiplied, and the exponent represents the number of times the base is used as a factor. In this example, (–5) is the base, and 4 is the exponent. The product is 625. Notice that the base appears inside the grouping symbols. The meaning changes with the removal of the grouping symbols. For example, -5^4 means 5·5·5·5 negated which results in a product of -625. The expression $-(5)^4$ means to take the opposite of 5·5·5·5 which is -625. Students should be exposed to all three representations. • Scientific notation is used to represent very large or very small numbers. • A number written in scientific notation is the product of two factors: a decimal greater than or equal to one but less than 10 multiplied by a power of 10 (e.g., $3.1 \times 10^5 = 310{,}000$ and $3.1 \times 10^{-5} = 0.000031$). • Any real number raised to the zero power is 1. The only exception to this rule is zero itself. <u>Zero raised to the zero power is undefined.</u> • <u>All state approved scientific calculators use algebraic logic (follow the order of operations).</u>		

8.2 The student will describe orally and in writing the relationship between the subsets of the real number system.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The sets of natural or counting numbers, whole numbers, integers, rational and irrational numbers are the subsets of the real number system. • The set of natural numbers is the set of counting numbers (1, 2, 3, 4, ...). • The set of whole numbers includes the set of all the natural numbers or counting numbers and zero (0, 1, 2, 3…). • The set of integers includes the set of whole numbers and their opposites (…-2, -1, 0, 1, 2…). • The set of rational numbers includes the set of all numbers that can be expressed as fractions in the form $\frac{a}{b}$ where a and b are integers and b does not equal zero (√25, ¼, -2.3, 75%, $4.59\overline{59}$. • The set of irrational numbers is the set of all non-repeating, nonterminating decimals. An irrational number cannot be written in fraction form (π, √2, 2, 1.232332333…). • The set of real numbers ~~is~~ <u>includes</u> ~~the sets of~~ all rational and irrational numbers. ~~An irrational number cannot be expressed as an integer or the quotient of integers.~~	~~**All students should**~~ • ~~Understand the relationship between the subsets of the real number system.~~ • <u>How are the real numbers related?</u> <u>Some numbers can appear in more than one subset, e.g., 4 is an integer, a whole number, a counting or natural number and a rational number. The attributes of one subset can be contained in whole or in part in another subset.</u>	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe orally and in writing the relationships among the sets of natural or counting numbers, whole numbers, integers, rational numbers, irrational numbers, and real numbers. • Illustrate the relationships among the subsets of the real number system by using graphic organizers such as Venn diagrams. Subsets include ~~real numbers,~~ rational numbers, irrational numbers, integers, whole numbers, and natural <u>or counting</u> numbers. • Identify the subsets of the real number system to which a given number belongs. • Determine whether a given number is a member of a particular subset of the real number system, and explain why. • Describe each subset of the set of real numbers <u>and include examples and nonexamples</u>.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct through active learning experiences a more advanced understanding of mathematics;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop conceptual and algorithmic understanding of operations with integers and rational numbers through concrete activities and discussions that bring meaning to why procedures work and make sense.
- Students develop and refine estimation strategies and develop an understanding of when to use algorithms and when to use calculators. Students learn when exact answers are appropriate and when, as in many life experiences, estimates are equally appropriate.
- Students learn to make sense of the mathematical tools they use by making valid judgments of the reasonableness of answers.
- Students reinforce skills with operations with whole numbers, fractions, and decimals through problem solving and application activities.

8.3 The student will

a) solve practical problems involving rational numbers, percents, ratios, and proportions; and

b) the student will determine the percent increase or decrease for a given situation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Practical problems may include, but not be limited to, those related to economics, sports, science, social sciences, transportation, and health. Some examples include problems involving the amount of a pay check per month, the discount price on a product, temperature, simple interest, sales tax and installment buying. • A percent is a special ratio with a denominator of 100. • A discount is a percent of the original price. The discount price is the original price minus the discount. • Simple interest for a number of years is determined by multiplying the principle by the rate of interest by the number of years of the loan or investment (I=ptr). • The total value of an investment is equal to the sum of the original investment and the interest earned. • The total cost of a loan is equal to the sum of the original cost and the interest paid. • Percent increase and percent decrease are both percents of change. • Percent of change is the percent that a quantity increases or decreases.	~~**All students should**~~ • ~~Select an appropriate method or methods for computing with rational numbers and percents according to the context of the problem.~~ • ~~Understand how to set up a proportion given the relationship between two~~ items~~.~~ • What is the difference between percent increase and percent decrease? Percent increase and percent decrease are both percents of change measuring the percent a quantity increases or decreases. Percent increase shows a growing change in the quantity while percent decrease shows a lessening change. • What is a percent? A percent is a special ratio with a denominator of 100.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write a proportion given the relationship between two ratios. • Solve practical problems by using computation procedures for whole numbers, integers, ~~rational numbers~~ fractions, percents, ratios, and proportions. Some problems may require the application of a formula. • Maintain a checkbook and check registry for five or fewer transactions. • Compute a discount or markup and the resulting sale price for one discount or markup. • Compute the percent increase or decrease for a one-step equation found in a real life situation. • Compute the sales tax or tip and resulting total. • Substitute values for variables in given formulas. For example, use the simple interest formula I=prt to determine the value of any missing variable when given specific information. • Compute the simple interest and/or new balance earned in an investment or on a loan for a given number of years.

8.3 The student will

a) solve practical problems involving rational numbers, percents, ratios, and proportions; and

b) the student will determine the percent increase or decrease for a given situation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Percent increase determines the rate of growth and may be calculated using the following ratio: $\frac{\text{Change (new – original)}}{\text{original.}}$ • The change will result in a positive number. • Percent decrease determines the rate of decline and may be calculated using the same ratio as percent increase. However, the change will result in a negative number.		

8.4 The student will apply the order of operations to evaluate algebraic expressions for given replacement values of the variables.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Algebraic expressions use operations with algebraic symbols (variables) and numbers. • Algebraic expressions are evaluated by ~~replacing the variables with numbers~~ substituting numbers for variables and applying the order of operations to simplify the resulting expression. • ~~The replacement values are the numbers that replace the variables in an algebraic expression.~~ • The order of operations is as follows: Complete all operations within grouping symbols*. If there are grouping symbols within other grouping symbols (embedded), do the innermost operation first. Evaluate all exponential expressions. Multiply and/or divide in order from left to right. Add and/or subtract in order from left to right. *Grouping symbols include parentheses ( ), brackets [ ], braces { }, the absolute value $\lvert\ \rvert$, division/fraction bar −, and the square root symbol √.	~~**All students should**~~ • ~~Evaluate an algebraic expression by substituting a number for each variable and then simplifying the result.~~ • ~~Understand how to apply the order of operations after substituting given values for variables in algebraic expressions.~~ • What is the role of the order of operations when evaluating expressions? Using the order of operations assures only one correct answer for an expression.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Substitute numbers for variables in ~~an~~ algebraic expressions and simplify the expressions by using the order of operations. Exponents are positive and limited to ~~used are~~ whole numbers less than 4. Square roots are limited to perfect squares. • Apply the order of operations to evaluate formulas. Problems will be limited to positive exponents. Square roots may be included in the expressions but limited to perfect squares.

8.5 The student will

a) identify a given whole number as a perfect square; and

b) find the two consecutive whole numbers between which a square root lies.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A perfect square is a whole number whose square root is ~~a whole number~~ an integer (e.g., $\sqrt{25}$ is 5 and -5; thus, 25 is a perfect square). • The square root of a number is ~~that~~ any number which when multiplied by itself equals the number. • Whole numbers have both positive and negative roots. • Any whole number other than a perfect square has a square root that lies between two consecutive whole numbers. • The square root of a whole number that is not a perfect square is an irrational number (e.g., $\sqrt{2}$ is an irrational number). An irrational number cannot be expressed exactly as a ratio. • Students can use grid paper and estimation to determine what is needed to build a perfect square.	~~**All students should**~~ • ~~Understand that a perfect square is the product of a number multiplied by itself.~~ • ~~Develop strategies for finding the square root of a number.~~ • How does the area of a square relate to the square of a number? The area determines the perfect square number. If it is not a perfect square, the area provides a means for estimation. • Why do numbers have both positive and negative roots? The square root of a number is ~~that~~ any number which when multiplied by itself equals the number. A product, when multiplying two positive factors, is always the same as the product when multiplying their opposites. For example, if the number is 49, then $7 \cdot 7 = 49$ and $-7 \cdot -7 = 49$.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the perfect squares from 0 to ~~100~~ 400. • Identify the two consecutive whole numbers between which the square root of a given whole number from 0 to ~~100~~ 400 lies (e.g., $\sqrt{57}$ lies between 7 and 8 since $7^2 = 49$ and $8^2 = 64$). • Define a perfect square. • Find the positive or positive and negative roots of a given whole number from 0 to 400. (Use the symbol $\sqrt{}$ to ask for the positive root and $\pm\sqrt{}$ when asking for the positive and negative roots.)

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop the measurement skills that provide a natural context and connection among many mathematics concepts. Estimation skills are developed in determining length, weight/mass, liquid volume/capacity, and angle measure. Measurement is an essential part of mathematical explorations throughout the school year.
- Students continue to focus on experiences in which they measure objects physically and develop a deep understanding of the concepts and processes of measurement. Physical experiences in measuring various objects and quantities promote the long-term retention and understanding of measurement. Actual measurement activities are used to determine length, weight/mass, and liquid volume/capacity.
- Students examine perimeter, area, and volume, using concrete materials and practical situations. Students focus their study of surface area and volume on rectangular prisms, cylinders, pyramids, and cones.

8.6 The student will

a) verify by measuring and describe the relationships among vertical angles, adjacent angles, supplementary angles, and complementary angles; and

b) measure angles of less than 360°.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Vertical angles are ~~the opposite angles~~ all nonadjacent angles formed by two intersecting lines and have only a vertex in common. Vertical angles are congruent. • Complementary angles are any two angles such that the sum of their measures is 90°. • Supplementary angles are any two angles such that the sum of their measures is 180°. • Reflex angles measure more than 180°. • Vertical angles are the opposite angles formed by two intersecting lines. Vertical angles are congruent and share a common vertex. • Adjacent angles are any two angles that share a common side and a common vertex.	~~**All students should**~~ • ~~Understand the meaning of the term *angle*.~~ • ~~Understand how to use angle-measuring tools.~~ • ~~Understand that pairs of angles are named by their defining attributes.~~ • How are vertical, adjacent, complementary and supplementary angles related? Adjacent angles are any two angles that share a common side and a common vertex. Vertical angles will always be nonadjacent angles. Supplementary and complementary angles may or may not be adjacent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Measure angles of less than 360° to the nearest degree, using appropriate tools. • Identify and describe the relationships among the ~~2~~ two types of angles formed by two intersecting lines. • Identify and describe pairs of vertical angles that are vertical. • Identify and describe pairs of angles that are supplementary. • Identify and describe pairs of angles that are complementary. • Identify and describe pairs of angles that are adjacent.

8.7 The student will

a) investigate and solve practical problems involving volume and surface area of prisms, cylinders, cones, and pyramids; and

b) describe how changing one measured attribute of the figure affects the volume and surface area.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A polyhedron is a solid figure whose faces are all polygons. • A pyramid is a polyhedron with a base that is a polygon and other faces that are triangles with a common vertex. • ~~The lateral area of a pyramid is the sum of the areas of the triangular faces.~~ • The area of the base of a pyramid is the area of the polygon which is the base. • The total surface area of a pyramid is the sum of the ~~lateral area~~ areas of the triangular faces and the area of the base. • The volume of a pyramid is $\frac{1}{3}Bh$, where B is the area of the base and h is the height. • ~~A circular cone is a geometric solid whose base is a circle and whose side is a surface composed of line segments connecting points on the base to a fixed point (the vertex) not on the base.~~ • ~~The lateral area of a right circular cone is the area of the surface connecting the base with the vertex and is equal to πrl, where l is the slant height.~~ • The area of the base of a circular cone is πr^2. • The surface area of a right circular cone is $\pi r^2 + \pi rl$.	~~**All students should**~~ • ~~Understand the derivation of formulas for volume and surface area of prisms, cylinders, cones, and pyramids.~~ • ~~Understand the differences between volume and surface area.~~ • How does the volume of a three-dimensional figure differ from its surface area? Volume is the amount a container holds. Surface area of a figure is the sum of the area on surfaces of the figure. • How are the formulas for the volume of prisms and cylinders similar? For both formulas you are finding the area of the base and multiplying that by the height. • How are the formulas for the volume of cones and pyramids similar? For cones you are finding 1/3 of the volume of the cylinder with the same size base and height. For pyramids you are finding 1/3 of the volume of the prism with the same size base and height. • In general what effect does changing one attribute of a prism by a scale factor have on the volume of the prism? When you increase or decrease the length, width or height of a prism by a factor greater than 1, the volume of the prism is also increased by that factor.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Distinguish between situations that are applications of surface area and those that are applications of volume. • Investigate and ~~C~~ compute the surface area of a square or triangular pyramid by finding the sum of the areas of the triangular faces and the base using concrete objects, nets, diagrams and formulas. • Investigate and ~~C~~ compute the surface area of a cone by calculating the sum of the areas of the side and the base, using concrete objects, nets, diagrams and formulas. • Investigate and compute the surface area of a right cylinder using concrete objects, nets, diagrams and formulas. • Investigate and compute the surface area of a rectangular prism using concrete objects, nets, diagrams and formulas. • Investigate and ~~C~~compute the volume ~~and surface area~~ of ~~rectangular solids (~~prisms~~)~~, cylinders, cones, and ~~square~~ pyramids, using concrete objects, nets, diagrams and formulas. • ~~Investigate and s~~ Solve practical problems involving volume and surface area of ~~rectangular solids (~~prisms~~)~~, cylinders, cones and pyramids. • Compare and contrast the volume of a prism with one

8.7 The student will

a) investigate and solve practical problems involving volume and surface area of prisms, cylinders, cones, and pyramids; and

b) describe how changing one measured attribute of the figure affects the volume and surface area.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The volume of a cone is $\frac{1}{3}\pi r^2 h$, where h is the height and πr^2 is the area of the base. • The surface area of a right circular cylinder is $2\pi r^2 + 2\pi rh$. • The volume of a cylinder is the area of the base of the cylinder multiplied by the height. • The surface area of a prism is the sum of the areas of the 6 faces. • The volume of a prism is calculated by multiplying the length, width and height of the prism. • A prism is a solid figure that has a congruent pair of parallel bases and faces that are parallelograms. The surface area of a prism is the sum of the areas of the faces and bases. • When one attribute of a prism is changed through multiplication or division the volume increases by the same factor that the attribute increased by. For example, if a prism has a volume of 2 x 3 x 4, the volume is 24. However, if one of the attributes are doubled, the volume doubles. • The volume of a prism is Bh, where B is the area of the base and h is the height of the prism. • Nets are two-dimensional representations that can be folded into three-dimensional figures.		set of attributes with the volume of a prism where one of the attributes has been increased by a factor of 2, 3, 5 or 10.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students expand the informal experiences they have had with geometry in the elementary grades and develop a solid foundation for the exploration of geometry in high school. Spatial reasoning skills are essential to the formal inductive and deductive reasoning skills required in subsequent mathematics learning.
- Students learn geometric relationships by visualizing, comparing, constructing, sketching, measuring, transforming, and classifying geometric figures. A variety of tools such as geoboards, pattern blocks, dot paper, patty paper, miras, and geometry software provides experiences that help students discover geometric concepts. Students describe, classify, and compare plane and solid figures according to their attributes. They develop and extend understanding of geometric transformations in the coordinate plane.
- Students apply their understanding of perimeter and area from the elementary grades in order to build conceptual understanding of the surface area and volume of prisms, cylinders, pyramids, and cones. They use visualization, measurement, and proportional reasoning skills to develop an understanding of the effect of scale change on distance, area, and volume. They develop and reinforce proportional reasoning skills through the study of similar figures.
- Students explore and develop an understanding of the Pythagorean Theorem. Mastery of the use of the Pythagorean Theorem has far-reaching impact on subsequent mathematics learning and life experiences.

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)

- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)
- **Level 3: Abstraction.** Definitions are meaningful, with relationships being perceived between properties and between figures. Logical implications and class inclusions are understood, but the role and significance of deduction is not understood. (Students should transition to this level during grades 5 and 6 and fully attain it before taking Algebra.)
- **Level 4: Deduction.** Students can construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. Students should be able to supply reasons for steps in a proof. (Students should transition to this level before taking Geometry.)

8.8 The student will

a) apply transformations to plane figures; and

b) identify applications of transformations.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A rotation of a geometric figure is a clockwise or counterclockwise turn of the figure around a fixed point. The point may or may not be on the figure. The fixed point is called the *center of rotation.* • A reflection of a geometric figure ~~is a flip of the figure~~ moves all of the points of the figure across ~~a line~~ an axis. Each point on the reflected figure is the same distance from the ~~line~~ axis as the corresponding point in the original figure. • A translation of a geometric figure ~~is a slide of the figure in which~~ moves all the points on the figure ~~move~~ the same distance in the same direction. • A dilation of a geometric figure is a transformation that changes the size of a figure by a scale factor to create a similar figure. • ~~Real-life~~ Practical applications may include, but are not limited to, the following: – A rotation of the hour hand of a clock from 2:00 to 3:00 shows a turn of 30° clockwise; – A reflection of a boat in water shows an image of the boat flipped upside down with the water line being the line of reflection~~.~~; – A translation of a ~~shape~~ figure on a wallpaper pattern shows the same ~~shape~~ figure slid the same distance in the same direction~~.~~; and – A dilation of a model airplane is the production model of the airplane. • The image of a polygon is the resulting polygon after a transformation. The preimage is the original polygon before the transformation.	~~**All students should**~~ • ~~Understand the relationship between transformations in a coordinate plane and their application in real-life.~~ • ~~Explain that rotations, reflections, translations and dilations are transformations~~. • How does the transformation of a figure on the coordinate grid affect the congruency, orientation, location and symmetry of an image? Translations, rotations and reflections maintain congruence between the preimage and image but change location. Dilations by a scale factor other than 1 produce an image that is not congruent to the pre-image but is similar. Rotations and reflections change the orientation of the image.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Demonstrate the reflection of a ~~figure~~ polygon over ~~a~~ the vertical or horizontal ~~line~~ axis on a coordinate grid. • Demonstrate 90°, 180°, 270°, and 360° clockwise and counterclockwise rotations of a figure on a coordinate grid. The center of rotation will be limited to the origin. • Demonstrate the translation of a ~~figure~~ polygon on a coordinate grid. • Demonstrate the dilation of a ~~figure~~ polygon from a fixed point on a coordinate grid. • Identify practical applications of transformations including, but not limited, to tiling, fabric and wallpaper designs, art and scale drawings. • Identify the type of transformation in a given example.

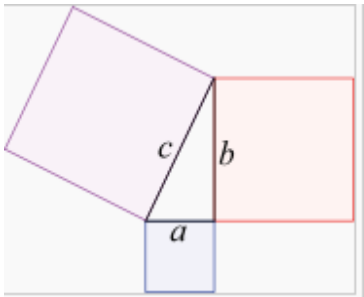
8.9 The student will construct a three-dimensional model, given the top or bottom, side and front views.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Three-dimensional models of geometric solids can be used to understand perspective and provide tactile experiences in determining two-dimensional perspectives. • Three-dimensional models of geometric solids can be represented on isometric paper. • The top view is a mirror image of the bottom view.	~~**All students should**~~ • How does knowledge of two-dimensional figures inform work with three-dimensional objects? ~~Understand~~ It is important to know that a three-dimensional object can be represented as a two-dimensional model with views of the object from different perspectives.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct three-dimensional models, given ~~top, side, and bottom views.~~ the top or bottom, side and front views. • Identify three-dimensional models given a two-dimensional perspective.

8.10 The student will

a) verify the Pythagorean Theorem; and

b) apply the Pythagorean Theorem.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the legs (altitude and base). This relationship is known as the Pythagorean Theorem: $a^2 + b^2 = c^2$.  • The Pythagorean Theorem is used to find the measure of any one of the three sides of a right triangle if the measures of the other two sides are known. • Whole number triples that are the measures of the sides of right triangles, such as (3,4,5), (6,8,10), (9,12,15), and (5,12,13), are commonly known as Pythagorean triples. • The hypotenuse of a right triangle is the side opposite the right angle. • The hypotenuse of a right triangle is always the longest side of the right triangle. • The legs of a right triangle form the right angle.	~~**All students should**~~ • How can the area of squares generated by the legs of a right triangle be used to verify the Pythagorean theorem? ~~Understand that, f~~ For a right triangle, the area of a square with one side equal to ~~of~~ the measure of the hypotenuse equals the sum of the areas of the squares with one side each equal to the measures of the ~~base and altitude.~~legs of the triangle. • ~~Understand that the Pythagorean Theorem is a tool to find the measure of any side of a right triangle, given the measures of the other two sides.~~ • ~~Demonstrate at least one model of the Pythagorean Theorem.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the parts of a right triangle (the hypotenuse and the legs). • Verify the Pythagorean Theorem, using diagrams, concrete materials, and measurement. • Find the measure of a side of a right triangle, given the measures of the other two sides. ~~The~~ measures ~~of the sides of the triangle may be whole numbers no larger than 15 or decimals in tenths.~~ • Solve ~~real-life~~ practical problems involving right triangles by using the Pythagorean Theorem.

8.11 The student will solve practical area and perimeter problems involving composite, plane figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A polygon is a simple, closed plane figure with sides that are line segments. • The perimeter of a polygon is the distance around the figure. • The area of any composite figure is based upon knowing how to find the area of the composite parts such as triangles and rectangles. • The area of a rectangle is computed by multiplying the lengths of two adjacent sides. (A = l x w). • The area of a triangle is computed by multiplying the measure of its base by the measure of its height and dividing the product by 2. (A = ½ bh). • The area of a parallelogram is computed by multiplying the measure if its base by the measure of its height (A = bh). • The area of a trapezoid is computed by taking the average of the measures of the two bases and multiplying this average by the height. [$A = \frac{1}{2}(b_1 + b_2)h$] • The area of a circle is computed by multiplying Pi times the radius squared ($A = \pi r^2$). • The circumference of a circle is found by multiplying Pi by the diameter or multiplying Pi by 2 times the radius. ($A = \pi d$ or $A = \pi r^2$). • An estimate of the area of a composite figure can be	~~All students should~~ • How does knowing the areas of polygons assist in calculating the areas of composite figures? The area of a composite figure can be found by subdividing the figure into triangles, rectangles, squares, trapezoids and semi-circles, calculating their areas, and adding the areas together.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Subdivide a figure into triangles, rectangles, squares, trapezoids and/or semicircles. Estimate the area of subdivisions and combine to determine the area of the composite figure. Figures will be limited to three subdivisions. • Use the attributes of the subdivisions to determine the perimeter and/or circumference of a figure. • Apply perimeter, circumference and/or area formulas to solve real-life problems.

8.11 The student will solve practical area and perimeter problems involving composite, plane figures.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
made by subdividing the polygon into triangles, rectangles, squares, trapezoids and semicircles, estimating their areas, and adding the areas together.		

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students develop an awareness of the power of data analysis and probability by building on their natural curiosity about data and making predictions.
- Students explore methods of data collection and use technology to represent data with various types of graphs. They learn that different types of graphs represent different types of data effectively. They use measures of ~~central tendency~~ center and dispersion to analyze and interpret data.
- Students integrate their understanding of rational numbers and proportional reasoning into the study of statistics and probability.
- Students explore experimental and theoretical probability through experiments and simulations by using concrete, active learning activities.

8.12 The student will determine the probability of independent and dependent events with and without replacement.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Two events are either dependent or independent. • If the outcome of one event does not influence the occurrence of the other event, they are called independent. If events are independent, then the second event occurs regardless of whether or not the first occurs. For example, the first roll of a number cube does not influence the second roll of the number cube. Other examples of independent events are, but not limited to: flipping two coins; spinning a spinner and rolling a number cube; flipping a coin and selecting a card; and choosing a card from a deck, replacing the card and selecting again. • To find the probability of independent events, use the formula: P (A and B) = P(A) · P(B). • If the outcome of one event has an impact on the outcome of the other event, the events are called dependent. If events are dependent then the second event is considered only if the first event has already occurred. For example, if you are dealt a King from a deck of cards and you do not place the King back into the deck before selecting a second card, the chance of selecting a King the second time is diminished because there are now only three Kings remaining in the deck. Other examples of dependent events are, but not limited to: choosing two marbles from a bag but not replacing the first after selecting it; and picking a sock out of a drawer and then picking a second sock without replacing the first. • To find the probability of dependent events, use the formula: P (B/A) = P (A) · P (A/B).	~~**All students should**~~ • How are the probabilities of dependent and independent events similar? Different? If events are dependent then the second event is considered only if the first event has already occurred. If events are independent, then the second event occurs regardless of whether or not the first occurs.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations** • Determine the probability of no more than 3 independent events with replacement. • Determine the probability of no more than 2 dependent events without replacement. • Compare the outcomes of events with and without replacement.

8.13 The student will:

a) make comparisons, predictions, and inferences, using information displayed in graphs; and

b) construct and analyze scatterplots.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Comparisons, predictions, and inferences are made by examining characteristics of a data set displayed in a variety of graphical representations to draw conclusions. • The information displayed in different graphs may be examined to determine how data are or are not related, ascertaining differences between characteristics (comparisons), trends that suggest what new data might be like (predictions), and/or "what could happen if" (inferences). • A scatterplot illustrates the relationship between two sets of data. A scatterplot consists of points. The coordinates of the point represent the measures of the two attributes of the point. • Scatterplots can be used to predict trends and estimate a line of best fit. • In a scatterplot, each point is represented by an independent and dependent variable. The independent variable is graphed on the horizontal axis and the dependent is graphed on the vertical axis.	~~**All students should**~~ • Why do we estimate a line of best fit for a scatterplot? A line of best fit helps in making interpretations and predictions about the situation modeled in the data set. • What are the inferences that can be drawn from sets of data points having a positive relationship, a negative relationship, and no relationship? Sets of data points with positive relationships demonstrate that the values of the two variables are increasing. A negative relationship indicates that as the value of the independent variable increases, the value of the dependent variable decreases.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations** • ~~Make comparisons, predictions, and inferences, given data sets of no more than 20 items that are displayed in frequency distributions; box-and-whisker plots; scatterplots; line, bar, circle, and picture graphs; and histograms.~~ • Collect, organize and interpret a data set of no more than 20 items using scatterplots. Predict from the trend an estimate of the line of best fit with a drawing. • Interpret the set of data points in a scatterplot as having a positive relationship, a negative relationship, or no relationship.

In the middle grades, the focus of mathematics learning is to

- build on students' concrete reasoning experiences developed in the elementary grades;
- construct a more advanced understanding of mathematics through active learning experiences;
- develop deep mathematical understandings required for success in abstract learning experiences; and
- apply mathematics as a tool in solving ~~real-life~~ practical problems.

Students in the middle grades use problem solving, mathematical communication, mathematical reasoning, connections, and representations to integrate understanding within this strand and across all the strands.

- Students extend their knowledge of patterns developed in the elementary grades and through life experiences by investigating and describing functional relationships.
- Students learn to use algebraic concepts and terms appropriately. These concepts and terms include *variable, term, coefficient, exponent, expression, equation, inequality, domain*, and *range*. Developing a beginning knowledge of algebra is a major focus of mathematics learning in the middle grades.
- Students learn to solve equations by using concrete materials. They expand their skills from one-step to two-step equations and inequalities.
- Students learn to represent relations by using ordered pairs, tables, rules, and graphs. Graphing in the coordinate plane linear equations in two variables is a focus of the study of functions.

8.14 The student will

a) represent a given relationship used in table, graph, word and rule form; and

b) make connections between any two forms.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A relation is any set of ordered pairs. For each first member ~~(domain~~), there may be many second members ~~(range)~~. • A function is a relation in which there is one and only one second member ~~(range)~~ for each first member ~~(domain)~~. • As a table of values, a function has a unique value assigned to the second variable ~~(range)~~ for each value of the first variable ~~(domain)~~. • As a graph, a function is any curve (including straight lines) such that any vertical line would pass through the curve only once. • Some relations are functions; all functions are relations. • Graphs of functions can be discrete or continuous. • In a discrete function graph there are separate, distinct points. You would not use a line to connect these points on a graph. The points between the plotted points have no meaning and cannot be interpreted. • In a graph of continuous function every point in the domain can be interpreted therefore it is possible to connect the points on the graph with a continuous line as every point on the line answers the original question being asked. • Functions can be represented as tables, graphs, equations, physical models, or in words.	~~**All students should**~~ • ~~Understand the difference between functions and relations.~~ • ~~Understand that a function is a one-to-one relationship between the domain and range.~~ • What is the relationship among tables, graphs, equations in modeling a given situation? Any given function can be represented by all three.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Graph in a coordinate plane ordered pairs that represent a relation. • ~~Write a rule that represents a relation from a table of values.~~ • ~~Write a table of values from the rule that represents a relation.~~ • ~~Write a table of values from the graph of ordered pairs of a relation.~~ • Describe and represent relations and functions, using tables, graphs, words, and ~~rules~~ equations. Given one representation, students will be able to represent the relation in another form. • Relate and compare different representations for the same relation.

8.15 The student will

a) solve multistep linear equations in one variable on one and two sides of the equation;
b) solve two-step linear inequalities and graph the results on a number line; and
c) identify properties of operations used to solve an equation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A multistep equation is an equation that requires more than one different mathematical operation to solve. • A two-step inequality is defined as an inequality that requires the use of two different operations to solve (e.g., $3x - 4 > 9$). • In an equation, the equal sign indicates that the value on the left is the same as the value on the right. • To maintain equality, an operation that is performed on one side of an equation must be performed on the other side. • When both expressions of an inequality are multiplied or divided by a negative number, the inequality sign reverses. • The commutative property for addition states that changing the order of the addends does not change the sum (e.g., $5 + 4 = 4 + 5$). • The commutative property for multiplication states that changing the order of the factors does not change the product (e.g., $5 \cdot 4 = 4 \cdot 5$). • The associative property of addition states that regrouping the addends does not change the sum [e.g., $5 + (4 + 3) = (5 + 4) + 3$]. • The associative property of multiplication states that regrouping the factors does not change the product [e.g., $5 \cdot (4 \cdot 3) = (5 \cdot 4) \cdot 3$].	~~**All students should**~~ • ~~Understand that an operation that is performed on one side of an equation must be performed on the other side to maintain equality.~~ • ~~Understand that when both expressions are multiplied or divided by a negative number, the inequality symbol reverses.~~ • How does the solution to an equation differ from the solution to an inequality? While a linear equation has only one replacement value for the variable that makes the equation true, an inequality can have more than one.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve two- to four- step linear equations in one variable ~~by showing the steps and using algebraic sentences.~~ using concrete materials, pictorial representations and paper and pencil illustrating the steps performed. • Solve two-step inequalities in one variable by showing the steps and using algebraic sentences. • Graph solutions to two-step linear inequalities on a number line. • Identify properties of operations used to solve an equation from among: a) the commutative properties of addition and multiplication; b) the associative properties of addition and multiplication; c) the distributive property; d) the identity properties of addition and multiplication; e) the zero property of multiplication; f) the additive inverse property; and g) the multiplicative inverse property.

8.15 The student will

a) solve multistep linear equations in one variable on one and two sides of the equation;
b) solve two-step linear inequalities and graph the results on a number line; and
c) identify properties of operations used to solve an equation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Subtraction and division are neither commutative nor associative. • The distributive property states that the product of a number and the sum (or difference) of two other numbers equals the sum (or difference) of the products of the number and each other number [e.g., $5 \cdot (3 + 7) = (5 \cdot 3) + (5 \cdot 7)$, or $5 \cdot (3 - 7) = (5 \cdot 3) - (5 \cdot 7)$]. • Identity elements are numbers that combine with other numbers without changing the other numbers. The additive identity is zero (0). The multiplicative identity is one (1). There are no identity elements for subtraction and division. • The additive identity property states that the sum of any real number and zero is equal to the given real number (e.g., $5 + 0 = 5$). • The multiplicative identity property states that the product of any real number and one is equal to the given real number (e.g., $8 \cdot 1 = 8$). Inverses are numbers that combine with other numbers and result in identity elements [e.g., $5 + (-5) = 0$; $\frac{1}{5} \cdot 5 = 1$]. • The additive inverse property states that the sum of a number and its additive inverse always equals zero [e.g., $5 + (-5) = 0$]. • The multiplicative inverse property states that the product of a number and its multiplicative inverse (or reciprocal) always equals one (e.g., $4 \cdot \frac{1}{4} = 1$).		

8.15 The student will

a) solve multistep linear equations in one variable on one and two sides of the equation;
b) solve two-step linear inequalities and graph the results on a number line; and
c) identify properties of operations used to solve an equation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Zero has no multiplicative inverse. • The multiplicative property of zero states that the product of any real number and zero is zero. • Division by zero is not a possible arithmetic operation. • Combining like terms means to combine terms that have the same variable and the same exponent (e.g., $8x + 11 – 3x$ can be $5x +11$ by combining the like terms of $8x$ and $-3x$).		

8.16 The student will graph a linear equation in two variables using a table of ordered pairs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A linear equation is an equation in two variables whose graph is a straight line, a type of continuous function (see SOL 8.14). • A linear equation represents a situation with a constant rate. For example, when driving at a rate of 35 mph, the distance increases as the time increases, but the rate of speed remains the same. • Graphing a linear equation requires determining a table of ordered pairs by substituting into the equation values for one variable and solving for the other variable, plotting the ordered pairs in the coordinate plane, and connecting the points to form a straight line. • The axes of a coordinate plane are generally labeled *x* and *y*; however, any letters may be used that are appropriate for the function.	~~**All students should**~~ • ~~Understand that the graph of a linear equation in two variables is the set of all ordered pairs that satisfy the equation.~~ • What types of real life situations can be represented with linear equations? Any situation with a constant rate can be represented by a linear equation.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct a table of ordered pairs by substituting values for *x* in a linear equation to find values for *y*. • Plot in the coordinate plane ordered pairs (*x*, *y*) from a table. • Connect the ordered pairs to form a straight line (a continuous function).

8.17 The student will identify the domain, range, independent variable or dependent variable in a given situation.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Only)

- The domain is the ~~possible~~ set of all the input values for the independent variable in a given situation.
- The range is the ~~possible~~ set of all the output values for the dependent variable in a given situation.
- The independent variable is the input value.
- The dependent variable depends on the independent variable and is the output value.
- Below is a table of values for finding the circumference of circles, $C = \pi d$, where the value of π is approximated as 3.14.

Diameter	Circumference
1 in.	3.14 in.
2 in.	6.28 in.
3 in.	9.42 in.
4 in.	12.56 in.

- The independent variable, or input, is the diameter of the circle. The values for the diameter make up the domain.
- The dependent variable, or output, is the circumference of the circle. The set of values for the circumference make up the range.

ESSENTIAL UNDERSTANDINGS

~~**All students should**~~

- ~~Understand that the domain represents all the values for the independent variables and the range represents all the values for the dependent variables.~~
- ~~Understand that the independent variable is the value that causes the change in the dependent variable and the dependent variable is affected by the independent variable.~~
- What are the similarities and differences among the terms domain, range, independent variable and dependent variable?
  The value of the dependent variable changes as the independent variable changes. The domain is the set of all input values for the independent variable. The range is the set of all possible values for the dependent variable.

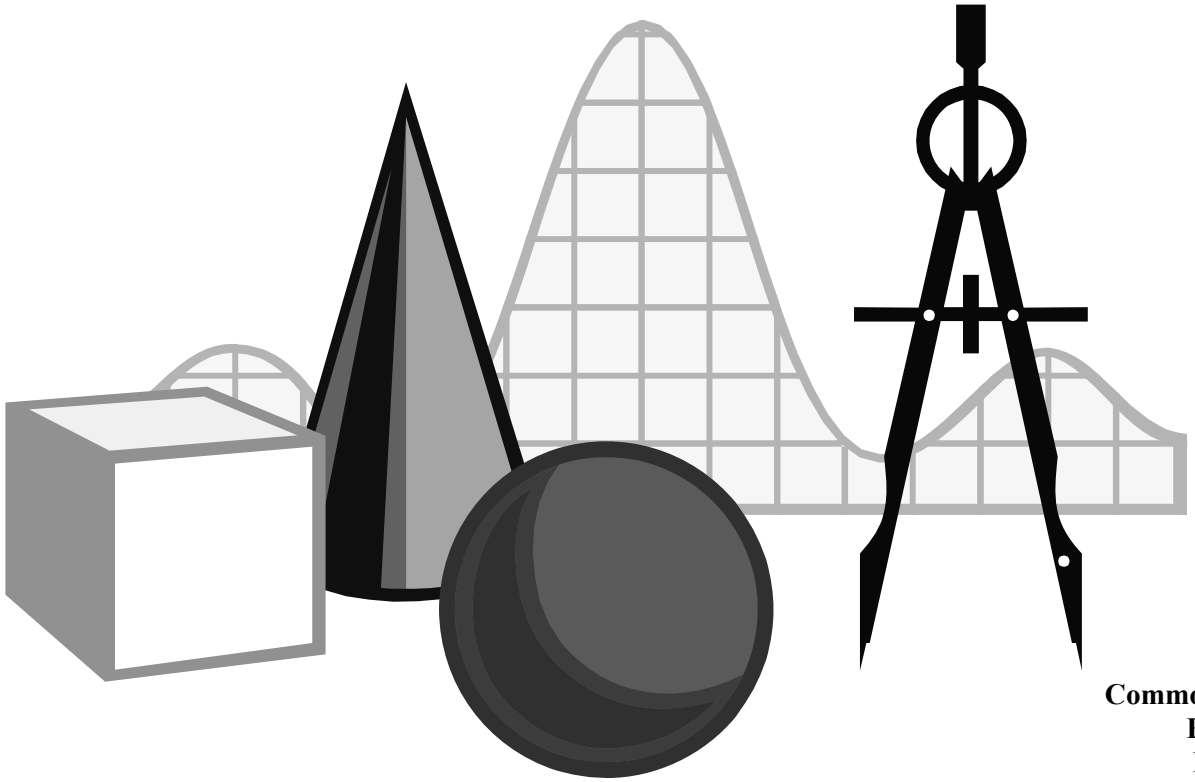
ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Apply the following algebraic terms appropriately: *domain*, *range*, *independent variable*, and *dependent variable.*
- Identify examples of domain, range, independent variable, and dependent variable.
- Determine the domain of a function.
- Determine the range of a function.
- Determine the independent variable of a relationship.
- Determine the dependent variable of a relationship.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Algebra I



Commonwealth of Virginia
Board of Education
Richmond, Virginia
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NOTICE TO THE READER

The Virginia Department of Education does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities.

The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA I
STANDARD A.1

The student will represent verbal quantitative situations algebraically and evaluate these expressions for given replacement values of the variables.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Algebra is a tool for reasoning about quantitative situations so that relationships become apparent. • Algebra is a tool for describing and representing patterns and relationships. • Mathematical modeling involves creating algebraic representations of quantitative real-world situations. • The numerical value of an expression is dependent upon the values of the replacement set for the variables. • There are a variety of ways to compute the value of a numerical expression and evaluate an algebraic expression. • The operations and the magnitude of the numbers in an expression impact the choice of an appropriate ~~method of computation~~ computational technique. • An appropriate computational technique could be mental mathematics, calculator, or paper and pencil.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Translate verbal quantitative situations ~~expressions~~ into algebraic expressions and vice versa ~~with three or fewer terms~~. • ~~Relate a polynomial expression with three or fewer terms to a verbal expression.~~ • Model real-world situations with algebraic expressions in a variety of representations (concrete, pictorial, symbolic, verbal). • Evaluate algebraic expressions for a given replacement set to include ~~integers and~~ rational numbers. • ~~Apply appropriate computational techniques to evaluate an algebraic expression.~~ • Evaluate expressions that contain absolute value, square roots, and cube roots.

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA I
STANDARD A.2

The student will perform operations on polynomials, including

a) applying the laws of exponents to perform operations on expressions;
b) adding, subtracting, multiplying, and dividing polynomials; and
c) factoring completely first- and second-degree binomials and trinomials in one or two variables. Graphing calculators will be used as a tool for factoring and for confirming algebraic factorizations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Repeated multiplication can be represented with exponents.~~ • The laws of exponents can be investigated using ~~patterns~~ inductive reasoning. • ~~The base and the exponent impact the magnitude of the expression.~~ • A relationship exists between the laws of exponents and scientific notation. • ~~A relationship exists between arithmetic operations and operations with polynomials.~~ • ~~Polynomials can be represented in a variety of forms.~~ • Operations with polynomials can be represented concretely, pictorially, and ~~algebraically~~ symbolically. • Polynomial expressions can be used to model real-~~life~~ world situations. • The distributive property is the unifying concept for polynomial	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify the base, exponent, and coefficient in a monomial expression.~~ • Simplify monomial expressions and ratios of monomial expressions in which the exponents are integers, using the laws of exponents. • ~~Express numbers, using scientific notation, and perform operations, using the laws of exponents.~~ • Model sums, differences, products, and quotients of polynomials with concrete objects and their related pictorial representations. • Relate concrete and pictorial ~~representations for~~ manipulations that model polynomial operations to their corresponding ~~algebraic manipulations~~ symbolic representations. • Find sums and differences of polynomials. • Find products of polynomials. The factors will have no more than five total terms. (i.e. (4x+2)(3x+5) represents four terms and

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA I
STANDARD A.2

The student will perform operations on polynomials, including

a) applying the laws of exponents to perform operations on expressions;
b) adding, subtracting, multiplying, and dividing polynomials; and
c) factoring completely first- and second-degree binomials and trinomials in one or two variables. Graphing calculators will be used as a tool for factoring and for confirming algebraic factorizations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
operations. • Factoring reverses polynomial multiplication. • Some polynomials are prime polynomials and cannot be factored over the set of real numbers. • Polynomial expressions ~~in a variable *x* and their factors~~ can be used to define functions ~~by setting *y* equal to the polynomial expression or *y* equal to a factor,~~ and these functions can be represented graphically. • There is a relationship between the factors of ~~a~~ any polynomial and the *x*-intercepts of ~~its related~~ the graph of its related function.	$(x+1)(2x^2+x+3)$ represents five terms) • ~~Multiply polynomials by monomials and binomials by binomials symbolically.~~ • Find the quotient of polynomials, using a monomial or binomial divisor, or a completely factored divisor. • ~~Use the distributive property to "factor out" all common monomial factors.~~ • Factor completely first- and second-degree polynomials ~~and binomials~~ with integral coefficients ~~and a positive leading coefficient less than four~~. • Identify prime polynomials ~~that cannot be factored over the set of real numbers~~. • Use the *x*-intercepts from the graphical representation of the polynomial to determine and confirm its factors.

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA I
STANDARD A.3

The student will express the square roots and cube roots of whole numbers and the square root of a monomial algebraic expression in simplest radical form.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~The square root of a perfect square is an integer.~~ • ~~The square root of a non-perfect square lies between two consecutive integers.~~ • ~~The inverse of squaring a number is determining the square root.~~ • A ~~radical~~ square root in simplest form is one in which the radicand (argument) has no perfect square factors other than one. • A cube root in simplest form is one in which the argument has no perfect cube factors other than one. • ~~The square root of a product is the product of the square roots.~~ • The cube root of a perfect cube is an integer. • The cube root of a nonperfect cube lies between two consecutive integers. • The inverse of cubing a number is determining the cube root. • In the real number system, the argument of a square root must be nonnegative while the argument of a cube root may be any real number.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Estimate the square root of a non-perfect square to the nearest tenth by~~ – ~~identifying the two perfect squares it lies between;~~ – ~~finding the square root of those two perfect squares; and~~ – ~~using those values to estimate the square root of the non-perfect square.~~ • ~~Find the square root of a number, and make a reasonable interpretation of the displayed value for a given situation, using a calculator.~~ • Express ~~the~~ square roots of a whole number ~~less than 1,000~~ in simplest ~~radical~~ form. • Express the cube root of a whole number in simplest form. • Express the principal square root of monomial algebraic expression in simplest form.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.4

The student will solve multistep linear and quadratic equations in two variables, including

a) solving literal equations (formulas) for a given variable;
b) justifying steps used in simplifying expressions and solving equations, using field properties and axioms of equality that are valid for the set of real numbers and its subsets;
c) solving quadratic equations algebraically and graphically;
d) solving multistep linear equations algebraically and graphically;
e) solving systems of two linear equations in two variables algebraically and graphically; and
f) solving real-world problems involving equations and systems of equations.

Graphing calculators will be used both as a primary tool in solving problems and to verify algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A solution to an equation is the value or set of values that can be substituted to make the equation true. • ~~Equations can be solved in a variety of ways.~~ • The solution of an equation in one variable can be found by graphing each ~~side~~ member of the equation separately and finding the *x*-coordinate of the point of intersection. • ~~Practical~~ Real-world problems can be interpreted, represented, and solved using linear and quadratic equations ~~and inequalities in one variable~~. • The ~~representation and manipulation~~ process of solving ~~expressions,~~ linear and quadratic equations~~, and inequalities~~ can be modeled in a variety of ways, using concrete, pictorial, and symbolic representations. • Properties of real numbers and properties of equality can be used	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Translate verbal sentences to algebraic equations in one variable.~~ • Solve multistep linear equations. ~~in one variable with the variable in both sides of the equation or inequality.~~ • Solve quadratic equations. ~~algebraically or by using the graphing calculator~~. ~~When solutions are represented in radical form, the decimal approximation will also be given.~~ • ~~Solve multistep linear equations in one variable with grouping symbols in one or both sides of the equation or inequality.~~ • ~~Solve multistep equations in one variable with rational coefficients and constants.~~ • Solve a literal equation (formula) for a specified variable.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.4

The student will solve multistep linear and quadratic equations in two variables, including

a) **solving literal equations (formulas) for a given variable;**
b) **justifying steps used in simplifying expressions and solving equations, using field properties and axioms of equality that are valid for the set of real numbers and its subsets;**
c) **solving quadratic equations algebraically and graphically;**
d) **solving multistep linear equations algebraically and graphically;**
e) **solving systems of two linear equations in two variables algebraically and graphically; and**
f) **solving real-world problems involving equations and systems of equations.**

Graphing calculators will be used both as a primary tool in solving problems and to verify algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
to justify equation solutions and expression simplification. • ~~Justifications will include the use of concrete objects; pictorial representations.~~ • A system of linear equations with exactly one solution is characterized by the graphs of two lines whose intersection is a single point, and the coordinates of this point satisfy both equations. • ~~A point shared by two intersecting graphs and the ordered pair that satisfies the equations characterize a system of equations with only one solution.~~ • A system of two linear equations with no solution is characterized by the graphs of two lines that are parallel. • A system of two linear equations having infinite solutions is characterized by two graphs that coincide (the graphs will appear to be the graph of one line), and ~~all~~ the coordinates of all points	• ~~Apply skills for solving linear equations to practical situations.~~ • Confirm algebraic solutions to linear and quadratic equations, using a graphing calculator. • Simplify expressions and solve equations, using the ~~commutative, associative, and distributive~~ field properties of the real numbers and properties of equality to justify simplification and solution. • ~~Simplify expressions and solve equations and inequalities, using the order of operations.~~ • Given a system of two linear equations in two variables that has a unique solution, solve the system by substitution or elimination to find the ordered pair which satisfies both equations. • Given a system of two linear equations in two variables that has a unique solution, solve the system graphically ~~to find~~ by identifying the point of intersection. • Determine whether a system of two linear equations has one

ALGEBRA I
STANDARD A.4

The student will solve multistep linear and quadratic equations in two variables, including

a) solving literal equations (formulas) for a given variable;
b) justifying steps used in simplifying expressions and solving equations, using field properties and axioms of equality that are valid for the set of real numbers and its subsets;
c) solving quadratic equations algebraically and graphically;
d) solving multistep linear equations algebraically and graphically;
e) solving systems of two linear equations in two variables algebraically and graphically; and
f) solving real-world problems involving equations and systems of equations.

Graphing calculators will be used both as a primary tool in solving problems and to verify algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
on ~~this one~~ the line satisfy both equations.	solution, no solution, or infinite solutions.
• Systems of two linear equations can be used to model two real-world conditions that must be satisfied simultaneously.	• Write a system of two linear equations that ~~describes~~ models a ~~practical~~ real-world situation.
• The zeros or the *x*-intercepts of the quadratic function are the real root(s) or solution(s) of the quadratic equation that is formed by setting the given quadratic expression equal to zero.	• Interpret and determine the reasonableness of the algebraic or graphical solution of a system of two linear equations that ~~describes~~ models a ~~practical~~ real-world situation.
• ~~Quadratic equations can be solved in a variety of ways.~~	• ~~Verify algebraic solutions, using the graphing calculator.~~
• ~~A quadratic equation can have two solutions, one solution, or no solution.~~	• Identify the ~~*x*-intercepts~~ roots of ~~the~~ a quadratic function as the solution(s) to the quadratic equation that is formed by setting the given quadratic expression equal to zero.
• ~~A solution to a quadratic equation is the value or set of values that can be substituted to make the equation true.~~	
• Equations and systems of equations can be used as mathematical models for real-world situations.	
• Set builder notation may be used to represent solution sets of	

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.4

The student will solve multistep linear and quadratic equations in two variables, including

a) **solving literal equations (formulas) for a given variable;**
b) **justifying steps used in simplifying expressions and solving equations, using field properties and axioms of equality that are valid for the set of real numbers and its subsets;**
c) **solving quadratic equations algebraically and graphically;**
d) **solving multistep linear equations algebraically and graphically;**
e) **solving systems of two linear equations in two variables algebraically and graphically; and**
f) **solving real-world problems involving equations and systems of equations.**

Graphing calculators will be used both as a primary tool in solving problems and to verify algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
equations and inequalities.	

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.5

The student will solve multistep linear inequalities in two variables, including

a) solving multistep linear inequalities algebraically and graphically;
b) justifying steps used in solving inequalities, using axioms of inequality and properties of order that are valid for the set of real numbers and its subsets;
c) solving real-world problems involving inequalities; and
d) solving systems of inequalities.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A solution to an inequality is the value or set of values that can be substituted to make the inequality true. • ~~Inequalities can be solved in a variety of ways.~~ • ~~Practical~~ Real-world problems can be ~~interpreted, represented,~~ modeled and solved using linear inequalities ~~in one variable~~. • Properties of inequality and order can be used to solve inequalities. • Set builder notation may be used to represent solution sets of inequalities.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Translate verbal sentences to algebraic inequalities in one variable.~~ • Solve multistep ~~noncompound~~ linear inequalities ~~in one variable with the variable in both sides of the equation or inequality~~. • ~~Solve multistep linear inequalities in one variable with grouping symbols in one or both sides of the inequality.~~ • ~~Solve multistep inequalities in one variable with rational coefficients and constants.~~ • ~~Confirm algebraic solutions to linear inequalities, using a graphing calculator.~~ • Justify steps used in solving inequalities, using axioms of inequality and properties of order that are valid for the set of real numbers. • ~~Simplify expressions and solve inequalities, using the~~

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.5

The student will solve multistep linear inequalities in two variables, including

a) **solving multistep linear inequalities algebraically and graphically;**
b) **justifying steps used in solving inequalities, using axioms of inequality and properties of order that are valid for the set of real numbers and its subsets;**
c) **solving real-world problems involving inequalities; and**
d) **solving systems of inequalities.**

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	~~commutative, associative, and distributive properties.~~ • ~~Simplify expressions and solve inequalities, using the order of operations.~~ • ~~Create and interpret pictorial representations for simplifying expressions and solving equations and inequalities.~~ • Solve systems of linear inequalities algebraically and graphically.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.6

The student will graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Linear functions and inequalities can be written in a variety of forms.~~ • ~~Linear functions and inequalities can be graphed, using a variety of techniques.~~ • ~~An appropriate technique for graphing linear functions and inequalities can be determined by the given information and/or the tools available.~~ • Changes in slope may be described by dilations or reflections or both. • Changes in the y-intercept may be described by translations. • ~~Justification of an appropriate technique for graphing linear equations and inequalities is dependent upon the application of slope, *x*- and *y*-intercepts, and graphing by transformations.~~ • Linear equations can be graphed using slope, x- and y-intercepts, and/or transformations of the parent function. • The slope of a ~~linear function~~ line represents a constant rate of change in the dependent variable when the independent variable	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Graph linear equations and inequalities in two variables, including those that arise from a variety of ~~practical~~ real-world situations. • Use the ~~line~~ parent function $y = x$ ~~as a reference,~~ and ~~apply~~ describe transformations defined by changes in the slope or *y*-intercept. • ~~Express linear functions or inequalities in slope-intercept form, and use the graphing calculator to display the relationship.~~ • ~~Explain why a given technique is appropriate for graphing a linear function.~~ • ~~Recognize that *m* represents the slope in the equation of the form $y = mx + b$.~~ • Find the slope of the line, given the equation of a linear function. • ~~Calculate~~ Find the slope of a line, given the coordinates of two points on the line.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.6

The student will graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
changes by a ~~fixed~~ constant amount. • ~~The slope of a line determines its relative steepness~~. • ~~The slope of a line can be determined in a variety of ways.~~ • ~~Changes in slope affect the graph of a line.~~ • The equation of a line defines the relationship between two variables. • The graph of a line represents the set of points that satisfies the equation of a line. • A line can be represented by its graph or by an equation. • ~~The equation of a line can be determined by two points on the line or by the slope and a point on the line.~~ • The graph of the solutions of a linear inequality is a half-plane bounded by the graph of its related linear equation. Points on the boundary are included unless it is a strict inequality. • Parallel lines have equal slopes.	• Find the slope of a line, given the graph of a line. • Recognize and describe a line with a slope that is positive, negative, zero, or undefined. • ~~Compare the slopes of graphs of linear functions, using the graphing calculator.~~ • ~~Describe slope as a constant rate of change between two variables.~~ • Use transformational graphing to investigate effects of changes in equation parameters on the graph of the equation. • ~~Recognize that equations of the form $y = mx + b$ and $Ax + By = C$ are equations of lines.~~ • Write an equation of a line when given the graph of a line. • Write an equation of a line when given two points on the line whose coordinates are integers. • Write an equation of a line when given the slope and a point on the line whose coordinates are integers.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA I
STANDARD A.6

The student will graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The product of the slopes of perpendicular lines is -1.	• Write an equation of a vertical line as x =a. • Write the equation of a horizontal line as $y = c$.

TOPIC: FUNCTIONS

ALGEBRA I
STANDARD A.7

The student will investigate and analyze function (linear and quadratic) families and their characteristics both algebraically and graphically, including

a) determining whether a relation is a function;
b) domain and range;
c) zeros of a function;
d) *x*- and *y*-intercepts;
e) finding the values of a function for elements in its domain; and
f) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A set of data may be characterized by patterns, and those patterns can be represented in multiple ways. • Graphs can be used as visual representations to investigate relationships between quantitative data. • ~~Algebra is a tool for describing patterns, making generalizations, and representing a relationship in which output is related to input.~~ • Inductive reasoning may be used to make conjectures about characteristics of function families. • ~~A function is a relation for which there is a unique output for each input.~~ • ~~A relation can be represented by a set of ordered pairs.~~ • Each element in the domain of a relation is the abscissa of a point of the graph of the relation.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Analyze a table of ordered pairs for the existence of a pattern that defines the change relating input and output values.~~ • ~~Write a linear equation to represent a pattern in which there is a constant rate of change between variables.~~ • Determine from a set of ordered pairs, a table, or a graph whether a relation is a function. • Identify the domain, range, zeros, and intercepts of a function presented algebraically or graphically. • ~~Identify the domain and range for a relation, given a set of ordered pairs, a table, or a graph.~~ • ~~Use physical representations, such as algebra manipulatives, to~~

TOPIC: FUNCTIONS

ALGEBRA I
STANDARD A.7

The student will investigate and analyze function (linear and quadratic) families and their characteristics both algebraically and graphically, including

a) determining whether a relation is a function;
b) domain and range;
c) zeros of a function;
d) *x*- and *y*-intercepts;
e) finding the values of a function for elements in its domain; and
f) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Each element in the range of a relation is the ordinate of a point of the graph of the relation. • ~~The domain consists of the first coordinates of the ordered pairs.~~ • ~~The range consists of the second coordinates of the ordered pairs.~~ • A relation is a function if and only if each element in the domain is paired with a unique element of the range. • ~~An equation represents the relationship between the independent and dependent variables.~~ • The values of $f(x)$ are the ordinates of the points of the graph of f. • The object $f(x)$ is the unique object in the range of the function f that is associated with the object x in the domain of f. • For each x in the domain of f, x is a member of the input of the function f, $f(x)$ is a member of the output of f, and the ordered pair	~~represent quantitative data.~~ • For each x in the domain of f, find $f(x)$. • ~~Identify the zeros of the function algebraically and confirm them, using the graphing calculator~~. • Detect patterns in data and represent arithmetic and geometric patterns algebraically. • Detect departures from patterns in data.

TOPIC: FUNCTIONS

ALGEBRA I
STANDARD A.7

The student will investigate and analyze function (linear and quadratic) families and their characteristics both algebraically and graphically, including

a) determining whether a relation is a function;
b) domain and range;
c) zeros of a function;
d) *x*- and *y*-intercepts;
e) finding the values of a function for elements in its domain; and
f) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
$[x, f(x)]$ is a member of f. • An object x in the domain of f is an x-intercept or a zero of a function f if and only if $f(x) = 0$. • <u>Set builder notation may be used to represent domain and range of a relation.</u>	

TOPIC: FUNCTIONS

ALGEBRA I
STANDARD A.8

The student, given a situation in a real-world context, will analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The constant of proportionality ~~k~~ in a direct variation is represented by the ratio of ~~y to x~~ the dependent variable to the independent variable ~~($k = \frac{y}{x}$), where y is the dependent variable~~. • The constant of proportionality in an inverse variation is represented by the product of the dependent variable and the independent variable. • ~~Direct variation is used to represent a constant rate of change in practical applications.~~ • A direct variation can be represented by a line passing through the origin. • ~~In direct variation, equal changes in x result in proportional changes in y.~~ • Real-world problems may be modeled using direct and/or inverse variations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given a situation, including a real-world situation, ~~table of values,~~ determine whether a direct variation exists. • Given a situation, including a real-world situation, determine whether an inverse variation exists. • Write an equation for a direct variation, given a set of data. • Write an equation for an inverse variation, given a set of data. • ~~Graph a direct variation from a table of values or a practical situation.~~ • Graph an equation representing a direct variation, given a set of data.

TOPIC: STATISTICS

ALGEBRA I
STANDARD A.9

The student, given a set of data, will interpret variation in real-world contexts and calculate and interpret mean absolute deviation, standard deviation, and z-scores.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Descriptive statistics may include measures of center and variation. • Variance, standard deviation, and mean absolute deviation may be used to measure the variability in the data. • Standard deviation is expressed in the original units of measurement of the data. • Standard deviation addresses the dispersion of data about the mean. • A z-score is a measure of position derived from the mean and standard deviation of data.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given data, including data in a real-world context, calculate and interpret the mean absolute deviation. • Given data, including data in a real-world context, calculate and interpret the variance and standard deviation. • Given data, including data in a real-world context, calculate and interpret z-scores for the data. • Analyze descriptive statistics to determine the implications for the real-world situations from which the data derive. • Explain ways in which standard deviation addresses dispersion by examining the formula for standard deviation. • Compare and contrast mean absolute deviation and standard deviation in a real-world context.

TOPIC: STATISTICS

ALGEBRA I
STANDARD A.10

The student will compare and contrast multiple univariate data sets using box-and-whisker plots.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Statistical techniques can be used to organize, display, and compare sets of data. • Box-and-whisker plots can be used to analyze data.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare, contrast, and analyze ~~two sets of~~ data, including data from real-world situations ~~using~~ displayed in box-and-whisker plots.

TOPIC: STATISTICS

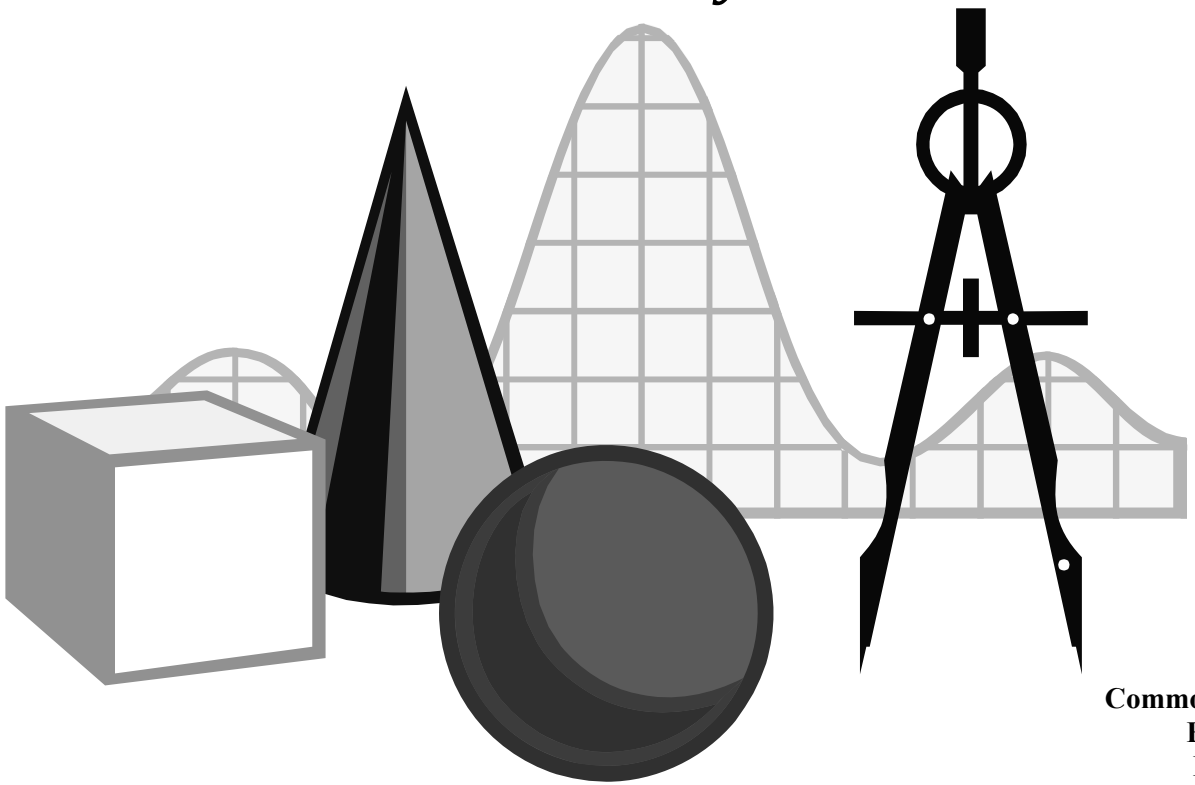
ALGEBRA I
STANDARD A.11

The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems using mathematical models. Mathematical models will include linear and quadratic functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The graphing calculator can be used to determine the equation of a curve of best fit for a set of data. • The curve of best fit for the relationship among a set of data points can be used to make predictions where appropriate. • Many problems can be solved by using a mathematical model as an interpretation of a real-world situation. The solution must then refer to the original real-world situation. • Considerations such as sample size, randomness, and bias should affect experimental design.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write an equation for ~~the line~~ a curve of best fit, given a set of ~~six to ten~~ no more than twenty data points in a table, ~~on~~ a graph, or ~~from~~ a ~~practical~~ real-world situation. • Make predictions about unknown outcomes, using the equation of the curve of best fit. • Design experiments and collect data to address specific, real-world questions. • Evaluate the contextual validity of a mathematical model of a real-world situation.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Geometry



Commonwealth of Virginia
Board of Education
Richmond, Virginia
Draft July 23, 2009

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Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: REASONING, LINES, AND TRANSFORMATIONS

GEOMETRY
STANDARD G.1

The student will construct and judge the validity of a logical argument consisting of a set of premises and a conclusion. This will include

a) identifying the converse, inverse, and contrapositive of a conditional statement;
b) translating a short verbal argument into symbolic form;
c) using Venn diagrams to represent set relationships; and
d) using deductive reasoning.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Reasoning~~ Inductive reasoning, deductive reasoning, and proof are critical in establishing general claims. • Deductive reasoning is the method that uses logic to draw conclusions based on definitions, postulates, and theorems. • Inductive reasoning is the method of drawing conclusions from a limited set of observations. • Proof is a justification that is logically valid and based on initial assumptions, definitions, postulates, and theorems. • Logical arguments consist of a set of premises or hypotheses and a conclusion. • Euclidean geometry is an axiomatic system based on undefined terms (point, line and plane), postulates, and theorems. • When a conditional and its converse are true, the statements can be written as a biconditional, i.e., *iff* or *if and only if*.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the converse, inverse, and contrapositive of a conditional statement. • Translate ~~short~~ verbal arguments into symbolic form, such as $(p \rightarrow q)$ and $(\sim p \rightarrow \sim q)$. • Determine the validity of a logical argument. • Use valid forms of deductive reasoning, including the law of syllogism, the law of the contrapositive, the law of detachment, and counterexamples. • Select and use various types of reasoning and methods of proof, as appropriate. • ~~Use and interpret Venn diagrams.~~ • Use Venn diagrams to represent set relationships, such as intersection, and union.

TOPIC: REASONING, LINES, AND TRANSFORMATIONS

GEOMETRY
STANDARD G.1

The student will construct and judge the validity of a logical argument consisting of a set of premises and a conclusion. This will include

a) identifying the converse, inverse, and contrapositive of a conditional statement;
b) translating a short verbal argument into symbolic form;
c) using Venn diagrams to represent set relationships; and
d) using deductive reasoning.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	• Interpret Venn diagrams. • Recognize and use the symbols of formal logic, which include $\rightarrow$, $\leftrightarrow$, $\sim$, $\therefore$, $\wedge$, and $\vee$.

TOPIC: REASONING, LINES, AND TRANSFORMATIONS

GEOMETRY
STANDARD G.2

The student will use the relationships between angles formed by two lines cut by a transversal to

a) determine whether two lines are parallel;
b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and
c) solve real-world problems involving angles formed when parallel lines are cut by a transversal.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Parallel lines ~~cut~~ intersected by a transversal form angles with specific relationships. • ~~A proof is a chain of logical statements starting with given information and leading to a conclusion.~~ • Some angle relationships may be used ~~to prove~~ when proving ~~that~~ two lines ~~cut~~ intersected by a transversal are parallel. • The Parallel Postulate differentiates Euclidean from non-Euclidean geometries such as spherical geometry and hyperbolic geometry.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Use properties, postulates, and theorems to determine whether two lines are parallel.~~ • Use algebraic~~,~~ and coordinate methods as well as deductive ~~methods~~ proofs to ~~determine~~ verify whether two lines are parallel. • Solve problems by using the relationships between pairs of angles including corresponding angles, alternate interior angles, alternate exterior angles, and same-side (consecutive) interior angles. • Solve ~~practical~~ real-world problems involving intersecting and parallel lines in a plane.

TOPIC: REASONING, LINES, AND TRANSFORMATIONS

GEOMETRY
STANDARD G.3

The student will use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include

a) investigating and using formulas for finding distance, midpoint, and slope;
b) applying slope to verify and determine whether lines are parallel or perpendicular;
c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and
d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Transformations and combinations of transformations can be used to describe movement of objects in a plane. • The distance formula is an application of the Pythagorean Theorem. • Geometric figures can be represented in the coordinate plane. • Techniques for investigating symmetry may include paper folding, coordinate methods, and dynamic geometry software. • Parallel lines have the same slope. • <u>The product of the slopes of perpendicular lines is -1.</u> • <u>The image of an object or function graph after an isomorphic transformation is congruent to the preimage of the object.</u>	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the coordinates of the midpoint of a segment, using the midpoint formula. • <u>Compare the slopes to determine whether two lines are parallel, perpendicular, or neither.</u> • Determine whether a figure has point symmetry, line symmetry, or neither. • Given an image and preimage, identify the transformation that has taken place as a reflection, rotation, <u>dilation</u>, or translation. • Apply the distance formula to find the length of a line segment when given the coordinates of the endpoints.

TOPIC: REASONING, LINES, AND TRANSFORMATIONS

GEOMETRY
STANDARD G.4

The student will construct and justify the constructions of

a) a line segment congruent to a given line segment;
b) the perpendicular bisector of a line segment;
c) a perpendicular to a given line from a point not on the line;
d) a perpendicular to a given line at a given point on the line;
e) the bisector of a given angle;
f) an angle congruent to a given angle; and
g) a line parallel to a given line through a point not on the given line.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Construction techniques are used to solve ~~real-life~~ real-world problems in engineering, architectural design, and building construction. • Construction techniques may include using a straightedge and compass, paper folding, and dynamic geometry software.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct and justify the constructions of – a line segment congruent to a given line segment; – the perpendicular bisector of a line segment; – a perpendicular to a given line from a point not on the line; – a perpendicular to a given line at a point on the line; – the bisector of a given angle; – an angle congruent to a given angle; and – a line parallel to a given line through a point not on the given line.

TOPIC: TRIANGLES

GEOMETRY
STANDARD G.5

The student, given information concerning the lengths of sides and/or measures of angles in triangles, will

a) order the sides by length, given the angle measures;
b) order the angles by degree measure, given the side lengths;
c) determine whether a triangle exists; and
d) determine the range in which the length of the third side must lie.

These concepts will be considered in the context of real-world situations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The longest side of a triangle is opposite the largest angle of the triangle and the shortest side is opposite the smallest angle. • In a triangle, ~~the measure of an angle and the lengths of the adjacent sides~~ the length of two sides and the included angle determine the length of the side opposite the angle. • In order for a triangle to exist, the length of each side must be within a range that is determined by the lengths of the other two sides.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Arrange the sides of a triangle in order from smallest to largest when given the measures of the angles.~~ Order the sides of a triangle by their lengths when given the measures of the angles. • Arrange the angles of a triangle in order from smallest to largest when given the lengths of the sides. Order the angles of a triangle by their measures when given the lengths of the sides. • Given the lengths of three segments, determine whether a triangle could be formed. • Given the lengths of two sides of a triangle, determine the range in which the length of the third side must lie. • Solve real-world problems given information about the lengths of sides and/or measures of angles in triangles.

TOPIC: TRIANGLES

GEOMETRY
STANDARD G.6

The student, given information in the form of a figure or statement, will prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Congruence has real-life applications in a variety of areas, including art, architecture, and the sciences. • Congruence does not depend on the position of the triangle. • Concepts of logic can demonstrate congruence or similarity. • Congruent figures are also similar, but similar figures are not necessarily congruent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use definitions, postulates, and theorems to ~~determine~~ <u>prove</u> ~~whether~~ triangles ~~are~~ congruent. • Use coordinate methods, such as the distance formula and the slope formula, to prove two triangles are congruent. • <u>Use algebraic methods to prove two triangles are congruent</u>.

TOPIC: TRIANGLES

GEOMETRY
STANDARD G.7

The student, given information in the form of a figure or statement, will prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Similarity has real-~~life~~ world applications in a variety of areas, including art, architecture, and the sciences. • Similarity does not depend on the position of the triangle. • Congruent figures are also similar, but similar figures are not necessarily congruent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use definitions, postulates, and theorems to ~~determine~~ prove ~~whether~~ triangles ~~are~~ similar. • Use algebraic methods, such as properties of proportions, to prove that triangles are similar. • Use coordinate methods, such as the distance formula, to prove two triangles are similar.

TOPIC: TRIANGLES

GEOMETRY
STANDARD G.8

The student will solve real-world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles, and right triangle trigonometry.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The Pythagorean Theorem is essential for solving problems involving right triangles. • Many historical and algebraic proofs of the Pythagorean Theorem exist. • The relationships between the sides and angles of right triangles are useful in many applied fields. • Some practical problems can be solved by choosing an efficient representation of the problem. • Another formula for the area of a triangle is $A = \frac{1}{2} ab \sin C$. • The ratios of side lengths in similar right triangles (adjacent/hypotenuse or opposite/hypotenuse) are independent of the scale factor and depend only on the angle the hypotenuse makes with the adjacent side, thus justifying the definition and calculation of trigonometric functions using the ratios of side lengths for similar right triangles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine whether a triangle formed with three given lengths is a right triangle. • Solve for missing lengths in geometric figures, using properties of 45°-45°-90° triangles. • Solve for missing lengths in geometric figures, using properties of 30°-60°-90° triangles. • Solve problems involving right triangles, using sine, cosine, and tangent ratios. • Solve real-world problems, using right triangle trigonometry and properties of right triangles.

TOPIC: POLYGONS AND CIRCLES

GEOMETRY
STANDARD G.9

The student will verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The terms characteristics and properties can be used interchangeably to describe quadrilaterals. The term characteristics is used in elementary and middle school mathematics. • Quadrilaterals have a hierarchical nature based on the relationships between their sides, angles, and diagonals. • ~~Properties~~ Characteristics of quadrilaterals can be used to identify the quadrilateral and to find the measures of sides and angles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve ~~practical~~ problems, including real-world problems, using the properties specific to parallelograms, rectangles, rhombi, squares, isosceles trapezoids, and trapezoids. • Prove that quadrilaterals have specific properties, using coordinate and algebraic methods, such as the distance formula, slope, and midpoint formula. • Prove the ~~properties~~ characteristics of quadrilaterals, using deductive reasoning, algebraic, and coordinate methods.

TOPIC: POLYGONS AND CIRCLES

GEOMETRY
STANDARD G.10

The student will solve real-world problems involving angles of polygons.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A regular polygon will tessellate the plane if the measure of an interior angle is a factor of 360. • Both regular and nonregular polygons can tessellate the plane. • Two intersecting lines form angles with specific relationships. • An exterior angle is formed by extending a side of a polygon. • The exterior angle and the corresponding interior angle form a linear pair. • The sum of the measures of the interior angles of a convex polygon may be found by dividing the interior of the polygon into nonoverlapping triangles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve real-world problems involving the measures of interior and exterior angles of polygons. • Identify tessellations in art, construction, and nature. • Find the sum of the measures of the interior and exterior angles of a convex polygon. • Find the measure of each interior and exterior angle of a regular polygon. • Find the number of sides of a regular polygon, given the measures of interior or exterior angles of the polygon.

TOPIC: POLYGONS AND CIRCLES

GEOMETRY
STANDARD G.11

The student will use angles, arcs, chords, tangents, and secants to

a) investigate, verify, and apply properties of circles;
b) solve real-world problems involving properties of circles; and
c) find arc lengths and areas of sectors in circles.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Many relationships exist between and among angles, arcs, secants, chords, and tangents of a circle. • All circles are similar. • A chord is part of a secant. • Real-world applications may be drawn from architecture, art, and construction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find lengths, angle measures, and arc measures associated with – two intersecting chords; – two intersecting secants; – an intersecting secant and tangent; – two intersecting tangents; and – central and inscribed angles. • Calculate the area of a sector and the length of an arc of a circle, using proportions. • Solve real-world problems associated with circles, using properties of angles, lines, and arcs. • Prove properties of circles, using deductive reasoning, algebraic, and coordinate methods.

TOPIC: POLYGONS AND CIRCLES

GEOMETRY
STANDARD G.12

The student, given the coordinates of the center of a circle and a point on the circle, will write the equation of the circle.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A circle is a locus of points equidistant from a given point, the center. • Standard form for the equation of a circle is $(x - h)^2 + (y - k)^2 = r^2$. • The coordinates of the center of the circle are (h, k) and r is the length of the radius. • The circle is a conic section.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the center of a circle from a given standard equation. • Use the distance formula to find the radius of a circle. • Given the coordinates of the center and radius of the circle, identify a point on the circle. • Given the equation of a circle, identify the coordinates of the center and find the radius of the circle. • Given the coordinates of the endpoints of a diameter, find the equation of the circle.

TOPIC: THREE-DIMENSIONAL FIGURES

GEOMETRY
STANDARD G.13

The student will use formulas for surface area and volume of three-dimensional objects to solve real-world problems.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The surface area of a three-dimensional object is the sum of the areas of all its faces. • The volume of a three-dimensional object is the number of unit cubes that would fill the object.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the total surface area of cylinders, prisms, pyramids, cones, and spheres, using the appropriate formulas. • Calculate the volume of cylinders, prisms, pyramids, cones, and spheres, using the appropriate formulas. • Solve ~~practical~~ problems, <u>including real-world problems,</u> involving total surface area and volume of cylinders, prisms, pyramids, cones, and spheres as well as combinations of three-dimensional figures. • <u>Calculators may be used to find decimal approximations for results.</u>

TOPIC: THREE-DIMENSIONAL FIGURES

GEOMETRY
STANDARD G.14

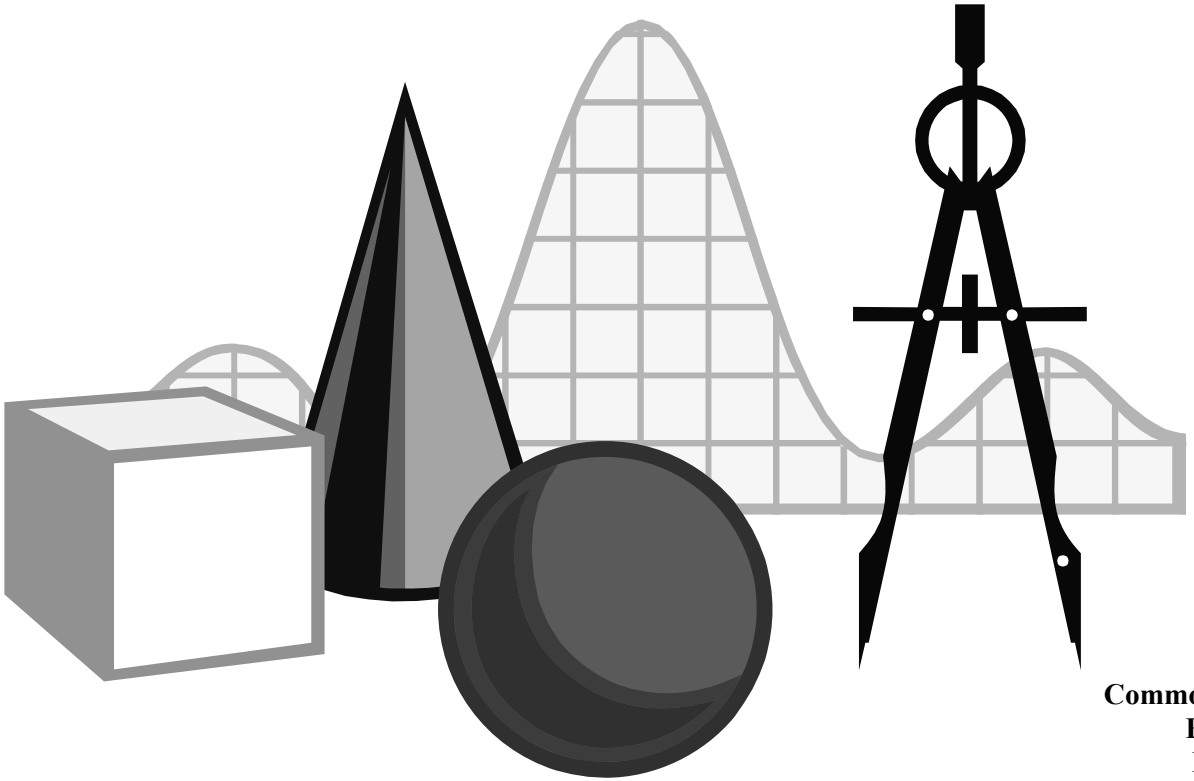
The student will use similar geometric objects in two- or three-dimensions to

a) compare ratios between side lengths, perimeters, areas, and volumes;
b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;
c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and
d) solve real-world problems about similar geometric objects.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A change in one dimension of an object results in predictable changes in area and/or volume. • A constant ratio exists between corresponding lengths of sides of similar figures. • Proportional reasoning is integral to comparing attribute measures in similar objects.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Compare perimeters and areas of similar two-dimensional figures, using proportions.~~ • Describe how ~~a~~ changes in one or more ~~measures~~ dimensions affect~~s~~ other derived measures (perimeter, area, total surface area, and volume) of an object. • Describe how changes in one or more measures (perimeter, area, total surface area, and volume) affect other measures of an object. • Solve ~~practical~~ real-world problems involving measured attributes of similar objects.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Algebra, Functions, and Data Analysis



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Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

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TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS
STANDARD AFDA.1

The student will investigate and analyze function (linear, quadratic, exponential, and logarithmic) families and their characteristics. Key concepts include:

a) continuity
b) local and absolute maxima and minima
c) domain and range
d) zeros
e) intercepts
f) intervals in which the function is increasing/decreasing
g) end behaviors
h) asymptotes

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The domain of a function consists of the first coordinates of the ordered pairs that are elements of a function. Each element in the domain is an input into the independent variable of the function. • The range of a function consists of the second coordinates of the ordered pairs that are elements of a function. Each element in the range is an output in the dependent variable of a function. • For each x in the domain of f, x is a member of the input of the function f, $f(x)$ is a member of the output of f, and the ordered pair $[x, f(x)]$ is a member of f. • A value x in the domain of f is an x-intercept or a zero of a function f if and only if $f(x) = 0$. • Functions describe the relationship between two variables where each input is paired to a unique output.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the domain and range for a relation, given a set of ordered pairs, a table, or a graph. • For each x in the domain of f, find $f(x)$. • Identify the zeros of the function algebraically and confirm them, using the graphing calculator. • Identify the domain, range, zeros, and intercepts of a function presented algebraically or graphically. • Recognize restricted/discontinuous domains and ranges. • Recognize graphs of parent functions for linear, quadratic, exponential and logarithmic functions.

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS
STANDARD AFDA.1

The student will investigate and analyze function (linear, quadratic, exponential, and logarithmic) families and their characteristics. Key concepts include:

a) continuity
b) local and absolute maxima and minima
c) domain and range
d) zeros
e) intercepts
f) intervals in which the function is increasing/decreasing
g) end behaviors
h) asymptotes

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Functions are used to model real-world phenomena. • A function is increasing on an interval if its graph, as read from left to right, is rising in that interval. • A function is decreasing on an interval if its graph, as read from left to right, is going down in that interval. • Exponential and logarithmic functions are either strictly increasing or strictly decreasing. • A function is continuous on an interval if the function is defined for every value in the interval and there are no breaks in the graph. A continuous function can be drawn without lifting the pencil. • A turning point is a point on a continuous interval where the graph changes from increasing to decreasing or from decreasing to increasing.	• Identify *x*-intercepts (zeros), *y*-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, points of discontinuity, end behavior, and maximum and minimum points, given a graph of a function. • Describe continuity of a function on its domain or at a point. • Express intervals using correct interval notation and/or a compound inequality.

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.1

The student will investigate and analyze function (linear, quadratic, exponential, and logarithmic) families and their characteristics. Key concepts include:

a) continuity
b) local and absolute maxima and minima
c) domain and range
d) zeros
e) intercepts
f) intervals in which the function is increasing/decreasing
g) end behaviors
h) asymptotes

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A function, f, has a local maximum in some interval at $x = a$ if $f(a)$ is the largest value of f in that interval. • A function, f, has a local minimum in some interval at $x = a$ if $f(a)$ is the smallest value of f in that interval. • Asymptotes can be used to describe local behavior and end behavior of graphs. They are lines or other curves that approximate the graphical behavior of a function. • The following statements are equivalent: – k is a zero of the polynomial function f; – k is a solution of the polynomial equation $f(x) = 0$; – k is an x-intercept for the graph of the polynomial; and – $(x - k)$ is a factor of the polynomial. • Continuous and discontinuous functions can be identified by their equations or graphs. The end behavior of a function refers to the	

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS
STANDARD AFDA.1

The student will investigate and analyze function (linear, quadratic, exponential, and logarithmic) families and their characteristics. Key concepts include:

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h) asymptotes

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
graphical behavior of a function as x goes to positive and negative infinity.	

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.2

The student will use knowledge of transformations to write an equation given the graph of a function (linear, quadratic, exponential, and logarithmic).

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Knowledge of transformational graphing using parent functions can be used to generate a mathematical model from a scatter plot that approximates the data. • Transformations include: - Translations (horizontal and vertical shifting of a graph) - Reflections - Dilations (stretching and compressing graphs) and - Rotations • The equation of a line can be determined by two points on the line or by the slope and a point on the line.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write an equation of a line when given the graph of a line. • Recognize graphs of parent functions for linear, quadratic, exponential and logarithmic functions. • Write the equation of a linear, quadratic, exponential, or logarithmic function in *(h, k)* form given the graph of the parent function and transformation information. • Describe the transformation from the parent function given the equation written in *(h, k)* form or the graph of the function. • Given the equation of a function, recognize the parent function and transformation to graph the given function. • Recognize the vertex of a parabola given a quadratic equation in *(h, k)* form or graphed. • Describe the parent function represented by a scatter plot.

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.3

The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The regression equation modeling a set of data points can be used to make predictions where appropriate. • Data and scatter plots may indicate patterns that can be modeled with a function. • Graphing calculators can be used to collect, organize, picture, and create an algebraic model of the data. • Data that fit linear, quadratic, exponential, and logarithmic models arise from practical situations. • Two variables may be strongly associated without a cause-and-effect relationship existing between them. • Each data point may be considered to be comprised of two parts: fit (the part explained by the model) and residual (the result of chance variation or of variables not measured). • Residual = Actual – Fitted • Least squares regression generates the equation of the line that minimizes the sum of the squared distances between the data points and the line.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write an equation for the line of best fit, given a set of data points in a table, on a graph, or from a practical situation. • Make predictions about unknown outcomes, using the equation of a line of best fit. • Collect and analyze data to make decisions and justify conclusions. • Investigate scatter plots to determine if patterns exist, and identify the patterns. • Find an equation for the curve of best fit for data, using a graphing calculator. Models will include linear, quadratic, exponential, and logarithmic functions. • Make predictions, using data, scatter plots, or equation of curve of best fit. • Given a set of data, determine the model that would best describe the data. • Describe the errors inherent in extrapolation beyond the range of

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.3

The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A correlation coefficient measures the degree of association between two variables that are related linearly.	the data. • Estimate the correlation coefficient when given data and/or scatter plots.

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.4

The student will transfer between and analyze multiple representations of functions including algebraic formulae, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The most appropriate representation of a function depends on the questions to be answered and/or the analysis to be done. • Given data may be represented as discrete points or as a continuous graph with respect to the real-world context. • Real-world data may best be represented as a table, a graph, or as a formula.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given an equation, graph a linear, quadratic, exponential or logarithmic function with the aid of a graphing calculator. • Make predictions given a table of values, a graph, or an algebraic formula. • Describe relationships between data represented in a table, in a scatter plot, and as elements of a function. • Determine the appropriate representation of data derived from real-world situations. • Analyze and interpret the data in context of the real-world situation.

TOPIC: ALGEBRA AND FUNCTIONS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.5

The student will determine optimal values in problem situations by identifying constraints and using linear programming techniques.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Linear programming models an optimization process. • A linear programming model consists of a system of constraints and an objective quantity that can be maximized or minimized. • Any maximum or minimum value will occur at a corner point of a feasible region.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model practical problems with systems of linear inequalities. • Solve systems of linear inequalities with pencil and paper and using a graphing calculator. • Solve systems of equations algebraically and graphically. • Identify the feasibility region of a system of linear inequalities. • Identify the coordinates of the corner points of a feasibility region. • Find the maximum or minimum value for the function defined over the feasibility region. • Describe the meaning of the maximum or minimum value within its context.

TOPIC: DATA ANALYSIS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.6

The student will calculate probabilities. Key concepts include:

a) **conditional probability**
b) **dependent and independent events**
c) **addition and multiplication rules**
d) **counting techniques (permutations and combinations)**
e) **Law of Large Numbers**

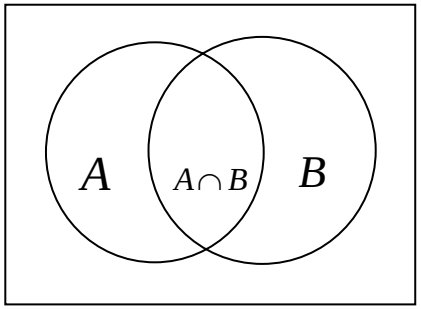
ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The *Fundamental Counting Principle* states that if one decision can be made *n* ways and another can be made *m* ways, then the two decisions can be made *nm* ways. • *Permutations* are used to calculate the number of possible arrangements of objects. • *Combinations* are used to calculate the number of possible selections of objects without regard to the order selected. • A *sample space* is the set of all possible outcomes of a random experiment. • An *event* is a subset of the sample space. • *P(E)* is a way to represent the probability that the event E occurs. • *Mutually exclusive events* are events that cannot both occur simultaneously. • If *A* and *B* are mutually exclusive then $P(A \cup B) = P(A) + P(B)$.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast permutations and combinations. • Calculate the number of permutations of *n* objects taken *r* at a time. • Calculate the number of combinations of *n* objects taken *r* at a time. • Define and give contextual examples of complementary, dependent, independent, and mutually exclusive events. • Given two or more events in a problem setting, determine if the events are complementary, dependent, independent, and/or mutually exclusive. • Find conditional probabilities for dependent, independent, and mutually exclusive events. • Represent and calculate probabilities using Venn diagrams and probability trees.

TOPIC: DATA ANALYSIS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.6

The student will calculate probabilities. Key concepts include:

a) conditional probability
b) dependent and independent events
c) addition and multiplication rules
d) counting techniques (permutations and combinations)
e) Law of Large Numbers

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The complement of event A consists of all outcomes in which event A does not occur. • *P(B|A)* is the probability that *B* will occur given that *A* has already occurred. *P(B|A)* is called *the conditional probability* of *B* given *A*. • Venn diagrams may be used to examine conditional probabilities.  $P(B\|A) = \frac{P(A \cap B)}{P(A)}$ $\Rightarrow P(A \cap B) = P(A)P(B\|A)$ • Two events, *A* and *B*, are independent if the occurrence of one does not affect the probability of the occurrence of the other. If *A* and *B* are not independent, then they are said to be dependent.	• Analyze, interpret and make predictions based on theoretical probability within real-world context. • Given a real-world situation, determine when to use permutations or combinations.

TOPIC: DATA ANALYSIS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.6

The student will calculate probabilities. Key concepts include:

a) conditional probability
b) dependent and independent events
c) addition and multiplication rules
d) counting techniques (permutations and combinations)
e) Law of Large Numbers

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• If A and B are independent events, then $P(A \cap B) = P(A)P(B)$. • The *Law of Large Numbers* states that as a procedure is repeated again and again, the relative frequency probability of an event tends to approach the actual probability.	

TOPIC: DATA ANALYSIS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS STANDARD AFDA.7

The student will analyze the normal distribution. Key concepts include:

a) characteristics of normally distributed data
b) percentiles
c) normalizing data using z-scores
d) area under the standard normal curve and probability

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Analysis of the descriptive statistical information generated by a univariate data set includes the relationships between central tendency, dispersion, and position. • The normal distribution curve is a family of symmetrical curves defined by the mean and the standard deviation. • Areas under the curve represent probabilities associated with continuous distributions. • The normal curve is a probability distribution and the total area under the curve is 1. • The mean of the data in a standard normal density function is 0 and the standard deviation is 1. This allows for the comparison of unlike data. • The amount of data that falls within 1, 2, or 3 standard deviations of the mean is constant and the basis of z-score data normalization.	• Interpret mean, median, mode, range, interquartile range, variance, and standard deviation of a univariate data set in terms of the problem's context. • Explain the influence of outliers on a univariate data set. • Explain ways in which standard deviation addresses dispersion by examining the formula for standard deviation. • Identify the properties of a normal probability distribution. • Describe how the standard deviation and the mean affect the graph of the normal distribution. • Determine the probability of a given event, using the normal distribution.

TOPIC: DATA ANALYSIS

ALGEBRA, FUNCTIONS AND DATA ANALYSIS
STANDARD AFDA.8

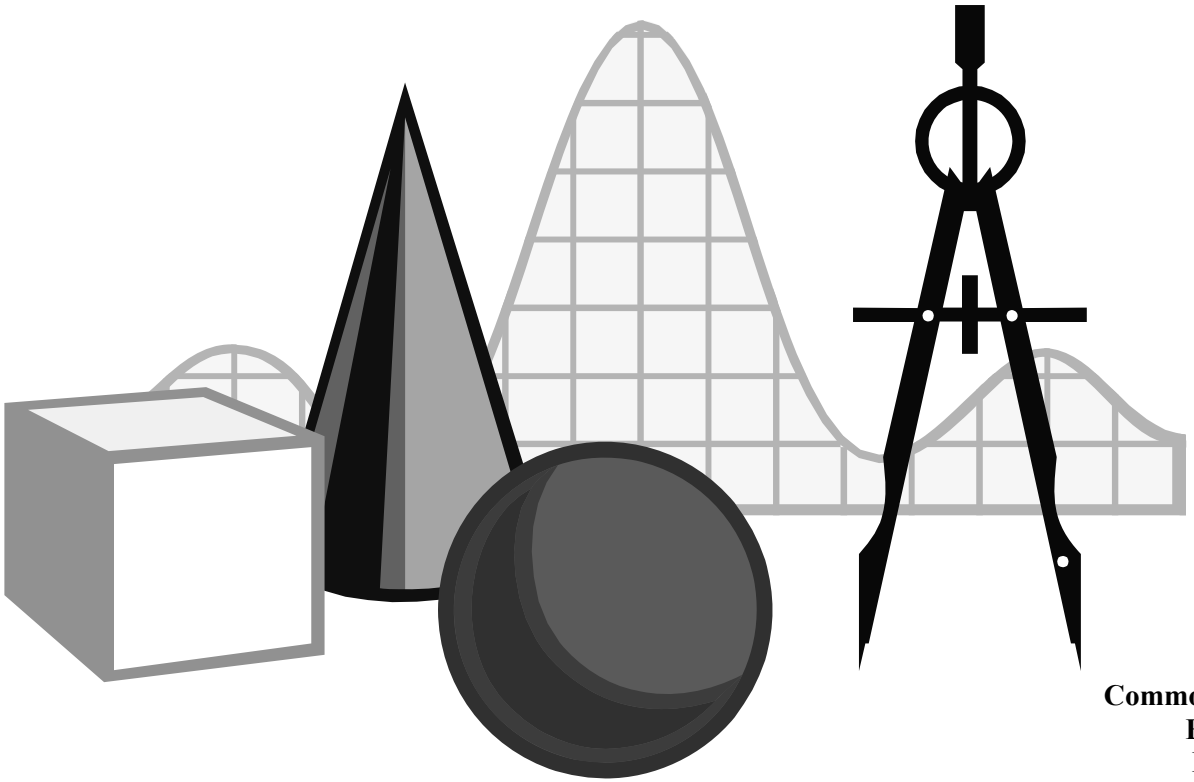
The student will design and conduct an experiment/survey. Key concepts include:

a) **sample size**
b) **sampling technique**
c) **controlling sources of bias and experimental error**
d) **data collection**
e) **data analysis and reporting**

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The value of a sample statistic may vary from sample to sample, even if the simple random samples are taken repeatedly from the population of interest. • Poor data collection can lead to misleading and meaningless conclusions. • The purpose of sampling is to provide sufficient information so that population characteristics may be inferred. • Inherent bias diminishes as sample size increases. • Experiments must be carefully designed in order to detect a cause-and-effect relationship between variables. • Principles of experimental design include comparison with a control group, randomization, and blindness.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast controlled experiments and observational studies and the conclusions one may draw from each. • Identify biased sampling methods. • Select a data collection method appropriate for a given context. • Investigate and describe sampling techniques, such as simple random sampling, stratified sampling, and cluster sampling. • Determine which sampling technique is best, given a particular context. • Plan and conduct an experiment or survey. The experimental design should address control, randomization, and minimization of experimental error. • Design a survey instrument.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Computer Mathematics



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Board of Education
Richmond, Virginia
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The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: PROBLEM SOLVING

COMPUTER MATHEMATICS
STANDARD COM.1

The student will apply programming techniques and skills to solve real-world problems in mathematics arising from consumer, business, personal finance, leisure activities, sports, probability and statistics, and other applications in mathematics. Problems will include opportunities for students to analyze data in charts, graphs, and tables and to use their knowledge of equations, formulas, and functions to solve these problems.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The computer is an essential tool for mathematical problem solving in consumer-related problems. • A subtask that has been solved previously may be used again and again. • Programming languages require the use of particular structures to express algorithms as programs. • Designing algorithms is the problem solving phase of computer programming. • Real-world problems that can be modeled mathematically can be solved with a computer program. • Data arising from probability and statistics applications can be displayed in tables and graphs and analyzed within the structure of a computer program.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design and implement computer programs to solve consumer problems. • Analyze and interpret graphs, charts, and tables in the design and implementation of a computer program. • Design and implement computer programs to – solve mathematical problems, using formulas; – solve mathematical problems, using equations; – solve mathematical problems, using functions; – solve problems related to geometry, business, and leisure; – solve probability problems; – solve data-analysis problems; and – solve statistical problems.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.2

The student will design, write, test, debug, and document a program. Programming documentation will include pre-conditions and post-conditions of program segments, input/output specifications, the step-by-step plan, the test data, a sample run, and the program listing with appropriately placed comments.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The successful completion of a structured program requires problem solving skills.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe what a computer program is. • List and describe the stages involved in writing a computer program. • Describe the function of an algorithm. • Describe the interplay between hardware and software in program execution. • Compare and contrast compiling and executing a program. • Determine what a given output statement will print. • Debug a program. • Provide required documentation for a program.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.3

The student will write program specifications that define the constraints of a given problem. These specifications will include descriptions of pre-conditions, post-conditions, the desired output, analysis of the available input, and an indication as to whether or not the problem is solvable under the given conditions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A programmer begins the programming process by analyzing the problem and developing a general solution (algorithm). • The successful completion of a structured program requires problem solving skills.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • For a given problem, describe the pre-conditions, post-conditions, and desired output. • Determine whether or not a problem is solvable. • Write program specifications that define the constraints of a problem.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.4

The student will design a step-by-step plan (algorithm) to solve a given problem. The plan will be in the form of a program flowchart, pseudo code, hierarchy chart, and/or data-flow diagram.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• All programs are implementations of algorithms.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design a step-by-step plan to solve a problem. • Utilize the following problem solving formats: – flowchart; – pseudo code; – hierarchy chart; and – data-flow diagram.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.5

The student will divide a given problem into manageable sections (modules) by task and implement the solution. The modules will include an appropriate user-defined function, subroutines, and procedures. Enrichment topics might include user-defined libraries (units) and object-oriented programming.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Functional decomposition is a way to develop a program in which the problem is divided into subproblems whose solutions comprise the solution to the original problem.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Subdivide a problem into modules by task. • Implement the solution of the problem. • Write task-oriented modules, including – a user-defined function; – subroutines; and – procedures. • Determine the need for a subroutine or user-defined function. • Determine the difference between and the need for internal and external subroutines and functions.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.12

The student will translate a mathematical expression into a computer statement, which involves writing assignment statements and using the order of operations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A variable identifies a location in memory where a data value that can be changed is stored. • An assignment statement stores the value of an expression into a variable. • The order of operations is – parentheses; – exponents; – multiplication and division in order from left to right; and – addition and subtraction in order from left to right. • Variable assignment statements will differ depending upon the programming language used.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Translate a mathematical expression into a computer statement. • Use the order of operations to simplify expressions. • Write variable assignment statements. • Construct and evaluate expressions that include multiple arithmetic operations.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.13

The student will select and implement built-in (library) functions in processing data.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The argument of a library function is a value or expression associated with the independent variable. • A library function is a subroutine.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use library functions in designing programs to process data. • Use library functions that are arithmetic or string operators. • Invoke a value-returning function.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.14

The student will implement conditional statements that include "if/then" statements, "if/then/else" statements, case statements, and Boolean logic.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Boolean logic is a system using variables with only two values: TRUE and FALSE. • The "if" statement is the fundamental control structure that allows branches in the flow of control.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct a simple logical (Boolean) expression to evaluate a given condition. • Construct an "if/then" statement to perform a specific task. • Construct an "if/then/else" statement to perform a specific task. • Use conditional statements to incorporate decision making into programs.

TOPIC: PROGRAM DESIGN

COMPUTER MATHEMATICS
STANDARD COM.17

The student will implement pre-existing algorithms, including sort routines, search routines, and simple animation routines.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Arranging values into an order is known as sorting. • A sequential search algorithm starts at the beginning of a list and examines each data value in sequence. • Implementation of animation routines will differ depending upon the programming language used.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Implement pre-existing algorithms into a program. • Implement a sort routine on a one-dimensional array. • Implement a sequential search routine on a one-dimensional array. • Implement a binary search routine on a one-dimensional array. • Implement a simple animation routine.

TOPIC: PROGRAM IMPLEMENTATION

COMPUTER MATHEMATICS
STANDARD COM.6

The student will design and implement the input phase of a program, which will include designing screen layout and getting information into the program by way of user interaction, data statements, and/or file input. The input phase also will include methods of filtering out invalid data (error trapping).

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A program needs data on which to operate. • A file is a named area in secondary storage that holds a collection of information.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design a screen layout to facilitate input. • Design program information input by – user interaction; – data statements (BASIC); and – file input. • Filter out invalid data, using a variety of methods (error trapping). • Construct input statements to read values into a program. • Determine the contents of variables that have been assigned values by input statements.

TOPIC: PROGRAM IMPLEMENTATION

COMPUTER MATHEMATICS
STANDARD COM.7

The student will design and implement the output phase of a computer program, which will include designing output layout, accessing a variety of output devices, using output statements, and labeling results.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Output is dependent on input. • Implementation of the output portion of a program includes designing the output and displaying it in the desired format.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design an output layout. • Access various output devices. • Use output statements. • Label results.

TOPIC: PROGRAM IMPLEMENTATION

COMPUTER MATHEMATICS
STANDARD COM.8

The student will design and implement computer graphics, which will include topics appropriate for the available programming environment as well as student background. Students will use graphics as an end in itself, as an enhancement to other output, and as a vehicle for reinforcing programming techniques.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Work with computer graphics is specific to the computer operating system.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design computer graphics. • Implement computer graphics. • Plot points and areas. • Determine and set window or screen dimensions. • Determine and set screen and background colors. • Use box commands. • Describe the role of graphics in the computer environment.

TOPIC: PROGRAM IMPLEMENTATION

COMPUTER MATHEMATICS
STANDARD COM.15

The student will implement loops, including iterative loops. Other topics will include single entry point, single exit point, pre-conditions, and post-conditions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A loop executes a sequence of statements repeatedly. • Nested loops contain other loops.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine when a loop is needed in a program. • Implement loops into programs. Include – iterative loops; – pre-test loops; and – post-test loops. • Incorporate single entry point, single exit point, pre-conditions, and post-conditions into loops.

TOPIC: PROGRAM IMPLEMENTATION

COMPUTER MATHEMATICS
STANDARD COM.16

The student will select and implement appropriate data structures, including arrays (one-dimensional and/or multidimensional), files, and records. Implementation will include creating the data structure, putting information into the structure, and retrieving information from the structure.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Structured data types are collections of components that are given a single name and whose organization is characterized by the method used to access the individual components. • Multidimensional arrays may be viewed as arrays of one-dimensional arrays.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Declare a one-dimensional or two-dimensional array for a given problem. • Choose an appropriate component type for an array. • Assign a value to an array component. • Fill an array with data, and process the data in the array. • Access a particular component of a two-dimensional array. • Process a two-dimensional array by rows and by columns. • Retrieve data from an array.

TOPIC: DATA MANIPULATION

COMPUTER MATHEMATICS
STANDARD COM.9

The student will define simple variable data types that include integer, real (fixed and scientific notation), character, string, and Boolean.

STANDARD COM.10

The student will use appropriate variable data types, including integer, real (fixed and scientific notation), character, string, and Boolean. This will also include variables representing structured data types.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A data type is a set of values and a set of operations on the values. • Boolean data has only two literal constants, and they represent TRUE and FALSE. • A string is an array for which there exists an aggregate constant.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Define and use variable data types, including – integer; – real (fixed and scientific notation); – character; – string; and – Boolean. • Write numeric and string variables, using valid names.

TOPIC: DATA MANIPULATION

COMPUTER MATHEMATICS
STANDARD COM.11

The student will describe the way the computer stores, accesses, and processes variables, including the following topics: the use of variables versus constants, variables' addresses, pointers, parameter passing, scope of variables, and local versus global variables.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Computers consist of hardware components that interact with software.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine when use of a variable is appropriate. • Describe how a computer stores, accesses, and processes variables. • Incorporate variable addresses, pointers, and parameter passing into programs. • Differentiate between local and global variables, and describe their appropriate use. • Compare and contrast variables and constants.

TOPIC: PROGRAM TESTING

COMPUTER MATHEMATICS
STANDARD COM.18

The student will test a program, using an appropriate set of data. The set of test data should be appropriate and complete for the type of program being tested.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A program test can reveal problems (bugs) in the program. • Testing a program for bugs is part of problem solving. • Various forms of data can be used to debug a program.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Test a program, using an appropriate and complete set of data.

TOPIC: PROGRAM TESTING

COMPUTER MATHEMATICS
STANDARD COM.19

The student will debug a program, using appropriate techniques (e.g., appropriately placed controlled breaks, the printing of intermediate results, and other debugging tools available in the programming environment), and identify the difference between syntax errors and logic errors.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Debugging a program is problem solving.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Debug a program, using controlled breaks, the printing of intermediate results, and other debugging tools. • Identify the differences among syntax errors, runtime errors, and logic errors.

TOPIC: PROGRAM TESTING

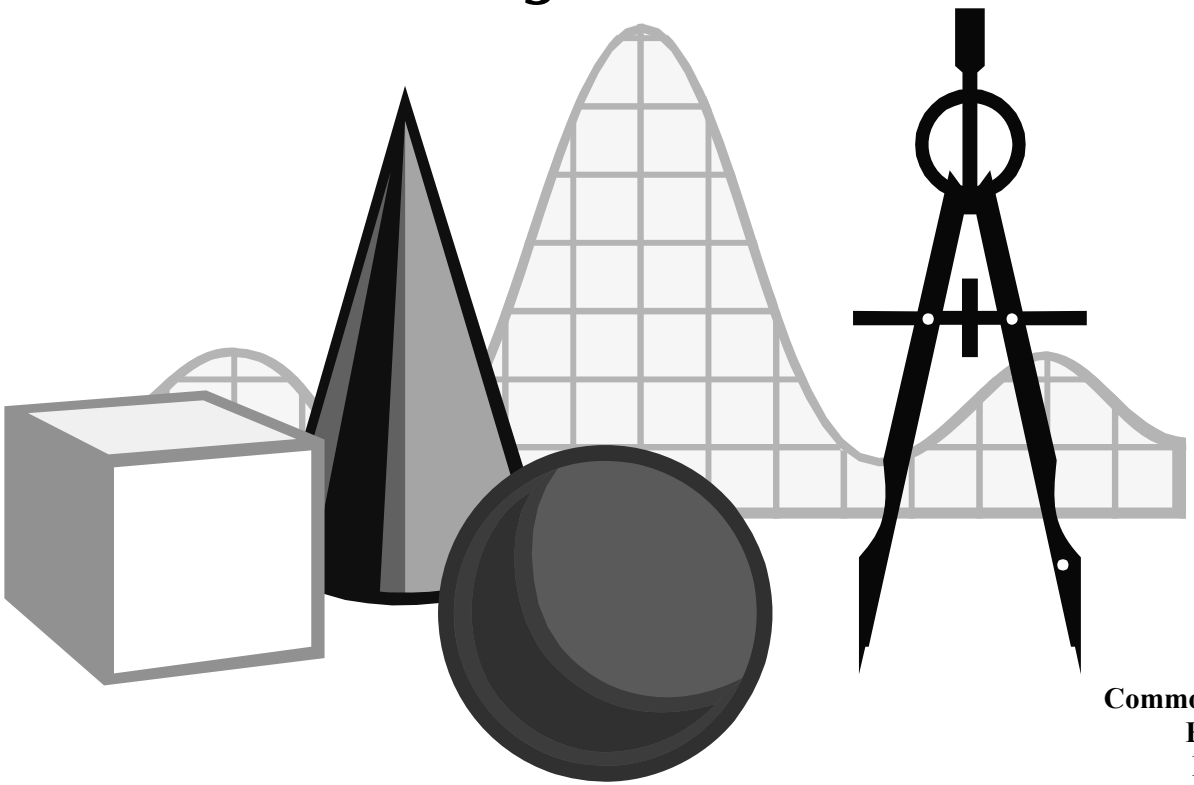
COMPUTER MATHEMATICS
STANDARD COM.20

The student will design, write, test, debug, and document a complete structured program that requires the synthesis of many of the concepts contained in previous standards.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The successful completion of a structured program requires problem solving skills.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design, write, test, debug, and document a complete structured program.

MATHEMATICS STANDARDS OF LEARNING
PROPOSED CURRICULUM FRAMEWORK

Algebra II



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Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA II
STANDARD AII.1

The student will

a) **add, subtract, multiply, divide, and simplify rational algebraic expressions;**
b) **add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents;**
c) **write radical expressions as expressions containing rational exponents and vice versa; and**
d) **factor polynomials completely.**

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Computational skills applicable to numerical fractions also apply to rational expressions involving variables. • Radical expressions can be written and simplified using rational exponents. • Only radicals with a common radicand and index can be added or subtracted. • A relationship exists among arithmetic complex fractions, algebraic complex fractions, and rational numbers. • The complete factorization of polynomials has occurred when each factor is a prime polynomial. • Pattern recognition can be used to determine complete factorization of a polynomial.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Add, subtract, multiply, and divide rational algebraic expressions ~~whose denominators are monomials or polynomial expressions in completely factored form~~. • Simplify a rational algebraic expression with common monomial or binomial factors. • Recognize a complex algebraic fraction, and simplify it as a quotient or product of simple algebraic fractions. • Simplify radical expressions containing positive rational numbers and variables. • Convert from radical notation to exponential notation, and vice versa. • Add and subtract radical expressions ~~with like radicands~~. • Multiply and divide radical expressions not requiring rationalizing

TOPIC: EXPRESSIONS AND OPERATIONS

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c) **write radical expressions as expressions containing rational exponents and vice versa; and**
d) **factor polynomials completely.**

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	the denominators. • ~~Determine the greatest monomial factor as a first step in complete factorization.~~ • ~~Recognize squares and cubes of positive integers.~~ • ~~Recognize examples of general patterns:~~ Factor polynomials by applying general patterns including difference of squares, sum and difference of cubes, and perfect square trinomials. • ~~Factor polynomials by applying general patterns.~~ • Factor polynomials completely over the integers

TOPIC: RELATIONS AND FUNCTIONS

ALGEBRA II
STANDARD AII.2

The student will investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first *n* terms, finding the nth term, and evaluating summation formulas. Notation will include $\sum$ and a_n.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Sequences and series arise from real-world situations. • The study of sequences and series is an application of the investigation of patterns. • <u>A sequence is a function whose domain is the set of natural numbers.</u> • <u>Sequences can be defined explicitly and recursively.</u>	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Distinguish between a sequence and a series. • ~~Recognize patterns in a sequence.~~ • <u>Generalize patterns in a sequence using explicit and recursive formulas.</u> • Use and interpret the notations $\sum$, n, n^{th} term, and a_n. • ~~Write the first *n* terms in an arithmetic or geometric sequence.~~ • Given the formula, find a_n (the nth term) for an arithmetic or a geometric sequence. • Given formulas, find the sum, S_n, of the first n terms of an arithmetic or geometric series, including infinite series. • <u>Use finite geometric series to model real-world situations.</u>

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA II
STANDARD AII.3

The student will perform operations on complex numbers, express the results in simplest form using patterns of the powers of *i*, and identify field properties that are valid for the complex numbers.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Complex numbers are organized into a hierarchy of subsets ~~with properties applicable to each subset~~. • ~~Complex numbers are a superset of real numbers and, as a system, contain solutions for equations that are not solvable over the set of real numbers.~~ • Equations having no real number solutions may have solutions in the set of complex numbers. • Field properties apply to complex numbers as well as real numbers. • All complex numbers can be written in the form a+b*i* where *a* and *b* are real numbers and *i is* $\sqrt{-1}$. • ~~Complex numbers are a superset of real numbers.~~	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Identify examples of field properties: commutative, associative, identity, inverse, and distributive.~~ • ~~Identify examples of axioms of equality: reflexive, symmetric, transitive, substitution, addition, and multiplication.~~ • ~~Identify examples of axioms of inequality and order: trichotomy, transitive, addition, and multiplication.~~ • Recognize that the square root of –1 is represented as *i*. • ~~Define and identify a complex number.~~ • ~~Apply the definition of *i* to simplify square roots of negative numbers.~~ • Determine which field properties apply to the complex number system. • Simplify radical expressions containing negative rational numbers and express in a+b*i* form. • Simplify powers of *i*.

TOPIC: EXPRESSIONS AND OPERATIONS

ALGEBRA II
STANDARD AII.3

The student will perform operations on complex numbers, express the results in simplest form using patterns of the powers of *i*, and identify field properties that are valid for the complex numbers.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	• Add, subtract, and multiply complex numbers. • Place the following sets of numbers in a hierarchy of subsets: complex, pure imaginary, real, rational, irrational, integers, whole, and natural. • Write a real number in a+b*i* form. • Write a pure imaginary number in a+b*i* form.

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA II
STANDARD AII.4

The student will solve, algebraically and graphically,

a) **absolute value equations and inequalities;**
b) **quadratic equations over the set of complex numbers;**
c) **equations containing rational algebraic expressions; and**
d) **equations containing radical expressions.**

Graphing calculators will be used for solving and for confirming the algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~A solution of an equation makes the equation true.~~ • A quadratic function whose graph does not intersect the *x*-axis has roots with imaginary components. • The quadratic formula can be used to solve any quadratic equation. • The value of the discriminant of a quadratic equation can be used to describe the nature of the roots. • ~~A quadratic equation whose graph does not intersect the *x*-axis has only complex solutions.~~ • ~~Complex solutions occur in pairs (conjugates).~~ • ~~Absolute value equations and inequalities can be used to model practical problems.~~ • The definition of absolute value (for any real numbers a and b, where b $\geq$ 0, if $\lvert a \rvert = b$, then a = b or –a = b) is used in solving	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve absolute value equations and inequalities algebraically and graphically. • ~~Solve absolute value equations in one variable algebraically and graphically, using a graphing calculator.~~ • ~~Solve absolute value inequalities in one variable algebraically and graphically.~~ • ~~Express the solutions to absolute value equations and inequalities in one variable graphically and as an algebraic inequality.~~ • ~~Graph absolute value equations in two variables.~~ • ~~Verify solutions to absolute value equations and inequalities in two variables, using a graphing calculator.~~ • ~~Recognize a quadratic equation~~. • Solve a quadratic equation over the set of complex numbers using

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA II
STANDARD AII.4

The student will solve, algebraically and graphically,

a) absolute value equations and inequalities;
b) quadratic equations over the set of complex numbers;
c) equations containing rational algebraic expressions; and
d) equations containing radical expressions.

Graphing calculators will be used for solving and for confirming the algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
absolute value equations and inequalities. • Real-world problems can be interpreted, represented, and solved using equations and inequalities. • The process of solving radical or rational equations can lead to extraneous solutions. • Equations can be solved in a variety of ways. • ~~The solution of an equation in one variable can be found by graphing each side of the equation separately and finding the *x*-coordinate of the point of intersection~~. • ~~Practical problems can be interpreted, represented, and solved using equations.~~	an appropriate strategy. • ~~Identify from a graph the real solutions to a quadratic equation.~~ • ~~Find the real roots of a quadratic equation, using a graphing calculator.~~ • Solve equations containing rational algebraic expressions with monomial or binomial denominators algebraically and graphically. • Solve an equation containing a radical expression algebraically and graphically. ~~The equation will contain a linear expression under the radical, and all terms outside the radical will be constants.~~ • Verify possible solutions to an equation containing rational or radical expressions. • Apply an appropriate equation to solve a real-world problem. • ~~Identify from a graph the solutions to an equation containing rational or radical expressions.~~

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA II
STANDARD AII.4

The student will solve, algebraically and graphically,

a) **absolute value equations and inequalities;**
b) **quadratic equations over the set of complex numbers;**
c) **equations containing rational algebraic expressions; and**
d) **equations containing radical expressions.**

Graphing calculators will be used for solving and for confirming the algebraic solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	• ~~Solve an equation containing rational or radical expressions, using a graphing calculator.~~ • ~~Check possible solutions to an equation containing rational or radical expressions, using a graphing calculator.~~

TOPIC: EQUATIONS AND INEQUALITIES

ALGEBRA II
STANDARD AII.5

The student will solve nonlinear systems of equations, including linear-quadratic and quadratic-quadratic, algebraically and graphically. Graphing calculators will be used as a tool to visualize graphs and predict the number of solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Solutions of a nonlinear system of equations are numerical values that satisfy every equation in the system. • The coordinates of points of intersection in any system of equations are solutions to the system. • Real-world problems can be interpreted, represented, and solved using systems of equations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Predict the number of solutions to a nonlinear system of two equations. • ~~Identify nonlinear systems of equations as linear-quadratic or quadratic-quadratic.~~ • ~~Visualize a nonlinear system of two equations, and predict the number of solutions, using the graphing calculator.~~ • Solve a linear-quadratic system of two equations algebraically and graphically. • Solve a quadratic-quadratic system of two equations algebraically and graphically.

TOPIC: FUNCTIONS

ALGEBRA II
STANDARD AII.6

The student will recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and will convert between graphic and symbolic forms of functions. A transformational approach to graphing will be employed. Graphing calculators will be used as a tool to investigate the shapes and behaviors of these functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The graphs/equations for a family of functions can be determined using a transformational approach. • Transformations of graphs include translations, reflections, and dilations. • A parent graph is an anchor graph from which other graphs are derived with transformations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize graphs of parent functions. • Given the equation and using a transformational approach, graph a function. • Given the graph of a function, identify the parent function. • Given the graph of a function, identify the transformations that map the image to the preimage in order to determine the equation of the image. • Using a transformational approach, write the equation of a function given its graph. • ~~Recognize graphs of parent functions for linear, quadratic, absolute value, step, and exponential functions.~~ • ~~Given an equation of a function, identify the function as linear, quadratic, absolute value, step, or exponential.~~ • ~~Write the equation of a linear (slope-intercept form), quadratic ([*h*, *k*] form), absolute value, step, or exponential function, given the graph of the parent function or an integral translation of a~~

TOPIC: FUNCTIONS

ALGEBRA II
STANDARD AII.6

The student will recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and will convert between graphic and symbolic forms of functions. A transformational approach to graphing will be employed. Graphing calculators will be used as a tool to investigate the shapes and behaviors of these functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
	~~parent function.~~ • ~~Given an equation, graph a linear, quadratic, absolute value, step, or exponential function with the aid of a graphing calculator.~~ • ~~Using the general shape of the graph of a function, identify the family of graphs to which a particular graph belongs. Characteristics of a graph may include the *x*- and *y*-intercepts, number and location of turning points, and end behaviors.~~

TOPIC: FUNCTIONS

ALGEBRA II
STANDARD AII.7

The student will investigate and analyze functions algebraically and graphically. Key concepts include

a) domain and range, including limited and discontinuous domains and ranges;
b) zeros;
c) *x*- and *y*-intercepts;
d) intervals in which a function is increasing or decreasing;
e) asymptotes;
f) end behavior;
g) inverse of a function; and
h) composition of multiple functions.

Graphing calculators will be used as a tool to assist in investigation of functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Functions may be used to model real-world situations. • A function can be described on an interval as increasing, decreasing, or constant. • ~~Exponential and logarithmic functions are either strictly increasing or strictly decreasing.~~ • Asymptotes may describe both local and global behavior of functions. • End behavior describes a function as *x* approaches positive and negative infinity. • The domain and range of a function may be restricted algebraically or by the real-world situation modeled by the function. • A zero of a function is a value of *x* that makes f(x) equal zero.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the domain, range, zeros, and intercepts of a function presented algebraically or graphically. • ~~Distinguish between relations and functions that are expressed algebraically and graphically.~~ • ~~Use interchange of variables to find the inverse of a function~~. • ~~Given the graphs, recognize that exponential and logarithmic functions are inverses of each other.~~ • Given the graph of a function, identify intervals on which the function is increasing and decreasing. • Describe the end behavior of a function.

TOPIC: FUNCTIONS

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STANDARD AII.7

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a) domain and range, including limited and discontinuous domains and ranges;
b) zeros;
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d) intervals in which a function is increasing or decreasing;
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f) end behavior;
g) inverse of a function; and
h) composition of multiple functions.

Graphing calculators will be used as a tool to assist in investigation of functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Functions describe the relationship between two variables.~~ • ~~Graphs of functions that are inverses of each other are reflections across the line $y = x$.~~ • ~~The composition of a function and its inverse is the identity function.~~ • ~~Functions arise from practical situations.~~ • If (a, b) is an element of a function, then (b, a) is an element of the inverse of the function. • Functions can be combined using composition of functions. • Exponential ($y = a^x$) and logarithmic ($y = \log_a x$) functions are inverses of each other. • ~~Shapes and behavior of graphs of polynomials can be determined~~	• ~~Recognize~~ Describe restricted/discontinuous domains and ranges. • Find the inverse of a function. • Find the composition of two functions. • ~~Find the value of a function for a given element from the domain.~~ • Graph the inverse of a function as a reflection across the line $y = x$. • Use composition of functions to verify two functions are inverses. • Investigate exponential and logarithmic functions, using the graphing calculator. • Convert between logarithmic and exponential forms of an equation. • Find the equations of vertical and horizontal asymptotes of

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ALGEBRA II
STANDARD AII.7

The student will investigate and analyze functions algebraically and graphically. Key concepts include

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b) zeros;
c) *x*- and *y*-intercepts;
d) intervals in which a function is increasing or decreasing;
e) asymptotes;
f) end behavior;
g) inverse of a function; and
h) composition of multiple functions.

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ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
~~by analyzing transformations of parent functions.~~ • ~~Using graphing calculators is a strategy for investigating the shape and behavior of polynomial functions.~~	functions. • ~~Investigate the shape and behavior of linear, quadratic, and cubic functions. Behaviors will include intercepts, number of turning points, and end behavior.~~ • ~~Investigate the shape and behavior of exponential ($a^x = y$) and logarithmic ($\log_b x = y$) functions, including intercepts and end behavior.~~

TOPIC: FUNCTIONS

ALGEBRA II
STANDARD AII.8

The student will investigate and describe the relationships among solutions of an equation, zeros of a function, *x*-intercepts of a graph, and factors of a polynomial expression.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The *Fundamental Theorem of Algebra* states that, including complex and repeated solutions, an nth degree polynomial equation has exactly n roots (solutions). • The following statements are equivalent: – k is a zero of the polynomial function f; – $(x - k)$ is a factor of $f(x)$; – k is a solution of the polynomial equation $f(x) = 0$; and – k is an x-intercept for the graph of $y = f(x)$.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph, and factors of a polynomial expression. • <u>Define a polynomial function, given its zeros.</u> • <u>Determine the factored form of a polynomial expression from the x-intercepts of the graph of its corresponding function.</u> • <u>For a function, identify zeros of multiplicity greater than 1 and describe the effect of those zeros on the graph of the function.</u> • Given a polynomial equation, determine the number of real solutions and nonreal solutions.

TOPIC: STATISTICS

ALGEBRA II
STANDARD AII.9

The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data and scatterplots may indicate patterns that can be modeled with an algebraic equation. • Graphing calculators can be used to collect, organize, picture, and create an algebraic model of the data. • Data that fit polynomial ($f(x) = a_n x^n + a_{n-1}x^{n-1} + ... + a_1 x + a_0$, where n is a nonnegative integer, and the coefficients are real numbers), exponential ($y = b^x$), and logarithmic ($y = \log_b x$) models arise from real-world situations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Collect and analyze data. • Investigate scatterplots to determine if patterns exist and then identify the patterns. • Find an equation for the curve of best fit for data, using a graphing calculator. Models will include ~~linear, quadratic~~, polynomial, exponential, and logarithmic functions. • Make predictions, using data, scatterplots, or the equation of the curve of best fit. • Given a set of data, determine the model that would best describe the data.

TOPIC: STATISTICS

ALGEBRA II
STANDARD AII.10

The student will identify, create, and solve real-world problems involving inverse variation, joint variation, and a combination of direct and inverse variations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Practical~~ Real-world problems can be modeled and solved by using inverse variation, joint variation, and a combination of direct and inverse variations. • Joint variation is a combination of direct variations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • ~~Translate "y varies jointly as x and z" as $y = kxz$.~~ • ~~Translate "y is directly proportional to x" as $y = kx$.~~ • ~~Translate "y is inversely proportional to x" as $y = \frac{k}{x}$.~~ • Given a situation, determine the value of the constant of proportionality~~, k, given initial conditions for x and y~~. • Set up and solve ~~practical~~ problems, including real-world problems, ~~using~~ involving inverse variation, joint variation, and a combination of direct and inverse variations.

TOPIC: STATISTICS

ALGEBRA II
STANDARD AII.11

The student will identify properties of a normal distribution and apply those properties to determine probabilities associated with areas under the standard normal curve.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The normal distribution curve is a family of symmetrical curves defined by the mean and the standard deviation. • Areas under the curve represent probabilities associated with continuous distributions. • The normal curve is a probability distribution and the total area under the curve is 1. • The mean of the data in a standard normal density function is 0 and the standard deviation is 1. This allows for the comparison of unlike data.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the properties of a normal probability distribution. • Describe how the standard deviation and the mean affect the graph of the normal distribution. • Compare two sets of normally distributed data using a standard normal curve and z-scores. • Represent probability as area under the curve of a standard normal probability distribution. • Use the graphing calculator or a standard normal probability table to determine probabilities or percentiles based on z-scores.

TOPIC: STATISTICS

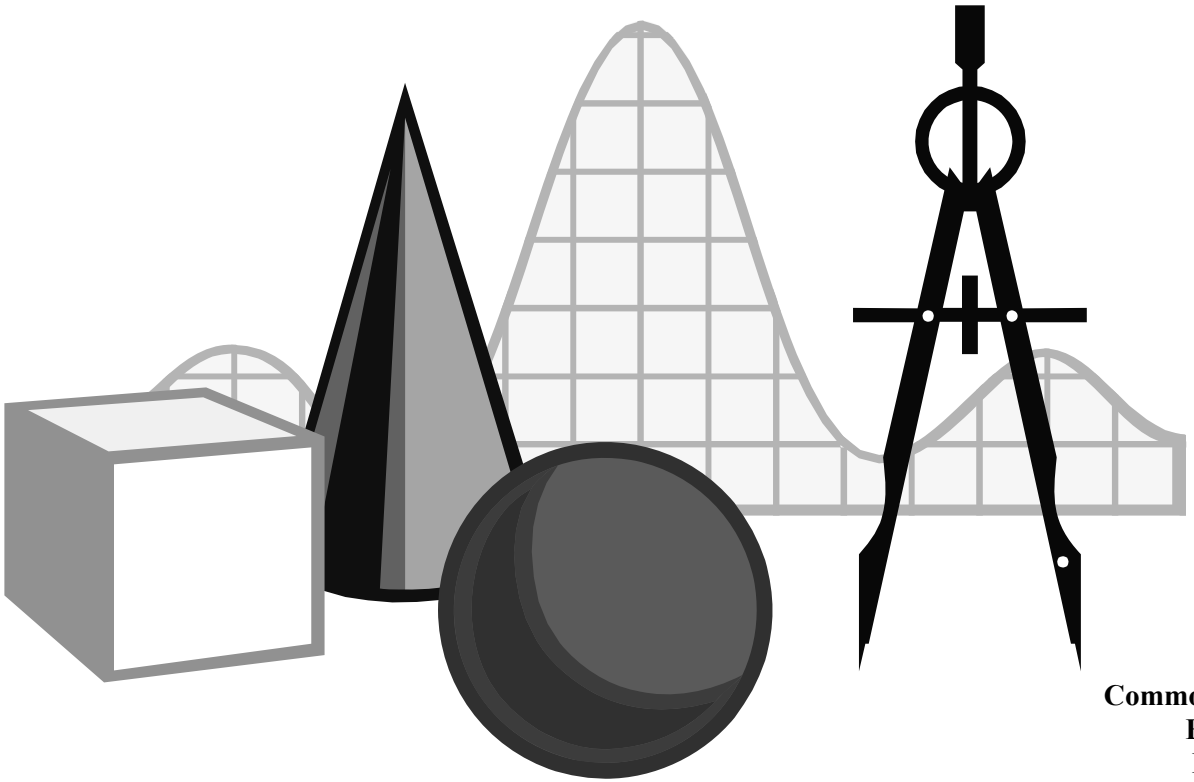
ALGEBRA II
STANDARD AII.12

The student will compute and distinguish between permutations and combinations and use technology for applications.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The *Fundamental Counting Principle* states that if one decision can be made *n* ways and another can be made *m* ways, then the two decisions can be made *nm* ways. • *Permutations* are used to calculate the number of possible arrangements of objects. • *Combinations* are used to calculate the number of possible selections of objects without regard to the order selected.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast permutations and combinations. • Calculate the number of permutations of *n* objects taken *r* at a time. • Calculate the number of combinations of *n* objects taken *r* at a time. • Use permutations and combinations as counting techniques to solve real-world problems.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Trigonometry



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TOPIC: TRIANGULAR AND CIRCULAR TRIGONOMETRIC FUNCTIONS

TRIGONOMETRY
STANDARD T.1

The student will use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of the angle in standard position, given a point other than the origin on the terminal side of the angle. Trigonometric functions defined on the unit circle will be related to trigonometric functions defined in right triangles.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Triangular trigonometric function definitions are related to circular trigonometric function definitions. • Both degrees and radians are units for measuring angles. • Drawing an angle in standard position will force the terminal side to lie in a specific quadrant. • A point on the terminal side of an angle determines a reference triangle from which the values of the six trigonometric functions may be derived.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Define the six triangular trigonometric functions of an angle in a right triangle. • Define the six circular trigonometric functions of an angle in standard position. • Make the connection between the triangular and circular trigonometric functions. • Recognize and draw an angle in standard position. • Show how a point on the terminal side of an angle determines a reference triangle.

TOPIC: TRIANGULAR AND CIRCULAR TRIGONOMETRIC FUNCTIONS

TRIGONOMETRY
STANDARD T.2

The student, given the value of one trigonometric function, will find the values of the other trigonometric functions, using the definitions and properties of the trigonometric functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• If one trigonometric function value is known, then a triangle can be formed to use in finding the other five trigonometric function values. • Knowledge of the unit circle is a useful tool for finding all six trigonometric values for special angles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given one trigonometric function value, find the other five trigonometric function values. • Develop the unit circle, using both degrees and radians. • Solve problems, using the circular function definitions and the properties of the unit circle. • Recognize the connections between the coordinates of points on a unit circle and – coordinate geometry; – cosine and sine values; and – lengths of sides of special right triangles (30°-60°-90° and 45°-45°-90°).

TOPIC: TRIANGULAR AND CIRCULAR TRIGONOMETRIC FUNCTIONS

TRIGONOMETRY
STANDARD T.3

The student will find, without the aid of a calculator, the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This will include converting angle measures from radians to degrees and vice versa.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Special angles are widely used in mathematics. • Unit circle properties will allow special angle and related angle trigonometric values to be found without the aid of a calculator. • Degrees and radians are units of angle measure. • A radian is the measure of the central angle that is determined by an arc whose length is the same as the radius of the circle.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find trigonometric function values of special angles and their related angles in both degrees and radians. • Apply the properties of the unit circle without using a calculator. • Use a conversion factor to convert from radians to degrees and vice versa without using a calculator.

TOPIC: INVERSE TRIGONOMETRIC FUNCTIONS

TRIGONOMETRY
STANDARD T.4

The student will find with the aid of a calculator the value of any trigonometric function and inverse trigonometric function.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The trigonometric function values of any angle can be found by using a calculator. • The inverse trigonometric functions can be used to find angle measures whose trigonometric function values are known. • Calculations of inverse trigonometric function values can be related to the triangular definitions of the trigonometric functions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use a calculator to find the trigonometric function values of any angle in either degrees or radians. • Define inverse trigonometric functions. • Find angle measures by using the inverse trigonometric functions when the trigonometric function values are given.

TOPIC: TRIGONOMETRIC IDENTITIES

TRIGONOMETRY
STANDARD T.5

The student will verify basic trigonometric identities and make substitutions, using the basic identities.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Trigonometric identities can be used to simplify trigonometric expressions, equations, or identities. • Trigonometric identity substitutions can help solve trigonometric equations, verify another identity, or simplify trigonometric expressions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use trigonometric identities to make algebraic substitutions to simplify and verify trigonometric identities. The basic trigonometric identities include – reciprocal identities; – Pythagorean identities; – sum and difference identities; – double-angle identities; and – half-angle identities.

TOPIC: TRIGONOMETRIC EQUATIONS, GRAPHS, AND PRACTICAL PROBLEMS

TRIGONOMETRY
STANDARD T.6

The student, given one of the six trigonometric functions in standard form, will

a) state the domain and the range of the function;
b) determine the amplitude, period, phase shift, vertical shift, and asymptotes;
c) sketch the graph of the function by using transformations for at least a two-period interval; and
d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The domain and range of a trigonometric function determine the scales of the axes for the graph of the trigonometric function. • The amplitude, period, phase shift, and vertical shift are important characteristics of the graph of a trigonometric function, and each has a specific purpose in applications using trigonometric equations. • The graph of a trigonometric function can be used to display information about the periodic behavior of a real-world situation, such as wave motion or the motion of a Ferris wheel.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the amplitude, period, phase shift, and vertical shift of a trigonometric function from the equation of the function and from the graph of the function. • Describe the effect of changing A, B, C, or D in the standard form of a trigonometric equation {e.g., $y = A \sin (Bx + C) + D$ or $y = A \cos [B(x + C)] + D$}. • State the domain and the range of a function written in standard form {e.g., $y = A \sin (Bx + C) + D$ or $y = A \cos [B(x + C)] + D$}. • Sketch the graph of a function written in standard form {e.g., $y = A \sin (Bx + C) + D$ or $y = A \cos [B(x + C)] + D$} by using transformations for at least one period or one cycle.

TOPIC: INVERSE TRIGONOMETRIC FUNCTIONS

TRIGONOMETRY
STANDARD T.7

The student will identify the domain and range of the inverse trigonometric functions and recognize the graphs of these functions. Restrictions on the domains of the inverse trigonometric functions will be included.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Restrictions on the domains of some inverse trigonometric functions exist.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the domain and range of the inverse trigonometric functions. • Use the restrictions on the domains of the inverse trigonometric functions in finding the values of the inverse trigonometric functions. • Identify the graphs of the inverse trigonometric functions.

TOPIC: TRIGONOMETRIC EQUATIONS, GRAPHS, AND PRACTICAL PROBLEMS

TRIGONOMETRY
STANDARD T.8

The student will solve trigonometric equations that include both infinite solutions and restricted domain solutions and solve basic trigonometric inequalities.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Solutions for trigonometric equations will depend on the domains. • A calculator can be used to find the solution of a trigonometric equation as the points of intersection of the graphs when one side of the equation is entered in the calculator as Y_1 and the other side is entered as Y_2.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve trigonometric equations with restricted domains algebraically and by using a graphing utility. • Solve trigonometric equations with infinite solutions algebraically and by using a graphing utility. • Check for reasonableness of results, and verify algebraic solutions, using a graphing utility.

TOPIC: TRIGONOMETRIC EQUATIONS, GRAPHS, AND PRACTICAL PROBLEMS

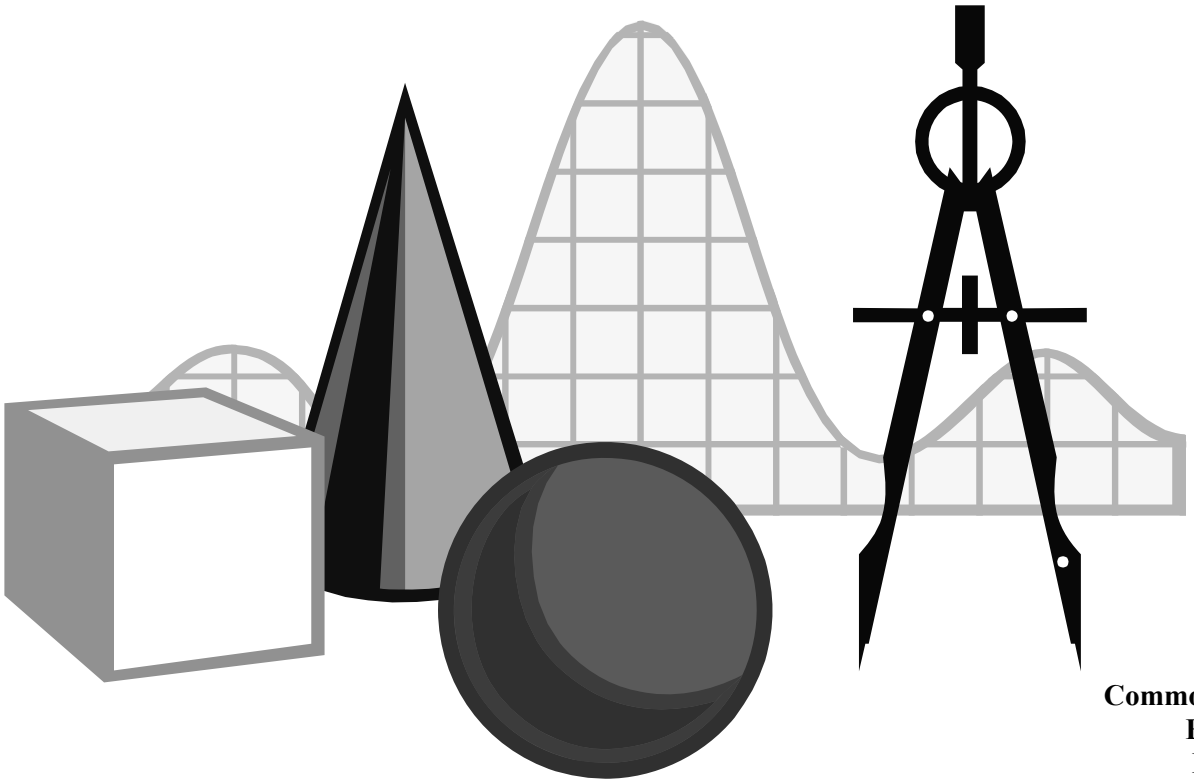
TRIGONOMETRY
STANDARD T.9

The student will identify, create, and solve real-world problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A ~~practical~~ real-world problem may be solved by using one of a variety of techniques associated with triangles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Write a ~~practical~~ real-world problem involving triangles. • Solve ~~practical~~ real-world problems involving triangles. • Use the trigonometric functions, Pythagorean Theorem, Law of Sines, and Law of Cosines to solve ~~practical~~ real-world problems. • Use the trigonometric functions to model real-world situations. • Identify a solution technique that could be used with a given problem.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Discrete Mathematics



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Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: GRAPHS

DISCRETE MATHEMATICS
STANDARD DM.1

The student will model problems, using vertex-edge graphs. The concepts of valence, connectedness, paths, planarity, and directed graphs will be investigated. Adjacency matrices and matrix operations will be used to solve problems (e.g., food chains, number of paths).

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A tournament is a digraph that results from giving directions to the edges of a complete graph. • Adjacent vertices are connected by an edge. • In a connected graph, every pair of vertices is adjacent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the valence of each vertex in a graph. • Use graphs to model situations in which the vertices represent objects, and edges (drawn between vertices) represent a particular relationship between objects. • Represent the vertices and edges of a graph as an adjacency matrix, and use the matrix to solve problems. • Investigate and describe valence and connectedness. • Determine whether a graph is planar or nonplanar. • Use directed graphs (digraphs) to represent situations with restrictions in traversal possibilities.

TOPIC: GRAPHS

DISCRETE MATHEMATICS
STANDARD DM.2

The student will solve problems through investigation and application of circuits, cycles, Euler Paths, Euler Circuits, Hamilton Paths, and Hamilton Circuits. Optimal solutions will be sought using existing algorithms and student-created algorithms.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Euler's Theorem states: If G is a connected graph and all its valences are even, then G has an Euler Circuit. • Pairs of routes (circuits) correspond to the same Hamilton Circuit because one route can be obtained from the other by traversing the vertices in reverse order. There are $\frac{(n-1)!}{2}$ Hamilton Circuits. • A multigraph is connected if there is a path between every pair of vertices.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine if a graph has an Euler Circuit or Path, and find it. • Determine if a graph has a Hamilton Circuit or Path, and find it. • Count the number of Hamilton Circuits for a complete graph with n vertices. • Use the Euler Circuit algorithm to solve optimization problems.

TOPIC: GRAPHS

DISCRETE MATHEMATICS
STANDARD DM.3

The student will apply graphs to conflict-resolution problems, such as map coloring, scheduling, matching, and optimization. Graph coloring and chromatic number will be used.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Every planar graph has a chromatic number that is less than or equal to four (the four-color-map theorem). • A graph can be colored with two colors if and only if it contains no cycle of odd length. • The chromatic number of a graph cannot exceed one more than the maximum number of degrees of the vertices of the graph.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model projects consisting of several subtasks, using a graph. • Use graphs to resolve conflicts that arise in scheduling.

TOPIC: GRAPHS

DISCRETE MATHEMATICS
STANDARD DM.4

The student will apply algorithms, such as Kruskal's, Prim's, or Dijkstra's, relating to trees, networks, and paths. Appropriate technology will be used to determine the number of possible solutions and generate solutions when a feasible number exists.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A spanning tree of a connected graph *G* is a tree that is a subgraph of *G* and contains every vertex of *G*.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use Kruskal's Algorithm to find the shortest spanning tree of a connected graph. • Use Prim's Algorithm to find the shortest spanning tree of a connected graph. • Use Dijkstra's Algorithm to find the shortest spanning tree of a connected graph.

TOPIC: ELECTION THEORY AND FAIR DIVISION

DISCRETE MATHEMATICS
STANDARD DM.7

The student will analyze and describe the issue of fair division (e.g., cake cutting, estate division). Algorithms for continuous and discrete cases will be applied.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Group decision making combines the wishes of many to yield a single fair result. • A fair division problem may be discrete or continuous. • The success of the estate division algorithm requires that each heir be capable of placing a value on each object in the estate. • A fair division problem consists of *n* individuals (players) who must partition some set of goods, *s*, into *n* disjoint sets.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate and describe situations involving discrete division (e.g., estate division). • Use an algorithm for fair division for a group of indivisible objects. • Investigate and describe situations involving continuous division of an infinitely divisible set (e.g., cake cutting). • Use an algorithm for fair division of an infinitely divisible set.

TOPIC: ELECTION THEORY AND FAIR DIVISION

DISCRETE MATHEMATICS
STANDARD DM.8

The student will investigate and describe weighted voting and the results of various election methods. These may include approval and preference voting as well as plurality, majority, run-off, sequential run-off, Borda count, and Condorcet winners.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Historically, popular voting methods have often led to counterintuitive results. • A candidate who wins over every other candidate in a one-on-one ballot is a Condorcet winner. • A Borda count assigns points in descending order to each voter's subsequent ranking and then adds these points to arrive at a group's final ranking. • To select a voting system is to compromise between the shortcomings inherent in each system.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine in how many different ways a voter can rank choices. • Investigate and describe the following voting procedures: – weighted voting; – plurality; – majority; – sequential (winners run off); – sequential (losers are eliminated); – Borda count; and – Condorcet winner. • Compare and contrast different voting procedures. • Describe the possible effects of approval voting, insincere and sincere voting, a preference schedule, and strategic voting on the election outcome.

TOPIC: ELECTION THEORY AND FAIR DIVISION

DISCRETE MATHEMATICS
STANDARD DM.9

The student will identify apportionment inconsistencies that apply to issues such as salary caps in sports and allocation of representatives to Congress. Historical and current methods will be compared.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The apportionment of Congressional representatives is based on the latest census.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast the Hamilton and Jefferson methods of political apportionment with the Hill-Huntington method (currently in use in the U.S. House of Representatives) and the Webster-Willcox method. • Solve allocation problems, using apportionment methods. • Investigate and describe how salary caps affect apportionment.

TOPIC: COMPUTER MATHEMATICS

DISCRETE MATHEMATICS
STANDARD DM.11

The student will describe and apply sorting algorithms and coding algorithms used in storing, processing, and communicating information. These will include

a) bubble sort, merge sort, and network sort; and
b) ISBN, UPC, Zip, and banking codes.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A bubble sort orders elements of an array by comparing adjacent elements. • A merge sort combines two sorted lists into a single sorted list. • Coding algorithms must account for the number of possible codes within the constraints of the coding system.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Select and apply a sorting algorithm, such as a – bubble sort; – merge sort; and – network sort. • Describe and apply a coding algorithm, such as – ISBN numbers; – UPC codes; – Zip codes; and – banking codes.

TOPIC: COMPUTER MATHEMATICS

DISCRETE MATHEMATICS
STANDARD DM.12

The student will select, justify, and apply an appropriate technique to solve a logic problem. Techniques will include Venn diagrams, truth tables, and matrices.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Two-valued (Boolean) algebra serves as a workable method for interpreting the logical truth and falsity of compound statements. • Venn diagrams provide pictures of topics in set theory, such as intersection and union, mutually exclusive sets, and the empty set.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Generate truth tables that encode the truth and falsity of two or more statements. • Use Venn diagrams to codify and solve logic problems. • Use matrices as arrays of data to solve logic problems.

TOPIC: RECURSION AND OPTIMIZATION

DISCRETE MATHEMATICS
STANDARD DM.5

The student will use algorithms to schedule tasks in order to determine a minimum project time. The algorithms will include critical path analysis, the list-processing algorithm, and student-created algorithms.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Critical path scheduling sometimes yields optimal solutions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Specify in a digraph the order in which tests are to be performed. • Identify the critical path to determine the earliest completion time (minimum project time). • Use the list-processing algorithm to determine an optimal schedule. • Create and test scheduling algorithms.

TOPIC: RECURSION AND OPTIMIZATION

DISCRETE MATHEMATICS
STANDARD DM.6

The student will solve linear programming problems. Appropriate technology will be used to facilitate the use of matrices, graphing techniques, and the Simplex method of determining solutions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Linear programming models an optimization process. • A linear programming model consists of a system of constraints and an objective quantity that can be maximized or minimized. • Any maximum or minimum value for a system of inequalities will occur at a corner point of a feasible region.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Model real-world problems with systems of linear inequalities. • Identify the feasibility region of a system of linear inequalities with no more than four constraints. • Identify the coordinates of the corner points of a feasibility region. • Find the maximum or minimum value of the system. • Describe the meaning of the maximum or minimum value in terms of the original problem.

TOPIC: RECURSION AND OPTIMIZATION

DISCRETE MATHEMATICS
STANDARD DM.10

The student will use the recursive process and difference equations with the aid of appropriate technology to generate

a) compound interest;
b) sequences and series;
c) fractals;
d) population growth models; and
e) the Fibonacci sequence.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Recursion is a process that creates new objects from existing objects that were created by the same process. • A fractal is a figure whose dimension is not a whole number. • Fractals are self-similar.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use finite differences and recursion to model compound interest and population growth situations. • Model arithmetic and geometric sequences and series recursively. • Compare and contrast the recursive process, and create fractals. • Compare and contrast the recursive process and the Fibonacci sequence. • Find a recursive relationship that generates the Fibonacci sequence.

TOPIC: RECURSION AND OPTIMIZATION

DISCRETE MATHEMATICS
STANDARD DM.13

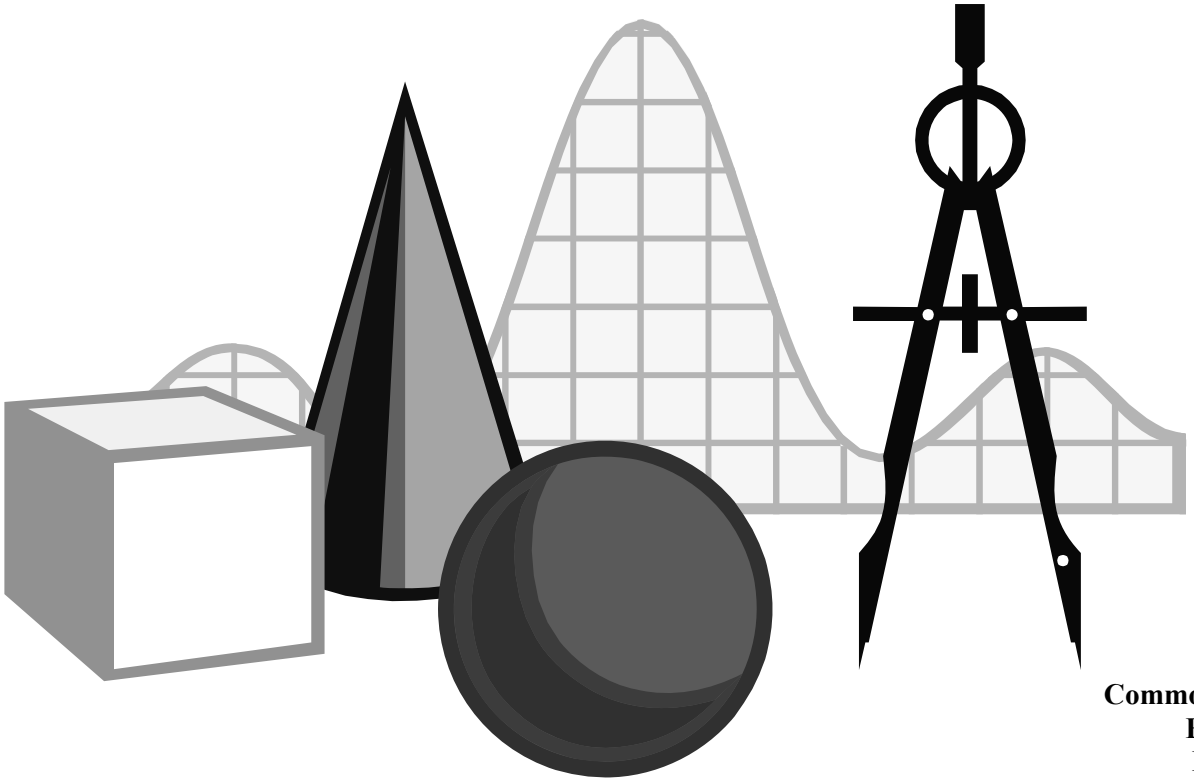
The student will apply the formulas of combinatorics in the areas of

a) **the Fundamental (Basic)Counting Principle;**
b) **knapsack and bin-packing problems;**
c) **permutations and combinations; and**
d) **the pigeonhole principle.**

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The branch of mathematics that addresses the number of ways objects can be arranged or combined is combinatorics. • If n and r are positive integers and $n \geq r$, $n\,P\,r = \frac{n!}{(n-r)!}$ and $n\,C\,r = \frac{n!}{r!\,(n-r)!}$. • A bin-packing problem determines the minimum number of containers of fixed volume (bins) required to hold a set of objects. • A knapsack problem determines the most valuable set of objects that fit into a container (knapsack) of fixed volume. • Bin packing and knapsack packing are optimization techniques.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the number of combinations possible when subsets of r elements are selected from a set of n elements without regard to order. • Use the Fundamental (Basic) Counting Principle to determine the number of possible outcomes of an event. • Use the knapsack and bin-packing algorithms to solve real-world problems. • Find the number of permutations possible when r objects selected from n objects are ordered. • Use the pigeonhole principle to solve packing problems to facilitate proofs.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Probability and Statistics



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Richmond, Virginia
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TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.1

The student will analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Appropriate technology will be used to create graphical displays.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning in a context. • Measures of central tendency describe how the data cluster or group. • Measures of dispersion describe how the data spread (disperse) around the center of the data. • Graphical displays of data may be analyzed informally. • Data analysis must take place within the context of the problem.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Create and interpret graphical displays of data, including dotplots, stem-and-leaf plots, and histograms. • Examine graphs of data for clusters and gaps, and relate those phenomena to the data in context. • Examine graphs of data for outliers, and explain the outlier(s) within the context of the data. • Examine graphs of data and identify the central tendency of the data as well as the spread. Explain the central tendency and the spread of the data within the context of the data.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.2

The student will analyze numerical characteristics of univariate data sets to describe patterns and departure from patterns, using mean, median, mode, variance, standard deviation, interquartile range, range, and outliers.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning within a context. • Analysis of the descriptive statistical information generated by a univariate data set should include the interplay between central tendency and dispersion as well as among specific measures. • Data points identified algorithmically as outliers should not be excluded from the data unless sufficient evidence exists to show them to be in error.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Interpret mean, median, mode, range, interquartile range, variance, and standard deviation of a univariate data set in terms of the problem's context. • Identify possible outliers, using an algorithm. • Explain the influence of outliers on a univariate data set. • Explain ways in which standard deviation addresses dispersion by examining the formula for standard deviation.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.3

The student will compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning in a context. • Statistical tendency refers to typical cases but not necessarily to individual cases.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast two or more univariate data sets by analyzing measures of center and spread within a contextual framework. • Describe any unusual features of the data, such as clusters, gaps, or outliers, within the context of the data. • Analyze in context kurtosis and skewness in conjunction with other descriptive measures.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.4

The student will analyze scatterplots to identify and describe the relationship between two variables, using shape; strength of relationship; clusters; positive, negative, or no association; outliers; and influential points.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A scatterplot serves two purposes: – to determine if there is a useful relationship between two variables, and – to determine the family of equations that describes the relationship. • Data are collected for a purpose and have meaning in a context. • Association between two variables considers both the direction and strength of the association. • The strength of an association between two variables reflects how accurately the value of one variable can be predicted based on the value of the other variable. • Outliers are observations with large residuals and do not follow the pattern apparent in the other data points.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Examine scatterplots of data, and describe skewness, kurtosis, and correlation within the context of the data. • Describe and explain any unusual features of the data, such as clusters, gaps, or outliers, within the context of the data. • Identify influential data points (observations that have great effect on a line of best fit because of extreme *x*-values) and describe the effect of the influential points.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.5

The student will find and interpret linear correlation, use the method of least squares regression to model the linear relationship between two variables, and use the residual plots to assess linearity.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning in a context. • Least squares regression generates the equation of the line that minimizes the sum of the squared distances from the data points to the line. • Each data point may be considered to be comprised of two parts: fit (the part explained by the model) and residual (the result of chance variation or of variables not measured). • Residual = Actual – Fitted • A correlation coefficient measures the degree of association between two variables that are related linearly. • Two variables may be strongly associated without a cause-and-effect relationship existing between them.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Calculate a correlation coefficient. • Explain how the correlation coefficient, *r*, measures association by looking at its formula. • Use regression lines to make predictions, and identify the limitations of the predictions. • Use residual plots to determine if a linear model is satisfactory for describing the relationship between two variables. • Describe the errors inherent in extrapolation beyond the range of the data. • Use least squares regression to find the equation of the line of best fit for a set of data. • Explain how least squares regression generates the equation of the line of best fit by examining the formulas used in computation.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.6

The student will make logarithmic and power transformations to achieve linearity.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A logarithmic transformation reduces positive skewness because it compresses the upper tail of the distribution while stretching the lower tail. • Nonlinear transformations do not preserve relative spacing between data points.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Apply a logarithmic transformation to data. • Explain how a logarithmic transformation works to achieve a linear relationship between variables. • Apply a power transformation to data. • Explain how a power transformation works to achieve a linear relationship between variables.

TOPIC: DESCRIPTIVE STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.7

The student, using two-way tables, will analyze categorical data to describe patterns and departure from patterns and to find marginal frequency and relative frequencies, including conditional frequencies.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning in a context. • Simpson's paradox refers to the fact that aggregate proportions can reverse the direction of the relationship seen in the individual parts. • Two categorical variables are independent if the conditional frequencies of one variable are the same for every category of the other variable.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Produce a two-way table as a summary of the information obtained from two categorical variables. • Calculate marginal, relative, and conditional frequencies in a two-way table. • Use marginal, relative, and conditional frequencies to analyze data in two-way tables within the context of the data.

TOPIC: DATA COLLECTION

PROBABILITY AND STATISTICS
STANDARD PS.8

The student will describe the methods of data collection in a census, sample survey, experiment, and observational study and identify an appropriate method of solution for a given problem setting.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The value of a sample statistic varies from sample to sample if the simple random samples are taken repeatedly from the population of interest. • Poor data collection can lead to misleading and meaningless conclusions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast controlled experiments and observational studies and the conclusions one can draw from each. • Compare and contrast population and sample and parameter and statistic. • Identify biased sampling methods. • Describe simple random sampling. • Select a data collection method appropriate for a given context.

TOPIC: DATA COLLECTION

PROBABILITY AND STATISTICS
STANDARD PS.9

The student will plan and conduct a survey. The plan will address sampling techniques (e.g., simple random and stratified) and methods to reduce bias.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The purpose of sampling is to provide sufficient information so that population characteristics may be inferred. • Inherent bias diminishes as sample size increases.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate and describe sampling techniques, such as simple random sampling, stratified sampling, and cluster sampling. • Determine which sampling technique is best, given a particular context. • Plan a survey to answer a question or address an issue. • Given a plan for a survey, identify possible sources of bias, and describe ways to reduce bias. • Design a survey instrument. • Conduct a survey.

TOPIC: DATA COLLECTION

PROBABILITY AND STATISTICS
STANDARD PS.10

The student will plan and conduct an experiment. The plan will address control, randomization, and measurement of experimental error.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Experiments must be carefully designed in order to detect a cause-and-effect relationship between variables. • Principles of experimental design include comparison with a control group, randomization, and blindness.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Plan and conduct an experiment. The experimental design should address control, randomization, and minimization of experimental error.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.11

The student will identify and describe two or more events as complementary, dependent, independent, and/or mutually exclusive.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The complement of event A consists of all outcomes in which event A does not occur. • Two events, A and B, are independent if the occurrence of one does not affect the probability of the occurrence of the other. If A and B are not independent, then they are said to be dependent. • Events A and B are mutually exclusive if they cannot occur simultaneously.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Define and give contextual examples of complementary, dependent, independent, and mutually exclusive events. • Given two or more events in a problem setting, determine if the events are complementary, dependent, independent, and/or mutually exclusive.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.12

The student will find probabilities (relative frequency and theoretical), including conditional probabilities for events that are either dependent or independent, by applying the "law of large numbers" concept, the addition rule, and the multiplication rule.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Data are collected for a purpose and have meaning in a context. • Venn diagrams may be used to find conditional probabilities. • The "law of large numbers" states that as a procedure is repeated again and again, the relative frequency probability of an event tends to approach the actual probability.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Calculate relative frequency and expected frequency. • Find conditional probabilities for dependent, independent, and mutually exclusive events.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.13

The student will develop, interpret, and apply the binomial probability distribution for discrete random variables, including computing the mean and standard deviation for the binomial variable.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A probability distribution is a complete listing of all possible outcomes of an experiment together with their probabilities. The procedure has a fixed number of independent trials. • A random variable assumes different values depending on the event outcome. • A probability distribution combines descriptive statistical techniques and probabilities to form a theoretical model of behavior.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Develop the binomial probability distribution within a real-world context. • Calculate the mean and standard deviation for the binomial variable. • Use the binomial distribution to calculate probabilities associated with experiments for which there are only two possible outcomes.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.14

The student will simulate probability distributions, including binomial and geometric.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A probability distribution combines descriptive methods and probabilities to form a theoretical model of behavior. • A probability distribution gives the probability for each value of the random variable.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Design and conduct an experiment that simulates a binomial distribution. • Design and conduct an experiment that simulates a geometric distribution.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.15

The student will identify random variables as independent or dependent and find the mean and standard deviations for sums and differences of independent random variables.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A random variable is a variable that has a single numerical value, determined by chance, for each outcome of a procedure.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare and contrast independent and dependent random variables. • Find the standard deviation for sums and differences of independent random variables.

TOPIC: PROBABILITY

PROBABILITY AND STATISTICS
STANDARD PS.16

The student will identify properties of a normal distribution and apply the normal distribution to determine probabilities, using a table or graphing calculator.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The normal distribution curve is a family of symmetrical curves defined by the mean and the standard deviation. • Areas under the curve represent probabilities associated with continuous distributions. • The normal curve is a probability distribution and the total area under the curve is 1.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the properties of a normal probability distribution. • Describe how the standard deviation and the mean affect the graph of the normal distribution. • Determine the probability of a given event, using the normal distribution.

TOPIC: INFERENTIAL STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.17

The student, given data from a large sample, will find and interpret point estimates and confidence intervals for parameters. The parameters will include proportion and mean, difference between two proportions, and difference between two means (independent and paired).

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A primary goal of sampling is to estimate the value of a parameter based on a statistic. • Confidence intervals use the sample statistic to construct an interval of values that one can be reasonably certain contains the true (unknown) parameter. • Confidence intervals and tests of significance are complementary procedures. • Paired comparisons experimental design allows control for possible effects of extraneous variables.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Construct confidence intervals to estimate a population parameter, such as a proportion or the difference between two proportions; or a mean or the difference between two means. • Select a value for alpha (Type I error) for a confidence interval. • Interpret confidence intervals in the context of the data. • Explain the importance of random sampling for confidence intervals. • Calculate point estimates for parameters and discuss the limitations of point estimates.

TOPIC: INFERENTIAL STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.18

The student will apply and interpret the logic of a hypothesis-testing procedure. Tests will include large sample test for proportion, mean, difference between two proportions, and difference between two means (independent and paired) and Chi-squared test for goodness of fit, homogeneity of proportions, and independence.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Confidence intervals and tests of significance are complementary procedures. • Paired comparisons experimental design allows control for possible effects of extraneous variables. • Tests of significance assess the extent to which sample data support a hypothesis about a population parameter. • The purpose of a goodness of fit test is to decide if the sample results are consistent with results that would have been obtained if a random sample had been selected from a population with a known distribution. • Practical significance and statistical significance are not necessarily congruent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use the Chi-squared test for goodness of fit to decide if the population being analyzed fits a particular distribution pattern. • Use hypothesis-testing procedures to determine whether or not to reject the null hypothesis. The null hypothesis may address proportion, mean, difference between two proportions or two means, goodness of fit, homogeneity of proportions, and independence. • Compare and contrast Type I and Type II errors. • Explain how and why the hypothesis-testing procedure allows one to reach a statistical decision.

TOPIC: INFERENTIAL STATISTICS

PROBABILITY AND STATISTICS
STANDARD PS.19

The student will identify the meaning of sampling distribution with reference to random variable, sampling statistic, and parameter and explain the Central Limit Theorem. This will include sampling distribution of a sample proportion, a sample mean, a difference between two sample proportions, and a difference between two sample means.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The Central Limit Theorem states: – The mean of the sampling distribution of means is equal to the population mean. – If the sample size is sufficiently large, the sampling distribution approximates the normal probability distribution. – If the population is normally distributed, the sampling distribution is normal regardless of sample size. • Sampling distributions have less variability with larger sample sizes.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe the use of the Central Limit Theorem for drawing inferences about a population parameter based on a sample statistic. • Describe the effect of sample size on the sampling distribution and on related probabilities. • Use the normal approximation to calculate probabilities of sample statistics falling within a given interval. • Identify and describe the characteristics of a sampling distribution of a sample proportion, mean, difference between two sample proportions, or difference between two sample means.

TOPIC: INFERENTIAL STATISTICS

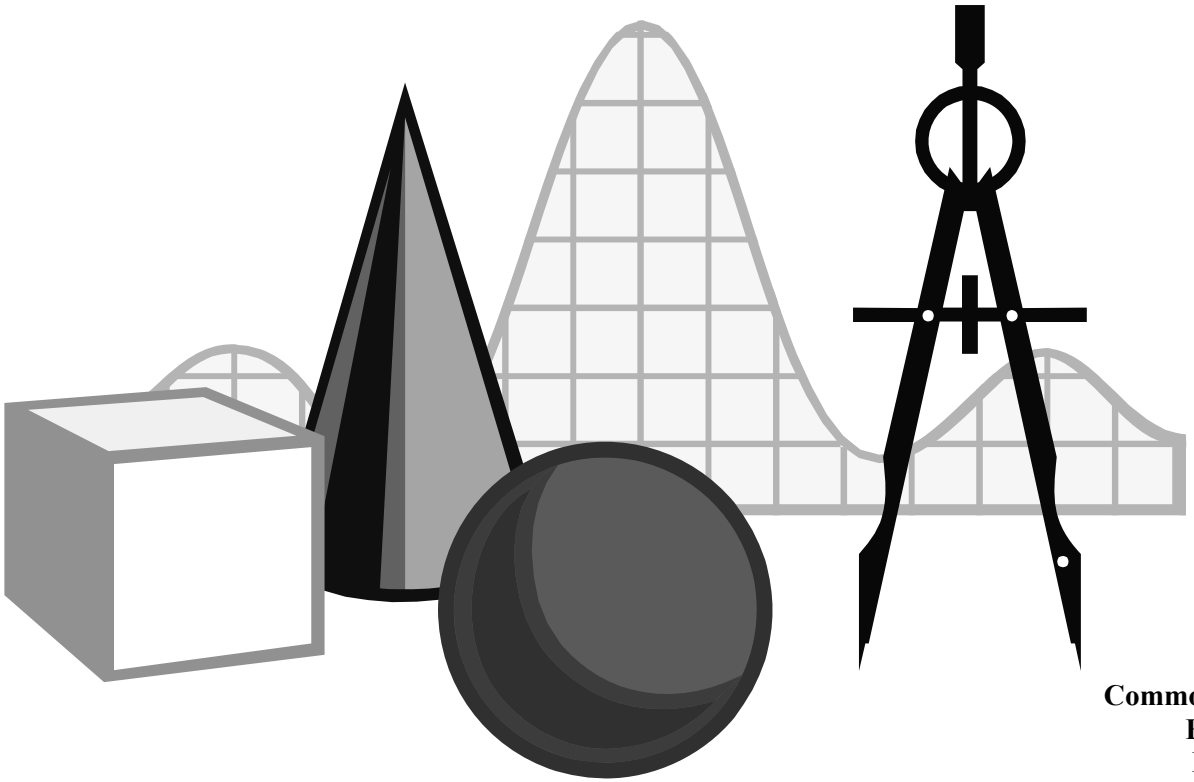
PROBABILITY AND STATISTICS
STANDARD PS.20

The student will identify properties of a t-distribution and apply t-distributions to single-sample and two-sample (independent and matched pairs) t-procedures, using tables or graphing calculators.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Paired comparisons experimental design allows control for possible effects of extraneous variables. • The sampling distribution of means with a small sample size follows a t-distribution.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the properties of a t-distribution. • Compare and contrast a t-distribution and a normal distribution. • Use a t-test for single-sample and two-sample data.

MATHEMATICS STANDARDS OF LEARNING PROPOSED CURRICULUM FRAMEWORK

Mathematical Analysis



Commonwealth of Virginia
Board of Education
Richmond, Virginia
Draft July 23, 2009

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NOTICE TO THE READER

The Virginia Department of Education does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities.

The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia 2009 *Mathematics Standards of Learning* Curriculum Framework
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into two columns: Essential Knowledge and Skills and Essential Understandings. The purpose of each column is explained below.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning.

Essential Knowledge and Skills
Each Standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for SOL assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

TOPIC: FUNCTIONS

MATHEMATICAL ANALYSIS
STANDARD MA.1

The student will investigate and identify the characteristics of polynomial and rational functions and use these to sketch the graphs of the functions. This will include determining zeros, upper and lower bounds, *y*-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, and maximum or minimum points. Graphing utilities will be used to investigate and verify these characteristics.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The graphs of polynomial and rational functions can be determined by exploring characteristics and components of the functions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a polynomial function, given an equation or graph. • Identify rational functions, given an equation or graph. • Identify zeros, upper and lower bounds, *y*-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, points of discontinuity, end behavior, and maximum and minimum points, given a graph of a function. • Sketch the graph of a polynomial function. • Sketch the graph of a rational function. • Investigate and verify characteristics of a polynomial or rational function, using a graphing calculator.

TOPIC: FUNCTIONS

MATHEMATICAL ANALYSIS
STANDARD MA.2

The student will apply compositions of functions and inverses of functions to real-world situations. Analytical methods and graphing utilities will be used to investigate and verify the domain and range of resulting functions.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In composition of functions, a function serves as input for another function. • A graph of a function and its inverse are symmetric about the line $y = x$. • $(f \circ f^{-1})(x) = (f^{-1} \circ f)(x) = x$	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Find the composition of functions. • Find the inverse of a function algebraically and graphically. • Determine the domain and range of the composite functions. • Determine the domain and range of the inverse of a function. • Verify the accuracy of sketches of functions, using a graphing utility.

TOPIC: FUNCTIONS

MATHEMATICAL ANALYSIS
STANDARD MA.3

The student will investigate and describe the continuity of functions, using graphs and algebraic methods.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Continuous and discontinuous functions can be identified by their equations or graphs.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Describe continuity of a function. • Investigate the continuity of absolute value, step, rational, and piece-wise-defined functions. • Use transformations to sketch absolute value, step, and rational functions. • Verify the accuracy of sketches of functions, using a graphing utility.

TOPIC: FUNCTIONS

MATHEMATICAL ANALYSIS
STANDARD MA.7

The student will find the limit of an algebraic function, if it exists, as the variable approaches either a finite number or infinity. A graphing utility will be used to verify intuitive reasoning, algebraic methods, and numerical substitution.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The limit of a function is the value approached by $f(x)$ as x approaches a given value or infinity.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Verify intuitive reasoning about the limit of a function, using a graphing utility. • Find the limit of a function algebraically, and verify with a graphing utility. • Find the limit of a function numerically, and verify with a graphing utility.

TOPIC: FUNCTIONS

MATHEMATICAL ANALYSIS
STANDARD MA.9

The student will investigate and identify the characteristics of exponential and logarithmic functions in order to graph these functions and solve equations and real-world problems. This will include the role of e, natural and common logarithms, laws of exponents and logarithms, and the solution of logarithmic and exponential equations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS

• Exponential and logarithmic functions are inverse functions.
• Some examples of appropriate models or situations for exponential and logarithmic functions are:
  • Population growth;
  • Compound interest;
  • Depreciation/appreciation;
  • Richter scale; and
  • Radioactive decay.
	The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
	• Identify exponential functions from an equation or a graph.
	• Identify logarithmic functions from an equation or a graph.
	• Define e, and know its approximate value.
	• Write logarithmic equations in exponential form and vice versa.
	• Identify common and natural logarithms.
	• Use laws of exponents and logarithms to solve equations and simplify expressions.
	• Model real-world problems, using exponential and logarithmic functions.
	• Graph exponential and logarithmic functions, using a graphing utility, and identify asymptotes, intercepts, domain, and range.

TOPIC: DISCRETE MATHEMATICS

MATHEMATICAL ANALYSIS
STANDARD MA.4

The student will expand binomials having positive integral exponents through the use of the Binomial Theorem, the formula for combinations, and Pascal's Triangle.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The Binomial Theorem provides a formula for calculating the product $(a + b)^n$ for any positive integer n. • Pascal's Triangle is a triangular array of binomial coefficients.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Expand binomials having positive integral exponents. • Use the Binomial Theorem, the formula for combinations, and Pascal's Triangle to expand binomials.

TOPIC: DISCRETE MATHEMATICS

MATHEMATICAL ANALYSIS
STANDARD MA.5

The student will find the sum (sigma notation included) of finite and infinite convergent series, which will lead to an intuitive approach to a limit.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Examination of infinite sequences and series may lead to a limiting process. • Arithmetic sequences have a common difference between any two consecutive terms. • Geometric sequences have a common factor between any two consecutive terms.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use and interpret the notation: $\sum$, n, nth, and a_n. • Given the formula, find the nth term, a_n, for an arithmetic or geometric sequence. • Given the formula, find the sum, S_n, if it exists, of an arithmetic or geometric series. • Model and solve problems, using sequence and series information. • Distinguish between a convergent and divergent series. • Discuss convergent series in relation to the concept of a limit.

TOPIC: DISCRETE MATHEMATICS

MATHEMATICAL ANALYSIS
STANDARD MA.6

The student will use mathematical induction to prove formulas and mathematical statements.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Mathematical induction is a method of proof that depends on a recursive process. • Mathematical induction allows reasoning from specific true values of the variable to general values of the variable.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare inductive and deductive reasoning. • Prove formulas/statements, using mathematical induction.

TOPIC: EQUATIONS

MATHEMATICAL ANALYSIS
STANDARD MA.10

The student will investigate and identify the characteristics of the graphs of polar equations, using graphing utilities. This will include classification of polar equations, the effects of changes in the parameters in polar equations, conversion of complex numbers from rectangular form to polar form and vice versa, and the intersection of the graphs of polar equations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The real number system is represented geometrically on the number line, and the complex number system is represented geometrically on the plane where $a + bi$ corresponds to the point (a, b) in the plane.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize polar equations (rose, cardioid, limacon, lemniscate, spiral, and circle), given the graph or the equation. • Determine the effects of changes in the parameters of polar equations on the graph, using a graphing utility. • Convert complex numbers from rectangular form to polar form and vice versa. • Find the intersection of the graphs of two polar equations, using a graphing utility.

TOPIC: EQUATIONS

MATHEMATICAL ANALYSIS
STANDARD MA.12

The student will use parametric equations to model and solve application problems.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Parametric equations are used to express two dependent variables, x and y, in terms of an independent variable (parameter), t. • Some curves cannot be represented as a function, $f(x)$. Parametric graphing enables the representation of these curves in terms of functions.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Graph parametric equations, using a graphing utility. • Use parametric equations to model motion over time. • Determine solutions to parametric equations, using a graphing utility. • Compare and contrast traditional solution methods with parametric methods.

TOPIC: EQUATIONS

MATHEMATICAL ANALYSIS
STANDARD MA.14

The student will use matrices to organize data and will add and subtract matrices, multiply matrices, multiply matrices by a scalar, and use matrices to solve systems of equations.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Matrices are a convenient shorthand for solving systems of equations. • Matrices can model a variety of linear systems. • Solutions of a linear system are values that satisfy every equation in the system. • Matrices can be used to model and solve real-world problems.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Add, subtract, and multiply matrices and multiply matrices by a scalar. • Model problems with a system of no more than three linear equations. • Express a system of linear equations as a matrix equation. • Solve a matrix equation. • Find the inverse of a matrix. • <u>Verify the commutative and associative properties for matrix addition and multiplication.</u>

TOPIC: ANALYTICAL GEOMETRY

MATHEMATICAL ANALYSIS
STANDARD MA.8

The student will investigate and identify the characteristics of conic section equations in (*h, k*) and standard forms. Transformations in the coordinate plane will be used to graph conic sections.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Matrices can be used to represent transformations of figures in the plane.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given a translation or rotation matrix, find an equation for the transformed function or conic section. • Investigate and verify graphs of transformed conic sections, using a graphing utility.

TOPIC: ANALYTICAL GEOMETRY

MATHEMATICAL ANALYSIS
STANDARD MA.11

The student will perform operations with vectors in the coordinate plane and solve real-world problems using vectors. This will include the following topics: operations of addition, subtraction, scalar multiplication, and inner (dot) product; norm of a vector; unit vector; graphing; properties; simple proofs; complex numbers (as vectors); and perpendicular components.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Every vector has an equal vector that has its initial point at the origin. • The magnitude and direction of a vector with the origin as the initial point are completely determined by the coordinates of its terminal point.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Use vector notation. • Perform the operations of addition, subtraction, scalar multiplication, and inner (dot) product on vectors. • Graph vectors and resultant vectors. • Express complex numbers in vector notation. • Define *unit vector*, and find the unit vector in the same direction as a given vector. • Identify properties of vector addition, scalar multiplication, and dot product. • Find vector components. • Find the norm (magnitude) of a vector. • Use vectors in simple geometric proofs.

TOPIC: ANALYTIC GEOMETRY

MATHEMATICAL ANALYSIS
STANDARD MA.13

The student will identify, create, and solve practical problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.

ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• ~~Real-life~~ Real-world problems can be modeled using trigonometry and vectors.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve and create problems, using trigonometric functions. • Solve and create problems, using the Pythagorean Theorem. • Solve and create problems, using the Law of Sines and the Law of Cosines.

Board of Education Agenda Item

Item: O. **Date:** July 23, 2009

Topic: Final Review of Revisions to Criteria for the *Virginia Index of Performance*, Virginia's Incentive Program to Encourage and Recognize School Accountability Performance and Competence to Excellence

Presenter: Dr. Deborah L. Jonas, Executive Director for Research and Strategic Planning

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Origin:

____ Topic presented for information only (no board action required)

____ Board review required by
- ____ State or federal law or regulation
- __X__ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting __ __ Action requested at future meeting: _____

Previous Review/Action:

___ No previous board review/action

__X__ Previous review/action
date June 25, 2009
action Accepted for first review

Background Information:
The *Regulations Establishing Standards for Accrediting Public Schools in Virginia* (8VAC 20-131-325) authorize the Board of Education to establish guidelines for recognizing and rewarding school accountability performance.

In July 2007, the Board of Education established the *Virginia Index of Performance (VIP)* incentive program to recognize and reward fully accredited schools and school divisions that make significant progress toward achieving specific measurable goals and objectives established by the Board of Education and supported by the Governor.

Student achievement is a fundamental component in determining the accreditation status of Virginia's public schools. For more than a decade in Virginia, student performance has been measured by achievement on the Standards of Learning (SOL) tests or additional assessments approved by the Board of Education. A school achieves fully accredited status primarily by meeting pass rates established for all students in four core academic content areas. The VIP program was intended to provide schools and divisions with incentives to strive for higher levels of achievement for all of our children.

VIP is intended to measure the extent to which students are progressing towards advanced proficiency levels in reading, mathematics, science, and history and social science and on other indicators of school and student performance. Schools and school divisions are eligible for VIP awards by meeting applicable federal and state achievement benchmarks (school accreditation and currently adequate yearly progress or AYP) for two consecutive years.

The VIP achievement measure is calculated using weighted student scores on Standards of Learning assessments. In the calculation, scores are weighted according to the achievement levels of basic, proficient, and advanced with the advanced level having the highest weight. The VIP score is determined by aggregating student scores in all of the content areas and adding up to five additional VIP points to the achievement measure. The additional VIP points may be earned when a school or division meets the following performance objectives established for the program or exceeds state goals in the target areas:

- Increase the percentage of third graders reading on grade level (95% state goal);
- Increase the percentage of students enrolled in Algebra I by grade 8 (45% state goal);
- Increase the percentage of high school students taking Advanced Placement, International Baccalaureate, and dual enrollment courses (25% state goal);
- Increase the number of career and technical industry certifications, state licenses, or successful national occupational assessment (15,000 state goal);
- Increase the percentage of high school graduates earning an Advanced Studies Diploma (57% state goal);
- Increase the percentage of students who receive a high school diploma recognized by the Board of Education (80% state interim target);
- Increase the percentage of schools that are fully accredited and making Adequate Yearly Progress (divisions only; 100% state goal);
- Increase the percent of at-risk four-year-olds who are being served by the Virginia Preschool Initiative (VPI; divisions only; 100% state goal);
- Increase the percentage of students in each student subgroup achieving at higher levels of proficiency on state assessments;
- Increase the percentage of students maintaining literacy proficiency throughout their adolescent years (95% state goal);
- Increase the percentage of schools offering foreign language instruction in the elementary grades; and
- Increase participation in the Governor's Nutrition and Physical Activity Scorecard Awards Program.

The chart below shows the number of schools and divisions earning each type of award under the existing criteria for each of the two years for which the program was in place.

Number of schools and school divisions earning VIP awards:

	Governor's Awards for Educational Excellence		Board of Education Awards					
			Excellence		Competence to Excellence		Rising Star	
Award year	Schools	Divisions	Schools	Divisions	Schools	Divisions	Schools	Divisions
2008-2009	162	0	544	24	276	10	2	0
2007-2008	89	0	475	19	322	25	N/A	N/A

N/A: Not applicable. Rising star awards were not available in the first year of the program.

Summary of Major Elements

One of the goals of the VIP program is that "high school students earn a high school diploma, especially advanced studies diplomas, within four years." At the time the program was established, the best available information on graduation rates was estimates of the four-year rate. Under the established program guidelines, schools and divisions that have a graduation rate of 80 percent or higher, or that increase their graduation rate from the previous year can earn up to one bonus point added to their VIP achievement score. As well, schools can earn up to one bonus point if they increase the percent of students who earn advanced studies diplomas or meet or exceed the state goal of 57 percent.

In October 2008, the Department of Education first published the Virginia On-Time Graduation Rate and in March 2009 published the full cohort report to document the status of all students in the on-time graduation cohort, including the cohort dropout rate. The proposed recommendations would update VIP award criteria and establish minimum criteria for each award level using data newly available from the cohort report, including graduation and dropout rates.

The VIP program was also designed as an incentive program that encourages schools to support more students moving from competence to excellence in all of the core academic content areas. To further emphasize the Board's commitment to the importance of each core content area, the proposed updates provide criteria that consider each core academic content area separately.

The primary objectives for the proposed revisions to the VIP award program were the following:

1. The minimum eligibility criteria for VIP awards would remain the same as current requirements. That is, to be eligible for VIP, schools would have to be fully accredited <u>and</u> make AYP for two consecutive years; school divisions would have to make AYP for two consecutive years.
2. Retain incentives for schools to:
    a. Have more students increase their proficiency levels over time (e.g., move from proficient to advanced proficient); and
    b. Achieve as many of the "additional indicators" as possible for their school level.
3. Enhance the incentives for students to earn high achievement levels in <u>each</u> academic content area (English/reading, mathematics, science, and history and social sciences).
4. Incorporate new cohort report data into VIP criteria.

<u>*Proposed updates to the VIP award criteria*</u>

1. In order to earn a Governor's Award for Educational Excellence, eligible schools and school divisions with a graduating class would be required to:
    a. Earn a minimum of 80 index points on the weighted VIP index points, using the current weightings[1], in <u>EACH</u> of the following content areas:
        - English/reading (combined reading and writing)
        - Mathematics
        - Science
        - History and Social Sciences; *and*
    b. Meet the current VIP excellence targets for Governor's awards as specified in the currently approved VIP program; *and*
    c. <u>Meet or exceed the state goal for on-time high school graduation rate, currently established at 80 percent on the Governor's scorecard; *and*</u>

[1] Current weightings are 0 points for below basic; 25 basic; 75 proficient; 100 advanced proficient.

d. The combined percent of cohort students who dropped out or have unconfirmed status is 10 percent or less.

2. To earn a Board of Education VIP Excellence Award, eligible schools and divisions would have to meet the following criteria:
   a. Earn a minimum of 80 index points on the weighted VIP index points, using the current weightings, in EACH of the following content areas:
      - English/reading (combined reading and writing)
      - Mathematics
      - Science
      - History and Social Sciences; *or*
   b. Achieve a minimum of 80 index points in each content area using the total number of additional index points earned through the program to meet the minimum of 80 total VIP points in each content area; *and*
   c. Meet or exceed the state goal for on-time high school graduation rate, currently established at 80 percent on the Governor's scorecard; *and*
   d. The combined percent of cohort students who dropped out or have unconfirmed status is 10 percent or less.

3. To earn a Board of Education VIP Competence to Excellence award, eligible schools and divisions would have to meet the following criteria:
   a. Earn a minimum of 75 index points on the weighted VIP index points, using the current weightings, in EACH of the following content areas:
      - English/reading (combined reading and writing)
      - Mathematics
      - Science
      - History and Social Sciences; *or*
   b. Achieve a minimum of 75 index points in each content area using the total number of additional index points earned through the program to meet the minimum of 75 total VIP points in each content area; *and*
   c. Meet or exceed the state goal for on-time high school graduation rate, currently established at 80 percent on the Governor's scorecard; *or*
   d. Have a combined percent of cohort students who dropped out or have unconfirmed status of 10 percent or less.

4. To earn a Board of Education VIP Rising Star Award, eligible schools and divisions would have to meet the following criteria:
   a. Demonstrate significant improvement in the VIP index in each academic content area in which they earn less than 75 index points:
      - English/reading (combined reading and writing)
      - Mathematics
      - Science
      - History and Social Sciences; *and*
   b. Meet or exceed the state goal for on-time high school graduation rate, currently established at 80 percent on the Governor's scorecard; *or*
   c. Have a combined percent of cohort students who dropped out or have unconfirmed status of 10 percent or less.

The table below illustrates how the data from each core content area and the additional index points can be used to achieve the criteria for Board of Education VIP Excellence and Competence to Excellence

awards. This approach would be used to determine awards when the weighted VIP index in one or more content areas falls below the proposed criteria of 80 and 75 for excellence and competence to excellence awards, respectively.

Content Area							
English/reading Weighted VIP index	**Mathematics Weighted VIP index**	**History and Social Science Weighted VIP index**	**Science Weighted VIP index**	**Total Additional VIP index points earned**	**Additional index points needed for Excellence award**	**Additional index points needed for Competence to Excellence award**	**VIP Award**
78	80	79	80	5	3	NA	Board of Education Excellence Award
74	80	75	74	3	17	2	Board of Education Competence to Excellence Award

The Department proposes to implement the revised VIP award criteria for awards given in the 2009-2010 school year.

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education adopt the recommended revisions to the criteria to earn VIP awards and instruct the Department of Education to implement the revised criteria in awards given during the 2009-2010 school year.

Impact on Resources:
The Department can absorb the costs to adjust the awards criteria for the VIP program.

Timetable for Further Review/Action:
None

Board of Education Agenda Item

Item: P. **Date:** July 23, 2009

Topic: First Review of Updates to the Virginia Board of Education *Student Conduct Policy Guidelines*

Presenter: Dr. Cynthia A. Cave, Director, Office of Student Services

Telephone Number: 804-225-2818 **E-Mail Address:** Cynthia.Cave @doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:

The Board of Education's *Student Conduct Policy Guidelines* were first developed in 1994 in response to action by the 1993 General Assembly that required the Board to establish such guidelines, as reflected in 22.1-279.6 of the *Code of Virginia.* The guidelines were revised in 2001 and again in 2004 and 2006 to reflect changes in federal and state laws, regulations, and relevant case law. The guidelines are intended to aid school boards in developing and implementing student conduct standards and policies. Local school boards are required to adopt and revise regulations for codes of student conduct that are consistent with, but may be more stringent than, these guidelines.

The 2009 General Assembly made changes to the *Code of Virginia* by adopting HB 1794 (Brink) and HB 1624 (Englin) which necessitate revisions to the *Student Conduct Policy Guidelines.* HB 1794 (Brink) amended § 22.1-77 of the *Code of Virginia* to restrict the use of suspension for truancy as follows "Pupils may be suspended or expelled from attendance at school for sufficient cause, *however, in no cases may sufficient cause for suspensions include only instances of truancy...*" HB 1624 (Englin) amended the *Code of Virginia* at § 22.1-279.6 to require the Board of Education model policies for codes of student conduct to include guidelines for "*...the* [mis-] *use of electronic means for purposes of bullying, harassment, and intimidation...*"

In addition, the revised *Regulations Governing Special Education Programs for Children with Disabilities in Virginia* became effective July 7, 2009. These revisions include updated requirements and regulations for disciplining children with disabilities, as outlined in the *Individuals with Disabilities Education Improvement Act of 2004*, and are included in the appendix of the Board's guidelines.

Summary of Major Elements

As shown in the attached revised *Student Conduct Policy Guidelines*, amendments to reflect 2009 legislative changes have been made as follows. The prohibition of using suspension as a consequence for truancy has been addressed in the sections on the *Authority and Duties of School Boards* (page two), *Short-term Suspension* and *Long-term Suspensions* (page eight), and *Attendance: Truancy* (page nineteen). Changes made to address the inappropriate use of electronic devices for causing harm are in the sections on *Bullying* (page twenty-one), *Internet Use* (page twenty-six) and *Threats: Intimidation* (page twenty-seven). Revisions to Appendix B of the guidelines include the requirements for disciplining students with disabilities, as outlined in the revised *Regulations Governing Special Education Programs for Children with Disabilities in Virginia* (pages thirty-six through thirty-nine).

Finally, the deletion of outdated information, the inclusion of current resources and publications, and minor edits enhance the purpose and usefulness of the guidelines. The following table provides the page numbers and brief descriptions of the 2009 changes to the *Student Conduct Policy Guidelines.*

Page Number	**Brief Description**
Cover page	Removed old dates
Acknowledgment Page	Provided current Office of Student Services contact information
2	Addition of no suspension for truancy
8	No short- or long-term suspension for truancy
12	Removed reference to 2006 General Assembly clarification of offense
19	No suspension for truancy
21	No use of electronic means to do harm (added harassment and electronic devises or other technology which may be used for cyber bullying)
24	Removed serious injury – is no longer a valid code – considered assault and battery
26	Removed dated information from the *Internet Use* section and added guidance to include the inappropriate use of the internet to cause harm
27	Addition of prohibition of use of electronic means for purposes of bullying, harassment, and intimidation
31	Updated information
35	Added amended language to *Appendix A: Code of Virginia § 22.1-279.6*
36-39	Updated regulations for *Appendix B: Discipline of Students With Disabilities*
42	Removed page – information outdated
43	Removed page – information outdated
44-46	Updated Web sites, publications, titles

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education waive first review and accept the guidelines for final review.

Impact on Resources:
The impact on resources will be minimal. The guidelines will be disseminated in electronic format and posted to the Virginia Department of Education Office of Student Services' Web site.

Timetable for Further Review/Action:
No further action is needed if Board of Education accepts the guidelines for final review.

STUDENT CONDUCT POLICY GUIDELINES

~~2006 Update~~

~~Originally Adopted by the~~
Virginia Board of Education
~~September 22, 2004~~
2009

Acknowledgments

The Virginia Board of Education's *Student Conduct Policy Guidelines* underwent major revision in content and format in 2004 incorporating numerous changes in state and federal laws and regulations, relevant case law, and emerging best practice principles. The 2004 *Guidelines* were updated in ~~both~~ 2005, ~~and~~ 2006, and 2009 primarily to incorporate changes in state laws enacted by the General Assembly ~~in the 2005 and 2006 Sessions~~. The Virginia Board of Education and the Virginia Department of Education express sincere appreciation to members of the 2004 Student Conduct Policy Guidelines Advisory Group who generously contributed their time and expertise to the development of these guidelines.

Members of the 2004 Student Conduct Policy Guidelines Advisory Group

Representation	Name
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Director of Alternative Education and Disciplinary Hearing Officer	Bill Sadler Hanover County Public Schools
Safe and Drug-Free Schools Coordinators	Jo Ann Burkholder, Roanoke County Public Schools Clarence Jones, Fairfax County Public Schools
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I. INTRODUCTION

Background

The Virginia Board of Education's *Student Conduct Policy Guidelines* were first developed in 1994 in response to action by the 1993 General Assembly requiring the Virginia Board of Education to establish such guidelines. In 2004, the *Guidelines* underwent a major revision in response to requirements of § 22.1-279.6. of the *Code of Virginia*, and reflecting numerous changes in state and federal laws and regulations, relevant case law, and emerging best practice principles. The *Virginia Student Conduct Policy Guidelines, 2004*, were originally adopted by the Virginia Board of Education on September 22, 2004. The guidelines were updated in 2005, 2006, and 2009 to incorporate changes in state laws and regulations. The guidelines are intended specifically to aid school boards in implementing student conduct policies. Local school boards are required to adopt and revise regulations on codes of student conduct that are consistent with, but may be more stringent than, these guidelines.

Legal Base

Statutory Authority for Guidelines

The Virginia Board of Education is required by law (§ 22.1-279.6. of the *Code of Virginia*) to establish guidelines and develop model policies for codes of student conduct to aid local school boards in the implementation of such policies.

The guidelines and model policies are required to include, but not be limited to, the following:

(i) Criteria for the removal of a student from a class, the use of suspension, expulsion, and exclusion as disciplinary measures, the grounds for suspension and expulsion and exclusion, and the procedures to be followed in such cases, including proceedings for such suspension, expulsion, and exclusion decisions and all applicable appeals processes

(ii) Standards, consistent with state, federal and case laws, for school board policies on alcohol and drugs, gang-related activity, hazing, vandalism, trespassing, threats, search and seizure, disciplining of students with disabilities, intentional injury of others, self-defense, bullying, dissemination of such policies to students, their parents, and school personnel

(iii) Standards for in-service training of school personnel in and examples of the appropriate management of student conduct and student offenses in violation of school board policies.

Procedures for suspension and expulsion are to be the minimum procedures that the school board may prescribe.

Section 22.1-279.6.C. requires the Board to establish standards to ensure compliance with the federal Improving America's Schools Act of 1994 (Part F-Gun-Free Schools Act of 1994), as amended.

Also required by § 22.1-279.6. are standards for school board policies on alcohol and drugs and search and seizure, including guidance for procedures relating to voluntary and mandatory drug testing in schools. *Guidelines Regarding Student Searches in Public Schools* were adopted by the Virginia Board of Education in

1999 and *Guidelines Concerning Student Drug Testing in Virginia Public Schools* were adopted by the Board in 2004. These guidelines can be found on the Virginia Department of Education Web site at http://www.doe.virginia.gov/VDOE/studentsrvcs/.

Authority and Duties of School Boards

Standards of Quality

Section 22.1-253.13:7.D.3. of the *Code of Virginia* (part of the section of the Code known as the Standards of Quality) requires local school boards to maintain and follow an up-to-date policy manual that includes "standards of student conduct and attendance and enforcement procedures designed to provide that public education be conducted in an atmosphere free of disruption and threat to persons or property and supportive of individual rights."

Local school boards must give consideration to the views of teachers, parents, and other concerned citizens in the development of policies.

School Board Regulations

Section 22.1-78. of the *Code* authorizes local school boards to adopt bylaws and regulations "for its own government, for the management of its official business and for the supervision of schools, including but not limited to the proper discipline of students, including their conduct going to and returning from school."

Section 22.1-279.6.B. of the *Code* requires local school boards to adopt and revise regulations on codes of student conduct that are consistent with, but may be more stringent than, the guidelines of the Board. School boards are required to include procedures for suspension, expulsion, and exclusion decisions, to biennially review student conduct code guidelines, and to include prohibitions against hazing and profane or obscene language or conduct. School boards are authorized to regulate certain communications devices and, at their discretion, require or encourage drug testing.

Section 22.1-279.9. of the *Code* requires school boards, in cooperation with the local law enforcement agencies, juvenile and domestic relations court judges and personnel, parents, and the community-at-large, to develop programs to prevent violence and crime on school property and at school-sponsored events.

Removal, Suspension and Expulsion of Pupils

Section 22.1-276.2. of the *Code* gives teachers initial authority to remove a student from a class for disruptive behavior and requires all school boards to establish the criteria for teachers to remove disruptive students, requirements for reporting incidents of disruptive behavior, procedures for written notification to a student and the student's parents, guidelines for alternative assignment and instruction of such students, and procedures for the return of students to class and teacher participation in the decision.

Section 22.1-277, of the *Code* authorizes the suspension or expulsion of pupils "for sufficient cause; however, in no cases may sufficient cause for suspensions include only instances of truancy." A suspension or expulsion may occur for ~~include~~ acts off school property when the acts lead to an adjudication of delinquency, a conviction of certain offenses, or a charge that would be a felony if committed by an adult.

Authorization for short-term suspensions (10 school days or less) and procedures for suspension and for readmission are set forth in § 22.1-277.04. of the *Code*.

Authorization for long-term suspensions (more than 10 school days but less than 365 calendar days) and procedures for suspension and for readmission are set forth in § 22.1- 277.05. of the *Code*.

Authorization for expulsion and procedures for expulsion and for readmission are set forth in § 22.1-277.06. Recommendations for expulsion for other than weapons and drug offenses are required to be based on consideration of factors specified in the *Code,* including the nature and seriousness of the violation and the student's disciplinary history.

Section 22.1-277.07. of the *Code* requires school boards to expel students who bring a firearm or other destructive device (defined in the Section) onto school property or to a school-sponsored event in violation of the Gun-Free Schools Act of 1994. School boards are authorized to consider factors listed in § 22.1-277.06. in determining "special circumstances" in particular cases that would justify another disciplinary action.

Section 22.1-277.08. of the *Code* requires school boards to expel students who bring a controlled substance, imitation controlled substance, or marijuana onto school property or to a school-sponsored event. School boards are authorized to consider factors listed in § 22.1- 277.06. in determining "special circumstances" in particular cases that would justify another disciplinary action.

Alternative Educational and Intervention Programs

Section 22.1-277.2:1. of the *Code* authorizes school boards to require any student to attend an alternative education program under prescribed circumstances. Procedures to be followed when requiring an alternative education program are also prescribed. It should be noted that alternative education programs are authorized but not required by the *Code* to be established.

In its 2006 Session, the General Assembly added to the list of persons who may participate in the GED testing program to include (i) persons 16 years of age or older who have been expelled from school and (ii) persons required by court order to participate in the testing program (Section 22.1-254.2.A.6. and 7.).

School boards may require any student who has been found in possession of, or under the influence of, drugs or alcohol on a school bus, on school property, or at a school-sponsored activity to undergo evaluation for drug or alcohol abuse, or both, and, if recommended by the evaluator and with the consent of the student's parent, to participate in a treatment program.

Legal Responsibilities of Others

Role of the Principal and School Administration

The Virginia Standards of Accreditation (2000), Section 8 VAC 20-131-210.A., states that the principal "is recognized as the instructional leader of the school and is responsible for effective school management that promotes positive student achievement, a safe and secure environment in which to teach and learn, and efficient use of resources." Section B.2. specifies that the principal shall "ensure that the school division's student code of conduct is enforced and seek to maintain a safe and secure school environment." Section 8 VAC 20-131-260.C.3., requires a school administration to ensure "a written procedure, in accordance with guidelines established by the local board, for responding to violent, disruptive or illegal activities by students on school property or during a school-sponsored activity."

Parental Responsibility

Section 22.1-279.3. of the *Code of Virginia* sets forth the duty of each parent of a student enrolled in a public school to assist the school in enforcing the standards of student conduct and compulsory school attendance.

Procedures are set forth for notifying parents of their responsibilities, documenting the notification, and taking steps against parents for willful and unreasonable refusal to participate in efforts to improve their child's behavior or school attendance. Each parent of a student must sign a statement acknowledging the receipt of the school board's standards of student conduct and return it to the school.

Section 22.1-3.2.A.and B. of the *Code of Virginia* requires a parent or guardian to provide a public school, upon registration of a student, information concerning criminal convictions or delinquency adjudications for any offense listed in subsection G of § 16.1-260. These include homicide, felonious assault and bodily wounding, criminal sexual assault, manufacture, sale, or distribution of Schedule I or II controlled substances or marijuana, arson, burglary and robbery, prohibited street gang activity, and recruitment for street gang activity. When the school registration results from foster care placement, the information is to be furnished by the local social services agency or licensed child-placing agency that made the foster care placement. This requirement was added by the 2006 General Assembly.

Responsibilities of Law Enforcement Agencies

Section 22.1-279.3:1.B. of the *Code of Virginia* requires law enforcement agencies to notify a division superintendent, a principal, or a designee when a student in their school commits certain offenses that would be a felony if committed by an adult or a violation of the Drug Control Act, or an adult misdemeanor as listed in § 22.1-279.3:1.A. and whether the student is released to the custody of his parent or, if 18 years of age or more, is released on bond. It further requires that any school superintendent who receives notification that a juvenile has committed an act that would be a crime if committed by an adult pursuant to subsection § 16.1-260 to report the information to the principal of the school in which the juvenile is enrolled. Requirements for law enforcement agencies to report the release status of the student and for school superintendents to inform principals were added by the 2006 General Assembly.

Reports to Law Enforcement Agencies

Section 22.1-279.3:1.A. of the *Code of Virginia* lists certain offenses that school officials are required to report to local law-enforcement agencies. Additional information about this requirement and a list of reportable offenses are on page 31 of these guidelines.

II. STUDENT CONDUCT POLICY GUIDELINES

Elements of Student Conduct Policy

School board policies on student conduct should address certain basic elements including the following:

1. Statement of purpose and intent and/or philosophy
2. Roles and responsibilities for student conduct policy
3. Relationship to related policies and regulations
4. Disciplinary action criteria, procedures, and processes
5. Policy for the development, dissemination and periodic review of standards of student conduct
6. Training of school personnel
7. Standards for student conduct

Described below are each of the basic elements listed with corresponding sample policy statements. Section 22.1-279.6.B. of the *Code* requires local school boards to adopt and revise regulations on codes of student conduct that are consistent with, but may be more stringent than, the guidelines of the Board of Education.

1. Purpose and Intent; Philosophy

Local school board policy on student conduct should include a statement of purpose and intent consistent with Virginia law. Examples of statutory language are as follows:

- The Standards of Quality (§ 22.1-253.13.7.D.3.) require standards and procedures "designed to provide that public education be conducted in an atmosphere free of disruption and threat to persons or property and supportive of individual rights."

- Section 22.1-279.3. sets forth parental responsibility and involvement requirements "in order that education may be conducted in an atmosphere free of disruption and threat to persons or property, and supportive of individual rights."

- Section 22.1-279.6. of the *Code* makes reference to incorporating discipline options and alternatives "to preserve a safe, non-disruptive environment for effective teaching and learning."

Sample Statements of Purpose and Intent

- The development, implementation, and enforcement of the student conduct policy is intended to ensure a safe, nondisruptive environment for effective teaching and learning.
- Standards of student conduct are designed to protect the health, safety and welfare of students.
- It is the belief of the (name of school board) that all students have the right to an environment that is safe, drug-free, and conducive to learning. To that end, the student conduct policy sets forth standards for student conduct.
- The primary objectives of the standards of student conduct are (1) to provide standards and guidelines for student behavior; (2) to assist the student in becoming a responsible, productive, and self-disciplined citizen; and (3) to maintain a safe and orderly environment in the classroom and all other areas of the school.

2. Roles and Responsibilities

Local school board policies should clearly define the roles and responsibilities of the school board, the superintendent, principals, teachers, and other staff with responsibility for enforcement of student conduct standards. Information about the duty of parents to assist the school in enforcing the standards of student conduct and compulsory school attendance also is appropriate to be included. A general statement about student rights and responsibilities also may be included, particularly when the local standards of student conduct articulate student rights and responsibilities related to specific conduct.

Sample Statement on Roles and Responsibilities

School board members, school personnel, parents, and students share the responsibility to create and maintain a school environment that is safe and conducive to learning. It is the responsibility of the School Board to adopt policies and regulations. The superintendent has responsibility to issue standards of student conduct including a list of corrective disciplinary actions for violation of the standards. The school principal has responsibility to enforce the student conduct standards using reasonable judgment. Each parent has a duty to assist the school in enforcing the standards of student conduct and compulsory school attendance. Students are expected to attend school regularly and to demonstrate good citizenship, enjoying the rights and fulfilling responsibilities set forth in the student conduct standards.

3. Relationship to Existing Policies

The relationship of the student conduct policy to other related local policies, rules, and regulations should be explicitly stated. Other related local policies may include, but are not limited to, those governing student searches, drug testing, attendance, and discipline of students with disabilities. Relevant sources such as federal and state regulations and guidance may be cross-referenced. A list of such regulations, guidelines, and credible resource publications and sources is included as Appendix D.

4. Disciplinary Action: Criteria, Procedures, and Processes

Teacher Removal of a Student from Class

Local school board policy should cite the initial authority of teachers to remove a student from a class for disruptive behavior and, in accordance with § 22.1-276.2. of the *Code*, is required to establish the following:

1. Criteria for teachers to remove disruptive students from their classes
2. Requirements for incident reports of disruptive behavior to school administrators and any other documentation to support such removals from class
3. Procedures for the written notification of a student and the student's parents of any incident report and its contents and for the opportunity to meet with the teacher and school administrators to discuss the student's behavior and the possible consequences if such behavior does not cease
4. Guidelines for the alternative assignment and instruction of such students and for the duration of such removals
5. Procedures for the return of students to class, for teacher participation in any decision by the principal to return a student to the class from which the student has been removed, and for the resolution of any disagreements between the principal and teacher regarding the return.

"Disruptive behavior" is defined in § 22.1-276.01. of the *Code* as conduct that interrupts or obstructs the learning environment.

Sample Statement on the Removal of a Student from Class

Teachers shall have the initial authority to remove a student from a class for disruptive behavior that interrupts or obstructs the learning environment, using the following criteria:

1) The removal of the student is necessary to restore a learning environment free from interruptions or obstructions caused by the student's behavior.
2) The removal of the student occurs only after teacher or administrative interventions have failed to end the disruptive behavior. However, nothing shall preclude the immediate removal of a student for behavior that might warrant suspension from school.
3) The removal of a student is an appropriate response to student behavior that is a violation of the rules of conduct.
4) Written notice of the student's behavior and removal from class is given to the parent by the teacher.

Short-term Suspensions

"Short-term suspension" is defined in § 22.1-277.04. of the *Code* as any disciplinary action whereby a student is not permitted to attend school for a period not to exceed 10 school days. <u>However, in no case may a student be suspended based solely on instances of truancy.</u>

A local school board policy should cite the authority to suspend a student, and include procedures for notice to the student, reporting to the parent and division superintendent, review upon petition, and for appeal consistent with § 22.1-277.04.of the *Code.* School boards may prescribe in regulation whether appeals of short-term suspensions may be made to the school board, a committee thereof, or to the division superintendent or his designee. "Superintendent's designee" is defined in § 22.1-276.01.B. as a "(i) trained hearing officer or (ii) professional employee within the administrative offices of the school division who reports directly to the division superintendent and who is not a school-based instructional or administrative employee."

A school board policy must require, in accordance with § 22.1-277.04.of the *Code*, that any oral or written notice to the parent of a student suspended from school for not more than 10 school days include the following:

> The length of the suspension, information regarding the availability of community-based educational programs, alternative education programs or other educational options, and the student's right to return to regular school attendance upon the expiration of the suspension.

A school board may include a statement specifying that the costs of any community-based educational program, or alternative education program or educational option, which is not a part of the educational program offered by the school division, is the responsibility of the parent of the student. A decision of the division superintendent or designee may be appealed to the school board or its committee, in accordance with local school board regulations.

Sample Statement on Short-Term Suspension

A student may be suspended out-of-school for violations of the *Code of Conduct.* For out-of school suspensions of 10 days or less, the school administrator shall inform the student of the specific violation and provide the student with opportunities to respond to the charges. The student may present the student's version of what occurred. When the school suspends a student, the school shall 1) notify the student of the right to appeal; 2) make a reasonable effort to notify the student's parent of the suspension, inform the parent that a copy of the rules governing suspensions and the procedures for appeal are being sent home with the student, and make arrangements for the student's return home; and 3) send written notification to the parent informing the parent of the suspension, of its reason, the length of the suspension, the right to appeal, the student's right to return to school, and any conditions for that return.

Long-term Suspensions

"Long-term suspension" is defined in § 22.1-277.05. of the *Code* as any disciplinary action whereby a student is not permitted to attend school for more than ten school days but less than 365 calendar days. <u>However, in no case may a student be suspended based solely on instances of truancy.</u>

A local school board policy should cite the authority to suspend a student and establish procedures for written notice to the pupil and parent of the action, its reason, and right to appeal in accordance with § 22.1-277.05. of the *Code of Virginia*. A school board may prescribe in regulation whether appeals of long-term suspensions may be to the school board, a committee thereof, or the division superintendent or his designee. If regulations provide for a hearing by the superintendent or designee, the regulations must provide for an appeal of the decision to the full school board and such an appeal must be decided by the school board within thirty days. If the regulations provide for a hearing by a committee of the school board, the regulations must provide that the committee may confirm or disapprove the suspension of a student. The committee must be composed of at least three members and, if the committee's decision is not unanimous, the pupil or the pupil's parent may appeal the committee's decision to the full school board. Such an appeal must be decided by the school board within thirty days.

School board policy must require that the written notice of a suspension for more than ten days include the following:

- The length of the suspension
- Information concerning the availability of community-based educational, alternative education, or intervention programs
- The student's eligibility to return to regular school attendance upon the expiration of the suspension or to attend an appropriate alternative education program approved by the school board during or upon the expiration of the suspension.

A school board may include a statement specifying that the costs of any community-based educational program, or alternative education program or educational option, which is not a part of the educational program offered by the school division, is the responsibility of the parent of the student.

School board policy may permit or require students suspended for more than 10 days to attend an alternative education program provided by the school board for the term of the suspension in accordance with procedures set forth in § 22.1-277.2:1. of the *Code.* Alternative education programs are authorized but not required to be established.

Sample Statement on Long-Term Suspension

A student may be suspended for more than 10 days following a hearing before a hearing officer designated by the superintendent. For certain offenses, a student may be suspended for the remainder of the semester or the school year. The school administration may determine that transfer to another school serves the best interest of the student and the school.

The discipline committee of the school board may confirm or disapprove the suspension of a student. A hearing shall be held before the discipline committee within ten days of the date of notice from the principal. If the decision of the three-member committee to uphold the suspension is unanimous, there is no right of appeal. If, however, the decision of the committee is not unanimous, the student and his/her parent/guardian may appeal the decision to the full board.

When a student is placed on long-term suspension, written notice of the suspension shall be sent in accordance with state law.

Expulsions
"Expulsion" is defined in § 22.1-277.06. of the *Code of Virginia* as “any disciplinary action imposed by a school board or a committee thereof, as provided in school board policy, whereby a student is not permitted to attend school within the school division and is ineligible for readmission for 365 calendar days after the date of the expulsion.”

A local school board policy should cite the authority to expel a student and establish the procedures for written notice to the pupil and parent of the action, its reason, and right to a hearing and confirmation in accordance with § 22.1-277.06. of the *Code* and with regulations of the school board. A school board may prescribe in regulation whether the hearing is before the school board or a committee thereof. If the regulations provide for a hearing by a committee of the school board, the regulations must also provide that the committee may confirm or disapprove the expulsion. The committee must be composed of at least three members and, if the committee's decision is not unanimous, the pupil or pupil’s parent may appeal the committee's decision to the full school board. Such an appeal must be decided by the school board within thirty days. School board policy must also provide for confirmation or disapproval of a proposed expulsion by the school board or a committee thereof, regardless of whether the pupil exercises the right to a hearing.

The school board policy must require, in accordance with § 22.1-277.06. of the *Code*, that the written notice of expulsion include the following:

- The length of the expulsion
- Information to the parent of the student concerning the availability of community-based educational, training, and intervention programs
- Whether or not the student is eligible to return to regular school attendance, or to attend an appropriate alternative education program approved by the school board, or an adult education program offered by the school division, during or upon the expiration of the expulsion
- A notice advising that the student may petition the school board for readmission to be effective one calendar year from the date of the student’s expulsion, if the school board determines that the student is ineligible to return to regular school attendance or to attend during the expulsion an alternative education program or an adult education program in the school division
- The terms and conditions, if any, under which readmission may be granted.

A school board may include a statement specifying that the costs of any community-based educational program, or alternative education program or educational option, which is not a part of the educational program offered by the school division, is the responsibility of the parent of the student.

School board policy may permit or require students expelled to attend an alternative education program provided by the school board for the term of the expulsion in accordance with procedures set forth in § 22.1-277.2:1. of the *Code.* Alternative education programs are authorized but not required to be established. In its 2006 Session, the General Assembly added to the list of persons who may participate in the GED testing program (i) those persons 16 years of age or older who have been expelled from school and (ii) persons required by court order to participate in the testing program (Section 22.1-254.2.A.6. and 7.).

A school board must establish, by regulation, a schedule by which pupils who have been expelled may apply and reapply for readmission to school. The schedule must be designed to ensure that the hearing or ruling on any initial petition for readmission, if granted, would enable the student to resume school attendance one calendar year from the date of the expulsion. Some school divisions develop an individualized plan or contract for expelled students specifying conditions the student must meet for readmission and actions the student has agreed to take to meet the conditions.

Recommendations for expulsion for other than weapons- and drug-related violations (specified in §§ 22.1-277.07. and 22.1-277.08. of the, *Code of Virginia*) are required to be based on a consideration of factors listed below, as provided in § 22.1-277.06.C.

1. The nature and seriousness of the violation
2. The degree of danger to the school community
3. The student's disciplinary history, including the seriousness and number of previous infractions
4. The appropriateness and availability of an alternative education placement or program
5. The student's age and grade level
6. The results of any mental health, substance abuse, or special education assessments
7. The student's attendance and academic records
8. Other matters as deemed to be appropriate

It should be noted that no decision to expel a student may be reversed on the grounds that the above factors were not considered. These factors may be considered by a school board as "special circumstances" in cases involving weapons- and drug-related violations when determining whether a pupil will be provided an alternative educational placement.

Sample Statement on Expulsion

A student may be expelled only by action of the school board or a disciplinary committee of the school board based on the recommendation of the principal and the superintendent.

In the case of a recommendation for expulsion by the principal, the superintendent or his designee shall conduct a review of the recommendation. The review shall take into account the following factors:

1. The nature and seriousness of the violation
2. The degree of danger to the school community
3. The student's disciplinary history, including the seriousness and number of previous infractions
4. The appropriateness and availability of an alternative education placement or program
5. The student's age and grade level
6. The results of any mental health, substance abuse, or special education assessments
7. The student's attendance and academic records
8. Such other matters as deemed to be appropriate

Sample Statement on Expulsion (continued)

If the superintendent/designee upholds the recommendation, a hearing shall be held before the discipline committee within 10 days of the date of notice from the principal. If the decision of the three-member committee to uphold the expulsion is unanimous, there is no right of appeal. If, however, the decision of the committee is not unanimous, the student and his/her parent or guardian may appeal the decision to the full board.

When a student is expelled, written notice of the expulsion shall be sent in accordance with state law. The superintendent or his designee shall establish a schedule by which pupils who have been expelled may apply and reapply for readmission to school.

Expulsions for Weapons-Related Offenses

School board policy, in accordance with § 22.1-277.07. of the *Code of Virginia*, must provide for the mandatory expulsion for a period of not less than one year (365 days) of any student determined to possess a firearm, destructive device, a firearm muffler or firearm silencer, or a pneumatic gun on school property or at a school-sponsored activity. Definitions of "firearm," "destructive devices," and “pneumatic gun” are set forth in § 22.1-277.07.E. of the *Code*, and are consistent with the federal Gun-Free Schools Act. A copy of this Act is included as Appendix E. This prohibition does not apply to Junior Reserve Officers Training Corps (JROTC) programs or to the possession of firearms as part of the curriculum or other programs sponsored by the schools or other organization permitted by the school to use its premises. ~~Note that the 2006 General Assembly clarified the offense as *possession*; previous law referred to “bringing” such firearms and devices to school.~~

A school board may establish policies and promulgate related guidelines for determining whether "special circumstances" exist that would allow for no disciplinary action or another disciplinary action, based on the facts of a particular situation. A school board may, by regulation, authorize the division superintendent or designee to conduct a preliminary review of such cases.

A school board policy may permit or require students expelled for weapons-related offenses to attend an alternative education program provided by the school board for the term of the expulsion.

Sample Statement on Expulsion for Weapons-Related Offense

Any student determined to be in possession of or to have brought any prohibited weapon onto school property or to a school-sponsored activity shall be expelled for a period of not less than one year (365 days). However, the school board may determine, based on the facts of a particular case, that special circumstances exist and another disciplinary action or term of expulsion is appropriate. The division superintendent may conduct a review in such cases to determine whether a disciplinary action other than expulsion is appropriate, and recommend that action to the school board for final determination.

Expulsions for Drug-Related Offenses

A school board policy, in accordance with § 22.1-277.08. of the *Code of Virginia*, must provide for the mandatory expulsion for a period of not less than one year of any student determined to have brought a controlled substance, imitation controlled substance, or marijuana as defined in § 18.2-247. onto school property or to a school-sponsored activity.

"One year" is defined as 365 days as required in federal regulation.

A school board may establish policy and promulgate related guidelines for determining whether "special circumstances" exist that would allow for no disciplinary action or another disciplinary action, based on facts of a particular situation. A school board may, by regulation, authorize the division superintendent or his designee to conduct a preliminary review of such cases.

School board policy may permit or require students expelled for drug-related offenses to attend an alternative education program provided by the school board for the term of the expulsion.

Sample Statement on Expulsion for Drug-Related Offense

Any student determined to have distributed or manufactured a controlled substance including anabolic steroids or prescription drugs, an imitation controlled drug, or other prohibited substance on school property or at a school-sponsored activity shall be expelled for a period of not less than one year. However, the school board may determine, based on the facts of a particular case, that special circumstances exist and another disciplinary action or term of expulsion is appropriate. The division superintendent may conduct a review in such cases to determine whether a disciplinary action other than expulsion is appropriate, and recommend that action to the school board for final determination.

Suspensions or Expulsions of Students with Disabilities

Local school board policy should specify, at a minimum, that suspensions and/or expulsions of students with disabilities will be in compliance with state regulations and federal law. Reference may be made to *Regulations Governing Special Education Programs for Children with Disabilities* (2002) that are available from the Virginia Department of Education Web site at http://www.doe.virginia.gov/VDOE/dueproc/. Additional information on students with disabilities is included in Appendix B.

Admission of Students Suspended or Expelled from Another School Division or a Private School

Section 22.1-277.2. of the *Code* authorizes the exclusion of a student suspended or expelled from another school division or a private school upon a finding that the student presents a danger to the other students or staff of the school division. This action is permitted after:

(i) Written notice to the student and student's parent that the student may be subject to exclusion, the reasons therefore, and, in the event of such exclusion, the right to appeal the decision at a hearing before the school board or a committee thereof; and

(ii) Review of the case by the division superintendent or designee and a recommendation of exclusion.

In cases where the suspension is for more than 30 days, the term of the exclusion may not exceed the duration of such suspension.

In cases of expelled students, the local school board may accept or waive any or all of any conditions for readmission imposed upon such a student by the expelling school board, but may not impose additional conditions for readmission to school.

A school board policy should cite the authority to exclude such students and establish procedures in accordance with § 22.1-277.2. of the *Code*. A school board may, but is not required, to permit students excluded to attend an alternative education program provided by the school board for the term of such exclusion.

Sample Statement for Admission of Students Suspended or Expelled from Another School Division

A student who has been expelled or suspended for more than 30 days from attendance at school by a school board or a private school, or for whom admission has been withdrawn by a private school, may be excluded from attendance for no more than one calendar year in the case of expulsion or withdrawal of admission, and in the case of suspension of more than 30 days, for not longer than the duration of such suspension. The school shall provide written notice to the student and his or her parent of the reasons for such possible exclusion and of the right to a hearing conducted by the division superintendent. The student may not attend school until a review of the case is conducted by the division superintendent. Exclusion shall be imposed upon a finding that the student presents a danger to the other students or staff members of the school division. The decision to exclude the student shall be final unless altered by the school board after timely written petition. Upon the expiration of the exclusion, the student may petition the division superintendent for admission.

5. Policy for Development, Dissemination and Periodic Review of Student Conduct Standards

Policy Development and Review

A school board policy should provide for the systematic review and update of existing policies, related regulations, and student conduct standards on an annual basis. The policy review process should involve, at a minimum, school board counsel, administrators most directly involved with student discipline (e.g., disciplinary hearing officer), and representatives of school-based administrators, teachers, students, and parents. Consultation with law enforcement and juvenile court officials and with other community agencies can be very beneficial.

The review should examine not only relevant statutory and case law and regulations, but also consider the policy and programmatic implications of local discipline data. This type of comprehensive review has been demonstrated to yield information useful in updating policy and in improving the effectiveness of its implementation. A comprehensive review also can be helpful in designing effective in-service training on student conduct policies for administrators and other staff.

Sample Statement on Review and Revision of Standards of Student Conduct

An annual evaluation of the *Standards of Student Conduct* will be conducted within a month of the close of school. Revision, if necessary, will be completed prior to the opening of the next school year.

Dissemination of Standards

Local school boards must provide written copies of the school board's standards of student conduct to students, parents of enrolled students, and school personnel. The format for written dissemination should be one that is understandable to students, parents, and school personnel and may include, but not be limited to, statements of student rights and responsibilities, rules of conduct, and disciplinary procedures. School boards in localities with substantial numbers of non-English-speaking populations may require the translation of the standards and related materials.

Student conduct standards may be published as a simple, stand-alone document or as part of a more lengthy, comprehensive handbook. School boards should determine the format and content most suited to local need. Some school divisions have included letters from local juvenile judges stating court positions on such matters as parent responsibilities, school attendance and student conduct. A glossary may be included to aid understanding of terminology. Some school divisions have developed separate documents detailing due process procedures that are given to pupils when disciplinary action is taken against them.

Dissemination procedures may include student and faculty orientations and other activities designed to ensure that each student has an opportunity to become familiar with the conduct standards. Some school divisions require classroom teachers to review standards with their students and others administer quizzes to assess student understanding of rules and consequences. Appropriate adaptations should be employed for students with disabilities. Procedures should address also the dissemination of standards to students who enroll after the beginning of the school year and to their parents.

Sample Statement on Distribution of Standards of Student Conduct

A copy of the *Standards of Student Conduct* will be issued to all students within one month of the opening of school. All transfer students will be issued a copy of the *Standards* as a part of the registration process. Principals will stress to all students that compliance with the *Standards* is mandatory. The “Acknowledgment of Parent Responsibility” form must be signed by the parent or guardian and returned to the school.

Each year, during the first week of school, all students will be provided a period of instruction on the contents of the *Standards of Student Conduct*. This instruction will be followed by an assessment appropriate to the student’s grade level.

6. In-Service Training of School Personnel

Effective training of administrators and other staff with responsibility for implementation of student conduct policy is critical. Such training should be designed to include, but not be limited to, the following:

- Purpose and intent of student conduct policy
- Specific staff roles and responsibilities for implementing student conduct policy
- Standards for student conduct
- Disciplinary processes and procedures
- Requirements and procedures for reporting offenses to local law enforcement authorities
- Relationship of student conduct policy to other policies and procedures

Such training should be designed to equip school personnel with knowledge of best practices for effective conduct policy implementation. The use of methods such as scenarios and table-top exercises has been demonstrated to be effective for such training. At the discretion of a local school board, depending on local conditions, consideration may also be given to including content on cultural awareness, gang awareness, and bullying prevention and intervention.

III. STANDARDS OF STUDENT CONDUCT

Application of Policy

Local school board policies and/or regulations should state explicitly the following:

- Standards of student conduct apply to all students under the jurisdiction of a school board.
- Disciplinary action will be determined based on the facts of each incident in the reasonable discretion of the school board and other appropriate school officials.
- Students are subject to corrective disciplinary action for misconduct that occurs:

    - in school or on school property
    - on a school vehicle
    - while participating in or attending any school-sponsored activity or trip
    - on the way to and from school and
    - off school property, when the acts lead to (1) an adjudication of delinquency or a conviction for an offense listed in § 16.1-305.1. of the *Code of Virginia* (unlawful purchase, possession or use of a weapon, homicide, felonious assault and bodily wounding, criminal sexual assault, manufacture, sale, gift, distribution or possession of Schedule I or II controlled substances or marijuana, arson, and related crimes, and burglary and related offenses), criminal street gang activity or recruitment for such activity, or (2) a charge that would be a felony if committed by an adult.

Range of Corrective Disciplinary Action

Codes of student conduct should identify a range of corrective disciplinary actions available to school administrators in response to misconduct. The options and alternatives may range from admonition to mandatory expulsion, and may include, but not be limited to, the following:

- Admonition and counseling
- Parent/pupil conference
- Modification of student classroom assignment or schedule
- Student behavior contract
- Referral to student assistance services
- After-school or in-school detention
- Suspension of student privileges for a specified period
- Removal from class
- Initiation of child study process
- Referral to in-school intervention, mediation, or community service programs
- Short-term suspension
- Long-term suspension
- Recommendation for expulsion
- Mandatory expulsion

Differentiation of Sanctions by Grade Level

Options for corrective disciplinary action for misconduct may be differentiated by grade level.

Other Disciplinary Consequences

A school board may allow a student who has been suspended to complete academic assignments during the period of suspension in accordance with conditions established by the school board. School board policy may provide for ongoing consequences after a student returns to school following suspension or expulsion including, but not limited to, probationary status requiring satisfactory performance and conduct, limitations of privileges, community service, or restitution.

Administrative Discretion

The degree of administrator discretion in determining appropriate disciplinary action granted by a school board is critical to the effectiveness of a school division's discipline policy and constitutes an issue that merits careful consideration. School boards have a legitimate interest in the consistency and fairness of policy implementation across school sites. To ensure greater consistency, some school boards have prescribed certain minimum and maximum disciplinary actions, others have identified levels of action appropriate for specified offenses and many have limited discretion in cases of very serious offenses. A closely related issue is planning for the training of school personnel in disciplinary policy, its enforcement and disciplinary procedures.

Offenses

Definitions of offenses that are also violations of law should be consistent with statutory definitions. When offenses are not defined in the *Code of Virginia*, definitions developed for the Virginia Department of Education *Annual Discipline, Crime, and Violence Report* may be helpful in establishing local operational definitions.

Alcohol and Drugs

Student conduct policy for alcohol and drugs should address the possession, use, consumption, purchase, distribution, manufacture, and/or sale of restricted substances on school property, on school vehicles, or during school sponsored activities on or off school property. This includes, but may not be limited to, tobacco products, anabolic steroids, inhalants, stimulants, depressants, hallucinogens, marijuana, imitation and look-alike drugs, drug paraphernalia, any prescription or non-prescription drug possessed in violation of school board policy and other controlled substances defined in the Drug Control Act, Chapter 15.1. of Title 54 of the *Code of Virginia*.

School boards may consider the use of graduated sanctions in which a substance abuse prevention/intervention program is available to students in cases of first possession or use violations. A student assistance program can serve as an important programmatic element for substance abuse prevention, intervention, and linkage to treatment.

School boards, in accordance with § 22.1-277.2:1. of the *Code*, may require any student who has been found in possession of, or under the influence of, drugs or alcohol in violation of school board policy to undergo evaluation for drug or alcohol abuse, or both, and, if recommended by the evaluator and with the consent of the student's parent, to participate in a treatment program.

Sample Conduct Standard: Alcohol and Other Drugs

A student may not possess, use, or distribute alcohol, tobacco and/or tobacco products, and other drugs on school grounds, on school buses, or during school activities, on or off school property. This includes, but may not be limited to, smokeless tobacco, anabolic steroids, look-alike drugs, drug paraphernalia, and any drug not prescribed for the student by a physician.

Any student who possesses or uses prohibited substances may participate in prevention and intervention activities deemed appropriate by the superintendent.

Assault: Assault and Battery

An *assault* is a threat of bodily injury. A *battery* is any bodily hurt, however slight, done to another in an angry, rude or vengeful manner.

Student conduct policy should specifically prohibit the threatening or physical assaulting of students and of staff. Other related offenses that may be included as part of student conduct standards include sexual assault or battery (including improper touching), mob assault, and bullying.

Sample Conduct Standard: Assault

The following violations shall result in disciplinary action and may require mandatory sanctions:

1) Threatening or physically assaulting another student or another person (other than a staff member) who has reason to be at school, whether or not causing injury, shall result in disciplinary measures up to and including a 10-day suspension and a recommendation for expulsion.

2) Physically assaulting a school staff member shall result in suspension from school for up to 10 days, and the principal may recommend expulsion. In the event of injury to the staff member, expulsion shall be recommended.

Attendance: Truancy

Attendance requirements may be included as part of student conduct policy or may be addressed elsewhere in policy at the discretion of the school board. The policy should establish an expectation for regular attendance, criteria for absences to be excused and not excused, and applicable ~~academic and~~ disciplinary consequences and intervention assistance for ~~of nonattendance~~ unexcused absences and tardies. The comprehensive policy should address parental responsibilities, duties of the school division's attendance officer and procedures for taking action against the child and/or parent for failure to comply with applicable law.

According to § 16.1-228.A. of the *Code of Virginia*, a “child in need of supervision” who is truant means:

- A child who, while subject to compulsory school attendance, is habitually and without justification absent from school, and
- The child has been offered an adequate opportunity to receive the benefit of any and all educational services and programs that are required to be provided by law and which meet the child's particular educational needs, and
- The school division from which the child is absent or other appropriate agency has made a reasonable effort to affect the child’s regular attendance without success, and
- The school division has provided documentation that it has complied with the provisions of § 22.1-258 that address actions to be taken when a pupil fails to report to school.

Sample Conduct Standard: Attendance

Student attendance is a cooperative effort; schools shall involve parents and students in accepting responsibility for regular attendance.

Each parent or guardian of a child within the compulsory school attendance age shall be responsible for the child’s regular and punctual attendance at school as required by law.

Students shall attend school on a regular and punctual basis unless otherwise excused in accordance with school board regulation.

Bomb Threat

School board policy should specifically prohibit bomb threats. Other related offenses that may constitute components of a comprehensive policy include, but are not limited to, conduct involving firebombs, explosives, incendiary devices or chemical bombs.

Threats to bomb or damage buildings and giving false information as to danger to such buildings are prohibited by § 18.2-83. of the *Code of Virginia*. Definitions of "explosive material," "fire bomb," and "hoax explosive device" are defined in § 18.2-85. of the *Code*.

Sample Conduct Standard: Bomb Threat

Students shall not engage in any illegal conduct involving firebombs, explosive or incendiary materials or devices, or hoax explosive devices, or chemical bombs as defined in the *Code of Virginia*. Moreover, students shall not make any threats or false threats to bomb other students, school personnel or property.

Bullying

According to the National Center for Education Statistics, [*Indicators of School Crime and Safety*, 2002 (July 2004)], bullying can contribute to a climate of fear and intimidation in schools. Bullying is not specifically defined in Virginia law. Patterns of behavior associated with bullying that is criminal offenses are as follows:

Assault	Extortion	Hazing
Larceny	Theft	Harassment
Battery	False Imprisonment	Sexual harassment
Robbery	Threats	

Non-criminal behavior associated with bullying includes intimidation, taunting, name-calling, and insults. The definition developed for the Virginia Department of Education *Annual Discipline, Crime, and Violence Report* is "repeated negative behaviors intended to frighten or cause harm" that may include, but are not limited to, verbal or written threats or physical harm. Another form of bullying ~~is~~ occurs through the use of electronic means and is referred to as cyber bullying. Typically, cyber bullying is ~~typically~~ defined as using information and communication technologies, such as cell phone ~~and pager~~ text messages and pictures and internet e-mail ~~instant messaging~~, social networking Web sites, defamatory personal Web sites, and defamatory online personal polling Web sites, to support deliberate, hostile, behavior intended to harm others.

Section 22.1-208.01 requires each school board to establish, within existing programs, a character education program; these programs are required to address the inappropriateness of bullying.

Sample Conduct Standard: Bullying

Students, either individually or as part of a group, shall not harass or bully others. The following conduct is illustrative of bullying:

- Physical intimidation, taunting, name calling, and insults
- Comments regarding the race, gender, religion, physical abilities or characteristics of associates of the targeted person
- Falsifying statements about other persons
- Use of technology such as e-mail, text messages, or Web sites to defame or harm others.

Bus-Related Offenses

School board policy should clearly communicate that rules governing student conduct apply not only at school but also on a school vehicle, while on a school-sponsored trip, and on the way to and from school, including at the bus stop.

Sample Conduct Standard: Bus-Related Conduct

Students are required to conduct themselves on school buses in a manner consistent with established standards for classroom behavior. Students who become disciplinary problems on school buses shall be reported to the principal by the driver and may have their riding privileges suspended. Students are also subject to the same disciplinary action as would be prescribed had the behavior occurred at school.

Cheating

Cheating is not defined in the *Code of Virginia*. A student conduct policy may address cheating as a single offense or approach it as one of several offenses related to integrity.

> ***Sample Conduct Standard: Cheating***
> Students are expected to perform honestly on any assigned schoolwork or tests. The following actions are prohibited:
>
> - Cheating on a test or assigned work by giving, receiving, offering, and/or soliciting information
> - Plagiarizing by copying the language, structure, idea, and/or thoughts of another
> - Falsifying statements on any assigned schoolwork, tests, or other school documents.

Communications Devices; Laser Pointers

Section 22.1-279.6.B. of the *Code* authorizes school boards to regulate the use or possession of beepers or other portable communications devices and laser pointers and establish disciplinary procedures for students violating such regulations. Policies prohibiting or limiting the use of communications devices typically address beepers, cellular telephones, personal digital assistants (PDAs) and similar devices.

> ***Sample Conduct Standard: Communication Devices; Laser Pointers***
>
> The following violations shall result in disciplinary action at the discretion of the principal:
>
> - Possession of any portable communication devices, including any beeper, cell phone, or other similar device, including any device capable of receiving or transmitting text messages, on school property and during the school day by an elementary or middle school student.
>
> - A high school student may possess such a portable communication device on school property during the school day; however, the device must be out of sight, turned off, and used only with authorization from the principal.
>
> - In addition to other disciplinary action associated with the possession or use of a portable communication device in violation of this provision, any such portable communication device shall be subject to confiscation by school officials and returned only to the student's parent or guardian.

Disruptive Behavior

"Disruptive behavior" is defined in § 22.1-276.01. of the *Code* as conduct that interrupts or obstructs the learning environment. Local school board policy should cite the initial authority of teachers to remove a student from a class for disruptive behavior.

The related offense of disorderly conduct is defined in § 18.2-415. as involving the intent to cause public inconvenience, annoyance or alarm, or recklessly creating a risk. Conduct is deemed to be disorderly when it disrupts the operation of any school or any activity conducted or sponsored by any school, if the disruption (i) prevents or interferes with the orderly conduct of the operation or activity or (ii) has a direct tendency to cause acts of violence by the person or persons at whom, individually, the disruption is directed.

Sample Conduct Standard: Disruptive Behavior

Students are entitled to a learning environment free of unnecessary disruption. Any physical or verbal disturbance within the school setting or during related activities, which interrupts or interferes with teaching and orderly conduct of school activities, is prohibited.

Dress Standards

Establishing standards for dress has the potential to be controversial. A key criteria used by many school boards in determining what is and is not acceptable dress is whether it interferes with or disrupts the educational environment. Health and safety are also primary considerations. Some policies approach dress standards as a component of personal symbolic expression that also addresses hairstyles and buttons and badges.

Sample Conduct Standard: Dress Standard

All students are expected to dress appropriately for a K-12 educational environment. Any clothing that interferes with or disrupts the educational environment is unacceptable. Clothing with language or images that are vulgar, discriminatory, or obscene, or clothing that promotes illegal or violent conduct, such as the unlawful use of weapons, drugs, alcohol, tobacco, or drug paraphernalia, or clothing that contains threats such as gang symbols is prohibited.

Clothing should fit, be neat and clean, and conform to standards of safety, good taste, and decency. Clothing that exposes cleavage, private parts, the midriff, or undergarments, or that is otherwise sexually provocative, is prohibited. Examples of prohibited clothing include, but are not limited to: sagging or low-cut pants, low-cut necklines that show cleavage, tube tops, halter tops, backless blouses or blouses with only ties in the back, clothing constructed of see-through materials, and head coverings unless required for religious or medical purposes.

Additionally, disciplinary action will be taken against any student taking part in gang-related activities that are disruptive to the school environment, which include the display of any apparel, jewelry, accessory, tattoo, or manner of grooming that, by virtue of its color, arrangement, trademark, or any other attribute, denotes membership in a gang that advocates illegal or disruptive behavior.

Parents of students requiring accommodation for religious beliefs, disabilities, or other good causes should contact the principal. Students not complying with this code will be asked to cover the noncomplying clothing, change clothes, or go home. Repeated infractions will result in disciplinary action.

Extortion

Extortion is defined in § 18.2-59. of the *Code* as unlawfully obtaining or attempting to obtain something of value from another by compelling the other person to deliver it by the threat of eventual physical injury or other harm to that person or the person's property, or a third person. "Blackmail" is the common name for extortion where the threat is not physical but relates to exposing some secret or true or alleged fact, which would do harm to someone's circumstances or damage his or her reputation.

Sample Conduct Standard: Extortion

No student may obtain or attempt to obtain anything of value from another by using a threat of any kind.

Fighting

Fighting is not specifically defined in the *Code of Virginia*. The key element differentiating fighting from assault is the mutual nature of contact.

Definitions developed for use in the Virginia Department of Education report on discipline, crime and violence are as follows:

- ~~Fighting with serious injury - Mutual participation in an incident involving physical violence, where there is serious injury. Requires medical attention.~~
- Fighting with no/minor injury - Mutual participation in an incident involving physical violence, where there is no or minor injury.

Sample Conduct Standard: Fighting

Exchanging mutual physical contact between two or more students by pushing, shoving, or hitting with or without injury is prohibited.

Gambling

Section 18.2-325. of the *Code of Virginia* defines illegal gambling as the "making, placing or receipt, of any bet or wager of money or other thing of value, made in exchange for a chance to win a prize, stake or other consideration or thing of value." A gambling device includes any device, machine, paraphernalia, equipment, or other thing, including books, records, and other papers, which are actually used in illegal gambling operations or activity.

Sample Conduct Standard: Gambling

A student shall not bet money or other things of value, or knowingly play or participate in any game involving a bet on school property or during any school-sponsored activity.

Gang-Related Activity

"Criminal street gang" is defined in § 18.2-46.1. as meaning “any ongoing organization, association, or group of three or more persons, whether formal or informal, (i) which has as one of its primary objectives or activities the commission of one or more criminal activities, (ii) which has an identifiable name or identifying sign or symbol, and (iii) whose members individually or collectively have engaged in the commission of, attempt to commit, conspiracy to commit, or solicitation of two or more predicate criminal acts, at least one of which is an act of violence, provided such acts were not part of a common act or transaction.”

Note that the 2005 General Assembly increased criminal penalties for gang activities taking place within 1000 feet of any public or private school. The 2006 General Assembly passed legislation to make it illegal to point, hold, or brandish in a threatening manner a machete or any weapon with an exposed blade 12 inches or longer, unless for justifiable self defense. If the offense occurs within 1000 feet of school property, the punishment is a Class 6 felony. See § 18.2-282.1 of the *Code*.

Section 16.1-260.G. of the *Code* requires an intake officer to report to the division superintendent any student against whom a petition is filed for certain offenses including:

- Prohibited criminal street gang activity pursuant to § 18.2-46.2.
- Recruitment of other juveniles for a criminal street gang activity pursuant to § 18.2-46.3.

Sample Conduct Standard: Gang-Related Activity

Gang-related activity will not be tolerated. Symbols of gang membership are expressly prohibited (i.e., clothing that symbolizes association, rituals associated with, or activities by an identified group of students).

Hazing

Local school board codes of student conduct, in accordance with § 22.1-279.6.B. of the *Code*, are required to prohibit hazing and to cite “the provisions of § 18.2-56., which defines and prohibits hazing and imposes a Class 1 misdemeanor penalty for violations; i.e., confinement in jail for not more than 12 months and a fine of not more than $2,500, either or both.”

Sample Conduct Standard: Hazing

No student shall engage in hazing. Hazing means to recklessly and intentionally endanger the health or safety of a student or students or to inflict bodily harm on a student or students in connection with or for the purpose of initiation, admission into or affiliation with, or as a condition for, continued membership in a club, organization, association, fraternity, sorority, or student body, regardless of whether the student or students so endangered or injured participated voluntarily in the activity.

Hazing is a Class 1 misdemeanor which may be punished by confinement in jail for up to 12 months and a fine of up to $2,500, or both, in addition to any disciplinary consequences which may be imposed. In addition, any person receiving bodily injury by hazing has a right to sue, civilly, the person or persons guilty thereof, whether adults or minors. The principal of any school at which hazing which causes bodily injury occurs shall report the hazing to the local Commonwealth Attorney.

Internet Use

Student conduct policy related to computer use should be developed in accordance with information provided in the Virginia Department of Education's *Acceptable Use Policies: A Handbook*, available on the Department's Web site at http://www.doe.virginia.gov/. In its 2006 Session, the General Assembly amended § 22.1-70.2 of the *Code* to require school divisions to add to their acceptable use policies a component on Internet safety for students that is integrated with a school division's instructional program. ~~The Superintendent of Public Instruction is to issue guidelines to school divisions regarding instructional programs related to the internet. See SUPTS. MEMO NO. 15 (Administrative), April 21, 2006, Internet Safety Instruction in Schools~~. Also See Guidelines and Resources for Internet Safety in Schools (August 2006). Virginia Department of Education, Office of Educational Technology. Available at http://www.doe.virginia.gov/VDOE/Technology/

The 2009 General Assembly amended § 22.1-279.6 of the *Code* to include the inappropriate "use of electronic means for purposes of bullying, harassment, and intimidation..." It is important that students become aware of the harm and consequences of internet misuse. (Reference *Bullying and Threats: Intimidation* in this document for policy guidance.)

Profane or Obscene Language or Conduct

School board student conduct policy, in accordance with § 22.1-279.6.B. of the *Code*, is required to prohibit profane or obscene language or conduct. These terms are not specifically defined in the *Code of Virginia*. Conduct typically prohibited under this provision includes swearing and obscene/offensive gestures, materials, and communications.

Sample Conduct Standard: Profane or Obscene Language or Conduct
Students shall not use vulgar, profane, or obscene language, or gestures, or engage in conduct that is vulgar, profane, or obscene, or disrupts the teaching and learning environment.

Property Violations

Property violations include, but are not limited to, arson, destruction of property, vandalism, and theft.

Arson - § 18.2-79. of the *Code of Virginia,* prohibits the burning or destroying of any school. The destruction may be in whole or in part--only a *slight* burning is necessary to violate this section of the *Code*.

Destruction of property - § 22.1-280.4. of the *Code* authorizes school boards to seek reimbursement from a pupil or the pupil's parent for any "actual loss, breakage, or destruction of or failure to return property, owned by or under the control of the school board, caused or committed by such pupil in pursuit of his studies."

Theft - Larceny is the wrongful taking of the property of another without the owner's consent and with the intention to permanently deprive the owner of possession of the property.

Vandalism - § 18.2-138. of the *Code* prohibits the willful and malicious damaging of public buildings, including schools.

Sample Conduct Standard: Property Offenses

The following violations shall result in disciplinary action at the discretion of the principal and may require a report to local law enforcement authorities:

- Willful causing or attempting to cause damage to school property
- Theft of, taking, or trying to take another person's property or money by force, fear, or other means
- Vandalism, arson, or any threat or false threat to bomb, burn, damage, or destroy in any manner a school building or school property.

A student (or the student's parent) shall be required to reimburse the school board for any actual loss of, breakage or, destruction of, or failure to return property owned by or under the control of the school board caused or committed by such student.

Stalking

Stalking is defined in § 18.2-60.3. of the *Code of Virginia* as conduct, occurring on more than one occasion and directed at another person, that places that other person in reasonable fear of death, criminal sexual assault, or bodily injury. The 2005 General Assembly added stalking to the list of offenses required to be reported to law enforcement officials (see page 31).

Sample Conduct Standard: Stalking

Students shall not engage in a pattern of behavior that places another person in fear of serious harm.

Theft

See Property Violations.

Threats: Intimidation

Threats to kill or to do bodily harm are specifically prohibited by § 18.2-60. of the *Code of Virginia*. The prohibition includes threats to any person or persons "(i) on the grounds or premises of any elementary, middle or secondary school property, (ii) at any elementary, middle or secondary school-sponsored event or (iii) on a school bus," Section 18.2-60.B. of the *Code* prohibits an oral threat to kill or to do bodily injury to any employee of any elementary, middle or secondary school, while on a school bus, on school property, or at a school-sponsored activity. The 2009 General Assembly amended § 22.1-279.6 of the *Code of Virginia* to prohibit the "use of electronic means for purposes of bullying, harassment, and intimidation..."

Sample Conduct Standard: Threats: Intimidation

Students shall not make any verbal or physical threat of bodily injury or use of force directed toward another person for the purpose of extortion or for any other reason. Students shall not use electronic technology or communication devices, such as the internet or cell phones, to intimidate or threaten for any reason.

Trespassing

Trespassing upon church or school property, including school buses, is specifically prohibited by § 18.2-128. of the *Code of Virginia*. The definition developed for the Virginia Department of Education's discipline, crime, and violence report is as follows:

> To enter or remain on a public school campus or school board facility without authorization or invitation and with no lawful purpose for entry, including students under suspension or expulsion, and unauthorized persons who enter or remain on a campus or school board facility after being directed to leave by the chief administrator or designee of the facility, campus, or function.

Sample Conduct Standard: Trespassing

A student shall not trespass on school property or use school facilities without proper authority or permission, or during a period of suspension or expulsion.

All visitors to a school or its grounds shall report to the main office immediately. Persons who fail to do so may be considered trespassers and subject to legal action, and student visitors who fail to do so also may be subject to disciplinary action as well as legal action. Any person whose presence or action interferes with or disrupts the operation of the school, its students, or school activities shall be prohibited from entering school or remaining on school property or remaining at a school-sponsored activity, wherever located.

Vandalism

See Property Violations.

Weapons or Other Dangerous Articles

Student conduct policy on weapons should address the possession, use, sale or purchase of restricted items on school property, on school vehicles, or during school sponsored activities on or off school property. This includes, but may not be limited to, any firearm or weapon. A school board additionally may prohibit the possession of unloaded weapons by students on their persons or in their lockers, backpacks, or vehicles.

Weapons for which mandatory expulsion is required include those enumerated in *Virginia Code* § 18.2-308.1., in the federal Gun-Free Schools Act, and in *Virginia Code* § 22.1-277.01.D. In accordance with § 22.1-277.01 of the *Code*, the expulsion shall be for no less than 365 days.

An exception to this policy may be made for students participating in an authorized extracurricular activity or team involving the use of firearms.

Carrying, bringing, using, or possessing dangerous instruments in any school building, on school grounds, in any school vehicle, or at any school-sponsored activity on or off school property is grounds for disciplinary action. Examples of dangerous instruments include letter openers, screwdrivers, hammers, hatchets, and other devices that could be used to inflict harm upon another person. Not subject to mandatory expulsion is possession of a knife that is customarily used for food preparation or service and is possessed by the student for the sole purpose of personal food preparation and service.

Sample Conduct Standard: Weapons

Students shall not have in their possession any type of unauthorized firearm or other article which may be used as a weapon.

Other Conduct

A school board may consider including an "other conduct" category that addresses conduct not specifically listed elsewhere. The "other conduct" should be confined to that which disrupts the educational environment or is a violation of federal, state, or local law.

Sample Conduct Standard: Other Conduct

In addition to those specific standards, students shall not engage in any conduct which materially and substantially disrupts the ongoing educational process or which is otherwise in violation of federal, state, or local law.

Self Defense

A code of student conduct may, but is not required to, address consideration of self defense as a factor in determining appropriate disciplinary action. Procedures for such consideration should include an opportunity for the student(s) to present the student's version of what occurred, as well as a review of facts, involving school personnel and others as appropriate. The fact-seeking process may include students and other staff who may have witnessed the incident or have observed previous interactions between the students involved. In cases where self defense is claimed, there may be a "history" between the students that often takes the investigation beyond looking at the single incident to examining patterns of interaction, past threats, and bullying. Persons from whom information is obtained could include a bus driver, other students, and parents.

School boards developing disciplinary policies including self defense should provide criteria that defines when an incident would be considered an act of self defense. Based on the criteria used in the judicial system for a claim of self defense to apply, the following conditions should be met. The person claiming self defense must:

- Be without fault in provoking or bringing on the fight or incident
- Have reasonably feared, under the circumstances as they appeared to him, that he was in danger of harm
- Have used no more force than was reasonably necessary to protect him from the threatened harm.

A school board's policy addressing self defense should retain a prohibition for bringing weapons of any kind to school for the purpose of self defense and explicitly state that self defense does not constitute a valid defense against possession or use of a weapon on school property or at any school-sponsored activity.

Sample Statement on Self Defense

Students are subject to disciplinary action for misconduct. Cases for which self defense is claimed must meet the following criteria: (1) the claimant must not have provoked or behaved in a manner to cause the incident; (2) the claimant must have had reasonable fear of danger of harm; and (3) the claimant used no more force than needed for protection from the threatened harm. Such incidents should be reported immediately to school officials. When claims of self defense have been established, the administrator shall: (1) allow the student to present his version of what occurred and (2) review circumstances and relevant information from others pertaining to the incident, including relationships and previous patterns of interaction among the students involved. Findings from the review of circumstances and other relevant information should be considered in determining appropriate corrective disciplinary action. Claims of self defense do not constitute a valid defense against possession or use of a weapon on school property or at any school-sponsored activity. Weapons are prohibited on school property and at school-sponsored events.

Related Policy Issues

Notification of Parental Responsibilities and Involvement

A local school board policy must provide for notification of parental responsibilities in accordance with § 22.1-279.3. of the *Code of Virginia* that sets forth the duty of each parent of a student enrolled in a public school to assist the school in enforcing the standards of student conduct and compulsory school attendance.

Within one calendar month of the opening of school, school boards are required to send the parents of each enrolled student (i) a notice of parental responsibilities; (ii) a copy of the school board's standards of student conduct; and (iii) a copy of the compulsory school attendance law. These materials must include a notice to the parents that, by signing the statement of receipt, parents shall not be deemed to waive, but to expressly reserve, their rights protected by the constitutions or laws of the United States or the Commonwealth. The notice also informs a parent of the right to express disagreement with a school's or school division's policies or decisions. A school board’s policy should address documentation of receipt of materials, the conditions for requiring parent involvement, and criteria/steps for proceeding against parents in juvenile and domestic relations court for willful and unreasonable refusal to participate in efforts to improve the student's behavior or school attendance.

Reporting of Certain Offenses to Law Enforcement Authorities

Local school board policy must provide for notification of local law enforcement authorities in accordance with § 22.1-279.3:1.D. of the *Code of Virginia* that requires principals to immediately report to the local law enforcement agency any act enumerated in clauses (ii) through (vii) of §22.1-279.3:1.A. that may constitute a criminal offense. A principal may report to the local law enforcement agency any incident described in clause (i) of subsection A. When there is injury, or the battery is against school personnel, reporting is mandatory.

Section 22.1-279.3:1.A. of the *Code* lists offenses as stated below:

i. The assault or assault and battery, without bodily injury, of any person on a school bus, on school property, or at a school-sponsored activity
ii. The assault and battery that results in bodily injury, sexual assault, death, shooting, stabbing, cutting, or wounding of any person, or stalking of any person as described § 18.2-60.3, on a school bus, on school property, or at a school-sponsored activity
iii. Any conduct involving alcohol, marijuana, a controlled substance, imitation controlled substance, or an anabolic steroid on a school bus, on school property, or at a school-sponsored activity, including the theft or attempted theft of student prescription medications
iv. Any threats against school personnel while on a school bus, on school property or at a school-sponsored activity
v. The illegal carrying of a firearm, as defined in § 22.1-277.07, onto school property
vi. Any illegal conduct involving firebombs, explosive materials or devices, or hoax explosive devices, as defined in § 18.2-85, or explosive or incendiary devices, as defined in § 18.2-433.1, or chemical bombs, as described in § 18.2-87.1, on a school bus, on school property, or at a school-sponsored activity
vii. Any threats or false threats to bomb, as described in § 18.2-83, made against school personnel or involving school property or school buses, or
viii. The arrest of any student for an incident occurring on a school bus, on school property, or at a school-sponsored activity, including the charge therefore.

The principal or designee must also report these incidents to the superintendent of the school division, who then reports them to the Department of Education in accordance with § 22.1-279.3:1(C) of the *Code of Virginia*. Incidents are reported to the Department of Education in the *Annual Discipline, Crime and Violence Report*. Reports of such incidents must accurately indicate any offenses, arrests, or charges as recorded by law enforcement authorities. Effective ~~for~~ since the 2005-2006 school year, compliance with this requirement ~~will be~~ is documented in the *Annual Discipline, Crime and Violence Report*.

The principal or designee must also notify the parent of any student involved in the incidents listed above, as well as incidents committed by students enrolled at the school if the offense would be a felony if committed by an adult, regardless of where the offense is committed, or would be a violation of the Drug Control Act if it occurs on a school bus, school property, or at a school-sponsored activity [§ 22.1-279.3:1(B) and (C)]. The 2005 General Assembly amended § 22.1-279.3:1.D. to require that principals notify parents that the incident has been reported to local law enforcement as required by law and that the parents may contact local law enforcement for further information, if they so desire.

Whenever a student commits a reportable incident named in the *Code*, the student shall be required to participate in prevention and intervention activities as determined appropriate by the superintendent or designee (§ 22.1-279.3:1(C).). A school board may require reporting of other offenses. This determination is best made in consultation with local school and law enforcement officials.

Access to Certain Juvenile Records

Section 16.1-300 of the *Code of Virginia* governs the confidentiality of Department of Juvenile Justice records of children who have been before a juvenile court, under probation supervision, received services from a court service unit, or who are committed to the Department of Juvenile Justice. In its 2006 Session, the General Assembly specified that a school administration is among the entities that may have access to these records by order of the court when they are deemed to have a legitimate interest in the case or the juvenile.

Clarifying the Parameters of Legal and Administrative Authorities

An effective school-law enforcement partnership is characterized by clarity about the nature of misconduct that occurs, about respective law enforcement and administrator roles, and about available sanctions. Positive outcomes for students, for schools, and for school-law enforcement partnerships are far more likely to be achieved when law enforcement officers and school administrators work together to apply available sanctions.

The first challenge is to establish clarity about what is a crime and what is a disciplinary matter -- what requires law enforcement response and what requires an administrative response? What behaviors distinguish between criminal and noncriminal actions? For example,

- Under what circumstances will "bullying" be labeled "assault" or "extortion" or “hazing” and result in criminal charges?
- Under what circumstances will fighting result in charges of assault and battery?
- When does a dispute over an allegedly borrowed jacket become a theft and result in a larceny charge?

Determination of criminal versus noncriminal behavior is a serious issue that requires examination and clear understanding between the school division and the law enforcement agency. According to the Northwest Regional Educational Laboratory’s Clearinghouse on school safety, recent experience with school-law enforcement partnerships has taught the following:

- Law enforcement officers are not school disciplinarians.
- The officer’s presence does not reduce the responsibility of teachers and of administrators to enforce school rules and the school division’s student code of conduct.
- Classroom management rests with the teacher.
- Disciplinary responses remain the responsibility of school administrators.
- The focus of law enforcement involvement in conduct matters is properly centered on incidents that involve a violation of law.

Effective school-law enforcement partnerships handle all incidents--whether violations of codes of conduct or violations of law--in a manner designed to ensure an appropriate, coordinated response and improve the likelihood of a desirable outcome for the school, the student, and public safety.

When school-law enforcement partnerships are formed, commitments of the school division and of the law enforcement agency are best formalized in a written interagency agreement called a Memorandum of

Understanding (MOU) that outlines the purpose of the partnership and the fundamental responsibilities of each agency. The MOU establishes the framework in which a school resource officer (SRO) program operates. A MOU specifies, at minimum, the following:

- The purpose of establishing the school/law enforcement partnership
- The roles and responsibilities of the school and the law enforcement agency
- The general chain of command and channels of communication
- The schedule for updating and renewing the agreement.

A more comprehensive MOU may incorporate key division-level policies and procedures including standard operating procedures for information sharing, investigation of crimes and interrogation, search and seizure and arrest of students, and procedures for handling critical incidents such as bomb threats, riots, and shootings.

Experience has shown that the process of developing the MOU and the operational procedures has great value in clarifying expectations and in anticipating and avoiding operational glitches during implementation. Both the MOU and operational procedures are *evolving documents*, and should be reviewed annually.

Key Definitions: School Resource Officer and School Security Officer

"School resource officer" is defined in § 9.1-101. of the *Code of Virginia* as “a certified law enforcement officer hired by the local law-enforcement agency to provide law enforcement and security services to Virginia public elementary and secondary schools.”

The roles of the School Resource Officer (SRO) in Virginia are identified as:

1. Law enforcement officer
2. Law-related educator
3. Community liaison and
4. Role model.

"School security officer" is defined in § 9.1-101. of the *Code of Virginia* as “an individual who is employed by the local school board for the singular purpose of maintaining order and discipline, preventing crime, investigating violations of school board policies, and detaining students violating the law or school board policies on school property or at school-sponsored events and who is responsible solely for ensuring the safety, security, and welfare of all students, faculty, staff, and visitors in the assigned school.”

Authoritative information about School Resource Officer (SRO) programs and about the training and certification of both school resource officers and school security officers is available from the Virginia Department of Criminal Justice Services, Virginia Center for School Safety.

APPENDICES

APPENDIX A: CODE OF VIRGINIA § 22.1-279.6

§ 22.1-279.6. Board of Education guidelines and model policies for codes of student conduct; school board regulations.

A. The Board of Education shall establish guidelines and develop model policies for codes of student conduct to aid local school boards in the implementation of such policies. The guidelines and model policies shall include, but not be limited to, (i) criteria for the removal of a student from a class, the use of suspension, expulsion, and exclusion as disciplinary measures, the grounds for suspension and expulsion and exclusion, and the procedures to be followed in such cases, including proceedings for such suspension, expulsion, and exclusion decisions and all applicable appeals processes; (ii) standards, consistent with state, federal and case laws, for school board policies on alcohol and drugs, gang-related activity, hazing, vandalism, trespassing, threats, search and seizure, disciplining of students with disabilities, intentional injury of others, self-defense, bullying, *the use of electronic means for purposes of bullying, harassment, and intimidation* and dissemination of such policies to students, their parents, and school personnel; and (iii) standards for in-service training of school personnel in and examples of the appropriate management of student conduct and student offenses in violation of school board policies.

In accordance with the most recent enunciation of constitutional principles by the Supreme Court of the United States of America, the Board's standards for school board policies on alcohol and drugs and search and seizure shall include guidance for procedures relating to voluntary and mandatory drug testing in schools, including, but not limited to, which groups may be tested, use of test results, confidentiality of test information, privacy considerations, consent to the testing, need to know, and release of the test results to the appropriate school authority.

In the case of suspension and expulsion, the procedures set forth in this article shall be the minimum procedures that the school board may prescribe.

B. School boards shall adopt and revise, as required in § 22.1-253.13:7.and in accordance with the requirements of this section, regulations on codes of student conduct that are consistent with, but may be more stringent than, the guidelines of the Board. School boards shall include, in the regulations on codes of student conduct, procedures for suspension, expulsion, and exclusion decisions and shall biennially review the model student conduct code to incorporate discipline options and alternatives to preserve a safe, nondisruptive environment for effective teaching and learning.

Each school board shall include, in its code of student conduct, prohibitions against hazing, profane or obscene language or conduct. School boards shall also cite, in their codes of student conduct, the provisions of § 18.2-56. which defines and prohibits hazing and imposes a Class 1 misdemeanor penalty for violations, i.e., confinement in jail for not more than 12 months and a fine of not more than $2,500, either or both?

A school board may regulate the use or possession of beepers or other portable communications devices and laser pointers by students on school property or attending school functions or activities and establish disciplinary procedures pursuant to this article to which students violating such regulations will be subject. Nothing herein shall be construed to require any school board to adopt policies requiring or encouraging any drug testing in schools. However, a school board may, in its discretion, require or encourage drug testing in accordance with the Board of Education's guidelines and model student conduct policies required by subsection A and the Board's guidelines for student searches required by § 22.1-279.7.

C. The Board of Education shall establish standards to ensure compliance with the federal Improving America's Schools Act of 1994 (Part F-Gun-Free Schools Act of 1994), as amended, in accordance with § 22.1-277.07.

This subsection shall not be construed to diminish the authority of the Board of Education or to diminish the Governor's authority to coordinate and provide policy direction on official communications between the Commonwealth and the United States government.

APPENDIX B: DISCIPLINE OF STUDENTS WITH DISABILITIES

Excerpt from *The Regulations Governing Special Education Programs for Children with Disabilities in Virginia*, effective July 7, 2009, (the Virginia Regulations). These regulations replace Appendix B: discipline of Students With Disabilities in the 2006 Student Code of Conduct.

8VAC20-81-160. Discipline procedures.

A. General. (§ 22.1-277 of the Code of Virginia; 34 CFR 300.530(a); 34 CFR 300.324(a)(2)(i))

1. A child with a disability shall be entitled to the same due process rights that all children are entitled to under the Code of Virginia and the local educational agency's disciplinary policies and procedures.

2. In the event that the child's behavior impedes the child's learning or that of others, the IEP team shall consider the use of positive behavioral interventions, strategies, and supports to address the behavior. The IEP team shall consider either:
   a. Developing goals and services specific to the child's behavioral needs; or
   b. Conducting a functional behavioral assessment and determining the need for a behavioral intervention plan to address the child's behavioral needs.

3. School personnel may consider any unique circumstances on a case-by-case basis when deciding whether or not to order a change in placement for a child with a disability that violates a code of student conduct.
   a. In reviewing the disciplinary incident, school personnel may review the child's IEP and any behavioral intervention plan, or consult with the child's teacher(s) to provide further guidance in considering any unique circumstances related to the incident.
   b. School personnel may convene an IEP team for this purpose.

B. Short-term removals.

1. A short-term removal is for a period of time of up to 10 consecutive school days or 10 cumulative school days in a school year. (34 CFR 300.530(b))
   a. School personnel may short-term remove a child with a disability from the child's current educational setting to an appropriate interim alternative educational setting, another setting, or suspension, to the extent those alternatives are applied to a child without disabilities.
   b. Additional short-term removals may apply to a child with a disability in a school year for separate incidents of misconduct as long as the removals do not constitute a pattern. If the short-term removals constitute a pattern, the requirements of subsection C of this section apply.
      (1) The local educational agency determines when isolated, short-term removals for unrelated instances of misconduct are considered a pattern.
      (2) These removals only constitute a change in placement if the local educational agency determines there is a pattern.

2. Services during short-term removals.
   a. The local educational agency is not required to provide services during the first 10 school days in a school year that a child with a disability is short-term removed if services are not provided to a child without a disability who has been similarly removed. (34 CFR 300.530(b)(2))
   b. For additional short-term removals, which do not constitute a pattern, the local educational agency shall provide services to the extent determined necessary to enable the student to continue to participate in the general education curriculum and to progress toward meeting the goals of the student's IEP. School personnel, in consultation with the student's special education teacher, make the service determinations. (34 CFR 300.530(b)(2))
   c. For additional short-term removals that do not constitute a pattern, the local educational agency shall ensure that children with disabilities are included in the Virginia Department of Education and division wide assessment programs in accordance with the provisions of subdivision 4 of 8VAC20-81-20. (20 USC § 1412(a)(16)(A))

C. Long-term removals.

1. A long-term removal is for more than 10 consecutive school days; or (34 CFR 300.530; 34 CFR 300.536)

2. The child has received a series of short-term removals that constitutes a pattern:
   a. Because the removals cumulate to more than 10 school days in a school year;
   b. Because the child's behavior is substantially similar to the child's behavior in previous incidents that results in a series of removals; and
   c. Because of such additional factors such as the length of each removal, the total amount of time the student is removed, and the proximity of the removals to one another.

3. The local educational agency determines on a case-by-case basis whether a pattern of removals constitutes a change in placement. This determination is subject to review through due process and judicial proceedings. (34 CFR 300.530(a) and (b) and 34 CFR 300.536)

4. On the date on which the decision is made to long-term remove the student because of a violation of a code of student conduct, the local educational agency shall notify the parent(s) of the decision and provide the parent(s) with the procedural safeguards. (34 CFR 300.530(h))

5. Special circumstances. (34 CFR 300.530(g))
   a. School personnel may remove a child with a disability to an appropriate interim alternative educational setting for the same amount of time that a child without a disability would be subject to discipline, but for not more than 45 school days without regard to whether the behavior is determined to be a manifestation of the child's disability, if:
      (1) The child carries a weapon to or possesses a weapon at school, on school premises, or at a school function under the jurisdiction of a local educational agency or the Virginia Department of Education; or
      (2) The child knowingly possesses or uses illegal drugs or sells or solicits the sale of a controlled substance while at school, on school premises, or at a school function under the jurisdiction of a local educational agency or the Virginia Department of Education; or
      (3) The child inflicts serious bodily injury upon another person at school, on school premises, or at a school function under the jurisdiction of a local educational agency or the Virginia Department of Education.
   b. For purposes of this part, "weapon," "controlled substance," and "serious bodily injury" have the meaning given the terms under 8VAC20-81-10.

6. Services during long-term removals.
   a. A child with a disability who is long-term removed receives services during the disciplinary removal so as to enable the student to: (34 CFR 300.530(d))
      (1) Continue to receive educational services so as to enable the student to continue to participate in the general educational curriculum, although in another setting;
      (2) Continue to receive those services and modifications including those described in the child's current IEP that will enable the child to progress toward meeting the IEP goals; and
      (3) Receive, as appropriate, a functional behavioral assessment, and behavioral intervention services and modifications, that are designed to address the behavior violation so that it does not recur.
   b. For long-term removals, the local educational agency shall ensure that children with disabilities are included in the Virginia Department of Education and divisionwide assessment programs in accordance with the provisions of subdivision 4 of 8VAC20-81-20. (20 USC § 1412(a)(16)(A))
   c. The IEP team determines the services needed for the child with a disability who has been long-term removed. (34 CFR 300.530(d)(5) and 34 CFR 300.531)

D. Manifestation determination. (34 CFR 300.530(c), (e), (f), and (g))

1. Manifestation determination is required if the local educational agency is contemplating a removal that constitutes a change in placement for a child with a disability who has violated a code of student conduct of the local educational agency that applies to all students.

2. The local educational agency, the parent(s), and relevant members of the child's IEP team, as determined by the parent and the local educational agency, constitute the IEP team that shall convene immediately, if possible, but not later than 10 school days after the date on which the decision to take the action is made.

3. The IEP team shall review all relevant information in the child's file, including the child's IEP, any teacher observations, and any relevant information provided by the parent(s).

4. The IEP team then shall determine the conduct to be a manifestation of the child's disability:
   (1) If the conduct in question was caused by, or had a direct and substantial relationship to, the child's disability; or
   (2) If the conduct in question was the direct result of the local educational agency's failure to implement the child's IEP.

5. If the IEP team determines that the local educational agency failed to implement the child's IEP, the local educational agency shall take immediate steps to remedy those deficiencies.

6. If the IEP team determines that the child's behavior was a manifestation of the child's disability:
   a. The IEP team shall return the child to the placement from which the child was removed unless the parent and the local educational agency agree to a change in placement as part of the modification of the behavioral intervention plan. The exception to this provision is when the child has been removed for not more than 45 school days to an interim alternative educational setting for matters described in subdivision C 5 a of this section. In that case, school personnel may keep the student in the interim alternative educational setting until the expiration of the 45-day period.
      (1) Conduct a functional behavioral assessment, unless the local educational agency had conducted this assessment before the behavior that resulted in the change in placement occurred, and implement a behavioral intervention plan for the child.
         (a) A functional behavioral assessment may include a review of existing data or new testing data or evaluation as determined by the IEP team.
         (b) If the IEP team determines that the functional behavioral assessment will include obtaining new testing data or evaluation, then the parent is entitled to an independent educational evaluation in accordance with 8VAC20-81-170 B if the parent disagrees with the evaluation or a component of the evaluation obtained by the local educational agency; or
      (2) If a behavioral intervention plan already has been developed, review this plan, and modify it, as necessary, to address the behavior.

7. If the IEP team determines that the child's behavior was not a manifestation of the child's disability, school personnel may apply the relevant disciplinary procedures to children with disabilities in the same manner and for the same duration as the procedures would be applied to children without disabilities, except that services shall be provided in accordance with subdivision C 6 a of this section.

E. Appeal. (34 CFR 300.532(a) and (c))

1. If the child's parent(s) disagrees with the determination that the student's behavior was not a manifestation of the student's disability or with any decision regarding placement under these disciplinary procedures, the parent(s) may request an expedited due process hearing.

2. A local educational agency that believes that maintaining the current placement of the child is substantially likely to result in injury to the child or others, may request an expedited due process hearing.

3. The local educational agency is responsible for arranging the expedited due process in accordance with the Virginia Department of Education's hearing procedures at 8VAC20-81-210.
   a. The hearing shall occur within 20 school days of the date the request for the hearing is filed.
   b. The special education hearing officer shall make a determination within 10 school days after the hearing.
   c. Unless the parent(s) and the local educational agency agree in writing to waive the resolution meeting, or agree to use the mediation process,
      (1) A resolution meeting shall occur within 7 calendar days of receiving the request for a hearing.
      (2) The due process hearing may proceed unless the matter has been resolved to the satisfaction of both parties within 15 calendar days of the receipt of the request for a hearing.
   d. The decisions on expedited due process hearings are appealable consistent with 8VAC20-81-210.

F. Authority of the special education hearing officer. (34 CFR 300.532(a) and (b))

1. A local educational agency may request an expedited due process hearing under the Virginia Department of Education's due process hearing procedures to effect a change in placement of a child with a disability for not more than 45 school days without regard to whether the behavior is determined to be a manifestation of the child's disability, if the local educational agency believes that the child's behavior is substantially likely to result in injury to self or others.

2. The special education hearing officer under 8VAC20-81-210 may:
   a. Return the child with a disability to the placement from which the child was removed if the special education hearing officer determines that the removal was a violation of subsections C and D of this section, or that the child's behavior was a manifestation of the child's disability; or
   b. Order a change in the placement to an appropriate interim alternative educational setting for not more than 45 school days if the special education hearing officer determines that maintaining the current placement of the child is substantially likely to result in injury to the student or others.

3. A local educational agency may ask the special education hearing officer for an extension of 45 school days for the interim alternative educational setting of a child with a disability when school personnel believe that the child's return to the regular placement would result in injury to the student or others.

G. Placement during appeals. (34 CFR 300.533)

1. The child shall remain in the interim alternative educational setting pending the decision of the special education hearing officer, or

2. Until the expiration of the time for the disciplinary period set forth in this section, whichever comes first, unless the parent and the local educational agency agree otherwise.

H. Protection for children not yet eligible for special education and related services. (34 CFR 300.534)

1. A child who has not been determined to be eligible for special education and related services and who has engaged in behavior that violates a code of student conduct of the local educational agency may assert any of the protections provided in this chapter if the local educational agency had knowledge that the child was a child with a disability before the behavior that precipitated the disciplinary action occurred.

2. A local educational agency shall be deemed to have knowledge that a child is a child with a disability if before the behavior that precipitated the disciplinary action occurred:
   (a) The parent(s) of the child expressed concern in writing (or orally if the parent(s) does not know how to write or has a disability that prevents a written statement) to school personnel that the child is in need of special education and related services;
   (b) The parent(s) of the child requested an evaluation of the child to be determined eligible for special education and related services; or
   (c) A teacher of the child or school personnel expressed concern about a pattern of behavior demonstrated by the child directly to the director of special education of the local educational agency or to other supervisory personnel of the local educational agency.

3. A local educational agency would not be deemed to have knowledge that a child is a child with a disability if:
   (a) The parent of the child has not allowed a previous evaluation of the child or has refused services; or

(b) The child has been evaluated in accordance with 8VAC20-81-70 and 8VAC20-81-80 and determined ineligible for special education and related services.

4. If the local educational agency does not have knowledge that a child is a child with a disability prior to taking disciplinary measures against the child, the child may be subjected to the same disciplinary measures applied to a child without a disability who engages in comparable behaviors.

5. If a request is made for an evaluation of a child during the time period in which the child is subjected to disciplinary measures under this section, the evaluation shall be conducted in an expedited manner.
   a. Until the evaluation is completed, the child remains in the educational placement determined by the school personnel, which can include suspension or expulsion without educational services.
   b. If the child is determined to be a child with a disability, taking into consideration information from the evaluations conducted by the local educational agency and information provided by the parent(s), the local educational agency shall provide special education and related services as required for a child with a disability who is disciplined.

I. Referral to and action by law enforcement and judicial authorities. (34 CFR 300.535)

1. Nothing in this chapter prohibits a local educational agency from reporting a crime by a child with a disability to appropriate authorities, or prevents state law enforcement and judicial authorities from exercising their responsibilities with regard to the application of federal and state law to crimes committed by a child with a disability to the extent such action applies to a student without a disability.

2. In reporting the crime, the local educational agency shall ensure that copies of the special education and disciplinary records of the child are transmitted for consideration by the appropriate authorities to whom school personnel report the crime. Transmission of such records shall be in accordance with requirements under the Management of the Student's Scholastic Record in the Public Schools of Virginia (8VAC20-150).

J. Information on disciplinary actions. (34 CFR 300.229)

1. The Virginia Department of Education requires that local educational agencies include in the records of a child with a disability a statement of any current or previous disciplinary action that has been taken against the child.

2. Local educational agencies are responsible for transmitting the statement to the Virginia Department of Education upon request to the same extent that the disciplinary information is included in, and transmitted with, the student records of nondisabled students.

3. The statement may include:
   a. A description of any behavior engaged in by the child who required disciplinary action;
   b. A description of the disciplinary action; and
   c. Any other information that is relevant to the safety of the child and other individuals involved with the child.

4. If the child transfers from one school to another, the transmission of any of the child's records shall include the child's current IEP and any statement of current or previous disciplinary action that has been taken against the child.

APPENDIX C: SAMPLE FORMS AND FORMATS

Sample: Parent Acknowledgment of Parental Responsibility

Acknowledgment of Parental Responsibility

This form is for parents/legal guardians of all students enrolled in XXXX Public Schools to ensure that they have received and reviewed the following important documents.

Student Name_____ DOB _____

School_____

Homeroom Teacher _____ Grade _____

I have received and reviewed each of the following:

1. Standards of Student Conduct.

2. A copy of § 22.1-279.3. of the *Code of Virginia* that sets forth the duty of each parent of a student enrolled in a public school to assist the school in enforcing the standards of student conduct and compulsory school attendance.

3. A copy of the compulsory attendance law.

My signature acknowledges receipt of above-listed documents. By signing this statement of receipt, I do not waive, but expressly reserve, my rights protected by the constitution or laws of the United States or Virginia. I retain the right to express disagreement with a school's or school division's policies or decisions.

Print Parent/Legal Guardian/Eligible Student Name _____

Signature of Parent/Legal Guardian _____

Date _____

Signature of Student Age 18 or above _____

Date _____

Please return this form to your child's homeroom teacher no later than [INSERT DATE].

Sample: Annual Policy Review Checklist

	Tasks
	Review ongoing log of issues/concerns maintained since distribution of Standards
	November - Meet with elementary, middle, high school principals' committee
	December – Meet with legal counsel and superintendent
	January – March – Review relevant General Assembly bills and resolutions
	January – Draft preliminary changes/updates to Standards for review by superintendent and senior administration
	March – determine estimated number of copies of Standards needed in English and in other languages; obtain preliminary estimates of costs for translation and for printing
	April – Review final General Assembly action
	April – Attend school board work session
	May – Return to school board for final discussion and approval
	May – Coordinate production of document with graphics specialist
	Late May/early June – complete final review before printing; approve and send to printer
	Late May/early June – document sent for translation into required languages; as translations are completed, documents are approved and sent to printer
	New Standards in English and other languages are distributed to school sites via internal mail services
	August – In-service training is provided to school administrators and other school staff.

~~Sample: Quick Guide to Rules of Conduct and Disciplinary Consequences~~

~~This Quick Guide contains examples of actions for which students may be disciplined, as well as the probable consequences. Typical situations are identified; other measures may be used.~~

~~Suspension of 10 Days and Mandatory Recommendation for Expulsion~~

- ~~Physical assault on staff with bodily injury~~
- ~~Sexual assault or battery~~
- ~~Mob assault~~
- ~~Distribution or manufacture of alcohol or inhalants~~
- ~~Possession of controlled or imitation controlled substance~~
- ~~Illegal use or possession of prescription drugs (second offense)~~
- ~~Distribution or manufacture of a controlled or imitation controlled substance, illegal drugs, or drug paraphernalia~~
- ~~Unauthorized use or possession of any weapon or any object used as a weapon~~
- ~~Under influence of marijuana or other controlled substance within 12 months of prior offense~~

~~Suspension of Up to 10 Days~~

- ~~Use, possession, or under influence of alcohol, inhalants, or nonalcoholic beer~~
- ~~Under influence of marijuana or other controlled substance (first offense)~~
- ~~Possession of drug paraphernalia (first offense.~~
- ~~Distribution of nonprescription drugs.~~
- ~~Illegal use or possession of prescription drugs (not classified as controlled substances) (first offense)~~
- ~~Assault or assault and battery~~

~~Discretion of the Principal (Consequences range from an intervention without suspension to a recommendation for expulsion.)~~

- ~~Threat to assault a staff member; threat or assault of another student~~
- ~~Disruption, disobedience, insubordination, defiance of school officials~~
- ~~Endangering well-being of others: fighting, bullying~~
- ~~Possession or display of obscenity; indecent exposure~~
- ~~Cursing, verbal abuse including gestures~~
- ~~Fireworks – use or possession~~
- ~~Forgery, cheating, plagiarism, dishonesty~~
- ~~Gambling~~
- ~~Improper touching~~
- ~~Unauthorized or illegal use or disruption of information technology~~
- ~~Unauthorized laser devices~~
- ~~Gang-related activities~~
- ~~Portable communications devices~~
- ~~Attendance violations~~
- ~~Use or possession of nonprescription drugs~~
- ~~Vandalism of school property; bomb threats~~
- ~~Unauthorized presence~~
- ~~Tobacco violations~~
- ~~Hazing~~

~~Sample: Quick Guide to Disciplinary Action~~

~~Suspension of 10 Days and Recommendation for Expulsion~~	~~Report to Law Enforcement~~
~~Physical assault on staff member with bodily injury~~	~~Yes~~
~~Sexual assault or battery~~	~~Yes~~
~~Mob assault~~	~~Yes~~
~~Distribution or manufacture of alcohol or inhalants~~	~~Yes~~
~~Possession of controlled or imitation controlled substance~~	~~Yes~~
~~Illegal use or possession of prescription drugs (second offense)~~	~~Yes~~
~~Distribution or manufacture of a controlled or imitation controlled substance, illegal drugs, or drug paraphernalia~~	~~Yes~~
~~Unauthorized use or possession of any weapon or any object used as a weapon~~	~~Yes~~

~~Suspension for Up to 10 Days~~	~~Report to Law Enforcement~~
~~Threat to assault a staff member~~	~~Yes~~
~~Threat or assault of another student~~	~~Possible~~
~~Use, possession, or under influence of alcohol, inhalants, or nonalcoholic beer~~	~~Yes~~
~~Assault or assault and battery of another student or person other than staff member with bodily injury~~	~~Yes~~
~~Assault or assault and battery without bodily injury~~	~~Possible~~

~~Discretion of the Principal~~	~~Report to Law Enforcement~~
~~Improper touching~~	~~Possible~~
~~Endangering well-being of others: fighting, bullying~~	~~Possible~~
~~Fireworks – use or possession~~	~~Possible~~
~~Unauthorized or illegal use or disruption of information technology~~	~~Possible~~
~~Gang-related activities~~	~~Yes~~
~~Vandalism of school property; bomb threats~~	~~Yes~~
~~Theft~~	~~Possible~~
~~Unauthorized presence~~	~~Possible~~
~~Tobacco (second and subsequent violations)~~	~~Possible~~
~~Hazing~~	~~Yes (report to Commonwealth's Attorney)~~

APPENDIX D: RELATED RESOURCES

The following list of related policies, regulations, nonregulatory guidance and credible resource publications is intended as supplemental information that may be used by school boards in the development of student conduct policy.

Virginia Board of Education Guidelines

Title	Statutory Reference	Superintendents Memo
Guidelines Concerning Student Searches in Virginia Public Schools (Approved November 19, 1999)	§ 22.1-279.7, Code of Virginia	Student Search Guidelines. SUPTS. MEMO NO. 9 (Administrative), March 17, 2000
Guidelines Concerning Student Drug Testing in Virginia Public Schools (Approved June 23, 2004)	§ 22.1-279.7, Code of Virginia	Drug Testing Guidelines. SUPTS. MEMO NO. 148 (Informational), July 30, 2004
Persistently Dangerous Schools, Identification Process and Criteria under the No Child Left Behind Act of 2001 (Approved April 29, 2003)	No Child Left Behind Act of 2001, at Title IX, Section 9532.	Unsafe School Choice Option: Identification of Persistently Dangerous Schools. SUPTS. MEMO NO. 86 (Informational), May 9, 2003

Related Virginia Regulations and Guidelines

Standards of Quality
Section 22.1-253.13:7., *Code of Virginia*

Standards of Accreditation
Section 8 VAC 20-131-210.A., Role of the Principal
Section 8 VAC 20-131-260.C.3., Facilities and Safety

Regulations Governing Special Education Programs for Children with Disabilities in Virginia (July 7, 2009). Virginia Department of Education. Available at http://www.doe.virginia.gov/VDOE/Instruction/Sped/varegs.pdf
See Section 8 VAC 20-81-160 - Discipline Procedures (p. 80.)

Guidelines for the Management of the Student's Scholastic Record in the Public Schools of Virginia (May 2004). Full document available on the Virginia Department of Education Web site at http://www.doe.virginia.gov/VDOE/studentsrvcs/MSSRedit.pdf

Related Federal Regulations, and Nonregulatory Guidance

Safe and Drug-Free Schools and Communities Act Grant Programs: Guidance for State and Local Implementation of Programs (December 2002). U.S. Department of Education. Available online http://www.ed.gov/programs/dvpformula/legislation.html

Guidance Concerning State and Local Responsibilities Under the Gun-Free Schools Act (January 22, 2004). U.S. Department of Education. Available at http://www.ed.gov/programs/dvpformula/legislation.html

Unsafe School Choice Option Non-Regulatory Guidance (May, 2004). U.S. Department of Education. Available at http://www.ed.gov/policy/elsec/guid/unsafeschoolchoice.pdf/

Related Resource Materials and Publications

Virginia School Search Resource Guide. (October 2000). Virginia Department of Education. Available online at: http://www.doe.virginia.gov/VDOE/Instruction/ssg.pdf

Virginia Juvenile Law Handbook for School Administrators 2006 2004 Update. Virginia Department of Criminal Justice Services. Available online at www.dcja.org/vcss/documents/

Guidelines for the Development of Policies and Procedures for Managing Student Behaviors in Emergency Situations in Virginia Public Schools. (2005) Virginia Department of Education. Available at: www.doe.virginia.gov/VDOE/sess/

Functional Behavioral Assessment, Behavioral Intervention Plans, and Positive Intervention and Supports: An Essential Part of Effective Schoolwide Discipline in Virginia (2008) Virginia Department of Education. Available at http://www.doe.virginia.gov/VDOE/sped

<u>Attendance</u>
Improving School Attendance: A Resource Guide for Virginia Schools (2005). Virginia Department of Education. Available at http://www.doe.virginia.gov/VDOE/studentsrvcs/

<u>Computer Use</u>
Acceptable Use Policies: A Handbook. Virginia Department of Education. Available at http://www.doe.virginia.gov/VDOE/Technology/AUP/home.shtml#intro

<u>Crisis Management</u>
Model School Crisis Management Plan (2002). Virginia Department of Education. Download at *http://www.doe.virginia.gov/VDOE/Instruction/model.html*

Resource Guide for Crisis Management and Emergency Response in Virginia Schools. (2002) (2007). Virginia Department of Education. Download at http://www.doe.virginia.gov/support/ sdfsca/crisis_management/crisis_mgmt_guide_2007_finalmk.pdf

Practical Information on Crisis Planning: A Guide for Schools and Communities (2003) (2007). Download at http://www.ed.gov/admins/lead/safety/emergencyplan/crisisplanning.pdf

Disaster Preparedness and Response for Schools. National Clearinghouse for Educational Facilities. See resources at http://www.edfacilities.org/rl/disaster.cfm

The Virginia Educator's Guide for Planning and Conducting School Emergency Drills. Virginia Department of Criminal Justice Services. Available online at http://www.dcjs.virginia.gov/vcss/

Bomb Threats
Bomb Threat Assessment Guide (Oct. 2003), an interactive CD-ROM, developed by the U.S. Department of Education and the Bureau of Alcohol, Tobacco, and Firearms. Access at http://www.threatplan.org/

Internet/Technology Use
Acceptable Use Policies: A Handbook. Virginia Department of Education. Available at http://www.doe.virginia.gov/VDOE/Technology/AUP/home.shtml#intro

Guidelines and Resources for Internet Safety in Schools (August 2006). Virginia Department of Education, Office of Educational Technology. Available at http://www.doe.virginia.gov/VDOE/Technology

School-Law Enforcement Partnerships
Fostering School-Law Enforcement Partnerships (2003). National Resource Center for Safe Schools, School Safety Guide 5. Available from http://www.safetyzone.org/safe_secure.htm l

Other Sources of Information

Virginia Center for School Safety (http://www.dcjs.virginia.gov/vcss/). Information is available on the following topics and issues:

- School safety audits
- School resource officer (SRO) training and programs
- School security officer (SSO) training
- School critical incident response

APPENDIX E: PUBLIC LAW 107-110, NO CHILD LEFT BEHIND ACT OF 2001, TITLE IV, PART A, SECTION 4141, GUN-FREE REQUIREMENTS

SEC. 4141. GUN-FREE REQUIREMENTS.

(a) SHORT TITLE- This subpart may be cited as the Gun-Free Schools Act.

(b) REQUIREMENTS-

(1) IN GENERAL- Each State receiving Federal funds under any title of this Act shall have in effect a State law requiring local educational agencies to expel from school for a period of not less than 1 year a student who is determined to have brought a firearm to a school, or to have possessed a firearm at a school, under the jurisdiction of local educational agencies in that State, except that such State law shall allow the chief administering officer of a local educational agency to modify such expulsion requirement for a student on a case-by-case basis if such modification is in writing.

2) CONSTRUCTION- Nothing in this subpart shall be construed to prevent a State from allowing a local educational agency that has expelled a student from such a student's regular school setting from providing educational services to such student in an alternative setting.

(3) DEFINITION- For the purpose of this section, the term firearm has the same meaning given such term in section 921(a) of title 18, United States Code.

(c) SPECIAL RULE- The provisions of this section shall be construed in a manner consistent with the Individuals with Disabilities Education Act.

(d) REPORT TO STATE- Each local educational agency requesting assistance from the State educational agency that is to be provided from funds made available to the State under any title of this Act shall provide to the State, in the application requesting such assistance -

(1) an assurance that such local educational agency is in compliance with the State law required by subsection (b); and

(2) a description of the circumstances surrounding any expulsions imposed under the State law required by subsection (b), including -

(A) the name of the school concerned;
(B) the number of students expelled from such school; and
(C) the type of firearms concerned.

(e) REPORTING- Each State shall report the information described in subsection (d) to the Secretary on an annual basis.

(f) DEFINITION- For the purpose of subsection (d), the term school means any setting that is under the control and supervision of the local educational agency for the purpose of student activities approved and authorized by the local educational agency.

(g) EXCEPTION- Nothing in this section shall apply to a firearm that is lawfully stored inside a locked vehicle on school property, or if it is for activities approved and authorized by the local educational agency and the local educational agency adopts appropriate safeguards to ensure student safety.

(h) POLICY REGARDING CRIMINAL JUSTICE SYSTEM REFERRAL-

(1) IN GENERAL- No funds shall be made available under any title of this Act to any local educational agency unless such agency has a policy requiring referral to the criminal justice or juvenile delinquency system of any student who brings a firearm or weapon to a school served by such agency.

(2) DEFINITION- For the purpose of this subsection, the term school has the same meaning given to such term by section 921(a) of title 18, United States Code.

Definitions of "Other Firearms"

Firearms other than handguns, rifles or shotguns as defined in Section 921, Title 18 of the United States Code. According to Section 921, the following are within the definitions:

- any weapon (including a starter gun) which will or is designed to or may readily be converted to expel a projectile from the action of any explosive;
- the frame or receiver of any weapon described above;
- any firearm muffler or firearm silencer;
- any destructive device, which includes:

(a) any explosive, incendiary, or poison gas

(1) Bomb;
(2) Grenade,
(3) Rocket having a propellant charge of more than four ounces,
(4) Missile having an explosive or incendiary charge of more than one-quarter ounce,
(5) Mine, or
(6) Similar device.

(b) any weapon which will, or which may be readily converted to expel a projectile by the action of an explosive or other propellant, and which has any barrel with a bore of more than one-half inch in diameter.

(c) any combination or parts either designed or intended for use in converting any device into any destructive device described in the two immediately preceding examples, and from which a destructive device may be readily assembled.

Note: This definition does not apply to items such as toy guns, cap guns, bb guns, and pellet guns. According to Section 921, antique firearms are not included in the definition.

Board of Education Agenda Item

Item: Q **Date:** July 23, 2009

Topic: Final Review of Proposed Guidelines for the Neighborhood Assistance Program for Education

Presenter: Mr. Paul Raskopf, Director, Division of Special Education and Student Services

Telephone Number: (804) 225-2080 **E-Mail Address:** paul.raskopf@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

____ Board review required by
__X__ State or federal law or regulation
____ Board of Education regulation
____ Other: _____

_X___ Action requested at this meeting ____ Action requested at future meeting: _____ (date)

Previous Review/Action:

___ No previous board review/action

_X__ Previous review/action
date June 25, 2009
action first review

Background Information:

Effective July 1, 2009, the Neighborhood Assistance Act (§ 58.1-439) requires that the Virginia Department of Education will administer the distribution of tax credits to qualifying corporations and individuals for donations to nonprofit organizations implementing approved education programs. The Act allocates $4.9 million for education proposals for approval by the Superintendent of Public Instruction. The Board of Education was authorized by the Act to adopt guidelines for the approval or disapproval of proposals by neighborhood organizations.

Summary of Major Elements

In accordance with the Act, the guidelines shall provide for the equitable allocation of the available amount of tax credits among the approved proposals submitted by neighborhood organizations. To be eligible for tax credits, 50 percent of the persons served by the organization must meet the definition of impoverished people as defined in § 58.1-439.18.

The proposed guidelines require that at least 50 percent of an approved organization's expenditures are for the purpose of providing scholastic instruction or scholastic assistance to impoverished people. The proposed guidelines outline the program's purpose, eligibility criteria for organizations, and procedures for submitting proposals and administration of tax credits.

Since the Board's first review of the proposed guidelines, VDOE received constituent recommendtions and review from the Virginia Department of Taxation. The proposed guidelines have been amended based upon comments received.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education approve the proposed guidelines and authorize staff to distribute the guidelines as presented.

Impact on Resources:

No additional funds will be needed.

Timetable for Further Review/Action:

The Department of Education will post the guidelines on its Web site and implement the guidelines effective August 1, 2009.

Virginia Board of Education

Guidelines for Neighborhood Assistance Act Tax Credit Program for Education

Chapter 851, Virginia Acts of Assembly (2009), established a program, known as the *Neighborhood Assistance Act tax credit program*, whereby individuals or businesses may receive tax credits for eligible contributions made to Neighborhood Organizations whose primary function is providing neighborhood education assistance for impoverished people. The Act language specified that the Department of Education is to issue guidelines for the approval or disapproval of proposals and administration of this program which is effective July 1, 2009.

The Neighborhood Assistance Act tax credit program for education is established in §§ 58.1-439.18, 58.1-439.20, 58.1-439.21, 58.1-439.22, 58.1-439.23, and 58.1-439.24 of the Code of Virginia.

Definitions:

Under this Program, definitions are set forth in § 58.1-439.18 and further include the following:

"Contracting services" means the same as the definition set forth in § 58.1-439.18 except that clause (i) of such definition shall not apply for purposes of these guidelines, and for purposes of clause (ii) of such definition "buildings" means buildings used by neighborhood organizations for the purpose of providing scholastic instruction or scholastic assistance to impoverished people.

"Job training" means the same as the definition set forth in § 58.1-439.18. The term shall include scholastic instruction or scholastic assistance.

"Neighborhood education assistance" means providing education.

"Primary function" means at least 50% of total persons served are impoverished people, and at least 50% of total expenditures are for the purpose of providing scholastic instruction or scholastic assistance to impoverished people.

Purpose; procedure for submitting proposals; eligibility criteria; termination of approval of program of a neighborhood organization; appeal procedure:

A. The purpose of the Neighborhood Assistance Act tax credit program for education is to encourage businesses and individuals to contribute directly to neighborhood organizations whose primary function is providing neighborhood education assistance for impoverished people.

B. Neighborhood organizations wishing to obtain an allocation of tax credits under this program must submit a proposal as set forth under § 58.1-439.20, of the Code of Virginia and provide the following information to the Superintendent of Public Instruction:

1. A description of their eligibility as a neighborhood organization, the education program to be conducted, the impoverished people to be assisted, the estimated amount that will be donated to the program, and plans for implementing the program.

2. Proof of the neighborhood organization's current exemption from income taxation under the provisions of § 501 (c) (3) or § 501 (c) (4) of the Internal Revenue Code, or the organization's eligibility as a community action agency as defined in the Economic Opportunity Act of 1964 (42 USC § 2701 et seq.) or housing authority as defined in § 36-3 of the Code of Virginia.

3. A copy of the neighborhood organization's current audit, review, or compilation as required by OMB Circular No. A-133 as may be applicable to nonprofit organizations, <u>or a current audit, review or compilation prepared in accordance with generally accepted accounting principles for nonprofit organizations;</u> a copy of the organization's current federal form 990; ~~a current brochure describing~~ <u>materials that describe</u> the organization's programs; and a copy of the annual report filed with the Department of Agriculture and Consumer Services' Division of Consumer Protection.

4. A statement of objective and measurable outcomes that are expected to occur and the method the organization will use to evaluate the education program's effectiveness <u>and, for established programs, a statement about the measureable outcomes that have occurred, and the method used to evaluate the program's effectiveness.</u>

C. To be eligible for participation in the Neighborhood Assistance Act Tax credit Program for Education, the applicant must meet the following criteria:

1. Applicants must have been in operation as a viable entity, providing neighborhood assistance for impoverished people for at least 12 months prior to the time an application is submitted to the Superintendent of Public Instruction.

2. Applicants must be able to demonstrate that at least 50% of the total persons served are impoverished people, and at least 50% of total expenditures are for the purpose of providing scholastic instruction or scholastic assistance to "impoverished people."

3. Applicant's audit must not contain any significant findings or areas of concern for the ongoing operation of the neighborhood organization.

D. 1. For the time period July 1, 2009 to June 30, 2010, the Department shall allocate all available tax credits by July 1, 2009, or as soon thereafter as practicable.

2. Beginning in calendar year 2010 and thereafter, the application period will start no later than March 15 of each year. All applications must be received by the Virginia Department of Education no later than the first business day of May. The program year will run from July 1 through June 30 of the following year.

E. Those applicants submitting proposals, including all required information and reports and meeting the eligibility criteria described in this section will be notified by the Superintendent of Public Instruction of the approval or disapproval of such proposals.

F. The Superintendent of Public Instruction may request the assistance of the Department of Taxation for purposes of determining whether or not anticipated donations for which tax credits are requested by a neighborhood organization likely qualify as a charitable donation under federal tax laws and regulations.

G. The Superintendent of Public Instruction may terminate a neighborhood organization's eligibility to participate under the Neighborhood Assistance Act tax credit program for education based on a finding of program abuse including, but not limited to illegal activities, fraudulent valuation or reporting of contributions, material deviations from the approved proposal or other actions that are inconsistent with the purpose of the Neighborhood Assistance Act tax credit program. ~~involving illegal activities or fraudulent reporting of contributions.~~

H. Any neighborhood organization that disagrees with the disposition of its application, or its termination as an approved organization, may appeal to the Superintendent of Public Instruction in writing for reconsideration. Such requests must be made within 30 days of the denial or termination. The Superintendent of Public Instruction will act on the request and render a final decision within 30 days of the request for reconsideration.

I. Actions of the Superintendent of Public Instruction or the Department of Education relating to the review of neighborhood organization proposals and the allocation of tax credits to proposals shall be exempt from the provisions of the Administrative Process Act (§ 2.2-4000 et seq.). Decisions of the Superintendent of Public Instruction shall be final and not subject to review or appeal.

Allocation of tax credits:

A. The available tax credits will be allocated equitably among the approved proposals submitted by neighborhood organizations as set forth in § 58.1-439.20 of the Code of Virginia.

B. If the Superintendent of Public Instruction approves a proposal submitted by a neighborhood organization, the organization shall make the allocated tax credit amounts available to business firms and individuals making donations to the approved program. A neighborhood organization shall not assign or transfer an allocation of tax credits to another neighborhood organization without the approval of the Superintendent of Public Instruction. Such action will be deemed program abuse and will be cause for termination of a neighborhood organization's eligibility to participate under the Neighborhood Assistance Act tax credit program for education.

C. During the program year, neighborhood organizations that have used at least 75% of their allocation of tax credits for education programs may request additional allocation of tax credits for education purposes within the limits described in the Act. Requests will be evaluated on a basis of reasonableness and tax credits will be reallocated on a first-come basis as they are available.

D. Tax credits to be allocated are limited to the amounts as set forth in § 58.1-439.20. If the amount of tax credits requested by neighborhood organizations and approved by the Superintendent for education proposals is less than the total amount allocated by law for education proposals, then the balance of such amount shall be allocated to programs for approval by the Commissioner of the Department of Social Services.

E. Organizations may release all or a portion of their unused tax credit allocation to be reallocated in accordance with subsection C of this section.

Value of donations:

A. The neighborhood organization with an approved education proposal is responsible for maintaining documentation as required by the Virginia Department of Education to verify the date and value of all donations.

B. The value of money, property, motor vehicles, professional services and contracting services donated by a business firm during its taxable year shall be valued in accordance with § 58.1-439.21.

C. The valued of donated rent/lease of the neighborhood organization's facility must be reasonable and cannot exceed the prevailing square footage rental charge for comparable property.

D. Donations from individuals eligible for tax credits are limited to monetary donations and donations of marketable securities, which shall be valued at fair market value as of the date of the donation.

E. Except as otherwise provided by law, the value of a donation from an organization or individual shall be such value as determined for federal income tax purposes using the laws and regulations of the United States related to federal income taxes.

Minimum and maximum amounts:

A. ~~Tax credits granted~~ Organizations shall grant tax credits to business firms ~~are subject to~~ consistent with the minimum and maximum amounts and other provisions set forth in § 58.1-439.21 of the Code of Virginia.

B. ~~Tax credits granted~~ Organizations shall grant tax credits to individuals ~~are subject to~~ consistent with the minimum and maximum amounts and other provisions set forth in § 58.1-439.24 of the Code of Virginia.

~~C. Any tax credit not useable for the taxable year the donation is made may be carried over to the extent useable for the next five succeeding taxable years or until the credit has been utilized, whichever is sooner.~~

D. The neighborhood organization shall complete a certification on a form prescribed by the Department of Education. The certification shall identify the date, type, donor and value of the donation eligible for tax credits.

E. Upon receipt and approval of the certification, the Superintendent of Public Instruction shall issue a tax credit certificate to the donor eligible for the tax credit.

Determining date of donation:

A. The date of donation for cash, marketable, securities and property to be used by the neighborhood organization is the date used for federal income tax purposes according to IRS regulations.

B. The date of donation for professional services or contracting services is the dates such services are rendered. The neighborhood organization with an approved education proposal is responsible for maintaining documentation as required by the Virginia Department of Education to verify the date and value of all services donations.

C. The date of donation for donated rent/lease is the effective date of the lease.

Board of Education Agenda Item

Item: R. **Date:** July 23, 2009

Topic: First Review of the Direct Aid to Public Education Budget for the 2010-2012 Biennium

Presenter: Mr. Kent C. Dickey, Assistant Superintendent for Finance

Telephone Number: 225-2025 **E-Mail Address:** kent.dickey@doe.virginia.gov

Origin:

____ Topic presented for information only (no board action required)

_X_ Board review required by
- _X_ State or federal law or regulation
- ____ Board of Education regulation
- ____ Other: _____

_X_ Action requested at this meeting ___ Action requested at future meeting: _____

Previous Review/Action:

_X_ No previous board review/action

____ Previous review/action
date _____
action _____

Background Information:

The Direct Aid to Public Education budget for the 2010-2012 biennium is being presented to the Board of Education for first review. In each odd-numbered year, the Direct Aid to Public Education budget is rebenchmarked for the next biennium. This rebenchmarking is part of the biennial budget development process that involves the Board of Education, the Governor, and the General Assembly. The rebenchmarked budget represents the state cost of continuing the existing Direct Aid to Public Education programs with updates in the input data used to determine the cost of the programs. In addition, appropriation act language adopted by the 2009 General Assembly requires the Department of Education to calculate a 2010-2012 rebenchmarking cost with the support position funding cap applied and a 2010-2012 rebenchmarking cost with the support position funding cap removed.

Summary of Major Elements:

The cost projections presented in this item represent changes in funding based on standard technical revisions made to Direct Aid accounts for each year of the 2010-2012 biennium. These cost projections do not reflect any changes in policy or technical methodology. The projections are based strictly on current approved methodologies or directives specifically approved and directed by the General

Assembly and the Governor. The budget figures presented in this item represent the state cost of continuing the current Direct Aid programs in the 2010-2012 biennium with the required revisions and updates to input data using the approved funding methodologies, as well as the state cost to remove the support position funding cap.

A technical briefing presented on July 22, 2009, to the Board's SOQ Committee outlines the rebenchmarking process and the Direct Aid cost projections for the 2010-2012 biennium.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board waive first review and adopt these proposed budget projections that continue current Direct Aid programs in the 2010-2012 biennium rebenchmarked for standard technical revisions and showing the cost of removal of the support position funding cap without proposing permanent changes in funding policy. It is further recommended that staff be directed to update and revise costs as additional technical revisions are completed consistent with the current funding methodology and policy adopted by the Board. In addition, as required by the General Assembly, it is recommended that the department report the final calculations and related costs of rebenchmarking (with the support position funding cap applied and removed) to the Governor and the Chairmen of House Appropriations and Senate Finance Committees prior to September 1, 2009.

Impact on Resources:

The 2010-2012 Direct Aid budget approved by the Board will be sent to the Governor for action and ultimately for inclusion in his budget for the 2010-2012 biennium. This budget will establish the level of state funding required by the foundation program established in the Standards of Quality (SOQ), as well as other Direct Aid accounts. The final state cost of the 2010-2012 Direct Aid budget is dependent on final technical updates to be made in fall 2009 and any funding policy decisions affecting cost.

Timetable for Further Review/Action:

None.