

# Virginia Board of Education Agenda Item



Agenda Item: O

Date: May 23, 2013

<b>Title</b>	First Review of Standard Setting Studies and Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) for Passing Scores for the Following Licensure Assessments: 1) Virginia Communication and Literacy Assessment (VCLA); 2) Praxis Elementary Education: Multiple Subjects (5031); 3) Praxis Middle School English Language Arts (5047); 4) Praxis Middle School Mathematics (5169); 5) Praxis English Language Arts: Content Knowledge (5038); 6) Praxis Mathematics: Content Knowledge (5161)		
<b>Presenter</b>	Mrs. Patty S. Pitts, Assistant Superintendent, Division of Teacher Education and Licensure		
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**Purpose of Presentation:**

Action required by state or federal law or regulation.

**Previous Review or Action:**

No previous review or action.

**Action Requested:**

Action will be requested at a future meeting. Specify anticipated date below:

Date: June 27, 2013

**Alignment with Board of Education Goals: Please indicate (X) all that apply:**

	Goal 1: Accountability for Student Learning
	Goal 2: Rigorous Standards to Promote College and Career Readiness
	Goal 3: Expanded Opportunities to Learn
	Goal 4: Nurturing Young Learners
X	Goal 5: Highly Qualified and Effective Educators
	Goal 6: Sound Policies for Student Success
	Goal 7: Safe and Secure Schools
	Other Priority or Initiative. Specify:

**Background Information and Statutory Authority:**

Goal 5: The approval of passing scores on the professional assessments supports the goal of highly qualified and effective educators in Virginia’s classrooms and schools.

Section 22.1-298.1. **Regulations governing licensure** of the *Code of Virginia* requires that the Board of Education’s regulations “shall include requirements that a person seeking initial licensure: 1. Complete professional assessments as prescribed by the Board of Education;...”

Currently, the Virginia Board of Education requires the following licensure assessments:

- Virginia Communication and Literacy Assessment (VCLA)
- Praxis II: Specialty Area Tests
- Reading for Virginia Educators (RVE)
- School Leaders Licensure Assessment (SLLA)

The National Evaluation Group of Pearson administers the Virginia Communication and Literacy Assessment (VCLA). Test preparation resources and materials, including study guides and practice tests, are available on the [Pearson Test Preparation Web site](#).

The Educational Testing Service (ETS) administers the Praxis II Specialty Area tests that assess subject area content. Test preparation resources and materials, including study guides and practice tests, are available on the [ETS Test Preparation Web site](#).

### Summary of Important Issues:

Standard setting studies were conducted for six licensure assessments. Information about the passing scores recommended by the standard setting committees (Virginia panels and multistate panels), the Advisory Board on Teacher Education and Licensure recommendations, and the Superintendent of Public Instruction recommendations are summarized in Appendix A.

#### 1. VIRGINIA COMMUNICATION AND LITERACY ASSESSMENT (VCLA)

The Virginia Communication and Literacy Assessment (VCLA) has been required for initial licensure since 2006. On March 22, 2006, the Board of Education approved passing scores for the Virginia Communication and Literacy Assessment (VCLA). The VCLA is composed of two area subtests – a Reading Subtest (091) and a Writing Subtest (092). The National Evaluation Group of Pearson administers the Virginia Communication and Literacy Assessment (VCLA).

The current passing scores for the VCLA are as follows:

- Reading Subtest: 235 (20 out of 35)
- Writing Subtest: 235 (23 out of 41 multiple choice and sentence correction and 23 out of 40 points on writing assignments)
- **Composite Score:** 470

### Test Design

The following table describes each Subtest of the VCLA:

Subtest	Subtest Description
Reading Subtest (091)	<ul style="list-style-type: none"><li>• Designed to measure comprehension and analysis of readings, outlining and summarizing skills, and ability to interpret tables and graphs</li><li>• Consists of approximately 40 multiple-choice items</li></ul>

Subtest	Subtest Description
Writing Subtest (092)	<ul style="list-style-type: none"> <li>• Designed to measure the development of ideas in essay form on specific topics and the mastery of grammar, mechanics, and vocabulary</li> <li>• Consists of approximately 40 multiple-choice items, three short-answer items, a written summary assignment, and a written composition assignment</li> </ul>

The VCLA is criterion referenced and objective based and is designed to measure a candidate's knowledge and skills in relation to an established standard rather than in relation to the performance of other candidates.

At the March 19, 2012, meeting the Advisory Board on Teacher Education Licensure recommended that the Virginia Department of Education conduct a validation and standard setting study for the VCLA. A standard setting study was conducted on October 18, 2012, for the VCLA. The process used in the Virginia standard setting study is detailed in the *Standard Setting Conference Report – Virginia Communication and Literacy Assessment – February 28, 2013* (Appendix B).

At the March 18, 2013, meeting, the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing scores recommended by the standard setting panel for the VCLA to be implemented effective July 1, 2014:

- Reading – 26\* (26 out of 35)
- Writing – 29\* ( 29 out of 41 points on multiple choice and sentence correction and 29 out of 40 points on writing assignments)

\* The National Evaluation Group of Pearson will scale the raw scores.

## 2. PRAXIS ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031) ASSESSMENT

The Praxis II assessment currently required for individuals seeking an initial license with an endorsement in Early/Primary Education preK-3 or Elementary Education preK-6 is the Praxis Elementary Education: Content Knowledge (0014/5014) assessment. The standard setting and validation study for the assessment was conducted in May 2000, and the test has been required in Virginia since July 1, 2002.

The Educational Testing Service (ETS) has developed a new Praxis Elementary Education: Multiple Subjects (5031) assessment. This assessment, unlike the Praxis Elementary Education: Content Knowledge (0014/5014) assessment, requires a passing score for each of the four subtests.

At the March 19, 2012, meeting of the Advisory Board on Teacher Education and Licensure a motion was passed to recommend that the Virginia Department of Education (VDOE) conduct a validation and standard setting study for the Praxis Elementary Education: Multiple Subjects (5031) assessment. ETS conducted the standard setting study on October 16-17, 2012, on behalf of the VDOE for the new Praxis Elementary Education: Multiple Subjects (5031) assessment. A detailed summary of the study, *Standard Setting Technical Report – Praxis Elementary Education: Multiple Subjects (5031) –*

*November 2012*, is attached (Appendix C) and includes participants, methodology, and recommendations. An addendum is attached to the report that provides information regarding standard error of measurements for the passing scores recommended by the multistate panel.

In addition to the state-specific study, ETS also conducted a multistate standard setting study in July 2011 in Princeton, New Jersey. The results of this study, including the passing scores recommended by the multistate panels, are attached (Appendix D) and include participants, methodology, and recommendations.

The Praxis Elementary Education: Multiple Subjects (5031) *Test at a Glance* document (Appendix E) describes the purpose and structure of the assessment. In brief, the purpose of the test is to assess whether the entry-level elementary teacher has the content knowledge that is important, necessary, and needed at time of entry to the profession in order to teach English, mathematics, social studies, and science at the elementary level. A National Advisory Committee of elementary teachers and college faculty defined the content of the assessment, and a national survey of teachers and college faculty confirmed the content.

The Praxis Elementary Education: Multiple Subjects (5031) assessment contains 210 multiple-choice questions and covers Reading and Language Arts (65 questions); Mathematics (40); Social Science (55); and Science (50). To pass the Praxis Elementary Education: Multiple Subjects (5031) assessment, a candidate must meet or exceed the passing score on each of the four subtests. A combined score across the four subtests is not reported.

The following states have established passing scores on the Praxis Elementary Education: Multiple Subjects (5031) assessment. With the exception of Connecticut and Utah, these states have adopted the pass rates recommended by the multistate panel.

**Passing Scores by Other State Users**

State	Reading and Language Arts	Mathematics	Social Studies	Science
Connecticut	174	175	166	170
Idaho	165	164	155	159
Indiana	165	164	155	159
Kentucky	165	164	155	159
Maine	165	164	155	159
New Hampshire	165	164	155	159
New Jersey	165	164	155	159
Utah	165	165	155	159
Vermont	165	164	155	159

At the March 18, 2013, meeting, the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing scores recommended by the Virginia standard setting panel for the Praxis Elementary Education: Multiple Subjects (5031) assessment to become effective July 1, 2014.

- Reading and Language Arts – 40 raw-score points (152 scaled score);

- Mathematics – 24 raw-score points (150 scaled score);
- Social Studies – 34 raw-score points (153 scaled score points); and
- Science – 31 raw-score points (153 scaled score).

### 3. MIDDLE SCHOOL ENGLISH LANGUAGE ARTS (5047) ASSESSMENT

The Praxis II assessment currently required for individuals seeking an initial license with an endorsement in Middle Education 6-8: English is the Middle School English Language Arts (0049/5049) assessment. The test has been required in Virginia since July 1, 2002. The Educational Testing Service (ETS) that administers the Praxis II will be discontinuing this assessment and has developed the Middle School English Language Arts (5047) assessment.

ETS conducted the standard setting study on March 21, 2013, on behalf of the Virginia Department of Education (VDOE) for the Praxis Middle School English Language Arts (5047) assessment. A detailed summary of the study, *Standard Setting Technical Report – Praxis Middle School English Language Arts (5047)*, is attached (Appendix F) and includes participants, methodology, and recommendations.

In addition to the state-specific study, ETS also conducted a multistate standard setting study in March 2013 in Princeton, New Jersey. The results of this study, including the passing score recommended by the multistate panel, are attached (Appendix G) and include participants, methodology, and recommendations.

The Praxis *Test at a Glance* document (Appendix H) describes the purpose and structure of the assessment. In brief, the purpose of the test is to assess whether the entry-level English teacher has the content knowledge and skills believed necessary for competent practice. A National Advisory Committee of English teachers and college faculty defined the content of the assessment, and a national survey of teachers and college faculty confirmed the content.

The Middle School English Language Arts (5047) assessment contains 110 selected-response items and two constructed-response items covering four content areas: Reading (approximately 50 selected-response items and one constructed-response item); Language Use and Vocabulary (approximately 16 selected-response items); Writing, Speaking, and Listening (approximately 26 selected-response items); and English Language Arts Instruction (approximately 18 selected-response items and one constructed-response item). The selected-response component contributes 75 percent to the total score. The constructed-response score is weighted to contribute 25 percent. In addition, 20 of the 110 selected-response items are pretest items and do not contribute to a candidate's score. Therefore, the maximum raw score is 120 points. The reporting scale for the Middle School English Language Arts (5047) assessment ranges from 100 to 200 scaled-score points.

At the April 22, 2013, meeting the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing score recommended by the multistate standard setting panel for the Praxis Middle School English Language Arts (5047) assessment:

- 81 raw score points (164 scaled score)

#### 4. MIDDLE SCHOOL MATHEMATICS (5169) ASSESSMENT

The Praxis II assessment currently required for individuals seeking an initial license with an endorsement in Middle Education 6-8: Mathematics is the Middle School Mathematics (0069) assessment. The test has been required in Virginia since July 1, 2002. The Educational Testing Service (ETS) that administers the Praxis II will be discontinuing this assessment and has developed the Middle School Mathematics (5169) assessment.

ETS conducted the standard setting study on March 21, 2013, on behalf of the Virginia Department of Education (VDOE) for the Praxis Middle School Mathematics (5169) assessment. A detailed summary of the study, *Standard Setting Technical Report – Praxis Middle School Mathematics (5169)*, is attached (Appendix I) and includes participants, methodology, and recommendations.

In addition to the state-specific study, ETS also conducted a multistate standard setting study in February 2013 in Princeton, New Jersey. The results of this study, including the passing score recommended by the multistate panel, are attached (Appendix J) and include participants, methodology, and recommendations.

The Praxis *Test at a Glance* document (Appendix K) describes the purpose and structure of the assessment. In brief, the purpose of the test is to assess whether the entry-level mathematics teacher has the content knowledge and skills believed necessary for competent practice. A National Advisory Committee of mathematics teachers and college faculty defined the content of the assessment, and a national survey of teachers and college faculty confirmed the content.

The Middle School Mathematics (5169) assessment contains 55 selected-response and numeric-entry items covering two content areas: Arithmetic and Algebra (approximately 34 items) and Geometry and Data (approximately 21 items). Ten of the 55 selected-response and numeric-entry items are pretest items and do not contribute to a candidate's score. The reporting scale for the Middle School Mathematics (5169) assessment ranges from 100 to 200 scaled-score points.

At the April 22, 2013, meeting the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing score recommended by the multistate standard setting panel for the Praxis Middle School Mathematics (5169):

- 31 raw score points (165 scaled score)

#### 5. ENGLISH LANGUAGE ARTS: CONTENT KNOWLEDGE (5038) ASSESSMENT

The Praxis II assessment currently required for individuals seeking an initial license with an endorsement in English is the English Language, Literature and Composition: Content Knowledge (0041/5041) assessment. The test has been required in Virginia since July 1, 1999. The Educational Testing Service (ETS) that administers the Praxis II will be discontinuing this assessment and has developed the English Language Arts: Content Knowledge (5038) assessment.

ETS conducted the standard setting study on March 22, 2013, on behalf of the Virginia Department of Education (VDOE) for the Praxis II English Language Arts: Content Knowledge (5038) assessment.

A detailed summary of the study, *Standard Setting Technical Report – Praxis English Language Arts: Content Knowledge (5038)*, is attached (Appendix L) and includes participants, methodology, and recommendations.

In addition to the state-specific study, ETS also conducted a multistate standard setting study in March 2013 in Princeton, New Jersey. The results of this study, including the passing score recommended by the multistate panel, are attached (Appendix M) and include participants, methodology, and recommendations.

The Praxis *Test at a Glance* document (Appendix N) describes the purpose and structure of the assessment. In brief, the purpose of the test is to assess whether the entry-level English teacher has the content knowledge and skills believed necessary for competent practice. A National Advisory Committee of English teachers and college faculty defined the content of the assessment, and a national survey of teachers and college faculty confirmed the content.

The English Language Arts: Content Knowledge (5038) assessment contains 130 selected-response items covering three content areas: Reading (approximately 49 items), Language Use and Vocabulary (approximately 33 items), and Writing, Speaking, and Listening (approximately 48 items). Twenty of the 130 selected-response items are pretest items and do not contribute to a candidate's score. The reporting scale for the English Language Arts: Content Knowledge (5038) test ranges from 100 to 200 scaled-score points.

At the April 22, 2013, meeting the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing score recommended by the multistate standard setting panel for the Praxis English Language Arts: Content Knowledge (5038) assessment:

- 79 raw score points (167 scaled score)

## 6. MATHEMATICS: CONTENT KNOWLEDGE (5161) ASSESSMENT

The Praxis II assessment currently required for individuals seeking an initial license with an endorsement in mathematics is the Mathematics: Content Knowledge (0061/5061) assessment. The test has been required in Virginia since July 1, 1999. The Educational Testing Service (ETS) that administers the Praxis II will be discontinuing this assessment and has developed the Mathematics: Content Knowledge (5161) assessment.

A standard setting study was conducted on March 22, 2013, for the Praxis II assessment. ETS conducted the standard setting study on behalf of the Virginia Department of Education (VDOE) for the Praxis II Mathematics: Content Knowledge (5161) assessment. A detailed summary of the study, *Standard Setting Technical Report – Praxis Mathematics: Content Knowledge (5161)*, is attached (Appendix O) and includes participants, methodology, and recommendations.

In addition to the state-specific study, ETS also conducted a multistate standard setting study in February 2013 in Princeton, New Jersey. The results of this study, including the passing score recommended by the multistate panel, are attached (Appendix P) and include participants, methodology, and recommendations.

The Praxis *Test at a Glance* document (Appendix Q) describes the purpose and structure of the assessment. In brief, the purpose of the test is to assess whether the entry-level mathematics teacher has the content knowledge and skills believed necessary for competent practice. A National Advisory Committee of mathematics teachers and college faculty defined the content of the assessment, and a national survey of teachers and college faculty confirmed the content.

The Mathematics: Content Knowledge (5161) assessment contains 60 selected-response and numeric-entry items covering two content areas: Number and Quantity, Algebra, Functions, and Calculus (approximately 41 items) and Geometry, Probability and Statistics, and Discrete Mathematics (approximately 19 items). Ten of the 60 selected-response and numeric-entry items are pretest items and do not contribute to a candidate's score. The reporting scale for the Mathematics: Content Knowledge (5161) assessment ranges from 100 to 200 scaled-score points.

At the April 22, 2013, meeting, the Advisory Board on Teacher Education and Licensure recommended that the Board of Education set the following passing score recommended by the multistate standard setting panel for the Praxis Mathematics: Content Knowledge (5161) assessment:

- 32 raw score points (160 scaled score)

**Impact on Fiscal and Human Resources:**

Costs associated with the administration of the Virginia Communication and Literacy Assessment (VCLA) will be incurred by the National Evaluation Group of Pearson. Costs associated with the administration of Praxis Specialty Area Tests will be incurred by the Educational Testing Service. Prospective teachers are required to pay test fees.

**Timetable for Further Review/Action:**

This item with the recommendations of the Superintendent of Public Instruction will be presented to the Board of Education for final review at the June 27, 2013, meeting.

**Superintendent's Recommendation:**

The Superintendent of Public Instruction recommends that the Board of Education accept for first review the Advisory Board of Teacher Education and Licensure's recommendations that are summarized in Appendix A.

## Appendices

**Appendix A: Summary and Background Information on Proposed Passing Scores for Professional Assessments**

**Appendix B: Standard Setting Conference Report – Virginia Communication and Literacy Assessment – February 28, 2013**

**Appendix C: Virginia Standard Setting Technical Report – Praxis Elementary Education: Multiple Subjects (5031) – November 2012**

**Appendix D: Multistate Standard Setting Technical Report – Praxis Elementary Education: Multiple Subjects (5031) – August 2011**

**Appendix E: Test at a Glance – Praxis Elementary Education: Multiple Subjects (5031)**

**Appendix F: Virginia Standard Setting Technical Report – Praxis Middle School English Language Arts (5047) – March 2013**

**Appendix G: Multistate Standard Setting Technical Report – Praxis Middle School English Language Arts (5047) – March 2013**

**Appendix H: Test at a Glance – Praxis Middle School English Language Arts (5047)**

**Appendix I: Virginia Standard Setting Technical Report – Praxis Middle School Mathematics (5169) – March 2013**

**Appendix J: Multistate Standard Setting Technical Report – Praxis Middle School Mathematics (5169) – February 2013**

**Appendix K: Test at a Glance – Praxis Middle School Mathematics (5169)**

**Appendix L: Virginia Standard Setting Technical Report – Praxis English Language Arts: Content Knowledge (5038) – March 2013**

**Appendix M: Multistate Standard Setting Technical Report – Praxis English Language Arts: Content Knowledge (5038) – March 2013**

**Appendix N: Test at a Glance – Praxis English Language Arts: Content Knowledge (5038)**

**Appendix O: Virginia Standard Setting Technical Report – Praxis Mathematics:  
Content Knowledge (5161) – March 2013**

**Appendix P: Multistate Standard Setting Technical Report – Praxis Mathematics:  
Content Knowledge (5161) – March 2013**

**Appendix Q: Test at a Glance – Praxis Mathematics: Content Knowledge (5161)**

## **Appendix A**

### **Summary and Background Information on Proposed Passing Scores for Professional Assessments**

### Summary and Background Information on Proposed Passing Scores for Professional Assessments

Assessment Name	Background Information		Standard Setting Summary			
	Assessment Number	Current Pass Score	Virginia Panel Recommendation	Multistate Panel Recommendation	ABTEL Recommendation	Superintendent's Recommendation
VCLA Reading Subtest	(091)	20 out of 35	26 out of 35		26 out of 35	26 out of 35
VCLA Writing Multiple Choice/Sentence Correction	(092)	23 out of 41	29 out of 41		29 out of 41	29 out of 41
VCLA Writing Assignments	(092)	23 out of 40	29 out of 40		29 out of 40	29 out of 40
Praxis Elementary Education: Multiple Subjects/Reading and Language Arts	(5031-5032)		40 out of 65	46 out of 65	40 out of 65	46 out of 65
Praxis Elementary Education: Multiple Subjects/Mathematics	(5031-5033)		24 out of 40	28 out of 40	24 out of 40	28 out of 40
Praxis Elementary Education: Multiple Subjects/Social Studies	(5031-5034)		34 out of 55	35 out of 55	34 out of 55	35 out of 55
Praxis Elementary Education: Multiple Subjects/Science	(5031-5035)		31 out of 50	33 out of 50	31 out of 50	33 out of 50
Praxis Middle School English Language Arts	(5047)		79 out of 120	81 out of 120	81 out of 120	81 out of 120
Praxis Middle School Mathematics	(5169)		28 out of 45	31 out of 45	31 out of 45	31 out of 45
Praxis English Language Arts: Content Knowledge	(5038)		68 out of 110	79 out of 110	79 out of 110	79 out of 110
Praxis Mathematics: Content Knowledge	(5161)		30 out of 50	32 out of 50	32 out of 50	32 out of 50

## **Appendix B**

### **Standard Setting Conference Report Virginia Communication and Literacy Assessment February 28, 2013**



## STANDARD SETTING CONFERENCE REPORT

Prepared for:

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Department of Education  
P.O. Box 2120  
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March 18, 2013

Developed and Produced by



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## INTRODUCTION

### Overview

On March 23, 2005, the Virginia Board of Education approved the establishment of a *Special Committee of the Board of Education to Study and Make Recommendations Relative to Teacher Licensure Assessment*. The committee was charged with the responsibility of examining the use of teacher licensure assessments in Virginia and other states and making recommendations to the Board of Education. Based on the committee's recommendation, on June 22, 2005, the Board of Education approved the implementation of the Communication and Literacy Assessment in addition to the current content assessment and Virginia Reading Assessment (if applicable) as requirements for individuals seeking initial teacher licensure in Virginia.

The Virginia Communication and Literacy Assessment (VCLA) is designed to measure the communication and literacy skills necessary to teach and communicate effectively with parents and others in the education community. That is, candidates are expected to demonstrate comprehension and analysis of readings; development of ideas in essay form on specific topics; outlining and summarizing skills; interpreting tables and graphs; mastery of grammar, mechanics, and vocabulary; and writing.

The content on which the VCLA is based was determined by input from Virginia public school educators, college faculty from public and private teacher preparation programs, representatives from professional organizations and other organizations, the Virginia Department of Education (VDOE), and others as deemed appropriate by the VDOE. Educators have had opportunities to serve on review committees, respond to surveys, and provide field-testing support. Teacher licensure candidates have had the opportunity to participate in field testing activities.

In January 2006 the VCLA became one requirement for initial teacher licensure in the Commonwealth of Virginia. Pearson began administering the VCLA at that time. On March 18, 2010, the Board of Education accepted the recommendation of the Advisory Board on Teacher Education and Licensure to approve the continued use of the VCLA (Reading and Writing) as an optional test for Reading and Writing tests for individuals seeking entry into a Virginia teacher preparation program. In early 2012, the Virginia Department of Education asked Pearson to reconvene a standard setting panel to provide a new passing score recommendation to the Virginia Department of Education.

On October 18, 2012 Pearson convened a standard setting panel of Virginia educators who provided input on a new passing standard for the VCLA. This report describes the panel's activities and the panel's standard setting results.

### Test Design

The VCLA is composed of two areas—reading and writing. Each area is assessed by a separate subtest—a Reading subtest and a Writing subtest. The Reading subtest contains 40 multiple-choice items. The Writing subtest contains 40 multiple-choice items, three short-answer sentence correction items, and two constructed-response items—a writing summary and a written composition.

Approximately 10% of the multiple-choice items on each subtest form are designated as “nonscorable.” Nonscorable items are included so that data can be collected on the psychometric characteristics of the items for consideration of using the items as scorable on future test forms.

For the multiple-choice items, there are four response options per test item, one of which is the best response of the choices given. There is no penalty for guessing. Appendix A: VCLA Test Design provides further details regarding the test design for each subtest.

## **DETERMINATION OF PASSING STANDARDS**

### Overview

A passing standard (also called a “passing score”) is a score on a test that reflects the boundary line, as determined by the state, between candidates who satisfy the testing component of state requirements for teacher licensure and those who do not. The new passing standard for each subtest of the VCLA is determined by the Virginia Board of Education with input from licensed and practicing educators who provided professional judgments concerning the performance of “just acceptably qualified candidates” on the test.

The Virginia Board of Education will set a new passing standard for each of the VCLA subtests that was developed as part of the Virginia Communication and Literacy Assessment. The Board of Education will consider input from Virginia educators and others in determining the passing standard for each subtest.

The Standard Setting Meeting was conducted on October 18, 2012 in Richmond, VA to gather input from Virginia educators on actual test items. A panel of Virginia educators was trained to provide standard setting judgments. Then, the panels of educators reviewed the September 22, 2012 form for each subtest and provided their professional judgments concerning the performance of “just acceptably qualified candidates” on the test items (multiple-choice, short-answer, and constructed-response items).

The Standard Setting Panel included Virginia educators selected and approved by the VDOE. See Appendix B for the list of Virginia educators who sat on the standard setting panel.

### Selection of the Standard Setting Panels

The Standard Setting Panel consisted of licensed and practicing Virginia public school teachers and college faculty from Virginia colleges and universities who are currently preparing prospective teachers.

## Standard Setting Meeting

### **Overview**

The purpose of the Standard Setting meeting was to provide Virginia educators with the opportunity to make recommendations that would be used, in part, by the Virginia Board of Education in setting the new passing standard for each of the VCLA subtests.

An iterative procedure was used in which standard setting ratings were gathered in two rounds using procedures commonly referred to as a modified-Angoff method and the extended-Angoff method. In the first round, panel members provided item-by-item judgments of the performance of “just acceptably qualified candidates” on the multiple-choice items, short-answer items, and constructed-response items from the September 22, 2012 operational test form. In the second round, panelists reviewed the results from the initial round of ratings as well as examinee performance on the multiple-choice items. Panel members were given an opportunity to make revisions to their individual round-one item ratings.

### **Orientation and training**

Panel members were given an orientation that explained the passing score recommendation process, the materials they would use, the concept of the “just acceptably qualified candidate,” and the judgments about test items that they would be asked to make. Panelists also completed a training exercise, including items with a range of item difficulty, to prepare them for the actual rating activity. The role of the Virginia Board of Education in setting the passing standard was also explained.

### **Simulated test-taking activity**

To familiarize the panel members with the knowledge and skills associated with the test items, panel members were asked to “take the test.” Each panel member was provided with a copy of the September 22, 2012 operational test form, and was asked to read and answer the questions on the test without referring to the answer key. After panel members completed this activity they were provided with the answer key and were asked to score their own answers. Panelists were encouraged to write in their copy of the test booklet, to outline responses to the short-answer and constructed-response items or to write any notes to assist them with their review.

**Round one performance level judgments: multiple-choice items**

*Training session.* The Pearson facilitator led panel members through a training session in which the materials for the standard setting process were presented and explained, and the performance level judgment activities were described. Training included a description of the performance level judgment activities that the panel would perform, and an introduction to the concept of the "just acceptably qualified candidate" - the basis on which panel members were to provide their performance level judgments.

*Round one item-based performance level judgments: multiple-choice items.* The Pearson facilitator provided training in the main standard setting activity in which panel members made item-by-item judgments using a modified-Angoff procedure. The process was explained and panel members were provided instruction regarding how to mark their judgments on the Round One Item Rating Form they had received earlier. Referring to the test form they had received earlier, panel members were asked to provide, for each scorable item on the test form, their individual, independent judgment regarding the expected performance of "just acceptably qualified candidates" on the item.

Panel members were asked to envision a group of individuals who are just at the level of knowledge and skills required to perform the job of an entry-level teacher in Virginia public schools. Panel members were provided with a definition of the hypothetical group of "just acceptably qualified candidates" that they were asked to envision in making their standard setting judgments. Panel members were asked to refer to this definition of the "just acceptably qualified candidate" in making their judgments throughout the standard setting process.

Panel members were asked to indicate a performance level judgment for each scorable multiple-choice item by answering the following question.

Imagine a hypothetical group of individuals who are just at the level of knowledge and skills required to perform the job of an entry-level teacher effectively in Virginia public schools. What percentage of this group would answer the item correctly?

0% - 10% = 1	51% - 60% = 6
11% - 20% = 2	61% - 70% = 7
21% - 30% = 3	71% - 80% = 8
31% - 40% = 4	81% - 90% = 9
41% - 50% = 5	91% - 100% = 10

To prepare for making judgments, panelists were informed of the factors affecting item difficulty, such as cognitive level, content tested, homogeneity of distractors, item context and language. Panelists were engaged in a discussion of the "just acceptably qualified candidate" and were led through an exercise in which they provided and discussed their performance level judgments on a set of sample multiple-choice test items.

#### **Round one item-based performance level judgments: short-answer items**

Panelists made similar judgments regarding the short-answer items on the test form, using a procedure known as the "extended Angoff procedure." The scoring of short-answer items was explained to panelists. The training included a review and discussion of the scoring key used by scorers (see Appendix C). Panelists reviewed the scoring key and were asked to make performance level judgments for all short-answer items on the test form.

For the short-answer items, panelists were asked to envision a group of individuals who are just at the level of knowledge and skills required for performing the job of an entry-level teacher in Virginia public schools. After reviewing the short-answer item scoring key, as well as their own responses to the short-answer items that they had developed during the simulated test-taking activity, each panel member indicated for each item the score, from "0" to "2," that would best represent the responses of the "just acceptably qualified candidate." Panel members provided an independent rating, answering the following question.

Imagine a hypothetical individual who is just at the level of knowledge and skills required to perform the job of an entry-level teacher effectively in Virginia public schools. What score represents the level of response that would be achieved by this individual?

In making this rating, panel members provided for each short-answer item on the test form their judgment (0, 1, or 2) based on the established scoring key.

**Round one item-based performance level judgments: constructed-response items**

Panelists made similar judgments regarding the constructed-response items on the test form, again using a procedure known as the “extended Angoff procedure.” The scoring of constructed-response items was explained to panelists. The training included a review and discussion of the performance characteristics and four-point scoring scales used by scorers (see Appendix D), as well as examples of marker responses used to train scorers. The marker responses were selected to represent performance at each of the score points.

Panelists reviewed the appropriate scoring scale(s), the scoring process, the marker responses, how scores are combined, and the total number of points available for each constructed-response item. Panelists were then asked to make performance level judgments for all constructed-response items on the test form.

For the constructed-response items, panelists were asked to envision a group of individuals who are just at the level of knowledge and skills required for performing the job of an entry-level teacher in Virginia public schools. After reviewing the appropriate scoring scale and marker responses for each constructed-response item, as well as their own outlines of responses to the constructed-response items that they had developed during the simulated test-taking activity, each panel member indicated for each item the score point, from “2” to “8,” that would best represent the responses of the “just acceptably qualified candidate.” Panel members provided an independent rating by answering the following question.

Imagine a hypothetical individual who is just at the level of knowledge and skills required to perform the job of an entry-level teacher effectively in Virginia public schools. What score represents the level of response that would be achieved by this individual?

In making this rating, panel members provided for each constructed-response item on the test form, a rating based on the marker responses exemplifying the points on the scoring scale and on the total number of possible points available to a candidate for the item when it is scored by two independent scorers.

### **Analysis of round one results**

After the panelists completed their multiple-choice, short-answer, and constructed-response item ratings, Pearson analyzed their rating forms to produce a Round One Item Rating Summary Report to be given to each panelist. The report, which was customized for each panelist, contained, for each multiple-choice item, each short-answer item, and each constructed-response item, the panelist's item-by-item rating, the median rating provided by all panelists rating the item, and the distribution of item ratings across all panelists. Panelists were also provided with an Item Statistics Report that included information about the difficulty level of each multiple-choice item based on examinee performance statistics from test administrations held between September 1, 2008 and September 1, 2012.

### **Round two item-based performance level judgments**

For Round Two, panelists were provided with the Item Statistics Report and the Item Rating Summary Report from Round One. Pearson staff explained how to read and interpret these reports, with a focus on an understanding of how the individual item-by-item ratings made by each panelist in Round I contributed to the median item rating and how these ratings would be translated into recommended passing standards for each test.

Panelists were advised that the data provided in the Item Statistics Report represented the performance of all candidates, not just the hypothetical group of "just acceptably qualified candidates." Panelists were provided an opportunity to ask Pearson staff for further clarification of how to read and interpret the analyses. Each panelist was given an opportunity to review the ratings of each item made by the group of panelists

and compare these ratings to his/her own. For the short-answer items, panelists were referred to the scoring key; for the constructed-response items, raters were referred to the appropriate scoring scale (score point descriptions) and the marker responses provided for their use in Round I ratings.

Based on their review of the analyses provided, panelists had the opportunity to provide, on a Round Two Item Rating Form, a second rating to replace the first rating for any multiple-choice item, short-answer item, or constructed-response item.

### **Evaluation form**

Following all activities, panel members completed an evaluation form that asked them to provide their professional judgments about the Standard Setting Meeting. On a five point scale ("1" = "not at all well" to "5" = "very well") panel members were asked to rate how well they understood the training, how confident they were in their judgments, how satisfied they were with the time provided to complete the work, how satisfied they were with the coordination and logistics of the meeting, and how satisfied they were with the performance standard setting process. Panel members were also provided space to make any additional comments regarding the Standard Setting Meeting proceedings.

## Meeting outcomes

*Standard setting results.* Following the meeting, Pearson calculated recommended passing standards for the Reading Subtest and for each section (multiple-choice and constructed-response) of the Writing subtest based on the ratings provided by the Standard Setting Panel members. These calculations were based on the panel members' final rating on each item (i.e., either the unchanged first-round rating or the second-round rating if it was different from the first-round rating).

*Results of evaluation form.* Following the meeting, Pearson analyzed the responses to the meeting evaluation form. A summary of the panel member ratings appears in Table 1 below.

**Table 1: Results of Performance Standard Setting Meeting Evaluation Form**

Number of Standard Setting Participants: 16

Number of Participants Providing Ratings: 16

<b>Question</b> [Rating Scale: 1 (not at all well) to 5 (very well)]	<b>Mean Rating</b>
1. How well do you feel you understood the training that you received for making your item-based judgments?	4.00
2. How confident are you of the item-based judgments you made?	4.06
3. How satisfied are you that you were able to complete the work you were asked to do in the time that was provided?	3.75
4. How successful were the coordination and logistics of the performance standard setting meeting?	4.13
5. Overall, how satisfied are you with the validity verification and performance standard setting process in which you participated?	3.87

## Finalize VCLA Passing Standards

Based on a candidate's test score, the candidate is awarded a "pass" or "fail" status on a subtest. This score is the candidate's "observed" score. Each individual

candidate's observed score contains some level of measurement error. Each candidate's observed score is expected to be in a range around the true score. Accordingly, it is possible that some candidates might be classified as belonging to one category on the basis of their observed score when they would be classified differently on the basis of their true score.

Decisions based on a candidate's scores can fall into one of four categories based on the relationship of the observed score and the true score to the passing score on a test.

1. True positive: a candidate whose observed score and true score are both equal to or greater than the passing score.
2. True negative: a candidate whose observed score and true score are both less than the passing score.
3. False positive: a candidate whose observed score is equal to or greater than the passing score but whose true score is less than the passing score.
4. False negative: a candidate whose observed score is less than the passing score but whose true score is equal to or greater than the passing score.

Both false positive and false negative outcomes may result in any testing situation where a passing score is applied. One consideration in setting a passing score may be the relative consequences of false positives and false negatives. For example, a false positive decision on the test would result in a not-yet-qualified candidate receiving a passing score on the test and, if the candidate had also met all other licensing requirements, receiving a teaching license and being permitted to teach children in Virginia public schools.

On the other hand, a false negative decision on the test would result in a qualified candidate, who had met all other licensing requirements, being temporarily denied a license for not yet receiving a passing score on the test. The candidate would have the opportunity to retake the test at any subsequent test administration and pass it.

Those faced with setting the final passing standards need to consider the issues of protecting the public (i.e., children in the classroom) from not-yet-qualified candidates (limiting false positive decisions) versus ensuring that qualified candidates are identified as such (limiting false negative decisions).

The October 18, 2012 VCLA Standard Setting panel recommendations are listed below.

**VCLA Reading:** 26 out of 35 points.

**VCLA Writing:** multiple choice and short answer 29 out of 41 points.

**VCLA Writing:** Summary and Composition 29 out of 40 points.

Pearson has provided the following data to the Virginia Board of Education for use in establishing the passing standard for each subtest. These data can be found in Appendix E: Standard Setting Results and Pass Rate Analyses and Appendix F: Assessment Pass Rate Analyses.

- Panel Recommended Cut Scores – These tables show the results from the October 18, 2012 VCLA Standard Setting conference. Included in the tables are the panel-recommended cut scores with SEM adjustments above and below the panel recommendations. Please note that the scaled passing score will continue to be set at 235 for both subtests based on the VDOE’s final raw cut score decision.
- Pass Rate Analysis at the Current VCLA Cut Scores. – These tables include data for both subtests and list:
  - the number of first-time candidates that took each subtest between October 1, 2011 and September 30, 2012 and
  - the overall percent passing at the current cut scores for each subtest along with percent passing filtered by race/ethnicity and gender.
- Pass Rate Analysis at Panel Recommended Cut Scores with SEM adjustments. Please note that the panel-recommended cut scores are indicated as “+0 SEM” in each table. These tables include data for both subtests and list:
  - the number of first-time candidates that took each subtest between October 1, 2011 and September 30, 2012,
  - the overall percent passing at the panel recommendation and the panel-recommended passing standard plus one and two Standard Error(s) of Measurement and minus one and two Standard Error(s) of Measurement for each subtest and
  - for both subtests the number of examinees and the percent of those examinees (by race/ethnicity and gender) at the panel-recommended passing

standard, one and two Standard Error(s) above the panel recommendation and one and two Standard Error(s) below the panel-recommended passing standard for the subtest. For the Writing subtest, this number is the percent of examinees at or above the passing standard when the multiple-choice and constructed-response sections are combined. Each section raw score is scaled, and then multiplied by the section coefficient. The resulting section scores are combined to determine a total test score and passing status. For the Writing subtest, the section coefficients are 0.5 for the multiple-choice section and 0.5 for the constructed-response section. The proportions within the constructed-response section are 0.2 for the writing summary assignment and 0.3 for the written composition assignment.

- Interpretive notes for reading the Standard Setting Results and Pass Rate Analyses., including definitions of terms and interpretive cautions
- Appendix F: Assessment Pass Rate Analyses. – These tables show VCLA assessment pass rates for those who achieve a combined score of 470 on the Reading and Writing subtests. Appendix F shows assessment pass rates at the panel recommendations for both Reading and Writing and pass rates at the panel recommendation for Reading and -1 SEM for Writing.

These tables have been provided for use by the VDOE, ABTEL and the Virginia Board of Education in considering the implications of false positive and false negative decisions. The Virginia Board of Education will set the passing standard for each subtest based upon input from the panel-based recommendations and other sources. When the new passing score for the VCLA subtests is applied it will be implemented on a schedule approved by the VDOE.

# **Appendix A**

## **Virginia Communication and Literacy Assessment**

### **Test Design**

## VCLA TEST DESIGN

Objective	Number of multiple-choice items	Number of constructed-response items
<b>Reading</b>		
1. Understanding the meaning of words and phrases.	8	
2. Understand the main idea and supporting details in written material.	8	
3. Analyze the relationship among ideas in written material.	8	
4. Use critical-reasoning skills to evaluate written material.	8	
5. Apply skills for summarizing, outlining, and visually representing written materials and for interpreting information presented in graphic form.	8	
<b>Total multiple-choice items</b>	<b>40 (35 scorable)</b>	
<b>Writing</b>		
6. Understand the influence of purpose and audience in written communication.	6 – 7	
7. Apply principles of unity, focus, and development in writing.	6 – 7	
8. Apply principles of organization in writing.	6 – 7	
9. Apply principles of sentence and paragraph construction in writing.	6 – 7	
10. Apply correct usage in Standard English.	6 – 7	
11. Apply knowledge of mechanical conventions in Standard English.	6	
<b>Total multiple-choice items</b>	<b>40 (35 scorable)</b>	
12. (sentence correction)		6
13 (written summary)		1
14 (composition)		1

### Writing

Objectives	Percentage of Subtest Score
6 -12	50%
13 (written summary)	20%
14 (composition)	30%

## **Appendix B**

### **Virginia Communication and Literacy Assessment**

#### **Panel Participant Demographics**

**October 2012 VCLA Standard Setting Panel**

<b>Name</b>	<b>Affiliation</b>	<b>Field</b>
Timothy Bostic	Old Dominion University	English
Tyrone Burson	Alexandria City Public Schools	Language Arts
Derek Cantrell	Alleghany County Public Schools	Physical Education
Stacy Escobar	Rockingham County Public Schools	Spanish
Michael Farina	Carroll County Public Schools	Instrumental Music
Laurie Gallup	Spotsylvania County Public Schools	English
Brenda G'Fellers	Virginia Intermont College	Language and Literacy
Jamey Lovin	Chesapeake Public Schools	Mathematics
Chris Mann	Scott County Public Schools	All Subjects-Elementary
Kelly McClain	King George County Public Schools	Special Education
Katie Moran	Rockingham County Public Schools	History
Cristobal Nieto	Greensville County Public Schools	Spanish, English as a Second Language
Margaret Sloan	Virginia Beach City Public Schools	Mathematics
Jameka Williams	Petersburg Public Schools	All Subjects-Grades 9-12
Jessica Windish	Virginia Beach City Public Schools	Social Studies
Amy Wouters	Rockingham Public Schools	English

**Standard Setting Panel  
Panel Demographics**

16 Panel Members

	Number	Percent
<b>Gender</b>		
Female	10	63%
Male	6	37%
<b>Race/Ethnicity</b>		
African American	1	6%
White	9	56%
Hispanic	1	7%
American Indian	1	6%
Not Specified	4	25%
<b>Affiliation</b>		
College or University Faculty	2	13%
Public School educator	14	87%
Principal/Administrator	0	
<b>Years of Teaching Experience</b>		
4-6	5	31%
7-10	3	19%
11 or more	7	44%
Not reported	1	6%
<b>Educational Level</b>		
Bachelor's	3	19%
Master's	9	56%
Doctorate	3	19%
Not Reported	1	6%
<b>Instructional Level</b>		
PreK-3	2	
1-6	5	
5-9	3	
9-12	8	
All Levels	2	
Principal/Administrator	0	
Undergraduate	2	
Both Undergraduate and Graduate	0	

## **Appendix C**

### **Virginia Communication and Literacy Assessment**

#### **Scoring Key for Short-Answer Items**

**Virginia Communication and Literacy Assessment**  
**Writing Sentence Correction Exercises**  
**Scoring Key**

Correct Grammatical Errors: 3 sentence corrections

**Performance Characteristics:**

Accuracy in rewriting the text given and correcting the errors presented to conform to Standard English.

**Scoring Key:**

1. The response accurately conveys the meaning of the original text while correcting all grammatical errors and adding no new grammatical or mechanical (i.e., spelling, punctuation, capitalization) errors.
2. The response may revise or restructure the syntax of the original text, but the essential elements (e.g., names, places, actions) and relationships among those elements (e.g., cause/effect, before/after) must be maintained.
3. The text must be rewritten as one sentence.

**Possible Scores:**

**2 = Correct**

Both error A and error B are corrected and no new errors are introduced.

**1 = Partially Correct**

- a) Error A is corrected, error B is NOT corrected, and no new errors are introduced.
- b) Error A is NOT corrected, error B is corrected, and no new errors are introduced.
- c) Both error A and error B are corrected, but one or more new errors are introduced.

**0 = Incorrect**

- a) Error A is corrected, error B is NOT corrected, AND one or more new errors are introduced.
- b) Error A is NOT corrected, error B is corrected, AND one or more new errors are introduced.
- c) Neither error A nor error B is corrected.

## **Appendix D**

### **Virginia Communication and Literacy Assessment**

#### **Performance Characteristics and Scoring Scales for Constructed-Response Items**

**Performance Characteristics for the Writing Summary**

<p><b>Fidelity</b></p>	<p>Fidelity is the extent to which the candidate accurately and clearly represents in his or her own words the essential meaning, content, and point of view of the original passage.</p>
<p><b>Conciseness</b></p>	<p>Conciseness is the extent to which the candidate's response is of appropriate length, depth, and specificity to convey the essential meaning, content, and point of view of the original passage.</p>
<p><b>Organization</b></p>	<p>Organization is the extent to which the candidate's sequencing and paragraphing of ideas convey the essential meaning, logical structure, and point of view of the original passage.</p>
<p><b>Mechanics, Grammar, and Word Choice</b></p>	<p>Mechanics, grammar, and word choice are the extent to which words are spelled correctly and the candidate's writing follows the conventions of punctuation and capitalization; the effectiveness of the sentence structure and the extent to which the sentences are free of structural errors; and the extent to which the candidate's writing shows care and precision in word choice and is free of usage errors.</p>

**Scoring Scale for the Writing Summary**

Score Point	Score Point Description
4	<p><b>A well-formed written response</b></p> <ul style="list-style-type: none"> <li>Using his or her own words, the candidate accurately and clearly represents the essential meaning, content, and point of view of the original passage. The candidate does not distort or misrepresent the original meaning or substitute his/her own ideas or opinions for those expressed in the original text.</li> <li>The candidate's response is concise, but provides enough statements of appropriate depth and specificity to represent the essential meaning, content, and point of view of the original passage.</li> <li>The response exhibits control and organization; the sequencing and paragraphing of ideas clearly represent the essential meaning, logical structure, and point of view of the original passage.</li> <li>The candidate shows mastery of mechanical conventions (i.e., spelling, punctuation, and capitalization). The candidate uses correct and effective paragraph and sentence structure. The candidate's usage and choice of words are careful and precise.</li> </ul>
3	<p><b>A generally well-formed written response</b></p> <ul style="list-style-type: none"> <li>Using his or her own words, the candidate generally represents most of the meaning, content, and point of view of the original passage without distortion or misrepresentation.</li> <li>The candidate's response may be too long or too short, but generally provides enough statements of appropriate depth and specificity to convey most of the meaning, content, and point of view of the original passage.</li> <li>The candidate's organization of ideas may be somewhat unclear, incomplete, or partially ineffective, but sequencing and paragraphing of ideas generally represent the essential meaning, logical structure, and point of view of the original passage.</li> <li>The candidate may make some errors in the use of mechanical conventions (i.e., spelling, punctuation, and capitalization). The candidate uses adequate paragraph and sentence structure, but minor errors may be present. The candidate's usage and choice of words may display minor errors.</li> </ul>
2	<p><b>A partially formed written response</b></p> <ul style="list-style-type: none"> <li>The candidate represents only some of the meaning, content, and point of view of the original passage. The candidate may substitute his or her own ideas and opinions for those expressed in the original passage. The candidate may distort or misrepresent some of the original meaning. The candidate may rely heavily on the language of the original passage to express the essential ideas and meaning of the original passage.</li> <li>The candidate's response may be too long or too short, or lack appropriate depth or specificity, to convey the essential meaning, content, and point of view of the original passage.</li> <li>The candidate's organization, paragraphing, and sequencing of ideas may compromise or distort the meaning, logical structure, and/or point of view of the original passage.</li> <li>The candidate makes frequent errors in the use of mechanical conventions (i.e., spelling, punctuation, and capitalization). Sentence and paragraph structure are poor, with noticeable and distracting errors. Imprecision in usage and word choice is distracting.</li> </ul>
1	<p><b>An inadequately formed written response</b></p> <ul style="list-style-type: none"> <li>The candidate fails to represent the meaning, content, and point of view of the original passage in his or her own words. The original meaning is distorted, misrepresented, or merely copied.</li> <li>The candidate's response fails to convey the depth or specificity of meaning conveyed by the original passage.</li> <li>The candidate's organization, paragraphing and sequencing of ideas fail to convey the meaning, logical structure, and point of view of the original passage.</li> <li>The candidate makes serious and numerous errors in the use of mechanical conventions (i.e., spelling, punctuation, and capitalization). Sentence and paragraph structure are ineffective, and few sentences are free of errors. Imprecision in usage and word choice interferes with meaning.</li> </ul>

**Performance Characteristics for the Written Composition**

<b>Appropriateness</b>	Appropriateness is the extent to which the candidate addresses the topic and uses language and style appropriate to the given audience, purpose, and occasion.
<b>Organization</b>	Organization is the clarity of the writing and the logical sequence of the candidate's ideas.
<b>Focus and Unity</b>	Focus and unity are the clarity with which the candidate states and maintains focus on the main idea or point of view.
<b>Development</b>	Development is the extent to which the candidate provides statements of appropriate depth, specificity, and/or accuracy.
<b>Usage</b>	Usage is the extent to which the candidate's writing shows care and precision in word choice and is free of usage errors.
<b>Sentence Structure</b>	Sentence structure is the effectiveness of the sentence structure and the extent to which the sentences are free of structural errors.
<b>Mechanical Conventions</b>	Mechanical conventions are the extent to which words are spelled correctly and the candidate follows the conventions of punctuation and capitalization.

**Scoring Scale for the Written Composition**

<b>Score Point</b>	<b>Score Point Description</b>
<b>4</b>	<p><b>A well-formed written response</b></p> <ul style="list-style-type: none"><li>• The candidate addresses the assignment fully and uses appropriate language and style.</li><li>• The candidate exhibits control in the organization of ideas.</li><li>• The candidate clearly states a main idea and/or point of view, and maintains focus and unity throughout the response.</li><li>• The candidate develops the response fully by providing ample statements of appropriate depth, specificity, and accuracy.</li><li>• Usage and choice of words are careful and precise.</li><li>• Sentence structure is effective and free of errors.</li><li>• The candidate shows mastery of mechanical conventions (e.g., spelling, punctuation, and capitalization).</li></ul>
<b>3</b>	<p><b>A generally well-formed written response</b></p> <ul style="list-style-type: none"><li>• The candidate generally addresses the assignment and for the most part uses appropriate language and/or style.</li><li>• The organization of ideas is generally clear and logical, but there may be occasional ambiguity or partial ineffectiveness.</li><li>• The main idea and/or point of view of the response is generally clear, and focus and unity are generally maintained.</li><li>• The response is generally developed through the use of statements of appropriate depth, specificity, and accuracy.</li><li>• Minor errors in usage and word choice may be evident.</li><li>• Sentence structure is generally correct, although minor errors may be present.</li><li>• There may be some errors in the use of mechanical conventions (e.g., spelling, punctuation, and capitalization).</li></ul>
<b>2</b>	<p><b>A partially formed written response</b></p> <ul style="list-style-type: none"><li>• The candidate partially addresses the assignment and may use inappropriate language and/or style.</li><li>• The candidate may make an effort to organize and sequence ideas, but organization is largely unclear.</li><li>• The main idea and/or point of view is inconsistent and/or the focus and unity of the discussion are not sustained.</li><li>• The response includes very few statements that contribute effectively to the development of the response.</li><li>• Imprecision in usage and word choice is distracting.</li><li>• Sentence structure is poor, with noticeable and distracting errors.</li><li>• The candidate makes frequent errors in the use of mechanical conventions (e.g., spelling, punctuation, and capitalization).</li></ul>
<b>1</b>	<p><b>An inadequately formed written response</b></p> <ul style="list-style-type: none"><li>• The candidate attempts to address the assignment, but language and style are generally inappropriate for the given audience, purpose, and/or occasion.</li><li>• Any organization that is present fails to present an effective sequence of ideas.</li><li>• The main idea and/or point of view of the response is not identified.</li><li>• The candidate fails to include statements that contribute effectively to the development of the response.</li><li>• Imprecision in usage and word choice interferes with meaning.</li><li>• Sentence structure is ineffective, and few sentences are free of errors.</li><li>• The candidate makes serious and numerous errors in the use of mechanical conventions (e.g., spelling, punctuation, and capitalization).</li></ul>

## **Appendix E**

### **Virginia Communication and Literacy Assessment Standard Setting Results and Pass Rate Analyses**

***Virginia Communication and Literacy Assessment (VCLA)***  
***Panel Recommended Cut Scores***

**VCLA Reading**  
**Panel Recommended Cut Score (out of 35 points)**  
**with SEM adjustments**

<b>SEM</b>	<b>Cut Score</b>
-2	20
-1	23
+0	Panel Recommendation 26
+1	28
+2	31

**VCLA Writing**  
**Panel Recommended Cut Scores**  
**with SEM adjustments**

<b>SEM</b>	<b>Multiple-Choice and Sentence Correction Cut Score*</b>	<b>Constructed-Response Section Cut Score**</b>
-2	23	23
-1	26	26
+0	Panel Recommendation 29	Panel Recommendation 29
+1	32	32
+2	35	35

\* Multiple-Choice section includes 35 multiple choice items and three sentence correction items (maximum = 41 points)

\*\* Constructed-Response section consists of one summary and one composition question (maximum = 40 points).

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

	N	Percent Pass at Current Cut Scores*
Subtest		
Reading	8,770	99
Writing	8,816	93

*\*For Reading, the current cut score is 19 out of 35.*

*\*For Writing, the current cut scores are 24 out of 41 for multiple choice and sentence corrections, and 23 out of 40 for composition and summary constructed-response assignments.*

*\*Any difference between the current (2011-2012) cut scores listed above and the cut scores approved by the VDOE in 2006 is a result of test form equating.*

*As new test forms are developed, an equating procedure is used to ensure that the cut scores on each form are equivalent to the original approved cut scores. The cut scores used for the 2011-2012 test forms are equivalent to the cut scores approved by the VDOE in 2006.*

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

Subtest = Reading

	N	Percent Pass at current Cut Scores*
All	8,770	99
Gender		
Male	1,868	99
Female	6,712	99
No response	190	100
Ethnicity		
Native American or Alaskan Native	19	100
Asian or Pacific Islander	236	97
African American (not of Hispanic Origin)	778	95
Hispanic	277	99
White	6,392	99
Other	186	97
No response	882	99

*\*For Reading, the current cut score is 19 out of 35.*

*\*For Writing, the current cut scores are 24 out of 41 for multiple choice and sentence corrections, and 23 out of 40 for composition and summary constructed-response assignments.*

*\*Any difference between the current (2011-2012) cut scores listed above and the cut scores approved by the VDOE in 2006 is a result of test form equating.*

*As new test forms are developed, an equating procedure is used to ensure that the cut scores on each form are equivalent to the original approved cut scores.*

*The cut scores used for the 2011-2012 test forms are equivalent to the cut scores approved by the VDOE in 2006.*

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

Subtest = Writing

	N	Percent Pass at current Cut Scores*
All	8,816	93
Gender		
Male	1,884	90
Female	6,738	94
No response	194	94
Ethnicity		
Native American or Alaskan Native	20	90
Asian or Pacific Islander	243	89
African American (not of Hispanic Origin)	795	75
Hispanic	281	82
White	6,407	96
Other	187	87
No response	883	92

*\*For Reading, the current cut score is 19 out of 35.*

*\*For Writing, the current cut scores are 24 out of 41 for multiple choice and sentence corrections, and 23 out of 40 for composition and summary constructed-response assignments.*

*\*Any difference between the current (2011-2012) cut scores listed above and the cut scores approved by the VDOE in 2006 is a result of test form equating.*

*As new test forms are developed, an equating procedure is used to ensure that the cut scores on each form are equivalent to the original approved cut scores.*

*The cut scores used for the 2011-2012 test forms are equivalent to the cut scores approved by the VDOE in 2006.*

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

	N	Percent Pass at Panel-Recommended Cut Score*				
		-2 SEM	-1 SEM	+0 SEM	+1 SEM	+2 SEM
Subtest						
Reading	8,770	98	95	87	76	44
Writing	8,816	94	85	68	37	12

\*Panel recommendation is at 0 SEM.

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

Subtest = Reading	N	Percent Pass at Panel-Recommended Cut Score*					
		-2 SEM	-1 SEM	+0 SEM	+1 SEM	+2 SEM	
All	8,770	98	95	87	76	44	
Gender							
Male	1,868	98	95	88	80	50	
Female	6,712	98	95	87	75	43	
No response	190	100	96	91	81	55	
Ethnicity							
Native American or Alaskan Native	19	100	100	100	100	47	
Asian or Pacific Islander	236	97	92	83	70	38	
African American (not of Hispanic Origin)	778	93	83	65	50	22	
Hispanic	277	97	88	76	62	34	
White	6,392	99	97	91	80	48	
Other	186	96	88	80	62	38	
No response	882	98	95	86	77	46	

\*Panel recommendation is at 0 SEM.

*Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt  
October 1, 2011 - September 30, 2012*

Subtest = Writing	N	Percent Pass at Panel-Recommended Cut Score*				
		-2 SEM	-1 SEM	+0 SEM	+1 SEM	+2 SEM
All	8,816	94	85	68	37	12
Gender						
Male	1,884	91	80	62	35	11
Female	6,738	95	86	69	37	12
No response	194	94	88	72	47	18
Ethnicity						
Native American or Alaskan Native	20	90	85	70	40	25
Asian or Pacific Islander	243	90	81	62	36	11
African American (not of Hispanic Origin)	795	78	59	36	13	2
Hispanic	281	82	67	50	27	6
White	6,407	97	90	73	40	14
Other	187	88	79	57	33	11
No response	883	93	83	68	38	12

\*Panel recommendation is at 0 SEM.

**Virginia Communication and Literacy Assessment (VCLA)**  
**PRELIMINARY PASS RATE ANALYSIS**  
**INTERPRETIVE NOTES**

The notes below are an integral part of the accompanying tables.

- Data presented in the tables represent examinees who took the test between October 1, 2011 and September 30, 2012.
- Data reflects candidates' *initial (first time)* attempts.
- **Panel-Based Passing Standard for Each Subtest.** The panel-based passing standard is the sum of medians of panel member item judgments for the multiple-choice (and short answer for Writing) scorable item set, rounded to the nearest integer. The panel-based standard is indicated in each table as +0 SEM. For the constructed-response assignments the panel-recommended raw score for each assignment is multiplied two times for the writing summary assignment and 3 times for the written composition assignment to provide the appropriate 40%/60% weighting for the constructed-response section.
- **Percent of Examinees At or Above Panel Recommended Performance Standard for Each VCLA Subtest**= the number of examinees and the percent of those examinees at or above the combined passing standard for the subtest. Each section raw score is scaled and multiplied by the section coefficient, and then the resulting section scores are combined. For the Reading subtest there is only a multiple-choice section. For the Writing subtest, the section coefficients are 0.50 for the multiple-choice/short answer section and 0.50 for the constructed-response section.
  - **Number Tested for Each Subtest** = total number of examinees who took the test between October 1, 2011 and September 30, 2012.
  - **Percent Pass At Panel-Based Multiple-Choice (MC) or Combined Multiple Choice and Constructed-Response Passing Standard Minus One (or Two) S.E.M.** = sum of medians of panel member item judgments for the multiple-choice scorable item set minus one (or two) Standard Error(s) of Measurement (S.E.M.), rounded to the nearest integer.
  - **Percent Pass At Panel-Based Multiple-Choice (MC) or Combined Multiple Choice and Constructed-Response Passing Standard** = sum of medians of panel member item judgments for the multiple-choice scorable item set, rounded to the nearest integer.
  - **Percent Pass At Panel-Based Multiple-Choice (MC) or Combined Multiple Choice and Constructed-Response Passing Standard Plus One (or Two) S.E.M.** = sum of medians of panel member item judgments for the multiple-choice scorable item set plus one (or two) Standard Error(s) of Measurement (S.E.M.), rounded to the nearest integer.
  - **Estimated Standard Error of Measurement (S.E.M.)** =  $\sqrt{(1 / (i - 1)) \times c \times (i - c)}$  where  $i$  = number of scorable multiple-choice/short answer items on the test and  $c$  = panel-based passing standard.
  - **% Pass** = the percent of examinees who would pass at the given combination of multiple-choice and constructed-response item scores.

INTERPRETIVE CAUTIONS

- Examinee passing rates reflect a compensatory scoring model in which higher scores on one section of the test may compensate for lower scores on another section of the test.
- Examinees whose data are presented in this document may not reflect the same performance as that of examinees who will take these tests in the future.
- Extreme caution should be used in interpreting data for small numbers of examinees. The examinees for whom results are presented in this document may not reflect the same proportion of all the types and capabilities of examinees in the population who will take the tests in the future.

## **Appendix F**

# **Virginia Communication and Literacy Assessment Assessment Pass Rate Analyses**

**Virginia Communication and Literacy Assessment (VCLA)  
Pass Rate Analysis: Initial Attempt by Race/Ethnicity/Gender**  
October 1, 2011 - September 30, 2012

**VCLA Assessment Level Pass Rate\***

**Reading and Writing Combined**

At Committee Recommendation (0 SEM)

Reporting Group	N	Percent Pass
All	8,677	81
<b>Gender</b>		
Male	1,849	79
Female	6,638	82
No response	190	87
<b>Ethnicity</b>		
Native American or Alaskan Native	19	89
Asian or Pacific	232	76
African American (not of Hispanic Origin)	761	51
Hispanic	266	65
White	6,345	86
Other	182	71
No response	872	80

**Reading and Writing Combined**

Reading at Committee Recommendation (0) SEM

Writing at Committee Recommendation -1 SEM

Reporting Group	N	Percent Pass
All	8,677	88
<b>Gender</b>		
Male	1,849	87
Female	6,638	88
No response	190	92
<b>Ethnicity</b>		
Native American or Alaskan Native	19	89
Asian or Pacific	232	84
African American (not of Hispanic Origin)	761	62
Hispanic	266	71
White	6,345	92
Other	182	82
No response	872	87

\*Candidates pass the VCLA Assessment if they achieve a combined score of 470 on the Reading and Writing Subtests.

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Evaluation Systems  
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## **Appendix C**

**Virginia Standard Setting Technical Report  
Praxis Elementary Education: Multiple Subjects (5031)  
November 2012**



*Listening. Learning. Leading.*

Standard-setting Technical Report

**PRAXIS™ ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031)**

Prepared for the Virginia Department of Education

Licensure and Credentialing Research

Educational Testing Service

Princeton, New Jersey

November 2012

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## EXECUTIVE SUMMARY

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing scores, or cut scores, for the Praxis™ Elementary Education: Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on October 16-17, 2012. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers.

The Praxis Elementary Education: Multiple Subjects test is comprised of four, separately-timed subtests measuring core content areas.

- Reading and Language Arts (5032)
- Mathematics (5033)
- Social Studies (5034)
- Science (5035)

To “pass” the Praxis Elementary Education: Multiple Subjects test, a candidate must meet or exceed the passing score established by the VDOE for each of the four subtests. Therefore, the standard-setting study conducted on behalf of the VDOE recommends passing scores for the Reading and Language Arts, Mathematics, Social Studies and Science subtests.

## RECOMMENDED PASSING SCORE

The recommended passing scores are provided to help the VDOE determine appropriate operational passing scores. For the Praxis Elementary Education: Multiple Subjects subtests, the recommended passing scores are:

- **Reading and Language Arts:** The recommended passing score is 40 (out of a possible 65 raw-score points). The scaled score associated with a raw score of 40 is 152<sup>1</sup>.
- **Mathematics:** The recommended passing score is 24 (out of a possible 40 raw-score points). The scaled score associated with a raw score of 24 is 150<sup>1</sup>.
- **Social Studies:** The recommended passing score is 34 (out of a possible 55 raw-score points). The scaled score associated with a raw score of 34 is 153<sup>1</sup>.
- **Science:** The recommended passing score is 31 (out of a possible 50 raw-score points). The scaled score associated with a raw score of 31 is 153<sup>1</sup>.

## SUMMARY OF CONTENT SPECIFICATION JUDGMENTS

Panelists judged the extent to which the knowledge reflected by the content specifications were important for entry-level elementary school teachers. The favorable judgments of the panelists provided evidence that the content covered by the test is important for beginning practice.

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<sup>1</sup> Scaled scores are reported on a 100 – 200 scale.

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing scores, or cut scores, for the Praxis™ Elementary Education: Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers.

The Praxis Elementary Education: Multiple Subjects test is comprised of four, separately-timed subtests measuring core content areas.

- Reading and Language Arts (5032)
- Mathematics (5033)
- Social Studies (5034)
- Science (5035)

To “pass” the Praxis Elementary Education: Multiple Subjects test, a candidate must meet or exceed the passing score established by the VDOE for each of the four subtests. Therefore, the standard-setting study conducted on behalf of the VDOE recommends passing scores for the Reading and Language Arts, Mathematics, Social Studies and Science subtests.

The study involved an expert panel of educators. Panelists were recommended by the VDOE to participate. The VDOE recommended panelists with (a) experience, either as elementary school teachers or college faculty who prepare elementary school teachers and (b) familiarity with the knowledge and skills required of beginning elementary school teachers. (See Appendix A for the names and affiliations of the panelists.)

The panel was convened on October 16-17, 2012, in Richmond, Virginia. The following technical report is divided into three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

The passing-score recommendations for the Praxis Elementary Education: Multiple Subjects test are provided to the VDOE. The VDOE is responsible for establishing the final passing score for each subtest in accordance with applicable state regulations. The study provides recommended passing scores; each recommended passing score represents the combined judgments of one group of experienced educators. The full range of a state’s needs and expectations cannot likely be represented

during the standard-setting study. Therefore, the VDOE may want to consider the recommended passing scores and other sources of information when setting the final Praxis Elementary Education: Multiple Subjects passing scores (see Geisinger & McCormick, 2010). The VDOE may accept the recommended passing scores, adjust the scores upward to reflect more stringent expectations, or adjust the scores downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the state's needs.

Two sources of information to consider when setting the passing scores are the standard errors of measurement (SEMs) and the standard errors of judgment (SEJs). The former addresses the reliability of Praxis Elementary Education: Multiple Subjects test scores and the latter, the reliability of panelists' passing-score recommendations. The SEMs allow the VDOE to recognize that a Praxis Elementary Education: Multiple Subjects test scores—any test score on any test—is less than perfectly reliable. A test score only approximates what a candidate *truly* knows or *truly* can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJs allow the VDOE to consider the likelihood that the recommended passing scores from the current panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification error. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false negative occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The state needs to consider which decision error may be more important to minimize.

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# OVERVIEW OF THE PRAXIS ELEMENTARY EDUCATION: MULTIPLE SUBJECTS TEST

The Praxis Elementary Education: Multiple Subjects *Test at a Glance* document (ETS, 2012) describes the purpose and structure of the test. In brief, the test measures whether entry-level elementary school teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the test, and a national survey of the field confirmed the content.

The three and a half hour test contains four separately-timed subtests. Each subtest produces an overall score. To pass the Praxis Elementary Education: Multiple Subjects test, a candidate must meet or exceed the passing score on each of the four subtests. A combined score across the four subtests is not reported.

- **Reading and Language Arts Subtest** contains 65 multiple-choice questions covering *Reading* (approximately 32 questions) and *Language, Writing, and Communication* (approximately 33 questions).
- **Mathematics Subtest** contains 40 multiple-choice questions covering *Number Operations and Algebraic Thinking* (approximately 26 questions); and *Geometry, Measurement, Data, and Interpretation* (approximately 14 questions).
- **Social Studies Subtest** contains 55 multiple-choice questions covering *United States History, Government, and Citizenship* (approximately 25 questions); *Geography, Anthropology, and Sociology* (approximately 16 questions); and *World History and Economics* (approximately 14 questions).
- **Science Subtest** contains 50 multiple-choice questions covering *Earth Science* (approximately 16 questions); *Life Science* (approximately 17 questions); and *Physical Science* (approximately 17 questions)..

The reporting scale for all four of the Praxis Elementary Education: Multiple Subjects subtests ranges from 100 to 200 scaled-score points.

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## PROCESSES AND METHODS

The following section describes the standard-setting processes and methods. (The agenda for the panel meeting is presented in the Appendix B)

The design of the standard-setting study included an expert panel. The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator explained how the test was developed, provided an overview of standard setting, and presented the agenda for the study.

### REVIEWING THE TEST

For each of the subtests, the first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) For each subtest, the panelists were given approximately 45 minutes to respond to the multiple-choice questions. (Panelists were instructed not to refer to the answer key while taking the test.) The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists checked their responses against the answer key.

The panelists then engaged in a discussion of the major content areas being addressed by each subtest; they were also asked to remark on any content areas that they thought would be particularly challenging for entering elementary school teachers, and areas that addressed content that would be particularly important for entering elementary school teachers.

Panelists reviewed and completed their standard-setting judgments for the Reading/Language Arts subtest and then repeated the process for the Mathematics, Social Studies, and Science subtests.

## DEFINING THE JUST QUALIFIED CANDIDATE

Following the review of the subtest, panelists developed a definition of the Just Qualified Candidate (JQC). Separate JQC definitions were developed for each of the four subtests and were used by panelists to guide their standard-setting judgments. Panelists referred to the JQC definitions developed by previous multistate standard-setting panels and the Praxis Elementary Education: Multiple Subjects *Test at a Glance* to guide their definition. The JQC is the test taker who has the minimum level of knowledge believed necessary to be a qualified elementary school teacher. The JQC definitions are the operational definitions of the passing scores. The goal of the standard-setting process is to identify the subtest scores that align with the JQC definitions. The set of JQC definitions developed by the panels are in Appendix C.

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis Elementary Education: Multiple Subjects test was conducted separately for the four subtests. For each subtest, a probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision

located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on several questions on the test.

## JUDGMENT OF CONTENT SPECIFICATIONS

In addition to the standard-setting process, the panel judged the importance of the knowledge stated or implied in the content specifications for the job of an entry-level elementary education teacher. These judgments addressed the perceived content-based validity of the test. Judgments were made using a four-point scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the content categories and supporting statements.

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## RESULTS

### EXPERT PANEL

A summary of the panelists' demographic information are presented in Table 1. The panel included 14 educators. (See Appendix A for a listing of panelists.) In brief, 12 panelists were teachers, one was college faculty, and one was an administrator or department head. The panelist who was college faculty was currently involved in the training or preparation of elementary school teachers. Ten panelists were White, and four were Black or African American. Eleven panelists were female. Half of the panelists (7 of the 14 panelists) had seven or fewer years of experience as a teacher.

**Table 1**  
**Panel Member Demographics**

	<i>N</i>	<i>%</i>
<b>Current Position</b>		
Teacher	12	86%
Administrator/Department Head	1	7%
College Faculty	1	7%
<b>Race</b>		
White	10	71%
Black or African American	4	29%
<b>Gender</b>		
Female	11	79%
Male	3	21%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	13	93%
No	1	7%

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*Table 1 (continued)*

***Panel Member Demographics***

	<i>N</i>	<i>%</i>
<b>Are you currently teaching this subject in your state?</b>		
Yes	13	93%
No	1	7%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	6	43%
No	8	57%
<b>At what K-12 grade level are you currently teaching this subject?</b>		
Elementary (K-5 or K-6)	13	93%
Not currently teaching at the K-12 level	1	7%
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	0	0%
4 - 7 years	7	50%
8 - 11 years	3	21%
12 - 15 years	2	14%
16 years or more	2	14%
<b>Which best describes the location of your K-12 school?</b>		
Urban	4	29%
Suburban	5	36%
Rural	4	29%
Not currently working at the K-12 level	1	7%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	1	7%
No	0	0%
Not college faculty	13	93%

## INITIAL EVALUATION

The panelists completed an initial evaluation after receiving training on how to make standard-setting judgments. The primary information collected was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. All panelists indicated that they were prepared to make their judgments.

## SUMMARY OF STANDARD-SETTING JUDGMENTS

The standard-setting judgments are summarized in Table 2. The numbers in the table reflect the recommended passing scores—the number of raw points needed to “pass” each subtest—for each panelist. For each subtest, the panel’s average recommended passing score and highest and lowest passing scores are reported, as are the standard deviation (SD) of panelists’ passing scores and the standard error of judgment (SEJ).

The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments<sup>2</sup>. It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the subtest.

- **Reading and Language Arts.** The panel’s passing score recommendation for the Reading Language Arts subtest is 39.97. The value was rounded to 40, the next highest whole number, to determine the recommended operational passing score. The scaled score associated with 40 raw points is 152 (on a 100 - 200 scale).
- **Mathematics.** The panel’s passing score recommendation for the Mathematics subtest is 23.77. The value was rounded to 24, the next highest whole number, to determine the recommended operational passing score. The scaled score associated with 24 raw points is 150 (on a 100 - 200 scale).

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<sup>2</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, in press).

- **Social Studies.** The panel’s passing score recommendation for the Social Studies subtest is 33.26. The value was rounded to 34, the next highest whole number, to determine the recommended operational passing score. The scaled score associated with 34 raw points is 153 (on a 100 - 200 scale).
- **Science.** The panel’s passing score recommendation for the Science subtest is 30.22. The value was rounded to 31, the next highest whole number, to determine the recommended operational passing score. The scaled score associated with 31 raw points is 153 (on a 100 - 200 scale).

**Table 2**  
**Passing Score Summary**

<b>Panelist</b>	<b>Reading Language Arts</b>	<b>Mathematics</b>	<b>Social Studies</b>	<b>Science</b>
1	44.40	29.85	36.55	35.45
2	37.05	19.50	26.95	28.70
3	44.35	24.00	32.60	26.50
4	44.30	25.50	31.15	30.90
5	37.40	21.65	32.20	26.85
6	39.40	24.20	35.05	28.55
7	48.15	30.10	43.65	38.20
8	39.05	24.75	33.75	33.00
9	40.90	21.70	33.75	30.10
10	41.20	24.75	36.60	33.40
11	40.95	28.50	30.75	31.70
12	39.20	23.20	36.10	29.90
13	29.40	17.20	27.40	25.05
14	33.80	17.90	29.20	24.75
<b>Average</b>	39.97	23.77	33.26	30.22
<b>Lowest</b>	29.40	17.20	26.95	24.75
<b>Highest</b>	48.15	30.10	43.65	38.20
<b>SD</b>	4.76	4.01	4.34	3.91
<b>SEJ</b>	1.27	1.07	1.16	1.04

Tables 3-6 present the standard error of measurement (SEM) for the Praxis Elementary Education: Multiple Subjects test<sup>3</sup>. A standard error represents the uncertainty associated with a test score. The raw and scaled scores associated with 1 and 2 SEMs above and below the recommended passing score are provided

**Table 3**

***Passing Scores Within 1 and 2 SEMs of the Recommended Passing Score<sup>4</sup> - Reading/Language Arts***

Recommended passing score (SEM)		Scale score equivalent
	40 (2.93)	152
- 2 SEMs	35	141
-1 SEM	38	148
+1 SEM	43	159
+ 2 SEMs	46	165

**Table 4**

***Passing Scores Within 1 and 2 SEMs of the Recommended Passing Score<sup>4</sup> - Mathematics***

Recommended passing score (SEM)		Scale score equivalent
	24 (2.58)	150
- 2 SEMs	19	132
-1 SEM	22	143
+1 SEM	27	161
+ 2 SEMs	29	168

**Table 5**

***Passing Scores Within 1 and 2 SEMs of the Recommended Passing Score<sup>4</sup> – Social Studies***

Recommended passing score (SEM)		Scale score equivalent
	34 (2.97)	153
- 2 SEMs	28	137
-1 SEM	31	145
+1 SEM	37	160
+ 2 SEMs	40	168

<sup>3</sup> The raw score SEM value included in this report are updated as data become available. The SEM values listed in each edition of *Understanding Your Praxis Scores* ([http://www.ets.org/Media/Tests/PRAXIS/pdf/uyps\\_web.pdf](http://www.ets.org/Media/Tests/PRAXIS/pdf/uyps_web.pdf)) are scaled score SEM values based on candidate scores on one or more test forms.

<sup>4</sup> The unrounded SEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next highest whole number and the rounded values are converted to scaled scores.

**Table 6**  
**Passing Scores Within 1 and 2 SEMs of the Recommended Passing Score<sup>5</sup> - Science**

Recommended passing score (SEM)		Scale score equivalent
	31 (2.71)	153
- 2 SEMs	25	136
-1 SEM	28	144
+1 SEM	33	159
+ 2 SEMs	36	167

## SUMMARY OF CONTENT-SPECIFICATION JUDGMENTS

Panelists judged the extent to which the knowledge reflected by the content specifications was important for entry-level elementary school teachers. Panelists rated the knowledge statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Tables 7-10 (in Appendix D).

- **Reading and Language Arts.** All but three of the 19 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds, or ten panelists.
- **Mathematics.** All but two of the 19 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds, or ten panelists.
- **Social Studies.** All but one of the 18 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds, or ten panelists.
- **Science.** All but five of the 28 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds, or ten panelists.

<sup>5</sup> The unrounded SEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next highest whole number and the rounded values are converted to scaled scores.

## SUMMARY OF FINAL EVALUATIONS

The panelists completed a final evaluation at the conclusion of their standard-setting study. The final evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation. A summary of the final evaluation results is presented in Appendix D (see Table 11).

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study, and that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

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## SUMMARY

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing scores, or cut scores, for the Praxis™ Elementary Education: Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on October 16-17, 2012. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers.

The recommended passing scores are provided to help the VDOE determine appropriate operational passing scores. For the Praxis Elementary Education: Multiple Subjects subtests, the recommended passing scores are:

- **Reading and Language Arts:** The recommended passing score is 40 (out of a possible 65 raw-score points). The scaled score associated with a raw score of 40 is 152<sup>6</sup>.
- **Mathematics:** The recommended passing score is 24 (out of a possible 40 raw-score points). The scaled score associated with a raw score of 24 is 150<sup>6</sup>.
- **Social Studies:** The recommended passing score is 34 (out of a possible 55 raw-score points). The scaled score associated with a raw score of 34 is 153<sup>6</sup>.
- **Science:** The recommended passing score is 31 (out of a possible 50 raw-score points). The scaled score associated with a raw score of 31 is 153<sup>6</sup>.

Panelists judged the extent to which the knowledge reflected by the content specifications were important for entry-level elementary school teachers. The favorable judgments of the panelists provided evidence that the content covered by the test is important for beginning practice.

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<sup>6</sup> Scaled scores are reported on a 100 – 200 scale.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Praxis Elementary Education: Multiple Subjects*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Susan Altieri	Hanover County Public Schools
Mary Alice Barksdale	Virginia Tech
Bobby Corley	Greensville Elementary School
Martha Cowles	Spotsylvania County Public Schools
Lauren Dawson	Arlington Public Schools
Jennifer Harrington	Rural Retreat Elementary School
Paulette D. Matthews	Parkview Elementary School
Cynthia McDougal	Alexandria City Public Schools
Jessica L. Newton	Suffolk Public Schools
Jacquelyn Oster	Salem City Schools
Daniel J. Rule	Lynchburg City Schools
Ashley Sears	King William County Public Schools
John Tarpey	Arlington Public Schools
Krystle Yarbrough	King William County Public Schools

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APPENDIX B  
STUDY AGENDA

# AGENDA

## Praxis Elementary Education: Multiple Subjects (5031) Standard Setting Study

October 16, 2012

**8:00 – 8:30**      **Registration & Continental Breakfast**

**8:30**      **Welcome and Introduction**  
    • **Overview of Workshop Events**

**Overview of Standard Setting**

**Overview of the Praxis Elementary Education Assessment**

**“Take” the Praxis Elementary Education Assessment**  
    • **Reading Language Arts Subtest**

**Break**

**Define the Knowledge/Skills of a JQC**  
    • **Reading Language Arts Subtest**

**Standard Setting Training & Practice**

**Standard Setting Judgments:**  
    • **Reading Language Arts Subtest**

**Lunch**

**“Take” the Praxis Elementary Education Assessment**  
    • **Mathematics Subtest**

**Define the Knowledge/Skills of a JQC**  
    • **Mathematics Subtest**

**Break**

**Standard Setting Judgments:**  
    • **Mathematics**

**4:00**      **Collect Materials; End of Day 1**

# **AGENDA**

## **Praxis Elementary Education: Multiple Subjects (5031) Standard Setting Study**

**October 17, 2012**

**8:00 – 8:30 Registration & Continental Breakfast**

**8:30 Overview of Day 2**

**“Take” the Praxis Elementary Education Assessment**

- **Social Studies Subtest**

**Break**

**Define the Knowledge/Skills of a JQC**

- **Social Studies Subtest**

**Review Standard Setting Training**

**Standard Setting Judgments:**

- **Social Studies Subtest**

**Lunch**

**“Take” the Praxis Elementary Education Assessment**

- **Science Subtest**

**Define the Knowledge/Skills of a JQC**

- **Science Subtest**

**Break**

**Standard Setting Judgments:**

- **Science**

**Specification Judgments**

**Complete Final Evaluation**

**4:30 Collect Materials; End of Study**

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## APPENDIX C

### JUST QUALIFIED CANDIDATE (JQC) DEFINITION

**DESCRIPTION OF A JUST QUALIFIED CANDIDATE**  
**PRAXIS™ ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031)**  
**(Developed for the VDOE)**

**Reading and Language Arts**

**A JQC ...**

1. knows key ideas relevant to the foundations of literacy and reading development as it relates to each individual learner including phonological awareness, phonics, fluency, vocabulary, comprehension and the relationship between various types of written, printed and oral development.
2. understands the basic components of written language, sentence type, sentence structure and vocabulary.
3. understands the types, traits, and structures of writing.
4. understands the stages of writing process and how to use resource materials.
5. understands the different aspects and role of speaking, listening, viewing and language acquisition for all learners.
6. understands the basic elements of a variety of genres.

**DESCRIPTION OF A JUST QUALIFIED CANDIDATE  
PRAXIS™ ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031)  
(Developed for the VDOE)**

**Mathematics**

**A JQC ...**

1. understands foundations of mathematics, including prenumeration concepts, basic number systems, the four basic operations and their properties and basic concepts of number theory.
2. understands how to solve mathematical problems, including word problems, using multiple strategies.
3. understands basic algebraic methods and representations.
4. understands basic arithmetic, algebraic properties and special properties of 0 and 1.
5. understands visual displays.
6. understands properties, attributes and transformations of geometric figures.
7. understands non-standard, customary and metric units of measurement.
8. understands basic concepts of probability and statistics.

**DESCRIPTION OF A JUST QUALIFIED CANDIDATE  
PRAXIS™ ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031)  
(Developed for the VDOE)**

**Social Studies**

**A JQC ...**

1. knows the purposes and understands the functions of the U.S. government (federal, state, and local) and the rights and responsibilities of its citizens.
2. knows the basic important people, events, and artifacts in U.S. History from European exploration and Colonization to present time.
3. understands world and regional geography and how people of different cultures interact with their environment.
4. understands and is able to apply the basics of geography with visual aids in relation to past, present, and future events.
5. knows major contributions and developments of world civilizations from ancient to modern times.
6. knows key terms and understands the basic concepts of economics and its effects on society.

**DESCRIPTION OF A JUST QUALIFIED CANDIDATE  
PRAXIS™ ELEMENTARY EDUCATION: MULTIPLE SUBJECTS (5031)  
(Developed for the VDOE)**

**Science**

**A JQC ...**

1. understands scientific inquiry in Earth, life and physical sciences.
2. knows basic cycles and understands patterns, and changes in Earth, life and physical science.
3. knows the core processes, structures, and history of the Earth & our solar system within the universe.
4. knows the structures, functions, and interrelationships of living things from single-cell to complex organisms within their environments.
5. knows the basics of heredity, adaptation, and mutation.
6. knows about personal health.
7. understands the basic structures of matter and how it interacts with various forms of energy.
8. understands the relationships between forces and motions.
9. knows basic key terms used in Earth, life, and physical sciences.

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APPENDIX D

RESULTS FOR PRAXIS ELEMENTARY EDUCATION: MULTIPLE  
SUBJECTS

**Table 7**  
**Specification Judgments — Reading Language Arts (5032)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. Reading</b>								
• <b>Foundational Skills</b>	<b>11</b>	<b>79%</b>	<b>3</b>	<b>21%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands key ideas relevant to the foundations of literacy and reading development	9	64%	5	36%	0	0%	0	0%
• Understands the role of phonological awareness, and phonics and word analysis skills in literacy development	11	79%	3	21%	0	0%	0	0%
• Understands the role of fluency in supporting comprehension	7	50%	7	50%	0	0%	0	0%
• Knows the stages of early orthographic development	4	29%	7	50%	3	21%	0	0%
• <b>Literature and Informational Texts</b>	<b>6</b>	<b>43%</b>	<b>8</b>	<b>57%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands the role of comprehension	14	100%	0	0%	0	0%	0	0%
• Understands the basic elements of literature and informational texts	4	29%	9	64%	1	7%	0	0%
• Understands the basic elements of poetry and drama	0	0%	7	50%	7	50%	0	0%
• Understands how to determine the meanings of words and phrases as used in texts, including figurative language	5	36%	7	50%	2	14%	0	0%
<b>II. Language, Writing, and Communication</b>								
<b>A. Language</b>	7	50%	7	50%	0	0%	0	0%
• Knows the components of written language	10	71%	4	29%	0	0%	0	0%
• Knows sentence types and sentence structure	4	29%	5	36%	5	36%	0	0%
• Understands the basic components of vocabulary	5	36%	8	57%	1	7%	0	0%

**Table 7**  
**Specification Judgments — Reading Language Arts (5032)**

	Very Important		Important		Slightly Important		Not Important	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>B. Writing</b>	<b>6</b>	<b>43%</b>	<b>8</b>	<b>57%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Knows types and traits of writing	2	14%	11	79%	1	7%	0	0%
• Knows the stages of the writing process	12	86%	2	14%	0	0%	0	0%
• Knows structures and organization of writing	6	43%	8	57%	0	0%	0	0%
• Understands how to use resource material in reading and language arts	2	14%	12	86%	0	0%	0	0%
<b>C. Communication</b>	<b>2</b>	<b>14%</b>	<b>11</b>	<b>79%</b>	<b>1</b>	<b>7%</b>	<b>0</b>	<b>0%</b>
• Understands different aspects of speaking	4	29%	7	50%	3	21%	0	0%
• Understands different aspects of listening	3	21%	9	64%	2	14%	0	0%
• Understands different aspects of viewing	2	14%	7	50%	5	36%	0	0%
• Understands the role that speaking, listening, and viewing play in language acquisition for second-language learners	6	43%	7	50%	1	7%	0	0%

**Table 8**  
**Specification Judgments — Mathematics (5033)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. Number Operations and Algebraic Thinking</b>	<b>11</b>	<b>79%</b>	<b>3</b>	<b>21%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
<b>A. Number and Operations</b>								
• Understands prenumeration concepts	12	86%	2	14%	0	0%	0	0%
• Understands basic number systems	13	93%	1	7%	0	0%	0	0%
• Understands basic four operations and their properties	10	71%	4	29%	0	0%	0	0%
• Understands basic concepts of number theory	10	71%	3	21%	1	7%	0	0%
<b>B. Operations and Algebraic Thinking</b>								
• Understands how to solve problems, including word problems, using multiple strategies and assess the reasonableness of results	9	64%	5	36%	0	0%	0	0%
• Understands how to generate, describe, and explore numerical patterns and engage in mathematical investigations	4	29%	10	71%	0	0%	0	0%
• Understands basic algebraic methods and representations	4	29%	10	71%	0	0%	0	0%
• Understands the associative, commutative, and distributive properties	3	21%	8	57%	3	21%	0	0%
• Understands additive and multiplicative inverses	1	7%	7	50%	6	43%	0	0%
• Understands the special properties of zero and one	3	21%	6	43%	5	36%	0	0%
• Understands equations and inequalities	4	29%	7	50%	3	21%	0	0%
• Understands the appropriate application of formulas	4	29%	7	50%	3	21%	0	0%

**Table 8**  
**Specification Judgments — Mathematics (5033)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>II. Geometry, Measurement, Data, and Interpretation</b>	<b>3</b>	<b>21%</b>	<b>11</b>	<b>79%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
<b>A. Geometry</b>								
• Understands properties and attributes of two- or three-dimensional figures and their hierarchy of classification	5	36%	8	57%	1	7%	0	0%
• Understands transformations, geometric models, and net	2	14%	9	64%	3	21%	0	0%
<b>B. Measurement, Data, and Interpretation</b>								
• Understands nonstandard, customary, and metric units of measurement	9	64%	5	36%	0	0%	0	0%
• Understands visual displays of quantitative data	9	64%	4	29%	1	7%	0	0%
• Understands simple probability and intuitive concepts of chance	1	7%	11	79%	2	14%	0	0%
• Understands fundamental counting techniques	5	36%	7	50%	2	14%	0	0%
• Understands basic descriptive statistics	1	7%	9	64%	4	29%	0	0%

**Table 9**  
**Specification Judgments — Social Studies (5034)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. United States History, Government, and Citizenship</b>	<b>7</b>	<b>50%</b>	<b>7</b>	<b>50%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Knows European exploration and colonization in United States history and growth and expansion of the United States	6	43%	7	50%	1	7%	0	0%
• Knows about the American Revolution and the founding of the nation in United States history	6	43%	8	57%	0	0%	0	0%
• Knows the major events and developments in United States history from founding to present	9	64%	4	29%	1	7%	0	0%
• Knows about twentieth-century developments and transformations in the United States	1	7%	11	79%	2	14%	0	0%
• Understands connections between causes and effects of events	6	43%	7	50%	1	7%	0	0%
• Understands the nature, purpose, and forms of government	9	64%	5	36%	0	0%	0	0%
• Knows key documents and speeches in the history of the United States	4	29%	9	64%	1	7%	0	0%
• Knows the rights and responsibilities of citizenship in a democracy	9	64%	5	36%	0	0%	0	0%
<b>II. Geography, Anthropology, and Sociology</b>	<b>3</b>	<b>21%</b>	<b>11</b>	<b>79%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Knows world and regional geography	5	36%	8	57%	1	7%	0	0%
• Understands the interaction of physical and human systems	2	14%	10	71%	2	14%	0	0%
• Knows the uses of geography	2	14%	8	57%	4	29%	0	0%
• Knows how people of different cultural backgrounds interact with their environment, family, neighborhoods, and communities	5	36%	6	43%	3	21%	0	0%

**Table 9**  
**Specification Judgments — Social Studies (5034)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>III. World History and Economics</b>	<b>1</b>	<b>7%</b>	<b>12</b>	<b>86%</b>	<b>1</b>	<b>7%</b>	<b>0</b>	<b>0%</b>
• Knows the major contributions of classical civilizations	2	14%	9	64%	3	21%	0	0%
• Understands twentieth-century developments and transformations in World history	1	7%	10	71%	3	21%	0	0%
• Understands the role of cross-cultural comparisons in World history instruction	1	7%	7	50%	6	43%	0	0%
• Knows key terms and basic concepts of economics	3	21%	10	71%	1	7%	0	0%
• Understands how economics effects population, resources, and technology	2	14%	10	71%	2	14%	0	0%
• Understands the government’s role in economics and impact of economics on government	2	14%	8	57%	4	29%	0	0%

**Table 10**  
**Specification Judgments — Science (5035)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. Earth Science</b>	<b>3</b>	<b>21%</b>	<b>10</b>	<b>71%</b>	<b>1</b>	<b>7%</b>	<b>0</b>	<b>0%</b>
• Understands the structure of the Earth system	4	29%	9	64%	1	7%	0	0%
• Understands processes of the Earth system	4	29%	5	36%	5	36%	0	0%
• Understands Earth history	1	7%	9	64%	4	29%	0	0%
• Understands Earth and the universe	5	36%	8	57%	1	7%	0	0%
• Understands Earth patterns, cycles, and change	8	57%	6	43%	0	0%	0	0%
• Understands science as a human endeavor, process, and career	3	21%	3	21%	8	57%	0	0%
• Understands science as inquiry	10	71%	4	29%	0	0%	0	0%
• Understands how to use resource and research material in science	5	36%	8	57%	1	7%	0	0%
• Understands the unifying processes of science	3	21%	9	64%	2	14%	0	0%
<b>II. Life Science</b>	<b>3</b>	<b>21%</b>	<b>11</b>	<b>79%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands the structure and function of living systems	6	43%	8	57%	0	0%	0	0%
• Understands reproduction and heredity	1	7%	7	50%	6	43%	0	0%
• Understands change over time in living things	5	36%	9	64%	0	0%	0	0%
• Understands regulation and behavior	1	7%	9	64%	4	29%	0	0%
• Understands unity/diversity of life, adaptation, & classification	4	29%	8	57%	2	14%	0	0%
• Understands the interdependence of organisms	6	43%	6	43%	2	14%	0	0%
• Knows about personal health	7	50%	5	36%	2	14%	0	0%
• Understands science as a human endeavor, process, and career	3	21%	3	21%	8	57%	0	0%
• Understands science as inquiry	11	79%	3	21%	0	0%	0	0%
• Understands how to use resource and research material in science	4	29%	9	64%	1	7%	0	0%
• Understands the unifying processes of science	1	7%	11	79%	2	14%	0	0%

**Table 10**  
**Specification Judgments — Science (5035)**

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
<b>III.</b>	<b>Physical Science</b>	<b>4</b>	<b>29%</b>	<b>10</b>	<b>71%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Understands the physical and chemical properties and structure of matter	3	21%	9	64%	2	14%	0	0%
	• Understands forces and motions	3	21%	10	71%	1	7%	0	0%
	• Understands energy	4	29%	7	50%	2	14%	1	7%
	• Understands interactions of energy and matter	4	29%	9	64%	0	0%	1	7%
	• Understands science as a human endeavor, process, and career	3	21%	3	21%	8	57%	0	0%
	• Understands science as inquiry	11	79%	3	21%	0	0%	0	0%
	• Understands how to use resource and research material in science	4	29%	10	71%	0	0%	0	0%
	• Understands the unifying processes of science	2	14%	9	64%	3	21%	0	0%

**Table 11**  
**Final Evaluation**

	<b>Strongly Agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly Disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	13	93%	1	7%	0	0%	0	0%
• The instructions and explanations provided by the facilitator were clear.	14	100%	0	0%	0	0%	0	0%
• The opportunity to “take the test” and to discuss the test content was useful.	14	100%	0	0%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful.	14	100%	0	0%	0	0%	0	0%
• The training for the standard setting judgments was adequate to give me the information I needed to complete my assignment.	11	79%	3	21%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	13	93%	1	7%	0	0%	0	0%

## **Appendix D**

**Multistate Standard Setting Technical Report  
Praxis Elementary Education: Multiple Subjects (5031)  
August 2011**



*Listening. Learning. Leading.*

Multi-State Standard Setting Technical Report

**PRAXIS™ ELEMENTARY EDUCATION MULTIPLE SUBJECTS (5031)**

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

August 2011

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## **Executive Summary**

To support the decision-making process for state departments of education with regards to establishing passing scores, or cut scores, for the Praxis™ Elementary Education Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a multiple-panel, multi-state standard-setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers.

The Praxis Elementary Education Multiple Subjects test is comprised of four, separately-timed subtests measuring core content areas.

- Reading and Language Arts (5032)
- Mathematics (5033)
- Social Studies (5034)
- Science (5035)

To “pass” the Praxis Elementary Education Multiple Subjects test, a candidate must meet or exceed the passing score established by a state department of education for each of the four subtests. Therefore, the standard-setting study conducted on behalf of the departments of education recommends passing scores for the Reading and Language Arts, Mathematics, Social Studies and Science subtests.

### **Participating States**

Panelists from 15 states and Washington, D.C. were recommended by state departments of education to participate on expert panels. The state departments of education recommended panelists with (a) education experience, either as elementary school (grades K through 6) teachers or college faculty who prepare elementary school teachers and (b) familiarity with the knowledge required of beginning elementary school teachers.

## Recommended Cut Scores

The recommended passing scores are provided to help state departments of education determine appropriate operational passing scores. For the Praxis Elementary Education Multiple Subjects subtests, the recommended passing scores<sup>1</sup> are:

- **Reading and Language Arts (5032):** The recommended passing score is 46 (on the raw score metric), which represents 71% of the total available 65 raw score points. The scaled score associated with a raw score of 46 is 165 (on a 100 - 200 scale).
- **Mathematics (5033):** The recommended passing score is 28 (on the raw score metric), which represents 70% of the total available 40 raw score points. The scaled score associated with a raw score of 28 is 164 (on a 100 - 200 scale).
- **Social Studies (5034):** The recommended passing score is 35 (on the raw score metric), which represents 64% of the total available 55 raw score points. The scaled score associated with a raw score of 35 is 155 (on a 100 - 200 scale).
- **Science (5035):** The recommended passing score is 33 (on the raw score metric), which represents 66% of the total available 50 raw score points. The scaled score associated with a raw score of 33 is 159 (on a 100 - 200 scale).

## Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge reflected by the content specifications for each of the four subtests was important for entry-level elementary school teachers. The favorable judgments of the panelists provided evidence that the content covered by the subtests is important for beginning practice.

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<sup>1</sup> Results from each of the panels participating in the study were averaged to produce the recommended passing scores.

To support the decision-making process for state departments of education with regards to establishing passing scores, or cut scores, for the Praxis™ Elementary Education Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a multiple-panel, multi-state standard-setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers. Panelists were recommended by state departments of education<sup>2</sup> to participate on the expert panels. The state departments of education recommended panelists with (a) education experience, either as elementary school (grades K through 6) teachers or college faculty who prepare elementary school teachers and (b) familiarity with the knowledge and skills required of beginning elementary school teachers.

The Praxis Elementary Education Multiple Subjects test is comprised of four, separately-timed subtests measuring core content areas.

- Reading and Language Arts (5032)
- Mathematics (5033)
- Social Studies (5034)
- Science (5035)

To “pass” the Praxis Elementary Education Multiple Subjects test, a candidate must meet or exceed the passing score established by a state department of education for each of the four subtests. Therefore, the standard-setting study conducted on behalf of the departments of education recommends passing scores for the Reading and Language Arts, Mathematics, Social Studies and Science subtests.

The four, non-overlapping panels (a) allow each participating state to be represented and (b) provide a replication of the judgment process to strengthen the technical quality of the recommended passing scores. Fifteen states and Washington, D.C. (see Table 1) were represented by 55 panelists across the panels. (See Appendix A for the names and affiliations of the panelists.)

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<sup>2</sup> State departments of education that currently use one or more Praxis tests were invited to participate in the multi-state standard-setting study.

**Table 1**

**Participating States (and number of panelists) for Multi-State Panels**

---

Alabama (3 panelists)	New Jersey (3 panelists)
Connecticut (4 panelists)	South Carolina (4 panelists)
Hawaii (2 panelists)	Tennessee (4 panelists)
Idaho (2 panelists)	Utah (4 panelists)
Indiana (5 panelists)	Vermont (1 panelist)
Kentucky (5 panelists)	Washington, DC (4 panelists)
Missouri (4 panelists)	West Virginia (4 panelists)
New Hampshire (4 panelists)	Wisconsin (2 panelists)

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The panels were convened in July 2011 in Princeton, New Jersey. Across panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing scores.

The following technical report is divided into three sections. The first section describes the content and format of the subtests. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

The passing-score recommendations for the Praxis Elementary Education Multiple Subjects subtests are provided to each of the represented state departments of education. In each state, the department of education, the state board of education, or a designated educator licensure board is responsible for establishing the final passing scores in accordance with applicable state regulations. The study provides recommended passing scores, which represent the combined judgments of several groups of experienced educators. The full range of a state department of education's needs and expectations cannot likely be represented during the standard-setting study. Each state, therefore, may want to consider both the panels' recommended passing scores and other sources of information when setting the final Praxis Elementary Education Multiple Subjects passing scores (see Geisinger & McCormick, 2010). A state may accept the recommended passing scores, adjust one or more scores upward to reflect more stringent expectations, or adjust one or more scores downward to reflect more lenient expectations.

There are no *correct* decisions; the appropriateness of any adjustment may only be evaluated in terms of its meeting the state's needs.

Two sources of information to consider when setting the passing scores are the standard errors of measurement (SEM) and the standard errors of judgment (SEJ). The former addresses the reliability of Praxis Elementary Education Multiple Subjects subtest scores and the latter, the reliability of panelists' passing-score recommendations. The SEM allows a state to recognize that a Praxis Elementary Education Multiple Subjects subtest score—any test score on any test—is less than perfectly reliable. A subtest score only approximates what a candidate *truly* knows or *truly* can do on the subtest. The SEM, therefore, addresses the question: How close of an approximation is the subtest score to the *true* score? The SEJ allow a state to consider the likelihood that the recommended passing scores from the current panels would be similar to passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ the more likely that another panel would recommend a passing score for a subtest consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each state should consider the likelihood of classification error. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's subtest scores suggest he should receive a license/certificate, but his actual level of knowledge indicates otherwise (i.e., the candidate does not possess the required knowledge). A false negative occurs when a candidate's subtest scores suggest that she should not receive a license/certificate, but she actually does possess the required knowledge. The state needs to consider which decision error may be more important to minimize.

## Overview of the Praxis Elementary Education Multiple Subjects Test

The Praxis Elementary Education Multiple Subjects *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level elementary school teachers have the knowledge in four core content areas believed necessary for competent professional practice. The four content areas, or subtests, are Reading and Language Arts, Mathematics, Social Studies, and Science. A National Advisory Committee of expert practitioners and preparation faculty defined the content of each subtest, and a national survey of the field confirmed the content.

The three and a half hour test contains four separately-timed subtests. Each subtest produces an overall score. To pass the Praxis Elementary Education Multiple Subjects (5031) test, a candidate must meet or exceed the passing score on each of the four subtests. A combined score across the four subtests is not reported.

- **Reading and Language Arts Subtest (5032)** contains 65 multiple-choice questions covering *Reading* (approximately 32 questions) and *Language, Writing, and Communication* (approximately 33 questions). The maximum total number of raw points that may be earned is 65.
- **Mathematics Subtest (5033)** contains 40 multiple-choice questions covering *Number Operations and Algebraic Thinking* (approximately 26 questions); and *Geometry, Measurement, Data, and Interpretation* (approximately 14 questions). The maximum total number of raw points that may be earned is 40.
- **Social Studies Subtest (5034)** contains 55 multiple-choice questions covering *United States History, Government, and Citizenship* (approximately 25 questions); *Geography, Anthropology, and Sociology* (approximately 16 questions); and *World History and Economics* (approximately 14 questions). The maximum total number of raw points that may be earned is 55.

- **Science Subtest (5035)** contains 50 multiple-choice questions covering *Earth Science* (approximately 16 questions); *Life Science* (approximately 17 questions); and *Physical Science* (approximately 17 questions). The maximum total number of raw points that may be earned is 50.

The reporting scale for all four of the Praxis Elementary Education Multiple Subjects subtests ranges from 100 to 200 scaled-score points.

The first national administration of the new Praxis Elementary Education Multiple Subjects test will occur in fall 2012.

### **Processes and Methods**

For each of the expert panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing scores. The following section describes the standard-setting processes and methods. (The agendas for the panel meetings are presented in Appendix B.)

The design of the standard-setting study included four non-overlapping expert panels. The training provided to panelists as well as the study materials were consistent across panels with the exception of (a) defining the Just Qualified Candidate (JQC) and (b) the number of subtests considered.

To assure that all panels were using the same frame of reference when making question-level standard-setting judgments, the JQC definition developed through a consensus process by one of the four panels was used as the definition for the remaining panels. The remaining panels did complete a thorough review of the definition to allow panelists to internalize the definition. The processes for developing the definition and reviewing/internalizing the definition are described later, and the Just Qualified Candidate definitions are presented in Appendix C.

Figure 1 illustrates the assignment of subtests to panels. For the first two panels, Panels 1A and 1B, the panelists considered each of the four subtests and determined passing score recommendations for each subtest. The scope of work for the remaining two panels, Panels 2A and 2B, was reduced; each panel considered two of the four subtests. Therefore, standard-setting judgments for each subtest were collected from three independent expert panels.

**Figure 1**

*Alignment of Subtests to Panels*

<u>Panel 1A</u> • Completed all 4 subtests	<u>Panel 1B</u>	<u>Panel 2A</u> • Completed 2 of the 4 subtests	<u>Panel 2B</u>
1st. RLA <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Developed</b> the JQC definition</li> <li>○ Made standard-setting judgments</li> </ul>	1st. Social Studies <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Developed</b> the JQC definition</li> <li>○ Made standard-setting judgments</li> </ul>	1st. Mathematics <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1A)</li> <li>○ Made standard-setting judgments</li> </ul>	RLA <ul style="list-style-type: none"> <li>○ Not applicable for Panel 2B</li> </ul>
2nd. Mathematics <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Developed</b> the JQC definition</li> <li>○ Made standard-setting judgments</li> </ul>	2nd. Science <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Developed</b> the JQC definition</li> <li>○ Made standard-setting judgments</li> </ul>	2nd. RLA <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1A)</li> <li>○ Made standard-setting judgments</li> </ul>	Mathematics <ul style="list-style-type: none"> <li>○ Not applicable for Panel 2B</li> </ul>
3rd. Social Studies <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1B)</li> <li>○ Made standard-setting judgments</li> </ul>	3rd. RLA <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1A)</li> <li>○ Made standard-setting judgments</li> </ul>	Social Studies <ul style="list-style-type: none"> <li>○ Not applicable for Panel 2A</li> </ul>	1st. Science <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1B)</li> <li>○ Made standard-setting judgments</li> </ul>
4th. Science <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1B)</li> <li>○ Made standard-setting judgments</li> </ul>	4th. Mathematics <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1A)</li> <li>○ Made standard-setting judgments</li> </ul>	Science <ul style="list-style-type: none"> <li>○ Not applicable for Panel 2A</li> </ul>	2nd. Social Studies <ul style="list-style-type: none"> <li>○ “Took” the subtest</li> <li>○ <b>Reviewed</b> the JQC definition (from Panel 1B)</li> <li>○ Made standard-setting judgments</li> </ul>

RLA = Reading and Language Arts

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the content specifications (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the subtests.

The standard-setting study began with a welcome and introduction by the meeting facilitators, Drs. Clyde Reese and Wanda Swiggett from the Center for Validity Research. They explained how the subtests were developed, provided an overview of standard setting, and presented the agenda for the study. The following activities were completed for each of the four subtests.

### **Reviewing the Test**

For each of the subtests considered by a panel, the first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) Figure 1 illustrates the subtests assigned to each panel and the order in which the subtests were presented to the panel. For each subtest, the panelists were given approximately 30 to 40 minutes to respond to the multiple-choice questions. (Panelists were instructed not to refer to the answer key while taking the test.) The purpose of “taking the test” was for the panelists to become familiar with the format, content, and difficulty of the subtest. After “taking the test,” the panelists checked their responses against the answer key.

The panelists then engaged in a discussion of the major content areas being addressed by the subtest; they were also asked to remark on any content areas that they thought would be particularly challenging for entering teachers, and areas that addressed content that would be particularly important for entering teachers.

## Defining the Just Qualified Candidate

Following the review of the subtest, panelists internalized the definition of the Just Qualified Candidate (JQC). Separate JQC definitions were developed for each of the four subtests and were used by panelists to guide their standard-setting judgments. The JQC is the test taker who has the minimum level of knowledge believed necessary to be a qualified elementary school teacher. The JQC definition is the operational definition of the passing score. The goal of the standard-setting process is to identify the subtest score that aligns with this definition of the JQC.

Panel 1A developed the JQC definitions for the Reading and Language Arts and Mathematics subtests; Panel 1B developed the definitions for the Social Studies and Science subtests<sup>3</sup>. (Figure 1 illustrates, by subtest, whether a panel developed the JQC definition or used a definition developed by another panel.) For each assigned subtest, the panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to the Praxis Elementary Education Multiple Subjects *Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach a consensus on each definition (see Appendix C for the definitions).

For the panels that did not develop the definition for a particular subtest, the panelists began with the definition of the JQC developed by either Panel 1A or Panel 1B. Given that the multi-state standard-setting study was designed to replicate processes and procedures across the panels, it was important that all panels use consistent JQC definitions to frame their judgments. The panelists reviewed the JQC definition, and any ambiguities were discussed and clarified. The panelists then were split into smaller groups, and each group developed performance indicators or “can do” statements based on the definition. The purpose of the indicators was to provide clear examples of what might be observed to indicate that the teacher had the defined knowledge. The performance indicators were shared across the group, discussed, and added to the definition.

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<sup>3</sup> The four expert panels were convened in pairs, Panels 1A and 1B met on July 18-19, 2011 and Panels 2A and 2B met on July 21-22.

## Panelists' Judgments

The standard-setting process for the Praxis Elementary Education Multiple Subjects test was conducted separately for the four subtests. For each subtest, a probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each multiple-choice question, a panelist decides on the likelihood (probability or chance) that a JQC would answer the question correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- Difficult questions for a JQC were in the 0 to .30 range.
- Moderately difficult/easy questions for a JQC were in the .40 to .60 range.
- Easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments.

The panelists engaged in two rounds of judgments. Following Round 1, feedback was provided to the panel, including each panelist's recommended passing score and the panel's average recommended passing score, highest and lowest passing score, and standard deviation. Following discussion, question-level feedback was provided to the panel. The panelists' judgments were displayed for each question. The panelists' judgments were summarized by the three general difficulty levels (0 to .30, .40 to .60, and .70 to 1), and the panel's average question judgment was provided. Questions were

highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located a question in the same difficulty range) or diverged in their judgments. Panelists were asked to share their rationales for the judgments they made. Following this discussion, panelists were provided an opportunity to change their question-level standard-setting judgments (Round 2).

Standard-setting judgments were not shared across panels. Other than the JQC definitions, the four panels were independent.

The judgment process was conducted by subtest. The number of subtests and the order in which they were considered varied across panels (see Figure 1).

- Panel 1A first made Round 1 judgments for Reading and Language Arts then discussed the judgments and made Round 2 changes. The process was repeated for Mathematics, Social Studies and Science, in that order.
- Panel 1B first made Round 1 judgments for Social Studies then discussed the judgments and made Round 2 changes. The process was repeated for Science, Reading and Language Arts, and Mathematics, in that order.
- Panel 2A first made Round 1 judgments for Mathematics then discussed the judgments and made Round 2 changes. The process was repeated for Reading and Language Arts.
- Panel 2B first made Round 1 judgments for Science then discussed the judgments and made Round 2 changes. The process was repeated for Social Studies.

### **Judgment of Content Specifications**

In addition to the two-round standard-setting process, each panel judged the importance of the knowledge stated or implied in the content specifications for the job of an entry-level elementary school teacher. These judgments addressed the perceived content-based validity of the subtests. Judgments were made using a four-point scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the knowledge categories and knowledge statements. Panels 1A and 1B judged the content specifications for all four subtest; Panels 2A and 2B judged the two subtests they considered.

## **Results**

The recommended passing scores presented are the average of the results from the separate panels. Results from the separate panels also are presented. More detailed results are presented in Appendix D.

### **Expert Panels**

The four panels that comprised the study included 55 educators representing 15 states and Washington, D.C. (See Appendix A for a listing of panelists.) In brief, 39 panelists were teachers, 15 were college faculty, and one was a reading coach. Fourteen of the panelists who were college faculty were currently involved in the training or preparation of teachers. Thirty-six panelists were White, 11 were Black or African American, four were Hispanic or Latino, two were Asian or Asian American, and two panelists indicated “other.” Forty-five panelists were female. Of the panelists who indicated they were currently teachers, approximately three-quarters of the panelists (31 of the 40 panelists or 77%) had 11 or fewer years of experience as a teacher.

The number of experts by panel and their demographic information is presented in Appendix D (see Table D1).

### **Initial Evaluation Forms**

The panelists completed an initial evaluation after receiving training on how to make standard-setting judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. Across the panels, all panelists indicated that they were prepared to make their judgments.

**Table 2*****Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Current Position</b>		
Teacher	39	71%
College Faculty	15	27%
Reading Coach	1	2%
<b>Race</b>		
White	36	65%
Black or African American	11	20%
Hispanic or Latino	4	7%
Asian or Asian American	2	4%
Other	2	4%
<b>Gender</b>		
Female	45	82%
Male	10	18%
<b>If you are working in a K-12 setting, are you currently supervising or mentoring other elementary school teachers?</b>		
Yes	11	20%
No	29	53%
Not currently working at the K-12 level	15	27%
<b>How many years of experience do you have as an elementary school teacher?</b>		
7 years or less	19	35%
8 - 11 years	12	22%
12 - 15 years	3	5%
16 years or more	6	11%
Not currently working at the K-12 level	15	27%
<b>Which best describes the location of your K-12 school?</b>		
Urban	12	22%
Suburban	15	27%
Rural	13	24%
Not currently working at the K-12 level	15	27%
<b>If you are college faculty, are you currently involved in the training/preparation of elementary-school teachers?</b>		
Yes	14	25%
No	1	2%
Not college faculty	40	73%

## Summary of Standard-setting Judgments

Summaries of the standard-setting judgments are presented in Tables 3-6. The numbers in the tables summarize the recommended passing scores—the number of raw points needed to pass each subtest. The panel’s average recommended passing score and highest and lowest passing scores are reported, as are the standard deviations (SD) of panelists’ passing scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments<sup>4</sup>. It indicates how likely it would be for other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the subtest. A comparable panel’s passing score would be within 1 SEJ of the current average passing score 68 percent of the time.

- **Reading and Language Arts.** The panels’ passing score recommendations for the Reading and Language Arts subtest ranged from 42.98 to 48.57 (see Table 3). The recommended passing scores for the three panels were averaged (45.74) and the value was rounded to 46, the next highest whole number, to determine the recommended operational passing score. The value of 46 represents 71% of the total available 65 raw-score points that could be earned on the subtest. The scaled score associated with 46 raw points is 165 (on a 100 - 200 scale).

**Table 3**  
*Summary of Standard-setting Judgments – Reading and Language Arts*

	Panel 1A	Panel 1B	Panel 2A	Panel 2B
<b>Average</b>	42.98	45.68	48.57	--
<b>SD</b>	4.75	3.50	4.32	--
<b>SEJ</b>	1.32	0.94	1.11	--
<b>Highest</b>	49.55	51.55	59.30	--
<b>Lowest</b>	35.50	39.40	42.40	--

<sup>4</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, in press).

- Mathematics.** The panels' passing score recommendations for the Mathematics subtest ranged from 26.49 to 28.18 (see Table 4). The recommended passing scores for the three panels were averaged (27.39) and the value was rounded to 28, the next highest whole number, to determine the recommended operational passing score. The value of 28 represents 70% of the total available 40 raw-score points that could be earned on the subtest. The scaled score associated with 28 raw points is 164 (on a 100 - 200 scale).

**Table 4**

*Summary of Standard-setting Judgments – Mathematics*

	Panel 1A	Panel 1B	Panel 2A	Panel 2B
<b>Average</b>	26.49	27.49	28.18	--
<b>SD</b>	2.83	2.57	2.66	--
<b>SEJ</b>	0.79	0.69	0.69	--
<b>Highest</b>	31.40	30.90	34.30	--
<b>Lowest</b>	22.00	22.40	24.60	--

- Social Studies.** The panels' passing score recommendations for the Social Studies subtest ranged from 32.68 to 36.92 (see Table 5). The recommended passing scores for the three panels were averaged (34.37) and the value was rounded to 35, the next highest whole number, to determine the recommended operational passing score. The value of 35 represents 64% of the total available 55 raw-score points that could be earned on the subtest. The scaled score associated with 35 raw points is 155 (on a 100 - 200 scale).

**Table 5**

*Summary of Standard-setting Judgments – Social Studies*

	Panel 1A	Panel 1B	Panel 2A	Panel 2B
<b>Average</b>	36.92	33.51	--	32.68
<b>SD</b>	3.86	3.03	--	4.60
<b>SEJ</b>	1.07	0.81	--	1.27
<b>Highest</b>	43.85	39.85	--	42.85
<b>Lowest</b>	30.10	27.20	--	24.90

- **Science.** The panels’ passing score recommendations for the Science subtest ranged from 30.61 to 34.30 (see Table 6). The recommended passing scores for the three panels were averaged (32.70) and the value was rounded to 33, the next highest whole number, to determine the recommended operational passing score. The value of 33 represents 66% of the total available 50 raw-score points that could be earned on the subtest. The scaled score associated with 33 raw points is 159 (on a 100 - 200 scale).

**Table 6**

*Summary of Standard-setting Judgments – Science*

	Panel 1A	Panel 1B	Panel 2A	Panel 2B
<b>Average</b>	34.30	33.19	--	30.61
<b>SD</b>	3.93	2.33	--	3.74
<b>SEJ</b>	1.09	0.62	--	1.04
<b>Highest</b>	42.00	38.20	--	35.30
<b>Lowest</b>	29.70	29.10	--	22.10

Panelist-level results, for Rounds 1 and 2, are presented in Appendix D (see Tables D2-D5).

Tables 7-10 present the estimated conditional standard error of measurement (CSEM) around the recommended passing scores. A standard error represents the uncertainty associated with a subtest score. The scaled scores associated with 1 and 2 CSEMs above and below the recommended passing score are provided. The conditional standard errors of measurement provided are estimates, given that the Praxis Elementary Education Multiple Subjects test has not yet been administered operationally.

**Table 7**

*Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>5</sup> – Reading and Language Arts*

Recommended passing score (CSEM)		Scale score equivalent
	46 (3.70)	165
- 2 CSEMs	39	150
-1 CSEM	43	159
+1 CSEM	50	174
+ 2 CSEMs	54	183

<sup>5</sup> The unrounded CSEM value is added to or subtracted from the rounded passing score recommendation. The resulting values are rounded up to the next highest whole number and the rounded values are converted to scaled scores.

**Table 8*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>6</sup> – Mathematics***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	28 (2.94)	164
- 2 CSEMs	23	146
-1 CSEM	26	157
+1 CSEM	31	175
+ 2 CSEMs	34	186

**Table 9*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>6</sup> – Social Studies***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	35 (3.85)	155
- 2 CSEMs	28	137
-1 CSEM	32	147
+1 CSEM	39	166
+ 2 CSEMs	43	176

**Table 10*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>6</sup> – Science***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	33 (3.67)	159
- 2 CSEMs	26	139
-1 CSEM	30	150
+1 CSEM	37	170
+ 2 CSEMs	41	181

<sup>6</sup> The unrounded CSEM value is added to or subtracted from the rounded passing score recommendation. The resulting values are rounded up to the next highest whole number and the rounded values are converted to scaled scores.

## Summary of Content-specification Judgments

Panelists judged the extent to which the knowledge reflected by the content specifications was important for entry-level elementary school teachers. Panelists rated the knowledge statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Appendix D (see Tables D6-D9).

- **Reading and Language Arts.** The five major content areas were judged to be *Very Important* or *Important* by all of the panelists who responded. All but one of the knowledge statements were judged to be *Very Important* or *Important* by at least 95% of the panelists.
- **Mathematics.** Both of the major content areas were judged to be *Very Important* or *Important* by all of the panelists who responded. All but two of the knowledge statements were judged to be *Very Important* or *Important* by at least 85% of the panelists.
- **Social Studies.** Two of the three major content areas were judged to be *Very Important* or *Important* by all of the panelists; the third (World History and Economics) was judged to be *Very Important* or *Important* by all but three of the panelists. All but three of the knowledge statements were judged to be *Very Important* or *Important* by at least 85% of the panelists.
- **Science.** Two of the three major content areas were judged to be *Very Important* or *Important* by all of the panelists who responded; the third (Physical Science) was judged to be *Very Important* or *Important* by all but one of the panelists who responded. All of the knowledge statements were judged to be *Very Important* or *Important* by at least 80% of the panelists.

## Summary of Final Evaluations

The panelists completed an evaluation form at the conclusion of their standard-setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. Results of the final evaluations, by panel, are presented in Appendix D.

All panelists *agreed* or *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard-setting judgments. Across the panels, all but two of the panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the definition of the JQC was at least *somewhat influential* in guiding their standard-setting judgments; 80% of panelists indicated the definition was *very influential*. All but one of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. More than three-quarters of the panelists (45 of the 55 panelists) indicated that the knowledge/skills required to answer each question was *very influential* in guiding their judgments.

Across panels<sup>7</sup>, the majority of panelists indicated they were comfortable with the passing scores they recommended and that the passing scores were about right. A summary of the final evaluation results are presented in Appendix D (see Tables D10-D13).

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<sup>7</sup> Panel 1B was asked to respond to their level of comfort for each of the four subtests; similar judgments were collected for the two subtests considered by Panel 2A. (Due to a data-collection error, similar information was not collected for Panel 2B.) Panel 1A responded to their comfort level overall across the four subtests.

## Summary

To support the decision-making process for state departments of education with regards to establishing passing scores, or cut scores, for the Praxis Elementary Education Multiple Subjects (5031) test, research staff from Educational Testing Service (ETS) designed and conducted a multiple-panel, multi-state standard-setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level elementary school teachers.

The recommended passing scores are provided to help state departments of education determine appropriate operational passing scores. For the Praxis Elementary Education Multiple Subjects subtests, the recommended passing scores<sup>8</sup> are:

- **Reading and Language Arts (5032):** The recommended passing score is 46 (on the raw score metric), which represents 71% of the total available 65 raw score points. The scaled score associated with a raw score of 46 is 165 (on a 100 - 200 scale).
- **Mathematics (5033):** The recommended passing score is 28 (on the raw score metric), which represents 70% of the total available 40 raw score points. The scaled score associated with a raw score of 28 is 164 (on a 100 - 200 scale).
- **Social Studies (5034):** The recommended passing score is 35 (on the raw score metric), which represents 64% of the total available 55 raw score points. The scaled score associated with a raw score of 35 is 155 (on a 100 - 200 scale).
- **Science (5035):** The recommended passing score is 33 (on the raw score metric), which represents 66% of the total available 50 raw score points. The scaled score associated with a raw score of 33 is 159 (on a 100 - 200 scale).

Panelists judged the extent to which the knowledge reflected by the content specifications for each of the four subtests were important for entry-level elementary school teachers. The favorable judgments of the panelists provided evidence that the content of the subtests is important for beginning practice.

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<sup>8</sup> Results from each of the panels participating in the study were averaged to produce the recommended passing scores.

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**Appendix A**  
**Panelists' Names & Affiliations**

## Praxis Elementary Education Multiple Subjects

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### Panelist

John P. Acampora  
Graciela Aparicio  
Rosela Balinbin  
Amy L. Bassett  
LaVada Brandon  
Gresham Brown  
Ramona Claridy  
Lana Clauss  
Cassandra Coles  
Becky Cox  
Kezia Curry  
Michelle Dudley-Jones  
Brigette Golmen  
Doug Greek  
Kristal S. Harne  
Pam Hedgpeth  
Patricia Higgins  
Sarah B. Hill  
Andria Hodge  
Darrell C Hucks  
Stacey Jensen  
Sara Kaminski  
Jennifer Kelemen  
Shannon Lamb  
Sharon Lancaster  
Timothy Leonard  
Lauren Lochel  
Jill Maniakas  
Cathy Meredith

### Affiliation

Slackwood Elementary School (NJ)  
Ogden School District (UT)  
University of Hawaii at Manoa (HI)  
Mountainside Elementary (UT)  
Purdue University Calumet (IN)  
Stone Academy of Communication Arts (SC)  
Smiths Station Elementary School (AL)  
Tennessee Tech University (TN)  
Nora Elementary School (IN)  
The University of TN at Martin (TN)  
University of Hawaii at Manoa (HI)  
The Queen City Academy Charter School (NJ)  
Nixa R-II School District-Helen Mathews Elementary (MO)  
Schofield Elementary School, Republic R3 (MO)  
Liberty Elementary School\Casey County School District (KY)  
Southwest Baptist University (MO)  
Kentucky State University (KY)  
Canaan Elementary School (NH)  
Camdenton R-III School District Dogwood Elementary (MO)  
Keene State College (NH)  
Edahow Elementary (ID)  
Live Oaks Elementary School (CT)  
Columbus School (CT)  
Kindle Farm School (VT)  
Indian Hills Elementary (KY)  
Shepherd Elementary School (DC)  
Fort Mill School District (SC)  
Nora Elementary (IN)  
University of Memphis (TN)

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## **Praxis Elementary Education Multiple Subjects (continued)**

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### **Panelist**

Nicolasa Moreau  
Jennifer Mueller  
Joanna Mulligan  
Lori Neurohr  
Jamil Odom  
Raquel Ortiz  
Sharon Owens  
Bob Pooler  
Betsy Potts  
Amanda Preece  
Gabrielle Rhodes  
Kristal Salyer  
Prajakta Sane  
Stacey Spears  
Judy Stechly  
Kelly Taylor  
Raschelle Theoharis  
Mary Thomas  
Sam Thomas  
Tara M. Watts  
James Weidenborner  
Angela R. Williams  
Holly Williamson  
Kaleb Yates  
Janet Young

### **Affiliation**

Hollis Upper Elementary School (NH)  
Univeristy of Wisconsin - Milwaukee (WI)  
Teacher (WV)  
Kohler Elementary School (WI)  
Mary Bryan Elementary School (IN)  
Cardinal Valley Elementary (KY)  
Loachapoka Elementary School (AL)  
Hollis Upper Elementary School (NH)  
Goodlettsville Elementary (MNPS) (TN)  
Genoa Elementary School (WV)  
Union Elementary School (WV)  
Clinton Elementary (SC)  
Branchville Elementary School (CT)  
Argillite Elementary School (KY)  
West Liberty University (WV)  
Burr Elementary School (CT)  
Gallaudet University (DC)  
District of Columbia Public Schools (DC)  
Richmond Community Schools (IN)  
DCPS\Bancroft Elementary School (DC)  
Gregory Elementary School/Montclair State University (NJ)  
Alabama A&M University (AL)  
Williamsburg County School District (SC)  
Foothills Elementary (UT)  
Brigham Young University (UT)

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\*One panelist did not wish to be listed in the final report.

**Appendix B**  
**Study Agendas**

**Praxis Elementary Education: Multiple Subjects (5031)  
Standard Setting Study – Panel 1A<sup>9</sup>**

**Day 1**

<b>8:00 – 8:15</b>	<b>Welcome and Introduction</b>
<b>8:15 – 8:30</b>	<b>Overview of Standard Setting &amp; the Praxis Elementary Education Test</b>
<b>8:30 – 9:00</b>	<b>“Take” the Praxis Elementary Education Assessment: Reading and Language Arts Subtest</b>
<b>9:00 – 9:45</b>	<b>Define the Knowledge of a JQC: Reading and Language Arts Subtest</b>
<b>9:45 – 9:50</b>	<b>Break</b>
<b>9:50 – 10:15</b>	<b>Standard Setting Training</b>
<b>10:15 – 11:15</b>	<b>Round 1 Standard Setting Judgments: Reading and Language Arts Subtest</b>
<b>11:15 – 11:30</b>	<b>Break</b>
<b>11:30 – 12:15</b>	<b>Round 1 Feedback &amp; Round 2 Judgments: Reading and Language Arts Subtest</b>
<b>12:15 – 1:00</b>	<b>Lunch</b>
<b>1:00 – 1:30</b>	<b>“Take” the Praxis Elementary Education Assessment: Mathematics Subtest</b>
<b>1:30 – 2:15</b>	<b>Define the Knowledge/Skills of a JQC: Mathematics Subtest</b>
<b>2:15 – 2:20</b>	<b>Break</b>
<b>2:20 – 3:15</b>	<b>Round 1 Standard Setting Judgments: Mathematics Subtest</b>
<b>3:15 – 3:30</b>	<b>Break</b>
<b>3:30 – 4:15</b>	<b>Round 1 Feedback &amp; Round 2 Judgments: Mathematics Subtest</b>
<b>4:15 – 4:30</b>	<b>Collect Materials; End of Day 1</b>

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<sup>9</sup> Similar agenda followed for Panel 1B.

**Praxis Elementary Education: Multiple Subjects (5031)  
Standard Setting Study – Panel 1A**

**Day 2**

<b>8:00 – 8:15</b>	<b>Overview of Day 2</b>
<b>8:15 – 8:45</b>	<b>“Take” the Praxis Elementary Education Assessment: Social Studies Subtest</b>
<b>8:45 – 9:30</b>	<b>Review the Knowledge/Skills of a JQC: Social Studies Subtest</b>
<b>9:30 – 9:35</b>	<b>Break</b>
<b>9:35 – 9:45</b>	<b>Standard Setting Review</b>
<b>9:45 – 10:45</b>	<b>Round 1 Standard Setting Judgments: Social Studies Subtest</b>
<b>10:45 – 11:00</b>	<b>Break</b>
<b>11:00 – 11:45</b>	<b>Round 1 Feedback &amp; Round 2 Judgments: Social Studies Subtest</b>
<b>11:45 – 12:30</b>	<b>Lunch</b>
<b>12:30 – 1:00</b>	<b>“Take” the Praxis Elementary Education Assessment: Science Subtest</b>
<b>1:00 – 1:45</b>	<b>Review the Knowledge/Skills of a JQC: Science Subtest</b>
<b>1:45 – 1:50</b>	<b>Break</b>
<b>1:50 – 2:45</b>	<b>Round 1 Standard Setting Judgments: Science Subtest</b>
<b>2:45 – 3:00</b>	<b>Break</b>
<b>3:00 – 3:45</b>	<b>Round 1 Feedback &amp; Round 2 Judgments: Science Subtest</b>
<b>3:45 – 3:50</b>	<b>Break</b>
<b>3:50 – 4:15</b>	<b>Specification Judgments</b>
<b>4:15 – 4:30</b>	<b>Feedback on Round 2 Recommended Cut Scores &amp; Complete Final Evaluation</b>
<b>4:30 – 4:45</b>	<b>Collect Materials; End of Study</b>

**Praxis Elementary Education: Multiple Subjects (5031)  
Standard Setting Study – Panel 2A<sup>10</sup>**

**Day 1**

<b>8:00 – 8:15</b>	<b>Welcome and Introduction</b> <ul style="list-style-type: none"><li>• Overview of Workshop Events</li></ul>
<b>8:15 – 8:30</b>	<b>Overview of Standard Setting</b>
<b>8:30 – 8:45</b>	<b>Overview of the Praxis Elementary Education Assessment</b>
<b>8:45 – 9:30</b>	<b>“Take” the Praxis Elementary Education Assessment</b> <ul style="list-style-type: none"><li>• Mathematics Subtest</li></ul>
<b>9:30 – 9:35</b>	<b>Break</b>
<b>9:35 – 10:45</b>	<b>Review the Knowledge/Skills of a JQC</b> <ul style="list-style-type: none"><li>• Mathematics Subtest</li></ul>
<b>10:45 – 11:15</b>	<b>Standard Setting Training &amp; Practice</b>
<b>11:15 – 12:15</b>	<b>Round 1 Standard Setting Judgments:</b> <ul style="list-style-type: none"><li>• Mathematics Subtest</li></ul>
<b>12:15 – 1:15</b>	<b>Lunch</b>
<b>1:00 – 2:30</b>	<b>Round 1 Feedback &amp; Round 2 Judgments:</b> <ul style="list-style-type: none"><li>• Mathematics Subtest</li></ul>
<b>2:30 – 2:45</b>	<b>Break</b>
<b>2:45 – 3:00</b>	<b>Specification Judgments</b> <ul style="list-style-type: none"><li>• Mathematics Subtest</li></ul>
<b>3:00 – 3:15</b>	<b>Collect Materials; End of Day 1</b>

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<sup>10</sup> Similar agenda followed for Panel 2B.

**Praxis Elementary Education: Multiple Subjects (5031)  
Standard Setting Study – Panel 2A**

**Day 2**

<b>9:00 – 9:05</b>	<b>Overview of Day 2</b>
<b>9:05 – 10:00</b>	<b>“Take” the Praxis Elementary Education Assessment</b> <ul style="list-style-type: none"><li>• <b>Reading Language Arts Subtest</b></li></ul>
<b>10:00 – 11:15</b>	<b>Review the Knowledge/Skills of a JQC</b> <ul style="list-style-type: none"><li>• <b>Reading Language Arts Subtest</b></li></ul>
<b>11:15 – 12:15</b>	<b>Round 1 Standard Setting Judgments:</b> <ul style="list-style-type: none"><li>• <b>Reading Language Arts Subtest</b></li></ul>
<b>12:15 – 1:15</b>	<b>Lunch</b>
<b>1:00 – 2:30</b>	<b>Round 1 Feedback &amp; Round 2 Judgments:</b> <ul style="list-style-type: none"><li>• <b>Reading Language Arts Subtest</b></li></ul>
<b>2:30 – 2:45</b>	<b>Break</b>
<b>2:45 – 3:00</b>	<b>Specification Judgments</b> <ul style="list-style-type: none"><li>• <b>Reading Language Arts Subtest</b></li></ul>
<b>3:00 – 3:30</b>	<b>Feedback on Round 2 Recommended Passing Scores &amp; Complete Final Evaluation</b>
<b>3:30 – 3:45</b>	<b>Collect Materials; End of Study</b>

## **Appendix C**

### **Just Qualified Candidate (JQC) Definitions**

**Description of a Just Qualified Candidate<sup>11</sup>**  
**Reading and Language Arts**

**A JQC ...**

1. Knows key ideas relevant to the foundations of literacy and reading development (e.g., concepts of print, language acquisition) as it relates to each individual learner (e.g., second-language learners), including phonological awareness (e.g., rhyming); phonics (e.g., basic letter sounds, syllabication); fluency (e.g., rate, accuracy, prosody); comprehension (meaning, prior knowledge, vocabulary, predicting, figurative language etc.); and orthography (relationship between various types of written, printed and oral development)
  - a. Can explain the difference between similes and metaphors
  - b. Can explain the importance of high-frequency word in relation to fluency
2. Understands the basic components of written language, sentence type, sentence structure and vocabulary
  - a. Can recognize types of sentences (e.g., simple, complex)
  - b. Can distinguish parts of speech
3. Understands the types, traits, and structures of writing
  - a. Can describe the structures of various types or genres of writing
  - b. Can describe the purposes of different types of writing
4. Understands the stages of writing process and how to use resource materials
  - a. Can create a web for brainstorming
  - b. Can use a dictionary and thesaurus to improve word choice
5. Understands the different aspects and role of speaking, listening, viewing and language acquisition for all learners. (NOTE: listening and viewing would include media literacy)
  - a. Can discern a writer's message
  - b. Can ask and answer questions appropriately
6. Understands the basic elements of a variety of genres (e.g., informational, poetry, drama)
  - a. Can identify the basic elements of a narrative
  - b. Can identify the purpose(s) of various genres

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<sup>11</sup> Examples of the “can do” statements developed by the panels provided.

**Description of a Just Qualified Candidate<sup>12</sup>**  
**Mathematics**

**A JQC ...**

1. Understands foundations of mathematics, including prenumeration concepts (e.g., patterns), basic number systems (e.g., whole numbers), basic four operations and their properties (e.g., order of operations)
  - a. Can expand a pattern to identify a particular element
  - b. Can solve two-step arithmetic problems
2. Understands basic concepts of number theory
  - a. Can explain place values
  - b. Can explain decimals, fractions, and ratios
3. Knows mathematical problem solving (e.g., word problems), investigation, estimation, and application of formulas
  - a. Can use multiple strategies to solve multi-step problems
  - b. Can identify relevant variables and operations in a complex problem
4. Knows basic algebraic methods
  - a. Can apply the order of operations to expand algebraic expressions
  - b. Can solve one-variable equations
5. Understands basic algebraic representations (variables, equations, inequalities, x-y graphs)
  - a. Can identify correct equations to represent a written relationship
  - b. Can interpret a line graph
6. Understands basic arithmetic and algebraic properties (associative, commutative, etc) and special properties of 0 and 1
  - a. Can use appropriate mathematics vocabulary
  - b. Can explain the associative property
7. Understands tables, graphs, and visual displays
  - a. Can draw conclusions from bar graphs
  - b. Can construct a pie chart
8. Understands properties and attributes of 2- and 3-dimensional figures
  - a. Can explain lines of symmetry
  - b. Can calculate perimeter and area of geometric figures (e.g., triangle, rectangle, square)
9. Understands measurement systems and units of measure
  - a. Can convert measurements within a measurement system (e.g., inches to feet)
  - b. Can identify the appropriate unit of measure
10. Understands basic concepts of probability (permutations, chance) and statistics (mean, median, mode, range)
  - a. Can interpret a set of data
  - b. Can calculate the mean, median and mode

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<sup>12</sup> Examples of the “can do” statements developed by the panels provided.

**Description of a Just Qualified Candidate<sup>13</sup>**  
**Social Studies**

**A JQC ...**

1. Knows the purposes and functions of the U.S. government (federal, state, and local) and the rights and responsibilities of its citizens.
  - a. Can identify key features and key responsibilities of the three branches of government
  - b. can identify important local or national issues that are addressed through government and the responsibilities of active citizenship
2. Knows the basic important people, events, and artifacts in U.S. History from Colonization to present time.
  - a. Can identify key concepts (e.g., colonization, migration, California Gold Rush) of the growth and expansion of the United States
  - b. given an amendment, can recognize if it is associated with the Bill of Rights
3. Knows world and regional geography (commonly used terms, places, regions across time) and how people of different cultures interact with their environment
  - a. Can describe the geographic regions of the U.S. and their natural resources
  - b. Can describe the basic vocabulary of geography and maps (e.g., continents, interpret time zone differences, cardinal directions)
4. Knows and is able to apply the basics of geography (including the usage of maps, charts, and grids) in relation to past, present, and future events.
  - a. Can interpret maps, charts and grids from historical to current times
  - b. Can create a basic map of their community including key map elements (e.g., direction, legend, symbols)
5. Knows major contributions and developments of world civilizations from ancient to modern times.
  - a. Can attribute major contributions to the civilization of origin
  - b. Can describe how multiple cultures influence society
6. Knows key terms and basic concepts of economics and its effects on society.
  - a. Can describe the impact of natural disasters and conflicts on an economy
  - b. Can describe import and export between countries

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<sup>13</sup> Examples of the “can do” statements developed by the panels provided.

## **Description of a Just Qualified Candidate<sup>14</sup> Science**

### **A JQC ...**

1. Understands various processes, technologies, and methods (research) used in scientific inquiry in Earth, life and physical sciences
  - a. Can select appropriate tools and resources to support scientific inquiry (e.g., basic microscope, graduated cylinder)
  - b. Can identify and apply the principles of scientific inquiry
2. Recognizes science as a human endeavor, process, and career within Earth, life, & physical sciences
  - a. Can identify given roles of various scientists (e.g., paleontologist, anthropologist, chemist)
  - b. Can identify some major scientific discoveries of major pioneers in science
3. Knows basic cycles, patterns, and change in Earth, life, and physical science
  - a. Can identify the developmental stages in a life cycle of a given organism
  - b. Can describe the cause and effect of weather patterns
4. Knows the core processes, structures, and history of Earth, it's systems, & our solar system within the universe
  - a. Can identify the interrelationships between the Earth, the moon and the sun
  - b. Can describe and identify how the structures (layers/plates) of Earth are formed and changed
5. Knows the structures, functions, and interrelationships of living things from single-cell to complex organisms within their environments
  - a. Can identify the characteristics of an ecosystem
  - b. Can describe the difference between plant & animal cells
6. Knows the basics of heredity, adaptation, and mutation
  - a. Can identify and interpret a Punnett square, but not necessarily know the term
  - b. Can give an example of environmental adaptation and its importance for a species' survival
7. Awareness of personal health issues
  - a. Can identify common illnesses and diseases
  - b. Can identify at least 5 elements of a healthy lifestyle and explain the effects on communities
8. Knows the basic structures of matter and how matter interacts with various forms of energy
  - a. Can identify the properties of matter and the process to change states
  - b. Can recognize ways that matter interacts with energy (electricity, magnetism, and sound)
9. Knows relationships between forces and motions
  - a. Can identify laws of motion
  - b. Can describe the effects of potential & kinetic energy but not necessarily the terms
10. Knows key terms used in Earth, life, and physical sciences
  - a. Can distinguish between Earth, life and physical sciences based on terminology
  - b. Can define at least 5 terms that relate to each of the sciences

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<sup>14</sup> Examples of the “can do” statements developed by the panels provided.

## **Appendix D**

### **Results for Praxis Elementary Education Multiple Subjects Standard Setting Study**

**Table D1*****Panel Member Demographics (By Panels)***

	Panel 1A		Panel 1B		Panel 2A		Panel 2B	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>Current Position</b>								
Teacher	9	69%	11	79%	10	67%	9	69%
College Faculty	3	23%	3	21%	5	33%	4	31%
Reading Coach	1	8%	0	0%	0	0%	0	0%
<b>Race</b>								
White	8	62%	9	64%	10	67%	9	69%
Black or African American	3	23%	3	21%	2	13%	3	23%
Hispanic or Latino	1	8%	1	7%	1	7%	1	8%
Asian or Asian American	0	0%	1	7%	1	7%	0	0%
Other	1	8%	0	0%	1	7%	0	0%
<b>Gender</b>								
Female	11	85%	11	79%	13	87%	10	77%
Male	2	15%	3	21%	2	13%	3	23%
<b>If you are working in a K-12 setting, are you currently supervising or mentoring other elementary school teachers?</b>								
Yes	6	46%	3	21%	2	13%	0	0%
No	4	31%	8	57%	8	53%	9	69%
Not currently working at the K-12 level	3	23%	3	21%	5	33%	4	31%

**Table D1 (continued)*****Panel Member Demographics***

	Panel 1A		Panel 1B		Panel 2A		Panel 2B	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>How many years of experience do you have as an elementary school teacher?</b>								
7 years or less	4	31%	4	29%	7	47%	4	31%
8 - 11 years	3	23%	3	21%	2	13%	4	31%
12 - 15 years	0	0%	2	14%	1	7%	0	0%
16 years or more	3	23%	2	14%	0	0%	1	8%
<b>Which best describes the location of your K-12 school?</b>								
Urban	4	31%	2	14%	3	20%	3	23%
Suburban	4	31%	6	43%	2	13%	3	23%
Rural	2	15%	3	21%	5	33%	3	23%
Not currently teaching at the K-12 level	3	23%	3	21%	5	33%	4	31%
<b>If you are college faculty, are you currently involved in the training/preparation of elementary-school teachers?</b>								
Yes	3	23%	3	21%	4	27%	4	31%
No	0	0%	0	0%	1	7%	0	0%
Not college faculty	10	77%	11	79%	10	66%	9	69%

**Table D2****Passing Score Summary by Round of Judgments — Panel 1A**

<b>Panelist</b>	<b>Reading Lang. Arts</b>		<b>Mathematics</b>		<b>Social Studies</b>		<b>Science</b>	
	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>
1	41.00	40.90	25.10	25.20	34.75	34.75	30.30	30.50
2	33.80	35.50	26.20	26.10	34.45	34.45	30.20	30.70
3	41.85	42.45	26.20	26.20	37.35	37.95	35.70	35.70
4	44.35	44.35	27.50	28.15	39.30	39.30	36.95	36.95
5	46.75	46.55	27.40	27.60	39.05	38.85	35.45	35.55
6	41.30	41.30	24.30	24.10	34.30	34.60	33.00	33.50
7	36.20	35.90	20.90	22.00	29.70	30.10	29.80	30.20
8	46.50	46.20	23.30	24.40	35.25	35.45	31.90	32.30
9	50.15	49.45	29.25	29.95	41.15	41.75	39.75	40.05
10	47.50	47.50	28.95	28.75	43.85	43.85	42.00	42.00
11	49.05	49.55	31.70	31.40	41.45	40.55	37.10	36.80
12	41.00	41.00	28.10	28.10	35.60	35.60	31.80	31.90
13	38.55	38.15	22.45	22.45	32.25	32.75	29.30	29.70
<b>Average</b>	42.92	42.98	26.26	26.49	36.80	36.92	34.10	34.30
<b>SD</b>	4.99	4.75	3.02	2.83	4.01	3.86	4.07	3.93
<b>SEJ</b>	1.38	1.32	0.84	0.79	1.11	1.07	1.13	1.09
<b>Highest</b>	50.15	49.55	31.70	31.40	43.85	43.85	42.00	42.00
<b>Lowest</b>	33.80	35.50	20.90	22.00	29.70	30.10	29.30	29.70

**Table D3****Passing Score Summary by Round of Judgments — Panel 1B**

<b>Panelist</b>	<b>Reading Lang. Arts</b>		<b>Mathematics</b>		<b>Social Studies</b>		<b>Science</b>	
	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>
1	45.70	47.90	28.70	28.70	29.40	31.45	35.20	34.30
2	51.75	51.55	30.90	30.90	36.80	36.90	38.20	38.20
3	43.20	42.90	26.05	26.05	24.70	27.20	33.20	33.05
4	39.40	39.40	24.70	24.20	31.50	31.20	28.60	29.10
5	44.10	45.30	27.65	27.65	35.80	34.65	29.80	35.00
6	39.30	41.70	24.15	25.35	31.65	31.65	30.35	30.85
7	41.00	41.40	22.20	22.40	33.45	33.35	29.35	29.55
8	42.75	43.35	25.65	26.05	33.85	33.85	34.15	34.55
9	50.55	49.65	25.80	26.20	31.70	32.10	34.45	33.85
10	49.05	48.75	29.70	29.40	28.00	31.65	33.25	33.45
11	46.35	46.65	30.40	30.40	35.20	35.50	33.10	32.90
12	47.40	47.20	31.05	30.85	41.50	39.85	32.65	32.65
13	48.40	47.80	28.95	29.05	36.30	35.20	34.65	34.70
14	44.30	45.90	28.60	27.70	35.15	34.55	32.55	32.55
<b>Average</b>	45.23	45.68	27.46	27.49	33.21	33.51	32.82	33.19
<b>SD</b>	3.93	3.50	2.74	2.57	4.19	3.03	2.60	2.33
<b>SEJ</b>	1.05	0.94	0.73	0.69	1.12	0.81	0.70	0.62
<b>Highest</b>	51.75	51.55	31.05	30.90	41.50	39.85	38.20	38.20
<b>Lowest</b>	39.30	39.40	22.20	22.40	24.70	27.20	28.60	29.10

**Table D4****Passing Score Summary by Round of Judgments — Panel 2A**

<b>Panelist</b>	<b>Reading Lang. Arts</b>		<b>Mathematics</b>	
	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>
1	59.30	59.30	34.30	34.30
2	50.40	50.90	29.90	29.75
3	50.20	49.65	27.10	28.60
4	49.20	50.50	28.00	29.70
5	44.45	44.85	28.90	28.90
6	48.90	50.50	25.10	25.40
7	42.60	42.60	23.25	25.15
8	47.05	47.05	27.25	27.65
9	38.50	42.40	28.05	28.55
10	44.05	44.25	27.05	26.65
11	51.10	50.80	24.10	24.60
12	49.85	49.95	30.50	29.60
13	51.30	50.90	32.15	31.70
14	43.90	45.40	24.55	26.05
15	44.95	49.55	23.80	26.05
<b>Average</b>	47.72	48.57	27.60	28.18
<b>SD</b>	4.91	4.32	3.20	2.66
<b>SEJ</b>	1.27	1.11	0.83	0.69
<b>Highest</b>	59.30	59.30	34.30	34.30
<b>Lowest</b>	38.50	42.40	23.25	24.60

**Table D5****Passing Score Summary by Round of Judgments — Panel 2B**

<b>Panelist</b>	<b>Social Studies</b>		<b>Science</b>	
	<b>Rd 1</b>	<b>Rd 2</b>	<b>Rd 1</b>	<b>Rd 2</b>
1	33.55	33.75	32.50	32.50
2	31.15	32.65	30.55	30.75
3	33.90	33.80	35.40	35.30
4	26.70	28.65	26.30	27.20
5	29.40	29.30	33.25	33.10
6	35.70	36.20	32.60	31.80
7	24.90	24.90	25.60	25.80
8	28.90	29.70	30.40	30.40
9	32.15	32.95	33.40	32.90
10	31.45	30.95	28.70	29.30
11	44.15	42.85	31.70	31.70
12	39.00	38.30	35.75	35.05
13	31.10	30.80	21.70	22.10
<b>Average</b>	32.47	32.68	30.60	30.61
<b>SD</b>	5.08	4.60	4.08	3.74
<b>SEJ</b>	1.41	1.27	1.13	1.04
<b>Highest</b>	44.15	42.85	35.75	35.30
<b>Lowest</b>	24.90	24.90	21.70	22.10

**Table D6**

**Specification Judgments — Reading and Language Arts (5032)**

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
<b>I.</b>	<b>Reading</b>								
	<b>A. Foundational Skills</b>	<b>41</b>	<b>98%</b>	<b>1</b>	<b>2%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Understands key ideas relevant to the foundations of literacy and reading development	40	95%	2	5%	0	0%	0	0%
	• Understands the role of phonological awareness, and phonics and word analysis skills in literacy development	39	93%	3	7%	0	0%	0	0%
	• Understands the role of fluency in supporting comprehension	31	74%	11	26%	0	0%	0	0%
	• Knows the stages of early orthographic development	19	45%	22	52%	1	2%	0	0%
	<b>B. Literature and Informational Texts</b>	<b>29</b>	<b>69%</b>	<b>13</b>	<b>31%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Understands the role of comprehension	38	90%	4	10%	0	0%	0	0%
	• Understands the basic elements of literature and informational texts	30	71%	11	26%	1	2%	0	0%
	• Understands the basic elements of poetry and drama	8	19%	26	62%	8	19%	0	0%
	• Understands how to determine the meanings of words and phrases as used in texts, including figurative language	29	69%	13	31%	0	0%	0	0%

**Table D6**

**Specification Judgments — Reading and Language Arts (5032)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>II. Language, Writing, and Communication</b>								
<b>A. Language</b>	<b>31</b>	<b>74%</b>	<b>11</b>	<b>26%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Knows the components of written language	34	81%	8	19%	0	0%	0	0%
• Knows sentence types and sentence structure	25	60%	15	36%	2	5%	0	0%
• Understands the basic components of vocabulary	30	71%	11	26%	1	2%	0	0%
<b>B. Writing<sup>15</sup></b>	<b>32</b>	<b>76%</b>	<b>7</b>	<b>17%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Knows types and traits of writing	28	67%	14	33%	0	0%	0	0%
• Knows the stages of the writing process	35	83%	7	17%	0	0%	0	0%
• Knows structures and organization of writing	30	71%	12	29%	0	0%	0	0%
• Understands how to use resource material in reading and language arts	19	45%	22	52%	1	2%	0	0%
<b>C. Communication</b>	<b>27</b>	<b>64%</b>	<b>15</b>	<b>36%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands different aspects of speaking	23	55%	18	43%	1	2%	0	0%
• Understands different aspects of listening	28	67%	14	33%	0	0%	0	0%
• Understands different aspects of viewing	16	38%	25	60%	1	2%	0	0%
• Understands the role that speaking, listening, and viewing play in language acquisition for second-language learners	30	71%	12	29%	0	0%	0	0%

<sup>15</sup> Three panelists did not respond to this question.

**Table D7**

**Specification Judgments — Mathematics (5033)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. Number Operations and Algebraic Thinking<sup>16</sup></b>	<b>32</b>	<b>76%</b>	<b>9</b>	<b>21%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands prenumeration concepts	31	74%	10	24%	1	2%	0	0%
• Understands basic number systems	38	90%	4	10%	0	0%	0	0%
• Understands basic four operations and their properties	38	90%	4	10%	0	0%	0	0%
• Understands basic concepts of number theory	31	74%	11	26%	0	0%	0	0%
• Understands how to solve problems, including word problems, using multiple strategies and assess the reasonableness of results	33	79%	9	21%	0	0%	0	0%
• Understands how to generate, describe, and explore numerical patterns and engage in mathematical investigations	23	55%	19	45%	0	0%	0	0%
• Understands basic algebraic methods and representations	24	57%	15	36%	3	7%	0	0%
• Understands the associative, commutative, and distributive properties	13	31%	23	55%	6	14%	0	0%
• Understands additive and multiplicative inverses	8	19%	21	50%	11	26%	2	5%
• Understands the special properties of zero and one	18	43%	19	45%	5	12%	0	0%
• Understands equations and inequalities	22	52%	18	43%	2	5%	0	0%
• Understands the appropriate application of formulas	21	50%	18	43%	3	7%	0	0%

<sup>16</sup> One panelist did not respond to this question.

**Table D7**

**Specification Judgments — Mathematics (5033)**

		<b>Very Important</b>		<b>Important</b>		<b>Slightly Important</b>		<b>Not Important</b>	
		<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
<b>II.</b>	<b>Geometry, Measurement, Data, and Interpretation</b>	<b>22</b>	<b>52%</b>	<b>20</b>	<b>48%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Understands properties and attributes of two- or three-dimensional figures and their hierarchy of classification	22	52%	20	48%	0	0%	0	0%
	• Understands transformations, geometric models, and net	11	26%	23	55%	7	17%	1	2%
	• Understands nonstandard, customary, and metric units of measurement	27	64%	13	31%	2	5%	0	0%
	• Understands visual displays of quantitative data	28	67%	13	31%	1	2%	0	0%
	• Understands simple probability and intuitive concepts of chance	10	24%	30	71%	2	5%	0	0%
	• Understands fundamental counting techniques	28	67%	11	26%	3	7%	0	0%
	• Understands basic descriptive statistics	18	43%	20	48%	4	10%	0	0%

**Table D8**

**Specification Judgments — Social Studies (5034)**

		Very Important		Important		Slightly Important		Not Important	
		N	%	N	%	N	%	N	%
<b>I.</b>	<b>United States History, Government, and Citizenship</b>	<b>23</b>	<b>58%</b>	<b>17</b>	<b>43%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Knows European exploration and colonization in United States history and growth and expansion of the United States	16	40%	22	55%	2	5%	0	0%
	• Knows about the American Revolution and the founding of the nation in United States history	21	53%	18	45%	1	3%	0	0%
	• Knows the major events and developments in United States history from founding to present	23	58%	17	43%	0	0%	0	0%
	• Knows about twentieth-century developments and transformations in the United States	17	43%	20	50%	3	8%	0	0%
	• Understands connections between causes and effects of events	25	63%	14	35%	1	3%	0	0%
	• Understands the nature, purpose, and forms of government	26	65%	14	35%	0	0%	0	0%
	• Knows key documents and speeches in the history of the United States	8	20%	23	58%	9	23%	0	0%
	• Knows the rights and responsibilities of citizenship in a democracy	29	73%	11	28%	0	0%	0	0%
<b>II.</b>	<b>Geography, Anthropology, and Sociology</b>	<b>13</b>	<b>33%</b>	<b>27</b>	<b>68%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
	• Knows world and regional geography	21	53%	17	43%	2	5%	0	0%
	• Understands the interaction of physical and human systems	6	15%	31	78%	3	8%	0	0%
	• Knows the uses of geography	20	50%	20	50%	0	0%	0	0%
	• Knows how people of different cultural backgrounds interact with their environment, family, neighborhoods, and communities	23	58%	16	40%	1	3%	0	0%

**Table D8****Specification Judgments — Social Studies (5034)**

	<b>Very Important</b>		<b>Important</b>		<b>Slightly Important</b>		<b>Not Important</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
<b>III. World History and Economics</b>	<b>9</b>	<b>23%</b>	<b>28</b>	<b>70%</b>	<b>3</b>	<b>8%</b>	<b>0</b>	<b>0%</b>
• Knows the major contributions of classical civilizations	5	13%	25	63%	10	25%	0	0%
• Understands twentieth-century developments and transformations in World history	8	20%	27	68%	5	13%	0	0%
• Understands the role of cross-cultural comparisons in World history instruction	4	10%	26	65%	10	25%	0	0%
• Knows key terms and basic concepts of economics	19	48%	17	43%	4	10%	0	0%
• Understands how economics effects population, resources, and technology	11	28%	25	63%	4	10%	0	0%
• Understands the government’s role in economics and impact of economics on government	14	35%	20	50%	6	15%	0	0%

**Table D9**

**Specification Judgments — Science (5035)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>I. Earth Science</b>	<b>20</b>	<b>50%</b>	<b>20</b>	<b>50%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands the structure of the Earth system	20	50%	20	50%	0	0%	0	0%
• Understands processes of the Earth system	15	38%	24	60%	1	3%	0	0%
• Understands Earth history	8	20%	26	65%	6	15%	0	0%
• Understands Earth and the universe <sup>17</sup>	20	50%	19	48%	0	0%	0	0%
• Understands Earth patterns, cycles, and change	26	65%	14	35%	0	0%	0	0%
• Understands science as a human endeavor, process, and career	18	45%	18	45%	4	10%	0	0%
• Understands science as inquiry	37	93%	3	8%	0	0%	0	0%
• Understands how to use resource and research material in science	26	65%	12	30%	2	5%	0	0%
• Understands the unifying processes of science	10	25%	27	68%	3	8%	0	0%
<b>II. Life Science</b>	<b>24</b>	<b>60%</b>	<b>16</b>	<b>40%</b>	<b>0</b>	<b>0%</b>	<b>0</b>	<b>0%</b>
• Understands the structure and function of living systems	28	70%	12	30%	0	0%	0	0%
• Understands reproduction and heredity	14	35%	19	48%	7	18%	0	0%
• Understands change over time in living things	18	45%	22	55%	0	0%	0	0%
• Understands regulation and behavior	14	35%	24	60%	2	5%	0	0%
• Understands unity/diversity of life, adaptation, & classification	16	40%	19	48%	5	13%	0	0%
• Understands the interdependence of organisms	23	58%	14	35%	3	8%	0	0%
• Knows about personal health	29	73%	9	23%	2	5%	0	0%
• Understands science as a human endeavor, process, and career	14	35%	19	48%	7	18%	0	0%
• Understands science as inquiry	35	88%	4	10%	1	3%	0	0%
• Understands how to use resource and research material in science	25	63%	13	33%	2	5%	0	0%
• Understands the unifying processes of science	13	33%	23	58%	4	10%	0	0%

<sup>17</sup> One panelist did not respond to this question.

**Table D9**

**Specification Judgments — Science (5035)**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<b>III. Physical Science<sup>18</sup></b>	<b>17</b>	<b>43%</b>	<b>21</b>	<b>53%</b>	<b>1</b>	<b>3%</b>	<b>0</b>	<b>0%</b>
• Understands the physical and chemical properties and structure of matter	20	50%	18	45%	2	5%	0	0%
• Understands forces and motions	11	28%	24	60%	5	13%	0	0%
• Understands energy	13	33%	24	60%	3	8%	0	0%
• Understands interactions of energy and matter	11	28%	25	63%	4	10%	0	0%
• Understands science as a human endeavor, process, and career	17	43%	16	40%	7	18%	0	0%
• Understands science as inquiry	36	90%	3	8%	1	3%	0	0%
• Understands how to use resource and research material in science	26	65%	12	30%	2	5%	0	0%
• Understands the unifying processes of science	15	38%	22	55%	3	8%	0	0%

<sup>18</sup> One panelist did not respond to this question.

**Table D10****Final Evaluation — Panel 1A**

	<b>Strongly Agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly Disagree</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• I understood the purpose of this study.	11	85%	2	15%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	8	62%	5	38%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	10	77%	3	23%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	10	77%	1	8%	2	15%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	10	77%	3	23%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow. <sup>19</sup>	7	64%	3	27%	1	9%	0	0%

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<sup>19</sup> Two panelists did not respond to this question.

**Table D10 (continued)**

**Final Evaluation — Panel 1A**

<b>How influential was each of the following factors in guiding your standard setting judgments?</b>	<b>Very Influential</b>		<b>Somewhat Influential</b>		<b>Not Influential</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• The definition of the JQC	11	85%	2	15%	0	0%		
• The between-round discussions	5	38%	8	62%	0	0%		
• The knowledge/skills required to answer each test question	10	77%	2	15%	1	8%		
• The cut scores of other panel members	1	8%	11	85%	1	8%		
• My own professional experience	11	85%	2	15%	0	0%		
	<b>Very Comfortable</b>		<b>Somewhat Comfortable</b>		<b>Somewhat Uncomfortable</b>		<b>Very Uncomfortable</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• Overall, how comfortable are you with the panel's recommended cut scores? <sup>20</sup>	7	64%	4	36%	0	0%	0	0%
	<b>Too Low</b>		<b>About Right</b>		<b>Too High</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• Overall, the recommended cut score is: <sup>21</sup>	0	0%	12	100%	0	0%		

<sup>20</sup> Two panelists did not respond to this question.

<sup>21</sup> One panelist did not respond to this question.

**Table D11****Final Evaluation — Panel 1B**

	<b>Strongly Agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly Disagree</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• I understood the purpose of this study.	11	79%	3	21%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	11	79%	3	21%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	9	64%	5	36%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear. <sup>22</sup>	11	85%	2	15%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	11	79%	3	21%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow. <sup>16</sup>	7	54%	6	46%	0	0%	0	0%

<sup>22</sup> One panelist did not respond to this question.

**Table D11 (continued)**

**Final Evaluation — Panel 1B**

<b>How influential was each of the following factors in guiding your standard setting judgments?</b>	<b>Very Influential</b>		<b>Somewhat Influential</b>		<b>Not Influential</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• The definition of the JQC	12	86%	2	14%	0	0%		
• The between-round discussions	9	64%	5	36%	0	0%		
• The knowledge/skills required to answer each test question	13	93%	0	0%	1	7%		
• The cut scores of other panel members	3	21%	5	36%	6	43%		
• My own professional experience	11	79%	3	21%	0	0%		

<b>Overall, how comfortable are you with the panel's recommended cut scores?</b>	<b>Very Comfortable</b>		<b>Somewhat Comfortable</b>		<b>Somewhat Uncomfortable</b>		<b>Very Uncomfortable</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• Reading and Language Arts	8	57%	6	43%	0	0%	0	0%
• Mathematics	13	93%	0	0%	1	7%	0	0%
• Social Studies	8	57%	5	36%	1	7%	0	0%
• Science	10	71%	4	29%	0	0%	0	0%

<b>Overall, the recommended cut score is:</b>	<b>Too Low</b>		<b>About Right</b>		<b>Too High</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• Reading and Language Arts	4	29%	9	64%	1	7%
• Mathematics <sup>23</sup>	0	0%	13	100%	0	0%
• Social Studies	4	29%	9	64%	1	7%
• Science	1	7%	12	86%	1	7%

<sup>23</sup> One panelist did not respond to this question.

**Table D12****Final Evaluation — Panel 2A**

	<b>Strongly Agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly Disagree</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• I understood the purpose of this study.	10	67%	5	33%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	8	53%	7	47%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	7	47%	8	53%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	10	67%	5	33%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	9	60%	5	33%	1	7%	0	0%
• The process of making the standard setting judgments was easy to follow.	9	60%	5	33%	1	7%	0	0%

**Table D12 (continued)**

**Final Evaluation — Panel 2A**

<b>How influential was each of the following factors in guiding your standard setting judgments?</b>	<b>Very Influential</b>		<b>Somewhat Influential</b>		<b>Not Influential</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• The definition of the JQC	10	67%	5	33%	0	0%		
• The between-round discussions	12	80%	2	13%	1	7%		
• The knowledge/skills required to answer each test question	13	87%	1	7%	1	7%		
• The cut scores of other panel members	7	47%	6	40%	2	13%		
• My own professional experience	12	80%	2	13%	1	7%		
<b>Overall, how comfortable are you with the panel's recommended passing scores?</b>	<b>Very Comfortable</b>		<b>Somewhat Comfortable</b>		<b>Somewhat Uncomfortable</b>		<b>Very Uncomfortable</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• Reading and Language Arts	10	67%	4	27%	1	7%	0	0%
• Mathematics	9	60%	4	27%	2	13%	0	0%
<b>Overall, the recommended passing score is:</b>	<b>Too Low</b>		<b>About Right</b>		<b>Too High</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• Reading and Language Arts	0	0%	15	100%	0	0%		
• Mathematics	4	27%	10	67%	1	7%		

**Table D13****Final Evaluation — Panel 2B**

	<b>Strongly Agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly Disagree</b>	
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>
• I understood the purpose of this study.	10	77%	3	23%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	13	100%	0	0%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	12	92%	1	8%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	10	77%	3	23%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	11	85%	2	15%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	12	92%	1	8%	0	0%	0	0%
<b>How influential was each of the following factors in guiding your standard setting judgments?</b>	<b>Very Influential</b>		<b>Somewhat Influential</b>		<b>Not Influential</b>			
	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>	<i>N</i>	<b>Percent</b>		
• The definition of the JQC	11	85%	2	15%	0	0%		
• The between-round discussions	10	77%	3	23%	0	0%		
• The knowledge/skills required to answer each test question	9	69%	4	31%	0	0%		
• The cut scores of other panel members	2	15%	10	77%	1	8%		
• My own professional experience	8	62%	5	38%	0	0%		
• The definition of the JQC	11	85%	2	15%	0	0%		

## Addendum

### Multistate Standard Setting Technical Report – Praxis Elementary Education: Multiple Subjects (5031) – November 2012

The results of the July 2011 multistate standard setting study were reported to participating states in August 2011; recommended passing scores for each of the four subtests were reported as were estimated conditional standard error of measurements (CSEMs). Estimated CSEMs were reported because the new test had not yet been administered. Since then, the Praxis Elementary Education: Multiple Subjects assessment has been administered nationally and SEMs for each of the subtests have been calculated using candidate data from the initial administrations (shown in multistate tables below). The SEMs for the multistate studies are as follows.

#### Standard Error of Measurement Summaries Elementary Education: Multiple Subjects (5031) Assessment

##### *Passing Scores Within 1 and 2 SEMs of the Recommended Passing Score*

Reading and Language Arts Multistate Panel		
Recommended Passing Score (SEM)	Scale Score Equivalent	
<b>46 (2.93)</b>	<b>165</b>	
- 2 SEMs	40	152
-1 SEM	43	159
+1 SEM	49	172
+ 2 SEMs	52	179

Mathematics Multistate Panel		
Recommended Passing Score (SEM)	Scale Score Equivalent	
<b>28 (2.58)</b>	<b>164</b>	
- 2 SEMs	23	146
-1 SEM	25	154
+1 SEM	30	171
+ 2 SEMs	33	182

Social Studies Multistate Panel		
Recommended Passing Score (SEM)	Scale Score Equivalent	
<b>35 (2.97)</b>	<b>155</b>	
- 2 SEMs	29	140
-1 SEM	32	147
+1 SEM	38	163
+ 2 SEMs	41	171

**Science  
Multistate Panel**

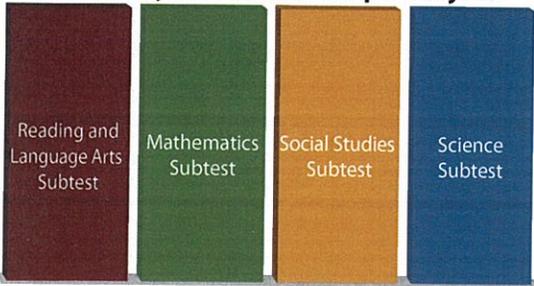
<b>Recommended Passing Score (SEM)</b>		<b>Scale Score Equivalent</b>
	<b>33 (2.71)</b>	<b>159</b>
- 2 SEMs	28	144
-1 SEM	30	150
+1 SEM	36	167
+ 2 SEMs	39	176

**Appendix E**

**Test at a Glance**

**Praxis Elementary Education: Multiple Subjects (5031)**

## Elementary Education: Multiple Subjects (5031)

<i>Test at a Glance</i>			
Test Name	Elementary Education: Multiple Subjects		
Test Code	5031		
Total Time	3.5 hours (4 separately timed subjects)		
Format	Multiple-choice questions, scientific or four-function calculator use permitted.		
Elementary Education: Multiple Subjects			
	Subtests	Subject Test Length (Time)	Subject Test Length (Questions)
	5032 Reading and Language Arts	60	65
	5033 Mathematics	50	40
	5034 Social Studies	50	55
	5035 Science	50	50

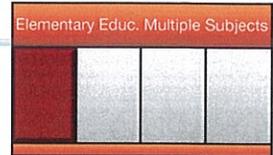
### About This Test

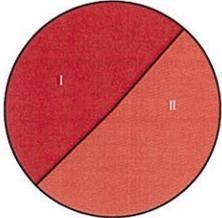
The purpose of the test is to assess whether the entry-level elementary teacher has the content knowledge that is important, necessary, and needed at time of entry to the profession in order to teach English, mathematics, social studies, and science at the elementary level. The test is designed to support a generalist elementary school license.

This test may contain some questions that will not count toward your score.

# Elementary Education: Reading and Language Arts Subtest (5032)

Time: 60 minutes, Format: Multiple-choice



	Reading and Language Arts Categories	Approximate Number of Questions	Approximate Percentage of Subtest
	I. Reading	32	49%
II. Language, Writing, and Communication	33	51%	
<b>Total</b>	<b>65</b>	<b>100%</b>	

## About This Subtest

The Elementary Education: Multiple Subjects: Reading and Language Arts subtest is designed to assess whether an examinee has the broad knowledge and competencies necessary to be licensed as a beginning teacher at the elementary school level. The 65 multiple-choice questions are based on the material typically covered in a bachelor's degree program in elementary education.

## Topics Covered

### I. Reading

- Foundational Skills
  - Understands key ideas relevant to the foundations of literacy and reading development (e.g., language acquisition, support of second-language learners, concepts of print)
  - Understands the role of phonological awareness (e.g., rhyming, phonemic deletion and substitution, segmenting onsets and rimes), and phonics and word analysis skills (e.g., letter-sound correspondences, syllabication patterns, morphology) in literacy development
  - Understands the role of fluency (e.g., rate, accuracy, and prosody) in supporting comprehension
  - Knows the stages of early orthographic development (e.g., drawing pictures, scribble, letter-sound correspondence in word writing)

- Literature and Informational Texts

- Understands the role of comprehension (e.g., role of prior knowledge, referring to explicit and inferred text details and examples, metacognition)
- Understands the basic elements of literature and informational texts
- Understands the basic elements of poetry (e.g., verse, rhythm, meter) and drama (e.g., puppetry, story theatre)
- Understands how to determine the meanings of words and phrases as used in texts, including figurative language (e.g., metaphor, simile, alliteration)

### II. Language, Writing, and Communication

- Language
  - Knows the components of written language (e.g., elements of grammar, usage, syntax)
  - Knows sentence types (e.g., declarative, imperative) and sentence structure (e.g., simple, compound, complex)
  - Understands the basic components of vocabulary (e.g., affixes, root words, context clues)

- Writing
  - Knows types (e.g., narrative, persuasive, journaling) and traits (e.g., tone, purpose, audience) of writing
  - Knows the stages of the writing process (e.g., draft, edit, publish)
  - Knows structures (e.g., description, definition, examples) and organization (e.g., descriptive, comparison/contrast, persuasion) of writing
  - Understands how to use resource material (e.g., types of resources, graphic organizers) in reading and language arts
- Communication
  - Understands different aspects of speaking (e.g., purpose, audience, tone)
  - Understands different aspects of listening (e.g., following directions, responding to questions appropriately, focusing on the speaker)
  - Understands different aspects of viewing (e.g., interpreting images, evaluating media techniques, understanding the message)
  - Understands the role that speaking, listening, and viewing play in language acquisition for second-language learners

## Reading and Language Arts Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

1. Entries in outlines are generally arranged according to which of the following relationships of ideas?
  - (A) Literal and inferential
  - (B) Concrete and abstract
  - (C) Linear and recursive
  - (D) Main and subordinate
  
2. Manuel is the tallest of the two boys.  
Which of the following statements about the above sentence is true?
  - (A) The sentence is written correctly.
  - (B) The subject and verb do not agree.
  - (C) The word "boys" should be possessive.
  - (D) "Tallest" modifies Manuel incorrectly.
  
3. All of the following statements are descriptive of listening behavior EXCEPT:
  - (A) Careful listening can lead to anticipation of a speaker's actions.
  - (B) People learn to listen selectively and can even shut out what is undesirable.
  - (C) Listening comprises at least one-half of all communication.
  - (D) The ability to be a good listener comes naturally and without training.
  
4.
  - I. The teacher from Nebraska displayed Native American artifacts to her class.
  - II. The teacher displayed Native American artifacts from Nebraska to her class.

The meaning of sentence I differs from that of sentence II in that the

  - (A) subject of sentence I is "teacher" whereas the subject of sentence II is "artifacts"
  - (B) first sentence ends in a prepositional phrase whereas the second sentence does not
  - (C) sentences do not have the same simple predicate
  - (D) adjective phrase "from Nebraska" modifies different nouns
  
5. They set two rats in cages side by side, and one was furtive, timid, and small, and the other was glossy, bold, and big.  
The sentence above is an example of a
  - (A) simple sentence
  - (B) compound sentence
  - (C) complex sentence
  - (D) compound-complex sentence
  
6. My sister and I always loved sledding down the hill behind our house.  
The underlined word in the sentence above is an example of
  - (A) a conjunction
  - (B) an infinitive
  - (C) a gerund
  - (D) an adverb

7. Free writing, brainstorming, clustering, and idea mapping are most important during which stage of the writing process?
- (A) Prewriting
  - (B) Drafting
  - (C) Revising
  - (D) Proofreading

**Questions 8–9 refer to the following poem:**

Leave me, O love which reaches but to dust;  
And thou, my mind, aspire to higher things;  
Grow rich in that which never taketh rust,  
Whatever fades but fading pleasure brings.

8. In line 1 “dust” serves as a metaphor for
- (A) ignorance
  - (B) death
  - (C) loneliness
  - (D) confusion
9. The lines above comment on the speaker’s desire to
- (A) seek out immediate pleasures
  - (B) enrich himself
  - (C) reject that which is transitory
  - (D) revive the past

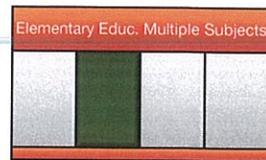
10. According to research, which of the following is the single most important home-based activity for preschool children in building the knowledge required for children’s eventual success in reading?
- (A) Children’s memorizing nursery rhymes
  - (B) Families’ talking about school
  - (C) Parents’ reading aloud to children
  - (D) Parents’ teaching the alphabet
11. When a student who is reading aloud substitutes a word with a similar meaning for a word that appears in print, the teacher’s most appropriate response would be to
- (A) ask the student to reread the word correctly
  - (B) correct the miscue by pronouncing the correct word aloud
  - (C) write both words down, and have the student identify the word as it appears in the text
  - (D) allow the student to continue reading
12. Research shows that fluency increases when readers frequently engage in easy reading. Which of the following is most likely to be effective in making easy books acceptable to a nonfluent older student?
- (A) Providing opportunities for the older student to discuss with classmates the experience of reading self-selected books to a younger student
  - (B) Asking a much younger, fluent reader to read an easy book aloud to the older student
  - (C) Assigning an easy-to-read nonfiction book to the older student for independent reading
  - (D) Encouraging other older students to interrupt and correct when the student is reading easy books aloud
13. The best way to develop students’ metacognitive skills is for teachers to do which of the following?
- (A) Give the students a few global prereading questions to guide their reading.
  - (B) Advocate and model self-questioning during reading.
  - (C) Have the students memorize the new vocabulary words needed to comprehend the reading selection.
  - (D) Provide opportunities for students to write comprehension questions for each other.

## Reading and Language Arts Answers

1. The correct answer is (D). The entries in outlines generally present a main idea followed by a hierarchical arrangement of subordinate ideas.
2. The correct answer is (D). "Tallest" is in the superlative degree which is used when comparing more than two things. "Taller" is the correct word to use since it is in the comparative degree.
3. The correct answer is (D). Authorities agree that effective listening is not a natural ability but requires study and practice.
4. The correct answer is (D). The meaning of the two sentences differs because in sentence I the teacher is "from Nebraska" and in sentence II the Native American artifacts are "from Nebraska." Thus, the placement of the adjective phrase "from Nebraska" after two different nouns changes the meaning of the sentences. (A) is incorrect because "teacher" is the subject of both sentences. (B) is incorrect because both sentences end in the prepositional phrase "to her class." (C) is incorrect because the simple predicate of both sentences is "displayed."
5. The correct answer is (B). A simple sentence contains only one independent clause. This sentence has three independent clauses joined by the conjunction "and." Without dependent clauses, the sentence cannot be characterized as either "complex" or "compound-complex."
6. The correct answer is (C). In this sentence, the word "sledding" is a gerund, a verb form (the present participle) functioning as a noun.
7. The correct answer is (A). The terms mentioned are processes and devices associated with generating new ideas and organizing them. These processes and devices would not be associated with proofreading (D). While they might be part of drafting (B) or revising (C), they are most important during the prewriting stage of the writing process.
8. The correct answer is (B). In literature the word "dust" is often associated with death because life forms decay into soil after death. A metaphor is figurative language that connects one image or idea with another.
9. The correct answer is (C). The word "transitory" refers to change, and the speaker mentions a desire to reject things that turn to dust, acquire dust, and start to fade. These are all types of change.
10. The correct answer is (C). Research shows that parents' reading aloud to children during the preschool years is the most influential home literacy activity and is especially beneficial when children are active participants.
11. The best answer is (D). According to Ken Goodman, the developer of miscue analysis, miscues are not random and have a variety of causes. They are the result of reader's constructions of the linguistic message and therefore are made by everyone when reading aloud.
12. The best answer is (A). Fluency refers to reading smoothly, quickly, and with expression. Option (A) offers the older student opportunities to engage in meaningful literary experiences while gaining courage, self-esteem, and experiencing ownership.
13. The best answer is (B). In order to create strategic readers, it is important to show students how to use the strategy and be explicit about why the strategy is helpful to them.

## Elementary Education: Mathematics Subtest

(5033) Time: 50 minutes, Format: Multiple-choice



	Mathematics Categories	Approximate Number of Questions	Approximate Percentage of Subtest
	I. Number, Operations, and Algebraic Thinking	26	65%
II. Geometry, Measurement, Data, and Interpretation	14	35%	
<b>Total</b>	<b>40</b>	<b>100%</b>	

### About This Subtest

The Elementary Education: Multiple Subjects: Mathematics subtest is designed to assess whether an examinee has the broad knowledge and competencies necessary to be licensed as a beginning teacher at the elementary school level. The 40 multiple-choice questions are based on the material typically covered in a bachelor's degree program in elementary education.

- Understands basic algebraic methods and representations (e.g., variables, expressions, ordered pairs, tables, graphs)
- Understands the associative, commutative, and distributive properties
- Understands additive and multiplicative inverses
- Understands the special properties of zero and one
- Understands equations and inequalities
- Understands the appropriate application of formulas

### Topics Covered

#### I. Number, Operations, and Algebraic Thinking

- Number and Operations
  - Understands prenumeration concepts (e.g., informal counting, meaning of number, patterns)
  - Understands basic number systems (e.g., whole numbers, integers, rational numbers, fractions, decimals)
  - Understands four basic operations (i.e., addition, subtraction, multiplication, and division) and their properties (e.g., commutative, associative, distributive, order of operations)
  - Understands basic concepts of number theory (e.g., factors, multiples, place value, odd/even, prime/composite)
- Operations and Algebraic Thinking
  - Understands how to solve problems, including word problems, using multiple strategies (e.g., modeling, estimation, algorithms) and assess the reasonableness of results
  - Understands how to generate, describe, and explore numerical patterns and engage in mathematical investigations

#### II. Geometry, Measurement, Data, and Interpretation

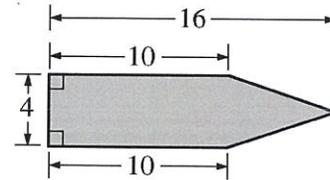
- Geometry
  - Understands properties and attributes of two- or three-dimensional figures and their hierarchy of classification
  - Understands transformations (i.e., rotations, reflections, and translations), geometric models, and nets
- Measurement, Data, and Interpretation
  - Understands nonstandard, customary, and metric units of measurement (e.g., length, time, temperature, volume, mass)
  - Understands visual displays of quantitative data (e.g., picture graphs, bar graphs, pie charts, line plots)
  - Understands simple probability and intuitive concepts of chance (e.g., flipping a coin, spinning a spinner, rolling a number cube)
  - Understands fundamental counting techniques (e.g., permutations, combinations, tree diagrams)
  - Understands basic descriptive statistics (i.e., mean, median, mode, and range)

## Mathematics Sample Test Questions

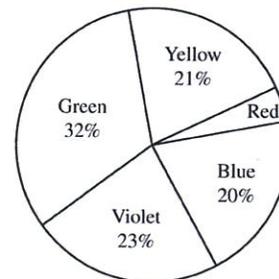
The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

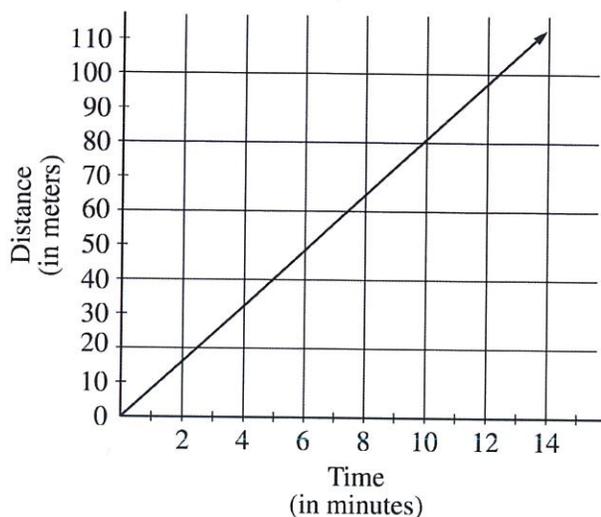
- Riding on a school bus are 20 students in 9th grade, 10 in 10th grade, 9 in 11th grade, and 7 in 12th grade. Approximately what percent of the students on the bus are in 9th grade?
  - 23%
  - 43%
  - 46%
  - 76%
- Which of the following is equal to  $8^4$ ?
  - 4,032
  - 4,064
  - 4,096
  - 4,128
- In the formula  $x = 10y$ , if  $y$  is positive and the value of  $y$  is multiplied by 2, then the value of  $x$  is
  - divided by 10.
  - multiplied by 10.
  - halved.
  - doubled.



- What is the area, in square units, of the shaded region above?
  - 30
  - 52
  - 64
  - 116



- The circle graph above represents the percent of colored gems in a collection. If the collection has a total of 50 gems, how many gems are red?
  - 2
  - 3
  - 4
  - 5
- The only prime factors of a certain number are 2, 3, and 7. Which of the following could be the number?
  - $18 \times 28$
  - $20 \times 21$
  - $22 \times 63$
  - $24 \times 35$



7. Which of the following equations best represents the relationship between  $D$ , distance in meters, and  $t$ , time in minutes, shown in the graph above?

- (A)  $D = 1.8t$
- (B)  $D = 8t$
- (C)  $D = 10t$
- (D)  $D = 10.8t$

8. If a fair coin and a number cube with its faces numbered 1 through 6 are tossed at the same time, what is the probability that the coin will land heads up and the cube will land with the face numbered 4 up?

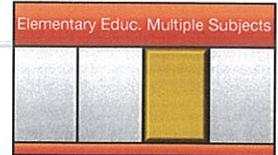
- (A)  $\frac{1}{12}$
- (B)  $\frac{1}{8}$
- (C)  $\frac{1}{6}$
- (D)  $\frac{2}{3}$

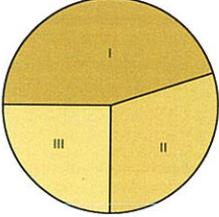
## Mathematics Answers

1. The correct answer is (B). Percent refers to “how many out of one hundred” or, in decimal form, “how many hundredths.” To find a percent, divide the group (20) by the total (46) and round the decimal to the hundredths place (0.43). This is 43 hundredths or 43/100 or 43%.
2. The correct answer is (C). The exponent 4 tells how many times to multiply the base 8 by itself. In this case,  $8^4 = 8 \times 8 \times 8 \times 8 = 4,096$ .
3. The correct answer is (D). This can be shown algebraically as follows. Given that  $10y = x$ , then 10 times  $2y$  equals  $20y$ , which is 2 times  $x$ . Thus, when the value of  $y$  is doubled, the value of  $x$  is doubled.
4. The correct answer is (B). The figure is composed of a rectangle and a triangle. The rectangle has length 10 and width 4; so its area is 40. The triangle can be thought of as having a base 4 and an altitude of 6. Its area is  $\frac{1}{2} \times 4 \times 6$ , or 12. The combined area is therefore  $40 + 12$ , or 52.
5. The correct answer is (A). A circle graph of percents represents 100% of a group. So, to find the percent of red gems, subtract the total percent of the other colors, 96%, from 100% to get 4%. Since 4% or  $\frac{4}{100}$  of the gems are red, 2 out of the total of 50 gems are red. This can be determined by multiplying 50 by 4% or 0.04, or by setting up equivalent fractions:  $4/100 = 2/50$ .
6. The correct answer is (A). The prime factorization of 18 is  $2 \times 3^2$  and the prime factorization of 28 is  $2^2 \times 7$ . So the prime factorization of  $18 \times 28 = 2^3 \times 3^2 \times 7$ .
7. The correct answer is (B). The relationship appears to be linear, so only two points are needed to find the equation. The two easiest points to identify are at (0, 0) and (10, 80). These two points give a rate of change of 80 meters in 10 seconds, which reduces to 8 meters per second. So the distance,  $D$ , increases by 8 meters for every 1 minute increase in time,  $t$ . This corresponds with the equation  $D = 8t$ .
8. The correct answer is (A). The coin has 2 possible outcomes: heads or tails. The probability of the coin landing heads up is 1 out of 2, or  $\frac{1}{2}$ . The cube has 6 possible outcomes: 1, 2, 3, 4, 5, or 6. The probability of the face numbered 4 landing up is 1 out of 6, or  $\frac{1}{6}$ . To find the combined probability, multiply the two independent probabilities together,  $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$ .

# Elementary Education: Social Studies Subtest

(5034) Time: 50 minutes, Format: Multiple-choice



	Social Studies Categories	Approximate Number of Questions	Approximate Percentage of Subtest
	I. United States History, Government, and Citizenship	25	45%
II. Geography, Anthropology, and Sociology	16	30%	
III. World History and Economics	14	25%	
<b>Total</b>	<b>55</b>	<b>100%</b>	

## About This Subtest

The Elementary Education: Multiple Subjects: Social Studies subtest is designed to assess whether an examinee has the broad knowledge and competencies necessary to be licensed as a beginning teacher at the elementary school level. The 55 multiple-choice questions are based on the material typically covered in a bachelor's degree program in elementary education.

## Topics Covered

### I. United States History, Government, and Citizenship

- Knows European exploration and colonization in United States history and growth and expansion of the United States
- Knows about the American Revolution and the founding of the nation in United States history
- Knows the major events and developments in United States history from founding to present (e.g., westward expansion, industrialization, Great Depression)
- Knows about twentieth-century developments and transformations in the United States (e.g., assembly line, space age)
- Understands connections between causes and effects of events
- Understands the nature, purpose, and forms (e.g., federal, state, local) of government
- Knows key documents and speeches in the history of the United States (e.g., United States Constitution, Declaration of Independence, Gettysburg Address)

- Knows the rights and responsibilities of citizenship in a democracy

### II. Geography, Anthropology, and Sociology

- Knows world and regional geography (e.g., spatial terms, places, and regions)
- Understands the interaction of physical and human systems (e.g., how humans change the environment, how the environment changes humans, importance of natural and human resources)
- Knows the uses of geography (e.g., apply geography to interpret past, to interpret present, to plan for future)
- Knows how people of different cultural backgrounds interact with their environment, family, neighborhoods, and communities

### III. World History and Economics

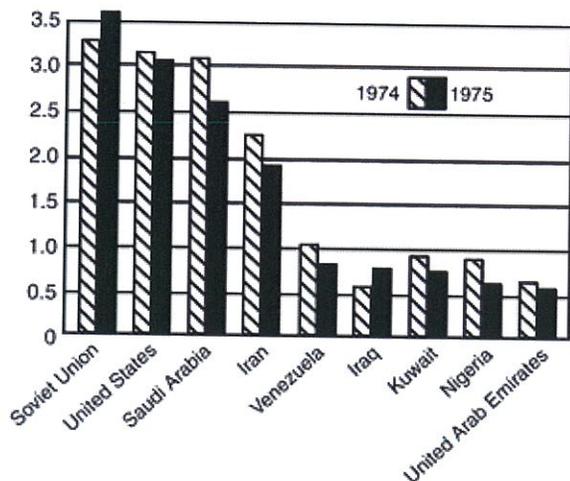
- Knows the major contributions of classical civilizations (e.g., Egypt, Greece, Rome)
- Understands twentieth-century developments and transformations in World history
- Understands the role of cross-cultural comparisons in World history instruction
- Knows key terms and basic concepts of economics (e.g., supply and demand, scarcity and choice, money and resources)
- Understands how economics affects population, resources, and technology
- Understands the government's role in economics and impact of economics on government

## Social Studies Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

- Mount Rainier is located in which of the following mountain ranges?
  - The Cascades
  - The Rockies
  - The Appalachians
  - The Alps
- Which of the following types of maps shows the boundaries of countries, states or municipalities?
  - Thematic
  - Topographic
  - Political
  - Meteorological
- Which of the following is believed to have occurred during the last Ice Age as a result of a land bridge created between what are now Siberia and Alaska?
  - The invention of new technologies for sheltering humans against sustained cold
  - The blockage of important trade routes
  - The establishment of human settlements in North America
  - Widespread famine
- Since the end of the United States Civil War in 1865, all of the following have been major objectives of groups seeking civil rights for Black people EXCEPT
  - passage of affirmative action legislation
  - desegregation of public educational facilities
  - creation of a third party in national politics
  - passage of antilynching laws
- The legal doctrine known as separate but equal was overturned by the Supreme Court's ruling in which of the following cases?
  - Plessy v. Ferguson*
  - Brown v. Board of Education of Topeka*
  - Miranda v. Arizona*
  - Mapp v. Ohio*
- In the United States, the division of power between the national and state governments demonstrates the principle of
  - checks and balances
  - federalism
  - separation of powers
  - the rule of law
- What percent of the seats in the United States House of Representatives are up for election every two years?
  - 33%
  - 50%
  - 66%
  - 100%
- Historically India's society has been organized into hierarchical groups known as
  - tribes
  - castes
  - clans
  - denominations
- Which of the following major world religions is monotheistic?
  - Hinduism
  - Buddhism
  - Islam
  - Shintoism



10. According to the graph above, how many of the countries shown produced more crude oil in 1975 than 1974?
- (A) 1
  - (B) 2
  - (C) 3
  - (D) 4

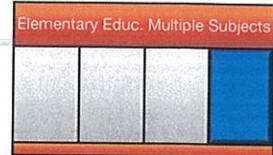
11. Jane is saving to buy a new car. Her friends are planning a weekend trip to the beach. She wants to go, but decides that saving for the car is more important. Jane's choice best demonstrates which of the following economic concepts?
- (A) Opportunity cost
  - (B) Supply and demand
  - (C) Scarcity of resources
  - (D) Comparative advantage

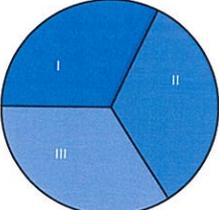
## Social Studies Answers

1. The correct answer is (A). Mount Rainier is located in the state of Washington. The greatest single-peak glacial system in the United States radiates from this dormant volcano in the Cascade Mountains.
2. The correct answer is (C). A political map shows boundaries of countries, states and municipalities. A thematic map presents specific information related to a geographic area such as the location of natural resources. A topographic map shows the physical features of the land. A meteorological map presents information about weather and climate.
3. The correct answer is (C). During the Ice Age, the level of the water in the Pacific Ocean lowered, exposing a land bridge across the Bering Strait. The cold northern climate encouraged many people to migrate throughout the continent in search of better living conditions.
4. The correct answer is (C). The creation of a third party in national politics would be a political action, not one of civil rights.
5. The correct answer is (B). In *Brown v. Board of Education of Topeka*, the Supreme Court ruled that segregating schools on the basis of race was inherently discriminatory. This decision overturned the precedent set by *Plessy v. Ferguson*, which had upheld the constitutionality of racial segregation in public facilities.
6. The correct answer is (B), federalism. Federalism is the division of power between a central government and constituent governments, called states in the United States. Checks and balances refers to the constitutional arrangement of powers that prevents one branch of the government from becoming too powerful. Separation of powers refers to the division of power among the three branches of the United States government. The rule of law is the principle which holds that no person is above the law.
7. The correct answer is (D). Article 1 Section 2 of the Constitution of the United States says, "The House of Representatives shall be composed of Members chosen every second Year by the People... ." All members of the House are elected at the same time every two years.
8. The correct answer is (B). In the fifteenth century AD, explorers from Portugal encountered the social system of India and called these groups castes. As time went on, the four basic castes gradually grew more complex, with hundreds of subdivisions.
9. The correct answer is (C). Of the major world religions listed, Islam is the only one that is monotheistic. Each of the other religions listed has as a central tenet a belief in more than one deity.
10. The correct answer is (B). Since the numbers on the left side of the graph increase from bottom to top, it is a matter of determining how many shaded bars are higher than their corresponding striped bars.
11. The correct answer is (A). Opportunity cost is the value of what is forgone when an economic choice is made. In this example, the opportunity cost of saving for the car is forgoing a weekend trip with friends.

# Elementary Education: Science Subtest

(5035) Time: 50 minutes, Format: Multiple-choice



	Science Categories	Approximate Number of Questions	Approximate Percentage of Subtest
	I. Earth Science	16	32%
II. Life Science	17	34%	
III. Physical Science	17	34%	
<b>Total</b>	<b>50</b>	<b>100%</b>	

## About This Subtest

The Elementary Education: Multiple Subjects: Science subtest is designed to assess whether an examinee has the broad knowledge and competencies necessary to be licensed as a beginning teacher at the elementary school level. The 50 multiple-choice questions are based on the material typically covered in a bachelor's degree program in elementary education.

## Topics Covered

### I. Earth Science

- Understands the structure of the Earth system (e.g., structure and properties of the solid Earth, the hydrosphere, the atmosphere)
- Understands processes of the Earth system (e.g., earth processes of the solid Earth, the hydrosphere, the atmosphere)
- Understands Earth history (e.g., origin of Earth, paleontology, the rock record)
- Understands Earth and the universe (e.g., stars and galaxies; the solar system and planets; Earth, Sun, and Moon relationships)
- Understands Earth patterns, cycles, and change
- Understands science as a human endeavor, process, and career
- Understands science as inquiry (e.g., questioning, gathering data, drawing reasonable conclusions)
- Understands how to use resource and research material in science
- Understands the unifying processes of science (e.g., systems, order, and organization)

### II. Life Science

- Understands the structure and function of living systems (e.g., living characteristics and cells, tissues and organs, life processes)
- Understands reproduction and heredity (e.g., growth and development, patterns of inheritance of traits, molecular basis of heredity)
- Understands change over time in living things (e.g., life cycles, mutations, adaptation and natural selection)
- Understands regulation and behavior (e.g., life cycles, responses to external stimuli, controlling the internal environment)
- Understands unity and diversity of life, adaptation, and classification
- Understands the interdependence of organisms (e.g., ecosystems, populations, communities)
- Knows about personal health (e.g., nutrition, communicable diseases, substance abuse)
- Understands science as a human endeavor, process, and career
- Understands science as inquiry (e.g., questioning, gathering data, drawing reasonable conclusions)
- Understands how to use resource and research material in science
- Understands the unifying processes of science (e.g., systems, order, and organization)

### III. Physical Science

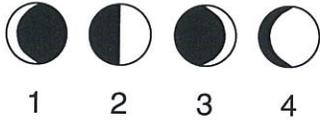
- Understands the physical and chemical properties and structure of matter (e.g., changes of states, mixtures and solutions, atoms and elements)
- Understands forces and motions (e.g., types of motion, laws of motion, forces and equilibrium)
- Understands energy (e.g., forms of energy, transfer and conservation of energy, simple machines)
- Understands interactions of energy and matter (e.g., electricity, magnetism, sound)
- Understands science as a human endeavor, process, and career
- Understands science as inquiry (e.g., questioning, gathering data, drawing reasonable conclusions)
- Understands how to use resource and research material in science
- Understands the unifying processes of science (e.g., systems, order, and organization)

## Science Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

- Which of the following geological processes adds new rock to the surface of the Earth?
  - Volcanic activity
  - Glacial activity
  - Soil erosion
  - Weathering



- Which of the diagrams above best depicts the Moon as viewed from Earth at the first quarter of the lunar cycle?
  - 1
  - 2
  - 3
  - 4
- Which of the following is NOT a way in which mammals keep themselves warm in winter?
  - Shivering
  - Perspiring
  - Fluffing out coat hair
  - Contracting certain blood vessels
- Which of the following would be observed in a vacuum if a feather and two stones of different weights were dropped simultaneously from a height of ten feet?
  - Both stones would hit the ground at the same time, but before the feather.
  - The heavier stone would hit the ground first.
  - The lighter stone would hit the ground first.
  - All three objects would hit the ground at the same time.

- Which of the following laboratory instruments would be most appropriate to use in determining the volume of a large block of wood of unknown density?
  - A metric ruler
  - A triple-beam balance
  - A 200 mL volumetric flask
  - A micrometer
- Which of the following best describes a scientific hypothesis?
  - It ensures that successful results will be obtained from an experiment.
  - It must be accepted as true by the scientific community.
  - It is a testable proposal that may lead to experimentation.
  - It must be formulated by a renowned scientist.
- Which of the following is the broadest category in the biological taxonomy?
  - Kingdom
  - Order
  - Genus
  - Species
- Some human traits are carried by genes on the Y chromosome. A man will transmit these traits to
  - one-half of his male offspring only
  - one-half of his female offspring only
  - all of his male offspring
  - all of his female offspring

9. A chlorine compound is added to swimming pools in order to
- (A) monitor the pH of the water
  - (B) add color to the water
  - (C) soften the water by precipitating harmful chemicals
  - (D) destroy bacteria through an oxidation reaction
10. Two campers want to bake potatoes in a fire. Both wrap their potatoes in aluminum foil. One camper, however, sticks a large nail through her potato. Which of the following is most likely to happen after the potatoes are placed in the fire?
- (A) Both potatoes will cook at the same rate.
  - (B) Neither potato will cook because the foil will reflect the heat.
  - (C) The potato with the nail will cook faster because heat will be conducted into the potato.
  - (D) The potato with the nail will cook more slowly because heat will be conducted out of the potato.

## Science Answers

1. The correct answer is (A). Volcanic activity is the only process by which material from inside the Earth is brought to the surface. The other processes are means of wearing down Earth's surface.
2. The correct answer is (B). At the first lunar quarter the Sun, Earth, and Moon form a right triangle, with Earth at the right angle, so that the half of the Moon facing Earth appears half lighted and half dark.
3. The correct answer is (B). Perspiring is an adaptation that allows mammals to lose heat. When the body temperature rises, sweat is produced. As the water in the sweat evaporates, the skin is cooled, not warmed.
4. The correct answer is (D). In a vacuum, the only external force acting on each of the objects would be the gravitational force of the Earth. This gravitational force is equal to  $M \times g$ , where  $M$  is the object's mass and  $g$  is the constant acceleration of gravity (9.8 meters per second squared). According to Newton's second law, the acceleration,  $a$ , of an object times its mass is equal to the external force acting on it. For this situation, Newton's second law gives  $M \times a = M \times g$ , or  $a = g$ . Thus, in a vacuum all objects fall freely with the same constant acceleration  $g$  regardless of their mass.
5. The correct answer is (A). To find the volume of a large rectangular block of wood, first use the metric ruler to find the length, width, and height of the block. Then use the formula for the volume of a rectangular solid—length  $\times$  width  $\times$  height—to determine the volume.
6. The correct answer is (C). A hypothesis is a best guess or a possible explanation of a scientific problem. Scientific experimentation can either support or fail to support the hypothesis.
7. The correct answer is (A). When putting living things into a biological classification scheme, the broadest category is kingdom, followed by phylum, class, order, family, genus, and species.
8. The correct answer is (C). Human males generally have one X and one Y chromosome. Male offspring will only receive a Y chromosome from their father, while female offspring will only receive an X chromosome from their father. Therefore, genes on the Y chromosome are passed only to male offspring.
9. The correct answer is (D). Chlorine and certain chlorine containing compounds are highly reactive oxidizing agents that are used as chemical disinfectants in a variety of situations including swimming pools.
10. Although the aluminum foil will reflect radiant energy, it will not significantly reduce the flow of energy by conduction. Because a nail is a good thermal conductor, heat will flow through the nail and cook the potato from the inside as well as from the outside. Thus, the potato with the imbedded nail will cook faster. (C) is the correct answer.



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## **Appendix F**

**Virginia Standard Setting Technical Report  
Praxis Middle School English Language Arts (5047)  
March 2013**



*Listening. Learning. Leading.*

Standard-Setting Technical Report

**PRAXIS™ MIDDLE SCHOOL ENGLISH LANGUAGE ARTS (5047)**

Prepared for the Virginia Department of Education

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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## EXECUTIVE SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School English Language Arts (5047) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on March 21, 2013.

### RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Middle School English Language Arts test, the recommended passing score is 79 out of a possible 120 raw-score points. The scaled score associated with a raw score of 79 is 162 on a 100–200 scale.

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School English Language Arts (5047) test, research staff from ETS designed and conducted a standard-setting study on March 21, 2013, in Richmond, Virginia.

The study involved an expert panel of educators. The VDOE recommended panelists with (a) experience as either English teachers or college faculty who prepare English teachers and (b) familiarity with the knowledge and skills required of beginning English teachers (See Appendix A for the names and affiliations of the panelists.)

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the standard-setting study to the VDOE. The VDOE is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a panel of experienced educators. The VDOE may want to consider the recommended passing score but also other sources of information when setting the final Praxis Middle School English Language Arts passing score (see Geisinger & McCormick, 2010). The VDOE may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Middle School English Language Arts test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows the VDOE to recognize that any test score on any standardized test—including a Praxis Middle School English Language Arts test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to gauge the likelihood that the recommended passing score from this panel would be similar to the passing scores recommended by other panels of experts similar in

composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error is more important to minimize.

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## OVERVIEW OF THE PRAXIS MIDDLE SCHOOL ENGLISH LANGUAGE ARTS TEST

The Praxis Middle School English Language Arts *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level middle school English teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hours and forty minutes assessment contains 110 selected-response items<sup>1</sup> and two constructed-response items covering four content areas: *Reading* (approximately 50 selected-response items and one constructed-response item), *Language Use and Vocabulary* (approximately 16 selected-response items), *Writing, Speaking and Listening* (approximately 26 selected-response items) and *English Language Arts Instruction* (approximately 18 selected-response items and one constructed-response item).<sup>2</sup> The reporting scale for the Praxis Middle School English Language Arts test ranges from 100 to 200 scaled-score points.

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<sup>1</sup> Twenty of the 110 selected-response items are pretest items and do not contribute to a candidate's score.

<sup>2</sup> The number of items for each content area may vary slightly from form to form of the test.

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## PROCESSES AND METHODS

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

### DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panel created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate.

The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

## PANELISTS' JUDGMENTS

The Praxis Middle School English Language Arts test includes both dichotomously-scored (selected-response items) and constructed-response items. Panelists received training in two distinct standard-setting approaches: one standard-setting approach for the dichotomously-scored items and another approach for the constructed-response items.

A panel's passing score is the sum of the interim passing scores recommended by the panelists for (a) the dichotomously-scored items and (b) the constructed-response items. As with scoring and reporting, the panelists' judgments for the constructed-response items were weighted such that they contributed 25% of the overall score.

**Dichotomously scored items.** The standard-setting process for the dichotomously-scored items was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

**Constructed-response items.** An Extended Angoff method (Cizek & Bunch, 2007; Hambleton & Plake, 1995) was used for the constructed-response items. For this portion of the study, a panelist decided on the assigned score value that would most likely be earned by the target candidate for each constructed-response item. Panelists were asked first to review the definition of the target candidate and then to review the constructed-response item and its rubric. The rubric for a constructed-response item defines (holistically) the quality of the evidence that would merit a response earning a particular score. During this review, each panelist independently considered the level of knowledge/skill required to respond to the constructed-response item and the features of a response that would earn a particular score, as defined by the rubric. Each panelist decided on the score most likely to be earned by the target candidate from the possible values a test taker can earn.

A test-taker's response to a constructed-response item is independently scored by two raters, and the sum of the raters' scores is the assigned score<sup>3</sup>; possible scores, therefore, range from zero (both raters assigned a score of zero) to six (both raters assigned a score of three). For their ratings, each panelist decided on the score most likely to be earned by a target candidate from the following possible values: 0, 1, 2, 3, 4, 5, or 6. For each of the constructed-response item, panelists recorded the score (0 through 6) that a target candidate would most likely earn.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

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<sup>3</sup> If the two raters' scores differ by more than one point (non-adjacent), the Chief Reader for that item assigns the score, which is then doubled.

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## RESULTS

### EXPERT PANELS

Table 1 presents a summary of the panelists' demographic information. (See Appendix A for a listing of panelists.) Fourteen panelists were teachers, one was college faculty, one was an administrator or department head. The faculty member's job responsibilities included the training of English teachers.

**Table 1**  
*Panel Member Demographics*<sup>4</sup>

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	14	88%
Administrator/Department head	1	6%
College faculty	1	6%
<b>Race</b>		
White	11	69%
Black or African American	4	25%
Asian or Asian American	1	6%
<b>Gender</b>		
Female	14	88%
Male	2	13%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	14	88%
No	2	13%
<b>Are you currently teaching this subject in your state?</b>		
Yes	15	94%
No	1	6%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	6	38%
No	10	63%

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<sup>4</sup> One panelist was unable to complete the study and is not included in the reported results.

**Table 1 (continued)**  
**Panel Member Demographics**

	<i>N</i>	<i>%</i>
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Middle school (6–8 or 7–9)	14	88%
Not currently teaching at the K–12 level	2	13%
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	0	0%
4–7 years	10	63%
8–11 years	5	31%
12–15 years	1	6%
16 years or more	0	0%
<b>Which best describes the location of your K–12 school?</b>		
Urban	3	19%
Suburban	5	31%
Rural	6	38%
Not currently working at the K–12 level	2	13%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	1	6%
No	0	0%
Not college faculty	15	94%

## STANDARD-SETTING JUDGMENTS

Table 2 summarize the standard-setting judgments of panelists. The table shows the passing scores—the number of raw points needed to pass the test—recommended by each panelist. The table also include estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>5</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test.

<sup>5</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 2**  
*Passing Score Summary*

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<b>Panelist</b>	<b>Passing Score</b>
1	70.40
2	65.70
3	80.20
4	78.80
5	81.45
6	83.25
7	79.80
8	79.95
9	84.25
10	86.10
11	74.80
12	76.75
13	86.45
14	65.00
15	82.25
16	78.35
<b>Average</b>	78.34
<b>Lowest</b>	65.00
<b>Highest</b>	86.45
<b>SD</b>	6.50
<b>SEJ</b>	1.63

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The panel's passing score recommendation for the Praxis Middle School English Language Arts test is 78.34 (out of a possible 120 raw-score points). The value was rounded to 79 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 79 raw points is 162.

Table 3 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 3**

***Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>6</sup>***

Recommended passing score (CSEM)		Scale score equivalent
	79 (5.07)	162
-2 CSEMs	69	151
-1 CSEM	74	156
+ 1 CSEM	85	168
+ 2 CSEMs	90	174

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study and that the facilitator’s instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All of the panelists who responded *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

<sup>6</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

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## SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School English Language Arts (5047) test, research staff from ETS designed and conducted a standard-setting study on March 21, 2013.

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Middle School English Language Arts test, the recommended passing score is 79 out of a possible 120 raw-score points. The scaled score associated with a raw score of 79 is 162 on a 100–200 scale.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*<sup>7</sup>

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Stephanie Anstey	Montevideo Middle School/Rockingham County Public Schools
Alison Baker	Fairfax County Public Schools
Leila Christenbury	Virginia Commonwealth Univeristy
Beverly Debreczeni	Dozier Middle School
Tanya Hall	Spotsylvania Middle School
Carroll Hill	Kate Collins Middle School
Keisha Jackson	Lafayette-Winona Middle School
Anne Pennypacker	Midlothian Middle School
Sonya Pierce	E. W. Wyatt Middle School
Megan Prior	Stonewall Jackson Middle School
Alfreda J. Reynolds	Brunswick County Public Schools
Danielle Rowe	Rippon Middle School/Prince William County Public Schools
Tiffany Truitt	John F. Kennedy Middle School
Frances Uitto	Laurel Park Middle School
Kenneth Wright	James Madison University
Emma Zayas	Caroline Middle School

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<sup>7</sup> One panelist was unable to complete the study and is not listed above or included in the reported results.

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APPENDIX B  
STUDY AGENDA

# **AGENDA**

## **Praxis Middle School English Language Arts (5047) Standard-Setting Study**

Welcome and Introduction

Overview of Study

“Take” the Praxis Middle School ELA Test

(Take breaks as needed)

Discuss the Praxis Middle School ELA Test

Discuss the Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate

Break

Training for Standard-Setting Judgments for Selected-Response Items

Complete Standard Setting Judgments for Selected-Response Items

Training for Standard-Setting Judgments for Constructed-Response Questions

Complete Standard Setting Judgments for Constructed-Response Questions

Complete Final Evaluation

Collect Materials

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## APPENDIX C

### TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>8</sup>

### A target candidate ...

#### Reading

1. Identify and differentiate the defining characteristics of major subgenres and genres
2. Analyze how poetic devices and structure contribute to the meaning of a text
3. Analyze the literary elements and how they impact the meaning of a text
4. Understands the methods that authors use to convey purpose and perspective within informational texts including organizational pattern, word choice and tone
5. Understand how literal and inferential interpretation of informational text can be supported with textual evidence

#### Language Use & Vocabulary

6. Understand the functions of syntactical and semantic features (such as roots and affixes) to determine advanced and complex word meaning
7. Has awareness of the dialect and diction across region cultural groups and time periods

#### Writing, Speaking, and Listening

8. Evaluate and assess what constitutes effective writing including strong details, supporting evidence, purpose, format, audience

#### English Language Arts Instruction

9. Select commonly used research-based approaches to middle grades ELA instruction (reading, writing, speaking, listening and viewing)
10. Knows commonly used research-based approaches to grouping and differentiated instruction to meet specific instructional objectives and to motivate adolescents
11. Understands approaches to and purposes of formative and summative assessment of reading, writing, speaking and listening
12. Analyze the impact of word choice on the meaning and tone of a literary text
13. Draw inferences from a text
14. Understands the conventions of standard English grammar, usage, syntax and mechanics

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<sup>8</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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## APPENDIX D

# EVALUATION RESULTS

**Table D1*****Final Evaluation***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	11	69%	5	31%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	8	50%	8	50%	0	0%	0	0%
• The opportunity to "take the test" and to discuss the test content was useful. <sup>9</sup>	10	67%	5	33%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful.	9	56%	6	38%	1	6%	0	0%
• The training for the Standard Setting judgments was adequate to give me the information I needed to complete my assignment.	11	69%	5	31%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow. <sup>9</sup>	10	67%	5	33%	0	0%	0	0%

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<sup>9</sup> One panelist did not give a response to this statement.

## **Appendix G**

**Multistate Standard Setting Technical Report  
Praxis Middle School English Language Arts (5047)  
March 2013**



*Listening. Learning. Leading.*

Multistate Standard-Setting Technical Report

**PRAXIS™ MIDDLE SCHOOL ENGLISH LANGUAGE ARTS (5047)**

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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# EXECUTIVE SUMMARY

To support the decision-making process of education agencies establishing a passing score (cut score) for the Praxis™ Middle School English Language Arts (5047) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study.

## PARTICIPATING STATES

Panelists from 18 states and Washington, DC were recommended by their respective education agencies. The education agencies recommended panelists with (a) experience as either English teachers or college faculty who prepare English teachers and (b) familiarity with the knowledge and skills required of beginning English teachers.

## RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Middle School English Language Arts test, the recommended passing score<sup>1</sup> is 81 out of a possible 120 raw-score points. The scaled score associated with a raw score of 81 is 164 on a 100–200 scale.

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<sup>1</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis™ Middle School English Language Arts (5047) test, research staff from ETS designed and conducted a multistate standard-setting study in March 2013 in Princeton, New Jersey. Education agencies<sup>2</sup> recommended panelists with (a) experience as either English teachers or college faculty who prepare English teachers and (b) familiarity with the knowledge and skills required of beginning English teachers. Eighteen states and Washington, DC (Table 1) were represented by 28 panelists. (See Appendix A for the names and affiliations of the panelists.)

**Table 1**  
*Participating Jurisdictions and Number of Panelists*

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Alaska (2 panelists)	North Carolina (2 panelists)
Arkansas (2 panelists)	North Dakota (1 panelist)
Delaware (1 panelist)	Rhode Island (1 panelist)
Hawaii (1 panelist)	South Dakota (2 panelists)
Kansas (1 panelist)	Utah (2 panelists)
Kentucky (2 panelists)	Vermont (2 panelists)
Louisiana (1 panelist)	Washington, DC (2 panelists)
Maryland (1 panelist)	West Virginia (1 panelist)
New Hampshire (2 panelists)	Wyoming (1 panelist)
Nevada (1 panelist)	

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The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each jurisdiction, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score,<sup>3</sup> which represents the combined judgments of two panels of experienced educators. Each jurisdiction may want to consider the recommended passing score but also other sources of information when setting the final

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<sup>2</sup> States and jurisdictions that currently use Praxis were invited to participate in the multistate standard-setting study.

<sup>3</sup> In addition to the recommended passing score averaged across the two panels, the recommended passing scores for each panel are presented.

Praxis Middle School English Language Arts passing score (see Geisinger & McCormick, 2010). A jurisdiction may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the jurisdiction's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Middle School English Language Arts test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows a jurisdiction to recognize that any test score on any standardized test—including a Praxis Middle School English Language Arts test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows a jurisdiction to gauge the likelihood that the recommended passing score from a particular panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each jurisdiction should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The jurisdiction needs to consider which decision error is more important to minimize.

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# OVERVIEW OF THE PRAXIS MIDDLE SCHOOL ENGLISH LANGUAGE ARTS TEST

The Praxis Middle School English Language Arts *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level English teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hours and forty minutes assessment contains 110 selected-response items<sup>4</sup> and two constructed-response items covering four content areas: *Reading* (approximately 50 selected-response items and one constructed-response item), *Language Use and Vocabulary* (approximately 16 selected-response items), *Writing, Speaking and Listening* (approximately 26 selected-response items) and *English Language Arts Instruction* (approximately 18 selected-response items and one constructed-response item).<sup>5</sup> The reporting scale for the Praxis Middle School English Language Arts test ranges from 100 to 200 scaled-score points.

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## PROCESSES AND METHODS

The design of the standard-setting study included two, independent expert panels. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

For each panel, the standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

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<sup>4</sup> Twenty of the 110 selected-response items are pretest items and do not contribute to a candidate's score.

<sup>5</sup> The number of items for each content area may vary slightly from form to form of the test.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

## DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

Panel 1 created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate. The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

For Panel 2, the panelists began with the description of the target candidate developed by Panel 1. Given that the multistate standard-setting study was designed to provide two recommendations for the same performance standard, it was important that panels use consistent target candidate description to frame their judgments. The panelists reviewed the target candidate description, and any ambiguities were discussed and clarified.

## PANELISTS' JUDGMENTS

The Praxis Middle School English Language Arts test includes both dichotomously-scored (selected-response items) and constructed-response items. Panelists received training in two distinct standard-setting approaches: one standard-setting approach for the dichotomously-scored items and another approach for the constructed-response items.

A panel's passing score is the sum of the interim passing scores recommended by the panelists for (a) the dichotomously-scored items and (b) the constructed-response items. As with scoring and reporting, the panelists' judgments for the constructed-response items were weighted such that they contributed 25% of the overall score.

**Dichotomously scored items.** The standard-setting process for the dichotomously-scored items was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate

training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

**Constructed-response items.** An Extended Angoff method (Cizek & Bunch, 2007; Hambleton & Plake, 1995) was used for the constructed-response items. For this portion of the study, a panelist decided on the assigned score value that would most likely be earned by the target candidate for each constructed-response item. Panelists were asked first to review the definition of the target candidate and then to review the constructed-response item and its rubric. The rubric for a constructed-response item defines (holistically) the quality of the evidence that would merit a response earning a particular score. During this review, each panelist independently considered the level of knowledge/skill required to respond to the constructed-response item and the features of a response that would earn a particular score, as defined by the rubric. Each panelist decided on the score most likely to be earned by the target candidate from the possible values a test taker can earn.

A test-taker's response to a constructed-response item is independently scored by two raters, and the sum of the raters' scores is the assigned score<sup>6</sup>; possible scores, therefore, range from zero (both raters assigned a score of zero) to six (both raters assigned a score of three). For their ratings, each panelist decided on the score most likely to be earned by a target candidate from the following possible values: 0, 1, 2, 3, 4, 5, or 6. For each of the constructed-response item, panelists recorded the score (0 through 6) that a target candidate would most likely earn.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

**Multiple Rounds.** Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. For dichotomously-scored items, items were highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located an item in the same difficulty range) or diverged in their judgments.

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<sup>6</sup> If the two raters' scores differ by more than one point (non-adjacent), the Chief Reader for that item assigns the score, which is then doubled.

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the target candidate and helped to clarify aspects of items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to another's judgment, but to understand the different relevant perspectives among the panelists.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

Other than the description of the target candidate, results from Panel 1 were not shared with Panel 2. The item-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

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## RESULTS

### EXPERT PANELS

Table 2 presents a summary of the panelists' demographic information. The panel included 28 educators representing 18 states and Washington, DC. (See Appendix A for a listing of panelists.) Twenty panelists were teachers, six were college faculty, one was an administrator or department head, and one held another position. Five of the six faculty members' job responsibilities included the training of English teachers.

The number of experts by panel and their demographic information are presented in Appendix D (Table D1).

**Table 2**  
***Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	20	71%
Administrator/Department head	1	4%
College faculty	6	21%
Other	1	4%
<b>Race</b>		
White	23	82%
Black or African American	5	18%
<b>Gender</b>		
Female	23	82%
Male	5	18%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	26	93%
No	2	7%
<b>Are you currently teaching this subject in your state?</b>		
Yes	21	75%
No	7	25%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	14	50%
No	14	50%
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Middle school (6–8 or 7–9)	19	68%
High school (9–12 or 10–12)	1	4%
Middle and High School	1	4%
Not currently teaching at the K–12 level	7	25%

**Table 2 (continued)*****Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	5	18%
4–7 years	7	25%
8–11 years	7	25%
12–15 years	6	21%
16 years or more	3	11%
<b>Which best describes the location of your K–12 school?</b>		
Urban	4	14%
Suburban	7	25%
Rural	10	36%
Not currently working at the K–12 level	7	25%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	5	18%
No	1	4%
Not college faculty	22	79%

**STANDARD-SETTING JUDGMENTS**

Table 3 summarizes the standard-setting judgments (Round 2) of panelists. The table also includes estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>7</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test. The confidence intervals created by adding/subtracting two SEJs to each panel’s recommended passing score overlap, indicating that they may be comparable.

Panelist-level results, for Rounds 1 and 2, are presented in Appendix D (Table D2).

<sup>7</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 3**  
*Summary of Round 2 Standard-setting Judgments*

	<b>Panel 1</b>	<b>Panel 2</b>
Average	81.52	78.74
Lowest	73.15	69.65
Highest	91.10	83.70
SD	5.43	4.84
SEJ	1.40	1.34

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for each panel (see Table D2 in Appendix D). The Round 2 average score is the panel’s recommended passing score.

The panels’ passing score recommendations for the Praxis Middle School English Language Arts test are 81.52 for Panel 1 and 78.74 for Panel 2 (out of a possible 120 raw-score points). The values were rounded to the next highest whole number, to determine the functional recommended passing score — 82 for Panel 1 and 79 for Panel 2. The scaled scores associated with 82 and 79 raw points are 165 and 162, respectively.

In addition to the recommended passing score for each panel, the average passing score across the two panels is provided to help education agencies determine an appropriate passing score. The panels’ average passing score recommendation for the Praxis Middle School English Language Arts test is 80.13 (out of a possible 120 raw-score points). The value was rounded to 81 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 81 raw points is 164.

Table 4 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 4*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>8</sup>***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	81 (5.01)	164
-2 CSEMs	71	153
-1 CSEM	76	158
+ 1 CSEM	87	170
+ 2 CSEMs	92	176

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were also shown the panel's recommended passing score and asked (a) how comfortable they are with the recommended passing score and (b) if they think the score was too high, too low, or about right. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study. Twenty-three of the 28 panelists *strongly agreed* or *agreed* that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the description of the target candidate was at least *somewhat influential* in guiding their standard-setting judgments; 21 of the 28 panelists indicated the description was *very influential*. All but two of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Thirteen of the 28 panelists indicated that their own professional experience was *very influential* in guiding their judgments.

<sup>8</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

All but one of the panelists indicated they were at least *somewhat comfortable* with the passing score they recommended; 19 of the 28 panelists were *very comfortable*. Twenty-seven of the 28 panelists indicated the recommended passing score was *about right*, the remaining panelist indicated that the passing score was *too high*.

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## SUMMARY

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis Middle School English Language Arts test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Middle School English Language Arts test, the recommended passing score<sup>9</sup> is 81 out of a possible 120 raw-score points. The scaled score associated with a raw score of 81 is 164 on a 100–200 scale.

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<sup>9</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Anne Brenner Armstrong	University of Alaska Fairbanks (AK)
Amy Brockway	Olathe Public Schools (KS)
Stephanie Buelow	University of Hawaii at Manoa (HI)
Stephanie Carey	Achorage School District (AK)
Christopher Carter	Davis School District (UT)
Sandra Celauro	Rutland Middle School (VT)
Staci Collins	Northwest Cabarrus Middle School (NC)
Dana Emery	Tooele Junior High School (UT)
Jody Fernandez	Morehead State University (KY)
Adrienne Fortune	Missisquoi Valley Union Middle/High School (VT)
TeKyesha Gault	Conway Public School District (AR)
Katherine M. Golec	Jim Bridger Middle School (NV)
Katesha Harrell	A. G. Cox Middle (NC)
Ronnie Harrison	Southern University (LA)
Lynn Johnson	Trinity Washington University (DC)
Stephanie Kaffenberger	Western Hills Middle School (RI)
Jacob Knodel	Discovery Middle School (ND)
Latwayla Knowlton	Annie Camp Junior High (AR)
Patricia Lamontagne	Pelham Memorial School (NH)
Kelly Neal	Bondurant Middle School (KY)
David W. Nicholson	Stevenson University (MD)

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*Participating Panelists With Affiliation (continued)*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Ashley Rousseau	Pine Bluffs Junior/Senior High School (WY)
Evelyn Ruffin-Burris	Bayard Middle School (DE)
Alex Scarelli	Campbell High School (NH)
Brandi Swalve	Aberdeen School District (Holgate Middle School) (SD)
Ashley White	Lenore K-8 School (WV)
Christina Yuknis	Gallaudet University (DC)
Susan Zueger	Sioux Falls School District/Memorial Middle School (SD)

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APPENDIX B  
STUDY AGENDA

# AGENDA

## **Praxis Middle School English Language Arts (5047) Standard-Setting Study**

Day 1

Welcome and Introduction

Overview of Standard Setting and the Praxis Middle School English Language Arts Test

“Take” the Praxis Middle School English Language Arts Test  
(Take breaks as needed)

Discuss the Praxis Middle School English Language Arts Test

Define the Knowledge/Skills of a Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate (continued)

Break

Standard-Setting Training for Selected-Response Items

Round 1 Standard Setting Judgments for Selected-Response

Collect Materials; End of Day 1

# AGENDA

## Praxis Middle School English Language Arts (5047) Standard-Setting Study

Day 2

Overview of Day 2

Standard Setting Training for Constructed-Response Questions

Round 1 Standard Setting Judgments for Constructed-Response Questions

Round 1 Feedback & Round 2 Judgments

Break

Round 1 Feedback & Round 2 Judgments (continued)

Lunch

Round 1 Feedback & Round 2 Judgments (continued)

Break

Feedback on Round 2 Recommended Passing Score

Complete Final Evaluation

Collect Materials; End of Study

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## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>10</sup>

### A target candidate ...

#### Reading

1. Identify and differentiate the defining characteristics of major subgenres
2. Analyze how poetic devices and structure contribute to the meaning of a poem
3. Analyze how differences in characters' POV's, setting and characterization influence the overall meaning and individual elements of a text (mood, tone, conflict, etc.)
4. Understand literal and inferential methods that authors use to convey purpose and perspective within informational texts including organizational pattern, word choice and tone
5. Understand how literal and inferential interpretation of informational text can be supported with textual evidence

#### Language Use & Vocabulary

6. Understand the functions of syntactical and semantic features (such as affixes) to determine advanced and complex word meaning
7. Has awareness of the dialect and diction across regions, cultural groups and time periods

#### Writing, Speaking, and Listening

8. Evaluate and assess what constitutes effective writing including strong details, supporting evidence, purpose, format, audience

#### English Language Arts Instruction

9. Select commonly used research-based approaches to middle grades ELA instruction (reading, writing, speaking, listening and viewing)
10. Knows commonly used research-based approaches to grouping and differentiated instruction to meet specific instructional objectives and to motivate adolescents
11. Understands approaches to and purposes of formative and summative assessment of reading, writing, speaking and listening

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<sup>10</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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# APPENDIX D

## RESULTS

**Table D1**  
**Panel Member Demographics (by Panel)**

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Current position</b>				
Teacher	8	53%	12	92%
Administrator/Department head	0	0%	1	8%
College faculty	6	40%	0	0%
Other	1	7%	0	0%
<b>Race</b>				
White	13	87%	10	77%
Black or African American	2	13%	3	23%
<b>Gender</b>				
Female	12	80%	11	85%
Male	3	20%	2	15%
<b>Are you currently certified to teach this subject in your state?</b>				
Yes	14	93%	12	92%
No	1	7%	1	8%
<b>Are you currently teaching this subject in your state?</b>				
Yes	9	60%	12	92%
No	6	40%	1	8%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>				
Yes	8	53%	6	46%
No	7	47%	7	54%
<b>At what K–12 grade level are you currently teaching this subject?</b>				
Middle school (6–8 or 7–9)	9	60%	10	77%
High school (9–12 or 10–12)	0	0%	1	8%
Middle and High School	0	0%	1	8%
Not currently teaching at the K–12 level	6	40%	1	8%

**Table D1 (continued)****Panel Member Demographics (by Panel)**

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Including this year, how many years of experience do you have teaching this subject?</b>				
3 years or less	2	13%	3	23%
4–7 years	3	20%	4	31%
8–11 years	6	40%	1	8%
12–15 years	3	20%	3	23%
16 years or more	1	7%	2	15%
<b>Which best describes the location of your K–12 school?</b>				
Urban	1	7%	3	23%
Suburban	5	33%	2	15%
Rural	3	20%	7	54%
Not currently working at the K–12 level	6	40%	1	8%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>				
Yes	5	33%	0	0%
No	1	7%	0	0%
Not college faculty	9	60%	13	100%

**Table D2*****Passing Score Summary by Round of Judgments***

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	<b>Panel 1</b>		<b>Panel 2</b>	
<b>Panelist</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 1</b>	<b>Round 2</b>
1	72.05	80.80	77.50	81.35
2	77.40	75.50	84.55	83.35
3	90.85	91.10	80.65	80.85
4	87.80	82.85	74.65	73.80
5	86.35	86.75	68.95	77.75
6	78.05	77.45	86.95	83.70
7	87.80	84.60	79.40	80.30
8	85.00	82.10	64.65	69.75
9	72.85	73.75	65.80	69.65
10	72.70	76.60	85.90	82.90
11	71.75	73.15	78.80	79.10
12	95.70	88.55	81.60	82.70
13	77.75	80.25	78.05	78.40
14	82.50	85.85		
15	73.85	83.45		
<b>Average</b>	80.83	81.52	77.50	78.74
<b>Lowest</b>	71.75	73.15	64.65	69.65
<b>Highest</b>	95.70	91.10	86.95	83.70
<b>SD</b>	7.73	5.43	7.22	4.84
<b>SEJ</b>	2.00	1.40	2.00	1.34

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**Table D3*****Final Evaluation: Panel 1***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	14	93%	1	7%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	11	73%	4	27%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	11	73%	4	27%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	13	87%	2	13%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	12	80%	3	20%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	9	60%	6	40%	0	0%	0	0%

**Table D3 (continued)**  
**Final Evaluation: Panel 1**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	9	60%	6	40%	0	0%		
• The between-round discussions	7	47%	6	40%	2	13%		
• The knowledge/skills required to answer each test item	13	87%	2	13%	0	0%		
• The passing scores of other panel members	3	20%	8	53%	4	27%		
• My own professional experience	5	33%	9	60%	1	7%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	9	60%	5	33%	1	7%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	0	0%	14	93%	1	7%		

**Table D4*****Final Evaluation: Panel 2***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	13	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	12	92%	1	8%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	11	85%	2	15%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	9	69%	4	31%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	9	69%	4	31%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	9	69%	4	31%	0	0%	0	0%

**Table D4 (continued)**  
**Final Evaluation: Panel 2**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	12	92%	1	8%	0	0%		
• The between-round discussions	6	46%	7	54%	0	0%		
• The knowledge/skills required to answer each test item	11	85%	2	15%	0	0%		
• The passing scores of other panel members	1	8%	9	69%	3	23%		
• My own professional experience	8	62%	3	23%	2	15%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	10	77%	3	23%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	0	0%	13	100%	0	0%		

## **Appendix H**

### **Test at a Glance**

### **Praxis Middle School English Language Arts (5047)**

## Middle School English Language Arts (5047)

### Test at a Glance

Test Name	Middle School English Language Arts		
Test Code	5047		
Time	160 minutes: 130 minutes for Selected Response (SR) section + 30 minutes for Constructed Response (CR) section		
Number of Questions	110 SR questions and 2 CR questions		
Format	The SR section, which accounts for 75% of the total test score, consists of single-selection multiple-choice questions with four options, as well as innovative question types, which may include multiple-selection multiple-choice, order/match, audio stimulus, table/grid, select in passage, and video stimulus. The CR section accounts for 25% of the total test score.		
	Content Categories	Approximate Number of Questions	Approximate Percent of Examination
	I. Reading	50 SR and 1 CR	46%
	II. Language Use and Vocabulary	16 SR	11% SR
	III. Writing, Speaking, and Listening	26 SR	18% SR
	IV. English Language Arts Instruction	18 SR and 1 CR	25%

## About This Test

The Middle School English Language Arts test measures whether prospective middle school English language arts teachers have the standards-relevant knowledge, skills, and abilities believed necessary for competent professional practice. Aligned to the Common Core State Standards (CCSS) for English Language Arts, the test measures examinees' skills and knowledge of concepts relevant to four categories: reading, including the study of literature (i.e., stories, drama, and poetry) and informational texts (i.e., literary nonfiction, such as essays, biographies, and speeches); use of the English language, including conventions of standard English and vocabulary development; writing, speaking, and listening; and English language arts instruction. The 110 selected response questions will address all of these categories. The two constructed response (CR) questions, or short essays, will also address the first and fourth categories, reading and English language arts instruction. The first CR question will ask examinees to interpret a piece of literature or informational text; the second will ask examinees to discuss approaches to teaching reading or writing, given a particular student writing sample or classroom context.

This test may contain some questions that will not count toward your score.

# Topics Covered

## I. READING

### A. General Knowledge

- Knows the major works, authors, and contexts of United States, British, and world literature appropriate for adolescents.
  - Identify the authors and titles of major works of fiction, poetry, drama, and literary nonfiction appropriate for adolescents.
  - Identify the historical or literary context of major works of fiction, poetry, drama, and literary nonfiction appropriate for adolescents.
- Understands the defining characteristics of literary genres (e.g., poetry, literary nonfiction, drama).
  - Identify typical characteristics of a genre.
  - Apply correct terminology for a genre (e.g., stanza vs. paragraph).
  - Compare and contrast different genres.
- Knows the defining characteristics of major subgenres (e.g., sonnet, historical fiction, functional text).
  - Identify characteristics of sub-genres through distinctions in form or content (e.g., sonnets vs. ballads, satire vs. realism).
  - Differentiate between two sub-genres (e.g., historical fiction and science fiction).

## B. Literature

- Understands how literal and inferential interpretations of a literary text can be supported with textual evidence.
  - Comprehend the literal meaning of a text.
  - Draw inferences from a text.
  - Determine the textual evidence that supports an analysis of what a text says or implies.
- Understands how a theme is developed within and across works from a wide variety of literary genres and other media.
  - Identify the theme of a given text.
  - Analyze how a theme is developed throughout one or more works.
  - Recognize universal themes from myths, traditional stories, or religious works and how they are rendered or alluded to in contemporary works.
- Understands how literary elements (e.g., characterization, setting, plot development) contribute to the meaning of a text.
  - Analyze the impact of differences in the points of view of characters and readers.
  - Analyze the structure of a plot.
  - Analyze how setting contributes to mood, tone, and conflict.
  - Analyze how particular lines of dialogue or story events impact meaning.
  - Analyze the text for the use of indirect and direct characterization.

- Understands how word choice (e.g., figurative, connotative, or informal language) contributes to the meaning and tone of a literary text.
  - Distinguish between connotation and denotation in a text.
  - Identify examples of various types of figurative language (e.g., extended metaphor, imagery, hyperbole).
  - Distinguish between what is directly stated in a text and what is meant (e.g., satire, irony, understatement).
  - Determine meaning of words and phrases as they are used in a text, including figurative and connotative meaning.
  - Analyze the impact of specific word choices on meaning and tone.
- Understands how poetic devices and structure contribute to the meaning of a poem.
  - Analyze how poetic devices (e.g. rhyme scheme, rhythm, figurative language) contribute to the meaning of a poem.
  - Analyze how the structure of a poem contributes to its meaning (e.g. stanza, free verse, concrete poem).
- Understands literacy skills to support active reading of a literary text (e.g., making predictions, making connections with the text, summarizing).
  - Identify literacy skills to support active reading (e.g., text-to-self connection, prediction, summarizing).
  - Evaluate a summary of a passage.
  - Evaluate the strength of a prediction based on textual evidence.

### C. Informational Texts & Rhetoric

- Understands how literal and inferential interpretations of an informational text can be supported with textual evidence.
  - Comprehend the literal meaning of a text.
  - Draw inferences from a text.
  - Determine the textual evidence that supports an analysis of what a text says or implies.
  - Compare two or more texts that provide conflicting facts or perspectives on the same topic.
- Knows a variety of organizational patterns that can be used to develop a central idea in an informational text.
  - Identify the central idea of a text.
  - Analyze how an author develops or refines a central idea in a text.
  - Identify the organizational pattern of a text (e.g., problem-solution, cause-effect, sequence order).
  - Analyze how ideas are connected and distinguished from one another in a text.
- Understands how word choice (e.g., figurative, connotative, or technical language) contributes to the meaning and tone of an informational text.
  - Distinguish between connotation and denotation in a text.
  - Identify the purpose of technical language in a text.
  - Distinguish between what is directly stated in an informational text and what is meant (e.g., satire, irony, understatement).
- Understands methods that authors use to convey purpose and perspective in informational texts.
  - Determine an author's point of view or purpose.
  - Analyze how an author uses rhetoric to support the point of view and/or purpose of a text.

## II. LANGUAGE USE & VOCABULARY

- Understands the conventions of standard English grammar, usage, syntax, and mechanics (e.g., sentence types, verb tenses, punctuation).
  - Explain the function of different parts of speech.
  - Identify errors in standard English grammar, usage, syntax, and mechanics (e.g., inconsistent verb tense, non-parallel structure).
  - Justify grammar, usage, syntax, and mechanics choices (e.g., colon vs. semi-colon, its vs. it's, saw vs. seen).
  - Identify examples of different sentence types (e.g., simple, compound, compound-complex).
- Understands the use of affixes, context, and syntax to determine word meaning.
  - Apply knowledge of affixes to determine word meaning.
  - Use context clues to determine word meaning.
  - Apply knowledge of syntax to determine word meaning.
- Understands the use of print and digital reference materials to support correct language usage.
  - Determine the most appropriate print or digital reference material for a particular language usage task.
- Is familiar with variation in dialect and diction across regions, cultural groups, and time periods.
  - Identify variation in dialect and diction across regions, cultural groups, and time periods.

## III. WRITING, SPEAKING, & LISTENING

- Understands the distinct characteristics of various types of writing (e.g., argumentative, informative/explanatory, narrative).
  - Distinguish among common types of writing.
  - Identify examples of common types of writing.
  - Identify typical characteristics of a type of writing.
- Understands that effective writing is appropriate to the task, purpose, and audience.
  - Identify the task, purpose, or intended audience for a piece of writing.
  - Choose the most appropriate type of writing for a particular task, purpose, or audience.
  - Evaluate the effectiveness of a particular piece of writing for a specific task, purpose, or audience.
- Understands the characteristics of clear and coherent writing (e.g., development, organization, and style).
  - Identify details that help to develop a main idea.
  - Choose appropriate transitions.
  - Justify stylistic choices within a clear and coherent piece of writing.
- Knows effective research practices, including evaluating the credibility of multiple print and digital sources, gathering relevant information, and citing sources accurately.
  - Identify relevant information during research on a given topic.
  - Evaluate the credibility of a print or digital source.
  - Identify effective research practices.
  - Interpret a citation of a print or digital source.
  - Apply appropriate documentation techniques when quoting or paraphrasing source material in order to avoid plagiarism.

- Understands the effective delivery of a speech or presentation (e.g., eye contact, visual aids, tone).
  - Identify characteristics of effective delivery of a speech or presentation.
  - Evaluate the integration of multi-media components or visual displays in a particular presentation.
  - Evaluate the advantages and disadvantages of using different media to present ideas.
- Understands methods that authors use to appeal to a specific audience.
  - Identify methods of appeal or persuasion (e.g., expert opinion, generalization, testimonial).
  - Evaluate the effectiveness of an author's methods of appeal.
- Understands what constitutes an effective written argument with strong supporting evidence.
  - Evaluate the argument and specific claims in an expository or persuasive text.
  - Assess whether an author's reasoning is sound.
  - Assess whether evidence is relevant, factual, and sufficient.
- Knows techniques for instructing students to participate productively in collaborative discussions (one-on-one, in groups, and teacher-led) and listen actively.
  - Identify a variety of techniques for instructing students to participate productively in collaborative discussions and listen actively (e.g., selecting age-appropriate topics, facilitating appropriate discussion behavior, ensuring accountability).
  - Evaluate the effectiveness of specific techniques for achieving particular discussion goals.
- Knows techniques for instructing students to communicate effectively and appropriately using technological tools (e.g., presentation software, blogs, wikis).
  - Identify a variety of techniques for instructing students to communicate effectively and appropriately using technological tools.
  - Evaluate the effectiveness of specific technology-based techniques for achieving particular communication goals.
- Knows commonly used research-based approaches to grouping and differentiated instruction to meet specific instructional objectives in English language arts (e.g., literature circles, peer conferencing, collaborating with educators of exceptional/special needs or linguistically diverse children).
  - Identify approaches to grouping or differentiated instruction to meet specific instructional objectives in English language arts.
  - Evaluate the effectiveness of specific grouping or differentiation approaches for achieving particular instructional goals.

#### IV. ENGLISH LANGUAGE ARTS INSTRUCTION

- Knows commonly used research-based approaches to supporting language acquisition and vocabulary development for diverse learners.
  - Recognize approaches to supporting language acquisition or vocabulary development.
  - Evaluate the effectiveness of specific approaches to supporting language acquisition or vocabulary development.
  - Interpret research and apply it to particular instructional challenges related to language acquisition or vocabulary development.
- Is familiar with approaches to choosing texts for students based on ability and interests.
  - Identify approaches to choosing texts for students based on ability and interests.

- Understands commonly used research-based strategies for teaching adolescent reading (e.g., activating prior knowledge, modeling metacognitive practices).
  - Recognize commonly used research-based strategies for teaching adolescent reading.
  - Evaluate the effectiveness of specific strategies to support a particular reading task.
  - Interpret research and apply it to particular reading instruction challenges.
  
- Understands commonly used research-based approaches to teaching components of writing (e.g., writing workshop, modeling).
  - Recognize commonly used research-based approaches to teaching components of writing.
  - Evaluate the effectiveness of specific strategies to support a particular writing task.
  - Interpret research and apply it to particular writing instruction challenges.
  
- Knows approaches to and purposes of formative and summative assessment of reading, writing, speaking, and listening (e.g., use of rubrics, conferencing techniques, providing useful feedback).
  - Recognize a variety of approaches to and purposes of formative and summative assessment of reading, writing, speaking, and listening.
  - Evaluate the effectiveness of a variety of approaches to formative and summative assessment of reading, writing, speaking, and listening.
  - Interpret research and apply it to particular assessment challenges.
  
- Knows effective approaches to incorporating student input into the design and use of English language arts curriculum and assessments (e.g., literature selection, collaboratively designed rubrics).
  - Identify approaches to gathering student input, feedback, and reflection that motivate students and support the development of an inclusive learning environment.
  - Identify approaches to helping students become monitors of their own work and growth in speaking, listening, writing, reading, enacting, and viewing.

## **Appendix I**

**Virginia Standard Setting Technical Report  
Praxis Middle School Mathematics (5169)  
March 2013**



*Listening. Learning. Leading.*

Standard-Setting Technical Report

**PRAXIS™ MIDDLE SCHOOL MATHEMATICS (5169)**

Prepared for the Virginia Department of Education

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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# EXECUTIVE SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School Mathematics (5169) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on March 21, 2013.

## RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Middle School Mathematics test, the recommended passing score is 28 out of a possible 45 raw-score points. The scaled score associated with a raw score of 28 is 157 on a 100–200 scale.

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School Mathematics (5169) test, research staff from ETS designed and conducted a standard-setting study on March 21, 2013, in Richmond, Virginia.

The study involved an expert panel of educators. The VDOE recommended panelists with (a) experience as either middle school mathematics teachers or college faculty who prepare middle school mathematics teachers and (b) familiarity with the knowledge and skills required of beginning middle school mathematics teachers (See Appendix A for the names and affiliations of the panelists.)

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the standard-setting study to the VDOE. The VDOE is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a panel of experienced educators. The VDOE may want to consider the recommended passing score but also other sources of information when setting the final Praxis Middle School Mathematics passing score (see Geisinger & McCormick, 2010). The VDOE may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Middle School Mathematics test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows the VDOE to recognize that any test score on any standardized test—including a Praxis Middle School Mathematics test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to gauge the likelihood that the recommended passing score from this panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The

smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error is more important to minimize.

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## OVERVIEW OF THE PRAXIS MIDDLE SCHOOL MATHEMATICS TEST

The Praxis Middle School Mathematics *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level middle school mathematics teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hour assessment contains 55 selected-response and numeric-entry items<sup>1</sup> covering two content areas: *Arithmetic and Algebra* (approximately 34 items) and *Geometry and Data* (approximately 21 items).<sup>2</sup> The reporting scale for the Praxis Middle School Mathematics test ranges from 100 to 200 scaled-score points.

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<sup>1</sup> Ten of the 55 selected-response and numeric-entry items are pretest items and do not contribute to a candidate's score.

<sup>2</sup> The number of items for each content area may vary slightly from form to form of the test.

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## PROCESSES AND METHODS

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

### DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panel created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate.

The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis Middle School Mathematics test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

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## RESULTS

### EXPERT PANELS

Table 1 presents a summary of the panelists' demographic information. (See Appendix A for a listing of panelists.) Fourteen panelists were teachers, two were college faculty, and two were administrators or department heads. One of the two faculty members' job responsibilities included the training of middle school mathematics teachers.

**Table 1**  
*Panel Member Demographics*

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	14	78%
Administrator/Department head	2	11%
College faculty	2	11%
<b>Race</b>		
White	14	78%
Black or African American	3	17%
Other	1	6%
<b>Gender</b>		
Female	14	78%
Male	4	22%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	18	100%
No	0	0%
<b>Are you currently teaching this subject in your state?</b>		
Yes	16	89%
No	2	11%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	8	44%
No	10	56%

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**Table 1 (continued)**  
**Panel Member Demographics**

	<i>N</i>	<i>%</i>
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Middle school (6–8 or 7–9)	16	89%
Not currently teaching at the K–12 level	2	11%
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	2	11%
4–7 years	10	56%
8–11 years	6	33%
12–15 years	0	0%
16 years or more	0	0%
<b>Which best describes the location of your K–12 school?</b>		
Urban	5	28%
Suburban	7	39%
Rural	4	22%
Not currently working at the K–12 level	2	11%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	1	6%
No	1	6%
Not college faculty	16	89%

## STANDARD-SETTING JUDGMENTS

Table 2 summarize the standard-setting judgments of panelists. The table shows the passing scores—the number of raw points needed to pass the test—recommended by each panelist. The table also include estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>3</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test.

<sup>3</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 2**  
*Passing Score Summary*

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<b>Panelist</b>	<b>Passing Score</b>
1	26.50
2	21.50
3	28.30
4	30.70
5	22.55
6	29.80
7	28.90
8	32.20
9	26.00
10	27.65
11	27.90
12	27.20
13	29.10
14	33.65
15	28.00
16	26.35
17	24.55
18	25.00
<b>Average</b>	27.55
<b>Lowest</b>	21.50
<b>Highest</b>	33.65
<b>SD</b>	3.08
<b>SEJ</b>	0.73

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The panel's passing score recommendation for the Praxis Middle School Mathematics test is 27.55 (out of a possible 45 raw-score points). The value was rounded to 28 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 28 raw points is 157.

Table 3 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 3**

*Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>4</sup>*

Recommended passing score (CSEM)		Scale score equivalent
	28 (3.29)	157
-2 CSEMs	22	139
-1 CSEM	25	148
+ 1 CSEM	32	168
+ 2 CSEMs	35	177

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study and that the facilitator’s instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

<sup>4</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

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## SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Middle School Mathematics (5169) test, research staff from ETS designed and conducted a standard-setting study on March 21, 2013.

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Middle School Mathematics test, the recommended passing score is 28 out of a possible 45 raw-score points. The scaled score associated with a raw score of 28 is 157 on a 100–200 scale.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
George Adkins	Martinsville Middle School
Jaime Arnett	Pocahontas Middle School
Pamela R.H. Bailey	George Mason University
Shamika Carey	Caroline County Public Schools
William Fox	G.W. Carver Middle School
Patricia Freeman	Longfellow Middle School
Javanese Hailey	Arlington Public Schools
Ingrid E. James	Fredericksburg City Public Schools
Karen L. Jones	Montgomery County Public Schools
Michael Kelly	Regent University
Michael McCormick	Cradock Middle School
Noël Sciegaj	James Wood Middle School
Nancy Scott	Phenix PreK-8 School
Courtney Shortridge	Lunenburg Middle School
Carolyn Swift	Buford Middle School
Susan Ullestad	Toano Middle School
Katelyn Woods	Plaza Middle School
Gessica Wright	Sandusky Middle School

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APPENDIX B  
STUDY AGENDA

# **AGENDA**

## **Praxis Middle School Mathematics (5169) Standard-Setting Study**

Welcome and Introduction

Overview of Study

“Take” the Praxis Middle School Mathematics Test  
(Take breaks as needed)

Discuss the Praxis Middle School Mathematics Test

Discuss the Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate

Break

Training for Standard-Setting Judgments

Complete Standard Setting Judgments

Complete Final Evaluation

Collect Materials

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## APPENDIX C

### TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>5</sup>

### A target candidate ...

#### Numbers and Operations

1. Understands proportional reasoning and ratio relationships
2. Knows and applies rational number operations and properties of real numbers to solve problems (standard and real world)
3. Recognizes the reasonableness of results within the context of a given problem

#### Algebra

4. Understands how to represent and solve linear inequalities and systems of linear equations
5. Knows how to recognize and represent sequences and linear relationships algebraically

#### Functions and Their Graphs

6. Understands how to analyze and represent functions that model given information through multiple representations
7. Understands the basic characteristics and shape of the graph of functions, including domain, range, slope and intercepts

#### Geometry and Measurement

8. Understands how to apply geometry skills including multi-step applications of basic concepts (including area, perimeter, volume, angles/lines, shapes, etc.)
9. Knows how to analyze geometric relationships (e.g., basic transformations, distance, similarity, congruence)
10. Understands systems of measurement (e.g., metric, customary)

#### Probability and Statistics

11. Knows how to interpret, analyze and represent data sets in various forms and understands which form is most appropriate in a given situation
12. Knows how to analyze and interpret measures of central tendency and variability
13. Knows how to develop and analyze probability models

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<sup>5</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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## APPENDIX D

# EVALUATION RESULTS

**Table D1*****Final Evaluation***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	16	89%	2	11%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	16	89%	2	11%	0	0%	0	0%
• The opportunity to "take the test" and to discuss the test content was useful.	16	89%	2	11%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful.	11	61%	7	39%	0	0%	0	0%
• The training for the Standard Setting judgments was adequate to give me the information I needed to complete my assignment.	16	89%	2	11%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	15	83%	3	17%	0	0%	0	0%

## **Appendix J**

**Multistate Standard Setting Technical Report  
Praxis Middle School Mathematic (5169)  
March 2013**



*Listening. Learning. Leading.*

Multistate Standard-Setting Technical Report

**PRAXIS™ MIDDLE SCHOOL MATHEMATICS (5169)**

Licensure and Credentialing Research

ETS

Princeton, New Jersey

February 2013

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## EXECUTIVE SUMMARY

To support the decision-making process of education agencies establishing a passing score (cut score) for the Praxis™ Middle School Mathematics (5169) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study.

### PARTICIPATING STATES

Panelists from 18 states and Washington, DC were recommended by their respective education agency. The education agencies recommended panelists with (a) experience either as middle school mathematics teachers or college faculty who prepare middle school mathematics teachers and (b) familiarity with the knowledge and skills required of beginning middle school mathematics teachers.

### RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Middle School Mathematics test, the recommended passing score<sup>1</sup> is 31 out of a possible 45 raw-score points. The scaled score associated with a raw score of 31 is 165 on a 100–200 scale.

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<sup>1</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis™ Middle School Mathematics (5169) test, research staff from ETS designed and conducted a multistate standard-setting study in February 2013 in Princeton, New Jersey. Education agencies<sup>2</sup> recommended panelists with (a) experience, either as middle school mathematics teachers or college faculty who prepare middle school mathematics teachers and (b) familiarity with the knowledge and skills required of beginning middle school mathematics teachers. Eighteen states and Washington, DC (see Table 1) were represented by 30 panelists. (See Appendix A for the names and affiliations of the panelists.)

**Table 1**

***Participating Jurisdictions and Number of Panelists***

---

Alaska (1 panelist)	New Jersey (2 panelists)
Arkansas (1 panelist)	Nevada (2 panelists)
Idaho (2 panelists)	South Carolina (2 panelists)
Kentucky (1 panelist)	South Dakota (2 panelists)
Louisiana (1 panelist)	Utah (2 panelists)
Maryland (2 panelists)	Vermont (1 panelist)
Mississippi (2 panelists)	Washington, DC (2 panelists)
North Carolina (2 panelists)	West Virginia (1 panelist)
North Dakota (1 panelist)	Wyoming (1 panelist)
New Hampshire (2 panelists)	

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The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each jurisdiction, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score,<sup>3</sup> which represents the combined judgments of two panels of experienced educators. Each jurisdiction may want

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<sup>2</sup> States and jurisdictions that currently use Praxis were invited to participate in the multistate standard-setting study.

<sup>3</sup> In addition to the recommended passing score averaged across the two panels, the recommended passing scores for each panel are presented.

to consider the recommended passing score but also other sources of information when setting the final Praxis Middle School Mathematics passing score (see Geisinger & McCormick, 2010). A jurisdiction may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the jurisdiction's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Middle School Mathematics test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows a jurisdiction to recognize that any test score on any standardized test—including a Praxis Middle School Mathematics test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows a jurisdiction to gauge the likelihood that the recommended passing score from a particular panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each jurisdiction should consider the likelihood of classification error. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The jurisdiction needs to consider which decision error may be more important to minimize.

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# OVERVIEW OF THE PRAXIS MIDDLE SCHOOL MATHEMATICS TEST

The Praxis Middle School Mathematics *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level middle school mathematics teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hour assessment contains 55 selected-response and numeric-entry items<sup>4</sup> covering two content areas: *Arithmetic and Algebra* (approximately 34 items) and *Geometry and Data* (approximately 21 items).<sup>5</sup> The reporting scale for the Praxis Middle School Mathematics test ranges from 100 to 200 scaled-score points.

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## PROCESSES AND METHODS

The design of the standard-setting study included two, independent expert panels. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

For each panel, the standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

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<sup>4</sup> Ten of the 55 selected-response and numeric-entry items are pretest items and do not contribute to a candidate's score.

<sup>5</sup> The number of items for each content area may vary slightly from form to form of the test.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

## DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

Panel 1 created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate. The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

For Panel 2, the panelists began with the description of the target candidate developed by Panel 1. Given that the multistate standard-setting study was designed to provide two recommendations for the same performance standard, it was important that panels use consistent target candidate description to frame their judgments. The panelists reviewed the target candidate description, and any ambiguities were discussed and clarified.

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis Middle School Mathematics test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. Items were highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located an item in the same difficulty range) or diverged in their judgments.

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the target candidate and helped to clarify aspects of

items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to another's judgment, but to understand the different relevant perspectives among the panelists.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

Other than the description of the target candidate, results from Panel 1 were not shared with Panel 2. The item-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

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## RESULTS

### EXPERT PANELS

Table 2 presents a summary of the panelists' demographic information. The panels included 30 educators representing 18 states and Washington, DC. (See Appendix A for a listing of panelists.) Twenty-one panelists were teachers, eight were college faculty, and one was an administrator or department head. All of the faculty members' job responsibilities included the training of middle school mathematics teachers.

The number of experts by panel and their demographic information are presented in Appendix D (see Table D1).

**Table 2**  
***Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	21	70%
Administrator/Department head	1	3%
College faculty	8	27%
<b>Race</b>		
White	22	73%
Black or African American	5	17%
Hispanic or Latino	1	3%
Asian or Asian American	1	3%
American Indian or Alaskan Native	1	3%
<b>Gender</b>		
Female	22	73%
Male	8	27%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	24	80%
No	6	20%
<b>Are you currently teaching this subject in your state?</b>		
Yes	27	90%
No	3	10%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	18	60%
No	12	40%
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Elementary (K–5 or K–6)	1	3%
Middle school (6–8 or 7–9)	20	67%
Middle and High school	1	3%
Not currently teaching at the K–12 level	8	27%

**Table 2 (continued)*****Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	2	7%
4–7 years	13	43%
8–11 years	2	7%
12–15 years	7	23%
16 years or more	6	20%
<b>Which best describes the location of your K–12 school?</b>		
Urban	9	30%
Suburban	8	27%
Rural	5	17%
Not currently working at the K–12 level	8	27%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	8	27%
No	0	0%
Not college faculty	22	73%

**STANDARD-SETTING JUDGMENTS**

Table 3 summarizes the standard-setting judgments (Round 2) of panelists. The table also includes estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>6</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test. The confidence intervals created by adding/subtracting two SEJs to each panel’s recommended passing score overlap, indicating that they may be comparable.

Panelist-level results, for Rounds 1 and 2, are presented in Appendix D (see Table D2).

<sup>6</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 3**  
***Summary of Round 2 Standard-setting Judgments***

	<b>Panel 1</b>	<b>Panel 2</b>
Average	29.18	31.45
Lowest	23.80	25.40
Highest	33.70	35.85
SD	2.59	2.81
SEJ	0.72	0.68

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for Panel 2 (see Table D2 in Appendix D). The standard deviation increased slightly between rounds for Panel 1. The Round 2 average score is the panel’s recommended passing score.

The panels’ passing score recommendations for the Praxis Middle School Mathematics test are 29.18 for Panel 1 and 31.45 for Panel 2 (out of a possible 45 raw-score points). The values were rounded to the next highest whole number, to determine the functional recommended passing score — 30 for Panel 1 and 32 for Panel 2. The scaled scores associated with 30 and 32 raw points are 162 and 168, respectively.

In addition to the recommended passing score for each panel, the average passing score across the two panels is provided to help education agencies determine an appropriate passing score. The panels’ average passing score recommendation for the Praxis Middle School Mathematics test is 30.32 (out of a possible 45 raw-score points). The value was rounded to 31 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 31 raw points is 165.

Table 4 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 4*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>7</sup>***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	31 (3.14)	165
-2 CSEMs	25	148
-1 CSEM	28	157
+ 1 CSEM	35	177
+ 2 CSEMs	38	186

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were also shown the panel's recommended passing score and asked (a) how comfortable they are with the recommended passing score and (b) if they think the score was too high, too low, or about right. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the description of the target candidate was at least *somewhat influential* in guiding their standard-setting judgments; 26 of the 30 panelists indicated the description was *very influential*. All of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. More than half of the panelists (17 of the 30 panelists) indicated that their own professional experience was *very influential* in guiding their judgments.

<sup>7</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

All of the panelists indicated they were at least *somewhat comfortable* with the passing score they recommended; 25 of the 30 panelists were *very comfortable*. Twenty-seven of the 30 panelists indicated the recommended passing score was *about right*.

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## SUMMARY

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis Middle School Mathematics test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Middle School Mathematics test, the recommended passing score<sup>8</sup> is 31 out of a possible 45 raw-score points. The scaled score associated with a raw score of 31 is 165 on a 100–200 scale.

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<sup>8</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Sarah B. Bush	Bellarmine University (KY)
Brett Distel	Douglas Middle School (SD)
John E. Donovan II	Plymouth State University (NH)
Gina Dunn	Lander University (SC)
Karen M. Feld	Pleasant Grove Jr High School (UT)
Carla R. Gales	Douglas Byrd Middle School (NC)
SeLisa Godfrey	Chowan Middle School (NC)
Jennifer Guest	Hand Middle School (SC)
Katrina Hall	Hollis Brookline Middle School (NH)
Melissa Horn	Treasure Mountain Junior High School (UT)
Jessica Ivy	Mississippi State University (MS)
James Kelly	Bob Miller Middle School (NV)
Thomas Klein	Marshall University (WV)
Claudine Korsorku	Memorial Middle School (NJ)
Arthur W. Martin III	Holt Middle School (AR)
John McKain	Laramie Junior High School (WY)
Hertensia Mixon	Desoto Central Middle School (MS)
Lynne Nielsen	Louisiana Tech University (LA)
Rebecca Peters	Beulah Middle School (ND)
Eric A. Porter	Hardy Middle School (DC)
Marianna Rivera	Cortney Junior High School (NV)

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*Participating Panelists With Affiliation (continued)*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Moniqua Sawyer	John Eaton Elementary School (DC)
Deborah Serafino	Christ the King School (VT)
Scott Sirota	Eric S. Smith Middle School (NJ)
Jamalee Stone	Black Hills State University (SD)
Brenda Turner	Colony Middle School (AK)
Sasha Wang	Boise State University (ID)
Theresa Wheeler	Sudlersville Middle School (MD)
Leora White	Lone Star Middle School (ID)
Greta L. Wildasin	Howard County Public School System – Murray Hill Middle School (MD)

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APPENDIX B  
STUDY AGENDA

# **AGENDA**

## **Praxis Middle School Mathematics (5169) Standard-Setting Study**

Day 1

Welcome and Introduction

Overview of Standard Setting and the Praxis Middle School Mathematics Test

Review the Praxis Middle School Mathematics Test

Discuss the Praxis Middle School Mathematics Test

Lunch

Define the Knowledge/Skills of a Target Candidate

Break

Standard-Setting Training

Round 1 Standard Setting Judgments

Collect Materials; End of Day 1

# **AGENDA**

## **Praxis Middle School Mathematics (5169) Standard-Setting Study**

Day 2

Overview of Day 2

Round 1 Feedback and Round 2 Judgments

Lunch

Feedback on Round 2 Recommended Cut Score

Complete Final Evaluation

Collect Materials; End of Study

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## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>9</sup>

A target candidate ...

### **Numbers and Operations**

1. Understands proportional reasoning and ratios relationships
2. Knows and applies rational number operations and properties to solve problems (standard and real world)
3. Recognizes the reasonableness of results within the context of a given problem

### **Algebra**

4. Understands how to represent and solve linear inequalities and systems of linear equations
5. Knows how to recognize and represent sequences and linear relationships algebraically

### **Functions and Their Graphs**

6. Understands how to analyze and represent functions that model given information through multiple representations
7. Understands the basic characteristics and shape of the graph of functions, including domain, range, minimum/maximum, slope, and intercepts

### **Geometry and Measurement**

8. Understands how to apply geometry skills including multi-step applications of basic concepts (including area, perimeter, volume, angles/lines, shapes, etc.)
9. Knows how to analyze geometric relationships (e.g., basic transformations, distance, similarity, congruence)

### **Probability and Statistics**

10. Knows how to interpret, analyze and represent data in various forms and understands which form is most appropriate in a given situation
11. Knows how to analyze and interpret measures of central tendency and variability
12. Knows how to develop and analyze probability models

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<sup>9</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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# APPENDIX D

## RESULTS

**Table D1**  
***Panel Member Demographics (by Panel)***

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>
<b>Current position</b>				
Teacher	10	77%	11	65%
Administrator/Department head	1	8%	0	0%
College faculty	2	15%	6	35%
<b>Race</b>				
White	8	62%	14	82%
Black or African American	3	23%	2	12%
Hispanic or Latino	1	8%	0	0%
Asian or Asian American	0	0%	1	6%
American Indian or Alaskan Native	1	8%	0	0%
<b>Gender</b>				
Female	9	69%	13	76%
Male	4	31%	4	24%
<b>Are you currently certified to teach this subject in your state?</b>				
Yes	10	77%	14	82%
No	3	23%	3	18%
<b>Are you currently teaching this subject in your state?</b>				
Yes	12	92%	15	88%
No	1	8%	2	12%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>				
Yes	7	54%	11	65%
No	6	46%	6	35%
<b>At what K–12 grade level are you currently teaching this subject?</b>				
Elementary (K–5 or K–6)	0	0%	1	6%
Middle school (6–8 or 7–9)	10	77%	10	59%
Middle and High school	1	8%	0	0%
Not currently teaching at the K–12 level	2	15%	6	35%

**Table D1 (continued)*****Panel Member Demographics (by Panel)***

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Including this year, how many years of experience do you have teaching this subject?</b>				
3 years or less	1	8%	1	6%
4–7 years	6	46%	7	41%
8–11 years	0	0%	2	12%
12–15 years	5	38%	2	12%
16 years or more	1	8%	5	29%
<b>Which best describes the location of your K–12 school?</b>				
Urban	4	31%	5	29%
Suburban	7	54%	1	6%
Rural	0	0%	5	29%
Not currently working at the K–12 level	2	15%	6	35%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>				
Yes	2	15%	6	35%
No	0	0%	0	0%
Not college faculty	11	85%	11	65%

**Table D2**  
*Passing Score Summary by Round of Judgments*

<b>Panelist</b>	<b>Panel 1</b>		<b>Panel 2</b>	
	<b>Round 1</b>	<b>Round 2</b>	<b>Round 1</b>	<b>Round 2</b>
1	27.10	28.15	32.70	32.20
2	24.90	23.80	28.00	27.20
3	29.80	33.70	33.05	33.45
4	31.30	31.70	31.90	32.00
5	25.20	26.90	32.75	34.10
6	27.80	28.60	31.25	33.95
7	27.65	27.70	33.00	33.30
8	30.05	30.60	27.80	28.90
9	33.40	32.40	37.45	35.85
10	27.90	28.65	25.65	28.55
11	26.70	27.60	31.30	31.00
12	28.15	29.45	30.25	30.55
13	30.80	30.15	30.70	32.50
14			26.50	30.00
15			22.20	25.40
16			28.05	30.80
17			34.85	34.85
<b>Average</b>	28.52	29.18	30.44	31.45
<b>Lowest</b>	24.90	23.80	22.20	25.40
<b>Highest</b>	33.40	33.70	37.45	35.85
<b>SD</b>	2.45	2.59	3.72	2.81
<b>SEJ</b>	0.68	0.72	0.90	0.68

**Table D3*****Final Evaluation: Panel 1***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	12	92%	1	8%	0	0%	0	0%
• The instructions and explanations provided by the facilitator were clear.	11	85%	2	15%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	12	92%	1	8%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	11	85%	2	15%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	12	92%	1	8%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	10	77%	3	23%	0	0%	0	0%

**Table D3 (continued)**  
**Final Evaluation: Panel 1**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	11	85%	2	15%	0	0%		
• The between-round discussions	8	62%	5	38%	0	0%		
• The knowledge/skills required to answer each test item	12	92%	1	8%	0	0%		
• The passing scores of other panel members	0	0%	11	85%	2	15%		
• My own professional experience	8	62%	4	31%	1	8%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	11	85%	2	15%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	0	0%	12	92%	1	8%		

**Table D4*****Final Evaluation: Panel 2***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	17	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitator were clear.	17	100%	0	0%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	16	94%	1	6%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	17	100%	0	0%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	17	100%	0	0%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	15	88%	2	12%	0	0%	0	0%

**Table D4 (continued)**  
**Final Evaluation: Panel 2**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	15	88%	2	12%	0	0%		
• The between-round discussions	14	82%	3	18%	0	0%		
• The knowledge/skills required to answer each test item	12	71%	5	29%	0	0%		
• The passing scores of other panel members	1	6%	11	65%	5	29%		
• My own professional experience	9	53%	8	47%	0	0%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	14	82%	3	18%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	2	12%	15	88%	0	0%		

## **Appendix K**

### **Test at a Glance Praxis Middle School Mathematic (5169)**

**Middle School Mathematics (5169)**

***Test at a Glance***

Test Name	<b>Middle School Mathematics</b>		
Test Code	<b>5169</b>		
Time	<b>120 Minutes</b>		
Number of Questions	<b>55 Selected Response Questions</b>		
Format	<b>Multiple-choice</b>		
	Content Categories	Approximate Number of Questions	Approximate Percent of Examination
	I. Arithmetic and Algebra	34	62%
	II. Geometry and Data	21	38%

**About This Test**

The Middle School Mathematics measures whether entry-level middle school mathematics educators have the standards-relevant knowledge, skills, and abilities believed necessary for competent professional practice.

This test may contain some questions that will not count toward your score.

# Topics Covered

## I. ARITHMETIC AND ALGEBRA

### A. Numbers and Operations

- Understands operations and properties of the real number system.
  - Solve problems using addition, subtraction, multiplication, and division of rational numbers.
  - Apply the order of operations.
  - Given operations on a number system, determine whether the properties hold (e.g., commutative, associative, distributive).
  - Compare, classify, and order real numbers.
  - Perform operations involving exponents, including negative exponents.
  - Simplify and approximate radicals.
  - Represent and compare very large and very small numbers (e.g., scientific notation).
- Understands the relationships among fractions, decimals, and percents.
  - Convert among fractions, decimals, and percents.
  - Represent fractions, decimals, and percents using various models.
- Knows how to use ratio reasoning to solve problems.
  - Apply the concept of a ratio and use ratio language and notation to describe a relationship between two quantities.
  - Compute unit rates.
  - Use ratio reasoning to convert rates.
  - Solve problems involving scale factors.

- Knows how to use proportional relationships to solve real-world problems.
  - Recognize and represent proportional and inversely proportional relationships between two quantities.
  - Use proportional relationships to solve multistep ratio and percent problems.
- Knows how to use basic concepts of number theory (e.g., divisibility, prime factorization, multiples) to solve problems.
  - Recognize relationships involving prime and composite numbers.
  - Solve problems involving odd or even numbers.
  - Solve problems involving factors, multiples, and divisibility.
- Knows a variety of strategies to determine the reasonableness of results.
  - Recognize the reasonableness of results within the context of a given problem.
  - Test the reasonableness of results using estimation.
  - Estimate absolute and relative error in the numerical answer to a problem.

### B. Algebra

- Knows how to evaluate and manipulate algebraic expressions, equations, and formulas.
  - Perform arithmetic operations on polynomials.
  - Manipulate and perform arithmetic operations on problems involving rational expressions.
  - Evaluate, manipulate, and compare algebraic expressions involving radicals and exponents, including negative exponents.
  - Use variables to construct and solve equations in real-world contexts.
  - Translate verbal relationships into algebraic equations or expressions.

- Knows how to recognize and represent linear relationships algebraically.
  - Determine the equation of a line.
  - Recognize and use the basic forms of linear equations.
- Knows how to solve linear equations and inequalities.
  - Solve one-variable linear equations and inequalities algebraically and represent solutions on a number line.
- Knows how to represent and solve nonlinear equations and inequalities.
  - Solve one-variable nonlinear equations and inequalities (e.g., absolute value, quadratic) algebraically and represent solutions on a number line.
- Knows how to represent and solve systems of equations and inequalities.
  - Represent and solve systems of linear equations and inequalities with two variables algebraically and graphically.
- Knows how to recognize and represent simple sequences or patterns (e.g., arithmetic, geometric).
  - Evaluate, extend, or algebraically represent rules that involve number patterns.
  - Describe or extend patterns involving shapes or figures.
  - Explore patterns in order to make conjectures, predictions, or generalizations.
- Knows how to determine and interpret the domain and the range of a function numerically, graphically, and algebraically.
  - Determine the domain and range of a given table of values.
  - Determine the domain and range from a given graph of a function.
  - Determine the domain and range of a given function.
  - Interpret domain and range in real-world settings.
- Understands basic characteristics of linear functions (e.g., slope, intercepts).
  - Determine the slope of a given linear function.
  - Interpret slope as a constant rate of change.
  - Determine the x- and y-intercepts of a given linear function.
  - Interpret the x- and y-intercepts of a given linear function.
- Understands the relationships among functions, tables and graphs.
  - Determine and interpret the x- and y-intercepts of any given function.
  - Given a graph (e.g., linear, quadratic, absolute value, simple exponential), select an equation that best represents the graph.
  - Determine the graphical properties and sketch a graph given an equation of a linear, quadratic, absolute value, or simple exponential function.
- Knows how to analyze and represent functions that model given information.
  - Develop a model (e.g., graph, equation, table) of a given set of conditions.
  - Evaluate whether a particular mathematical model (e.g., graph, equation, table) can be used to describe a given set of conditions.

### C. Functions and Their Graphs

- Knows how to identify, define, and evaluate functions.
  - Know function notation.
  - Given a set of conditions, decide whether they represent a function.
  - Evaluate functions for given values (algebraically, graphically, tabular).

## II. GEOMETRY AND DATA

### A. Geometry and Measurement

- Knows how to solve problems involving perimeter, area, surface area, and volume.
  - Calculate and interpret perimeter and area of geometric shapes.
  - Calculate and interpret surface area and volume of geometric shapes.
  - Use two-dimensional representations of three-dimensional objects to visualize and solve problems.
- Understands the concepts of similarity and congruence.
  - Use similarity and congruence to solve problems with two-dimensional and three-dimensional figures.
- Understands properties of lines (e.g., parallel, perpendicular, intersecting) and angles.
  - Solve problems involving parallel, perpendicular, and intersecting lines.
  - Apply angle relationships (e.g., supplementary, vertical, alternate interior) to solve problems.
- Understands properties of triangles.
  - Solve problems that involve sides (e.g., Pythagorean theorem) and angles.
  - Solve problems that involve medians, midpoints, and altitudes.
  - Solve problems involving special triangles (e.g., isosceles, equilateral, right).
- Understands properties of quadrilaterals (e.g., rectangle, rhombus, trapezoid) and other polygons.
  - Know geometric properties of various quadrilaterals (e.g., parallelogram, trapezoid)
  - Know relationships among quadrilaterals.
  - Solve problems involving angles and diagonals.
- Solve problems involving polygons with more than four sides.
- Understands properties of circles.
  - Solve problems involving circumference and area of a circle.
  - Solve problems involving diameter or radius of a circle.
  - Solve basic problems involving central angles, tangents, arcs, and sectors.
- Knows how to interpret geometric relationships in the  $xy$ -plane (e.g., transformations, distance, midpoint).
  - Use coordinate geometry to represent and examine the properties of geometric shapes (e.g., Pythagorean theorem, area of rectangle).
  - Determine the distance between two points.
  - Determine the midpoint of two points.
  - Interpret and solve problems involving transformations.
- Understands systems of measurement (e.g., metric, customary).
  - Solve measurement and estimation problems involving time, length, temperature, volume, and mass in both U.S. customary and metric systems, where appropriate.
  - Convert units within each system.
- Is familiar with how geometric constructions are made.
  - Identify formal geometric constructions made with a variety of tools and methods (e.g., copying a segment, bisecting an angle, constructing parallel and perpendicular lines).

## B. Probability, Statistics, and Discrete Mathematics

- Knows how to interpret and analyze data presented in various forms.
  - Analyze and interpret various displays of data (e.g., box plots, histograms, scatter plots, stem-and-leaf plots).
  - Draw conclusions based on graphical displays (e.g., misleading representation of data, line of best fit, interpolation).
- Knows how to represent data in various forms.
  - Construct circle graphs, bar graphs, line graphs, histograms, scatter plots, double bar graphs, double line graphs, stem-and-leaf plots, box plots, and line plots/dot plots.
  - Choose an appropriate graph based on data.
- Knows how to develop, use, and evaluate probability models.
  - Use counting techniques, including the counting principle, to answer questions involving a finite sample space.
  - Solve probability problems involving independent and dependent events.
  - Solve problems using geometric probability.
- Understands concepts associated with measures of central tendency and dispersion (spread).
  - Solve for the mean and weighted average of a given set of data.
  - Determine and interpret mean, median, and mode in a variety of problems.
  - Determine and interpret common features of a data set (e.g., range and outliers).
  - Choose an appropriate measure of central tendency to represent a given data set.
- Knows how to model and solve problems using simple diagrams, flowcharts, or algorithms.
  - Construct, use, and interpret simple diagrams (e.g., Venn diagrams, flowcharts) to solve problems.
  - Apply a given algorithm to solve a problem.

## **Appendix L**

**Virginia Standard Setting Technical Report  
Praxis English Language Arts: Content Knowledge (5038)  
March 2013**



*Listening. Learning. Leading.*

Standard-Setting Technical Report

**PRAXIS™ ENGLISH LANGUAGE ARTS: CONTENT KNOWLEDGE  
(5038)**

Prepared for the Virginia Department of Education

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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## EXECUTIVE SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ English Language Arts: Content Knowledge (5038) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on March 22, 2013.

### RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis English Language Arts: Content Knowledge test, the recommended passing score is 68 out of a possible 110 raw-score points. The scaled score associated with a raw score of 68 is 153 on a 100–200 scale.

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ English Language Arts: Content Knowledge (5038) test, research staff from ETS designed and conducted a standard-setting study on March 22, 2013, in Richmond, Virginia.

The study involved an expert panel of educators. The VDOE recommended panelists with (a) experience as either English language arts teachers or college faculty who prepare English language arts teachers and (b) familiarity with the knowledge and skills required of beginning English language arts teachers (See Appendix A for the names and affiliations of the panelists.)

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the standard-setting study to the VDOE. The VDOE is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a panel of experienced educators. The VDOE may want to consider the recommended passing score but also other sources of information when setting the final Praxis English Language Arts: Content Knowledge passing score (see Geisinger & McCormick, 2010). The VDOE may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis English Language Arts: Content Knowledge test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows the VDOE to recognize that any test score on any standardized test—including a Praxis English Language Arts: Content Knowledge test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to gauge the likelihood that the recommended passing score from this panel would be similar to the passing scores recommended by other panels of experts similar

in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error is more important to minimize.

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## OVERVIEW OF THE PRAXIS ENGLISH LANGUAGE ARTS: CONTENT KNOWLEDGE TEST

The Praxis English Language Arts: Content Knowledge *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level English language arts teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hour assessment contains 130 selected-response items<sup>1</sup> covering three content areas: *Reading* (approximately 49 items), *Language Use and Vocabulary* (approximately 33 items), and *Writing, Speaking, and Listening* (approximately 48 items).<sup>2</sup> The reporting scale for the Praxis English Language Arts: Content Knowledge test ranges from 100 to 200 scaled-score points.

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<sup>1</sup> Twenty of the 130 selected-response items are pretest items and do not contribute to a candidate's score.

<sup>2</sup> The number of items for each content area may vary slightly from form to form of the test.

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## PROCESSES AND METHODS

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

### DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panel created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate.

The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis English Language Arts: Content Knowledge test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

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## RESULTS

### EXPERT PANELS

Table 1 presents a summary of the panelists' demographic information. (See Appendix A for a listing of panelists.) Eighteen panelists were teachers, one was college faculty, and one was an administrator or department head. The one faculty member's job responsibility included the training of English language arts teachers.

**Table 1**  
*Panel Member Demographics*

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	18	90%
Administrator/Department head	1	5%
College faculty	1	5%
<b>Race</b>		
White	14	70%
Black or African American	6	30%
<b>Gender</b>		
Female	16	80%
Male	4	20%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	18	90%
No	2	10%
<b>Are you currently teaching this subject in your state?</b>		
Yes	18	90%
No	2	10%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	9	45%
No	11	55%

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**Table 1 (continued)**  
***Panel Member Demographics***

	<i>N</i>	<i>%</i>
<b>At what K–12 grade level are you currently teaching this subject?</b>		
High school (9–12 or 10–12)	18	90%
Not currently teaching at the K–12 level	2	10%
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	1	5%
4–7 years	14	70%
8–11 years	4	20%
12–15 years	0	0%
16 years or more	1	5%
<b>Which best describes the location of your K–12 school?</b>		
Urban	3	15%
Suburban	8	40%
Rural	7	35%
Not currently working at the K–12 level	2	10%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	1	5%
No	0	0%
Not college faculty	19	95%

## STANDARD-SETTING JUDGMENTS

Table 2 summarize the standard-setting judgments of panelists. The table shows the passing scores—the number of raw points needed to pass the test—recommended by each panelist. The table also include estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>3</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test.

<sup>3</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 2**  
*Passing Score Summary*

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<b>Panelist</b>	<b>Passing Score</b>
1	57.20
2	72.80
3	72.20
4	73.30
5	67.35
6	66.45
7	66.50
8	72.75
9	66.25
10	49.35
11	87.30
12	76.70
13	63.35
14	72.45
15	65.00
16	76.50
17	65.15
18	60.00
19	62.30
20	60.85
<b>Average</b>	67.69
<b>Lowest</b>	49.35
<b>Highest</b>	87.30
<b>SD</b>	8.24
<b>SEJ</b>	1.84

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The panel's passing score recommendation for the Praxis English Language Arts: Content Knowledge test is 67.69 (out of a possible 110 raw-score points). The value was rounded to 68 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 68 raw points is 153.

Table 3 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 3**

***Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>4</sup>***

Recommended passing score (CSEM)		Scale score equivalent
	68 (5.12)	153
-2 CSEMs	58	140
-1 CSEM	63	146
+ 1 CSEM	74	160
+ 2 CSEMs	79	167

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study. Sixteen of the 20 panelists *strongly agreed* or *agreed* that the facilitator’s instructions and explanations were clear. Nineteen of the 20 panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. Sixteen of the 20 panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

<sup>4</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

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## SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ English Language Arts: Content Knowledge (5038) test, research staff from ETS designed and conducted a standard-setting study on March 22, 2013.

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis English Language Arts: Content Knowledge test, the recommended passing score is 68 out of a possible 110 raw-score points. The scaled score associated with a raw score of 68 is 153 on a 100–200 scale.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Stefanie Anderson	Chatham High School
Cerise Ashburne	Hickory High School/Chesapeake Public Schools
Leslie P. Barger	Martinsville High School
Paula C. Barnes	Hampton University
Kristen Combs	Frederick County Public School
Ashley Dickson-Ellison	Broadway High School/Rockingham County Public School
Karen Drake	Lee-Davis High School
Jonathan Heller	Carroll County High School
Kevin Hogge	Mathews High School
Leigh Johnson	Marymount University
Ayanna S. Jones	Manchester High School
Christine M. Kelly	Greensville County High School
Amber Loyacano	Waynesboro High School
Adria Mayo	John Marshall High School
Michael P. McCormick	Floyd County High School
Jess Moore	Brentsville District High School
Shana Sabourin	Massaponax High School
Karyn Simonelli	Landstown High School
Sonia Smith	Meadowbrook High School
Carla Turner	Norfolk Education Transitional Academy

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APPENDIX B  
STUDY AGENDA

# **AGENDA**

## **Praxis English Language Arts: Content Knowledge (5038) Standard-Setting Study**

Welcome and Introduction

Overview of Standard Setting and the Praxis English Language Arts: Content Knowledge Test

“Take” the Praxis English Language Arts: Content Knowledge Test (Take breaks as needed)

Discuss the Praxis English Language Arts: Content Knowledge Test

Discuss the Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate

Break

Training for Standard-Setting Judgments

Complete Standard Setting Judgments

Complete Final Evaluation

Collect Materials

---

## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>5</sup>

### A target candidate ...

#### Reading Literature

1. Knows major works and authors of U.S., British, and world literature and can identify their historical, cultural and literary contexts.
2. Understands and identifies the defining characteristics of major literary genres and their forms.
3. Understands how textual evidence is used to support interpretations of literary text.
4. Understands how themes, literary elements and language contribute to the analysis of a text.
5. Understands commonly-used research-based strategies for reading and understands how reading strategies support comprehension.

#### Informational Texts & Rhetoric

6. Identifies and understands how a variety of organizational patterns and text structures can be used to develop a central idea in informational texts.
7. Understands rhetorical strategies that authors use to convey purpose and perspective in informational texts.

#### Language Use and Vocabulary

8. Understands strategies for supporting language acquisition and vocabulary development.
9. Understands the conventions of Standard English grammar, usage, syntax, punctuation, and spelling.

#### Writing, Speaking and Listening

10. Understands characteristics of clear and coherent writing and components of effective oral communication.
11. Understands how awareness of genre, task, purpose, and audience contributes to effective written and oral communication.
12. Understands commonly used research-based approaches to teaching and assessing reading, writing, speaking, and listening.
13. Knows how to instruct students in effective use of digital media as a means of conducting research, enhancing communication and evaluating the credibility of sources.
14. Realizes the need to adapt classroom instruction to reflect various perspectives, cultures and backgrounds that students bring to speaking and writing.

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<sup>5</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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## APPENDIX D

# EVALUATION RESULTS

**Table D1*****Final Evaluation***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	10	50%	10	50%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	3	15%	13	65%	4	20%	0	0%
• The opportunity to "take the test" and to discuss the test content was useful.	7	35%	10	50%	3	15%	0	0%
• The opportunity to practice making standard setting judgments was useful.	5	25%	13	65%	2	10%	0	0%
• The training for the Standard Setting judgments was adequate to give me the information I needed to complete my assignment.	6	30%	13	65%	1	5%	0	0%
• The process of making the standard-setting judgments was easy to follow.	5	25%	11	55%	4	20%	0	0%

## **Appendix M**

**Multistate Standard Setting Technical Report  
Praxis English Language Arts: Content Knowledge (5038)  
March 2013**



*Listening. Learning. Leading.*

Multistate Standard-Setting Technical Report

**PRAXIS™ ENGLISH LANGUAGE ARTS: CONTENT KNOWLEDGE  
(5038)**

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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# EXECUTIVE SUMMARY

To support the decision-making process of education agencies establishing a passing score (cut score) for the Praxis™ English Language Arts: Content Knowledge (5038) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study.

## PARTICIPATING STATES

Panelists from 22 states, Washington, DC, and Guam were recommended by their respective education agencies. The education agencies recommended panelists with (a) experience as either English teachers or college faculty who prepare English teachers and (b) familiarity with the knowledge and skills required of beginning English teachers.

## RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis English Language Arts: Content Knowledge test, the recommended passing score<sup>1</sup> is 79 out of a possible 110 raw-score points. The scaled score associated with a raw score of 79 is 167 on a 100–200 scale.

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<sup>1</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis™ English Language Arts: Content Knowledge (5038) test, research staff from ETS designed and conducted a multistate standard-setting study<sup>2</sup> in March 2013 in Princeton, New Jersey. Education agencies<sup>3</sup> recommended panelists with (a) experience as either English teachers or college faculty who prepare English teachers and (b) familiarity with the knowledge and skills required of beginning English teachers. Twenty-two states, Washington DC, and Guam (Table 1) were represented by 37 panelists. (See Appendix A for the names and affiliations of the panelists.)

**Table 1**  
*Participating Jurisdictions and Number of Panelists*

---

Alaska (2 panelists)	New Jersey (2 panelists)
Arkansas (1 panelist)	North Carolina (2 panelists)
Delaware (2 panelists)	North Dakota (2 panelists)
Guam (1 panelist)	Pennsylvania (1 panelist)
Hawaii (1 panelist)	Rhode Island (2 panelists)
Idaho (1 panelist)	South Carolina (1 panelist)
Kansas (1 panelist)	South Dakota (2 panelists)
Louisiana (1 panelist)	Tennessee (2 panelists)
Maine (1 panelist)	Utah (2 panelists)
Mississippi (2 panelists)	Washington, DC (1 panelist)
Montana (2 panelists)	Wisconsin (2 panelists)
Nevada (1 panelist)	West Virginia (2 panelists)

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The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each jurisdiction, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in

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<sup>2</sup> The multistate standard-setting study collected judgments for two related Praxis tests — Praxis English Language Arts: Content Knowledge (5038) and Praxis English Language Arts: Content and Analysis (5039). Separate technical reports were prepared for each test.

<sup>3</sup> States and jurisdictions that currently use Praxis were invited to participate in the multistate standard-setting study.

accordance with applicable regulations. This study provides a recommended passing score,<sup>4</sup> which represents the combined judgments of two panels of experienced educators. Each jurisdiction may want to consider the recommended passing score but also other sources of information when setting the final Praxis English Language Arts: Content Knowledge passing score (see Geisinger & McCormick, 2010). A jurisdiction may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the jurisdiction's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis English Language Arts: Content Knowledge test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows a jurisdiction to recognize that any test score on any standardized test—including a Praxis English Language Arts: Content Knowledge test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows a jurisdiction to gauge the likelihood that the recommended passing score from a particular panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each jurisdiction should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The jurisdiction needs to consider which decision error is more important to minimize.

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<sup>4</sup> In addition to the recommended passing score averaged across the two panels, the recommended passing scores for each panel are presented.

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# OVERVIEW OF THE PRAXIS ENGLISH LANGUAGE ARTS: CONTENT KNOWLEDGE TEST

The Praxis English Language Arts: Content Knowledge *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level English teachers have the knowledge/skills believed necessary for competent professional practice.

The two and a half-hour assessment contains 130 selected-response items<sup>5</sup> covering three content areas: *Reading* (approximately 49 items), *Language Use and Vocabulary* (approximately 33 items), and *Writing, Speaking and Listening* (approximately 48 items).<sup>6</sup> The reporting scale for the Praxis English Language Arts: Content Knowledge test ranges from 100 to 200 scaled-score points.

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## PROCESSES AND METHODS

The design of the standard-setting study included two, independent expert panels. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

For each panel, the standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

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<sup>5</sup> Twenty of the 130 selected-response items are pretest items and do not contribute to a candidate's score.

<sup>6</sup> The number of items for each content area may vary slightly from form to form of the test.

## DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

Panel 1 created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate. The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

For Panel 2, the panelists began with the description of the target candidate developed by Panel 1. Given that the multistate standard-setting study was designed to provide two recommendations for the same performance standard, it was important that panels use consistent target candidate description to frame their judgments. The panelists reviewed the target candidate description, and any ambiguities were discussed and clarified.

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis English Language Arts: Content Knowledge test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. Items were highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located an item in the same difficulty range) or diverged in their judgments.

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the target candidate and helped to clarify aspects of

items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to another’s judgment, but to understand the different relevant perspectives among the panelists.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

Other than the description of the target candidate, results from Panel 1 were not shared with Panel 2. The item-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

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## RESULTS

### EXPERT PANELS

Table 2 presents a summary of the panelists’ demographic information. The panel included 37 educators representing 22 states, Washington, DC, and Guam. (See Appendix A for a listing of panelists.) Nineteen panelists were teachers, thirteen were college faculty, four were administrators or department heads, and one held another position. Twelve of the thirteen faculty members’ job responsibilities included the training of English teachers.

The number of experts by panel and their demographic information are presented in Appendix D (Table D1).

**Table 2**  
**Panel Member Demographics (Across Panels)**

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	19	51%
Administrator/Department head	4	11%
College faculty	13	35%
Other	1	3%
<b>Race</b>		
White	30	81%
Black or African American	4	11%
Asian or Asian American	1	3%
American Indian or Alaskan Native	1	3%
Native Hawaiian or Other Pacific Islander	1	3%
<b>Gender</b>		
Female	30	81%
Male	7	19%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	28	76%
No	9	24%
<b>Are you currently teaching this subject in your state?</b>		
Yes	29	78%
No	8	22%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	22	59%
No	15	41%
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Middle school (6–8 or 7–9)	2	5%
High school (9–12 or 10–12)	17	46%
Middle and High School	2	5%
Not currently teaching at the K–12 level	16	43%

**Table 2 (continued)*****Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	5	14%
4–7 years	6	16%
8–11 years	9	24%
12–15 years	5	14%
16 years or more	12	32%
<b>Which best describes the location of your K–12 school?</b>		
Urban	7	19%
Suburban	6	16%
Rural	10	27%
Not currently working at the K–12 level	14	38%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	12	32%
No	1	3%
Not college faculty	24	65%

**STANDARD-SETTING JUDGMENTS**

Table 3 summarizes the standard-setting judgments (Round 2) of panelists. The table also includes estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>7</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test. The confidence intervals created by adding/subtracting two SEJs to each panel’s recommended passing score overlap, indicating that they may be comparable.

Panelist-level results, for Rounds 1 and 2, are presented in Appendix D (Table D2).

<sup>7</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 3**  
***Summary of Round 2 Standard-setting Judgments***

	<b>Panel 1</b>	<b>Panel 2</b>
Average	78.43	77.76
Lowest	69.00	69.95
Highest	90.25	88.20
SD	5.90	5.40
SEJ	1.35	1.27

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for each panel (see Table D2 in Appendix D). The Round 2 average score is the panel’s recommended passing score.

The panels’ passing score recommendations for the Praxis English Language Arts: Content Knowledge test are 78.43 for Panel 1 and 77.76 for Panel 2 (out of a possible 110 raw-score points). The values were rounded to the next highest whole number, to determine the functional recommended passing score — 79 for Panel 1 and 78 for Panel 2. The scaled scores associated with 79 and 78 raw points are 167 and 166, respectively.

In addition to the recommended passing score for each panel, the average passing score across the two panels is provided to help education agencies determine an appropriate passing score. The panels’ average passing score recommendation for the Praxis English Language Arts: Content Knowledge test is 78.10 (out of a possible 110 raw-score points). The value was rounded to 79 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 79 raw points is 167.

Table 4 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 4*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>8</sup>***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	79 (4.74)	167
-2 CSEMs	70	155
-1 CSEM	75	162
+ 1 CSEM	84	173
+ 2 CSEMs	89	180

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were also shown the panel's recommended passing score and asked (a) how comfortable they are with the recommended passing score and (b) if they think the score was too high, too low, or about right. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the description of the target candidate was at least *somewhat influential* in guiding their standard-setting judgments; 33 of the 37 panelists indicated the description was *very influential*. Thirty-six of the 37 panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. More than half of the panelists (twenty-four of the 37 panelists) indicated that their own professional experience was *very influential* in guiding their judgments.

<sup>8</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

All of the panelists indicated they were at least *somewhat comfortable* with the passing score they recommended; 22 of the 37 panelists were *very comfortable*. Thirty-three of the 37 panelists indicated the recommended passing score was *about right* with one of the remaining panelists indicating that the passing score was *too low* and three indicating that the passing score was *too high*.

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## SUMMARY

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis English Language Arts: Content Knowledge test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis English Language Arts: Content Knowledge test, the recommended passing score<sup>9</sup> is 79 out of a possible 110 raw-score points. The scaled score associated with a raw score of 79 is 167 on a 100–200 scale.

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<sup>9</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Valentina Abordonado	Hawaii Pacific University (HI)
Jacqueline Bach	Louisiana State University (LA)
Amy Baker-Sheridan	Seaford Senior High School (DE)
Krista Bruggeman	Lennox High School (SD)
Jill Byrne	Beacon Charter High School for the Arts (RI)
Linda Constanzo Cahir	Kean University (NJ)
Granville Caldwell	Harding University High School (NC)
Sean Campbell	Homer High School (AK)
Danyka Davis	William G. Enloe High School (NC)
Anne Faulks	Appling Middle School (TN)
Creed Hansen	Sun Prairie High School (WI)
Heather Jo Harper	Century High School (ND)
A. Waller Hastings	West Liberty University (WV)
Patricia Hinchey	Penn State University (PA)
Thelma Hinds	Wilmington University (DE)
Peggy F. Hopper	Mississippi State University (MS)
Amanda Jackson	Nevada Virtual Academy (NV)
Kevin Jones	University of Arkansas Fort Smith (AR)
Laura S. Kim	Independence High School (TN)
Sherry Kinkopf	University of Southern Mississippi (MS)
Rachel Kittoe	West High School (AK)

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*Participating Panelists With Affiliation (continued)*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Debra Kohn	Smoky Valley High School (KS)
Gerri Lallo	Juanita Sanchez Education Complex (RI)
Wade Landsverk	Freedom High School (WI)
Liliana Maggioni	The Catholic University of America (DC)
Donna L. Miller	Aaniiih Nakoda College (MT)
Martina Nelson	Guam Department of Education JRMS (GU)
Stu Palmer	Mt. Ararat High School (ME)
Kathleen Rapp	Monmouth University (NJ)
Laura F. Scarpulla	Salt Lake City School District (UT)
Angela Schwer	Fairmont State University (WV)
Kari Lee Siko	Charleston Southern University (SC)
Juli Stricklan	Rigby High School (ID)
Abigail Tibbetts	Dawson County High School (MT)
Lorraine Wallace	Utah Valley University (UT)
Mary Weber	Hazen High School (ND)
Meghan Wounded Head	Hamlin High School (SD)

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APPENDIX B  
STUDY AGENDA

# AGENDA

## **Praxis English Language Arts: Content Knowledge (5038) Standard-Setting Study**

Day 1

Welcome and Introduction

Overview of Standard Setting and the Praxis English Language Arts: Content Knowledge Test

“Take” the Praxis English Language Arts: Content Knowledge Test (Take breaks as needed)

Discuss the Praxis English Language Arts: Content Knowledge Test

Define the Knowledge/Skills of a Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate (continued)

Break

Standard-Setting Training for Selected-Response Items

Round 1 Standard Setting Judgments for Selected-Response

Collect Materials; End of Day 1

# AGENDA

## Praxis English Language Arts: Content Knowledge (5038) Standard-Setting Study

### Day 2

Overview of Day 2

Standard Setting Training for Constructed-Response Questions<sup>10</sup>

Round 1 Standard Setting Judgments for Constructed-Response Questions

Round 1 Feedback & Round 2 Judgments

Break

Round 1 Feedback & Round 2 Judgments (continued)

Lunch

Round 1 Feedback & Round 2 Judgments (continued)

Break

Feedback on Round 2 Recommended Passing Score

Complete Final Evaluation

Collect Materials; End of Study

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<sup>10</sup> The multistate standard-setting study collected judgments for two related Praxis tests — Praxis English Language Arts: Content Knowledge (5038) and Praxis English Language Arts: Content and Analysis (5039). The Praxis English Language Arts: Content and Analysis (5039) test included two constructed-response (essay) items. Separate technical reports were prepared for each test.

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## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>11</sup>

A target candidate ...

### Reading Literature

1. Knows major works and authors of U.S., British, and world literature and can identify their historical, cultural and literary contexts
2. Understands the defining characteristics of primary literary genres and can identify the defining characteristics of major forms within each primary literary genre
3. Understands how textual evidence supports interpretations of a literary text
4. Understands how themes, literary elements and language contribute to the meaning of a text
5. Knows commonly used research based strategies for reading instruction and understands how reading strategies support comprehension

### Informational Texts & Rhetoric

6. Understands how a variety of organizational patterns and text structures can be used to develop a central idea in informational texts
7. Understands rhetorical strategies that authors use to convey purpose and perspective in informational texts

### Language Use and Vocabulary

8. Knows strategies for supporting language acquisition and vocabulary development (e.g., using affixes, decoding, word ladders, context)
9. Understands the conventions of Standard English grammar, usage, syntax, and mechanics

### Writing, Speaking and Listening

10. Understands characteristics of clear and coherent writing and components of effective oral communication
11. Understands how awareness of mode, task, purpose, and audience contributes to effective written and oral communication
12. Knows commonly used research-based approaches to teaching and assessing reading, writing, speaking, and listening
13. Knows how to instruct students in effective use of digital media as a means of conducting research, enhancing communication and evaluating the credibility of sources
14. Knows how to adapt classroom instruction to accommodate various perspectives, cultures and backgrounds that students bring to speaking and writing

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<sup>11</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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# APPENDIX D

## RESULTS

**Table D1**  
**Panel Member Demographics (by Panel)**

	Panel 1		Panel 2	
	<i>N</i>	%	<i>N</i>	%
<b>Current position</b>				
Teacher	13	68%	6	33%
Administrator/Department head	3	16%	1	6%
College faculty	3	16%	10	56%
Other	0	0%	1	6%
<b>Race</b>				
White	16	84%	14	78%
Black or African American	1	5%	3	17%
Asian or Asian American	1	5%	0	0%
American Indian or Alaskan Native	0	0%	1	6%
Native Hawaiian or Other Pacific Islander	1	5%	0	0%
<b>Gender</b>				
Female	14	74%	16	89%
Male	5	26%	2	11%
<b>Are you currently certified to teach this subject in your state?</b>				
Yes	17	89%	11	61%
No	2	11%	7	39%
<b>Are you currently teaching this subject in your state?</b>				
Yes	17	89%	12	67%
No	2	11%	6	33%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>				
Yes	9	47%	13	72%
No	10	53%	5	28%
<b>At what K–12 grade level are you currently teaching this subject?</b>				
Middle school (6–8 or 7–9)	1	5%	1	6%
High school (9–12 or 10–12)	12	63%	5	28%
Middle and High School	2	11%	0	0%
Not currently teaching at the K–12 level	4	21%	12	67%

**Table D1 (continued)****Panel Member Demographics (by Panel)**

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Including this year, how many years of experience do you have teaching this subject?</b>				
3 years or less	2	11%	3	17%
4–7 years	4	21%	2	11%
8–11 years	4	21%	5	28%
12–15 years	4	21%	1	6%
16 years or more	5	26%	7	39%
<b>Which best describes the location of your K–12 school?</b>				
Urban	5	26%	2	11%
Suburban	4	21%	2	11%
Rural	7	37%	3	17%
Not currently working at the K–12 level	3	16%	11	61%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>				
Yes	3	16%	9	50%
No	0	0%	1	6%
Not college faculty	16	84%	8	44%

**Table D2**  
*Passing Score Summary by Round of Judgments*

<b>Panelist</b>	<b>Panel 1</b>		<b>Panel 2</b>	
	<b>Round 1</b>	<b>Round 2</b>	<b>Round 1</b>	<b>Round 2</b>
1	69.60	69.70	81.70	81.50
2	81.80	81.55	72.40	75.20
3	70.20	71.80	80.35	78.95
4	92.65	90.25	63.60	69.95
5	77.70	77.90	71.20	75.80
6	73.65	73.35	60.75	70.00
7	77.50	79.40	82.80	81.60
8	62.45	69.00	71.80	75.30
9	75.85	74.60	71.90	79.50
10	79.55	79.00	70.35	73.80
11	85.80	82.95	68.70	75.60
12	93.25	84.65	72.20	75.00
13	86.60	87.00	82.25	82.50
14	78.90	80.30	74.65	76.35
15	80.90	80.45	85.30	86.55
16	75.40	75.30	89.35	88.20
17	73.10	71.05	82.50	83.50
18	80.65	78.75	67.55	70.45
19	83.15	83.15		
<b>Average</b>	78.88	78.43	74.96	77.76
<b>Lowest</b>	62.45	69.00	60.75	69.95
<b>Highest</b>	93.25	90.25	89.35	88.20
<b>SD</b>	7.65	5.90	7.87	5.40
<b>SEJ</b>	1.76	1.35	1.86	1.27

**Table D3*****Final Evaluation: Panel 1***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	19	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	19	100%	0	0%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	16	84%	3	16%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	18	95%	1	5%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	17	89%	2	11%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	17	89%	2	11%	0	0%	0	0%

**Table D3 (continued)**  
**Final Evaluation: Panel 1**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	17	89%	2	11%	0	0%		
• The between-round discussions	9	47%	9	47%	1	5%		
• The knowledge/skills required to answer each test item	16	84%	2	11%	1	5%		
• The passing scores of other panel members	0	0%	17	89%	2	11%		
• My own professional experience	14	74%	5	26%	0	0%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	13	68%	6	32%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	0	0%	17	89%	2	11%		

**Table D4*****Final Evaluation: Panel 2***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	17	94%	1	6%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	13	72%	5	28%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	16	89%	2	11%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	15	83%	3	17%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	17	94%	1	6%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	13	72%	5	28%	0	0%	0	0%

**Table D4 (continued)**  
**Final Evaluation: Panel 2**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	16	89%	2	11%	0	0%		
• The between-round discussions	11	61%	7	39%	0	0%		
• The knowledge/skills required to answer each test item	16	89%	2	11%	0	0%		
• The passing scores of other panel members	4	22%	10	56%	4	22%		
• My own professional experience	10	56%	8	44%	0	0%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	9	50%	9	50%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	1	6%	16	89%	1	6%		

## **Appendix N**

### **Test at a Glance**

### **Praxis English Language Arts: Content Knowledge (5038)**

## English Language Arts: Content Knowledge (5038)

### Test at a Glance

Test Name	English Language Arts: Content Knowledge		
Test Code	5038		
Time	150 Minutes		
Number of Questions	130 Selected Response questions		
Format	The test includes single-selection multiple choice questions with four options. It also includes some of the following innovative question types: multiple-selection multiple choice, order/match, audio stimulus, table/grid, hot spots in text, and video stimulus.		
	Content Categories	Approximate Number of Questions	Approximate Percent of Examination
	I. Reading	49	38%
	II. Language Use and Vocabulary	33	25%
	III. Writing, Speaking, and Listening	48	37%

### About This Test

The English Language Arts: Content Knowledge test measures whether prospective secondary school English Language Arts teachers have the standards-relevant knowledge, skills, and abilities believed necessary for competent professional practice. Aligned to the Common Core State Standards (CCSS) for English Language Arts, the test measures examinees' skills and knowledge of concepts relevant to three categories: reading, including the study of literature (i.e., stories, drama, and poetry) and informational texts (i.e., literary nonfiction, such as essays, biographies, and speeches); use of the English language, including conventions of standard English and vocabulary development; and writing, speaking, and listening. The 130 selected response questions will address all of these categories.

This test may contain some questions that will not count toward your score.

# Topics Covered

## I. READING

### A. Literature

- Knows major works and authors of United States, British, World Literature, and Young Adult literature.
  - Identify the authors and titles of major works of fiction, poetry, drama, and literary nonfiction.
- Knows the historical, cultural, and literary contexts of major works and authors of United States, British, and world literature.
  - Identify the historical or literary context of major works of fiction, poetry, drama, and literary nonfiction.
- Understands the defining characteristics of primary literary genres.
  - Identify typical characteristics of a genre.
  - Apply correct terminology for a genre (e.g., stanza vs. paragraph).
- Knows the defining characteristics of major forms within each primary literary genre (e.g., poetry: ballad, haiku).
  - Identify characteristics of major forms within each genre through distinctions in structure and content (e.g., sonnets vs. ballads, satire vs. realism).
- Understands how textual evidence supports interpretations of a literary text.
  - Comprehend the literal and figurative meanings of a text.
  - Draw inferences from a text.
  - Determine the textual evidence that supports an analysis of a literary text.
- Understands how authors develop themes in a variety of genres.
  - Identify the theme(s) or central idea(s) of a given text.
  - Analyze how a theme or central idea is developed throughout one or more works.
  - Recognize universal themes from myths, traditional stories, or religious works and how they are rendered or alluded to in literary works.
- Understands how literary elements (e.g., characterization, setting, tone) contribute to the meaning of a text.
  - Analyze the impact of differences in the points of view of characters and/or narrators.
  - Analyze the structure of a plot.
  - Analyze how different elements contribute to mood, tone, and conflict.
  - Analyze how particular lines of dialogue or story events impact meaning.
  - Analyze the text for character development.
- Understands how figurative language contributes to the effect of a text.
  - Identify examples of various types of figurative language (e.g., extended metaphor, imagery, hyperbole).
  - Interpret figurative language in context and analyze its role in the text.
- Understands how poetic devices and structure contribute to the effect of a poem.
  - Analyze how poetic devices (e.g., rhyme scheme, rhythm, figurative language) contribute to meaning in a poem.
  - Analyze how structure (e.g., stanza, free verse, concrete poem) contributes to meaning in a poem.

- Understands how reading strategies (e.g., making predictions, making connections, summarizing) support comprehension.
  - Identify literacy skills to support active reading (e.g., text-to-self connection, prediction, summarizing).
  - Evaluate a summary of a passage.
  - Evaluate the strength of a prediction based on textual evidence.
- Knows commonly used research-based strategies for reading instruction (e.g., activating prior knowledge, modeling metacognitive practices, active reading).
  - Recognize commonly used research-based strategies for teaching reading (e.g., activating prior knowledge, modeling metacognitive practices).
  - Evaluate the effectiveness of specific strategies to support a particular reading task.
  - Interpret research and apply it to particular reading instruction challenges.
- Is familiar with various literary theories (e.g., reader-response, feminist criticism) for interpreting and critiquing literary texts.
  - Recognize ways literary theories are used to interpret and critique texts.
- Understands how a variety of organizational patterns and text structures can be used to develop a central idea in informational texts.
  - Identify the central idea of an informational text.
  - Analyze how an author develops or refines a central idea in an informational text.
  - Identify the organizational pattern of an informational text (e.g., problem-solution, cause-effect, sequence order).
  - Analyze how ideas are connected and distinguished from one another in an informational text.
  - Identify how text features (e.g., index, glossary, headings, footnotes, visuals) contribute to the central idea of an informational text.
- Understands how word choice contributes to the effect of an informational text.
  - Distinguish between connotation and denotation in an informational text.
  - Identify how technical language is used in an informational text.
  - Distinguish between what the text says explicitly and what may be inferred from the text.

## B. Informational Texts & Rhetoric

- Understands how textual evidence supports interpretations of an informational text.
  - Comprehend literal and figurative meanings of an informational text.
  - Draw inferences from an informational text.
  - Determine the textual evidence that supports an analysis of an informational text.
- Understands rhetorical strategies that authors use to convey purpose and perspective in informational texts.
  - Determine an author's point of view or purpose in an informational text.
  - Analyze how an author uses rhetoric to support point of view and/or purpose in an informational text.
  - Recognize rhetorical strategies (e.g., satire, irony, understatement, hyperbole).

- Understands methods that authors use to appeal to a specific audience.
  - Identify methods of appeal or persuasion (e.g., expert opinion, generalization, testimonial).
  - Evaluate the effectiveness of an author's methods of appeal.
  - Understand how technical or non-technical language is used to appeal to a targeted audience.
- Understands how authors develop and support a written argument.
  - Evaluate the argument and specific claims in a text.
  - Determine an author's purpose and evaluate an author's reasoning.
  - Evaluate whether evidence is relevant, factual, and/or sufficient.
  - Identify false statements and fallacious reasoning, (e.g., slippery slope, red herring, straw man, post hoc ergo propter hoc).
- Knows how to interpret media and non-print texts and how they influence an audience.
  - Evaluate multiple sources of information presented in different media or formats.
  - Determine persuasive techniques used in different media.

## II. LANGUAGE USE & VOCABULARY

- Understands the conventions of standard English grammar, usage, syntax, and mechanics.
  - Explain the function of the different parts of speech.
  - Identify errors in standard English grammar, usage, syntax, and mechanics (e.g., inconsistent verb tense, non-parallel structure, sentence fragments, run-ons).
  - Justify grammar, usage, syntax, and mechanics choices (e.g., colon vs. semi-colon, its vs. it's, saw vs. seen, etc.).
  - Identify different components of sentences (i.e., clauses, phrases).
  - Identify different structures of sentences (i.e., simple, complex, compound).
- Understands the use of affixes, context, and syntax to determine word meaning.
  - Apply knowledge of affixes to determine word meaning.
  - Use context clues to determine word meaning.
  - Apply knowledge of syntax to determine word meaning.
  - Analyze nuances of word meaning and figures of speech.
- Understands the use of print and digital reference materials to support and enhance language usage.
  - Determine the most appropriate print or digital reference material (spell checker, style manual, dictionary, glossary) for a particular language usage task.

- Is familiar with variations in dialect and diction across regions, cultural groups, and time periods.
  - Identify variation in dialect and diction across regions, cultural groups, and time periods.
  - Understand the concept of dialect and its appropriateness depending upon purpose and audience.
- Knows commonly used research-based approaches for supporting language acquisition and vocabulary development for diverse learners.
  - Recognize examples of commonly used research-based strategies for language acquisition or vocabulary development.
  - Evaluate the effectiveness of specific strategies to support language acquisition or vocabulary development.
  - Interpret research and apply it to particular instructional challenges related to language acquisition or vocabulary development.
- Understands how awareness of task, purpose, and audience contribute to effective writing.
  - Identify how the task, purpose, or intended audience affects a piece of writing.
  - Choose the most appropriate type of writing for a task, purpose, and audience.
  - Evaluate the effectiveness of a piece of writing for a specific task, purpose, and audience.
- Understands the characteristics of clear and coherent writing (e.g., supporting details, organization, conventions).
  - Identify details that develop a main idea.
  - Organize a text clearly and coherently.
  - Use varied and effective transitions throughout a text.
  - Justify stylistic choices within a clear and coherent piece of writing.
  - Introduce, develop, and conclude a text effectively.

### III. WRITING, SPEAKING, and LISTENING

- Understands the distinct characteristics of various modes of writing (e.g., informative, argumentative).
  - Distinguish between common modes of writing (e.g., argumentative, informative/explanatory, narrative).
  - Identify examples of common types within modes of writing (e.g., journal, letter, essay, speech, blog).
  - Determine which mode is the most appropriate for an author's purpose and audience.
- Understands effective and ethical research practices, including evaluating the credibility of multiple print and digital sources, gathering relevant information, and citing sources accurately.
  - Identify relevant information during research on a given topic.
  - Evaluate the credibility of a print or digital source.
  - Identify effective research practices (e.g., formulating a question, narrowing or broadening a topic, choosing effective sources).
  - Identify the components of a citation.
  - Cite source material appropriately.
  - Integrate information from source material to maintain the flow of ideas.

- Understands components of effective speech and presentation delivery.
  - Identify characteristics of effective delivery of a speech or presentation (e.g., eye contact, visual aids, tone).
  - Evaluate the advantages and disadvantages of using different media to present ideas.
  - Determine whether information is presented clearly, concisely, and logically.
- Knows approaches for instructing students on the effective use of digital media to support and enhance communication.
  - Identify techniques for instructing students to choose and use technological tools (e.g., presentation software, blogs, wikis) for effective communication.
  - Evaluate the effectiveness of specific technology-based strategies to achieve enhanced understanding of communication goals.
- Understands commonly used research-based approaches to teaching components of writing.
  - Recognize commonly used research-based strategies (e.g., writing workshop, modeling) for teaching components of the writing process.
  - Identify research-based strategies for teaching particular writing tasks.
  - Interpret research and apply it to particular writing instruction challenges.
- Understands purposes and methods of assessing reading, writing, speaking, and listening.
  - Recognize a variety of research-based approaches to and purposes of formative and summative assessment of reading, writing, speaking, and listening (e.g., use of rubrics, conferencing techniques, providing useful feedback).
  - Evaluate the effectiveness of a variety of research-based approaches to and purposes of formative and summative assessment of reading, writing, speaking, and listening (e.g., use of rubrics, conferencing techniques, providing useful feedback).
- Understands the components of effective oral communication in a variety of settings (e.g., one-on-one, in groups).
  - Identify a variety of techniques (e.g., selecting age-appropriate topics, facilitating appropriate discussion behavior, ensuring accountability) to ensure productive participation and active listening in collaborative discussions.
  - Evaluate the effectiveness of specific strategies for students initiating and participating effectively in discussions.
- Knows that students bring various perspectives, cultures, and backgrounds to reading, writing, listening, and speaking, and how to incorporate that awareness into classroom instruction.
  - Use knowledge of students' individual and group identities to plan instruction responsive to their needs.
  - Know strategies for creating a safe environment for reading, writing, speaking, and listening to take place.

## **Appendix O**

**Virginia Standard Setting Technical Report  
Praxis Mathematics: Content Knowledge (5161)  
March 2013**



*Listening. Learning. Leading.*

Standard-Setting Technical Report

**PRAXIS™ MATHEMATICS: CONTENT KNOWLEDGE (5161)**

Prepared for the Virginia Department of Education

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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# EXECUTIVE SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Mathematics: Content Knowledge (5161) test, research staff from Educational Testing Service (ETS) designed and conducted a standard-setting study on March 22, 2013.

## RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Mathematics: Content Knowledge test, the recommended passing score is 30 out of a possible 50 raw-score points. The scaled score associated with a raw score of 30 is 155 on a 100–200 scale.

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Mathematics: Content Knowledge (5161) test, research staff from ETS designed and conducted a standard-setting study on March 22, 2013, in Richmond, Virginia.

The study involved an expert panel of educators. The VDOE recommended panelists with (a) experience as either mathematics teachers or college faculty who prepare mathematics teachers and (b) familiarity with the knowledge and skills required of beginning mathematics teachers (See Appendix A for the names and affiliations of the panelists.)

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the standard-setting study to the VDOE. The VDOE is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a panel of experienced educators. The VDOE may want to consider the recommended passing score but also other sources of information when setting the final Praxis Mathematics: Content Knowledge passing score (see Geisinger & McCormick, 2010). The VDOE may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Mathematics: Content Knowledge test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows the VDOE to recognize that any test score on any standardized test—including a Praxis Mathematics: Content Knowledge test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to gauge the likelihood that the recommended passing score from this panel would be similar to the passing scores recommended by other panels of experts similar in

composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error is more important to minimize.

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## OVERVIEW OF THE PRAXIS MATHEMATICS: CONTENT KNOWLEDGE TEST

The Praxis Mathematics: Content Knowledge *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level mathematics teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hour assessment contains 60 selective-response and numeric-entry items<sup>1</sup> covering two content areas: *Number and Quantity, Algebra, Functions, and Calculus* (approximately 41 items) and *Geometry, Probability and Statistics, and Discrete Mathematics* (approximately 19 items).<sup>2</sup> The reporting scale for the Praxis Mathematics: Content Knowledge test ranges from 100 to 200 scaled-score points.

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<sup>1</sup> Ten of the 60 selective-response and numeric-entry items are pretest items and do not contribute to a candidate's score.

<sup>2</sup> The number of items for each content area may vary slightly from form to form of the test.

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## PROCESSES AND METHODS

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

### REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

### DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panel created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate.

The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis Mathematics: Content Knowledge test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

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## RESULTS

### EXPERT PANELS

Table 1 presents a summary of the panelists' demographic information. (See Appendix A for a listing of panelists.) Fifteen panelists were teachers, two were college faculty, and two held another position.

**Table 1**  
*Panel Member Demographics*

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	15	79%
College faculty	2	11%
Other	2	11%
<b>Race</b>		
White	14	74%
Black or African American	2	11%
Asian or Asian American	3	16%
<b>Gender</b>		
Female	9	47%
Male	10	53%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	18	95%
No	1	5%
<b>Are you currently teaching this subject in your state?</b>		
Yes	15	79%
No	4	21%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	8	42%
No	11	58%

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**Table 1 (continued)**  
**Panel Member Demographics**

	<i>N</i>	<i>%</i>
<b>At what K–12 grade level are you currently teaching this subject?</b>		
High school (9–12 or 10–12)	15	79%
Other	1	5%
Not currently teaching at the K–12 level	3	16%
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	0	0%
4–7 years	12	63%
8–11 years	5	26%
12–15 years	2	11%
16 years or more	0	0%
<b>Which best describes the location of your K–12 school?</b>		
Urban	3	16%
Suburban	10	53%
Rural	3	16%
Not currently working at the K–12 level	3	16%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	0	0%
No	2	11%
Not college faculty	17	89%

## STANDARD-SETTING JUDGMENTS

Table 2 summarize the standard-setting judgments of panelists. The table shows the passing scores—the number of raw points needed to pass the test—recommended by each panelist. The table also include estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>3</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test.

<sup>3</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 2**  
*Passing Score Summary*

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<b>Panelist</b>	<b>Passing Score</b>
1	26.80
2	29.85
3	31.75
4	29.40
5	30.95
6	26.55
7	23.00
8	29.40
9	31.05
10	36.70
11	33.20
12	29.20
13	30.50
14	26.05
15	27.15
16	29.00
17	28.95
18	27.75
19	29.00
<b>Average</b>	29.28
<b>Lowest</b>	23.00
<b>Highest</b>	36.70
<b>SD</b>	2.93
<b>SEJ</b>	0.67

---

The panel's passing score recommendation for the Praxis Mathematics: Content Knowledge test is 29.28 (out of a possible 50 raw-score points). The value was rounded to 30 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 30 raw points is 155.

Table 3 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 3**

*Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>4</sup>*

Recommended passing score (CSEM)		Scale score equivalent
	30 (3.50)	155
-2 CSEMs	24	139
-1 CSEM	27	147
+ 1 CSEM	34	165
+ 2 CSEMs	37	173

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study. Eighteen of the 19 panelists *strongly agreed* or *agreed* that the facilitator’s instructions and explanations were clear and that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

<sup>4</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

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## SUMMARY

To support the decision-making process of the Virginia Department of Education (VDOE) in establishing a passing score (cut score) for the Praxis™ Mathematics: Content Knowledge (5161) test, research staff from ETS designed and conducted a standard-setting study on March 22, 2013.

ETS provides a recommended passing score from the standard-setting study to help the VDOE determine an appropriate operational passing score. For the Praxis Mathematics: Content Knowledge test, the recommended passing score is 30 out of a possible 50 raw-score points. The scaled score associated with a raw score of 30 is 155 on a 100–200 scale.

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

***Participating Panelists With Affiliation***

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Ashley Alston	Suffolk Public Schools
Jason Breeding	Washington County Public Schools
Zach Carter	South Lakes High School
Kelley Clark	Jamestown High School
Erin Hoppie	Millbrook High School
Ben Java	Meadowbrook High School
Barry L. Lingerfelt Jr.	Martinsville High School
Nicholas Marchio	Stone Bridge High School
Iordanka Panayotova	Old Dominion University
Anna Papas	Stafford County Public Schools
Adam Reeves	Halifax County High School
Rosa Ross	Portsmouth Public Schools
Wylie Philip Schwieder	Henrico High School
Volkan Sevim	Virginia Commonwealth University
Hank Sohn	Charlottesville High School
Kimberly Steinbach	Grafton High School
Matthew Vuiller	Atlee High School
Charell Wingfield	James River High School
James Brandon Wright	Washington-Lee High School/Arlington Public Schools

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APPENDIX B  
STUDY AGENDA

# **AGENDA**

## **Praxis Mathematics: Content Knowledge (5161) Standard-Setting Study**

Welcome and Introduction

Overview of Study

“Take” the Praxis Mathematics: Content Knowledge Test  
(Take breaks as needed)

Discuss the Praxis Mathematics: Content Knowledge Test

Discuss the Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate

Break

Training for Standard-Setting Judgments

Complete Standard Setting Judgments

Complete Final Evaluation

Collect Materials

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## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>5</sup>

### A target candidate ...

#### Numbers & Quantity

1. Knows the structure and the basic operations of the complex number system and its subset.
2. Knows how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions
3. Knows how to determine the reasonableness of solutions within the context of a given problem
4. Understands ratios and proportions including inversely proportional relationships between two quantities
5. Understands the properties of exponents

#### Algebra

6. Understands how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions
7. Knows how to use varied techniques to solve systems of equations and inequalities

#### Functions

8. Understands how new functions are obtained from existing functions (e.g., domain, range, compositions, transformations, and inverses)
9. Understands how real world phenomena are modeled using trigonometric, polynomial, and exponential functions.
10. Understands how function behavior is analyzed using non-algebraic representations (e.g., graphs, mapping, and tables)
11. Understands how to solve trigonometric, logarithmic, and exponential, polynomial, and rational equations

#### Calculus

12. Knows the meaning of a limit of a function (e.g., find limit from a graph)
13. Knows the derivative as a slope of a tangent line and as a rate of change
14. Knows how to approximate or evaluate derivatives and integrals numerically given a table of values, a graph, or equation
15. Knows the relationship between differentiations and integration, including the role of the fundamental theorems of calculus

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<sup>5</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

## Description of the Target Candidate (continued)<sup>6</sup>

### A target candidate ...

#### Geometry

16. Understands how trigonometry is applied to all triangles
17. Understands arc length and area measurements of sectors of circles
18. Understands means for proving geometric properties (e.g., lines, angles, polygons, and their operations) using geometric and algebraic methods
19. Understands how perimeter, area, surface area, and volume formulas are used to solve problems

#### Probability & Stats

20. Understands how to interpret a regression model (e.g., rate of change, intercepts, and correlation coefficient) in the context of the data
21. Understands and compute the concepts of interdependence and conditional probability (such as simple events, probabilities of compound events, conditional probabilities) and how to apply those concepts to data
22. Understands how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., boxplots, dotplots, normal distribution)

#### Discrete Mathematics

23. Use logic to evaluate the truth or equivalence of statements
24. Knows how to represent arithmetic, recursive, geometric sequences and phenomena
25. Can identify and use concepts of basic set theory
26. Uses counting techniques such as permutations and combinations.

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<sup>6</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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## APPENDIX D

# EVALUATION RESULTS

**Table D1*****Final Evaluation***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	16	84%	3	16%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	16	84%	2	11%	1	5%	0	0%
• The opportunity to "take the test" and to discuss the test content was useful.	16	84%	3	16%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful.	12	63%	7	37%	0	0%	0	0%
• The training for the Standard Setting judgments was adequate to give me the information I needed to complete my assignment.	16	84%	2	11%	1	5%	0	0%
• The process of making the standard-setting judgments was easy to follow.	16	84%	3	16%	0	0%	0	0%

## **Appendix P**

**Multistate Standard Setting Technical Report  
Praxis Mathematics: Content Knowledge (5161)  
March 2013**



*Listening. Learning. Leading.*

Multistate Standard-Setting Technical Report

**PRAXIS™ MATHEMATICS: CONTENT KNOWLEDGE (5161)**

Licensure and Credentialing Research

ETS

Princeton, New Jersey

March 2013

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# EXECUTIVE SUMMARY

To support the decision-making process of education agencies establishing a passing score (cut score) for the Praxis™ Mathematics: Content Knowledge (5161) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study.

## PARTICIPATING STATES

Panelists from 24 states and Washington, DC were recommended by their respective education agency. The education agencies recommended panelists with (a) experience either as mathematics teachers or college faculty who prepare mathematics teachers and (b) familiarity with the knowledge and skills required of beginning mathematics teachers.

## RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Mathematics: Content Knowledge test, the recommended passing score<sup>1</sup> is 32 out of a possible 50 raw-score points. The scaled score associated with a raw score of 32 is 160 on a 100–200 scale.

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<sup>1</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis™ Mathematics: Content Knowledge (5161) test, research staff from ETS designed and conducted a multistate standard-setting study in February 2013 in Princeton, New Jersey. Education agencies<sup>2</sup> recommended panelists with (a) experience, either as mathematics teachers or college faculty who prepare mathematics teachers and (b) familiarity with the knowledge and skills required of beginning mathematics teachers. Twenty-four states and Washington, DC(see Table 1) were represented by 35 panelists. (See Appendix A for the names and affiliations of the panelists.)

**Table 1**  
*Participating Jurisdictions and Number of Panelists*

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Alaska (1 panelist)	North Dakota (1 panelist)
Arkansas (2 panelists)	Pennsylvania (1 panelist)
Delaware (1 panelist)	Rhode Island (1 panelist)
Idaho (2 panelists)	South Carolina (1 panelist)
Kentucky (1 panelist)	South Dakota (1 panelist)
Louisiana (1 panelist)	Tennessee (1 panelist)
Maine (1 panelist)	Utah (2 panelists)
Maryland (2 panelists)	Vermont (1 panelist)
Mississippi (2 panelists)	Washington, DC (1 panelist)
Nevada (1 panelist)	Wisconsin (2 panelists)
New Hampshire (2 panelists)	West Virginia (1 panelist)
New Jersey (2 panelists)	Wyoming (2 panelists)
North Carolina (2 panelists)	

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The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each jurisdiction, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in

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<sup>2</sup> States and jurisdictions that currently use Praxis were invited to participate in the multistate standard-setting study.

accordance with applicable regulations. This study provides a recommended passing score,<sup>3</sup> which represents the combined judgments of two panels of experienced educators. Each jurisdiction may want to consider the recommended passing score but also other sources of information when setting the final Praxis Mathematics: Content Knowledge passing score (see Geisinger & McCormick, 2010). A jurisdiction may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the jurisdiction's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the Praxis Mathematics: Content Knowledge test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows a jurisdiction to recognize that any test score on any standardized test—including a Praxis Mathematics: Content Knowledge test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allow a jurisdiction to gauge the likelihood that the recommended passing score from a particular panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each jurisdiction should consider the likelihood of classification error. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required

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<sup>3</sup> In addition to the recommended passing score averaged across the two panels, the recommended passing scores for each panel are presented.

knowledge/skills. The jurisdiction needs to consider which decision error may be more important to minimize.

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## OVERVIEW OF THE PRAXIS MATHEMATICS: CONTENT KNOWLEDGE TEST

The Praxis Mathematics: Content Knowledge *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level mathematics teachers have the knowledge/skills believed necessary for competent professional practice.

The two-hour assessment contains 60 selected-response and numeric-entry items<sup>4</sup> covering two content areas: *Number and Quantity, Algebra, Functions, and Calculus* (approximately 41 items) and *Geometry, Probability and Statistics, and Discrete Mathematics* (approximately 19 items).<sup>5</sup> The reporting scale for the Praxis Mathematics: Content Knowledge test ranges from 100 to 200 scaled-score points.

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## PROCESSES AND METHODS

The design of the standard-setting study included two, independent expert panels. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

For each panel, the standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

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<sup>4</sup> Ten of the 60 selected-response and numeric-entry items are pretest items and do not contribute to a candidate's score.

<sup>5</sup> The number of items for each content area may vary slightly from form to form of the test.

## REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

## DEFINING THE TARGET CANDIDATE

Following the review of the test, panelists described the target candidate. The *target candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

Panel 1 created a description of the target candidate — the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the target candidate. The full panel then reconvened and, through whole-group discussion, created the description of the target candidate to use for the remainder of the study.

The written description of the target candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the target candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate. The written description was distributed to panelists to use during later phases of the study (see Appendix C for the target candidate description).

For Panel 2, the panelists began with the description of the target candidate developed by Panel 1. Given that the multistate standard-setting study was designed to provide two recommendations for the same performance standard, it was important that panels use consistent target candidate description to frame their judgments. The panelists reviewed the target candidate description, and any ambiguities were discussed and clarified.

## PANELISTS' JUDGMENTS

The standard-setting process for the Praxis Mathematics: Content Knowledge test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the target candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the target candidate would answer the item correctly because the item is difficult for the target candidate. The higher the value, the more likely it is that the target candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, the item would be difficult for the target candidate, easy for the target candidate or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Difficult items for the target candidate are in the 0 to .30 range.
- Moderately difficult/easy items for the target candidate are in the .40 to .60 range.
- Easy items for the target candidate are in the .70 to 1 range.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that an item would be easy for the target candidate, the initial decision located the item in the .70 to 1 range. The second decision for the panelist was to decide if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationale. All panelists completed a post-training survey to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. Items were highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located an item in the same difficulty range) or diverged in their judgments.

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the target candidate and helped to clarify aspects of

items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to another’s judgment, but to understand the different relevant perspectives among the panelists.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

Other than the description of the target candidate, results from Panel 1 were not shared with Panel 2. The item-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

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## RESULTS

### EXPERT PANELS

Table 2 presents a summary of the panelists’ demographic information. The panel included 35 educators representing 24 states and Washington, DC. (See Appendix A for a listing of panelists.) Twenty-four panelists were teachers, nine were college faculty, one was an administrator or department head, and one held another position. All nine of the faculty members’ job responsibilities included the training of mathematics teachers.

The number of experts by panel and their demographic information are presented in Appendix D (see Table D1).

**Table 2**  
***Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Current position</b>		
Teacher	24	69%
Administrator/Department head	1	3%
College faculty	9	26%
Other	1	3%
<b>Race</b>		
White	29	83%
Black or African American	2	6%
Hispanic or Latino	3	9%
Native Hawaiian or Other Pacific Islander	1	3%
<b>Gender</b>		
Female	20	57%
Male	15	43%
<b>Are you currently certified to teach this subject in your state?</b>		
Yes	29	83%
No	6	17%
<b>Are you currently teaching this subject in your state?</b>		
Yes	31	89%
No	4	11%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>		
Yes	18	51%
No	17	49%
<b>At what K–12 grade level are you currently teaching this subject?</b>		
Middle school (6–8 or 7–9)	1	3%
High school (9–12 or 10–12)	20	57%
Middle and High school	3	9%
Not currently teaching at the K–12 level	11	31%

**Table 2 (continued)*****Panel Member Demographics (Across Panels)***

	<i>N</i>	<i>%</i>
<b>Including this year, how many years of experience do you have teaching this subject?</b>		
3 years or less	4	11%
4–7 years	13	37%
8–11 years	5	14%
12–15 years	6	17%
16 years or more	7	20%
<b>Which best describes the location of your K–12 school?</b>		
Urban	7	20%
Suburban	9	26%
Rural	10	29%
Not currently working at the K–12 level	9	26%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>		
Yes	9	26%
No	0	0%
Not college faculty	26	74%

**STANDARD-SETTING JUDGMENTS**

Table 3 summarizes the standard-setting judgments (Round 2) of panelists. The table also includes estimates of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel’s standard-setting judgments.<sup>6</sup> It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the subtest. The confidence intervals created by adding/subtracting two SEJs to each panel’s recommended passing score overlap, indicating that they may be comparable.

Panelist-level results, for Rounds 1 and 2, are presented in Appendix D (see Table D2).

<sup>6</sup> An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

**Table 3**  
***Summary of Round 2 Standard-setting Judgments***

	<b>Panel 1</b>	<b>Panel 2</b>
Average	33.10	29.81
Lowest	20.40	27.05
Highest	45.60	34.70
SD	6.20	2.19
SEJ	1.46	0.53

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for Panel 2 (see Table D2 in Appendix D). The standard deviation increased slightly between rounds for Panel 1. The Round 2 average score is the panel’s recommended passing score.

The panels’ passing score recommendations for the Praxis Mathematics: Content Knowledge test are 33.10 for Panel 1 and 29.81 for Panel 2 (out of a possible 50 raw-score points). The values were rounded to the next highest whole number, to determine the functional recommended passing score — 34 for Panel 1 and 30 for Panel 2. The scaled scores associated with 34 and 30 raw points are 165 and 155, respectively.

In addition to the recommended passing score for each panel, the average passing score across the two panels is provided to help education agencies determine an appropriate passing score. The panels’ average passing score recommendation for the Praxis Mathematics: Content Knowledge test is 31.46 (out of a possible 50 raw-score points). The value was rounded to 32 (next highest raw score) to determine the functional recommended passing score. The scaled score associated with 32 raw points is 160.

Table 4 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with one and two CSEMs above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

**Table 4*****Passing Scores Within 1 and 2 CSEMs of the Recommended Passing Score<sup>7</sup>***

<b>Recommended passing score (CSEM)</b>		<b>Scale score equivalent</b>
	32 (3.43)	160
-2 CSEMs	26	145
-1 CSEM	29	152
+ 1 CSEM	36	170
+ 2 CSEMs	39	178

**Note.** CSEM = conditional standard error of measurement.

## FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were also shown the panel's recommended passing score and asked (a) how comfortable they are with the recommended passing score and (b) if they think the score was too high, too low, or about right. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* or *agreed* that they understood the purpose of the study. Thirty-four of the 35 panelists *strongly agreed* or *agreed* that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All but one of the panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the description of the target candidate was at least *somewhat influential* in guiding their standard-setting judgments; 30 of the 35 panelists indicated the description was *very influential*. All of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Slightly less than half of the panelists (14 of the 35 panelists) indicated that their own professional experience was *very influential* in guiding their judgments.

<sup>7</sup> The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scaled scores.

All but two of the panelists indicated they were at least *somewhat comfortable* with the passing score they recommended; 23 of the 35 panelists were *very comfortable*. Thirty of the 35 panelists indicated the recommended passing score was *about right* with two of the remaining panelists indicated that the passing score was *too low* and three indicating that the passing score was *too high*.

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## SUMMARY

To support the decision-making process for education agencies establishing a passing score (cut score) for the Praxis Mathematics: Content Knowledge test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the Praxis Mathematics: Content Knowledge test, the recommended passing score<sup>8</sup> is 32 out of a possible 50 raw-score points. The scaled score associated with a raw score of 32 is 160 on a 100–200 scale.

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<sup>8</sup> Results from the two panels participating in the study were averaged to produce the recommended passing score.

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## REFERENCES

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## APPENDIX A

# PANELISTS' NAMES & AFFILIATIONS

*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Bertine Bahige	Campbell County School District #1 (WY)
Mary Bell	Peoples Academy (VT)
Lindsey Brewer	Huron High School (SD)
Sara Brown	Brown Deer High School (WI)
Emma Chandler	Salt Lake Center for Science Education (UT)
Tina Childress	Langdon Area High School (ND)
Kira Christensen	Sioux Falls Public Schools (SD)
Michelle Cirillo	University of Delaware (DE)
Jennifer Cribbs	Western Kentucky University (KY)
Nancy Jarger Daly	Millburn High School (NJ)
Brian DeMayo	Bohemia Manor High School – Cecil County Public Schools (MD)
Kimberly L. Dickerson	Southern University at New Orleans (LA)
Katy Witt Edgar	New Hope High School (SD)
Ariane Eicke	Laramie High School (WY)
Michael Fish	University of Maine at Machias (ME)
Brian Fleischer	Nevada Virtual Academy (NV)
Joseph Gonzales	Terry Sanford High School (NC)
Shiloh A. Harder	Conway High School (AR)
Jayne Heath-Wilmarth	Council Jr./Sr. High School (ID)
Christopher Hoyt	Dunbar SHS (DC)
Barry Kolar	University High School (WV)

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*Participating Panelists With Affiliation*

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<b><u>Panelist</u></b>	<b><u>Affiliation</u></b>
Trent Kull	Winthrop University (SC)
Meghan Leeming	Beacon Charter High School for the Arts (RI)
Deborah L. MacCullough	Cairn University (PA)
Patrice Marquette	Hollis Brookline Middle School (NH)
Ricardo Martinez	Henderson County Early College (NC)
Denise Raynes Pitcher	Western Governors University (UT)
Lincoln Robertson	White Mountains Community College (NH)
Kimberly Scarbrough	Riverside High School (AR)
Daniel M. Seaton	University of Maryland Eastern Shore (MD)
Alice Steimle	University of Mississippi (MS)
Michael Tamblyn	Whitewater High School (WI)
Christian Tomona	Newark Public Schools (NJ)
David Williams	Tennessee Department of Education (TN)
Holly Wood	Vallivue High School (ID)

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APPENDIX B  
STUDY AGENDA

# AGENDA

## **Praxis Mathematics: Content Knowledge (5161) Standard-Setting Study**

Day 1

Welcome and Introduction

Overview of Standard Setting & the Praxis Mathematics Test

“Take” the Praxis Mathematics Test  
(Take breaks as needed)

Discuss the Praxis Mathematics Test

Define the Knowledge/Skills of a Target Candidate

Lunch

Define the Knowledge/Skills of a Target Candidate (continued)

Break

Standard Setting Training

Round 1 Standard Setting Judgments

Collect Materials; End of Day 1

# **AGENDA**

## **Praxis Mathematics: Content Knowledge (5161) Standard-Setting Study**

Day 2

Overview of Day 2 & Review of Training

Round 1 Feedback & Round 2 Judgments

Break

Round 1 Feedback & Round 2 Judgments (continued)

Lunch

Feedback on Round 2 Recommended Passing Score

Complete Final Evaluation

Collect Materials; End of Study

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## APPENDIX C

# TARGET CANDIDATE DESCRIPTION

## Description of the Target Candidate<sup>9</sup>

A target candidate ...

### Numbers & Quantity

1. Knows the structure and the basic operations of the various number systems with irrational and imaginary numbers
2. Knows how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions
3. Knows how to determine the reasonableness of solutions within the context of a given problem
4. Understands ratios and proportions including inversely proportional relationships between two quantities

### Algebra

5. Understands how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions
6. Knows how to find real and imaginary roots of a cubic

### Functions

7. Understands how new functions are obtained from existing functions (e.g., domain, range, compositions, transformations, and inverses)
8. Understands how periodic phenomena are modeled using trigonometric functions
9. Understands how function behavior is analyzed using non-algebraic representations (e.g., graphs, mapping, and tables)
10. Understands how to solve trigonometric, logarithmic, and exponential equations

### Calculus

11. Knows the meaning of a limit of a function (e.g., find limit from a graph)
12. Understands the derivative as a slope of a tangent line and as a rate of change
13. Knows how to approximate or evaluate derivatives and integrals numerically given a table of values or a graph
14. Understands the relationship between differentiations and integration, including the role of the fundamental theorems of calculus

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<sup>9</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

## Description of the Target Candidate (continued)<sup>10</sup>

A target candidate ...

### Geometry

15. Understands how trigonometry is applied to non-right triangles
16. Understands arc length and area measurements of sectors of circles
17. Understands means for proving geometric properties (e.g., lines, angles, polygons, and their operations) using geometric and algebraic methods
18. Knows means for visualizing and reasoning algebraically among common 2D and 3D figures (e.g., prisms, pyramids, and cones)

### Probability & Stats

19. Understands how to interpret a linear regression model (e.g., rate of change, intercepts, and correlation coefficient) in the context of the data
20. Understands and compute the concepts of interdependence and conditional probability (such as simple events, probabilities of compound events, conditional probabilities) and how to apply those concepts to data

### Discrete Mathematics

21. Use logic to evaluate the truth or equivalence of statements
22. Knows how to represent arithmetic, recursive, geometric sequences and phenomena
23. Can identify and use concepts of basic set theory
24. Uses counting techniques such as permutations and combinations.

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<sup>10</sup> Description of the target candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

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# APPENDIX D

## RESULTS

**Table D1**  
**Panel Member Demographics (Across Panels)**

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Current position</b>				
Teacher	14	78%	10	59%
Administrator or Department Head	0	0%	1	6%
College faculty	4	22%	5	29%
Other	0	0%	1	6%
<b>Race</b>				
White	15	83%	14	82%
Black or African American	0	0%	2	12%
Hispanic or Latino	2	11%	1	6%
Native Hawaiian or Other Pacific Islander	1	6%	0	0%
<b>Gender</b>				
Female	9	50%	11	65%
Male	9	50%	6	35%
<b>Are you currently certified to teach this subject in your state?</b>				
Yes	16	89%	13	76%
No	2	11%	4	24%
<b>Are you currently teaching this subject in your state?</b>				
Yes	16	89%	15	88%
No	2	11%	2	12%
<b>Are you currently supervising or mentoring other teachers of this subject?</b>				
Yes	8	44%	10	59%
No	10	56%	7	41%
<b>At what K–12 grade level are you currently teaching this subject?</b>				
Middle school (6–8 or 7–9)	1	6%	0	0%
High school (9–12 or 10–12)	12	67%	7	41%
Middle and High school	0	0%	3	18%
Not currently teaching at the K–12 level	5	28%	7	41%

**Table D1 (continued)*****Panel Member Demographics (By Panel)***

	<b>Panel 1</b>		<b>Panel 2</b>	
	<i>N</i>	%	<i>N</i>	%
<b>Including this year, how many years of experience do you have teaching this subject?</b>				
3 years or less	4	22%	0	0%
4–7 years	8	44%	5	29%
8–11 years	0	0%	5	29%
12–15 years	2	11%	4	24%
16 years or more	4	22%	3	18%
<b>Which best describes the location of your K–12 school?</b>				
Urban	4	22%	3	18%
Suburban	6	33%	3	18%
Rural	4	22%	6	35%
Not currently working at the K–12 level	4	22%	5	29%
<b>If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?</b>				
Yes	4	22%	5	29%
No	0	0%	0	0%
Not college faculty	14	78%	12	71%

**Table D2**  
*Passing Score Summary by Round of Judgments*

<b>Panelist</b>	<b>Panel 1</b>		<b>Panel 2</b>	
	<b>Round 1</b>	<b>Round 2</b>	<b>Round 1</b>	<b>Round 2</b>
1	37.15	36.75	30.05	29.55
2	32.40	36.10	32.90	34.70
3	37.60	40.20	27.55	28.55
4	28.05	32.80	29.60	29.00
5	30.40	31.40	30.70	29.70
6	27.25	29.45	30.55	30.85
7	31.15	34.95	26.95	29.75
8	19.40	22.20	29.45	31.85
9	31.00	33.00	29.90	29.10
10	25.25	30.15	28.15	27.45
11	31.65	33.95	32.10	32.45
12	38.90	45.60	25.10	28.55
13	26.85	28.65	26.65	27.05
14	43.10	42.60	26.20	28.10
15	26.55	32.65	28.10	28.70
16	29.15	33.75	27.95	27.75
17	22.15	20.40	34.95	33.65
18	30.00	31.20		
<b>Average</b>	30.44	33.10	29.23	29.81
<b>Lowest</b>	19.40	20.40	25.10	27.05
<b>Highest</b>	43.10	45.60	34.95	34.70
<b>SD</b>	5.93	6.20	2.56	2.19
<b>SEJ</b>	1.40	1.46	0.62	0.53

**Table D3*****Final Evaluation: Panel 1***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	16	89%	2	11%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	8	44%	9	50%	1	6%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	11	61%	7	39%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	10	56%	8	44%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	14	78%	3	17%	1	6%	0	0%
• The process of making the standard-setting judgments was easy to follow.	5	28%	12	67%	1	6%	0	0%

**Table D3 (continued)**  
**Final Evaluation: Panel 1**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	14	78%	4	22%	0	0%		
• The between-round discussions	14	78%	4	22%	0	0%		
• The knowledge/skills required to answer each test item	12	67%	6	33%	0	0%		
• The passing scores of other panel members	1	6%	13	72%	4	22%		
• My own professional experience	9	50%	8	44%	1	6%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	9	50%	7	39%	1	6%	1	6%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	1	6%	14	78%	3	17%		

**Table D4*****Final Evaluation: Panel 2***

	<b>Strongly agree</b>		<b>Agree</b>		<b>Disagree</b>		<b>Strongly disagree</b>	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• I understood the purpose of this study.	15	88%	2	12%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	14	82%	3	18%	0	0%	0	0%
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	9	53%	8	47%	0	0%	0	0%
• The explanation of how the recommended passing score is computed was clear.	14	82%	3	18%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	15	88%	2	12%	0	0%	0	0%
• The process of making the standard-setting judgments was easy to follow.	9	53%	8	47%	0	0%	0	0%

**Table D4 (continued)**  
**Final Evaluation: Panel 2**

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• The description of the target candidate	16	94%	1	6%	0	0%		
• The between-round discussions	8	47%	9	53%	0	0%		
• The knowledge/skills required to answer each test item	12	71%	5	29%	0	0%		
• The passing scores of other panel members	1	6%	12	71%	4	24%		
• My own professional experience	5	29%	12	71%	0	0%		
	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
• Overall, how comfortable are you with the panel's recommended passing score?	14	82%	3	18%	0	0%	0	0%
	Too low		About right		Too high			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
• Overall, the recommended passing score is:	1	6%	16	94%	0	0%		

## **Appendix Q**

### **Test at a Glance**

### **Praxis Mathematics: Content Knowledge (5161)**

**Mathematics: Content Knowledge (5161)**

**Test at a Glance**

Test Name	<b>Mathematics: Content Knowledge</b>		
Test Code	<b>5161</b>		
Time	<b>150 Minutes</b>		
Number of Questions	<b>60 Selective Response Questions</b>		
Format	<b>Innovative Multiple-choice</b>		
	<b>Content Categories</b>	<b>Approximate Number of Questions</b>	<b>Approximate Percent of Examination</b>
	<b>I. Number and Quantity, Algebra, Functions, and Calculus</b>	41	68%
	<b>II. Geometry, Probability and Statistics, and Discrete Mathematics</b>	19	32%

**About This Test**

The Mathematics: Content Knowledge test measures whether entry-level mathematics educators have the standards relevant knowledge skills, and abilities believed necessary for competent professional practice.

This test may contain some questions that will not count toward your score.

# Topics Covered

## I. Number and Quantity, Algebra, Functions, and Calculus

### A. Number and Quantity

- Understands the properties of exponents.
  - Perform operations involving exponents, including negative and rational exponents.
  - Demonstrate an understanding of the properties of exponential expressions.
  - Use the properties of exponents to rewrite expressions that have radicals or rational exponents.
- Understands the properties of rational and irrational numbers, and the interactions between those sets of numbers.
  - Recognize that the sum or product of two rational numbers is rational.
  - Recognize that the sum of a rational number and an irrational number is irrational.
  - Recognize that the product of a nonzero rational number and an irrational number is irrational.
  - Recognize that the sum or product of two irrational numbers can be rational or irrational.
- Understands how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions).
  - Use units as a way to understand problems and to guide the solution of multistep problems.
  - Choose and interpret units consistently in formulas.
  - Choose and interpret the scale and the origin in graphs and data displays.
  - Recognize the reasonableness of results within the context of a given problem.
- Understands the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, −, ×, and ÷) on numbers in these systems are performed.
  - Solve problems using addition, subtraction, multiplication, and division of rational, irrational, and complex numbers.
  - Apply the order of operations.
  - Given operations on a number system, determine whether the properties (e.g., commutative, associative, distributive) hold.
  - Compare, classify, and order real numbers.
  - Simplify and approximate radicals.
  - Find conjugates of complex numbers.
  - Demonstrate an understanding of the properties of counting numbers (e.g., prime, composite, prime factorization, even, odd, factors, multiples).
- Understands how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions.
  - Solve quadratic equations with real coefficients that have complex solutions.
  - Extend polynomial identities to the complex numbers (e.g.,  $x^2 + y^2 = (x + yi)(x - yi)$ ).
  - Verify the fundamental theorem of algebra for quadratic polynomials.
- Understands how to perform operations on matrices and how to use matrices in applications.
  - Use matrices to represent and manipulate data.
  - Multiply matrices by scalars to produce new matrices.
  - Add, subtract, and multiply matrices of appropriate dimensions.

- Understand that matrix multiplication for square matrices is not a commutative operation but still satisfies the associative and distributive properties.
  - Understand the role played by zero, and identity matrices in matrix addition and multiplication.
  - Understand that the determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
  - Work with  $2 \times 2$  matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.
- Understands how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions.
    - Apply the concept of a ratio and use ratio language and notation to describe a relationship between two quantities.
    - Compute unit rates.
    - Use ratio reasoning to convert rates.
    - Solve problems involving scale factors.
    - Recognize and represent proportional and inversely proportional relationships between two quantities.
    - Use proportional relationships to solve multistep ratio, average, and percent problems.
    - Solve measurement and estimation problems involving time, length, temperature, volume, and mass in both the U.S. customary system and the metric system, where appropriate.
    - Convert units within the metric and customary systems.
  - Knows how to analyze both precision and accuracy in measurement situations.
    - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Calculate or estimate absolute and relative error in the numerical answer to a problem.
  - Understands various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude).
    - Represent and compare very large and very small numbers.
  - Understands how to both estimate and perform calculations on very large and very small quantities.
    - Use orders of magnitude to estimate very large and very small numbers.
    - Perform calculations on numbers in scientific notation.

## B. Algebra

- Understands how to write algebraic expressions in equivalent forms.
  - Use the structure of an expression to identify ways to rewrite it.
  - Understand how to rewrite quadratic expressions for specific purposes (e.g., factoring/finding zeros, completing the square/finding maxima or minima).
  - Use the properties of exponents to rewrite expressions for exponential functions.
- Understands how to perform arithmetic operations on polynomials.
  - Add, subtract, and multiply polynomials.
- Understands the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions.
  - Know and apply the remainder theorem: for a polynomial  $p(x)$  and a number  $a$ , the remainder on division by  $x - a$  is  $p(a)$ , so  $p(a) = 0$  if and only if  $(x - a)$  is a factor of  $p(x)$ .
  - Use factorization to identify zeros of polynomials.

- Use zeros of a polynomial to construct a rough graph of the function defined by the polynomial.
- Understands how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems.
  - Apply the binomial theorem for the expansion of  $(x + y)^n$  in powers of  $x$  and  $y$  for a positive integer  $n$ .
- Understands how to rewrite rational expressions and perform arithmetic operations on rational expressions.
  - Rewrite simple rational expressions in different forms.
  - Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.
  - Add, subtract, multiply, and divide rational expressions.
- Understands how to create equations and inequalities that describe relationships.
  - Create equations and inequalities in one variable and use them to solve problems and graph solutions on the number line.
  - Create equations and inequalities in two or more variables to represent relationships between quantities, solve problems, and graph them on the coordinate plane with labels and scales.
  - Represent constraints by equations, inequalities, or systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
  - Rearrange formulas to highlight a quantity of interest (e.g., solve  $d = rt$  for  $t$ ).
- Understands how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions.
  - Explain each step in solving a simple equation.
  - Solve simple rational and radical equations in one variable, incorporating analysis of possible extraneous solutions.
- Understands how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable.
  - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
  - Use the method of completing the square to transform any quadratic equation in  $x$  into the equivalent form  $(x - p)^2 = q$ .
  - Solve equations using a variety of methods (e.g., using graphs, using the quadratic formula, or factoring).
  - Use different methods (e.g., discriminant analysis, graphical analysis) to determine the nature of the solutions of a quadratic equation.
  - Write complex solutions in the form  $a \pm bi$ .
- Understands how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities.
  - Explain why, when solving a system of two equations using the elimination method, replacing one or both equations with a scalar multiple produces a system with the same solutions as the solutions of the original system.
  - Solve a system consisting of two linear equations in two variables algebraically and graphically.
  - Solve a system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.

- Represent a system of linear equations as a single matrix equation.
  - Find the inverse of a matrix if it exists, and use it to solve systems of linear equations.
  - Explain why the  $x$ -coordinates of the intersection points of the graphs of  $y = f(x)$  and  $y = g(x)$  are the solutions of  $f(x) = g(x)$ .
  - Find the solutions of  $f(x) = g(x)$  approximately (e.g., use technology to graph the functions, make tables of values, find successive approximations). Include cases where  $f(x)$  and/or  $g(x)$  are linear, polynomial, rational, absolute value, exponential, or logarithmic functions.
  - Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
- Understands the properties of number systems under various operations.
    - Given operations on algebraic expressions, determine whether the properties hold (e.g., commutative, associative, distributive).
  - Understands the concept of rate of change of nonlinear functions.
    - Calculate and interpret the average rate of change of a function presented symbolically, numerically, or graphically over a specified interval.
  - Understands the concepts of intercept(s) of a line and slope as a rate of change.
    - Calculate and interpret the intercepts of a line.
    - Calculate and interpret the slope of a line presented symbolically, numerically, or graphically.
    - Estimate the rate of change of a linear function from a graph.
  - Understands how to find the zero(s) of functions.
    - Uses a variety of techniques to find and analyze the zero(s) (real and complex) of functions.
- ### C. Functions
- Understands the function concept and the use of function notation.
    - Recognize that functions are sets of ordered pairs.
    - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.
    - Use function notation, evaluate functions, and interpret statements that use function notation in terms of a context.
    - Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
  - Understands how to find the domain and range of a function and a relation.
    - Identify the domain and range of a function or relation.
    - Determine the domain of a function from a function rule (e.g.,  $f(x) = 2x + 1$ ), graph, set of ordered pairs, or table.
- Understands how function behavior is analyzed using different representations. (e.g., graphs, mappings, tables).
- For a function that models a relationship between two quantities, interpret key features of graphs and tables (e.g., increasing/decreasing, maximum/minimum, periodicity) in terms of the quantities.
  - Given a verbal description of a relation, sketch graphs that show key features of that relation.

- Graph functions (i.e., radical, piecewise, absolute value, polynomial, rational, logarithmic, trigonometric) expressed symbolically and identify key features of the graph.
  - Write a function that is defined by an expression in different but equivalent forms to reveal different properties of the function (e.g., zeros, extreme values, symmetry of the graph).
  - Interpret the behavior of exponential functions (e.g., growth, decay).
  - Understand how to determine if a function is odd, even, or neither and any resulting symmetries.
- Understands how functions and relations are used to model relationships between quantities.
    - Write a function that relates two quantities.
    - Determine an explicit expression or a recursive process that builds a function from a context.
  - Understands how new functions are obtained from existing functions (e.g., compositions, transformations, inverses).
    - Describe how the graph of  $g(x)$  is related to the graph of  $f(x)$ , where  $g(x) = f(x) + k$ ,  $g(x) = k f(x)$ ,  $g(x) = f(kx)$ , or  $g(x) = f(x + k)$  for specific values of  $k$  (both positive and negative), and find the value of  $k$  given the graphs.
    - Determine if a function has an inverse and write an expression for the inverse.
    - Verify by composition if one function is the inverse of another.
    - Given that a function  $f$  has an inverse, find values of the inverse function from a graph or a table of  $f$ .
    - Given a noninvertible function, determine a largest possible domain of the function that produces an invertible function.
    - Understand the inverse relationship between exponential and logarithmic functions and use this relationship to solve problems.
- Combine standard function types using arithmetic operations.
  - Perform domain analysis on functions resulting from arithmetic operations.
  - Compose functions algebraically, numerically, and graphically.
  - Perform domain analysis on functions resulting from compositions.
- Understands differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems.
    - Understand that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
    - Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
    - Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
    - Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table).
    - Observe that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
    - Express the solution to an exponential equation with base  $b$  as a logarithm (e.g.,  $3 \cdot 25^t = 20$ ,  $3 \cdot e^{5t} = 20$ ).
    - Use technology to evaluate logarithms that have any base.
    - Interpret the parameters in a linear or exponential function in terms of a context (e.g.,  $A(t) = Pert$ ).
    - Use quantities that are inversely related to model phenomena.

- Understands how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains.
  - Understand radian measure (e.g., 1 radian is the measure of a central angle that subtends an arc with length equal to the length of the radius).
  - Understand how the domains of trigonometric functions can be extended beyond  $0$  to  $2\pi$  using the unit circle.
  - Use special triangles (i.e., 30-60-90, 45-45-90) to determine geometrically the values of sine, cosine, and tangent for  $\frac{\pi}{3}$ ,  $\frac{\pi}{4}$ , and  $\frac{\pi}{6}$ .
  - Use reference angles to find the values of trigonometric functions at angles outside the interval  $0$  to  $\frac{\pi}{2}$ .
  - Use the unit circle to explain symmetry and periodicity of trigonometric functions.
- Understands how periodic phenomena are modeled using trigonometric functions.
  - Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
  - Understand how to restrict the domain of a trigonometric function so that its inverse can be constructed.
  - Use inverse functions to solve trigonometric equations that arise in modeling contexts, and interpret them in terms of the context.
- Understands the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, and difference of angles).
  - Use Pythagorean identities (e.g.,  $\sin^2 \theta + \cos^2 \theta = 1$ ).
  - Use trigonometric identities to rewrite expressions and solve equations.

- Understand trigonometric identities in the context of equivalent graphs of trigonometric functions (e.g.,  $y = \sin x$  and  $y = \cos\left(\frac{\pi}{2} - x\right)$  are equivalent graphs).
- Prove Pythagorean identities (e.g.,  $\sin^2 \theta + \cos^2 \theta = 1$ ).

- Knows how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables).
  - Interpret representations of functions of two variables.
- Understands how to solve equations (e.g., trigonometric, logarithmic, exponential).
  - Solve trigonometric, logarithmic, and exponential equations.

#### D. Calculus

- Understands the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits.
  - Graphically analyze the limit of  $f(x)$  as  $x$  approaches a fixed value from both left and right.
  - Solve limit problems (e.g., a constant times a function, the sum of two functions, the product and quotient of two functions) using properties of limits, where all limits of the individual functions exist at the value that  $x$  is approaching.
  - Analyze one-sided limits for various functions to see whether or not the limit exists.
  - Recognize limits that do not exist, such as  $\lim_{x \rightarrow 0} \sin\left(\frac{1}{x}\right)$  and  $\lim_{x \rightarrow 0} \frac{1}{\sqrt[3]{x^2}}$ .

- Understands the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change.
  - Construct a function graph for a given function and a given point  $(a, f(a))$ , and explain what happens to the succession of slopes of secant lines connecting  $(a, f(a))$  to  $(x, f(x))$  as  $x$  approaches  $a$ , from both the right side and the left side.
  - State the limit definition of the derivative, and use it to find the derivative of a given function at a given value of  $x$  and to find the derivative function.
- Understands how to show that a particular function is continuous.
  - Apply the three steps (i.e.,  $f(a)$  exists,  $\lim_{x \rightarrow a} f(x)$  exists, and  $f(a) = \lim_{x \rightarrow a} f(x)$ ) that are part of the definition of what it means for a function to be continuous at  $x = a$  to verify whether a given function is continuous at a given point.
- Knows the relationship between continuity and differentiability.
  - Give examples of functions that are continuous at  $x = a$  but not differentiable at  $x = a$ , and explain why.
- Understands how to approximate derivatives and integrals numerically.
  - Given a table of values, use the slope of a secant line to approximate a derivative.
  - Use the midpoint rule, trapezoid rule, or other Riemann sums to find numerical approximations for integrals.
- Understands how and when to use standard differentiation and integration techniques.
  - Use standard differentiation techniques.
  - Use standard integration techniques.
- Understand the relationship between position, velocity, and acceleration functions of a particle in motion.
- Understands how to analyze the behavior of a function (e.g., extrema, concavity, symmetry).
  - Use the first and second derivatives to analyze the graph of a function.
- Understands how to apply derivatives to solve problems (e.g., related rates, optimization).
  - Apply derivatives to solve problems.
- Understands the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem).
  - Solve problems using the foundational theorems of calculus.
  - Understand the relationship between differentiation and integration, including the role of the fundamental theorems of calculus.
  - Match graphs of functions with graphs of their derivatives or accumulations.
  - Understand how to use differentiation and integration of a function to express rates of change and total change.
  - Understand and calculate the average value of a function over an interval (i.e., mean value theorem of integrals).
- Understands integration as a limit of Riemann sums.
  - Calculate a definite integral using a limit of Riemann sums.
- Understands how to use integration to compute area, volume, distance, or other accumulation processes.
  - Use integration techniques to compute area, volume, distance, or other accumulation processes.

- Knows how to determine the limits of sequences, if they exist.
  - Determine the limits of sequences when they exist.
- Is familiar with simple infinite series.
  - Determine if simple infinite series converge or diverge.
  - Find the sum of a simple infinite series if it exists.
  - Find the partial sum of a simple infinite series.

## II. Geometry, Probability and Statistics, and Discrete Mathematics

### A. Geometry

- Understands transformations in a plane.
  - Know precise definitions of angle, circle, line segment, perpendicular lines, and parallel lines.
  - Represent transformations in the plane.
  - Describe transformations as functions that take points in the plane as inputs, and give other points as outputs.
  - Recognize whether a transformation preserves distance and angle measure.
  - Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that map it onto itself.
  - Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
  - Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure.
  - Specify a sequence of transformations that will map a given figure onto another figure.
- Understands how geometric constructions are made with a variety of tools and methods.
  - Recognize formal geometric constructions.
  - Explain how formal geometric constructions are made (e.g., an equilateral triangle, a square, a regular hexagon inscribed in a circle).
- Understands congruence and similarity in terms of transformations.
  - Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure.
  - Verify the properties of dilations given by a center and a scale factor.
  - Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
  - Given two figures, use the definition of similarity in terms of dilations to decide if the figures are similar.
  - Explain how the criteria for triangle congruence (e.g., ASA, SAS, HL) follow from the definition of congruence in terms of rigid motions.
  - Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
  - Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

- Understands how trigonometric ratios are defined in right triangles.
  - Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
  - Explain and use the relationship between the sine and cosine of complementary angles.
  - Use trigonometric ratios and the Pythagorean theorem to solve right triangles in applied problems.
  
- Understands how trigonometry is applied to general triangles.
  - Derive the formula  $A = \frac{1}{2} ab \sin C$  for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side and use it to solve problems.
  - Apply the law of sines and the law of cosines to find unknown measurements in triangles.
  
- Understands and applies theorems about circles.
  - Identify and describe relationships among inscribed angles, radii, and chords.
  - Prove properties of angles for a quadrilateral inscribed in a circle.
  - Construct a tangent line from a point outside a given circle to the circle.
  
- Understands arc length and area measurements of sectors of circles.
  - Derive and use the fact that the length of the arc intercepted by a central angle is proportional to the circumference.
  - Derive and use the formula for the area of a sector.
  
- Knows how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section.
  - Derive and use the equation of a circle of given center and radius.
  - Complete the square to find the center and radius of a circle given by an equation in standard form.
  - Derive the equation of a parabola given a focus and directrix.
  - Derive and use the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from a point on the curve to the foci is constant.
  
- Understands how to use coordinate geometry to algebraically prove simple geometric theorems.
  - Use coordinates to prove simple geometric theorems algebraically.
  - Prove the slope criteria for parallel and perpendicular lines, and use parallel and perpendicular lines to solve geometric problems.
  - Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
  - Use coordinates to compute perimeters of polygons and areas of triangles and quadrilaterals.
  
- Understands how perimeter, area, surface area, and volume formulas are used to solve problems.
  - Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
  - Use the perimeter and area of geometric shapes to solve problems.
  - Use the surface area and volume of prisms, cylinders, pyramids, cones, and spheres to solve problems.

- Knows how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects.
  - Identify the shapes of two-dimensional cross sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
  - Use two-dimensional representations of three-dimensional objects to visualize and solve problems.
- Knows how to apply geometric concepts in real-world situations.
  - Use geometric shapes, their measures, and their properties to describe objects.
  - Apply concepts of density based on area and volume in modeling situations.
  - Apply geometric methods to solve design problems.
- Understands the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving.
  - Solve problems involving parallel, perpendicular, and intersecting lines.
  - Apply angle relationships (e.g., supplementary, vertical, alternate interior) to solve problems.
  - Solve problems that involve medians, midpoints, and altitudes.
  - Solve problems involving special triangles (e.g., isosceles, equilateral, right).
  - Know geometric properties of various quadrilaterals (e.g., parallelograms, trapezoids).
  - Know relationships among quadrilaterals.
  - Solve problems involving angles and diagonals.
  - Solve problems involving polygons with more than four sides.

## B. Probability and Statistics

- Understands how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions).
  - Represent data with plots on the real number line (e.g., dot plots, histograms, and box plots).
  - Use statistics appropriate to the shape of the data distribution to compare center (e.g., median, mean) and spread (e.g., interquartile range, standard deviation) of two or more different data sets.
  - Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers.
  - Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages, and recognize that there are data sets for which such a procedure is not appropriate.
  - Estimate areas under the normal curve.
- Understands how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series).
  - Summarize and interpret categorical data for two categories in two-way frequency tables (e.g., joint, marginal, conditional relative frequencies).
  - Recognize possible associations and trends in the data.
  - Represent data for two quantitative variables on a scatterplot, and describe how the variables are related.

- Understands how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient).
  - Use technology to fit a function to data (i.e., linear regression).
  - Use functions fitted to data to solve problems in the context of the data.
  - Assess the fit of a function by plotting and analyzing residuals.
  - Interpret the slope and the intercept of a regression line in the context of the data.
  - Compute and interpret a correlation coefficient.
  - Distinguish between correlation and causation.
- Understands statistical processes and how to evaluate them.
  - Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
  - Decide if a specified model is consistent with results from a given data-generating process (e.g., using simulation).
- Understands how to make inferences and justify conclusions from samples, experiments, and observational studies.
  - Recognize the purposes of and differences among samples, experiments, and observational studies, and explain how randomization relates to each.
  - Use data from a sample to estimate a population mean or proportion.
  - Use data from a randomized experiment to compare two treatments.
  - Use results of simulations to decide if differences between parameters are significant.
  - Evaluate reports based on data.
- Understands the concepts of independence and conditional probability and how to apply these concepts to data.
  - Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.
  - Understand that two events, A and B, are independent if and only if  $P(A \cap B) = P(A)P(B)$ .
  - Understand the conditional probability of A given B as  $\frac{P(A \text{ and } B)}{P(B)}$ , and interpret independence of A and B as saying that  $P(A|B) = P(A)$  and  $P(B|A) = P(B)$ .
  - Recognize and explain the concepts of conditional probability and independence.
- Understands how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities.
  - Calculate probabilities of simple and compound events.
  - Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
  - Find  $P(A|B)$ , and interpret it in terms of a given model.
  - Apply the addition rule,  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ , and interpret it in terms of a given model.
  - Apply the general multiplication rule in a uniform probability model,  $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$ , and interpret it in terms of a given model.
  - Calculate probabilities using the binomial probability distribution.

- Knows how to make informed decisions using probabilities and expected values.
  - Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space, and graph the corresponding probability distribution using the same graphical displays as for data distributions.
  - Calculate the expected value of a random variable, and interpret it as the mean of the probability distribution.
  - Develop a probability distribution for a random variable, defined for a sample space in which theoretical probabilities can be calculated, and find the expected value.
  - Develop a probability distribution for a random variable, defined for a sample space in which probabilities are assigned empirically, and find the expected value.
  - Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
  - Analyze decisions and strategies using probability concepts (e.g., fairness).
- Understands how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions.
  - Given the results of simulations, construct experimental probability distributions.
  - Given the results of simulations, make informal inferences about theoretical probability distributions.
- Understands how to find probabilities involving finite sample spaces and independent trials.
  - Use the fundamental counting principle to find probabilities involving finite sample spaces and independent trials.

### C. Discrete Mathematics

- Understands sequences (e.g., arithmetic, recursively defined, geometric)..
  - Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
  - Evaluate, extend, or algebraically represent rules that involve number patterns.
  - Explore patterns in order to make conjectures, predictions, or generalizations.
- Is familiar with how recursion can be used to model various phenomena.
  - Find values of functions defined recursively, and understand how recursion can be used to model various phenomena.
  - Convert between recursive and closed-form expressions for a function, where possible.
- Has knowledge of equivalence relations.
  - Determine whether a binary relation on a set is reflexive, symmetric, or transitive.
  - Determine whether a relation is an equivalence relation.
- Understands the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena.
  - Understand the differences between discrete and continuous representations (e.g., data, functions).
  - Understand how discrete and continuous representations can be used to model various phenomena.

- Understands basic terminology and symbols of logic.
  - Understand the basic terminology of logic.
  - Understand the symbols of logic.
  - Use logic to evaluate the truth of statements.
  - Use logic to evaluate the equivalence of statements (e.g., statement and contra positive).
  
- Understands how to use counting techniques such as the multiplication principle, permutations, and combinations.
  - Use counting techniques to solve problems.
  
- Understands basic set theory (e.g., unions, differences, Venn diagrams).
  - Solve problems using basic set theory (i.e., union, intersection, complement, difference).
  - Use Venn diagrams to answer questions about sets.

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