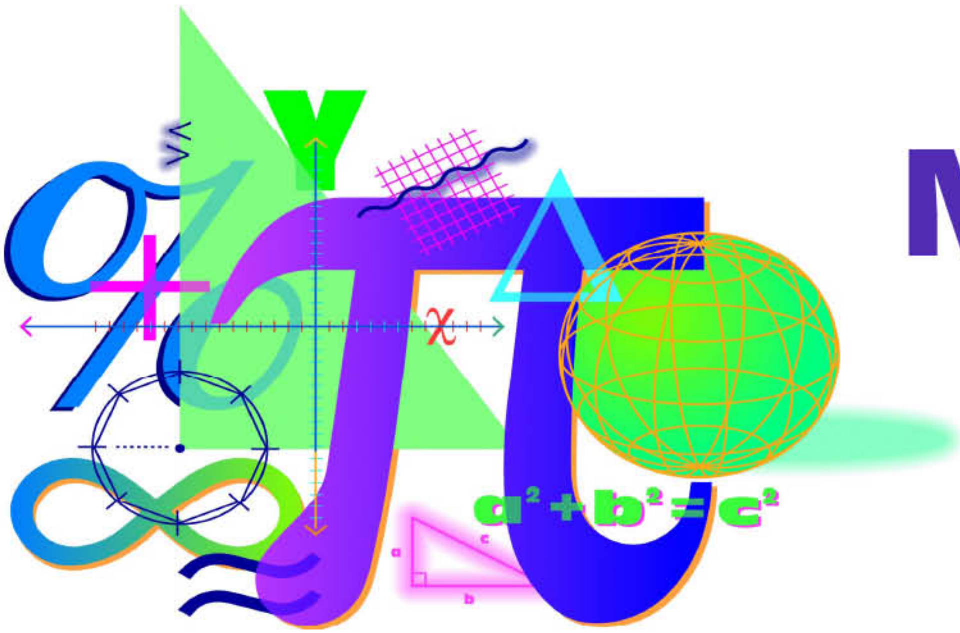


Mathematics

Standards of Learning

Curriculum Framework 2009

Grade 2

Board of Education
Commonwealth of Virginia

Acknowledgements
The Virginia Department of Education wishes to express sincere thanks to Deborah Kiger Bliss, Lois A. Williams, Ed.D., and Felicia Dyke, Ph.D. who assisted in the development of the 2009 *Mathematics Standards of Learning* Curriculum Framework.

The 2009 *Mathematics Curriculum Framework* can be found in PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov.

Virginia *Mathematics Standards of Learning* Curriculum Framework 2009
Introduction

The 2009 *Mathematics Standards of Learning* Curriculum Framework is a companion document to the 2009 *Mathematics Standards of Learning* and amplifies the *Mathematics Standards of Learning* by defining the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The Curriculum Framework provides additional guidance to school divisions and their teachers as they develop an instructional program appropriate for their students. It assists teachers in their lesson planning by identifying essential understandings, defining essential content knowledge, and describing the intellectual skills students need to use. This supplemental framework delineates in greater specificity the content that all teachers should teach and all students should learn.

Each topic in the *Mathematics Standards of Learning* Curriculum Framework is developed around the Standards of Learning. The format of the Curriculum Framework facilitates teacher planning by identifying the key concepts, knowledge and skills that should be the focus of instruction for each standard. The Curriculum Framework is divided into three columns: Understanding the Standard; Essential Understandings; and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes background information for the teacher (K-8). It contains content that may extend the teachers' knowledge of the standard beyond the current grade level. This section may also contain suggestions and resources that will help teachers plan lessons focusing on the standard.

Essential Understandings
This section delineates the key concepts, ideas and mathematical relationships that all students should grasp to demonstrate an understanding of the Standards of Learning. In Grades 6-8, these essential understandings are presented as questions to facilitate teacher planning.

Essential Knowledge and Skills
Each standard is expanded in the Essential Knowledge and Skills column. What each student should know and be able to do in each standard is outlined. This is not meant to be an exhaustive list nor a list that limits what is taught in the classroom. It is meant to be the key knowledge and skills that define the standard.

The Curriculum Framework serves as a guide for Standards of Learning assessment development. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework. Students are expected to continue to apply knowledge and skills from Standards of Learning presented in previous grades as they build mathematical expertise.

Students in grades K–3 have a natural curiosity about their world, which leads them to develop a sense of number. Young children are motivated to count everything around them and begin to develop an understanding of the size of numbers (magnitude), multiple ways of thinking about and representing numbers, strategies and words to compare numbers, and an understanding of the effects of simple operations on numbers. Building on their own intuitive mathematical knowledge, they also display a natural need to organize things by sorting, comparing, ordering, and labeling objects in a variety of collections.

Consequently, the focus of instruction in the number and number sense strand is to promote an understanding of counting, classification, whole numbers, place value, fractions, number relationships (“more than,” “less than,” and “equal to”), and the effects of single-step and multistep computations. These learning experiences should allow students to engage actively in a variety of problem solving situations and to model numbers (compose and decompose), using a variety of manipulatives. Additionally, students at this level should have opportunities to observe, to develop an understanding of the relationship they see between numbers, and to develop the skills to communicate these relationships in precise, unambiguous terms.

2.1 The student will
a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The number system is based on a simple pattern of tens where each place has ten times the value of the place to its right. • Opportunities to experience the relationships among hundreds, tens, and ones through hands-on experiences with manipulatives are essential to developing the ten-to-one place value concept of our number system and to understanding the value of each digit in a three-digit number. Ten-to-one trading activities with manipulatives on place value mats provide excellent experiences for developing the understanding of the places in the Base-10 system. • Models that clearly illustrate the relationships among hundreds, tens, and ones are physically proportional (e.g., the tens piece is ten times larger than the ones piece). • Students need to understand that 10 and 100 are special units of numbers (e.g., 10 is 10 ones, but it is also 1 ten). • Flexibility in thinking about numbers is critical. For example, 123 is 123 ones; or 1 hundred, 2 tens, and 3 ones; or 12 tens and 3 ones. • Rounding is finding the nearest easy-to-use number (e.g., the nearest 10) for the situation at hand.	**All students should** • Understand the ten-to-one relationship of ones, tens, and hundreds (10 ones equals 1 ten; 10 tens equals 1 hundred). • Understand that numbers are written to show how many hundreds, tens, and ones are in the number. • Understand that rounding gives a close, easy-to-use number to use when an exact number is not needed for the situation at hand. • Understand that a knowledge of place value is essential when comparing numbers. • Understand the relative magnitude of numbers by comparing numbers.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Demonstrate the understanding of the ten-to-one relationships among ones, tens, and hundreds, using manipulatives (e.g., beans and cups, Base-10 blocks, bundles of 10 sticks). • Determine the place value of each digit in a three-digit numeral presented as a pictorial representation (e.g., a picture of Base-10 blocks) or as a physical representation (e.g., actual Base-10 blocks). • Write numerals, using a Base-10 model or picture. • Read three-digit numbers when shown a numeral, a Base-10 model of the number, or a pictorial representation of the number. • Identify the place value (ones, tens, hundreds) of each digit in a three-digit numeral. • Determine the value of each digit in a three-digit numeral (e.g., in 352, the 5 represents 5 tens and its value is 50). • Round two-digit numbers to the nearest ten. • Compare two numbers between 0 and 999 represented pictorially or with concrete objects (e.g., Base-10 blocks), using the words *greater than, less than* or *equal to*.

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD **(Background Information for Instructor Use Only)**	**ESSENTIAL UNDERSTANDINGS**	**ESSENTIAL KNOWLEDGE AND SKILLS**
• Number lines are useful tools for developing the concept of rounding to the nearest ten. Rounding to the nearest ten using a number line is done as follows: – Locate the number on the number line. – Identify the two tens the number comes between. – Determine the closest ten. – If the number in the ones place is 5 (halfway between the two tens), round the number to the higher ten. • Once the concept for rounding numbers using a number line is developed, the procedure for rounding numbers to the nearest ten is as follows: – Look one place to the right of the digit in the place you wish to round to. – If the digit is less than 5, leave the digit in the rounding place as it is, and change the digit to the right of the rounding place to zero. – If the digit is 5 or greater, add 1 to the digit in the rounding place, and change the digit to the right of the rounding place to zero.		

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models;
b) round two-digit numbers to the nearest ten; and
c) compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A procedure for comparing two numbers by examining place value may include the following: – Line up the numbers by place value lining up the ones. – Beginning at the left, find the first place value where the digits are different. – Compare the digits in this place value to determine which number is greater (or which is less). – Use the appropriate symbol > or < or words *greater than* or *less than* to compare the numbers in the order in which they are presented. – If both numbers are the same, use the symbol = or the words *equal to*. • Mathematical symbols (>, <) used to compare two unequal numbers are called *inequality symbols*.		

2.2 The student will
a) identify the ordinal positions first through twentieth, using an ordered set of objects; and
b) write the ordinal numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Understanding the cardinal and ordinal meanings of numbers are necessary to quantify, measure, and identify the order of objects. • An ordinal number is a number that names the place or position of an object in a sequence or set (e.g., first, third). *Ordered position*, *ordinal position*, and *ordinality* are terms that refer to the place or position of an object in a sequence or set. • The ordinal position is determined by where one starts in an ordered set of objects or sequence of objects (e.g., left, right, top, bottom). • The ordinal meaning of numbers is developed by identifying and verbalizing the place or position of objects in a set or sequence (e.g., a student's position in line when students are lined up alphabetically by first name). • Ordinal position can also be emphasized through sequencing events (e.g., months in a year or sequencing in a story). • Cardinality can be compared with ordinality when comparing the results of counting. There is obvious similarity between the ordinal number words *third* through *twentieth* and the cardinal number words *three* through *twenty*.	**All students should** • Use ordinal numbers to describe the position of an object in a sequence or set.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Count an ordered set of objects, using the ordinal number words *first* through *twentieth*. • Identify the ordinal positions first through twentieth, using an ordered set of objects. • Identify the ordinal positions first through twentieth, using an ordered set of objects presented in lines or rows from – left to right; – right to left; – top to bottom; and – bottom to top. • Write 1^{st}, 2^{nd}, 3^{rd}, through 20^{th} in numerals.

2.3 The student will

a) identify the parts of a set and/or region that represent fractions for halves, thirds, fourths, sixths, eighths, and tenths;

b) write the fractions; and

c) compare the unit fractions for halves, thirds, fourths, sixths, eighths, and tenths.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The whole should be defined. • A fraction is a way of representing part of a whole (as in a region/area model) or part of a group (as in a set model). • In each fraction model, the parts must be equal (i.e., each pie piece must have the same area; the size of each chip in a set must be equal). In problems with fractions, a whole is broken into equal-size parts and reassembled into one whole. • Students should have experiences dividing a whole into additional parts. As the whole is divided into more parts, students understand that each part becomes smaller. • The denominator tells how many equal parts are in the whole or set. The numerator tells how many of those parts are being described. • Students should have opportunities to make connections among fraction representations by connecting concrete or pictorial representations with spoken or symbolic representations.	**All students should** • Understand that fractional parts are equal shares of a whole or a whole set. • Understand that the fraction name (*half*, *fourth*) tells the number of equal parts in the whole. • Understand that when working with unit fractions, the larger the denominator, the smaller the part and therefore the smaller the fraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize fractions as representing equal-size parts of a whole. • Identify the fractional parts of a whole or a set for $\frac{2}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{2}{6}$, $\frac{7}{8}$, $\frac{7}{10}$, etc. • Identify the fraction names (halves, thirds, fourths, sixths, eighths, tenths) for the fraction notations $\frac{2}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{2}{6}$, $\frac{7}{8}$, $\frac{7}{10}$, etc. • Represent fractional parts of a whole for halves, thirds, fourths, sixths, eighths, tenths using – region/area models (e.g., pie pieces, pattern blocks, geoboards); – sets (e.g., chips, counters, cubes); and – measurement models (e.g., fraction strips, rods, connecting cubes). • Compare unit fractions ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$, and $\frac{1}{10}$) using the words *greater than*, *less than* or *equal to* and the symbols (>, <, =).

2.3 The student will

a) identify the parts of a set and/or region that represent fractions for halves, thirds, fourths, sixths, eighths, and tenths;

b) write the fractions; and

c) compare the unit fractions for halves, thirds, fourths, sixths, eighths, and tenths.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions (e.g., *thirds* means "three equal parts of a whole" or $\frac{1}{3}$ represents one of three equal-size parts when a pizza is shared among three students) will further this development. • A unit fraction is one in which the numerator is one. • Using models when comparing unit fractions will assist in developing the concept that the larger the denominator the smaller the piece; therefore, $\frac{1}{3} > \frac{1}{4}$.		

2.4 The student will
a) count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10;
b) count backward by tens from 100; and
c) recognize even and odd numbers.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The patterns developed as a result of grouping and/or skip counting are precursors for recognizing numeric patterns, functional relationships, and concepts underlying money, time telling, multiplication, and division. Powerful models for developing these concepts include counters, hundred chart, and calculators. • Skip counting by twos supports the development of the concept of even numbers. • Skip counting by fives lays the foundation for reading a clock effectively and telling time to the nearest five minutes, counting money, and developing the multiplication facts for five. • Skip counting by tens is a precursor for use of place value, addition, counting money, and multiplying by multiples of 10. • Calculators can be used to display the numeric patterns resulting from skip counting. Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. • Odd and even numbers can be explored in different ways (e.g., dividing collections of objects into two equal groups or pairing objects).	**All students should** • Understand that collections of objects can be grouped and skip counting can be used to count the collection. • Describe patterns in skip counting and use those patterns to predict the next number in the counting sequence. • Understand that the starting point for skip counting by 2 does not always begin at 2. • Understand that the starting point for skip counting by 5 does not always begin at 5. • Understand that the starting point for skip counting by 10 does not always begin at 10. • Understand that every counting number is either even or odd.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine patterns created by counting by twos, fives, and tens on a hundred chart. • Skip count by twos, fives, and tens to 100, using manipulatives, a hundred chart, mental mathematics, a calculator, and/or paper and pencil. • Skip count by twos, fives, and tens to 100. • Count backward by tens from 100. • Use objects to determine whether a number is odd or even.

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling, discussing, and recording a variety of problem situations. This approach helps students transition from the concrete to the representation to the symbolic in order to develop meaning for the operations and how they relate to each other.

In grades K–3, computation and estimation instruction focuses on

- relating the mathematical language and symbolism of operations to problem situations;
- understanding different meanings of addition and subtraction of whole numbers and the relation between the two operations;
- developing proficiency with basic addition, subtraction, multiplication, division and related facts;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions.

2.5 The student will recall addition facts with sums to 20 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Associate the terms *addition, adding,* and *sum* with the concept of joining or combining. • Associate the terms *subtraction, subtracting, minus*, and *difference* with the process of "taking away" or separating (i.e., removing a set of objects from the given set of objects, finding the difference between two numbers, or comparing two numbers). • Provide practice in the use and selection of strategies. Encourage students to develop efficient strategies. Examples of strategies for developing the basic addition and subtraction facts include – counting on; – counting back; – "one-more-than," "two-more-than" facts; – "one-less-than," "two-less-than" facts; – "doubles" to recall addition facts (e.g., 2 + 2 =__; 3 + 3 =__); – "near doubles" [e.g., 3 + 4 = (3 + 3) + 1 = __]; – "make-ten" facts (e.g., at least one addend of 8 or 9); – "think addition for subtraction," (e.g., for 9 – 5 = __, think "5 and what number makes 9?"); – use of the commutative property, without naming the property (e.g., 4 +3 is the same as 3 + 4); – use of related facts (e.g., 4 + 3 = 7 , 3 + 4 = 7, 7 – 4 = 3, and 7 – 3 = 4); and – use of the additive identity property (e.g., 4 + 0 = 4), without naming the property but saying, "When you add zero to a number, you always get the original number."	**All students should** • Understand that addition involves combining and subtraction involves separating. • Develop fluency in recalling facts for addition and subtraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recall and write the basic addition facts for sums to 20 or less and the corresponding subtraction facts, when addition or subtraction problems are presented in either horizontal or vertical written format.

2.5 The student will recall addition facts with sums to 20 or less and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Manipulatives should be used initially to develop an understanding of addition and subtraction facts and to engage students in meaningful memorization. Rote recall of the facts is often achieved through constant practice and may come from a variety of formats, including presentation through counting on, related facts, flash cards, practice sheets, and/or games.		

2.6 The student, given two whole numbers whose sum is 99 or less, will
a) estimate the sum; and
b) find the sum, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimation is a number sense skill used instead of finding an exact answer. When an actual computation is not necessary, an estimate will suffice. • Rounding is one strategy used to estimate. • Estimation is also used before solving a problem to check the reasonableness of the sum when an exact answer is required. • By estimating the result of an addition problem, a place value orientation for the answer is established. • Strategies for mentally adding two-digit numbers include student-invented strategies, making-ten, partial sums, and counting on, among others. – partial sums: 56 + 41 = __ 50 + 40 = 90 6 + 1 = 7 90 + 7 = 97 – counting on: 36 + 62 = __ 36 + 60 = 96 96 + 2 = 98 • Addition means to combine or join quantities. • The terms used in addition are 23 → *addend* + 46 → *addend* 69 → *sum* • Strategies for adding two-digit numbers can include, but are not limited to, using a hundreds chart, number line, and invented strategies.	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in practical situations when exact answers are not required or needed. • Understand that estimation skills are also valuable in determining the reasonableness of the sum when solving for the exact answer is needed. • Understand that addition is used to join groups in practical situations when exact answers are needed. • Develop flexible methods of adding whole numbers by combining numbers in a variety of ways to find the sum, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Regroup 10 ones for 1 ten, using Base-10 models, when finding the sum of two whole numbers whose sum is 99 or less. • Estimate the sum of two whole numbers whose sum is 99 or less and recognize whether the estimation is reasonable. • Find the sum of two whole numbers whose sum is 99 or less, using Base-10 models, such as Base-10 blocks and bundles of tens. • Solve problems presented vertically or horizontally that require finding the sum of two whole numbers whose sum is 99 or less, using paper and pencil. • Solve problems, using mental computation strategies, involving addition of two whole numbers whose sum is 99 or less.

2.6 The student, given two whole numbers whose sum is 99 or less, will
a) estimate the sum; and
b) find the sum, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Building an understanding of the algorithm by first using concrete materials and then a do-and-write approach connects it to the written form of the algorithm. • The traditional algorithm for two-digit numbers is contrary to the natural inclination to begin with the left-hand number. • Regrouping is used in addition when a sum in a particular place value is 10 or greater.		

2.7 The student, given two whole numbers, each of which is 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Estimation is a number sense skill used instead of finding an exact answer. When an estimate is needed, the actual computation is not necessary. • Rounding is one strategy used to estimate. • Estimation is also used before solving a problem to check the reasonableness of the sum when an exact answer is required. • By estimating the result of a subtraction problem, a place value orientation for the answer is established. • Subtraction is the inverse operation of addition and is used for different reasons: – to remove one amount from another; – to compare one amount to another; and – to find the missing quantity when the whole quantity and part of the quantity are known. • Three terms often used in subtraction are *minuend* → 98 *subtrahend* → – 41 *difference* → 57 • Regrouping is a process of renaming a number to make subtraction easier. • An understanding of the subtraction algorithm should be built by first using concrete materials and then employing a do-and-write approach (i.e., use the manipulatives, then record what you have done). This connects the activity to the written form of the algorithm.	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in practical situations when exact answers are not required or needed. • Understand that estimation skills are also valuable in determining the reasonableness of the difference when solving for the exact answer is needed. • Understand that subtraction is used in practical situations when exact answers are needed. • Develop flexible methods of subtracting whole numbers to find the difference, by combining numbers in a variety of ways, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Regroup 1 ten for 10 ones, using Base-10 models, such as Base-10 blocks and bundles of tens. • Estimate the difference of two whole numbers each 99 or less and recognize whether the estimation is reasonable. • Find the difference of two whole numbers each 99 or less, using Base-10 models, such as Base-10 blocks and bundles of tens. • Solve problems presented vertically or horizontally that require finding the difference between two whole numbers each 99 or less, using paper and pencil. • Solve problems, using mental computation strategies, involving subtraction of two whole numbers each 99 or less.

2.7 The student, given two whole numbers, each of which is 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Mental computational strategies for subtracting two-digit numbers might include – lead-digit or front-end strategy: 56 – 21 = __ 50 – 20 = 30 6 – 1 = 5 30 + 5 = 35 – counting up: 87 – 25 = __ 20 + 60 = 80 5 + 2 = 7 60 + 2 = 62 or 87 – 25 = __ 25 + 60 = 85 85 + 2 = 87 60 + 2 = 62 or 87 – 25 = __ 25 + 2 = 27 27 + 60 = 87 2 + 60 = 62 – partial differences: 98 – 41 = __ 90 – 40 = 50 8 – 1 = 7 50 + 7 = 57. • Strategies for subtracting two-digit numbers may include using a hundreds chart, number line, and invented strategies.		

2.8 The student will create and solve one- and two-step addition and subtraction problems, using data from simple tables, picture graphs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Problem solving means engaging in a task for which a solution or a method of solution is not known in advance. Solving problems using data and graphs offers a natural way to connect mathematics to practical situations. • The ability to retrieve information from simple charts and picture graphs is a necessary prerequisite to solving problems. • An example of an approach to solving problems is Polya's four-step plan: – Understand: Retell the problem. – Plan: Decide what the operation is. – Solve: Write a number sentence. – Look back: Does the answer make sense? • The problem solving process is enhanced when students – create their own story problems; and – model word problems, using manipulatives or drawings.	**All students should** • Develop strategies for solving practical problems. • Enhance problem solving skills by creating their own problems.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the appropriate data and the operation needed to solve an addition or subtraction problem where the data are presented in a simple table, picture graph, or bar graph. • Solve addition and subtraction problems requiring a one- or two-step solution, using data from simple tables, picture graphs, bar graphs, and everyday life situations. • Create a one- or two-step addition or subtraction problem using data from simple tables, picture graphs, and bar graphs whose sum is 99 or less.

2.9 The student will recognize and describe the related facts that represent and describe the inverse relationship between addition and subtraction.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition and subtraction are inverse operations, that is, one undoes the other: 3 + 4 = 7 7 – 3 = 4 7 – 4 = 3 4 + 3 = 7 • For each addition fact, there is a related subtraction fact. • Developing strategies for solving missing addends problems and the missing part of subtraction facts builds an understanding of the link between addition and subtraction. To solve 9 – 5 = __, think 5 + __ = 9. • Demonstrate joining and separating sets to investigate the relationship between addition and subtraction.	**All students should** • Understand how addition and subtraction relate to one another.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the missing number in a number sentence (e.g., 3 + __ = 5 or __+ 2 = 5; 5 – __ = 3 or 5 – 2 = __). • Write the related facts for a given addition or subtraction fact (e.g., given 3 + 4 = 7, write 7 – 4 = 3 and 7 – 3 = 4).

Measurement is important because it helps to quantify the world around us and is useful in so many aspects of everyday life. Students in grades K–3 should encounter measurement in many normal situations, from their daily use of the calendar and from science activities that often require students to measure objects or compare them directly, to situations in stories they are reading and to descriptions of how quickly they are growing.

Measurement instruction at the primary level focuses on developing the skills and tools needed to measure length, weight/mass, capacity, time, temperature, area, perimeter, volume, and money. Measurement at this level lends itself especially well to the use of concrete materials. Children can see the usefulness of measurement if classroom experiences focus on estimating and measuring real objects. They gain deep understanding of the concepts of measurement when handling the materials, making physical comparisons, and measuring with tools.

As students develop a sense of the attributes of measurement and the concept of a measurement unit, they also begin to recognize the differences between using nonstandard and standard units of measure. Learning should give them opportunities to apply both techniques and nonstandard and standard tools to find measurements and to develop an understanding of the use of simple U.S. Customary and metric units.

Teaching measurement offers the challenge to involve students actively and physically in learning and is an opportunity to tie together other aspects of the mathematical curriculum, such as fractions and geometry. It is also one of the major vehicles by which mathematics can make connections with other content areas, such as science, health, and physical education.

2.10 The student will
a) count and compare a collection of pennies, nickels, dimes, and quarters whose total value is $2.00 or less; and
b) correctly use the cent symbol (¢), dollar symbol ($), and decimal point (.).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The money system used in the United States consists of coins and bills based on ones, fives, and tens, making it easy to count money. • The dollar is the basic unit. • Emphasis is placed on the verbal expression of the symbols for cents and dollars (e.g., $0.35 and 35¢ are both read as "thirty-five cents"; $3.00 is read as "three dollars"). • Money can be counted by grouping coins and bills to determine the value of each group and then adding to determine the total value. • The most common way to add amounts of money is to "count on" the amount to be added.	**All students should** • Understand how to count and compare a collection of coins and one-dollar bills whose total value is $2.00 or less. • Understand the proper use of the cent symbol (¢), dollar sign ($), and decimal point (.).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the value of a collection of coins and one-dollar bills whose total value is $2.00 or less. • Compare the values of two sets of coins and one-dollar bills (each set having a total value of $2.00 or less), using the terms *greater than, less than*, or *equal to*. • Simulate everyday opportunities to count and compare a collection of coins and one-dollar bills whose total value is $2.00 or less. • Use the cent (¢) and dollar ($) symbols and decimal point (.) to write a value of money which is $2.00 or less.

2.11 The student will estimate and measure
a) length to the nearest centimeter and inch;
b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and
c) liquid volume in cups, pints, quarts, gallons, and liters.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A clear concept of the size of one unit is necessary before one can measure to the nearest unit. • Knowledge of the exact relationships within the metric or U.S. Customary system of measurement for measuring liquid volume, such as 4 cups to a quart, is not required at this grade level. • Practical experiences measuring liquid volume, using a variety of actual measuring devices (e.g., containers for a cup, pint, quart, gallon, and liter), will help students build a foundation for estimating liquid volume with these measures. • The experience of making a ruler can lead to greater understanding of using one. • Proper placement of a ruler when measuring length (i.e., placing the end of the ruler at one end of the item to be measured) should be demonstrated. • Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?").	**All students should** • Understand that centimeters/inches are units used to measure length. • Understand how to estimate and measure to determine a linear measure to the nearest centimeter and inch. • Understand that pounds/ounces and kilograms/grams are units used to measure weight/mass. • Understand how to use a scale to determine the weight/mass of an object and use the appropriate unit for measuring weight/mass. • Understand that cups, pints, quarts, gallons, and liters are units used to measure liquid volume. • Understand how to use measuring devices to determine liquid volume in both metric and customary units.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Estimate and measure the length of various line segments and objects to the nearest inch and centimeter. • Estimate and then measure the weight/mass of objects to the nearest pounds/ounces and kilograms/grams, using a scale. • Estimate and measure liquid volume in cups, pints, quarts, gallons, and liters.

2.11 The student will estimate and measure
a) length to the nearest centimeter and inch;
b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and
c) liquid volume in cups, pints, quarts, gallons, and liters.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A balance is a scale for measuring mass. To determine the mass of an object by using a two-pan balance, first level both sides of the balance by putting standard units of mass on one side to counterbalance the object on the other; then find the sum of the standard units of mass required to level the balance. • Benchmarks of common objects need to be established for one pound and one kilogram. Practical experience measuring the mass of familiar objects helps to establish benchmarks. • Pounds and kilograms are not compared at this level. • The terms *cups, pints, quarts, gallons*, and *liters* are introduced as terms used to describe the liquid volume of everyday containers. • The exact relationship between a quart and a liter is not expected at this level.		

2.12 The student will tell and write time to the nearest five minutes, using analog and digital clocks.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Telling time requires reading a clock. The position of the two hands on an analog clock is read to tell the time. A digital clock shows the time by displaying the time in numbers which are read as the hour and minutes. • The use of a demonstration clock with gears ensures that the positions of the hour hand and the minute hand are precise at all times. • The face of an analog clock can be divided into 4 equal parts, called *quarter hours*, of 15 minutes each.	**All students should** • Apply an appropriate technique to determine time to the nearest five minutes, using analog and digital clocks. • Demonstrate an understanding of counting by fives to predict five minute intervals when telling time to the nearest five minutes.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Show, tell, and write time to the nearest five minutes, using an analog and digital clock. • Match a written time to a time shown on a clock face to the nearest five minutes.

2.13 The student will
a) determine past and future days of the week; and
b) identify specific days and dates on a given calendar.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The calendar is a way to represent units of time (e.g., days, weeks, and months). • Using a calendar develops the concept of day as a 24-hour period rather than a period of time from sunrise to sunset. • Practical situations are appropriate to develop a sense of the interval of time between events (e.g., Boy Scout meetings occur every week on Monday: there is a week between meetings).	**All students should** • Understand how to use a calendar as a way to measure time.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the days/dates before and after a given day/date. • Determine the day that is a specific number of days or weeks in the past or in the future from a given date, using a calendar. • Identify specific days and dates (e.g., the third Monday in a given month or what day of the week does May 11 fall on).

2.14 The student will read the temperature on a Celsius and/or Fahrenheit thermometer to the nearest 10 degrees.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The symbols for degrees in Celsius (°C) and degrees in Fahrenheit (°F) should be used to write temperatures. • Celsius and Fahrenheit temperatures should be related to everyday occurrences by measuring the temperature of the classroom, the outside, liquids, body temperature, and other things found in the environment. • Estimating and measuring temperatures in the environment in Fahrenheit and Celsius require the use of real thermometers. • A physical model can be used to represent the temperature determined by a real thermometer.	**All students should** • Understand how to measure temperature in Celsius and Fahrenheit with a thermometer.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Read temperature to the nearest 10 degrees from real Celsius and Fahrenheit thermometers and from physical models (including pictorial representations) of such thermometers.

Children begin to develop geometric and spatial knowledge before beginning school, stimulated by the exploration of figures and structures in their environment. Geometric ideas help children systematically represent and describe their world as they learn to represent plane and solid figures through drawing, block constructions, dramatization, and verbal language.

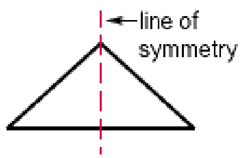
The focus of instruction at this level is on
- observing, identifying, describing, comparing, contrasting, and investigating solid objects and their faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, contrasting, sorting, and classifying figures; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these figures but do not develop precise meanings for many of the terms they use until they are thinking beyond Level 2 of the van Hiele theory (see below).

The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding.

- **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons.
- **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same. (This is the expected level of student performance during grades K and 1.)
- **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures. (Students are expected to transition to this level during grades 2 and 3.)

2.15 The student will
a) draw a line of symmetry in a figure; and
b) identify and create figures with at least one line of symmetry.

UNDERSTANDING THE STANDARD **(Background Information for Instructor Use Only)**	**ESSENTIAL UNDERSTANDINGS**	**ESSENTIAL KNOWLEDGE AND SKILLS**
• A figure is symmetric along a line when one-half of the figure is the mirror image of the other half. • A line of symmetry divides a symmetrical figure, object, or arrangement of objects into two parts that are congruent if one part is reflected over the line of symmetry.  • Children learn about symmetry through hands-on experiences with geometric figures and the creation of geometric pictures and patterns. • Guided explorations of the study of symmetry by using mirrors, miras, paper folding, and pattern blocks will enhance students' understanding of the attributes of symmetrical figures. • While investigating symmetry, children move figures, such as pattern blocks, intuitively, thereby exploring transformations of those figures. A transformation is the movement of a figure — either a translation, rotation, or reflection. A translation is the result of sliding a figure in any direction; rotation-is the result of turning a figure around a point or a vertex; and reflection is the result of flipping a figure over a line.	**All students should** • Develop strategies to determine whether or not a figure has at least one line of symmetry. • Develop strategies to create figures with at least one line of symmetry. • Understand that some figures may have more than one line of symmetry.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify figures with at least one line of symmetry, using various concrete materials. • Draw a line of symmetry — horizontal, vertical, and diagonal — in a figure. • Create figures with at least one line of symmetry using various concrete materials.

2.16 The student will identify, describe, compare, and contrast plane and solid geometric figures (circle/sphere, square/cube, and rectangle/rectangular prism).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The van Hiele theory of geometric understanding describes how students learn geometry and provides a framework for structuring student experiences that should lead to conceptual growth and understanding. – **Level 0: Pre-recognition.** Geometric figures are not recognized. For example, students cannot differentiate between three-sided and four-sided polygons. – **Level 1: Visualization.** Geometric figures are recognized as entities, without any awareness of parts of figures or relationships between components of a figure. Students should recognize and name figures and distinguish a given figure from others that look somewhat the same (e.g., "I know it's a rectangle because it looks like a door, and I know that a door is a rectangle."). – **Level 2: Analysis.** Properties are perceived but are isolated and unrelated. Students should recognize and name properties of geometric figures (e.g., "I know it's a rectangle because it is closed; it has four sides and four right angles, and opposite sides are parallel."). • An important part of geometry is naming and describing figures in two-dimensions (plane figures) and three-dimensions (solid figures). • A vertex is a point where two or more line segments, lines, or rays meet to form an angle. • An angle is two rays that share an endpoint. • Plane figures are two-dimensional figures formed by lines that are curved, straight, or a combination of both. They have angles and sides.	**All students should** • Understand the differences between plane and solid figures while recognizing the inter-relatedness of the two. • Understand that a solid figure is made up of a set of plane figures.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine similarities and differences between related plane and solid figures (e.g., circle/sphere, square/cube, rectangle/rectangular prism), using models and cutouts. • Trace faces of solid figures (e.g., cube and rectangular solid) to create the set of plane figures related to the solid figure. • Identify and describe plane and solid figures (e.g., circle/sphere, square/cube, and rectangle/rectangular prism), according to the number and shape of their faces, edges, and vertices using models. • Compare and contrast plane and solid geometric figures (e.g., circle/sphere, square/cube, and rectangle/rectangular prism) according to the number and shape of their faces (sides, bases), edges, vertices, and angles.

2.16 The student will identify, describe, compare, and contrast plane and solid geometric figures (circle/sphere, square/cube, and rectangle/rectangular prism).

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The identification of plane and solid figures is accomplished by working with and handling objects. • Tracing faces of solid figures is valuable to understanding the set of plane figures related to the solid figure (e.g., cube and rectangular prism). • A circle is a closed curve in a plane with all its points the same distance from the center. • A sphere is a solid figure with all of its points the same distance from its center. • A square is a rectangle with four sides of equal length. • A rectangular prism is a solid in which all six faces are rectangles. A rectangular prism has 8 vertices and 12 edges. • A cube is a solid figure with six congruent, square faces. All edges are the same length. A cube has 8 vertices and 12 edges. It is a rectangular prism. • A rectangle is a plane figure with four right angles. A square is a rectangle. • The edge is the line segment where two faces of a solid figure intersect. • A face is a polygon that serves as one side of a solid figure (e.g., a square is a face of a cube). • A base is a special face of a solid figure. • The relationship between plane and solid geometric figures, such as the square and the cube or the rectangle and the rectangular prism helps build the foundation for future geometric study of faces, edges, angles, and vertices.		

Students in the primary grades have a natural curiosity about their world, which leads to questions about how things fit together or connect. They display their natural need to organize things by sorting and counting objects in a collection according to similarities and differences with respect to given criteria.

The focus of probability instruction at this level is to help students begin to develop an understanding of the concept of chance. They experiment with spinners, two-colored counters, dice, tiles, coins, and other manipulatives to explore the possible outcomes of situations and predict results. They begin to describe the likelihood of events, using the terms *impossible, unlikely, equally likely, more likely,* and *certain.*

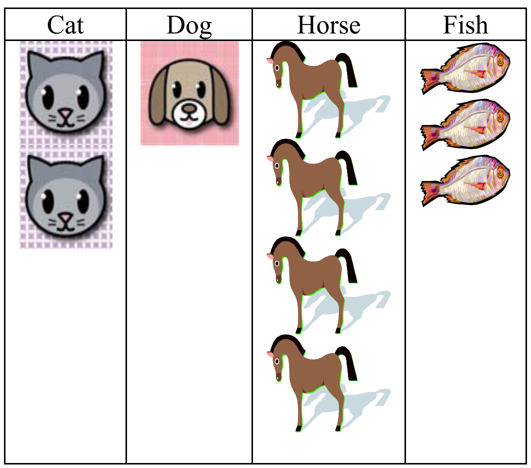
The focus of statistics instruction at this level is to help students develop methods of collecting, organizing, describing, displaying, and interpreting data to answer questions they have posed about themselves and their world.

2.17 The student will use data from experiments to construct picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- The purpose of a graph is to represent data gathered to answer a question.
- Picture graphs are graphs that use pictures to show and compare information. An example of a picture graph is:

Our Favorite Pets



ESSENTIAL UNDERSTANDINGS

All students should

- Understand that data may be generated from experiments.
- Understand how data can be collected and organized in picture graphs, pictographs, and bar graphs.
- Understand that picture graphs use pictures to show and compare data.
- Understand that pictographs use a symbol of an object, person, etc.
- Understand that bar graphs can be used to compare categorical data.

ESSENTIAL KNOWLEDGE AND SKILLS

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

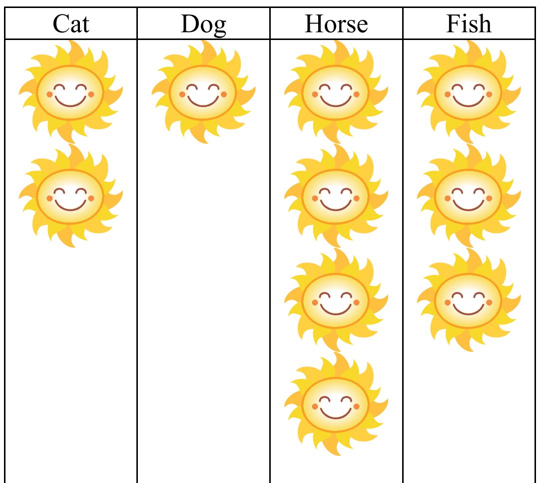
- Organize data from experiments, using lists, tables, objects, pictures, symbols, tally marks, and charts, in order to construct a graph.
- Read the information presented horizontally and vertically on picture graphs, pictographs, and bar graphs.
- Collect no more than 16 pieces of data to answer a given question.
- Represent data from experiments by constructing picture graphs, pictographs, and bar graphs.
- Label the axes on a bar graph, limiting the number of categories (categorical data) to four and the increments to multiples of whole numbers (e.g., multiples of 1, 2, or 5).
- On a pictograph, limit the number of categories to four and include a key where appropriate.

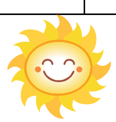
2.17 The student will use data from experiments to construct picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Pictographs are graphs that use symbols to show and compare information. A student can be represented as a stick figure in a pictograph. A key should be used to indicate what the symbol represents (e.g., one picture of a sneaker represents five sneakers in a graph of shoe types). An example of a pictograph is:

Our Favorite Pets





= 1 student

ESSENTIAL UNDERSTANDINGS

ESSENTIAL KNOWLEDGE AND SKILLS

2.17 The student will use data from experiments to construct picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Bar graphs are used to compare counts of different categories (categorical data). Using grid paper may ensure more accurate graphs. – A bar graph uses parallel, horizontal or vertical bars to represent counts for several categories. One bar is used for each category, with the length of the bar representing the count for that category. – There is space before, between, and after the bars. – The axis displaying the scale that represents the count for the categories should extend one increment above the greatest recorded piece of data. Second grade students should be collecting data that are recorded in increments of whole numbers, usually multiples of 1, 2, or 5. – Each axis should be labeled, and the graph should be given a title.		

2.18 The student will use data from experiments to predict outcomes when the experiment is repeated.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A spirit of investigation and experimentation should permeate probability instruction, where students are actively engaged in investigations and have opportunities to use manipulatives. • Investigation of experimental probability is continued through informal activities, such as dropping a two-colored counter (usually a chip that has a different color on each side), using a multicolored spinner (a circular spinner that is divided equally into two, three, four or more equal "pie" parts where each part is filled with a different color), using spinners with numbers, or rolling random number generators (dice). • Probability is the chance of an event occurring (e.g., the probability of landing on a particular color when flipping a two-colored chip is $\frac{1}{2}$, representing one of two possible outcomes). • An event is a possible outcome in probability. Simple events include the possible outcomes when tossing a coin (heads or tails), when rolling a random number generator (a number cube or a die where there are six equally likely outcomes and the probability of one outcome is $\frac{1}{6}$), or when spinning a spinner. • If all the outcomes of an event are equally likely to occur, the probability of an event is equal to the number of favorable outcomes divided by the total number of possible outcomes: the probability of the event = $\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$.	**All students should** • Understand that data may be generated from experiments. • Understand that the likelihood of an event occurring is to predict the probability of it happening.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Conduct probability experiments, using multicolored spinners, colored tiles, or number cubes and use the data from the experiments to predict outcomes if the experiment is repeated. • Record the results of probability experiments, using tables, charts, and tally marks. • Interpret the results of probability experiments (e.g., the two-colored spinner landed on red 5 out of 10 times). • Predict which of two events is more likely to occur if an experiment is repeated.

2.18 The student will use data from experiments to predict outcomes when the experiment is repeated.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• At this level, students need to understand only this fractional representation of probability (e.g., the probability of getting heads when flipping a coin is $\frac{1}{2}$). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *as likely as*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring. Activities should include practical examples.		

2.19 The student will analyze data displayed in picture graphs, pictographs, and bar graphs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Statements that represent an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences, least and greatest, the categories, and total number of responses) should be discussed with students and written. • When data are displayed in an organized manner, the results of investigations can be described, and the questions posed can be answered.	**All students should** • Understand how to read the key used in a graph to assist in the analysis of the displayed data. • Understand how to interpret data in order to analyze it. • Understand how to analyze data in order to answer the questions posed, make predictions, and generalizations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Analyze information from simple picture graphs, pictographs, and bar graphs by writing at least one statement that covers one or both of the following: – Describe the categories of data and the data as a whole (e.g., the total number of responses). – Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same. • Select the best analysis of a graph from a set of possible analyses of the graph.

Stimulated by the exploration of their environment, children begin to develop concepts related to patterns, functions, and algebra before beginning school. Recognition of patterns and comparisons are important components of children's mathematical development.

Students in kindergarten through third grade develop the foundation for understanding various types of patterns and functional relationships through the following experiences:

- sorting, comparing, and classifying objects in a collection according to a variety of attributes and properties;
- identifying, analyzing, and extending patterns;
- creating repetitive patterns and communicating about these patterns in their own language;
- analyzing simple patterns and making predictions about them;
- recognizing the same pattern in different representations;
- describing how both repeating and growing patterns are generated; and
- repeating predictable sequences in rhymes and extending simple rhythmic patterns.

The focus of instruction at the primary level is to observe, recognize, create, extend, and describe a variety of patterns. These students will experience and recognize visual, kinesthetic, and auditory patterns and develop the language to describe them orally and in writing as a foundation to using symbols. They will use patterns to explore mathematical and geometric relationships and to solve problems, and their observations and discussions of how things change will eventually lead to the notion of functions and ultimately to algebra.

2.20 The student will identify, create, and extend a wide variety of patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Identifying and extending patterns is an important process in mathematical thinking. • Analysis of patterns in the real world (e.g., patterns on a butterfly's wings, patterns on a ladybug's shell) leads to the analysis of mathematical patterns such as number patterns and geometric patterns. • Reproduction of a given pattern in a different manifestation, using symbols and objects, lays the foundation for writing numbers symbolically or algebraically. • The simplest types of patterns are repeating patterns. Opportunities to create, recognize, describe, and extend repeating patterns are essential to the primary school experience. • Growing patterns are more difficult for students to understand than repeating patterns because not only must they determine what comes next, they must also begin the process of generalization. Students need experiences with growing patterns in both arithmetic and geometric formats. • In numeric patterns, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Create an arithmetic number pattern. Sample numeric patterns include – 6, 9, 12, 15, 18, …(growing pattern); – 20, 18, 16, 14, … (growing pattern); – 1, 2, 4, 7, 11, 16, … (growing pattern); and – 1, 3, 5, 1, 3, 5, 1, 3, 5… (repeating pattern).	**All students should** • Understand patterns are a way to recognize order and to predict what comes next in an arrangement. • Analyze how both repeating and growing patterns are generated.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a growing and/or repeating pattern from a given geometric or numeric sequence. • Predict the next number, geometric figure, symbol, picture, or object in a given pattern. • Extend a given pattern, using numbers, geometric figures, symbols, pictures, or objects. • Create a new pattern, using numbers, geometric figures, pictures, symbols, or objects. • Recognize the same pattern in different manifestations.

2.20 The student will identify, create, and extend a wide variety of patterns.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation is the result of turning a figure around a point or a vertex, and reflection is the result of flipping a figure over a line.		

2.21 The student will solve problems by completing numerical sentences involving the basic facts for addition and subtraction. The student will create story problems, using the numerical sentences.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Recognizing and using patterns and learning to represent situations mathematically are important aspects of primary mathematics. • Discussing what a word problem is saying and writing a number sentence are precursors to solving word problems. • The patterns formed by related basic facts facilitate the solution of problems involving a missing addend in an addition sentence or a missing part (subtrahend) in a subtraction sentence. • Making mathematical models to represent simple addition and subtraction problems facilitates their solution. • By using story problems and numerical sentences, students begin to explore forming equations and representing quantities using variables. • Students can begin to understand the use of a symbol (e.g., __, ?, or □) to represent an unknown quantity.	**All students should** • Use mathematical models to represent and understand quantitative relationships. • Understand various meanings of addition and subtraction and the relationship between the two operations. • Understand how to write missing addend and missing subtrahend sentences.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Solve problems by completing a numerical sentence involving the basic facts for addition and subtraction (e.g., 3 + __ = 7, or 9 – __ = 2). • Create a story problem for a given numerical sentence.

2.22 The student will demonstrate an understanding of equality by recognizing that the symbol = in an equation indicates equivalent quantities and the symbol ≠ indicates that quantities are not equivalent.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The = symbol means that the values on either side are the same (balanced). • The ≠ symbol means that the values on either side are not the same (not balanced). • In order for students to develop the concept of equality, students need to see the = symbol used in various locations (e.g., 3 + 4 = 7 and 5 = 2 + 3). • A number sentence is an equation with numbers (e.g., 6 + 3 = 9; or 6 + 3 = 4 + 5).	**All students should** • Understand that the equal symbol means equivalent (same as) quantities. • The inequality symbol (≠) means not equivalent.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the equality (=) and inequality (≠) symbols. • Identify equivalent values and equations. (e.g., 8 = 8 and 8 = 4 + 4) • Identify nonequivalent values and equations. (e.g., 8 ≠ 9 and 4 + 3 ≠ 8) • Identify and use the appropriate symbol to distinguish between equal and not equal quantities. (e.g., 8 + 2 = 7 + 3 and 1 + 4 ≠ 6 + 2)