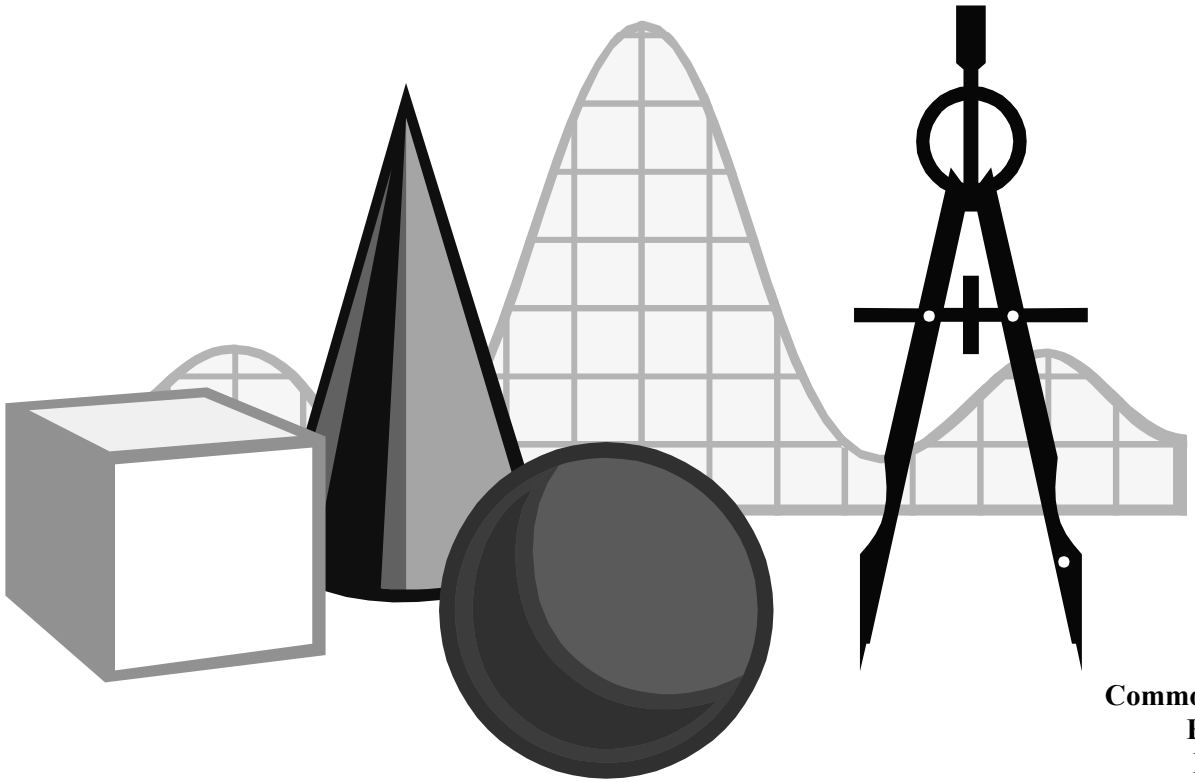
MATHEMATICS STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 2



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

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

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models; and

b) round two-digit numbers to the nearest ten.

UNDERSTANDING THE STANDARD (Teacher Notes)	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. continued	**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.	**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 Popsicle 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. • Round two-digit numbers to the nearest ten.

2.1 The student will

a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models; and

b) round two-digit numbers to the nearest ten.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • Number lines are useful tools for developing the concept of rounding to the nearest ten. Students can use the strategy of identifying a number on a number line and finding the multiple of ten that is closest to the identified number. • A strategy for rounding numbers to the nearest ten is as follows: – Look one place to the right of the digit 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.		

2.2 The student will compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than*, *less than*, or *equal to*).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Mathematical symbols (>, <) used to compare two unequal numbers are called *inequality symbols*. • A procedure for comparing two numbers by examining place value may include the following: – Line up the numbers by place value by lining up the ones. – Beginning at the left, find the first place value where the digits are different. – Compare the digits in this place value 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 words *equal to*.	**All students should** • 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** • Identify numbers that are greater than or less than a given number between 0 and 999. • Compare two numbers between 0 and 999, represented pictorially or with concrete objects (e.g., base-10 blocks), using the terms *greater than, less than* or *equal to*. • Compare the numerical value of two whole numbers between 0 and 999 by identifying one as greater than, less than, or equal to the other. • Write the symbols for less than (<), greater than (>), and equal to (=) to compare two numbers between 0 and 999.

2.3 The student will identify the ordinal positions first through twentieth, using an ordered set of objects.

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

2.4 The student will identify the part of a set and/or region that represents fractions for one-half, one-third, one-fourth, one-eighth, and one-tenth and write the corresponding fraction.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A fraction is a way of representing part of a whole (as in a region/area model) or part of a group (as in a set model). • In each fraction model, the parts must be equal (i.e., each pie piece must have the same area; the size of each chip in a set must be equal). In problems with fractions, a whole is broken into equal-size parts and reassembled into one whole. • The denominator (bottom number) tells how many equal parts are in the whole or set. The numerator (top number) tells how many of those parts are being described. • Students should have opportunities to make connections among fraction representations by connecting concrete or pictorial representations with spoken or symbolic representations. • Informal, integrated experiences with fractions at this level will help students develop a foundation for deeper learning at later grades. Understanding the language of fractions (e.g., *thirds* means "three equal parts of a whole" or $\frac{1}{3}$ represents one of three equal-size parts when a pizza is shared among three students) will further this development.	**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.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recognize fractions as representing equal-size parts of a whole. • Identify the fractional parts of a whole or a set for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$. • Identify the fraction names for the fraction notations $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$. Represent fractional parts of a whole for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$, using – region/area models (e.g., pie pieces, pattern blocks, geoboards); – sets (e.g., chips, counters, cubes); and – measurement models (e.g., fraction strips, cuisenaire rods, connecting cubes).

2.5 The student will

a) count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10, using mental mathematics, paper and pencil, hundred chart, calculators, and/or concrete objects, as appropriate;

b) count backward by tens from 100;

c) group objects by threes and fours; and

d) recognize even and odd numbers, using objects.

UNDERSTANDING THE STANDARD (Teacher Notes)	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. continued	**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.	**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, and/or paper and pencil. • Skip count by twos, fives, and tens to 100, using the constant feature on the calculator. • Count backward by tens from 100. • Group objects by threes. • Group objects by fours. • Use objects to determine whether a number is odd or even.

2.5 The student will

a) count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10, using mental mathematics, paper and pencil, hundred chart, calculators, and/or concrete objects, as appropriate;

b) count backward by tens from 100;

c) group objects by threes and fours; and

d) recognize even and odd numbers, using objects.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • Calculators can be used to display the numeric patterns resulting from skip counting. Use the constant feature of the four-function calculator to display the numbers in the sequence when skip counting by that constant. For example, when skip counting by twos, press 2 + 2 = = = … to produce 2, 4, 6, 8, 10, …; or when skip counting by fives, press 5 + 5 = = = … to produce 5, 10, 15, …. • Odd and even numbers can be explored in different ways (e.g., dividing collections of objects into two equal groups or pairing objects).		

A variety of contexts are necessary for children to develop an understanding of the meanings of the operations such as addition and subtraction. These contexts often arise from real-life experiences in which they are simply joining sets, taking away or separating from a set, or comparing sets. These contexts might include conversations, such as "How many books do we have altogether?" or "How many cookies are left if I eat two?" or "I have three more candies than you do." Although young children first compute using objects and manipulatives, they gradually shift to performing computations mentally or using paper and pencil to record their thinking. Therefore, computation and estimation instruction in the early grades revolves around modeling and discussing a variety of problem situations to help students move from the concrete to the abstract and 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, and multiplication facts and related fact families;
- gaining facility in manipulating whole numbers to add and subtract and in understanding the effects of the operations on whole numbers;
- developing and using strategies and algorithms to solve problems and choosing an appropriate method for the situation;
- choosing, from mental computation, estimation, paper and pencil, and calculators, an appropriate way to compute;
- recognizing whether numerical solutions are reasonable;
- experiencing situations that lead to multiplication and division, such as equal groupings of objects and sharing equally; and
- performing initial operations with fractions and decimals.

2.6 The student will recall basic addition facts — i.e., sums to 18 or less — and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Teacher Notes)	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 fact families (e.g., 4 + 3 = 7 , 3 + 4 = 7, 7 – 4 = 3, and 7 – 3 = 4); – use of the zero property (e.g., 4 + 0 = 4), without naming the property but saying, "When you add zero to a number, you always get the original number." continued	**All students should** • Understand that addition involves combining and subtraction involves separating. • Develop fluency in recalling basic facts for addition and subtraction.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Recall and write the basic addition facts for sums to 18 or less and the corresponding subtraction facts. • Recall and write the basic addition facts for sums to 18 or less and the corresponding subtraction facts, when addition or subtraction problems are presented in either horizontal or vertical written format.

2.6 The student will recall basic addition facts — i.e., sums to 18 or less — and the corresponding subtraction facts.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • 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 flash cards, practice sheets, and/or games.		

2.7 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 (mental computation, concrete materials, and paper and pencil).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition means to combine or join quantities. • The standard algorithm for addition is 23 → addend + 46 → addend 69 → sum • By estimating the result of an addition problem, a place-value orientation for the answer is established. • 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. • 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. • Strategies for adding two-digit numbers mentally include student-invented strategies, making-ten, and counting on, among others.	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in real-life situations when exact answers are not required or needed. • Develop flexible methods of adding whole numbers by combining numbers in a variety of ways, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • 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. • Determine 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.

2.8 The student, given two whole numbers each 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation (mental computation, concrete materials, and paper and pencil).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Three terms often used to discuss subtraction are *minuend* → 98 *subtrahend* → − 41 *difference* → 57 • 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. • Giving an estimate of the result of a subtraction problem establishes a place-value orientation for the answer. • 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. continued	**All students should** • Understand that estimation skills are valuable, time-saving tools particularly in real-life situations when exact answers are not required or needed. • Develop flexible methods of subtracting whole numbers by combining numbers in a variety of ways, most depending on place values.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • 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. • Determine 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.

2.8 The student, given two whole numbers each 99 or less, will
a) estimate the difference; and
b) find the difference, using various methods of calculation (mental computation, concrete materials, and paper and pencil).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • 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 – partial differences: 98 – 41 = __ 90 – 40 = 50 8 – 1 = 7 50 + 7 = 57.		

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

UNDERSTANDING THE STANDARD (Teacher Notes)	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 real-life 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 is presented in a simple table, picture graph, or bar graph. • Solve addition and subtraction problems requiring a one-step solution, using data from simple charts, picture graphs, bar graphs, and everyday-life situations. • Create a one-step addition or subtraction problem using data from simple tables, picture graphs, and bar graphs. For subtraction, the difference will be between two whole numbers each 99 or less.

2.10 The student, given a simple addition or subtraction fact, will recognize and describe the related facts which represent and describe the inverse relationship between addition and subtraction (e.g., 3 + __ = 7, __ + 3 = 7, 7 – 3 = __, and 7 – __ = 3).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Addition and subtraction are inverse operations, that is, one undoes the other: 3 + __ = 7 7 – 3 = __ 7 – __ = 3 __ + 3 = 7 • For each addition fact, there is a related subtraction fact. • Developing strategies for solving missing-addends problems and the missing part of subtraction facts (e.g., 7 – __ = 3) builds an understanding of the link between addition and subtraction. • 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.

2.11 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) identify the correct usage of the cent symbol (¢), dollar symbol ($), and decimal point (.).

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

2.12 The student will estimate and then use a ruler to make linear measurements to the nearest centimeter and inch, including the distance around a polygon in order to determine perimeter.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• A clear concept of the size of one unit (one inch or one centimeter) is necessary before one can measure to the nearest unit. • The experience of making a ruler can lead to greater understanding of using one. • Proper placement of a ruler when measuring length (i.e., placing the end of the ruler at one end of the item to be measured) should be demonstrated. • Perimeter is the distance around any two-dimensional shape and is found by adding the measures of the sides. • Linear metric measurement is based on the meter (a base-10 system) and includes centimeters. • Linear standard measurement is based on the foot and includes inches. • A polygon is a simple closed figure lying on a plane, such as a triangle or square. "Simple" means that the lines do not cross.	**All students should** • Understand how to estimate linear measures and how to use a ruler to determine a linear measure to the nearest centimeter and inch.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify an inch as a U.S. customary unit for measuring length. • Estimate and measure the length of various line segments and objects to the nearest inch. • Identify a centimeter as a metric unit for measuring length. • Estimate and measure the length of various line segments and objects to the nearest centimeter. • Measure each side of a variety of concrete polygons and add them to determine the distance around the polygon (its perimeter). • Determine the distance around a polygon (its perimeter), given the measurements of the sides in centimeters or inches.

2.13 The student, given grid paper, will estimate and then count the number of square units needed to cover a given surface in order to determine area.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Area is a two-dimensional measure and is therefore measured in square units. • Area is the number of square units needed to cover a figure, or more precisely, it is the measure in square units of the interior region of a two-dimensional figure.	**All students should** • Understand that area is determined by covering a given surface with square units and counting the square units.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate covering a given surface with square units, using concrete materials (e.g., inch tiles, geoboards, grid paper). • Determine the area of a given surface on grid paper by estimating and then counting the number of square units needed to cover the surface.

2.14 The student will estimate and then count the number of cubes in a rectangular box in order to determine volume.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Volume is a three-dimensional measure and is therefore measured in cubic units. • Volume is the number of same-sized objects needed to fill a container, or more precisely, it is the number of cubic units needed to fill a solid. • The volume of a rectangular box can be determined by – counting the number of cubes in the top layer of cubes; and – adding that number for each layer of cubes.	**All students should** • Understand the concept of volume of a rectangular box by estimating and counting cubes.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Investigate the concept of volume by filling boxes and building box shapes, using cubes. • Determine the volume of a rectangular box by counting the number of cubes needed to fill it. • Determine the volume of a rectangular box by – counting the number of cubes in the top layer of cubes; and – adding that number for each layer of cubes.

2.15 The student will estimate and then determine weight/mass of familiar objects in pounds and/or kilograms, using a scale.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Weight and mass are different. Mass is the amount of matter in an object. Weight is determined by the pull of gravity on the mass of an object. The mass of an object remains the same regardless of its location. The weight of an object changes dependent on the gravitational pull at its location. In everyday life, most people are actually interested in determining an object's mass, although they use the term *weight* (e.g., "How much does it weigh?" versus "What is its mass?"). • Mass is more difficult for young children to understand than length. • A balance is a scale for measuring mass. To determine the mass of an object by using a two-pan balance, first level both sides of the balance by putting standard units of mass on one side to counterbalance the object on the other; then find the sum of the standard units of mass required to level the balance. • Benchmarks of common objects need to be established for one pound and one kilogram (e.g., the mass of a math book is about one kilogram). Practical experience measuring the mass of familiar objects helps to establish benchmarks. • Pounds and kilograms are not compared at this level.	**All students should** • Understand how to use a scale to determine the weight/mass of an object and use the appropriate unit for measuring weight/mass.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify a pound as the U.S. customary unit for measuring weight. • Estimate and then measure the weight of familiar objects to the nearest pound, using a scale. • Identify a kilogram as a metric unit for measuring mass. • Estimate and then measure the mass of familiar objects to the nearest kilogram, using a scale.

2.16 The student will tell and write time to the quarter hour, using analog and digital clocks.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• Telling time requires reading a clock. The position of the two hands is read with the little hand indicating the hour and the long hand indicating the number of minutes after or before an hour. • The use of a demonstration clock with gears insures that the positions of the hour hand and the minute hand are precise at all times. • The face of an analog clock can be divided into 4 equal parts, called *quarter hours*, of 15 minutes each.	**All students should** • Apply an appropriate technique to determine time to the quarter hour, using analog and digital clocks.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Show and tell time to the quarter hour, using a model analog clock. • Write the time indicated on a digital clock to the nearest quarter hour. • Write the time indicated on an analog clock to the nearest quarter hour. • Match a written time to a time shown on a clock face to the quarter hour.

2.17 The student will use actual measuring devices to compare metric and U.S. Customary units (cups, pints, quarts, gallons, and liters) for measuring liquid volume, using the concepts of *more*, *less*, and *equivalent*.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• 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. • 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. • 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.	**All students should** • Understand how to use measuring devices to determine liquid volume in both metric and customary units. • Understand how to compare measures.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Identify the metric and U.S. customary units for measuring liquid volume (e.g., cups, pints, quarts, gallons, and liters). • Compare customary and metric units of liquid volume (e.g., cups to quarts, liters to quarts), using actual measuring devices and the concepts of *more*, *less*, and *equivalent*.

2.18 The student will

a) use calendar language appropriately (e.g., months, *today*, *yesterday*, *next week*, *last week*);
b) determine past and future days of the week; and
c) identify specific dates on a given calendar.

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

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

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

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

The focus of instruction at this level is on

- observing, comparing, and investigating three-dimensional objects and their two-dimensional faces;
- sorting objects and ordering them directly by comparing them one to the other;
- describing, comparing, sorting, and classifying shapes; and
- exploring symmetry, congruence, and transformation.

In the primary grades, children begin to develop basic vocabulary related to these shapes 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.)

2.20 The student will identify, describe, and sort three-dimensional (solid) concrete figures, including a cube, rectangular solid (prism), square pyramid, sphere, cylinder, and cone, according to the number and shape of the solid's faces, edges, and corners.

UNDERSTANDING THE STANDARD (Teacher Notes)	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."). • Critical links between the worlds of geometry and numbers are forged as the number of faces (sides, bases), edges, and corners are counted and described. continued	**All students should** • Understand the differences between two-dimensional (plane) and three-dimensional (solid) figures while recognizing the commonalties of the two.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Compare three-dimensional (solid) shapes (i.e., cube, rectangular solid, square pyramid, sphere, cylinder, and cone) to similar objects in everyday life (e.g., a party hat is like a cone). • Identify and name cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones by their appearance. • Identify and describe cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones according to the number and shape of their faces (sides, bases), edges, and corners.

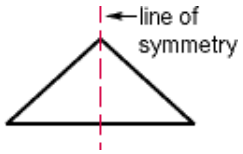
2.20 The student will identify, describe, and sort three-dimensional (solid) concrete figures, including a cube, rectangular solid (prism), square pyramid, sphere, cylinder, and cone, according to the number and shape of the solid's faces, edges, and corners.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • Three-dimensional figures are called *solid figures* or simply *solids.* Students should be reminded that a concrete three-dimensional object, even when called a "solid," may actually be hollow rather than solid. • A cube is a three-dimensional (solid) figure with six congruent square faces and every edge the same length. A cube has 8 corners and 12 edges. • A cylinder is a three-dimensional (solid) figure with two congruent, parallel circular surfaces joined by a curved surface. • A cone is a three-dimensional (solid), pointed figure that has a flat, round base (usually a circle) that is joined to a vertex by a curved surface. • A rectangular solid is a three-dimensional figure in which all six faces are rectangles with three pairs of parallel congruent opposite faces. • A square pyramid is a three-dimensional (solid) figure that has a square base and whose other faces are triangles that share a common vertex. • A sphere is a three-dimensional (solid) figure with all of its points the same distance from its center. continued		

2.20 The student will identify, describe, and sort three-dimensional (solid) concrete figures, including a cube, rectangular solid (prism), square pyramid, sphere, cylinder, and cone, according to the number and shape of the solid's faces, edges, and corners.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • A face is a polygon that serves as one side of a three-dimensional (solid) figure (e.g., a square is a face of a cube). • An edge is the line segment where two faces of a three-dimensional (solid) figure meet. • A corner is the point at which three or more edges meet. • A base is a special face of a three-dimensional (solid) figure.		

2.21 The student will identify and create figures, symmetric along a line, using various concrete materials.

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

2.22 The student will compare and contrast plane and solid geometric shapes (circle/sphere, square/cube, and rectangle/rectangular solid).

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• An important part of geometry is naming and describing shapes in two-dimensions (plane shapes) and three-dimensions (solid shapes). • Plane figures are two-dimensional figures formed by lines that are curved, straight, or a combination of both. • The identification of two- and three-dimensional figures is accomplished by working with and handling objects. • The relationship between plane and solid geometric figures, such as the square and the cube or the rectangle and the rectangular solid, helps build the foundation for future geometric study of faces, edges, and vertices.	**All students should** • Understand the differences between plane and solid figures while recognizing the inter-relatedness of the two.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine similarities and differences between plane and solid shapes (e.g., circle/sphere, square/cube, and rectangle/rectangular solid), using models and cutouts. • Trace faces of solid shapes (e.g., cube and rectangular solid) to create the set of plane figures related to the solid shape. • Compare and contrast plane and solid geometric shapes (e.g., circle/sphere, square/cube, and rectangle/rectangular solid) according to the number and shape of their faces (sides, bases), edges, and corners.

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.

2.23 The student will read, construct, and interpret a simple picture and bar graph.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
• The purpose of a graph is to represent data gathered to answer a question. • Picture and bar graphs are created to communicate the data collected. • Picture graphs are graphs that use pictures to show and compare information. A key is often used to indicate what each picture represents (e.g., one picture of a sneaker represents five sneakers in a graph of shoe types). • Bar graphs are used to compare counts of different categories (categorical data). Using grid paper ensures more accurate graphs. – A bar graph uses parallel horizontal or vertical bars to represent counts for several categories. One bar is used for each category, with the length of the bar representing the count for that category. – There is space before, between, and after the bars. – The axis displaying the scale that represents the count for the categories should extend one increment above the greatest recorded piece of data. Second grade students should be collecting data that are recorded in increments of whole numbers, usually multiples of 1 or 2. – Each axis should be labeled, and the graph should be given a title. continued	**All students should** • Understand how data can be collected and organized in picture and bar graphs. • Understand that picture graphs use pictures to show and compare data. • Understand that bar graphs can be used to compare categorical data.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Read the information presented horizontally and vertically on a simple bar or picture graph. • Collect no more than 16 pieces of data to answer a given question. • Organize data, using lists, tables, objects, pictorial representations, tally marks, and charts, in order to construct a graph. • Represent data by constructing a simple picture or bar graph. • Label the axes on a bar graph, limiting the number of categories (categorical data) to four and the increments to multiples of whole numbers (e.g., multiples of 1, 2, or 5). • Label the axes on a picture graph, limiting the number of categories to four and including a key where appropriate. • Interpret information from simple picture and bar graphs by writing at least one statement that covers one or both of the following: – Describe the categories of data and the data as a whole (e.g., the total number of responses). – Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same. • Select the best interpretation of a graph from a set of possible interpretations of the graph.

2.23 The student will read, construct, and interpret a simple picture and bar graph.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued – Statements representing an analysis and interpretation of the characteristics of the data in the graph (e.g., similarities and differences, least and greatest, the categories, and total number of responses) should be written. • When data is displayed in an organized manner, the results of investigations can be described, and the questions posed can be answered.		

2.24 The student will record data from experiments, using spinners and colored tiles/cubes, and use the data to predict which of two events is more likely to occur if the experiment is repeated.

UNDERSTANDING THE STANDARD (Teacher Notes)	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. continued	**All students should** • Understand and apply basic concepts of probability**.** • Understand that the likelihood of an event occurring is to determine 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. • 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.

2.24 The student will record data from experiments, using spinners and colored tiles/cubes, and use the data to predict which of two events is more likely to occur if the experiment is repeated.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • 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 = $\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$. At this level, students need to understand only this fractional representation of probability (e.g., the probability of getting heads when flipping a coin is $\frac{1}{2}$). • Students should have opportunities to describe in informal terms (i.e., *impossible*, *unlikely*, *as likely as unlikely*, *equally likely*, *likely*, and *certain*) the degree of likelihood of an event occurring. Activities should include real-life examples.		

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

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

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

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

2.25 The student will identify, create, and extend a wide variety of patterns, using numbers, concrete objects, and pictures.

UNDERSTANDING THE STANDARD (Teacher Notes)	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 number 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. continued	**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, or object in a given pattern. • Extend a given pattern, using numbers, geometric figures, symbols, or objects. • Create a new pattern, using numbers, geometric figures, symbols, or objects. • Recognize the same pattern in different manifestations.

2.25 The student will identify, create, and extend a wide variety of patterns, using numbers, concrete objects, and pictures.

UNDERSTANDING THE STANDARD (Teacher Notes)	ESSENTIAL UNDERSTANDINGS	ESSENTIAL KNOWLEDGE AND SKILLS
continued • In numeric patterns, students must determine the difference, called the *common difference*, between each succeeding number in order to determine what is added to each previous number to obtain the next number. Sample numeric patterns include – 6, 9, 12, 15, 18, …; – 5, 7, 9, 11, 13, … (repeating numeric pattern); and – 1, 2, 4, 7, 11, 16, … (growing numeric pattern). • In geometric patterns, students must often recognize transformations of a figure, particularly rotation or reflection. Rotation (turn) is the result of turning a figure around a point or a vertex, and reflection (flip) is the result of flipping a figure over a line.		

2.26 The student will solve problems by completing a numerical sentence involving the basic facts for addition and subtraction. Examples include: 3 + __ = 7, or 9 – __ = 2. Students will create story problems, using the numerical sentences.

UNDERSTANDING THE STANDARD (Teacher Notes)	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 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 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.