

MATHEMATICS PROGRAM OF STUDIES

Prekindergarten

Data Analysis/Statistics/Probability

Benchmark: Students will begin to participate in the process of collecting data in order to answer questions of interest.

Literature/Research Base: Data analysis develops naturally from children's sorting and classifying activities and their interests in comparing groups of objects. These early comparisons enable them to make rough estimates of which group has more and which group has less (*Baratta-Lorton, 1976*).

Indicators:

- DSP 1 Participates in creating real graphs that are of interest to children (e.g., students stand in groups by the types of shoes they wear)
- DSP 2 Participates in a discussion about the data to ask and answer questions (e.g., child notices which group has more, less or the same amount of children)
- DSP 3 Sorts a group of objects using one attribute (e.g., color, size or shape)

MATHEMATICS PROGRAM OF STUDIES

Prekindergarten

Geometry

Benchmark: Students begin to recognize, sort and describe geometric shapes as they solve problems involving shape, position and orientation in space.

Literature/Research Base: Geometry is the area of mathematics that involves space, size, position, direction and movement. Principles of geometry are related to spatial sense and are necessary for interpreting, understanding, and appreciating our inherently geometric world (*NCTM, 2000*).

Indicators:

- GEO 1 Recognizes squares, triangles, circles and rectangles
- GEO 2 Describes the position of objects in relation to other objects and themselves using the words: under/over, top/bottom, beside/next to, in front/behind, inside/outside
- GEO 3 Sorts a group of objects using one attribute (e.g., color, size or shape)

MATHEMATICS PROGRAM OF STUDIES

Prekindergarten

Measurement

Benchmark: Students will explore and develop the concept of measurement by using nonstandard units of measurement.

Literature/Research Base: Young children are not ready to understand concepts of conventional measurement such as foot, yard, pounds and degrees. Young children will use arbitrary measures, such as their hands, feet, a piece of rope-in order to learn the meaning of the processes of measuring and to gain an awareness of the size of things (*Copley, 2000; NCTM, 2001*).

Indicators:

- MEA 1 Begins to compare objects (e.g., bigger/smaller, heavier/lighter and hotter/colder)
- MEA 2 Shows an awareness of appropriate measurement tools (e.g., ruler, clock and calendar)
- MEA 3 Measures with assistance length and weight using nonstandard units (e.g. unifix cubes, string, hands, balance)
- MEA 4 Demonstrates an awareness of time concepts and sequence (e.g., “After small group we have work time.”)
- MEA 5 Begins to compare the duration of two events (e.g., “Work time is longer than group time.”)

PROBLEM SOLVING / APPLICATIONS

KINDERGARTEN

Students will use problem-solving approaches to understand concepts and skills. They will pose problems, solve problems, verify and explain solutions, and focus on process that leads to reasonable solutions.

OBJECTIVES

- PSA 1 Tell and retell a “math happening” story related to a familiar real-life situation that shows “how many altogether”; illustrate the action in the story.
- PSA 2 Tell and retell a “math happening” story related to a familiar real-life situation that shows “how many were taken away” and “how many are left”; illustrate the action in the story.
- PSA 3 Represent an addition or subtraction story problem using real objects or semi-concrete materials.
- PSA 4 Use strategies (act it out, draw a picture, make/use a pattern) to solve simple story problems; share and explain thinking about how a problem was solved.
EXT: Find an alternate way to solve a problem.

NUMBER CONCEPTS / NUMBER THEORY / NUMBER SENSE

KINDERGARTEN

Students will develop a sense of number and an understanding of numerical relationships that give them the flexibility to deal with numbers in many different forms. They will represent and model numbers verbally, physically, and symbolically to determine relative magnitude.

OBJECTIVES

- NCT 1 (K.1) Estimate and compare quantities using many, few, none, more, fewer, same, and different.
EXT: Explore equal groups.
- NCT 2 (K.1) Match the objects in two groups using one-to-one correspondence.
- NCT 3 (K.2) Represent numerals up to 10 with objects. Write numerals to 10.
EXT: Represent numerals to 20.
- NCT 4 (K.5) Count backward from 10.
EXT: Count backward from 20.
- NCT 5 Explore the part-part-whole relationship in contextual settings by counting the number of items/objects in the parts and relating the parts to the number in all (whole).
- NCT 6 (K.2) Develop a concept of numbers, zero through ten; count groups of 10 or fewer objects saying how many; record the number.
EXT: Read the number words one to ten.
- NCT 7 Explore the concept that number remains constant regardless of the arrangement of the objects that represent it (conservation of number).
- NCT 8 Seriate (order) up to 10 objects by length, weight, size, and number (e.g., order trains of two, four, seven, and ten).

- NCT 9 (K.2, K.5) Sequence numerals to 10, orally count to 30, and recognize numerals to 31.
EXT: Sequence numerals to 20.
- NCT 10 Find groups of objects that are one more than, one less than, and the same as a given group.
- NCT 11 (K.3) Use ordinal numbers to identify position (first, second, third, fourth, and fifth).
- NCT 12 Group a collection of objects in a variety of ways (e.g., groups of five, groups of three, groups of ten); talk about the left-overs.
- NCT 13 Explore dividing wholes (objects and groups) into “equal” and “not-equal” parts.

OPERATIONS

KINDERGARTEN

Students will model and develop an understanding of beginning operations and procedures for computation.

OPERATIONS

- OPR 1 (K.6) Model and explain addition and subtraction to 10 using concrete objects.
EXT: Use symbols for addition (+) and subtraction (-) and record the math sentence for facts to five.
- OPR 2 Count from a given number up to 10.
- OPR 3 Explain and demonstrate, with concrete materials, the concepts of “one more” and “one less.”
EXT: Explain and demonstrate, with concrete materials, the concepts of “two more” and “two less.”
- OPR 4 Explore, model, and talk about a variety of ways to make 10.

DATA ANALYSIS / STATISTICS / PROBABILITY

KINDERGARTEN

Students will solve problems in which there is a need to collect, organize, and display data; analyze, compare, and relate data; and represent mathematical situations to determine the probability of events.

OBJECTIVES

- DSP 1 (K.17) Sort and classify groups of objects by size, shape, or color.
EXT: Sort by function (student-generated criteria) and explain reasoning.
- DSP 2 (K.14) Gather real-life data by sorting, counting, and tallying.
- DSP 3 (K.15) Represent data by making object graphs, pictographs, and charts; read and discuss these graphs and charts.
EXT: Communicate findings by describing data using more than, less than, and same.
- DSP 4 (K.16) Explore the concept of chance by predicting the likelihood of everyday events occurring (e.g., in game situations, weather).
EXT: Explore probability with concrete materials (e.g., color spinners, objects in a bag, two-color counters) and communicate results.

GEOMETRY

KINDERGARTEN

Students will identify, classify, and describe geometric shapes and solve problems by using geometric models. They will recognize and appreciate geometry as a way to describe the world.

OBJECTIVES

- GEO 1 (K.3, K.12) Describe position and directionality of objects relative to other objects (left/right, top/bottom, over/under, beside/inside/outside/on, first/last, between, etc.).
- GEO 2 (K.12) Recognize squares, circles, triangles, and rectangles, regardless of orientation.
- GEO 3 (K.11, K.13) Match, identify, make, name, and sort squares, circles, triangles, and rectangles. Compare size and shape of plane geometric figures.
- GEO 4 (1.17) Find and discuss plane and solid shapes in the environment.
EXT: Sort plane and solid shapes by properties (e.g., straight and/or curved lines).

MEASUREMENT

KINDERGARTEN

Students will explore and/or develop a concept of the measurement process by using nonstandard units to estimate, measure, and compare length, capacity, weight, volume, time, and money.

OBJECTIVES

- MEA 1 (K.10) Compare two objects or events using direct comparison to determine shorter/longer, taller/shorter, heavier/lighter, hotter/colder.
- MEA 2 (K.10, 1.12) Estimate and measure length, weight, and capacity/volume using nonstandard units which may include foot length, hand span, paper clips, blocks, etc.
EXT: Relate a nonstandard linear measure to a 12 inch ruler.
- MEA 3 (K.8) Become aware of appropriate measurement tools used to measure length (ruler), weight (scale), time (clock and calendar), and temperature (thermometer).
- MEA 4 (K.7) Recognize and name pennies, nickels, dimes, and quarters; identify and use the cent sign. Determine the value of a collection of pennies and/or nickels up to ten cents.
EXT: Determine the value of a mixed collection of pennies, nickels, and dimes up to 20 cents.
- MEA 5 (K.9) Fill in the numbers on a clock.
EXT: Read time to the hour.
- MEA 6 Count, name, and sequence days of the week using a calendar, stories, and songs; name and describe seasons.
EXT: Sequence real-life events, referencing hours, days, weeks, etc.

PATTERNS / FUNCTIONS / ALGEBRA

KINDERGARTEN

Students will solve problems in which there is a need to recognize and extend or generate and design a pattern. They will investigate the concept of variable (missing part) and function (relationship).

OBJECTIVES

- PFA 1 (K.18) Identify, copy/model, and describe patterns found in common objects, sound, and movement.
- PFA 2 Identify the stem (AB, ABC, ABCD) and extend the pattern.
EXT: Find a missing element in a pattern.
- PFA 3 Create patterns using concrete materials focusing on the attributes of color, size, and shape.
EXT: Create patterns using concrete materials focusing on two attributes.
- PFA 4 (K.4) Explore number patterns such as odd/even, using concrete materials.
EXT: Build growing patterns to show counting by twos, fives, and tens; verify the pattern using the calculator.
- PFA 5 Estimate and count the number in the “missing part” when the “whole” is known and one “part” is shown with concrete materials.
- PFA 6 Investigate “one more” and simple “doubles” using a function box.

PROBLEM SOLVING / APPLICATIONS

FIRST GRADE

Students will use problem-solving approaches to understand concepts and skills. They will pose problems; solve routine, nonroutine, and multistep problems; verify, interpret, and generalize solutions; and focus on the processes that lead to reasonable solutions. Through a variety of problem-solving experiences, students will acquire confidence in using mathematics meaningfully.

OBJECTIVES

- PSA 1 Share a real-life event (math happening) and pose a question that can be answered using the information given in the story. Illustrate the number sentence by drawing a picture.
- PSA 2 (1.9) Represent a verbalized (one-step addition or subtraction) story problem, using real or semi-concrete materials; record the number sentence and solve.
EXT: Sort problems by operation and/or student-generated criteria.
- PSA 3 Select appropriate materials and tools to solve a problem (e.g., countables, measurement tools, calculators).
- PSA 4 Use strategies (guess and check; act it out; make/use a list, chart; make/use a graph; build a model; draw a picture; use estimation; use a pattern) to solve one-step routine and nonroutine problems.
- PSA 5 Solve problems by working collaboratively with a partner; explain how/why the solution makes “sense”.
- PSA 6 Share and explain (verbalize/record/demonstrate) thinking about how the problem was solved.

NUMBER CONCEPTS / NUMBER THEORY / NUMBER SENSE

FIRST GRADE

Students will develop a sense of number and an understanding of numerical relationships that give them the flexibility to deal with numbers in many different forms. They will represent and model numbers verbally, physically, and symbolically to determine relative magnitude.

OBJECTIVES

- NCT 1 (1.1, 1.4) Estimate, count, and represent numbers up to 100 using materials. Recognize and write numerals up to 100.
EXT: Explore number patterns beyond 100.
- NCT 2 (1.3) Count backward by 1s across a decade (e.g., 62, 61, 60, 59 ...).
- NCT 3 Recognize and explain/show that a whole (object, picture, set, or number) is made up of all its parts. Name a number in a variety of ways (e.g., $3+2$, $8-3$, $1+1+1+1+1$, cinco, fingers on one hand are names for 5).
- NCT 4 Read and write number words to 10.
EXT: Read and write number words to 19 in contextual settings (such a creating a book, poster, game, etc.).
- NCT 5 Understand numbers 11 to 19 as “ten and ___ more”.
- NCT 6 Estimate and compare sizes of groups using more than, less than, and equal to. Compare and order 2 digit numbers.
- NCT 7 (1.5) Identify ordinal position through tenth.
- NCT 8 Understand the concept of addition as demonstrated orally or through the use of models. Explore the commutative property.
EXT: Represent addition sentences using computer software such as KidPix.
- NCT 9 Model different subtraction situations including comparison of two groups, take away, and part-part-whole.

- NCT 10 Explore the relationship between addition and subtraction by modeling and recording fact families in contextual settings.
- NCT 11 Use and explain the addition and subtraction strategies of “counting on and back” (1, 2, and 3), adding zero; using doubles and near doubles; and making ten.
EXT: Explore the strategy of using 10 (e.g., $10 + 4 = 14$, so $9 + 4 = 13$).
- NCT 12 Explore the grouping of objects in a variety of ways (e.g., 19 can be 3 groups of six with 1 left over, 1 group of 10 with 9 left over, 3 groups of 5 with 4 left over, etc.).
- NCT 13 (1.2) Model 2 digit numbers by making groups of 10s and identifying the 1s left over. Write the corresponding numeral.
- NCT 14 Exchange tens for ones and vice versa using concrete materials. Exchange pennies for dimes and vice versa.
- NCT 15 (1.6) Recognize equal parts. Identify and represent the concepts of one-half and one-fourth using concrete materials.
EXT: Recognize and use the symbols to record fractional parts ($\frac{1}{2}$, $\frac{1}{4}$) of a region.
- NCT 16 (1.7) Make reasonable guesses (estimates) in terms of magnitude for familiar problem situations and explain the choice (e.g., given the options 1, 10, or 100, the student estimates the number of counters in a bag).

OPERATIONS

FIRST GRADE

Students will model, develop, explain, and analyze procedures for computation and strategies for estimation. They will learn to make informed decisions when faced with a problem situation.

OBJECTIVES

- OPR 1 Write and solve 1-digit addition and subtraction sentences written horizontally and vertically. Recognize and use plus, minus, and equal signs.
EXT: Add and subtract tens and ones; communicate strategies.
- OPR 2 (1.8) Mentally compute addition facts, sums to 10, and the corresponding subtraction facts.
- OPR 3 Estimate and add 3 addends, sums to 10.
- OPR 4 Find sums for doubles to $9 + 9$. Subtract doubles to $12 - 6$.
EXT: Add equal groups to explore multiplication.

DATA ANALYSIS / STATISTICS / PROBABILITY

FIRST GRADE

Students will solve problems in which there is a need to collect, organize, and display data; analyze, compare, and relate data; and represent mathematical situations by predicting and determining outcomes.

OBJECTIVES

- DSP 1 (1.18) Collect, count, and sort data. Justify the sorting rule.
- DSP 2 (1.18) Keep track of data by using concrete objects, tally marks, and organized lists.
- DSP 3 (1.18) Organize, record, and interpret data on grids and charts.
- DSP 4 (1.18, 1.19) Record and interpret data on object graphs, bar graphs and pictographs. Share findings.
- DSP 5 Explore probability with concrete materials (e.g., number cubes, coins, 2-colored counters, spinners) and communicate findings.
EXT: Make predictions about similar experiments based on findings (e.g., What would happen if—you were allowed more spins? —you added more cubes?)

GEOMETRY

FIRST GRADE

Students will identify, classify, and describe geometric shapes and solve problems by using geometric models. They will recognize and appreciate geometry as a way to describe the world.

OBJECTIVES

- GEO 1 Recognize the concept of symmetry.
EXT: Identify, make, and extend symmetrical (mirror image) patterns.
- GEO 2 (1.16) Recognize, identify, and draw 2-dimensional shapes (regular and irregular polygons, and non-polygons). Sort shapes by size, shape, sides, or corners and identify sorting rule.
EXT: Create multiple sorting rules for a given set of shapes.
- GEO 3 Explore congruence, using concrete materials (e.g., geoboards, pattern blocks).
EXT: Explore the results of combining and subdividing shapes to create different shapes.
- GEO 4 Explore 3-dimensional solids in the environment.
EXT: Identify and sort 3-dimensional solids in the environment.

MEASUREMENT

FIRST GRADE

Students will explore and/or develop a concept of the measurement process by using standard and nonstandard units to estimate; measure; and compare length, capacity, weight, volume, time, and money. Customary and metric units will be used.

OBJECTIVES

- MEA 1 (1.12) estimate, compare, and measure length using nonstandard units and inches.
EXT: Explore and identify centimeters.
- MEA 2 Explore area with concrete materials.
EXT: Explore the concept of volume by building or filling box shapes using cubes.
- MEA 3 (1.12, 1.14) Estimate and compare weight using nonstandard units. Estimate and compare the weights of objects up to 1 pound using a balance.
EXT: Estimate and compare the weight of an object to a kilogram.
- MEA 4 (1.13) Estimate and compare capacity using non-standard containers. Estimate, compare, and measure capacity in cups, pints, and quarts using physical materials.
EXT: Fill and compare containers that are more or less than a liter.
- MEA 5 Relate a given Fahrenheit thermometer reading to hot and cold.
EXT: Read a Fahrenheit thermometer and record temperature over a period of time.
- MEA 6 (1.10) Identify the number of pennies equivalent to a nickel, dime, and quarter. Find the value of a collection of pennies, the value of a collection of nickels, the value of a collection of dimes. Find the value of collections of mixed coins to \$1.00.
EXT: Find and record a variety of ways to show a given amount of money.

- MEA 7 (1.11) Relate time to daily activities. Read time to the hour; explore time to the half-hour on both digital and analog clocks.
- MEA 8 Name and sequence the days of the week. Recognize seasons and calendar patterns. Sequence time (e.g., daily schedule, classroom birthdays).
EXT: Name and sequence the months of the year.

PATTERNS / FUNCTIONS / ALGEBRA

FIRST GRADE

Students will solve problems in which there is a need to recognize and extend or generate and design a pattern. They will investigate the concept of variable (missing parts), function (relationship), and equation (number sentence).

OBJECTIVES

- PFA 1 (1.3) Count forward by 2s, 5s, and 10s up to 100.
EXT: Count forward by 10s starting at numbers other than multiples of 10 (e.g., 26, 36, 46, ...).
- PFA 2 (1.21) Identify and describe patterns in objects, places, numbers, and simple number sentences. Extend a pattern. Create patterns.
EXT: Create shape and numerical patterns using computer software and calculators.
- PFA 3 Explore the pattern of odd and even numbers.
- PFA 4 Find missing parts in part-whole situations using materials (e.g., “I have 10 M& M’s, six are green, and the rest are yellow. How many are yellow?”).
- PFA 5 Find a simple function rule given input and output data (e.g., if the number 3 becomes 4 and 6 becomes 7, what is the function rule that caused this?). Limit the rules to +1, -1, +2, -2, and doubles.

PROBLEM SOLVING / APPLICATIONS

SECOND GRADE

Students will use problem-solving approaches to understand concepts and skills. They will pose problems; solve routine, nonroutine and multistep problems; verify, interpret, and generalize solutions; and focus on the processes that lead to reasonable solutions. Through a variety of problem-solving experiences, students will acquire confidence in using mathematics meaningfully.

OBJECTIVES

- PSA 1 Share a real-life event (math happening) and pose a question that can be answered using the information given in the story.
- PSA 2 Illustrate “math happening” number sentences by drawing a picture or making a graphic representation.
- PSA 3 (2.9, 2.26) Represent a verbalized, one-step story problem, using semi-concrete materials and/or pictorial representations; record the number sentence and solve. Create story situations that fit given math sentences (equations).
EXT: Sort problems according to operation and problem structure.
- PSA 4 Solve problems using a logical procedure (a plan) by responding to sequential questions.
- PSA 5 Select appropriate materials and tools to solve a problem (e.g., countables, measurement tools, calculators).
- PSA 6 Develop and apply operations and strategies (guess and check; act it out; make/use a list, chart; make/use a graph; build a model; draw a picture; work backward; use estimation; use a pattern) to solve a variety of one-step routine and nonroutine problems.
- PSA 7 Solve problems by working collaboratively with a partner or small group; recognize that there may be more than one way to solve a problem; explain how/why the solution is reasonable.
- PSA 8 Share and explain (verbalize/record/demonstrate) thinking about how the problem was solved.

NUMBER CONCEPTS / NUMBER THEORY / NUMBER SENSE

SECOND GRADE

Students will develop a sense of number and an understanding of numerical relationships that give them the flexibility to deal with numbers in many different forms. They will represent and model numbers verbally, physically, and symbolically to determine relative magnitude.

OBJECTIVES

- NCT 1 (2.1) Estimate, count, write, and model numbers up to 999. Identify the place value of each digit. Name numbers in a variety of ways, (e.g., 25 +25, 5 groups of 10, 75 – 25, and 20 + 20 + 10 are all names for 50).
- NCT 2 Read and write number words for multiples of ten.
EXT: Read and write number words through 100.
- NCT 3 (2.1) Trade ones, tens, and hundreds using concrete materials; record the results.
- NCT 4 (2.2) Compare and order numbers up to and including three digits. Explore >, <, = signs.
- NCT 5 (2.3) Identify ordinal position through twentieth.
- NCT 6 (2.10) Write number sentences for fact families with sums to 18, demonstrating the inverse relationship between addition and subtraction. Demonstrate an understanding of the commutative property of addition.
EXT: Illustrate number sentences using computer software such as KidPix.
- NCT 7 Model and record different subtraction situations including comparison of two groups, missing part, and take away.
- NCT 8 Write repeated addition sentences, exploring the relationship between addition and multiplication (e.g., 7 + 7 + 7 + 7 is 4 groups of 7). Recognize the multiplication symbol “x”.
EXT: Use computer software to illustrate multiplication as repeated addition and arrays.

- NCT 9 (2.1) Round two-digit numbers to the nearest 10.
EXT: Round three-digit numbers to the nearest 10.
- NCT 10 Establish proficiency with basic facts to 18. Include these strategies: doubles, near doubles, “counting on and back” (1, 2, and 3), and making/using ten.
- NCT 11 (2.4) Model, identify, write, compare, and name fractional parts of regions ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$).
EXT: Model, identify, write, compare, and name fractional parts of sets.

OPERATIONS

SECOND GRADE

Students will model, develop, explain, and analyze procedures for computation and strategies for estimation. They will learn to make informed decisions when faced with a problem situation.

OBJECTIVES

- OPR 1 (2.6) Mentally compute addition and subtraction facts to 18.
- OPR 2 (2.7) Use models and record addition of two-digit numbers.
EXT: Explain the addition of three or more two-digit numbers using a mental strategy and/or concrete materials.
- OPR 3 (2.7) Estimate and add two-digit numbers including money amounts, using symbolic notation.
EXT: Estimate and add three-digit numbers, including money amounts.
- OPR 4 Estimate and add three or more addends, sums to 18.
- OPR 5 (2.8) Use models and record subtraction of two-digit numbers.
- OPR 6 (2.8) Estimate and solve two-digit subtraction problems including money amounts, using symbolic notation.
EXT: Estimate and subtract three-digit numbers, including money amounts.
- OPR 7 Add and subtract tens and ones using a hundreds chart or a number line.
EXT: Add and subtract tens and ones mentally.
- OPR 8 Use multiples and arrays to solve problems. Use models/manipulatives to explore division.
EXT: Explore the relationship between multiplication and division.
- OPR 9 Solve real-life problems with fractions using concrete materials.

DATA ANALYSIS / STATISTICS / PROBABILITY

SECOND GRADE

Students will solve problems in which there is a need to collect, organize, and display data; analyze, compare, and relate data; and represent mathematical situations to determine the probability of events.

OBJECTIVES

- DSP 1 Collect, count, record, and display data. Sort and justify the sorting rule.
EXT: Generate a survey question and design and implement a data collection plan.
- DSP 2 Make and interpret charts and schedules. Share findings.
- DSP 3 (2.29, 2.23) Make and interpret bar graphs and pictographs. Explain findings. Create and solve one-step addition and subtraction problems with the data.
- DSP 4 (2.24) Conduct simple probability experiments (e.g., spinners, cubes); record and explain the results.
- DSP 5 (2.24) Predict outcomes of probability experiments using recorded data, patterns, or observations.

GEOMETRY

SECOND GRADE

Students will identify, classify, and describe geometric shapes and solve problems by using geometric models. They will recognize and appreciate geometry as a way to describe the world.

OBJECTIVES

- GEO 1 (2.21) Identify lines of symmetry. Create symmetrical designs.
EXT: Create a design with two lines of symmetry.
- GEO 2 (2.22) Identify attributes of two-dimensional shapes (triangles, squares, circles, rectangles) and sort accordingly. Explore attributes of other two-dimensional shapes (regular and irregular polygons and non-polygons).
EXT: Sort shapes according to predetermined criteria (e.g., right angles vs. non-right angles, number of sides, polygons vs. non-polygons).
- GEO 3 Investigate the results of combining and subdividing shapes to create different shapes.
- GEO 4 Identify congruent shapes using concrete materials.
EXT: Create and make a collection of congruent shapes using concrete materials (e.g., construction paper, pipe cleaners, geoboards).
- GEO 5 (2.20, 2.22) Identify and sort solids (cube, rectangular solid, sphere, cylinder, cone, square pyramid) according to the number and shapes of faces and the number of edges and corners.
- GEO 6 (2.20, 2.22) Relate plane shapes to the faces of solid figures (e.g., square/cube, circle/cone, rectangle/rectangular solid).

MEASUREMENT

SECOND GRADE

Students will explore and/or develop a concept of the measurement process by using standard and nonstandard units to estimate; measure; and compare length, capacity, weight, volume, time, and money. Customary and metric units will be used.

OBJECTIVES

- MEA 1 (2.12) Estimate, measure, and compare length using nonstandard units, inches, centimeters, feet, and meters.
EXT: Explore measurement of curved paths.
- MEA 2 (2.12) Explore the perimeter of polygons using nonstandard units, inches, and centimeters.
- MEA 3 (2.13) Explore area with concrete materials and grid paper.
- MEA 4 (2.14) Explore the concept of volume by filling boxes and building box shapes using cubes.
- MEA 5 (2.15) Compare weights with a balance scale, relating objects to one pound or one kilogram.
EXT: Estimate, weigh, and order a collection of objects.
- MEA 6 (2.17) Estimate, measure, and compare capacity in nonstandard units and standard units (cups, pints, quarts, gallons, and liters).
EXT: Recognize equivalencies (e.g., 2 cups = 1 pint).
- MEA 7 (2.19) Read a Fahrenheit thermometer and record temperature over a period of time. Compare seasonal differences.
- MEA 8 Trade pennies for nickels, dimes, and quarters.

- MEA 9 (2.11) Count, compare, and order money amounts to \$5.00, using dollar bills and a collection of coins less than two dollars. Read and write money amounts using the cent sign, dollar sign and decimal point. Find and record a variety of ways to show a given amount of money.
EXT: Make change to \$1.00.
- MEA 10 (2.16) Estimate, read, and write time to the hour and half-hour using both digital and analog clocks. Explore time to the quarter hour.
EXT: Explore reading time to the nearest five minutes.
- MEA 11 Subtract or “count on” to determine time span (on the hours).
- MEA 12 (2.18) Name and sequence the days of the week and months of the year. Recognize calendar patterns.

PATTERNS / FUNCTIONS / ALGEBRA

SECOND GRADE

Students will solve problems in which there is a need to recognize, extend or generate, and design a pattern. They will investigate the concept of variable (missing parts), function (relationship), and equation (number sentence).

OBJECTIVES

- PFA 1 Complete a sequence (orally and in writing) of 10 or fewer consecutive numbers to 999.
- PFA 2 (2.5) Count forward by twos, fives, tens, and hundreds starting at various multiples of two, five, and ten. Count backward by tens from 100.
EXT: Make a record of counting by threes and fours. Compare it to other skip-counting patterns and explain.
- PFA 3 (2.25) Identify and extend a variety of patterns using objects and symbols, including numbers. Recognize patterns in number sentences. Create patterns.
EXT: Compare patterns from various cultures, describing likenesses and differences.
- PFA 4 (2.5) Recognize and record even and odd patterns.
EXT: Explore odd and even patterns in larger numbers. Use patterns to make predictions and to count in other numeric sequences; for example, will 45 be in the sequence when counting by fives starting at 13?
- PFA 5 (2.26) Find missing addends like $3 + \underline{\quad} = 7$ and $9 - \underline{\quad} = 2$.
- PFA 6 Find simple addition and subtraction function rules (e.g., +5) given input and output data (e.g., input 5, output 10; input 7, output 12).
EXT: Create a function rule problem for a friend to solve.
- PFA 7 Create additive patterns (e.g., $2 + 2 + 2 + 2 + 2 \dots$, $5 + 5 + 5 + 5 \dots$)
EXT: Explore finding missing factors; for example, how many groups of two does it take to make eight?

PROBLEM SOLVING / APPLICATIONS

THIRD GRADE

Students will use problem-solving approaches to understand concepts and skills. They will pose problems; solve routine, nonroutine, and multistep problems; verify, interpret, and generalize solutions; and focus on the process that leads to reasonable solutions. Through a variety of problem-solving experiences, students will acquire confidence in using mathematics meaningfully.

OBJECTIVES

- PSA 1 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- PSA 2 Solve problems using a logical procedure (a plan).
- PSA 3 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- PSA 4 (3.8) Solve problems using appropriate materials and tools (e.g., grid paper, collectibles, measurement tools, manipulatives, calculators).
- PSA 5 Develop and apply operations and strategies (e.g., act it out, build a model; draw a picture or diagram, guess and check, make a chart or a table, make a list, make a graph, use a pattern, work backward) to solve a wide variety of routine and nonroutine problems.
EXT: Find alternative ways to solve a problem.
- PSA 6 Solve problems by working collaboratively with peers; entertain others' points of view.
EXT: Recognize similarities and differences among solution paths.
- PSA 7 Share and explain (verbalize/record/demonstrate) thinking during and after solving a problem.
EXT: Recognize when a solution does or does not make sense. Explain why.

NUMBER CONCEPTS / NUMBER THEORY / NUMBER SENSE

THIRD GRADE

Students will develop a sense of number and an understanding of numerical relationships that give them the flexibility to deal with numbers in many different forms. They will represent and model numbers verbally, physically, and symbolically to determine relative magnitude.

OBJECTIVES

- NCT 1 (3.1) Read and write numbers through hundred thousands; identify the place value of each digit. Rename numbers through 9, 999 using place value.
EXT: Investigate other ways of grouping and writing numbers (e.g., Egyptian numbers).
- NCT 2 (3.3) Order and compare measurements and numbers to 9, 999 using the symbols $>$, $<$, and $=$.
EXT: Order and compare numbers to 999,999 using the symbols $>$, $<$, and $=$.
- NCT 3 Use ordinal numbers to identify position in a sequence.
- NCT 4 (3.2) Explore estimation strategies (rounding, compatible numbers, and using a referent). Round whole numbers, 9, 999 or less, to the nearest 10, 100, and 1,000.
- NCT 5 (3.4) Demonstrate the inverse relationship between multiplication and division by using fact families; explain the relationship between addition and multiplication.
- NCT 6 Recall basic strategies for addition and subtraction facts.
- NCT 7 (3.10) Develop concept of equal groups and use arrays to represent those groups. State the symbolic multiplication fact for an array. Organize the multiplication facts on a chart recognizing the square numbers and using the commutative property of multiplication.

- NCT 8 Develop and use the strategies to learn the multiplication facts through the nines (multiples/skip counting, properties of 0 and 1 as factors, square numbers, doubles, one more set, twice as much as a known fact, patterns, multiples of ten, etc.)
- NCT 9 Illustrate the concept of division in a problem-solving setting by identifying number of equal groups or how many are in each group; record the related division statement using \div and $\overline{)}$.
- NCT 10 (3.5) Recognize that a fraction represents equal parts of a whole or set; write the fraction when given the model (halves, thirds, fourths, eighths, and tenths); develop a model for a given fraction.
EXT: Investigate and model mixed numbers with concrete materials and on a number line.
- NCT 11 (3.6) Compare fractions less than one (halves, thirds, fourths, fifths, sixths, eighths, tenths) using models.
EXT: Use models to find equivalent fractions.
- NCT 12 (3.7) Interpret models to read and write decimals through hundredths.
EXT: Change fractions to decimals for tenths and hundredths and do the reverse.
- NCT 13 Relate “tenths as fractions” to “tenths as decimals” (i.e., $1/10 = 0.1$).
- NCT 14 Compare and order decimals through tenths.

OPERATIONS

THIRD GRADE

Students will model, develop, explain, and analyze procedures for computations and strategies for estimation. They will learn to make informed decisions when faced with a problem situation: must it be an exact answer or will an approximation do? Shall I mentally compute, use paper and pencil, or use a calculator?

OBJECTIVES

- OPR 1 (3.8) Estimate and add three-digit numbers to solve problems, with and without regrouping, including money amounts; extend the process to four-digit numbers. Check addition by using subtraction.
- OPR 2 (3.8) Estimate and add three or more addends (one and two-digit numbers).
- OPR 3 (3.8) Estimate and subtract three-digit numbers to solve problems, with and without regrouping, including subtracting money amounts and subtracting across zeroes; extend the process to include four-digit numbers. Check subtraction by using addition.
- OPR 4 (3.9) Mentally compute the multiplication facts through the nines; identify related division facts.
- OPR 5 (3.10) Estimate and multiply one-digit numbers by two-digit numbers.
EXT: Multiply one-digit numbers by three-digit numbers.
- OPR 6 Model division situations with and without remainders.
- OPR 7 (3.9) Estimate and divide a one- or two-digit number (with and without a remainder) by a one-digit number using the multiplication facts.
- OPR 8 (3.11) Estimate, add, and subtract fractions with like denominators (halves, thirds, fourths, fifths, sixths, eighths, or tenths) using concrete materials and pictorial models.
EXT: Estimate, add, and subtract mixed numbers with like denominators.

OPR 9 Find fractional parts of a group of up to 30 objects.

OPR 10 (3.12) Estimate, add, and subtract decimals to tenths using concrete materials and paper/pencil.

DATA ANALYSIS / STATISTICS / PROBABILITY

THIRD GRADE

Students will solve problems in which there is a need to collect, organize, and display data; analyze, compare, and relate data; and represent mathematical situations to determine the probability of events.

OBJECTIVES

- DSP 1 (3.21) Collect and organize data from a variety of sources, including content from other disciplines; represent data with tally marks and on charts/tables, pictographs, line plots, and bar graphs. Each graph will include an appropriate title and key. Explain findings.
EXT: Use a data base to record, organize, and present information.
- DSP 2 (3.22) Interpret pictographs, charts/tables, line plots and bar graphs. Write a sentence analyzing the data.
EXT: Investigate line graphs as a way to represent certain kinds of data.
- DSP 3 (3.23) Investigate and describe the concept of probability as chance and list possible results of a given situation.
- DSP 4 Determine if an event is equally likely (50% chance of occurring) or not equally likely to occur; make predictions based on results of simple experiments about the outcome of an event; organize in charts.
EXT: Record probability of an outcome as a ratio.

GEOMETRY

THIRD GRADE

Students will identify, classify, describe, draw, and transform geometric shapes and solve problems by using geometric models and applying properties. They will recognize and appreciate geometry as a way to describe the world.

OBJECTIVES

- GEO 1 (3.19) Identify and draw representations of points, lines, line segments, angles, horizontal lines, and vertical lines using the appropriate tools; recognize right angles.
EXT: Recognize and describe angles greater than 90 degrees as obtuse angles and angles less than 90 degrees as acute angles.
- GEO 2 (3.20) Identify and describe lines of symmetry.
EXT: Make a book illustrating symmetry using real-world contexts.
- GEO 3 (3.18) Identify a figure as open or closed; identify plane figures as polygons or nonpolygons; identify circles, triangles, rectangles, squares, and other polygons.
EXT: Investigate and classify quadrilaterals; explain the classification criteria.
- GEO 4 (3.20) Explore and identify congruent figures by manipulating shapes.
- GEO 5 Investigate moving figures using slides and/or flips.
EXT: Investigate moving figures by rotating.
- GEO 6 (3.18) Recognize, sort, and compare solid shapes and explore number and shape of faces, edges, and vertices (corners) of cubes, rectangular prisms, square pyramids, spheres, cones, and cylinders.
- GEO 7 Investigate the use of a grid (axis from 0-5) and ordered pairs to locate points.
EXT: Play the game "Battleship" and similar computer games.

MEASUREMENT

THIRD GRADE

Students will extend their understanding of the measurement process by selecting and using appropriate tools and units to estimate, measure, and compare measures including length, area, volume, capacity, weight, and time. Customary and metric units will be used.

OBJECTIVES

- MEA 1 (3.14) Estimate, measure, and compare (using $>$ or $<$) lengths to the nearest half-inch and centimeter. Select appropriate unit of measure. Know that 12 inches = 1 foot, 3 feet = 1 yard, 36 inches = 1 yard, and 100 centimeters = 1 meter.
EXT: Estimate, measure, and compare lengths to the nearest quarter inch.
- MEA 2 Find perimeter and area in problem-solving settings.
- MEA 3 Estimate and find the volume of rectangular solids using concrete materials.
- MEA 4 (3.14) Use a balance to measure weight in ounces, pounds, grams, and kilograms. Select appropriate unit of measure. Know that 16 ounces = 1 pound and 1000 grams = 1 kilogram.
- MEA 5 (3.14) Measure capacity in nonstandard units; estimate and measure capacity in cups, pints, quarts, gallons, and liters. Select appropriate unit of measure. Know that 2 cups = 1 pint, 2 pints = 1 quart, 4 quarts = 1 gallon.
EXT: Estimate and measure capacity in milliliters. Know that 1000 milliliters = 1 liter.
- MEA 6 (3.17) Read Fahrenheit and Celsius temperature on a thermometer.
- MEA 7 (3.13) Count, read, write, compare and find equivalent amounts of money to \$10.00. Make change for amounts to \$5.00.
EXT: Explore foreign currencies (e.g., money from China, Greece, or Egypt).

- MEA 8 (3.15) Read time to the nearest five minutes using both digital and analog clocks. Extend reading time to the nearest minute.
EXT: Subtract or count on in minutes to determine time intervals within an hour.
- MEA 9 (3.16) Know time equivalencies such as month/year, day/week, minute/hour, and hour/day.
- MEA 10 Develop strategies for estimating large quantities of objects.

PATTERNS / FUNCTIONS / ALGEBRA

THIRD GRADE

Students will solve problems in which there is a need to recognize AND extend or generate and design a pattern. They will investigate the concept of variable, expression, equation and coordinates.

OBJECTIVES

- PFA 1 (3.24) Recognize, describe, predict, extend, and create patterns of objects, pictures, charts of numbers, and simple number patterns.
EXT: Locate patterns in Native American and African art. Create a similar pattern.
- PFA 2 (3.25) Write simple equalities by finding missing addends and factors. Demonstrate an understanding of equality by recognizing that the equal (=) sign links equivalent quantities such as $4 \times 3 = 2 \times 6$.
- PFA 3 Multiply by multiples of ten (6×10 , 6×20) using patterns.
EXT: Use a calculator to investigate number patterns by multiplying by 100 and multiples of 100 (6×100 , $6 \times 200 \dots$); extend to 1000 and multiples of 1000 (6×1000 , $6 \times 2000 \dots$).
- PFA 4 Find the function rule (pattern) that completes a chart of factors or products.
- PFA 5 (3.25) Recognize, explain, and use the properties of addition including associative, commutative, and zero.
- PFA 6 (3.25) Recognize, explain, and use the properties of multiplication including commutative, zero, and one.

Program of Studies for Mathematics, Grade 4

4.1 Solve problems involving numerical relationships.

4.1.1 Students explain and apply properties of whole numbers.

- 4.1.1.1 Read, write, compare, and order numbers to millions. (SOL 4.1)
- 4.1.1.2 Recognize and use commutative (order) and associative (grouping) properties. (SOL 4.22)
- 4.1.1.3 Explain rounding and derive a rule for rounding whole numbers. Use the rule to round up to hundred thousands. (SOL 4.1, 4.4)

Extensions

- 4.1.1.4 Find different names based on place value for the same number.

4.1.2 Students explain and apply properties of fractions and decimals.

- 4.1.2.1 Estimate and identify fractional parts of figures or groups. (SOL 4.2)
- 4.1.2.2 Read, write, and compare fractions and mixed numbers. Order fractions with denominators of twelve or less using concrete material or pictures. (SOL 4.2, 4.3)
- 4.1.2.3 Explain rounding and derive a rule for rounding fractions and decimals. Use the rule to round decimals up to hundredths. (SOL 4.4)
- 4.1.2.4 Find equivalent fractions using models, paper folding, or graphics. (SOL 4.2)
- 4.1.2.5 Read, write, represent, compare and order decimals through thousandths, using symbols, concrete materials, and drawings.
- 4.1.2.6 Demonstrate that decimals and fractions are names for the same number. (SOL 4.2)

Extensions

- 4.1.2.7 Order fractions and mixed numbers.

4.1.2.8 Change mixed numbers to fractions greater than one by drawing representative models.

4.1.3 Students use problem solving approaches to understand concepts and skills. Students pose problems; students solve routine, non-routine and multi-step problems.

4.1.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.

4.1.3.2 Solve problems using a logical procedure (a plan).

4.1.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.

4.1.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.

4.1.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).

4.1.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.

4.1.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.

4.1.3.8 Share and explain (verbalize/record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.

4.1.3.9 Investigate alternative ways of solving a problem.

4.1.3.10 Use place value and numerical relationships including estimation strategies (rounding, front end, compatible numbers, or using a referent) in problem-solving settings. Refine estimates using terms such as closer to, between, and a little more than. (SOL 4.5)

Extensions

4.1.3.11 Compare and analyze solution paths (process used to solve a problem).

4.2 Solve problems involving operations with real numbers.

4.2.1 Students explain and analyze strategies for estimation.

- 4.2.1.1 Estimate the sum or difference of four-digit numbers to solve problems including money amounts and zeroes. (SOL 4.6)
- 4.2.1.2 Estimate products of one-digit numbers by two- and three-digit numbers. (SOL 4.7)
- 4.2.1.3 Estimate products of two-digit numbers and three-digit numbers by recognizing patterns from two-digit numbers by two-digit number models. (SOL 4.7)
- 4.2.1.4 Estimate quotients by using compatible numbers. (SOL 4.8)
- 4.2.1.5 Estimate the sum and difference of fractions with like denominators of twelve or less. (SOL 4.9)
- 4.2.1.6 Estimate the sum and difference of mixed numbers with like denominators. (SOL 4.9)
- 4.2.1.7 Estimate the sum and difference of decimals to thousandths by using models, pictorial representations, and paper and pencil. (SOL 4.9)
- 4.2.1.8 Estimate products of two-digit decimal numbers by one-digit whole numbers, referring to money.

Extensions

- 4.2.1.9 Estimate quotients. Divide by multiples of ten.

4.2.2 Students model, develop, explain, and analyze procedures for computation.

- 4.2.2.1 Add and subtract four-digit numbers to solve problems including subtracting money amounts and subtracting across zeroes. (SOL 4.6)
- 4.2.2.2 Review multiplication facts, identifying the difficult ones not known yet. Develop strategies and learn the remaining multiplication facts.
- 4.2.2.3 Recognize factors and products in multiplication sentences and explain their relationship and the relationship between multiplication and division.

- 4.2.2.4 Multiply one-digit numbers by two- and three-digit numbers and mentally by multiples of 10. (SOL 4.7)
- 4.2.2.5 Illustrate multiplication of two-digit numbers by two-digit numbers using models. Multiply two-digit by two-digit numbers. Recognize the regrouping pattern continues to three-digit numbers times two-digit numbers, finding the answers by using calculators. (SOL 4.7)
- 4.2.2.6 Demonstrate division with and without remainders, using concrete materials in a problem solving setting. Decide the significance of any remainders.
- 4.2.2.7 Illustrate division of two-digit and three-digit numbers by one-digit divisors using models. Find the quotient. (SOL 4.8)
- 4.2.2.8 Add and subtract fractions with like and unlike denominators of twelve or less. (SOL 4.9)
- 4.2.2.9 Add and subtract mixed numbers with like denominators. (SOL 4.9)
- 4.2.2.10 Add and subtract decimals to thousandths by using models, pictorial representations, and paper and pencil. (SOL 4.9)
- 4.2.2.11 Multiply two-digit decimal numbers by one-digit whole numbers, referring to money.

Extensions

- 4.2.2.12 Add and subtract larger numbers.
- 4.2.2.13 Add and subtract mixed numbers with unlike denominators using models.

4.2.3 Students use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 4.2.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 4.2.3.2 Solve problems using a logical procedure (a plan).

- 4.2.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 4.2.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 4.2.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 4.2.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 4.2.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 4.2.3.8 Share and explain (verbalize/record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 4.2.3.9 Investigate alternative ways of solving a problem.
- 4.2.3.10 Use addition, subtraction, multiplication, and division involving whole numbers, fractions, and decimals to solve real-life problems.

Extensions

- 4.2.3.11 Compare and analyze solution paths (process used to solve a problem).

4.3 Solve problems involving measurement.

4.3.1 Students extend their understanding of the measurement process for customary and metric units.

- 4.3.1.1 Select and use appropriate tools to estimate, measure, and compare measurements.
- 4.3.1.2 Estimate and measure to the nearest eighth inch and nearest millimeter. (SOL 4.11)
- 4.3.1.3 Identify equivalent measures within a system.
- 4.3.1.4 Estimate conversion between U.S. Customary and metric measures. (SOL 4.10, 4.11, 4.12)

- 4.3.1.5 Determine the volume of a rectangular prism by counting the number of cubes contained in it.
- 4.3.1.6 Classify angles as less than, equal to, or greater than a right angle.
- 4.3.1.7 Measure weight using ounces, pounds, grams, and kilograms. (SOL 4.10)
- 4.3.1.8 Measure capacity using cups, pints, quarts, gallons, milliliters, and liters. (SOL 4.12)
- 4.3.1.9 Measure temperature in degrees Fahrenheit or degrees Celsius.
- 4.3.1.10 Count coins and bills up to \$20.00. Make change by counting on.
- 4.3.1.11 Read analog and digital clocks; read and write calendar dates.

Extensions

- 4.3.1.12 Investigate contexts in which volume is measured using a variety of boxes and materials.
- 4.3.1.13 Use amounts greater than \$20.00.
- 4.3.1.14 Determine elapsed time in hours and minutes. Determine elapsed time in days, weeks, and months.

4.3.2 Students develop and apply procedures to solve measurement problems.

- 4.3.2.1 Find the perimeter of a polygon by measuring the distance around its edge. (SOL 4.13)
- 4.3.2.2 Find the area of regular and irregular polygons by covering and counting squares. (SOL 4.13)
- 4.3.2.3 Identify and describe situations representing the use of perimeter and area. (SOL 4.13)

Extensions

- 4.3.2.4 Investigate perimeter of pentominoes; explain the findings.
- 4.3.2.5 Find the area of the faces of cubes and rectangular prisms; combine to find surface area.

4.3.3 Students use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 4.3.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 4.3.3.2 Solve problems using a logical procedure (a plan).
- 4.3.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 4.3.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 4.3.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 4.3.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 4.3.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 4.3.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 4.3.3.9 Investigate alternative ways of solving a problem.
- 4.3.3.10 Use the measurement process in problem-solving settings.

Extensions

- 4.3.3.11 Compare and analyze solution paths (process used to solve a problem).

4.4 Solve problems involving geometric figures.

4.4.1 Students identify, classify, describe, draw, and transform geometric shapes.

- 4.4.1.1 Identify, define, and draw points, lines, line segments, rays, angles, parallel lines, perpendicular lines, and intersecting lines. (SOL 4.14, 4.15, 4.16)
- 4.4.1.2 Identify the shortest distance between two points on a plane as being a line segment. (SOL 4.15)
- 4.4.1.3 Draw lines of symmetry in plane shapes and pictures.
- 4.4.1.4 Identify and sort geometric shapes including triangles, quadrilaterals, pentagons, hexagons, octagons, and circles. (SOL 4.17)
- 4.4.1.5 Recognize congruent shapes including triangles. (SOL 4.17)
- 4.4.1.6 Analyze and compare the properties of three-dimensional solids (spheres, cubes, rectangular prisms). (SOL 4.17)
- 4.4.1.7 Investigate moving figures using slides (translations), flips (reflections), and turns (rotations). (SOL 4.17)
- 4.4.1.8 Locate points in the first quadrant of a coordinate plane using ordered pairs; name the coordinates of a given point. (SOL 4.18)

Extensions

- 4.4.1.9 Make models of cubes and rectangular prisms.
- 4.4.1.10 Build tessellations with congruent shapes using slides, flips, and turns.
- 4.4.1.11 Create a design on grid paper and list the coordinate pairs in the order necessary to reproduce it.

4.4.2 Students use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 4.4.2.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 4.4.2.2 Solve problems using a logical procedure (a plan).
- 4.4.2.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 4.4.2.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 4.4.2.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 4.4.2.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 4.4.2.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 4.4.2.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 4.4.2.9 Investigate alternative ways of solving a problem.
- 4.4.2.10 Solve problems by using geometric models (manipulatives, pictorial representations, real-world examples) and applying properties.

Extensions

- 4.4.2.11 Compare and analyze solution paths (process used to solve a problem).

4.5 Solve problems involving data analysis, statistics and probability.

4.5.1 Students collect, organize, display, compare, and analyze data.

- 4.5.1.1 Collect, organize, and display data on line graphs, line plots, bar graphs, and pictographs with scale increments of one or more than one. (SOL 4.20)
- 4.5.1.2 Interpret the results and make predictions based on those results. (SOL 4.20)
- 4.5.1.3 Explain the concept of average using concrete models.
- 4.5.1.4 Recognize that the mean, median, mode and range are different ways to describe the same data.
- 4.5.1.5 Read and interpret circle graphs.

Extensions

- 4.5.1.6 Find and record averages.
- 4.5.1.7 Compare circle graphs to data organized in other ways.

4.5.2 Students represent mathematical situations to determine the probability of events.

- 4.5.2.1 Discuss probability including trials and outcomes (certain, impossible, likely, “equally likely” and “unlikely”). (SOL 4.19)
- 4.5.2.2 Estimate probability and write as ratios. (SOL 4.19)
- 4.5.2.3 Show possible outcomes for single events by making tree diagrams. Determine probability using tree diagrams.

Extensions

- 4.5.2.4 Create problems that can be represented by tree diagrams.

4.5.3 Students use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 4.5.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 4.5.3.2 Solve problems using a logical procedure (a plan).
- 4.5.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 4.5.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 4.5.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 4.5.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 4.5.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 4.5.3.8 Share and explain (verbalize/record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 4.5.3.9 Investigate alternative ways of solving a problem.
- 4.5.3.10 Solve problems by collecting and displaying data; interpret the results and make predictions based on those results.

Extensions

- 4.5.3.11 Compare and analyze solution paths (process used to solve a problem).

4.6 Solve problems involving patterns, functions, and algebra.

4.6.1 Students solve problems by recognizing, extending, and designing patterns.

- 4.6.1.1 Recognize, create, and extend numerical and geometric patterns using concrete materials, number line, symbols, tables, and words. (SOL 4.21)
- 4.6.1.2 Multiply and divide by ten using patterns. (SOL 4.21)
- 4.6.1.3 Investigate patterns of multiples in a multiplication table. (SOL 4.21)

Extensions

- 4.6.1.4 Find other patterns on a multiplication table, describing and explaining them in written form.

4.6.2 Students investigate the concept of variable expression, equation, and functions.

- 4.6.2.1 Identify and find the missing addends and/or missing factors in equations.
- 4.6.2.2 Find the value of a function using positive integers as “input” (e.g., find the value (n) of the function $n=x + 4$ by substituting positive integers for x). (SOL 4.21)

Extensions

- 4.6.2.3 Write a number sentence with one unknown to solve a problem (i.e., $4 + x = 9$).

4.6.3 Students use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 4.6.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 4.6.3.2 Solve problems using a logical procedure (a plan).

- 4.6.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 4.6.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 4.6.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 4.6.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 4.6.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 4.6.3.8 Share and explain (verbalize/record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 4.6.3.9 Investigate alternative ways of solving a problem.
- 4.6.3.10 Identify and use patterns or functions to solve real-life problems.

Extensions

- 4.6.3.11 Compare and analyze solution paths (process used to solve a problem).

Program of Studies for Mathematics, Grade 5 Standards, Benchmarks, and Indicators

5.1 Solve problems involving numerical relationships.

5.1.1 Students explain and apply properties of whole numbers.

- 5.1.1.1 Read, write, compare, and order numbers to billions.
- 5.1.1.2 Explain the relationship (including the use of exponential notation) among place values of numbers up to one billion.
- 5.1.1.3 Explain/show the use of the distributive property to multiply a one-digit number by a two- or three-digit number.
- 5.1.1.4 Explain rounding and derive a rule for rounding whole numbers.
- 5.1.1.5 Choose an appropriate estimation strategy (compatible numbers, rounding, front end, clustering, or using a referent) to fit a given situation. (SOL 5.3)
- 5.1.1.6 Identify and find multiples, common multiples, composite, and prime numbers. Find the Greatest Common Factor (GCF) and the Least Common Multiple (LCM). Use the rules of divisibility for 2, 3, 5, and 10. (SOL 6.3)

Extensions

- 5.1.1.7 Investigate, develop, and use the rules of divisibility for the numbers 4, 6, 8, and 9.

5.1.2 Students explain and apply properties of fraction, decimals, and percents.

- 5.1.2.1 Estimate, analyze, and find equivalent fractions. (SOL 5.2)
- 5.1.2.2 Compare and order fractions, whole numbers, and mixed numbers. (SOL 5.2)
- 5.1.2.3 Analyze and rename mixed numbers to fractions greater than one and do the reverse.
- 5.1.2.4 Read, write, compare, order, and round decimals through the thousandths place. (SOL 5.1)

5.1.2.5 Understand the relationship between fractions and decimals and convert one to the other through hundredths. (SOL 5.1)

5.1.2.6 Investigate positive rational numbers including decimals, ratios, fractions, and percents.

Extensions

5.1.2.7 Convert one rational number to the other, including decimals, ratios, fractions, and percents.

5.1.3 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

5.1.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.

5.1.3.2 Solve problems using logical procedure (a plan).

5.1.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.

5.1.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.

5.1.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software)

5.1.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.

5.1.3.7 Solve problems by working collaboratively with peers; entertain others point of view.

5.1.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.

5.1.3.9 Investigate alternative ways of solving a problem.

- 5.1.3.10 Use properties of whole numbers, fractions, and decimals to solve real life problems.

Extensions

- 5.1.3.11 Investigate the use of spreadsheets to organize data.

5.2 Solve problems involving operations with real numbers.

5.2.1 Students explain and analyze strategies for estimation.

- 5.2.1.1 Estimate products of whole numbers with two digits in one factor and three digits in the other. (SOL 5.3)
- 5.2.1.2 Find an estimated quotient using multiplication and place value to solve problems with two-digit divisors. (SOL 5.5)
- 5.2.1.3 Estimate products of fractions by whole numbers and fractions by fractions. (SOL 6.6a)
- 5.2.1.4 Estimate sums and differences of decimal numbers through thousandths. (SOL 5.4)
- 5.2.1.5 Estimate products of two numbers expressed as decimals through thousandths. (SOL 5.4)
- 5.2.1.6 Estimate result of a decimal (tenths, hundredths, and thousandths) multiplied by 10 and 100.
- 5.2.1.7 Estimate quotients for a decimal through thousandths by a whole number less than ten. (SOL 5.6)

5.2.2 Students model, develop, explain, and analyze procedures for computation with rational numbers.

- 5.2.2.1 Add and subtract any whole numbers. (SOL 5.3)
- 5.2.2.2 Multiply whole numbers with two digits in one factor and three digits in the other. Recognize the use of properties. (SOL 5.3)
- 5.2.2.3 Divide by one- or two-digit divisors. Recognize alternative ways to express remainders. (SOL 5.5)

- 5.2.2.4 Add and subtract fractions and mixed numbers with same and different denominators of 12 or less. Express answers in simplest form. (SOL 5.7)
- 5.2.2.5 Explore the concept of multiplication of fractions and whole numbers by a fraction.
- 5.2.2.6 Add and subtract decimal numbers through thousandths. (SOL 5.4)
- 5.2.2.7 Multiply two numbers expressed as decimals through thousandths. (SOL 5.4)
- 5.2.2.8 Mentally multiply a decimal (tenths, hundredths, and thousandths) by 10 and 100. (SOL 5.4)
- 5.2.2.9 Divide a decimal through thousandths by a whole number less than ten. (SOL 5.6)

Extensions

- 5.2.2.10 Find unit prices and determine best buys by using estimation and division.
- 5.2.2.11 Demonstrate with physical materials and record division of whole numbers and fractions by fractions. (SOL 6.6a)
- 5.2.2.12 Mentally divide a decimal number by 10 and 100.
- 5.2.2.13 Investigate and interpret remainders in problem-solving settings.

5.2.3 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 5.2.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 5.2.3.2 Solve problems using logical procedure (a plan).
- 5.2.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.

- 5.2.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 5.2.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 5.2.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 5.2.3.7 Solve problems by working collaboratively with peers; entertain others point of view.
- 5.2.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 5.2.3.9 Investigate alternative ways of solving a problem.
- 5.2.3.10 Use addition, subtraction, multiplication and division involving whole numbers, fractions, and decimals to solve real life problems. (SOL 6.7, 6.8)
- 5.2.3.11 Generalize solutions and strategies to new problem situations including problems without numbers.

5.3 Solve problems involving measurement.

5.3.1 Students extend their understanding of the measurement process for customary and metric units..

- 5.3.1.1 Select and use appropriate tools and units to estimate, measure, and compare measures. (SOL 5.11)
- 5.3.1.2 Estimate and measure to the nearest eighth of an inch and to the nearest millimeter. (SOL 5.11a)
- 5.3.1.3 Estimate and measure mass (ounces, pounds, tons, grams, and kilograms) and capacity (cups, pint, quarts, gallons, liters, milliliters, and cubic centimeters) (SOL 5.11b,5.11c)
- 5.3.1.4 Estimate and measure temperature in degrees Fahrenheit and Celsius. (SOL 5.11e)
- 5.3.1.5 Solve problems involving elapsed time in hours, minutes, and seconds. (SOL 5.12)

5.3.2 Students develop and apply procedures and formulas to solve measurement problems.

- 5.3.2.1 Develop strategies for finding and estimating the perimeter and area of a square, rectangle, and right triangle. (SOL 5.8)
- 5.3.2.2 Investigate the relationship of diameter to circumference and to radius. (SOL 5.9)
- 5.3.2.3 Develop the formula for finding the volume of rectangular prisms. Determine whether a given situation requires finding area, perimeter, or volume. (SOL 5.10)
- 5.3.2.4 Measure and draw right, acute, obtuse angles and triangles using appropriate tools. (SOL 5.13)

Extensions

- 5.3.2.5 Develop formulas for perimeter and area.
- 5.3.2.6 Use $c = \pi \times d$ to find circumference.
- 5.3.2.7 Find the volume of irregular solids made of cubes (i.e., staircase).

5.3.3 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

- 5.3.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
- 5.3.3.2 Solve problems using logical procedure (a plan)
- 5.3.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 5.3.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 5.3.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).

- 5.3.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 5.3.3.7 Solve problems by working collaboratively with peers; entertain others point of view.
- 5.3.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 5.3.3.9 Investigate alternative ways of solving a problem.
- 5.3.3.10 Use measurement procedures to solve real life problems.

5.4 Solve problems involving geometric figures.

5.4.1 Students identify, classify, describe, draw, transform geometric shapes and solve problems by using geometrics models and applying properties.

- 5.4.1.1 Identify slides (translations), flips (reflections), and turns (rotations). (SOL 5.15e)
- 5.4.1.2 Build tessellations with congruent shapes using slides, flips, and turns. (SOL 5.15e)
- 5.4.1.3 Classify and illustrate acute, right, or obtuse angles. (SOL 5.14)
- 5.4.1.4 Classify and illustrate triangles by angles and/or sides. (SOL 5.14)
- 5.4.1.5 Draw congruent polygons. (SOL 5.15b)
- 5.4.1.6 Draw similar figures by using scale. (SOL 5.15b)
- 5.4.1.7 Investigate and describe the results of combining and subdividing shapes. (SOL 5.15c)
- 5.4.1.8 Describe, draw, and label points, lines, line segments, rays, angles, perpendicular lines, parallel lines, and lines of symmetry. (SOL 5.15d)
- 5.4.1.9 Recognize, identify, describe, and analyze the properties of plane figures (square, rectangle, triangle, parallelogram, rhombus, kite, and trapezoid). (SOL 5.15a)
- 5.4.1.10 Classify solids and identify the number of faces, edges, and vertices. (SOL 5.16)

5.4.1.11 Identify parts of a circle including diameter, radius, circumference, arcs, chords, and center. (SOL 5.9)

Extensions

5.4.1.12 Investigate and explain the relationship between faces, edges, and vertices of polyhedrons (e.g., prisms, pyramids, and cylinders).

5.4.1.13 Locate and name points using coordinates and a grid.

5.4.1.14 Enlarge and/or reduce an image using ratios and grids.

5.4.2 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

5.4.2.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.

5.4.2.2 Solve problems using logical procedure (a plan).

5.4.2.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.

5.4.2.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.

5.4.2.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software)

5.4.2.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.

5.4.2.7 Solve problems by working collaboratively with peers; entertain others point of view.

5.4.2.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.

5.4.2.9 Investigate alternative ways of solving a problem.

5.4.2.10 Use geometric properties to solve real life problems.

5.5 Collect, organize, describe, analyze data and determine probability.

5.5.1 Students collect, organize, display, compare, and analyze data.

5.5.1.1 Conduct surveys and analyze the data to make predictions. (SOL 5.18)

5.5.1.2 Read, collect, and interpret the data. (SOL 5.18)

5.5.1.3 Display data by making bar graphs, multi-bar graphs, stem-and-leaf plots, line plots, and line graphs. Data can be presented using graphing technologies. (SOL 5.18)

5.5.1.4 Solve real life problems by applying the skills of data gathering, graphing, and computation. (SOL 5.18)

5.5.1.5 Explain the concept of average; find the mean, median, mode, and range of set of data. (SOL 5.19)

5.5.2 Students represent mathematical situations to determine the probability of events.

5.5.2.1 Predict the probability of outcomes of simple experiments. (SOL 5.17b)

5.5.2.2 Conduct experiments to verify the predicted probabilities. (SOL 5.17b)

5.5.2.3 Determine the probability of multiple outcomes within a single event by constructing a sample representation of all possible results. (i.e., tree diagram) (SOL 5.17a)

5.5.2.4 Create a problem statement involving probability and based on information from a given problem situation. (SOL 5.17c)

5.5.3 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.

5.5.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical

reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.

- 5.5.3.2 Solve problems using logical procedure (a plan).
- 5.5.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
- 5.5.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
- 5.5.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
- 5.5.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
- 5.5.3.7 Solve problems by working collaboratively with peers; entertain others point of view.
- 5.5.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.
- 5.5.3.9 Investigate alternative ways of solving a problem.
- 5.5.3.10 Use probability of events to solve real life problems.

5.6 Solve problems involving patterns, functions, and algebra.

5.6.1 Students solve problems by recognizing, extending, and designing patterns.

- 5.6.1.1 Represent growth patterns by using variables and expressions. (SOL 5.21)
- 5.6.1.2 Analyze the structure of numerical and geometric patterns. (SOL 5.20)
- 5.6.1.3 Express the relationships of numerical and geometric patterns using words, tables, graphs, or mathematical sentences. Complete a chart showing input and output when given a function rule. (SOL 5.20)

5.6.2 Students investigate the concept of variable, expression, equation, and functions.

- 5.6.2.1 Investigate and describe the concept of a variable. (SOL 5.21a)
 - 5.6.2.2 Write an open sentence to represent a given mathematical relationship, using a variable. (SOL 5.21c)
 - 5.6.2.3 Write a variable expression that represents a verbal quantitative expression for one operation. (SOL 5.21b)
 - 5.6.2.4 Create a problem situation based on a given open sentence using a single variable. (SOL 5.22)
 - 5.6.2.5 Solve simple equations for missing addends or missing factors. (SOL 5.21b)
- 5.6.3 Students will use problem solving approaches to understand concepts and skills. Students pose problems; solve routine, non-routine and multi-step problems.**
- 5.6.3.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward) to solve a wide variety of routine and non-routine problems.
 - 5.6.3.2 Solve problems using logical procedure (a plan).
 - 5.6.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.
 - 5.6.3.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.
 - 5.6.3.5 Simplify and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).
 - 5.6.3.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.
 - 5.6.3.7 Solve problems by working collaboratively with peers; entertain others point of view.
 - 5.6.3.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results with respect to the original problem situation to determine if answers are reasonable.

- 5.6.3.9 Investigate alternative ways of solving a problem.
- 5.6.3.10 Use patterns and functions to solve real life problems.

Program of Studies for Mathematics, Grade 6

6.1 Solve problems involving numerical relationships.

6.1.1 Students explain and apply properties of real numbers (whole numbers, integers, fractions, decimals, and percents).

- 6.1.1.1 Read, write, round, compare, and order any whole or decimal number. Read and write numbers in scientific notation. (SOL 6.4, 6.5, PB 1)
- 6.1.1.2 Investigate the concept of square numbers, square roots, and exponents. Find the square of a given number. (SOL 6.22)
- 6.1.1.3 Write powers of ten as products of tens and in exponential form. (SOL 6.22)
- 6.1.1.4 Identify, model, compare, order, and round fractions and mixed numbers. Recognize equivalent representations of fractions and mixed numbers. (SOL 6.1, 6.4)
- 6.1.1.5 Find factors, multiples, primes, composite numbers, and prime factorization using a variety of methods including factor trees. (SOL 6.3)
- 6.1.1.6 Express numbers as fractions, decimals, ratios, and percents, and recognize the equivalent relationships; convert from one form to another. (SOL 6.1, 6.2, PB 2)
- 6.1.1.7 Estimate percent in problem-solving situations. Set up proportions and solve for an unknown. (SOL 6.7)
- 6.1.1.8 Distinguish between terminating and repeating decimals and write repeating decimals using the appropriate notation. (SOL 6.1)
- 6.1.1.9 Identify, represent, order, and compare integers. (SOL 6.5, PB 3)

Extensions

- 6.1.1.10 Develop techniques for estimating square roots.
- 6.1.1.11 Investigate the binary number system.
- 6.1.1.12 Write prime factorizations in exponential form.
- 6.1.1.13 Make predictions and solve problems using equivalent ratios.

6.1.1.14 Investigate absolute values.

6.1.2 Students use problem solving approaches to understand concepts and skills involving numerical relationships. Students pose problems; solve routine, non-routine and multi-step problems.

6.1.2.1 Develop and apply operations and strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of routine and non-routine problems.

6.1.2.2 Solve problems using logical procedure (a plan).

6.1.2.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs.

6.1.2.4 Identify and/or pose problems from everyday life and mathematical situations including problems to fit a given equation.

6.1.2.5 Simply and/or solve a problem using appropriate materials and tools (e.g., calculator, grid paper, collectibles, manipulatives, computer software).

6.1.2.6 Identify information that is available but not needed. Identify additional information needed to solve a problem.

6.1.2.7 Solve problems by working collaboratively with peers; entertain others' point of view.

6.1.2.8 Share and explain (verbalize/ record) thinking during and after solving a problem. Verify and interpret results of the original problem situation to determine if answers are reasonable.

6.1.2.9 Investigate alternative ways of solving a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.

6.1.2.10 Use properties of real numbers to solve real life problems.

6.2 Solve problems involving operations with real numbers (whole numbers, integers, fractions, decimals, and percents).

6.2.1 Students explain and analyze strategies for estimation.

- 6.2.1.1 Estimate sums and differences of whole numbers, integers, decimal numbers, fractions, and mixed numbers. (SOL 6.6a, PB 4)
- 6.2.1.2 Estimate products of whole numbers with three digits in each factor, decimal numbers to thousandths, fractions, and mixed numbers. (SOL 6.6a, PB 4)
- 6.2.1.3 Estimate quotients of whole numbers (including those with zero in the quotient) and decimal numbers through thousandths by divisors through thousandths (with no more than one non-zero digit). (SOL 6.6b)
- 6.2.1.4 Estimate quotients of whole numbers, fractions, and mixed numbers by whole numbers, fractions, and mixed numbers. (SOL 6.6b)
- 6.2.1.5 Estimate what percent one number is of another.

6.2.2 Students model, develop, explain, and analyze procedures for computation.

- 6.2.2.1 Add and subtract whole numbers, integers, decimal numbers, fractions, and mixed numbers to solve problems. Fractions and mixed numerals may have like or unlike denominators of 12 or less. (SOL 6.5, 6.6a, PB 4, PB 6)
- 6.2.2.2 Multiply whole numbers with three digits in each factor, decimal numbers to thousandths, fractions, and mixed numbers. (SOL 6.6a, PB 4)
- 6.2.2.3 Divide whole numbers (including those with zero in the quotient) and decimal numbers through thousandths by divisors through thousandths (with no more than one non-zero digit), writing remainders as fractions or decimals. Divide numbers with up to four digits by numbers with up to two digits. (SOL 6.6b, PB 5)
- 6.2.2.4 Multiply and divide by powers of ten. (SOL 6.21, PB 10)
- 6.2.2.5 Divide whole numbers, fractions, and mixed numbers by whole numbers, fractions, and mixed numbers. (SOL 6.6b)
- 6.2.2.6 Find the percent of a number using models.

- 6.2.2.7 Find what percent one number is of another.
- 6.2.2.8 Use order of operations and properties to solve problems. (SOL 6.7)

Extensions

- 6.2.2.9 Determine truth in statistics or advertising and adjust the misleading information.
- 6.2.2.10 Find the original price when given the sale price and percent of discount.
- 6.2.2.11 Write inverse equations to solve addition and subtraction of integers.

6.2.3 Students use problem-solving approaches to understand concepts and skills involving operations with real numbers. Students pose problems; solve routine, non-routine, and multi-step problems.

- 6.2.3.1 Develop and apply strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of non-routine and multi-step problems. (SOL 6.8)
- 6.2.3.2 Solve problems using a logical procedure. (SOL 6.8)
- 6.2.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs. (SOL 6.8)
- 6.2.3.4 Pose problems from everyday life situations. (SOL 6.8)
- 6.2.3.5 Select and use appropriate materials and tools needed to solve a problem.
- 6.2.3.6 Identify information that is available but is not needed to solve a problem.
- 6.2.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 6.2.3.8 Share, explain (verbalize/record), and justify (defend) reasoning during and after solving a problem. Verify and interpret results

with respect to the original problem situation. Compare and analyze solution paths (process used to solve problems.)

- 6.2.3.9 Investigate alternative ways of solving a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.
- 6.2.3.10 Use addition, subtraction, multiplication and division involving whole numbers, integers (+ and – only), fractions and decimals to solve real life problems. (SOL 6.7, 6.8)

6.3 Solve problems involving measurement.

6.3.1 Students extend their understanding of measurement for customary and metric units.

- 6.3.1.1 Select and use appropriate tools and units to estimate, measure, and compare measures including length, area, volume, capacity, weight, and time.
- 6.3.1.2 Estimate and determine length, weight/mass, area, and liquid volume/capacity, using standard and nonstandard units of measure. (SOL 6.10)
- 6.3.1.3 Estimate angle measures using 45, 90, and 180 degrees as referents. Identify, construct, name and measure angles. (SOL 6.13)
- 6.3.1.4 Derive approximations for pi from measurements for circumference and diameter, using concrete materials or computer models. (SOL 6.12b)
- 6.3.1.5 Determine and/or compare times in different time zones. Find elapsed time.

Extensions

- 6.3.1.6 Estimate lengths using indirect measurement.

6.3.2 Students develop and apply procedures and formulas to solve measurement problems.

- 6.3.2.1 Solve measurement problems by making and interpreting scale drawings; comparing and/or converting customary and metric units; and using tables of equivalents for length, capacity, and weight. (SOL 6.9)

- 6.3.2.2 Develop and apply formulas to find perimeter and area of rectangles, triangles, and parallelograms. (SOL 6.11, PB 7)
- 6.3.2.3 Determine if a problem situation involving polygons of three or four sides represents the application of perimeter or area. (SOL 6.11)
- 6.3.2.4 Develop and apply formulas to find circumference and area of a circle. (SOL 6.12a)
- 6.3.2.5 Find the sum of the angles for any triangle. (SOL 6.13, 6.14)
- 6.3.2.6 Investigate and develop procedures and formulas for volume of rectangular prisms, pyramids, cones, and cylinders. (SOL 6.10)

Extensions

- 6.3.2.7 Investigate the change in area and perimeter as the dimensions of a figure change; use a spreadsheet to record.
- 6.3.2.8 Develop strategies for finding the sum of the angles for any polygon. (SOL 7.22)
- 6.3.2.9 Explore how changing the dimensions (height and /or circumference) of a cylinder affects the volume. (SOL 7.9)

6.3.3 Students use problem-solving approaches to understand concepts and skills involving measurement. Students pose problems; solve routine, non-routine, and multi-step problems.

- 6.3.3.1 Develop and apply strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of routine and non-routine and multi-step problems. (SOL 6.8)
- 6.3.3.2 Solve problems using a logical procedure. (SOL 6.8)
- 6.3.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs. (SOL 6.8)
- 6.3.3.4 Pose problems from everyday life situations. (SOL 6.8)

- 6.3.3.5 Select and use appropriate materials and tools needed to solve a problem.
- 6.3.3.6 Identify information that is available but is not needed to solve a problem.
- 6.3.3.7 Solve problems by working collaboratively with peers; entertain others' points of view
- 6.3.3.8 Share, explain (verbalize/record), and justify (defend) reasoning during and after solving a problem. Verify and interpret results with respect to the original problem situation. Compare and analyze solution paths (process used to solve problems.)
- 6.3.3.9 Investigate alternative ways of solving a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.
- 6.3.3.10 Use addition, subtraction, multiplication and division involving measurement units to solve real life problems. (SOL 6.7, 6.8)

6.4 Solve problems involving geometric figures.

6.4.1 Students identify, classify, describe, draw, and transform geometric shapes and solve problems by using geometric models and applying properties.

- 6.4.1.1 Apply knowledge of basic geometric forms (e.g., lines, segments, angles, polygons, circles, and parts of circles) in problem solving and constructions.
- 6.4.1.2 Classify and define two-dimensional figures (e.g., concave/convex, number of sides, regular/irregular). (SOL 6.14)
- 6.4.1.3 Identify and draw congruent and similar figures. (SOL 6.15)
- 6.4.1.4 Measure and draw angles using a protractor, compass, and straight edge. Construct the perpendicular bisector of a line segment and the bisector of an angle using a straight edge and compass. (SOL 6.13, 6.16)
- 6.4.1.5 Identify, draw, and define slides (translations), flips (reflections), and turns (rotations) of polygons.
- 6.4.1.6 Compare, contrast, classify, define, and sketch three-dimensional figures (e.g., cones, prisms, pyramids, cylinders). Identify and verbalize the relationships among vertices, faces, and edges of

solids, including dotted lines to indicate unseen edges. Investigate surface area. (SOL 6.17)

6.4.1.7 Investigate the relationship between volume and surface area by building models of prisms. (SOL 6.17)

6.4.1.8 Determine possible nets for solid figures (e.g., pyramids, prisms, cylinders). (SOL 6.17)

Extensions

6.4.1.9 Investigate the Golden Ratio as applied to geometric figures.

6.4.1.10 Determine the angle of rotation of a polygon. (SOL 8.9)

6.4.1.11 Make two-dimensional drawings of three-dimensional solids, including dotted lines to indicate unseen edges.

6.4.1.12 Plan and design a product container (e.g., cereal box, perfume bottle). Construct a model, indicating the scale used and share with the class. (SOL 8.10)

6.4.1.13 Represent polygons and their transformations and dilations by graphing the coordinates of their respective vertices (up to and including all four quadrants of the Cartesian grid). (SOL 7.13, 7.15)

6.4.2 Students use problem-solving approaches to understand concepts and skills involving geometric figures. Students pose problems; solve routine, non-routine, and multi-step problems.

6.4.2.1 Develop and apply strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of non-routine and multi-step problems. (SOL 6.8)

6.4.2.2 Solve problems using a logical procedure. (SOL 6.8)

6.4.2.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs. (SOL 6.8)

6.4.2.4 Pose problems from everyday life situations. (SOL 6.8)

6.4.2.5 Select and use appropriate materials and tools needed to solve a problem.

- 6.4.2.6 Identify information that is available but is not needed to solve a problem.
- 6.4.2.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 6.4.2.8 Share, explain (verbalize/record), and justify (defend) reasoning during and after solving a problem. Verify and interpret results with respect to the original problem situation. Compare and analyze solution paths (process used to solve problems.)
- 6.4.2.9 Investigate alternate ways to solve a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.
- 6.4.2.10 Use addition, subtraction, multiplication and division involving whole numbers, fractions, and decimals to solve real life problems. (SOL 6.7, 6.8)

6.5 Collect, organize, describe, and analyze data, and determine probability.

6.5.1 Students collect, organize, display, compare, and analyze data.

- 6.5.1.1 Collect data and display it in an appropriate graphic representation (tables, charts, picto-, line, bar or circle graph; spreadsheets; or computer-generated graphs). (SOL 6.18)
- 6.5.1.2 Determine the mean, median, mode and range of a set of data and report the central tendency using the most appropriate measure. (SOL 6.19, PB 8)
- 6.5.1.3 Read, represent in an appropriate graphic representation, and interpret data using Venn diagrams, stem-and-leaf plots, box-and-whisker plots, and scatter plots. (SOL 6.18)
- 6.5.1.4 Collect data from a representative portion of a group using sampling and make predictions and/or recommendations about the larger group using that sample. (SOL 6.20b)
- 6.5.1.5 Analyze the data from surveys using percentages and circle graphs. (SOL 6.18)

Extensions

6.5.1.6 Find the mean, median, and mode from data given in a graph.

6.5.2 Students represent mathematical situations to determine the probability of events.

6.5.2.1 Determine the probability of single outcome (independent) events, recognizing that the probability of events which are certain is 1, impossible is 0, and all others lie between 0 and 1. (SOL 6.20b)

6.5.2.2 Determine all possible outcomes for single and multiple outcome events using a graphic representation (tree diagrams, organized lists, etc.); recognize that in some cases order is important and in some it is not. (SOL 6.20a)

6.5.2.3 Compare experimental probability with theoretical probability. Use simulations to determine probability, applying the concept of randomness.

Extensions

6.5.2.4 Explore and describe how the probability changes when each outcome is dependent upon previous outcomes.

6.5.3 Students use problem-solving approaches to understand concepts and skills involving data and probability. Students pose problems; solve routine, non-routine, and multi-step problems.

6.5.3.1 Develop and apply strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of non-routine and multi-step problems. (SOL 6.8)

6.5.3.2 Solve problems using a logical procedure. (SOL 6.8)

6.5.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs. (SOL 6.8)

6.5.3.4 Pose problems from everyday life situations. (SOL 6.8)

6.5.3.5 Select and use appropriate materials and tools needed to solve a problem.

- 6.5.3.6 Identify information that is available but is not needed to solve a problem.
- 6.5.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.
- 6.5.3.8 Share, explain (verbalize/record), and justify (defend) reasoning during and after solving a problem. Verify and interpret results with respect to the original problem situation. Compare and analyze solution paths (process used to solve problems).
- 6.5.3.9 Investigate alternative ways of solving a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.
- 6.5.3.10 Solve real life problems using sampling and simulations to determine possible outcomes.

6.6 Solve problems involving patterns, functions, and algebra.

6.6.1 Students solve problems in which there is a need to recognize and extend or generate and design a pattern.

- 6.6.1.1 Express positive and negative integers using the concept of opposites. (SOL 6.5)
- 6.6.1.2 Locate points in all four quadrants on a coordinate grid using ordered pairs of integers.
- 6.6.1.3 Express inequalities using the symbols for less than or equal to (\leq), greater than or equal to (\geq), or not equal to (\neq). Solve inequalities recognizing that more than one number can be used to solve an inequality. (SOL 6.4)
- 6.6.1.4 Represent number patterns using function table and exponents. (SOL 6.21, 6.22)
- 6.6.1.5 Explain the use of patterns to multiply and divide whole numbers with zeros. (SOL 6.21, PB 10)

Extensions

- 6.6.1.6 Extend and compare patterns of additive and multiplicative growth and ratio.
- 6.6.1.7 Represent numeric patterns using variable notation.

6.6.1.8 Plot points on a coordinate plane to represent a function (i.e., $y = x + 4$).

6.6.2 Students investigate the concept of variable, expression, equation, functions, coordinates, and integers.

6.6.2.1 Express functions using variable expressions such as $3x-5$. (SOL 6.23a)

6.6.2.2 Simplify and/or solve equations by applying the same operation to each side of an equation. (SOL 6.23a, PB 9)

6.6.3 Students use problem-solving approaches to understand concepts and skills involving patterns, functions, and algebra. Students pose problems; solve routine, non-routine, and multi-step problems.

6.6.3.1 Develop and apply strategies (e.g., act it out, build a model, draw a picture or diagram, guess and check, make a chart or table, make a list, make a graph, use a pattern, use logical reasoning, solve a simpler problem, work backward, use a formula) to solve a wide variety of non-routine and multi-step problems. (SOL 6.8)

6.6.3.2 Solve problems using a logical procedure. (SOL 6.8)

6.6.3.3 Solve problems and present data and conclusions in a variety of formats, including paragraphs, tables, and graphs. (SOL 6.8)

6.6.3.4 Pose problems from everyday life situations. (SOL 6.8)

6.6.3.5 Select and use appropriate materials and tools needed to solve a problem.

6.6.3.6 Identify information that is available but is not needed to solve a problem.

6.6.3.7 Solve problems by working collaboratively with peers; entertain others' points of view.

6.6.3.8 Share, explain (verbalize/record), and justify (defend) reasoning during and after solving a problem. Verify and interpret results with respect to the original problem situation. Compare and analyze solution paths (process used to solve problems.)

- 6.6.3.9 Investigate alternative ways of solving a problem. Compare and analyze solution paths. Generalize solutions and strategies to new problem situations including problems without numbers.
- 6.6.3.10 Solve real life problems by writing equations with one variable (i.e., $2x - 5 = 37$). (SOL 6.23b)
- 6.6.3.11 Use algebraic vocabulary (variable, coefficient, term, and equation) appropriately. (SOL 6.23c)