

Mathematics *Standards of Learning* for Virginia Public Schools

2023 Grade 6

The Grade 6 *Standards* provide a transition from the emphasis placed on whole number arithmetic in the elementary grades to an introduction to algebraic thinking. The *Standards* include a focus on single-step and multistep problems involving operations with integers and positive rational numbers. Students will determine equivalency, compare, and order decimals, fractions, and percents. Students will solve problems involving area and perimeter and begin to graph in a coordinate plane. In addition, students will continue using the data cycle by applying it to circle graphs and develop concepts regarding measures of center. Students will solve linear equations in one variable, write inequality statements, and use algebraic terminology. Students will use ratios to compare two quantities and represent proportional relationships as a precursor to the development of the concept of linear functions.

The building of mathematical knowledge can be enhanced by using technology tools when used strategically and to complement further learning during grades 6-8. The use of appropriate technology and the interpretation of the results from applying technology tools must be an integral part of teaching, learning, and assessment. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative and algebraic concepts or for proficiency in basic computations. Students must learn to use a variety of methods and tools to compute, including paper and pencil, mental arithmetic, estimation, and the use of instructional technology. Graphing utilities, spreadsheets, calculators, dynamic applications, and other technological tools support mathematical problem solving, reasoning, and justification, as well as application in science, engineering, business and industry, government, and practical affairs.

In grades 6-8, the acquisition of specialized mathematical vocabulary and language builds as students continue to deepen their understanding of mathematics through communication and problem solving.

Problem solving increases in complexity as students progress into middle and high school. Students continue to build upon their mathematical knowledge by participating in problem-solving activities that promote higher levels of critical thinking and analysis.

Number and Number Sense

6.NS.1 The student will reason and use multiple strategies to express equivalency, compare, and order numbers written as fractions, mixed numbers, decimals, and percents.

Students will demonstrate the following Knowledge and Skills:

- a) Estimate and determine the percent represented by a given model (e.g., number line, picture, verbal description), including percents greater than 100% and less than 1%.*
- b) Represent and determine equivalencies among decimals (through the thousandths place) and percents incorporating the use of number lines, and concrete and pictorial models.*
- c) Represent and determine equivalencies among fractions (proper or improper) and mixed numbers that have denominators that are 12 or less or factors of 100 and percents incorporating the use of number lines, and concrete and pictorial models.*
- d) Represent and determine equivalencies among decimals, percents, fractions (proper or improper), and mixed numbers that have denominators that are 12 or less or factors of 100 incorporating the use of number lines, and concrete and pictorial models.*

- e) Use multiple strategies (e.g., benchmarks, number line, equivalency) to compare and order no more than four positive rational numbers expressed as fractions (proper or improper), mixed numbers, decimals, and percents (decimals through thousandths, fractions with denominators of 12 or less or factors of 100) with and without models. Justify solutions orally, in writing or with a model. Ordering may be in ascending or descending order.*

* On the state assessment, items measuring this objective are assessed without the use of a calculator.

6.NS.2 The student will reason and use multiple strategies to represent, compare, and order integers.

Students will demonstrate the following Knowledge and Skills:

- a) Represent integers (e.g., number lines, concrete materials, pictorial models), including models derived from contextual situations, and identify an integer represented by a point on a number line.
- b) Compare and order integers using a number line.
- c) Compare integers, using mathematical symbols ($<$, $>$, $=$).
- d) Identify and describe the absolute value of an integer as the distance from zero on the number line.

6.NS.3 The student will recognize and represent patterns with whole number exponents and perfect squares.

Students will demonstrate the following Knowledge and Skills:

- a) Recognize and represent patterns with bases and exponents that are whole numbers.
- b) Recognize and represent patterns of perfect squares not to exceed 20^2 , by using concrete and pictorial models.
- c) Justify if a number between 0 and 400 is a perfect square through modeling or mathematical reasoning.
- d) Recognize and represent powers of 10 with whole number exponents by examining patterns in place value.

Computation and Estimation

6.CE.1 The student will estimate, demonstrate, solve, and justify solutions to problems using operations with fractions and mixed numbers, including those in context.

Students will demonstrate the following Knowledge and Skills:

- a) Demonstrate/model multiplication and division of fractions (proper or improper) and mixed numbers using multiple representations.*
- b) Multiply and divide fractions (proper or improper) and mixed numbers that include denominators of 12 or less. Answers are expressed in simplest form.*
- c) Investigate and explain the effect of multiplying or dividing a fraction, whole number, or mixed number by a number between zero and one.*
- d) Estimate, determine, and justify the solution to single-step and multistep problems in context that involve addition and subtraction with fractions (proper or improper) and mixed numbers, with and without regrouping, that include like and unlike denominators of 12 or less. Answers are expressed in simplest form.

- e) Estimate, determine, and justify the solution to single-step and multistep problems in context that involve multiplication and division with fractions (proper or improper) and mixed numbers that include denominators of 12 or less. Answers are expressed in simplest form.

*** On the state assessment, items measuring this objective are assessed without the use of a calculator.**

6.CE.2 The student will estimate, demonstrate, solve, and justify solutions to problems using operations with integers, including those in context.

Students will demonstrate the following Knowledge and Skills:

- a) Demonstrate/model addition, subtraction, multiplication, and division of integers using pictorial representations or concrete manipulatives.*
- b) Add, subtract, multiply, and divide two integers.*
- c) Simplify an expression that contains absolute value bars $| |$ and an operation with two integers (e.g., $-|5 - 8|$ or $\frac{|-12|}{8}$) and represent the result on a number line.
- d) Estimate, determine, and justify the solution to one and two-step contextual problems, involving addition, subtraction, multiplication, and division with integers.

*** On the state assessment, items measuring this objective are assessed without the use of a calculator.**

Measurement and Geometry

6.MG.1 The student will identify the characteristics of circles and solve problems, including those in context, involving circumference and area.

Students will demonstrate the following Knowledge and Skills:

- a) Identify and describe chord, diameter, radius, circumference, and area of a circle.
- b) Investigate and describe the relationship between:
 - i) diameter and radius;
 - ii) radius and circumference; and
 - iii) diameter and circumference.
- c) Develop an approximation for pi (3.14) by gathering data and comparing the circumference to the diameter of various circles, using concrete manipulatives or technological models.
- d) Develop the formula for circumference using the relationship between diameter, radius, and pi.
- e) Solve problems, including those in context, involving circumference and area of a circle when given the length of the diameter or radius.

6.MG.2 The student will reason mathematically to solve problems, including those in context, that involve the area and perimeter of triangles and parallelograms.

Students will demonstrate the following Knowledge and Skills:

- a) Develop the formula for determining the area of parallelograms and triangles using pictorial representations and concrete manipulatives (e.g., two-dimensional diagrams, grid paper).
- b) Solve problems, including those in context, involving the perimeter and area of triangles and parallelograms.

6.MG.3 The student will describe the characteristics of the coordinate plane and graph ordered pairs.

Students will demonstrate the following Knowledge and Skills:

- a) Identify and label the axes, origin, and quadrants of a coordinate plane.
- b) Identify and describe the location (quadrant or the axis) of a point given as an ordered pair. Ordered pairs will be limited to coordinates expressed as integers.
- c) Graph ordered pairs in the four quadrants and on the axes of a coordinate plane. Ordered pairs will be limited to coordinates expressed as integers.
- d) Identify ordered pairs represented by points in the four quadrants and on the axes of the coordinate plane. Ordered pairs will be limited to coordinates expressed as integers.
- e) Relate the coordinates of a point to the distance from each axis and relate the coordinates of a single point to another point on the same horizontal or vertical line. Ordered pairs will be limited to coordinates expressed as integers.
- f) Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to determine the length of a side joining points with the same first coordinate or the same second coordinate. Ordered pairs will be limited to coordinates expressed as integers. Apply these techniques in the context of solving contextual and mathematical problems.

6.MG.4 The student will determine congruence of segments, angles, and polygons.

Students will demonstrate the following Knowledge and Skills:

- a) Identify regular polygons.
- b) Draw lines of symmetry to divide regular polygons into two congruent parts.
- c) Determine the congruence of segments, angles, and polygons given their properties.
- d) Determine whether polygons are congruent or noncongruent according to the measures of their sides and angles.

Probability and Statistics

6.PS.1 The student will apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on circle graphs.

Students will demonstrate the following Knowledge and Skills:

- a) Formulate questions that require the collection or acquisition of data with a focus on circle graphs.
- b) Determine the data needed to answer a formulated question and collect the data (or acquire existing data) using various methods (e.g., observations, measurement, surveys, experiments).
- c) Determine the factors that will ensure that the data collected is a sample that is representative of a larger population.
- d) Organize and represent data using circle graphs, with and without the use of technology tools. The number of data values should be limited to allow for comparisons that have denominators of 12 or less or those that are factors of 100 (e.g., in a class of 20 students, 7 choose apples as a favorite fruit, so the comparison is 7 out of 20, $\frac{7}{20}$, or 35%).
- e) Analyze data represented in a circle graph by making observations and drawing conclusions.

- f) Compare data represented in a circle graph with the same data represented in other graphs, including but not limited to bar graphs, pictographs, and line plots (dot plots), and justify which graphical representation best represents the data.

6.PS.2 The student will represent the mean as a balance point and determine the effect on statistical measures when a data point is added, removed, or changed.

Students will demonstrate the following Knowledge and Skills:

- a) Represent the mean of a set of data graphically as the balance point represented in a line plot (dot plot).
- b) Determine the effect on measures of center when a single value of a data set is added, removed, or changed.
- c) Observe patterns in data to identify outliers and determine their effect on mean, median, mode, or range.

Patterns, Functions, and Algebra

6.PFA.1 The student will use ratios to represent relationships between quantities, including those in context.

Students will demonstrate the following Knowledge and Skills:

- a) Represent a relationship between two quantities using ratios.
- b) Represent a relationship in context that makes a comparison by using the notations $\frac{a}{b}$, $a:b$, and a to b .
- c) Represent different comparisons within the same quantity or between different quantities (e.g., part to part, part to whole, whole to whole).
- d) Create a relationship in words for a given ratio expressed symbolically.
- e) Create a table of equivalent ratios to represent a proportional relationship between two quantities, when given a ratio.
- f) Create a table of equivalent ratios to represent a proportional relationship between two quantities, when given a contextual situation.

6.PFA.2 The student will identify and represent proportional relationships between two quantities, including those in context (unit rates are limited to positive values).

Students will demonstrate the following Knowledge and Skills:

- a) Identify the unit rate of a proportional relationship represented by a table of values, a contextual situation, or a graph.
- b) Determine a missing value in a ratio table that represents a proportional relationship between two quantities using a unit rate.
- c) Determine whether a proportional relationship exists between two quantities, when given a table of values, context, or graph.
- d) When given a contextual situation representing a proportional relationship, find the unit rate and create a table of values or a graph.
- e) Make connections between and among multiple representations of the same proportional relationship using verbal descriptions, ratio tables, and graphs.

6.PFA.3 The student will write and solve one-step linear equations in one variable, including contextual problems that require the solution of a one-step linear equation in one variable.

Students will demonstrate the following Knowledge and Skills:

- a) Identify and develop examples of the following algebraic vocabulary: equation, variable, expression, term, and coefficient.
- b) Represent and solve one-step linear equations in one variable, using a variety of concrete manipulatives and pictorial representations (e.g., colored chips, algebra tiles, weights on a balance scale).
- c) Apply properties of real numbers and properties of equality to solve a one-step equation in one variable. Coefficients are limited to integers and unit fractions. Numeric terms are limited to integers.
- d) Confirm solutions to one-step linear equations in one variable using a variety of concrete manipulatives and pictorial representations (e.g., colored chips, algebra tiles, weights on a balance scale).
- e) Write a one-step linear equation in one variable to represent a verbal situation, including those in context.
- f) Create a verbal situation in context given a one-step linear equation in one variable.

6.PFA.4 The student will represent a contextual situation using a linear inequality in one variable with symbols and graphs on a number line.

Students will demonstrate the following Knowledge and Skills:

- a) Given the graph of a linear inequality in one variable on a number line, represent the inequality in two equivalent ways (e.g., $x < -5$ or $-5 > x$) using symbols. Symbols include $<$, $>$, \leq , \geq .
- b) Write a linear inequality in one variable to represent a given constraint or condition in context or given a graph on a number line.
- c) Given a linear inequality in one variable, create a corresponding contextual situation or create a number line graph.
- d) Use substitution or a number line graph to justify whether a given number in a specified set makes a linear inequality in one variable true.
- e) Identify a numerical value(s) that is part of the solution set of a given inequality in one variable.