# 6Grade 6

## Introduction

In grade 6, instructional time should focus on five critical areas: (1) connecting ratio and rate to whole number multiplication and division, and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; (4) developing understanding of statistical thinking; and (5) reasoning about geometric shapes and their measurements.

1. Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.
2. Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.
3. Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as 3*x* = *y*) to describe relationships between quantities.
4. Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.
5. Students in grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in grade 7 by drawing polygons in the coordinate plane.

The Standards for Mathematical Practice complement the content standards so that students increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years.

## 6Grade 6 Overview

### Ratios and Proportional Relationships

1. Understand ratio and rate concepts and use ratio reasoning to solve problems.

### The Number System

1. Apply and extend previous understandings of multiplication and division to divide fractions by fractions.
2. Compute fluently with multi-digit numbers and find common factors and multiples.
3. Apply and extend previous understandings of numbers to the system of rational numbers.

### Expressions and Equations

1. Apply and extend previous understandings of arithmetic to algebraic expressions.
2. Reason about and solve one-variable equations and inequalities.
3. Represent and analyze quantitative relationships between dependent and independent variables.

### Geometry

1. Solve real-world and mathematical problems involving area, surface area, and volume.

### Statistics and Probability

1. Develop understanding of statistical variability.
2. Summarize and describe distributions.

###### **Standards for Mathematical Practice**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

## Grade 6 Content Standards

### 6Ratios and Proportional Relationships 6.RP

**A. Understand ratio and rate concepts and use ratio and rate reasoning to solve problems.**

1. Understand the concept of a ratio including the distinctions between part:part and part:whole and the value of a ratio; part/part and part/whole. Use ratio language to describe a ratio relationship between two quantities.

For example: The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every two wings there was one beak; For every vote candidate A received, candidate C received nearly three votes, meaning that candidate C received three out of every four votes or ¾ of all votes.

1. Understand the concept of a unit rate *a*/*b* associated with a ratio *a*:*b* with *b* ≠ 0, and use rate language in the context of a ratio relationship, *including the use of units*.

For example: This recipe has a ratio of three cups of flour to four cups of sugar, so there is ¾ cup of flour for each cup of sugar; We paid $75 for 15 hamburgers, which is a rate of five dollars per hamburger.[[1]](#footnote-1)

1. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
   1. Make tables of equivalent ratios relating quantities with whole-number measurements. Find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
   2. Solve unit rate problems, including those involving unit pricing, and constant speed.

For example, if it took seven hours to mow four lawns, then, at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?

* 1. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30∕100 times the quantity); solve problems involving finding the whole, given a part and the percent.
  2. Use ratio reasoning to convert measurement units within and between measurement systems; manipulate and transform units appropriately when multiplying or dividing quantities.

For example, Malik is making a recipe, but he cannot find his measuring cups! He has, however, found a tablespoon. His cookbook says that 1 cup = 16 tablespoons. Explain how he could use the tablespoon to measure out the following ingredients: two cups of flour, ½ cup sunflower seed, and 1¼ cup of oatmeal.[[2]](#footnote-2)

* 1. Solve problems that relate the mass of an object to its volume.

### The Number System 6.NS

**A. Apply and extend previous understandings of multiplication and division to divide fractions by fractions.**

1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.

For example, create a story context for (2∕3) ÷ (3∕4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2∕3) ÷ (3∕4) = 8∕9 because 3∕4 of 8∕9 is 2∕3. In general, (a∕b) ÷ (c∕d) = ad∕bc. How much chocolate will each person get if three people share 1∕2 lb. of chocolate equally? How many 3∕4-cup servings are in 2∕3 of a cup of yogurt? How wide is a rectangular strip of land with length 3∕4 mile and area 1∕2 square mile?

**B. Compute fluently with multi-digit numbers and find common factors and multiples.**

1. Fluently divide multi-digit numbers using the standard algorithm.
2. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
3. Use prime factorization to find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two relatively prime numbers.

For example, express 36 + 8 as 4(9 + 2).

**C. Apply and extend previous understandings of numbers to the system of rational numbers.**

1. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, and positive/negative electric charge). Use positive and negative numbers (whole numbers, fractions, and decimals) to represent quantities in real-world contexts, explaining the meaning of zero in each situation.
2. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
   1. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself,   
      e.g., –(–3) = 3, and that zero is its own opposite.
   2. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.
   3. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.
3. Understand ordering and absolute value of rational numbers.
   1. Interpret statements of inequality as statements about the relative positions of two numbers on a number line diagram.

For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.

* 1. Write, interpret, and explain statements of order for rational numbers in real-world contexts.

For example, write –3oC > –7oC to express the fact that –3oC is warmer than –7oC.

* 1. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.

For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.

* 1. Distinguish comparisons of absolute value from statements about order.

For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.

1. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

### Expressions and Equations 6.EE

**A. Apply and extend previous understandings of arithmetic to algebraic expressions.**

1. Write and evaluate numerical expressions involving whole-number exponents.
2. Write, read, and evaluate expressions in which letters stand for numbers.
   1. Write expressions that record operations with numbers and with letters standing for numbers.

For example, express the calculation “Subtract y from 5” as 5 – y.

* 1. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, and coefficient); view one or more parts of an expression as a single entity.

For example, describe the expression 2(8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.

* 1. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).

For example, use the formulas V = s3 and A = 6s2 to find the volume and surface area of a cube with sides of length s = ½ .

1. Apply the properties of operations to generate equivalent expressions.

For example, apply the distributive property to the expression 3(2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6(4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.

1. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them).

For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.

**B. Reason about and solve one-variable equations and inequalities.**

1. Understand solving an equation or inequality as a process of answering a question: Which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
2. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
3. Solve real-world and mathematical problems by writing and solving equations of the form *x*+ *p* = *q* and *px* = *q* for cases in which *p*, *q*, and *x* are all nonnegative rational numbers.
4. Write an inequality of the form *x* > *c* or *x* < *c* to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form *x > c* or *x < c* have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

**C. Represent and analyze quantitative relationships between dependent and independent variables.**

1. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.

### Geometry 6.G

**A. Solve real-world and mathematical problems involving area, surface area, and volume.**

1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas *V* = *lwh* and *V* = *Bh* to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
3. Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.
4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface areas of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

### Statistics and Probability 6.SP

**A. Develop understanding of statistical variability.**

1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.

For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.

1. Understand that a set of data collected to answer a statistical question has a distribution, which can be described by its center (median, mean, and/or mode), spread (range, interquartile range), and overall shape.
2. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

**B. Summarize and describe distributions.**

1. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
   1. Read and interpret circle graphs.
2. Summarize numerical data sets in relation to their context, such as by:
   1. Reporting the number of observations.
   2. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
   3. Giving quantitative measures of center (median, and/or mean) and variability (range and/or interquartile range), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
   4. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

# 7Grade 7

## Introduction

In grade 7, instructional time should focus on four critical areas: (1) developing understanding of and applying proportional relationships; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and (4) drawing inferences about populations based on samples.

1. Students extend their understanding of ratios and rates and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios, rates, and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.
2. Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.
3. Students continue their work with area from grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
4. Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

The Standards for Mathematical Practice complement the content standards so that students increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years.

## 7Grade 7 Overview

### Ratios and Proportional Relationships

###### **Standards for Mathematical Practice**

Make sense of problems and persevere in solving them.

1. Reason abstractly and quantitatively.
2. Construct viable arguments and critique the reasoning of others.
3. Model with mathematics.
4. Use appropriate tools strategically.
5. Attend to precision.
6. Look for and make use of structure.
7. Look for and express regularity in repeated reasoning.
8. Analyze proportional relationships and use them to solve real-world and mathematical problems.

### The Number System

1. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

### Expressions and Equations

1. Use properties of operations to generate equivalent expressions.
2. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

### Geometry

1. Draw, construct and describe geometrical figures and describe the relationships between them.
2. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

### Statistics and Probability

1. Use random sampling to draw inferences about a population.
2. Draw informal comparative inferences about two populations.
3. Investigate chance processes and develop, use, and evaluate probability models.

## 7Grade 7 Content Standards

### Ratios and Proportional Relationships 7.RP

**A. Analyze proportional relationships and use them to solve real-world and mathematical problems.**

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.

For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½∕¼ miles per hour, equivalently 2 miles per hour.

1. Recognize and represent proportional relationships between quantities.
   1. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table, or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
   2. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
   3. Represent proportional relationships by equations.

For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.

* 1. Explain what a point (*x, y*) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r*) where *r* is the unit rate.

1. Use proportional relationships to solve multi-step ratio, rate, and percent problems.

For example: simple interest, tax, price increases and discounts, gratuities and commissions, fees, percent increase and decrease, percent error.

### The Number System 7.NS

**A. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.**

1. Apply and extend previous understandings of addition and subtraction to add and subtract integers and other rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.
   1. Describe situations in which opposite quantities combine to make zero.

For example: A hydrogen atom has zero charge because its two constituents are oppositely charged; If you open a new bank account with a deposit of $30 and then withdraw $30, you are left with a $0 balance.

* 1. Understand *p* + *q* as the number located a distance |*q*| from *p*, in the positive or negative direction depending on whether *q* is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
  2. Understand subtraction of rational numbers as adding the additive inverse, *p* – *q* = *p* + (–*q*). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.
  3. Apply properties of operations as strategies to add and subtract rational numbers.

1. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide integers and other rational numbers.
   1. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
   2. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then   
      –(*p*∕*q*) = (–*p*)∕*q* = *p*∕(–*q*). Interpret quotients of rational numbers by describing real-world contexts.
   3. Apply properties of operations as strategies to multiply and divide rational numbers.
   4. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.
2. Solve real-world and mathematical problems involving the four operations with integers and other rational numbers.[[3]](#footnote-3)

### Expressions and Equations 7.EE

**A. Use properties of operations to generate equivalent expressions.**

1. Apply properties of operations to add, subtract, factor, and expand linear expressions with rational coefficients.

For example, 4x + 2 = 2(2x +1) and -3(x – 5∕3) = -3x + 5.

1. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related.

For example, a + 0.05a = 1.05a means that “increase by 5%” is the same as “multiply by 1.05.” A shirt at a clothing store is on sale for 20% off the regular price, “p”. The discount can be expressed as 0.2p. The new price for the shirt can be expressed as p – 0.2p or 0.8p.

**B. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.**

1. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

For example, if a woman making $25 an hour gets a 10% raise, she will make an additional 1∕10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9¾ inches long in the center of a door that is 27½ inches wide, you will need to place the bar about 9 inches from each edge; This estimate can be used as a check on the exact computation.

1. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
   1. Solve word problems leading to equations of the form *px* + *q* = *r* and *p*(*x* ÷ *q*) = *r*, where *p*, *q*, and *r* are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?

* 1. Solve word problems leading to inequalities of the form *px* + *q* > *r* or *px* + *q* < *r*, where *p*, *q*, and *r* are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.

For example, as a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.

* 1. Extend analysis of patterns to include analyzing, extending, and determining an expression for simple arithmetic and geometric sequences (e.g., compounding, increasing area), using tables, graphs, words, and expressions.

### 7Geometry 7.G

**A. Draw, construct, and describe geometrical figures and describe the relationships between them.**

1. Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
2. Draw (freehand, with ruler and protractor, and with technology) two-dimensional geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
3. Describe the shape of the two-dimensional face of the figure that results from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

**B. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.**

1. Circles and measurement:
   1. Know that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle.
   2. Understand and describe the relationships among the radius, diameter, and circumference of a circle.
   3. Understand and describe the relationship among the radius, diameter, and area of a circle.
   4. Know the formulas for the area and circumference of a circle and use them to solve problems.
   5. Give an informal derivation of the relationship between the circumference and area of a circle.
2. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write simple equations and use them to solve for an unknown angle in a figure.
3. Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

### Statistics and Probability 7.SP

**A. Use random sampling to draw inferences about a population.**

1. Understand that statistics can be used to gain information about a population by examining a sample of the population; Generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.

**B. Draw informal comparative inferences about two populations.**

1. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability.

For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team and both distributions have similar variability (mean absolute deviation) of about 5 cm. The difference between the mean heights of the two teams (10 cm) is about twice the variability (5 cm) on either team. On a dot plot, the separation between the two distributions of heights is noticeable.

1. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.

For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.

**C. Investigate chance processes and develop, use, and evaluate probability models.**

1. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.
2. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.

For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

1. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
   1. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events.

For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.

* 1. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.

For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?

1. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
2. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
3. Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event.
4. Design and use a simulation to generate frequencies for compound events.

For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least four donors to find one with type A blood?

1. Expectations for unit rates in this grade are limited to non-complex fractions. [↑](#footnote-ref-1)
2. Example is from the Illustrative Mathematics Project: https://www.illustrativemathematics.org/content-standards/tasks/2174 [↑](#footnote-ref-2)
3. Computations with rational numbers extend the rules for manipulating fractions to complex fractions. [↑](#footnote-ref-3)