

# Grade 8 Unit 1 at a Glance: Analyzing Graphs

## Overview and Pacing Guide

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### Unit Overview

The unit starts with two exploratory lessons that ask students to represent the world outside their classroom mathematically. Students attempt to sketch a graph to represent what they see on a video. Next, students sketch graphs based on verbal descriptions of situations. The goal is to proceed deliberately from the concrete to the abstract and slowly formalize the graphing process.

In the next two lessons students develop vocabulary, such as increasing and decreasing, to describe graphs. Students attempt to re-create their partner's graphs just from the descriptions. When comparing the original graph and the re-created version, students begin to understand the importance of using precision in mathematics.

In subsequent lessons students confront a common misconception of graphs—that they always represent the path of an object. Students sketch a graph representing the speed of a roller coaster over the distance it travels and compare it to the graph of the height of the roller coaster over the distance it travels. Seeing two different graphs attached to the same context helps students confront this misconception.

The unit includes problems with real-world contexts, formative assessment lessons, quizzes, and Gallery problems. The unit ends with a unit assessment.



### Standards Functions

- ▶ 8.F.B.5

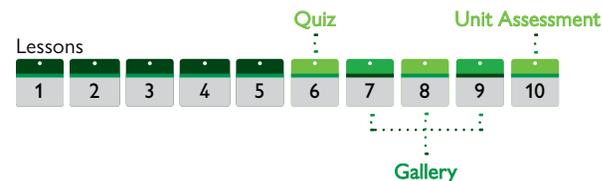
### Goals and Learning Objectives

- ▶ Describe events outside the classroom using graphs.
- ▶ Sketch graphs to represent verbal descriptions of real-world situations.
- ▶ Use vocabulary to describe and understand graphs.
- ▶ Sketch a graph to represent a real-world situation, the speed of a roller coaster along a track.
- ▶ Describe qualitatively the functional relationship between two quantities by analyzing a graph.
- ▶ Compare the graph of speed over distance to the expected action of a roller coaster on the track.
- ▶ Complete a card sort activity, matching verbal situations to the graphs they describe.
- ▶ Develop a comprehensive understanding of how graphs can represent real-world situations.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (5)
- ▶ Quiz (6)
- ▶ Unit Assessment (10)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 2 at a Glance: Roots and Exponents

## Overview and Pacing Guide

### Unit Overview

Students start with a paper-cutting activity to explore the pattern obtained by repeatedly multiplying by 2. Students review the meaning of positive integer exponents and learn the vocabulary associated with exponential notation including the terms *squared* and *cubed*. They learn about square roots and cube roots and use them to solve equations and to simplify expressions.

Next, students discover and apply properties of exponents: the product of powers; the quotient of powers; the power of a power; and the power of a product. Students are introduced to scientific notation and to the meaning of zero and negative integer exponents.

Students then extend what they know about scientific notation to include calculations with numbers in scientific notation. They solve problems involving very large and very small numbers and, after studying absolute values, they extend the definition of scientific notation to include negative numbers. Rational and irrational numbers are also covered with students converting between fraction and decimal forms of rational numbers. Students locate both rational and irrational numbers on the number line.

The unit includes two opportunities to complete self-assessment activities and two sets of Gallery problems to further explore concepts. It concludes with a unit assessment.



### Standards

#### The Number System

- ▶ 8.NS.A.1, 8.NS.A.2

#### Expressions and Equations

- ▶ 8.EE.A.1, 8.EE.A.2, 8.EE.A.3, 8.EE.A.4

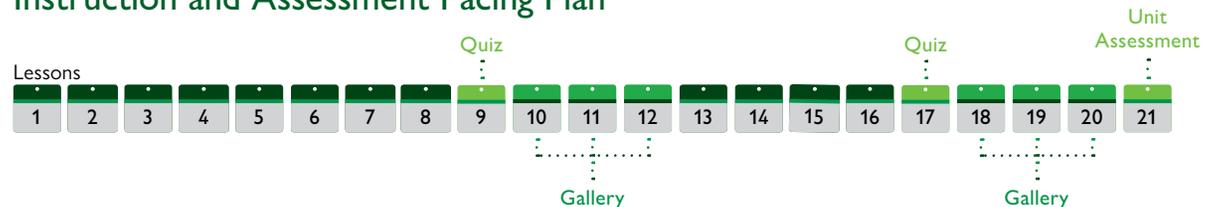
### Goals and Learning Objectives

- ▶ Identify equivalent numerical expressions including those involving exponents of 2 and 3.
- ▶ Understand the meaning of raising a fraction to an exponent. Reinforce the distinction between repeated multiplication and repeated addition.
- ▶ Simplify numerical expressions involving powers of 2 and 3, square roots, and cube roots.
- ▶ Recognize patterns in simplifying variable expressions in which two factors with the same base are multiplied or divided.
- ▶ Learn the definition of scientific notation, identify and write numbers written in scientific notation.
- ▶ Add, subtract, multiply, and divide numbers expressed in scientific notation using the properties of exponents and a calculator.
- ▶ Distinguish between rational and irrational numbers and understand that square roots of non-square numbers are irrational numbers.
- ▶ Approximate the values of irrational numbers, including square roots of non-square numbers and factors of  $\pi$ . Use the number line to order both rational and irrational numbers.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before each quiz (8, 16)
- ▶ Quiz (9, 17)
- ▶ Unit Assessment (21)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 3 at a Glance: Transformations

## Overview and Pacing Guide

### Unit Overview

The unit starts with an informal exploration of images of tessellations and everyday objects to introduce the idea of translations, rotations, and reflections. Students first determine that figures are congruent under translation, reflection, and rotation, without reference to the coordinate system. They then carry out each type of transformation in the coordinate plane. Students examine sequences of translations, reflections, and rotations and confirm that figures remain congruent under sequences of these three transformations.

Next, the focus becomes the transformation of dilation and the importance of scale factors. Students learn that dilated figures are similar, not congruent (unless the scale factor is 1). Then students focus on the effects of each transformation on the coordinates of points and make generalizations about a point  $(x, y)$  under given transformations. Students analyze and perform combinations of transformations with an emphasis on scale factor.

The last section builds on the similarity of dilated triangles, first with a focus on the conditions of similarity for triangles and then on using knowledge of similar triangles to find missing measurements of real-world objects. The unit ends with a final lesson and a Gallery, which provides a range of problems about transformations, and the Unit Assessment.



### Standards

#### Geometry

- ▶ 8.G.A.1, 8.G.A.1.a, 8.G.A.1.b, 8.G.A.1.c, 8.G.A.2, 8.G.A.3, 8.G.A.4, 8.G.A.5

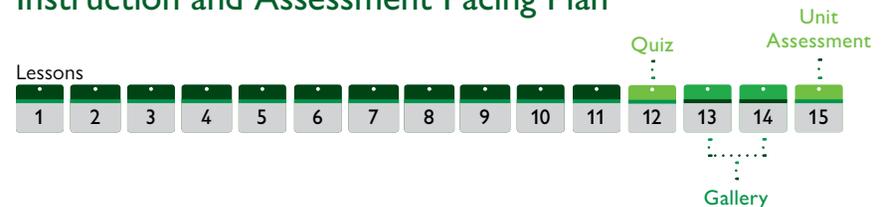
### Goals and Learning Objectives

- ▶ Identify transformations in real-world images and movements.
- ▶ Carry out translations, reflections, and rotations and examine features of the resulting figures: side lengths, angles, parallel lines.
- ▶ Understand the concept of dilation. Identify centers of dilation and scale factors in pairs and sets of similar figures.
- ▶ Explore the effects of transformations on the coordinates of points. Interpret and use algebraic notation to express the effects of transformations on the coordinates of points.
- ▶ Recognize transformations in a growth pattern. Apply sequences of translations, reflections, rotations, and dilations to produce a given figure with a repeating pattern.
- ▶ Identify and explain the similarity criteria for triangles. Recognize the connection between dilation and similarity among triangles.
- ▶ Identify similar triangles in diagrams and images of real-world objects. Use similar triangles to find missing measurements.
- ▶ Synthesize and connect strategies for investigating transformations. Apply deepened understanding of transformations to new problem situations.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (11)
- ▶ Quiz (12)
- ▶ Unit Assessment (15)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 4 at a Glance: Linear Relationships

## Overview and Pacing Guide

### Unit Overview

The unit begins with an exploratory lesson about a printer that prints at a nearly constant rate and has an initial time period when it prepares a given print job. Students recognize how this is different from a proportional relationship because of the initial preparation time for the print job.

Students then compare three different proportional relationships between time and distance for marathon runners running at three different average speeds. They begin an investigation into the concept of slope, expressed as rise over run, and the relationship between linear graphs and linear equations in slope-intercept form.

Students choose a project group and a topic for their linear relationships project. Students work on their project both in and out of the classroom.

Students go on to solidify their understanding of slope, linear equations in slope-intercept form, formulas to model linear relationships, and connections between equations, tables, and graphs of linear relationships. They examine the effects that adjusting the scales of the coordinate axes have on the appearance of linear graphs.

The unit concludes with a Gallery of problems, including several about modeling linear relationships in different contexts; 2 days of project presentations; and finally, the Unit Assessment.



### Standards

Expressions and Equations

- ▶ 8.EE.B.5, 8.EE.B.6

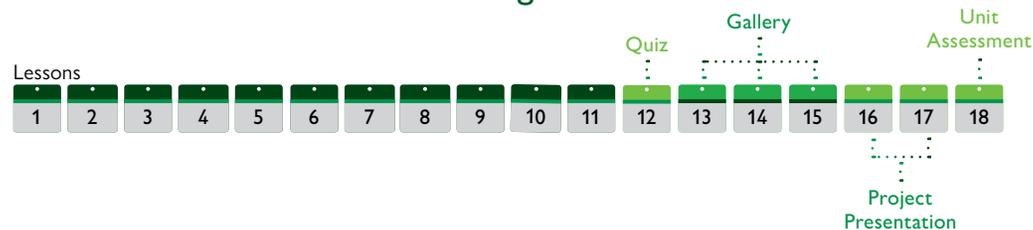
### Goals and Learning Objectives

- ▶ Know how to identify a constant rate. Apply understanding of graphs in order to represent a rate.
- ▶ Understand that constant speeds are represented as the slope of a graph. Interpret the meaning of specific points on graphs.
- ▶ Understand that the ratio of rise to run has the same value between any two points on the graph of a proportional relationship.
- ▶ Relate linear equations to linear graphs. Understand the relationship between the graph of a line and the slope-intercept form of the equation for that line.
- ▶ Match tables, graphs, and equations that represent the same linear relationship.
- ▶ Recognize linearity in formulas with a negative constant of proportionality. Explore the behavior of graphs with a negative slope.
- ▶ Understand the importance of the scale of the axes when reading a graph.
- ▶ Work on the linear-relationships project. Present projects and demonstrate understanding of linear relationships.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check two days before the quiz (10)
- ▶ Quiz (12)
- ▶ Unit Assessment (18)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 5 at a Glance: Linear Equations

## Overview and Pacing Guide

### Unit Overview

Students begin the unit by solving one-variable equations that have variable terms on both sides. These equations also involve using the distributive property and combining like terms.

Students learn to use algebraic transformations to identify equations in one variable that have exactly one solution, no solutions, or infinitely many solutions. Students then apply these skills to solving systems of equations in two variables.

Students also solve systems of equations using graphing as well as algebraic methods. They apply these methods to solve a variety of real-world and mathematical problems.

The unit concludes with a range of Gallery problems and a unit assessment.



### Standards

#### Expressions and Equations

- ▶ 8.EE.C.7, 8.EE.C.7.a, 8.EE.C.7.b, 8.EE.C.8, 8.EE.C.8.a, 8.EE.C.8.b, 8.EE.C.8.c

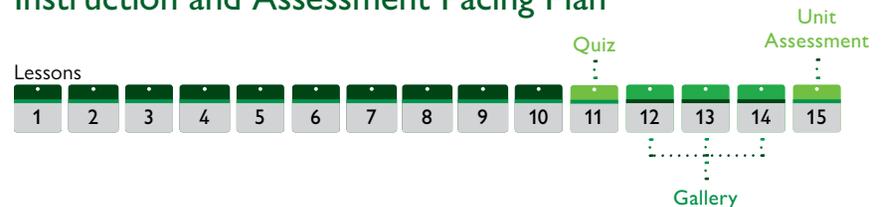
### Goals and Learning Objectives

- ▶ Review graphing of linear equations given the slope and  $y$ -intercept. Explore the meaning of the point of intersection of the graph of two linear equations.
- ▶ Use the addition and multiplication properties of equality, the distributive property, and knowledge of combining like terms to solve one-variable linear equations that contain variable terms on both sides.
- ▶ Use an algebraic process to determine when an equation has one solution, no solutions, or all numbers as solutions.
- ▶ Graph a system of two-variable linear equations to determine the number of solutions for a one-variable equation.
- ▶ Transform two-variable linear equations into slope-intercept form or into standard form. Understand that transforming an equation from one form to another produces an equivalent equation and that equivalent equations have the same graph.
- ▶ Solve systems of linear equations using graphing or algebra.
- ▶ Solve systems of linear equations using the substitution method or the elimination method.
- ▶ Recognize problems that can be solved using a system of equations; write a system of equations to solve the problem; and choose an efficient method for solving it.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (10)
- ▶ Quiz (11)
- ▶ Unit Assessment (15)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 6 at a Glance: Triangles and Beyond

## Overview and Pacing Guide

### Unit Overview

In this unit, an initial exploratory lesson on the art of M.C. Escher gets students thinking about geometry in general. The remaining lessons in the unit are divided into three parts: transversals and their related angles; the Pythagorean Theorem and its applications; and volume of cylinders, cones, and spheres.

The first set of lessons explores transversals intersecting parallel lines and the relationship of the resulting angles. Students look at congruent angles and angle sums and explore the sum of the angle measures in triangles. Students also examine the relationship of an exterior angle to the sum of the remaining two interior angles.

The second set of lessons focuses on understanding and applying the Pythagorean Theorem. Students apply the theorem to find lengths in two-dimensional and three-dimensional figures, and then they find lengths of line segments in the coordinate plane.

The third set of lessons focuses on three-dimensional figures involving circles and volume calculations. Students derive the formula for the volume of cylinders and then find the formula for the volume of a cone and the volume of spheres. Finally, students explore the relationships between the volumes of cylinders, cones, and spheres that have the same radius and height.

The unit finishes with a unit assessment.

### Goals and Learning Objectives

- ▶ Explore the relationship between geometry and art. Investigate the art of M.C. Escher and tessellations of triangles.
- ▶ Understand the relationships among angles created by transversals crossing parallel lines—which angles are congruent and which angles are supplementary.
- ▶ Understand why the sum of the angle measures of a triangle is  $180^\circ$ . Show that the sum of two interior angles of a triangle is equal to the third angle's exterior angle measure.
- ▶ Understand and apply the Pythagorean Theorem. Apply the converse of the Pythagorean Theorem to determine if a triangle is a right triangle.
- ▶ Find lengths of line segments in the coordinate plane. Understand a general method to find the length of a line segment.
- ▶ Derive the formulas for the volume of a cylinder, a cone, and a sphere. Apply the volume formulas to solve problems.
- ▶ Explore how the volumes of cylinders, cones, and spheres are related.
- ▶ Apply knowledge about angle relationships, the Pythagorean Theorem, and volume to solve problems.



### Standards

#### Geometry

- ▶ 8.G.A.5, 8.G.B.6, 8.G.B.7, 8.G.B.8, 8.G.C.9

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (10)
- ▶ Quiz (11)
- ▶ Unit Assessment (15)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 7 at a Glance: Functions

## Overview and Pacing Guide

### Unit Overview

The unit opens with an exploratory lesson on changing tides and how graphs can be used to model the information. Lessons then focus on how graphs represent information and show rates of change. Students also learn about linear and nonlinear graphs.

Next, students are introduced to the concept of a function. They learn the definition of a function, how to write a function, and how to determine the output values. They also learn to identify the domain and range of a function.

Students choose a project group and a project related to functions. Students have two class periods to work on the functions project and 2 days at the end of the unit for project presentations.

Next, students explore linear functions. They learn the definition of a linear function, how to write the formula for a linear function, and how to graph a linear function. Students explore all of the different ways to represent a function, including graphs, tables of values, equations in function notation, and verbal descriptions. The unit then explores using functions to model real-world situations and to make predictions.

The unit concludes with a Gallery, 2 days of project presentations, and the Unit Assessment.



### Standards

#### Functions

- ▶ 8.F.A.1, 8.F.A.2, 8.F.A.3, 8.F.B.4, 8.F.B.5

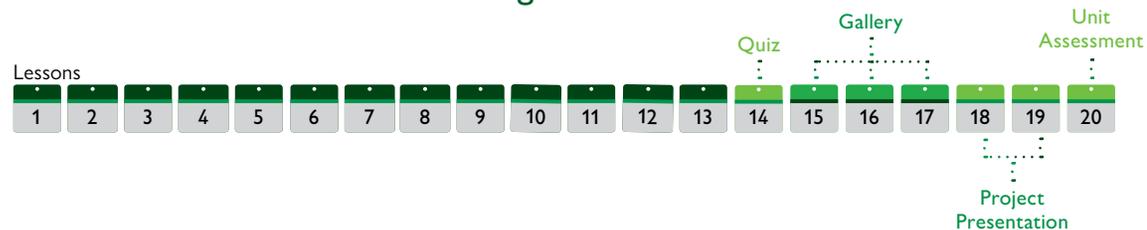
### Goals and Learning Objectives

- ▶ Identify linear and nonlinear graphs. Calculate rates of change. Understand that linear graphs have a constant rate of change.
- ▶ Understand the definition of a function and learn function notation. Find input and output values for a given function and identify the domain and range.
- ▶ Understand that linear functions exhibit a constant rate of change. Calculate slope and y-intercept for a linear function.
- ▶ Write the formula for a linear function given a point and the slope or given two points. Graph a linear function given a point and the slope.
- ▶ Interpret, represent, and solve a real-world problem using functions.
- ▶ Understand the steps of the modeling process. Create a mathematical model to represent the situation. Apply the model to solve the problem.
- ▶ Implement a plan for the functions project. Organize and interpret data presented in a problem situation. Create a mathematical model.
- ▶ Present projects and demonstrate understanding of functions and the different representations of a function.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (13)
- ▶ Quiz (14)
- ▶ Unit Assessment (20)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 8 at a Glance: Bivariate Data

## Overview and Pacing Guide

### Unit Overview

The initial, exploratory lesson of this unit gets students thinking in general about bivariate data. The remaining lessons are divided into two sections. The first focuses on scatterplots and the relationship between two numerical data variables. The second looks at two-way tables and the relationship between categorical data.

In the first set of lessons, students look at how two variables may be related. They find that the association between variables can be positive or negative, strong or weak, and linear or nonlinear. Students use data they measure themselves and data that is provided for them to produce different data sets. At this level, students do not quantify the association; they find a line that is close to approximating the relationship and find its equation which is used to describe the relationship between the variables and to predict outcomes.

In the second set of lessons, students focus on categorical data and two-way tables. They explore the strength of the relationship between two categorical topics, looking at relative frequency and percentages; for example, do students who get an allowance do chores? Students submit survey data about themselves to provide the data.

The unit includes a three-day Gallery—where students can further their investigations—and ends with a unit assessment.



### Standards

Statistics and Probability

- ▶ 8.SP.A.1, 8.SP.A.2, 8.SP.A.3, 8.SP.A.4

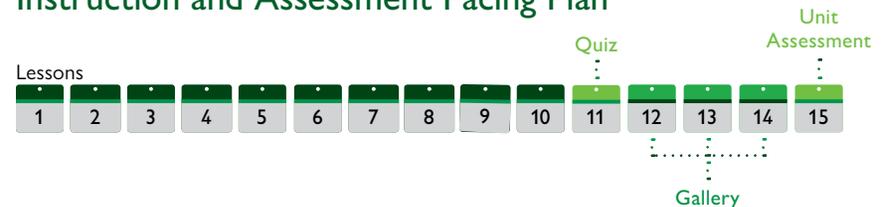
### Goals and Learning Objectives

- ▶ Think about bivariate data and how to show possible relationships. Think about what the position of the data points relative to each other might indicate.
- ▶ Find associations between two numerical variables. Graph bivariate data in a scatterplot. Interpret the scatterplot.
- ▶ Collect data about a variety of measurements and time estimates. Graph data on the quantities chosen, determine scale for the axes, and plot data values.
- ▶ Determine if the relationship between plotted data values is linear or nonlinear. Determine the relationship between the values.
- ▶ Find a line and its equation to describe a scatterplot. Describe the association in terms of the slope of the equation.
- ▶ Find the line that best represents the data in a scatterplot. Find the equation of the line and use it to describe the relationship between the variables in the scatterplot.
- ▶ Choose two variables to investigate. Predict the association between the variables, construct a scatterplot from the data, and describe the association between the variables.
- ▶ Read and interpret two-way tables. Create a two-way table and analyze the two-way table by comparing categories.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (10)
- ▶ Quiz (11)
- ▶ Unit Assessment (15)

### Instruction and Assessment Pacing Plan



# Grade 8 Unit 9 at a Glance: Putting Math to Work

## Overview and Pacing Guide

### Unit Overview

In this culminating, problem-solving unit, students apply and integrate the mathematics they have learned throughout the year to solve mathematical and real-world problems using a variety of problem-solving strategies.

Students explore two-dimensional (2-D) drawings of three-dimensional (3-D) figures; analyze data on geyser eruptions at two state parks and make predictions about when the geysers will erupt; and investigate a traffic signal at a busy intersection to design the appropriate time for each green light based on traffic patterns. Students apply the concept of slope to solve problems regarding the unit rise and run of stairs constructed using a variety of architectural rules. Students also use the concepts of similarity, indirect measurement, ratio, proportionality, and measurement to design a replica of an Iroquois longhouse and make a proposal for its construction.

As they work through this unit, strengthening and refining their problem-solving skills, students select a project to complete and are given a class day to work on their projects.

Students are also given 3 days to select and solve problems from a Gallery to test their problem-solving skills. Finally, students are given 2 days to present their projects to the class followed by a unit assessment.

### Goals and Learning Objectives

- ▶ Interpret a 2-D drawing to construct a 3-D model. Visualize 3-D spaces. Solve problems involving spatial reasoning. Find maximum and minimum values to fit constraints.
- ▶ Create scatterplots to find the relationship between two variables. Make predictions based on data. Describe what the steepness or slope of a line means in a contextual situation.
- ▶ Analyze patterns to make predictions. Interpret data presented in a table. Revise plans based on data collection. Analyze a solution for reasonableness.
- ▶ Express slope as a ratio of unit rise to unit run. Compare the slope of different stairs. Use rules and equations to design constructions to given specifications. Construct scale drawings of figures.
- ▶ Solve problems that involve indirect measurement, scale, linear measurement, area, and surface area. Use ratios and proportionality to solve problems.
- ▶ Identify a project idea and work collaboratively with a group on a problem-solving project. Create and implement a problem-solving plan.
- ▶ Use multiple representations—including tables, graphs, and equations—to organize and communicate data. Articulate strategies, thought processes, and approaches to solving a problem and defend why the solution is reasonable.
- ▶ Present project to the class. Give feedback on other project presentations. Exhibit good listening skills. Reflect on the problem-solving process.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Unit Assessment (16)



### Standards

#### Expressions and Equations

- ▶ 8.EE.B.5, 8.EE.C.7, 8.EE.C.7b

#### Geometry

- ▶ 8.G.C.9

#### Statistics and Probability

- ▶ 8.SP.A.1, 8.SP.A.2, 8.SP.A.3

### Instruction and Assessment Pacing Plan

