

# Grade 8 Unit 1 at a Glance: Analyzing Graphs

## Overview and Pacing Guide

### 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

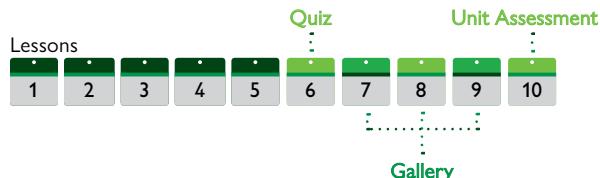
### Goals and Learning Objectives

- ▶ 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 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

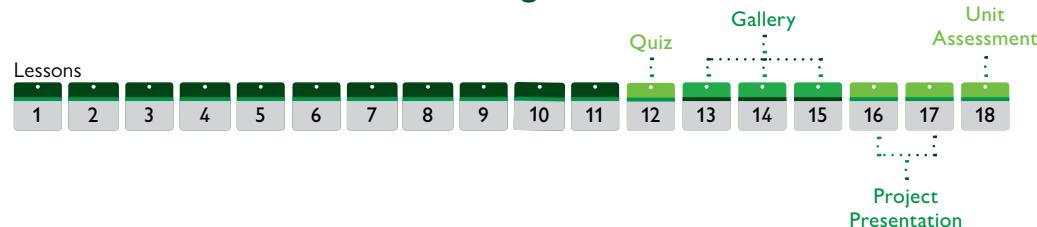
### Goals and Learning Objectives

- ▶ 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.



### 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)

### 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

### 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.

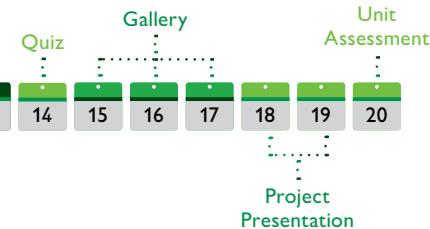
### Assessments

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

### Instruction and Assessment Pacing Plan

#### Lessons

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----



# Grade 9 Unit 1 at a Glance: Modeling With Functions

## Overview and Pacing Guide

### Unit Overview

Students will begin by exploring a real-world scenario that can be modeled using functions. Then they delve deeper into how to create functions and represent them as tables, graphs, and formulas. Students will compare linear functions with exponential ones and compare their differing domains and ranges. Students will then experiment with higher-order functions, comparing linear, quadratic, cubic, and exponential functions. Next, they will investigate the rates of change for these functions and discover that growth and decay can be modeled using different exponential functions. Lastly, students will investigate sequences and how they can represent the output values of functions.



### Goals and Learning Objectives

- ▶ Analyze different types of growth and decay.
- ▶ Learn the definition of a function.
- ▶ Understand that a function can be represented as a rule, a formula, a table, or a graph.
- ▶ Model real-world situations as functions, identifying inputs and outputs.
- ▶ Understand how context affects range, domain, and type of function.
- ▶ Determine points of intersection in the graphs of linear and exponential functions.
- ▶ Understand the similarities and differences between sequences and continuous functions.
- ▶ Write recursive rules to generate sequences, including arithmetic sequences and geometric sequences.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Quiz (11)
- ▶ Self Check the day before the quiz (10)
- ▶ Unit Assessment (14)

### Standards

#### Quantities

- ▶ HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3

#### Seeing Structure in Expressions

- ▶ HSA.SSE.B.3, HSA.SSE.B.3.c

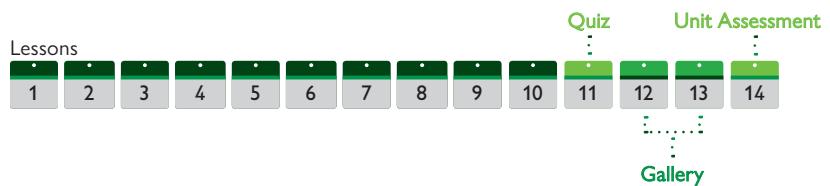
#### Interpreting Functions

- ▶ HSF.IF.A.1, HSF.IF.A.2, HSF.IF.A.3, HSF.IF.B.4, HSF.IF.B.5, HSF.IF.C.7, HSF.IF.C.7.a, HSF.IF.C.7.b, HSF.IF.C.8, HSF.IF.C.8.b, HSF.IF.C.9

#### Linear, Quadratic, and Exponential Models

- ▶ HSF.LE.A.1, HSF.LE.A.1.a, HSF.LE.A.1.b, HSF.LE.A.1.c, HSF.LE.A.2, HSF.LE.A.3, HSF.LE.B.5

### Instruction and Assessment Pacing Plan



# Grade 9 Unit 2 at a Glance: Linear Functions

## Overview and Pacing Guide

### Unit Overview

The unit starts by reviewing the definition of a function, represented as an input-output machine and a graph. Students then review in-depth linear functions, working with slopes and  $y$ -intercepts.

The focus moves to transforming basic linear functions by adding and multiplying a function by a constant. Students study how to transform functions by altering parent graphs and observing the resulting changes in slope,  $x$ - and  $y$ -intercepts, and rates of change. Students experiment with altering the input value of a function and observe the changes that occur to the graph.

The conceptual part of the unit ends with a look at absolute value functions, piecewise linear functions, and linear sequences to further understand domain, range, and rate of change.



### Goals and Learning Objectives

- ▶ Compare different functions in formula, graph, and table form.
- ▶ Use the concept of input-output machines to study functions.
- ▶ Learn and use different types of function notation.
- ▶ Compare functions and non-functions.
- ▶ Graph lines using only two data points, or one data point and the slope.
- ▶ Understand the relationship between functions and their inverses.
- ▶ Experiment with transformations of linear functions and observe the effects they have on their graphs.
- ▶ Understand the concept of absolute value and piecewise functions.

### Assessments

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

### Standards

#### Interpreting Functions

- ▶ HSF.IF.A.1, HSF.IF.A.2, HSF.IF.A.3, HSF.IF.B.4, HSF.IF.B.5, HSF.IF.C.7, HSF.IF.C.7.a, HSF.IF.C.7.b, HSF.IF.C.9

#### Building Functions

- ▶ HSF.BF.A.1, HSF.BF.A.1.a, HSF.BF.A.2, HSF.BF.B.3, HSF.BF.B.4, HSF.BF.B.4.a

#### Linear, Quadratic, and Exponential Models

- ▶ HSF.LE.A.1, HSF.LE.A.1.a, HSF.LE.A.1.b

### Instruction and Assessment Pacing Plan



# Grade 9 Unit 3 at a Glance: Linear Equations and Inequalities

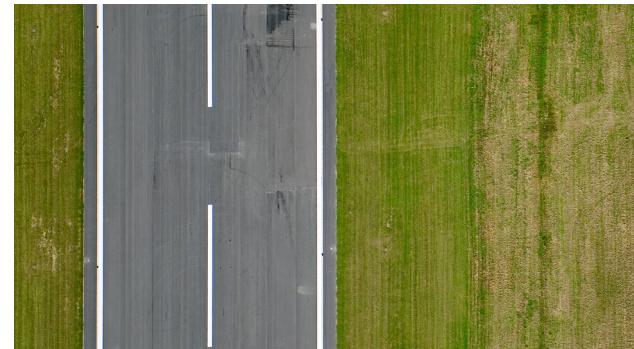
## Overview and Pacing Guide

### Unit Overview

The goal of the unit is for students to understand systems of linear equations and inequalities in two variables, as well as modeling and solving real-world situations with two variables and a set of constraints. Students represent these constraints as equations or inequalities with unknowns.

The unit begins by reviewing linear functions and their graphs. Linear equations in two variables are used to model real-world scenarios. The focus then shifts to finding the solutions to systems of linear equations. Students learn two methods for solving such systems algebraically—substitution and elimination. They also learn to represent their results graphically and see that a system of linear equations can have an infinite amount of solutions, no solutions, or just one solution.

Students move on to study literal interpretations of points not included in these functions. They are introduced to the graphs of linear inequalities as intervals on a number line and regions in the coordinate plane, as defined by the graphs of linear functions. They first experiment with linear inequalities in one variable before considering linear inequalities in two variables; students apply their knowledge of linear inequalities to view the solution to a system of linear inequalities as a bounded region in the coordinate plane.



### Standards

#### Creating Equations

- ▶ HSA.CED.A.1, HSA.CED.A.2, HSA.CED.A.3, HSA.CED.A.4

#### Reasoning with Equations and Inequalities

- ▶ HSA.REI.A.1, HSA.REI.B.3, HSA.REI.C.5, HSA.REI.C.6, HSA.REI.D.10, HSA.REI.D.11, HSA.REI.D.12

### Goals and Learning Objectives

- ▶ Graph linear equations and inequalities on a number line and on the coordinate plane.
- ▶ Graph systems of equations and use the graphs to find the solutions.
- ▶ Write and graph two functions using the two sides of a linear equation to illustrate its solution.
- ▶ Use the properties of equality to solve linear equations and simple rational equations.
- ▶ Understand the properties of inequality.
- ▶ Graph two or more inequalities on the same coordinate plane and interpret the various regions of the graph.
- ▶ Write linear equations and inequalities to model and answer questions about real-world situations.
- ▶ Set up a system of linear equations to model a real-world problem and solve the system using elimination, substitution, and graphing.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before each quiz (8, 16)
- ▶ Quiz (9, 17)
- ▶ Unit Assessment (20)

### Instruction and Assessment Pacing Plan

#### Lessons



# Grade 9 Unit 5 at a Glance: Working With Expressions

## Overview and Pacing Guide

### Unit Overview

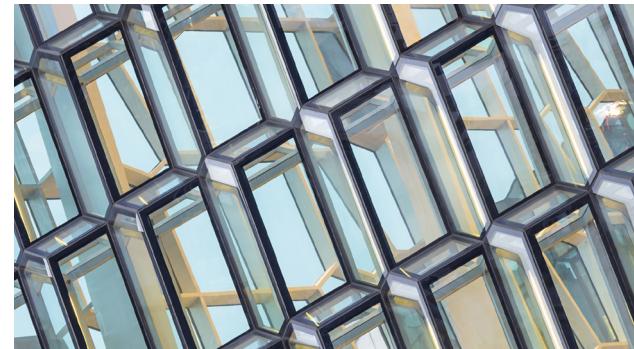
Students explore the relationship between squares and square roots and the use of fractional exponents. Students use the properties of exponents to simplify expressions containing square roots in simplest radical form.

Students learn how irrational numbers fit into the real number system. They learn that whole numbers are closed under addition and multiplication, integers are closed under subtraction, and rational numbers are closed under non-zero division and integer exponents. Including irrational numbers in the set of real numbers allows it to be closed under roots of non-negative numbers as well.

Students perform operations on polynomials. They learn to add, subtract, and multiply polynomials using properties of addition, multiplication, equality, and the distributive property.

Students then learn the general technique of factoring trinomials using clues from their structure to easily find the factors. Students also examine special products of binomials and use patterns to multiply and factor these special cases efficiently. Students divide polynomials, using concepts from the multiplicative inverse. They use properties of exponents and factoring to find the quotients.

Students then perform operations on radical expressions. They learn that the radicands must be the same when adding and subtracting radical expressions but not when multiplying and dividing them.



### Goals and Learning Objectives

- ▶ Use the properties of exponents to simplify expressions containing rational exponents and write radical expressions in simplest form.
- ▶ Explain the meaning of *rational* and *irrational* in terms of a number system.
- ▶ Add, subtract, and multiply polynomials, justifying the steps used with mathematical properties.
- ▶ Factor second-degree polynomials into two binomial factors.
- ▶ Use patterns to multiply special binomial pairs, and factor special trinomials fluently.
- ▶ Divide polynomials, and explain why polynomials are not closed under division.
- ▶ Add, subtract, multiply, and divide radical expressions.
- ▶ Solve radical equations and identify extraneous roots.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Self Check the day before the quiz (10)
- ▶ Quiz (11)
- ▶ Unit Assessment (13)

### Instruction and Assessment Pacing Plan

#### Lessons

1	2	3	4	5	6	7	8	9	10	11	12	13
---	---	---	---	---	---	---	---	---	----	----	----	----

#### Unit Assessment



# 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.



### 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 9 Unit 6 at a Glance: Quadratic Functions

## Overview and Pacing Guide

### Unit Overview

This unit covers quadratic functions, their real-world applications, and their graphs, which are parabolas. Students are introduced to the shape of parabolas as seen in real-world scenarios and begin to work with and manipulate quadratic functions.

Students explore transformations of the parabola. They investigate how altering a parent quadratic function causes direct changes in the resulting graph, such as translations and stretching vertically and horizontally.

Students then focus more on the geometric view of the parabola, covering topics such as finding the zeros and the vertex. Then students analyze the varying rate of change in quadratic functions and learn how this differs from a linear constant rate of change. They demonstrate the effect of operations on functions and their graphs. Students then relate square root functions to quadratics, including translations of square root functions.

The real-world problems in the unit involve finding the zeros and the maxima and minima of functions. Students work with formulas for functions in vertex form and general form. Students perform transformations on the quadratic functions and add and subtract quadratic functions.



### Standards

#### Seeing Structure in Expressions

- HSA.SSE.A.2

#### Interpreting Functions

- HSF.IF.B.4, HSF.IF.B.5, HSF.IF.B.6, HSF.IF.C.7, HSF.IF.C.7.a, HSF.IF.C.7.b, HSF.IF.C.8, HSF.IF.C.8.a, HSF.IF.C.9

#### Building Functions

- HSF.BF.A.1, HSF.BF.A.1.a, HSF.BF.A.1.b, HSF.BF.B.3, HSF.BF.B.4

### Goals and Learning Objectives

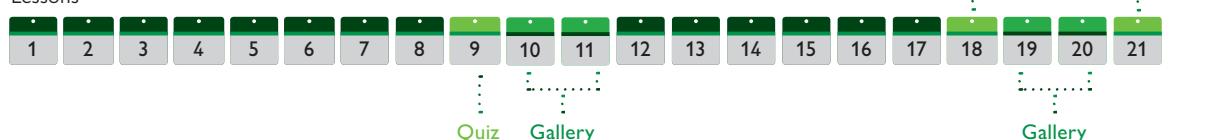
- Analyze properties of the graphs of quadratic functions.
- Model real-world problems using quadratic functions.
- Analyze types of transformations that change the parent function.
- Use the vertex form of a quadratic function to show transformations.
- Write quadratic functions in standard form, vertex form, and factored form.
- Calculate average rate of change.
- Calculate second differences.
- Graph a quadratic function and a square root function on the same graph.

### Assessments

- Exercises after each instructional lesson
- Self Check the day before each quiz (8, 17)
- Quiz (9, 18)
- Unit Assessment (21)

### Instruction and Assessment Pacing Plan

#### Lessons



# Grade 9 Unit 7 at a Glance: Quadratic Equations

## Overview and Pacing Guide

### Unit Overview

This unit goes in depth into the various methods for solving specific quadratic equations. Using vertex form, factored form, the quadratic formula, and the process of completing the square, students become well versed in determining the best method for solving any quadratic equation.

Additionally, they learn how to use the discriminant of the quadratic formula to determine the number of solutions as well as the nature of their corresponding graphs. Students cover multiple problem-solving exercises involving quadratic equations and solve systems of equations with quadratic and linear equations.

Students also solve problems involving quadratic inequalities. Complex numbers are introduced, enabling students to solve all quadratic equations.



### Goals and Learning Objectives

- ▶ Solve quadratic equations and determine what the solutions mean in the context of projectile motion.
- ▶ Identify the link between the roots of a quadratic function and the factors of its expression.
- ▶ Learn the *completing the square* method for solving quadratic equations.
- ▶ Derive the quadratic formula.
- ▶ Determine and justify the best method for solving a quadratic equation.
- ▶ Understand the relationship between the graph of a quadratic function and the value of its discriminant.
- ▶ Model real-world situations using quadratic and linear equations and inequalities.
- ▶ Solve quadratic equations that do not have real solutions.

### Assessments

- ▶ Exercises after each instructional lesson
- ▶ Quiz (16)
- ▶ Self Check the day before the quiz (15)
- ▶ Unit Assessment (20)

### Standards

#### The Complex Number System

- ▶ HSN.CN.A.1, HSN.CN.C.7

#### Seeing Structure in Expressions

- ▶ HSA.SSE.A.2, HSA.SSE.B.3, HSA.SSE.B.3.a, HSA.SSE.B.3.b

#### Arithmetic with Polynomials and Rational Expressions

- ▶ HSA.APR.B.3

#### Creating Equations

- ▶ HSA.CED.A.1

#### Reasoning with Equations and Inequalities

- ▶ HSA.REI.A.1, HSA.REI.B.4, HSA.REI.B.4.a, HSA.REI.B.4.b, HSA.REI.C.7

#### Interpreting Functions

- ▶ HSF.IF.C.8, HSF.IF.C.8.a

### Instruction and Assessment Pacing Plan

#### Lessons

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----

#### Quiz

#### Unit Assessment

#### Gallery