

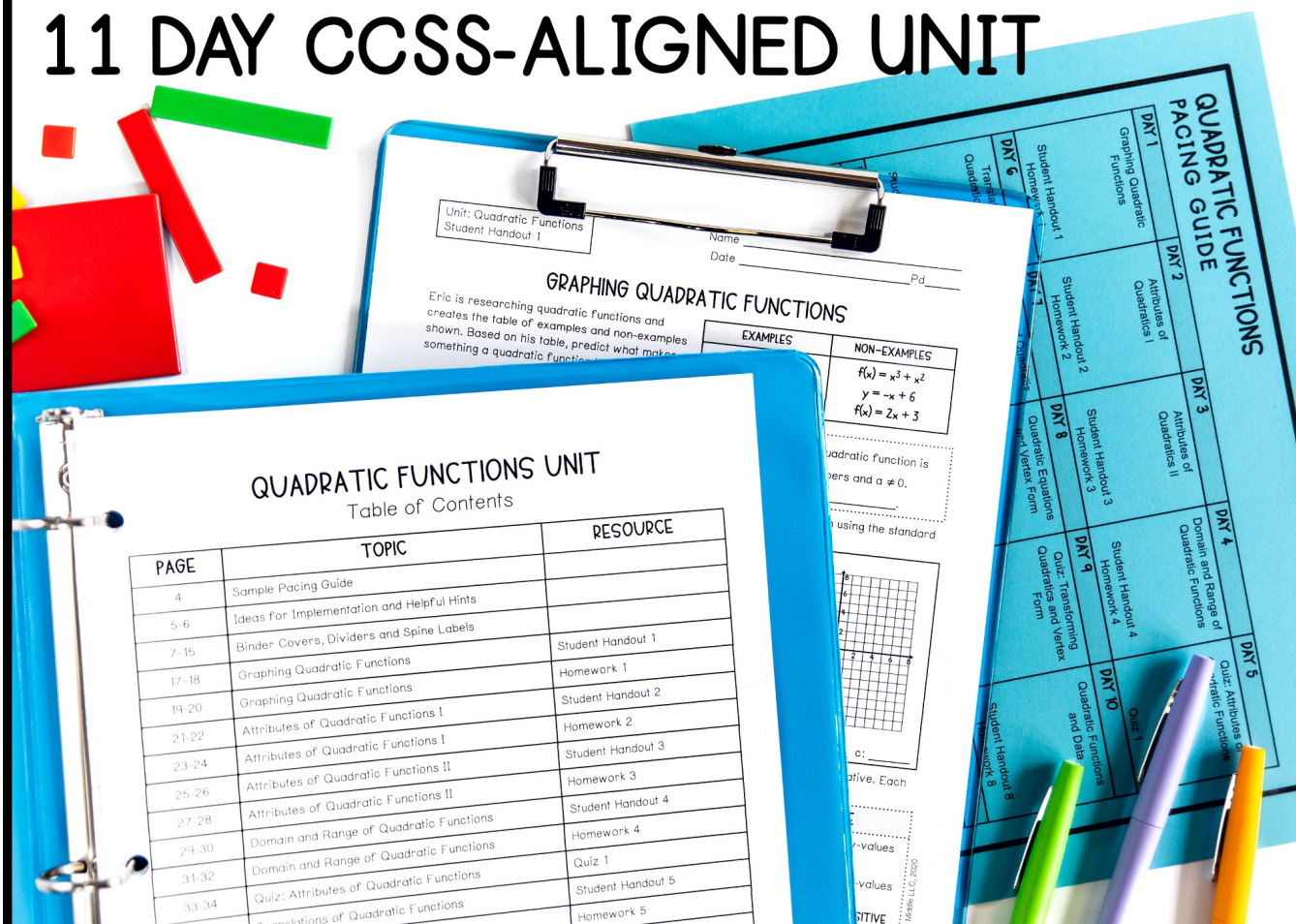
# learning focus:

- ✓ write and graph quadratic functions and identify key attributes
- ✓ find domain and range of quadratic functions
- ✓ determine the effects on the graph of the parent function  $f(x) = x^2$

# QUADRATIC FUNCTIONS UNIT

## 11 DAY CCSS-ALIGNED UNIT

**ALG  
1**



**A MANEUVERING THE MIDDLE® RESOURCE**

# QUADRATIC FUNCTIONS

**ALG  
1**

an 11 day CCSS-aligned unit

CCSS: F.IF.4, F.IF.5, F.IF.7A, F.IF.9, F.BF.3, S.ID.6A

**ready-to-go, scaffolded  
student materials**

## QUADRATIC FUNCTIONS UNIT

### Table of Contents

PAGE	TOPIC	RESOURCE
4	Sample Pacing Guide	
5-6	Ideas for Implementation and Helpful Hints	
7-15	Binder Covers, Dividers and Spine Labels	
17-18	Graphing Quadratic Functions	Student Handout 1
19-20	Graphing Quadratic Functions	Homework 1
21-22	Attributes of Quadratic Functions I	Student Handout 2
23-24	Attributes of Quadratic Functions I	Homework 2
25-26	Attributes of Quadratic Functions II	Student Handout 3
27-28	Attributes of Quadratic Functions II	Homework 3
29-30	Domain and Range of Quadratic Functions	Student Handout 4
31-32	Domain and Range of Quadratic Functions	Homework 4
33-34	Quiz: Attributes of Quadratic Functions	Quiz 1
35-36	Translations of Quadratic Functions	Student Handout 5
37-38	Translations of Quadratic Functions	Homework 5
39-40	Dilations of Quadratic Functions	Student Handout 6
41-42	Dilations of Quadratic Functions	Homework 6
43-44	Quadratic Equations and Vertex Form	Student Handout 7
45-46	Quadratic Equations and Vertex Form	Homework 7
47	Quiz: Transforming Quadratics and Vertex Form	Quiz 2
49-50	Quadratic Functions and Data	Student Handout 8
51	Quadratic Functions and Data	Homework 8
53-56	Quadratic Functions Study Guide	Review
57-59	Quadratic Functions Unit Test	Test

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student friendly + real-world  
application

graphic  
organizers

Unit: Quadratic Functions  
Student Handout 5

Name \_\_\_\_\_  
Date \_\_\_\_\_ Pd \_\_\_\_\_

## TRANSLATIONS OF QUADRATIC FUNCTIONS

A \_\_\_\_\_ function is the most basic function of a certain type. While the linear parent function is \_\_\_\_\_, the quadratic parent function is \_\_\_\_\_. Complete a-c to see how changes to the parent function will change the function's graph as well.

1. Complete the table for  $f(x)$  and graph the parent function. Then repeat the steps for  $g(x)$  and  $h(x)$ .

x	$f(x) = x^2$	$g(x) = x^2 + 2$
-2		
-1		
0		
1		
2		

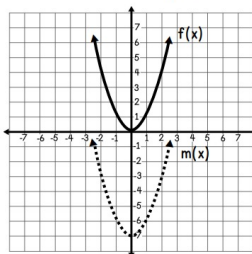
a. Describe how the equation and the graph of  $g(x)$  compare to  $f(x)$ .

b. Describe how the equation and the graph of  $h(x)$  compare to  $f(x)$ .

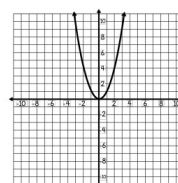
Summarize your findings by completing the table below.

VERTICAL TRANSLATIONS	
• If $f(x) = x^2$ , then	
• If $d > 0$ , $f(x) + d$	
• If $d < 0$ , $f(x) - d$	

2. Lorenzo translated  $f(x)$  to create  $m(x)$ .



The parent function  $f(x) = x^2$  is shown at the right. In a-b, observe how transforming a function using  $f(x - c)$  affects the graph of  $f(x)$ .



a. Enter the function  $p(x) = (x - 2)^2$  into your calculator. Sketch its graph at the right and describe how the equation and the graph compare to  $f(x)$ .

b. Predict how the graph of  $r(x) = (x + 3)^2$  will compare to  $f(x)$ . Use your graphing calculator and sketch the graph.

## HORIZONTAL TRANSLATIONS

- If  $f(x) = x^2$ , then
- If  $c > 0$ ,  $f(x - c)$
- If  $c < 0$ ,  $f(x + c)$

3. Complete the table to compare the features of  $f(x)$  and  $p(x)$  above. Then, circle the features that a horizontal shift will change.

The graph of  $f(x) = x^2$  was transformed to create  $p(x)$ .

A.  $g(x) = f(x) - 2.5$  B.  $h(x) = f(x - 3)$

4. Describe each transformation in your own words.

A: \_\_\_\_\_  
B: \_\_\_\_\_  
C: \_\_\_\_\_  
D: \_\_\_\_\_

5. Which cards have functions with the same features as  $f(x)$ ?

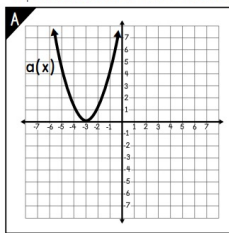
- the same axis of symmetry as  $f(x)$
- the same range as  $f(x)$
- the same vertex as  $f(x)$

Unit: Quadratic Functions  
Homework 5

Name \_\_\_\_\_  
Date \_\_\_\_\_ Pd \_\_\_\_\_

## TRANSLATIONS OF QUADRATIC FUNCTIONS

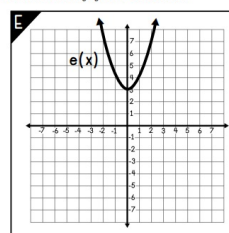
Representations A-E show a transformation of the parent function  $f(x) = x^2$ . Use the representations to mark each statement in the table as true or false. Justify your choices.



B.  $b(x) = (x + 4)^2$

C.  $c(x) = x^2 - 8.5$

D.  $d(x) = (x - 1.5)^2$



STATEMENT	T/F?	JUSTIFY
1. Function $a(x)$ can be represented by $a(x) = x^2 - 3$ .		
2. Function $b(x)$ represents a vertical shift 4 units up.		
3. Function $c(x)$ will have the same axis of symmetry as the parent function.		
4. Function $d(x)$ will not have the same range as the parent function $f(x)$ .		
5. Function $e(x)$ can be represented by $e(x) = x^2 + 3$ .		

Use your knowledge of translations to answer 6-10.

6. The graph of  $f(x) = x^2$  was transformed to create  $g(x) = f(x) - 9$ . Which of the following represents the vertex of  $g(x)$ ?

- a. (0, 9)
- b. (9, 0)
- c. (0, -9)
- d. (-9, 0)

7. Angel believes that a vertical shift of the parent function  $f(x) = x^2$  will always change the domain of the function. Do you agree or disagree? Explain.

error analysis



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CCSS: F.IF.4, F.IF.5, F.IF.7A, F.IF.9, F.BF.3, S.ID.6A

streamline your planning  
process with unit overviews

## QUADRATIC FUNCTIONS OVERVIEW



### STANDARD

**F.IF.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries

**F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

**F.IF.7A** Graph linear and quadratic functions and show intercepts, maxima, and minima.

**F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

**F.BF.3** Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

**S.ID.6.A** Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context.

### BIG IDEAS

- Quadratic functions form parabolas with characteristics depending on the direction of opening.
- The graphs of the quadratic functions are related to the original function.
- Vertex form is another way to represent a parabola.

### ESSENTIAL QUESTION

- How can attributes be used to describe a parabola?
- What are the real-world meanings of the attributes of a parabola?
- Which attributes are changeable?
- What advantages are there to using different representations of a parabola?

## QUADRATIC FUNCTIONS PACING GUIDE



DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Graphing Quadratic Functions	Attributes of Quadratics I	Attributes of Quadratics II	Domain and Range of Quadratic Functions	Quiz: Attributes of Quadratic Functions
Student Handout 1 Homework 1	Student Handout 2 Homework 2	Student Handout 3	Student Handout 4	
DAY 6	DAY 7			
Translations of Quadratic Functions	Dilations of Quadratic Functions			
Student Handout 5 Homework 5	Student Handout 6 Homework 6			
DAY 11	DAY 12			
Quadratic Functions Study Guide	Quadratic Functions Unit Test			
Review	Test			

## QUADRATIC FUNCTIONS OVERVIEW



TOPIC	TEACHING TIPS
Graphing Quadratic Functions	<ul style="list-style-type: none"><li>Prepare to spend time helping students become familiar with graphing quadratic functions on a calculator.</li><li>Use the table and trace function to explore how the y-values change as x increases to solidify the concepts of increasing/decreasing and positive/negative.</li><li>Reinforcing that a parabola with a negative "a" value will always open down will be helpful when students transform quadratics later in the unit, specifically with reflections.</li></ul>
Attributes of Quadratics	<ul style="list-style-type: none"><li>Search desmos.com for "Polygraph: Parabolas" for a fun, interactive game that students can play. Students will try and correctly guess the parabola by asking yes or no questions about the attributes of the graph to narrow down their choices.</li></ul>
Transformations of Quadratics	<ul style="list-style-type: none"><li>Desmos.com has a graphing calculator feature that can be especially helpful for demonstrating transformations to your class. You will be able to easily manipulate functions and see the effects on the graph in a way that is easy for students to observe.</li><li>Consider the following to help students grasp and practice transforming quadratics:<ul style="list-style-type: none"><li>Print a large copy of the parent function on a coordinate grid and laminate for each student.</li><li>Students can then use a dry erase marker to practice transformations easily.</li><li>Other than using dry erase markers, students could line up a pipe cleaner or wiki stick in the shape of the parent function and transform on the paper using their model. This would be especially helpful to establish the vocabulary of "compressing" and "stretching" both vertically and horizontally with dilations.</li></ul></li></ul>
Vertex Form	<ul style="list-style-type: none"><li>Keeping track of all the variables in vertex form can be challenging. Have students form the habit of always labeling the x and y-values of the given point as well as "h" and "k" of the vertex to help them substitute the correct variables in the correct places of the formula.</li><li>Have students practice using and referencing their formula chart to find vertex form so they are familiar with it when it comes time for standardized testing.</li></ul>
Quadratic Functions and Data	<ul style="list-style-type: none"><li>Students will need extra time on this topic to become familiar with entering data into a list on their graphing calculators and running a quadratic regression.</li></ul>

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teaching  
ideas

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## unit study guide + assessments

✓ quizzes

✓ editable unit test

Unit: Quadratic Functions  
Quiz 1

Name \_\_\_\_\_  
Date \_\_\_\_\_ Pd \_\_\_\_\_

**QUIZ: ATTRIBUTES OF QUADRATIC FUNCTIONS**  
Show all work and record your solutions in the box at the right.

1. Sketch the axis of symmetry on the quadratic function shown at the right. Then write the equation for the axis of symmetry in the answer bank.

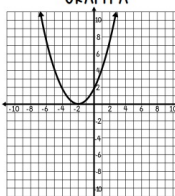
2. Find the vertex of the function  $g(x) = -x^2 + 6x - 8$ .

3. What is the range of  $y = -x^2 + 8x - 14$ ?

a.  $y \leq 4$       b.  $y \leq 2$       c. all real numbers

Use graphs A-C to answer questions 4-6.

**GRAPH A**



4. Which graph represents  $y = x^2 + 6x + 7$ ?

5. Which graph represents  $y = x^2 - 6x + 8$ ?

a. -5      b. 6.5  
c. 8      d. -2

Answers

1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_

Unit: Quadratic Functions  
Review

Name \_\_\_\_\_  
Date \_\_\_\_\_ Pd \_\_\_\_\_

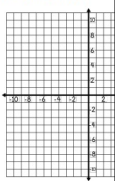
**QUADRATIC FUNCTIONS STUDY GUIDE**  
Solve each problem below. Be sure to ask questions if you need more help with a topic.

**I CAN GRAPH QUADRATIC FUNCTIONS AND IDENTIFY KEY ATTRIBUTES.**

1. Complete the table of values to create a graph of  $f(x) = x^2 - 10$ . Then determine where  $f(x)$  is increasing and decreasing.

x	f(x)
-2	
-1	
0	
1	
2	

2. Use the graph to identify the features of the parabola.



increasing: \_\_\_\_\_ decreasing: \_\_\_\_\_

3. Sketch a parabola that meets the following:

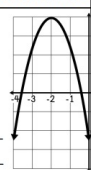
- negative "a" value
- vertex in quadrant II
- one positive and one negative zero

4. For  $g(x) = 4x^2 - 16x + 19$ , use  $-\frac{b}{2a}$  to find the axis of symmetry and the vertex.

axis of symmetry: \_\_\_\_\_  
vertex: \_\_\_\_\_

**I CAN DETERMINE THE DOMAIN AND RANGE OF A QUADRATIC FUNCTION.**

6. Find the domain and range of the quadratic function.



D: \_\_\_\_\_  
R: \_\_\_\_\_

ALGEBRA 1 CURRICULUM

# QUADRATIC FUNCTIONS

UNIT EIGHT: ANSWER KEY

answer keys  
included

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