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Lesson 2: Transformers: More Than Meets the y's

Solidify Understanding

Jump Start

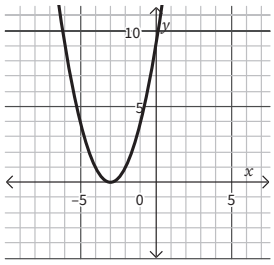
Without using technology, match each of the equations with the graph of the function. Be careful; there are more graphs than equations!

A. _____
$f(x) = x^2 - 3$

B. _____
$f(x) = 3x^2$

C. _____
$f(x) = (x - 3)^2$

D. _____
$f(x) = \frac{1}{3}x^2$

1.


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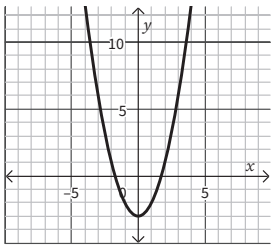

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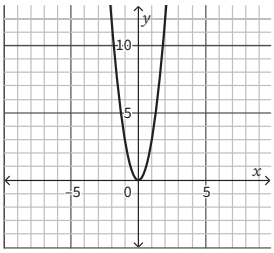

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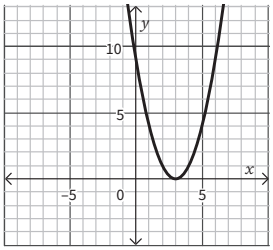

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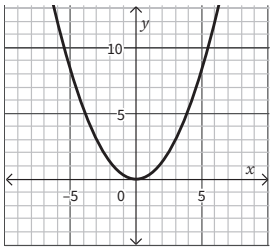

Learning Focus

Write equations for functions that are transformations of $f(x) = x^2$.

Find efficient methods for graphing transformations of $f(x) = x^2$.

What happens to the graph of $f(x) = x^2$ when more than one transformation is applied?

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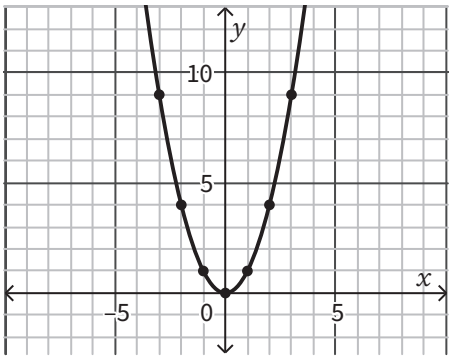
Open Up the Math
Launch, Explore, Discuss

In the previous lesson, you learned about transformations of the graph of $f(x) = x^2$. In this lesson, you will be writing equations and graphing functions that have more than one transformation. It will be a lot easier if you know a few points on $f(x) = x^2$ that we can use for comparisons. We'll call them anchor points.

1. Identify each anchor point shown on the graph of $f(x) = x^2$.



Anchor points:

- Vertex (_____, _____)
- $(1,$ _____$)$ and $(-1,$ _____$)$
- $(2,$ _____$)$ and $(-2,$ _____$)$
- $(3,$ _____$)$ and $(-3,$ _____$)$

Line of symmetry: $x =$ _____

Write the equation for each problem below. Use a second representation to check your equation.

2. The area of a square with side length x, where the side length is decreased by 3, the area is multiplied by 2, and then 4 square units are added to the area.

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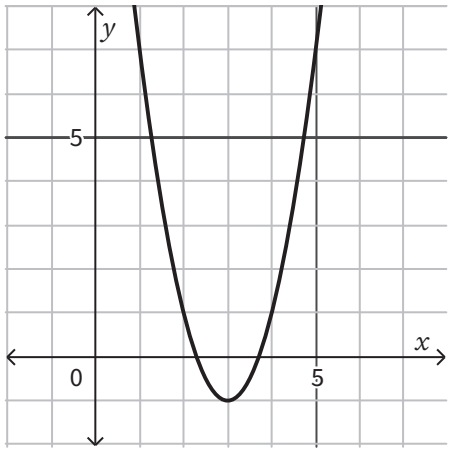
3.



4.

x	$f(x)$
-4	7
-3	2
-2	-1
-1	-2
0	-1
1	2
2	7
3	14
4	23

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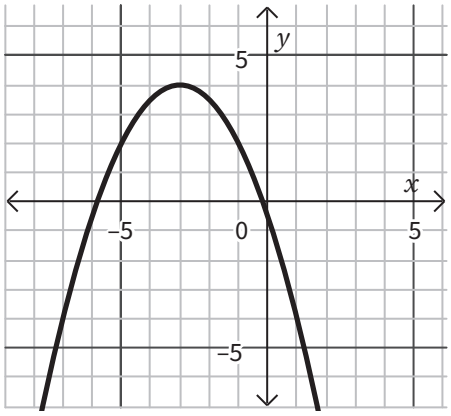
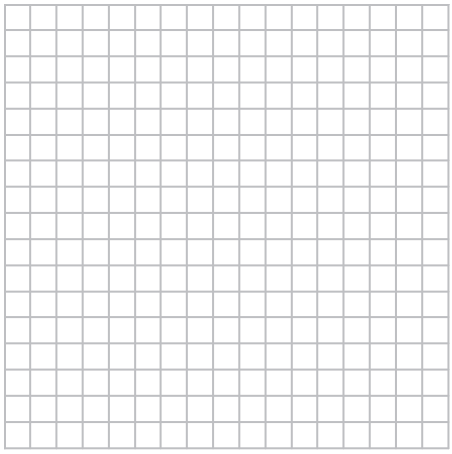
5.



Graph each equation without using technology. Be sure to have the exact vertex and at least two correct points on either side of the line of symmetry.

6. $f(x) = -x^2 + 3$



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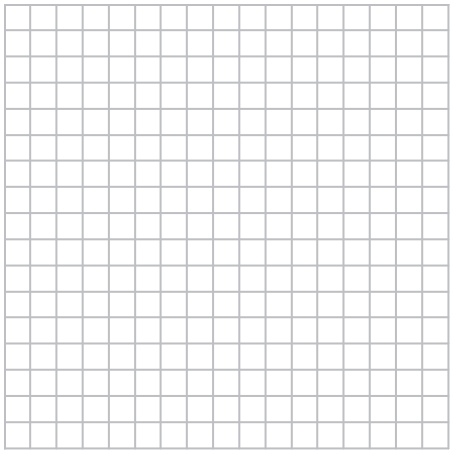
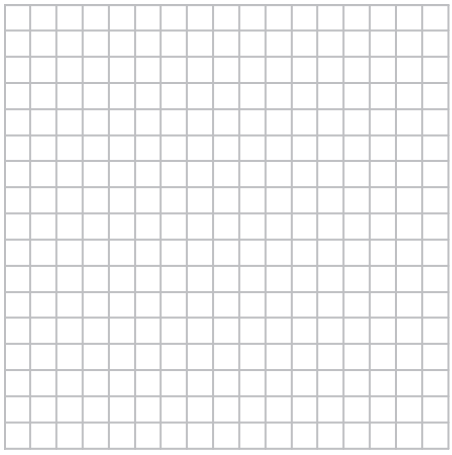
7. $g(x) = (x + 2)^2 - 5$



8. $h(x) = 3(x - 1)^2 + 2$



9. Given: $f(x) = a(x - h)^2 + k$

a. What point is the vertex of the parabola?

b. What is the equation of the line of symmetry?

c. How can you tell if the parabola opens up or down?

d. How do you identify the vertical stretch?

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10. Does it matter in which order the transformations are done? Explain why or why not.

Ready for More?

Think about applying the transformations to the parent function $f(x) = 2^x$.

1. What point makes sense to use as an anchor point on this function?

2. What do you think is the equation of the function with a horizontal shift left 3?

3. How does the horizontal shift on $y = 2^x$ work like the horizontal shift on $y = x^2$?

Takeaways

Vertex form of a quadratic equation:

- Vertex:
- Line of symmetry:
- Vertical stretch:
- Opens upward:
- Opens downward:

Quick-graph method for graphing quadratics:

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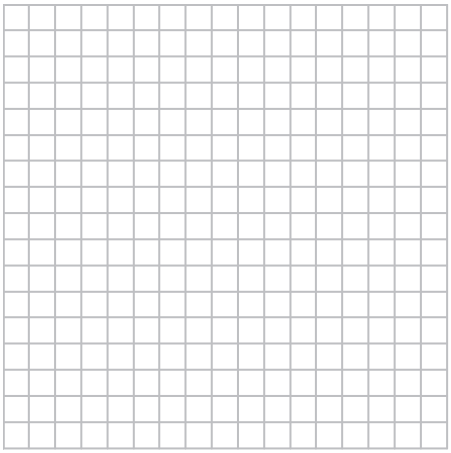
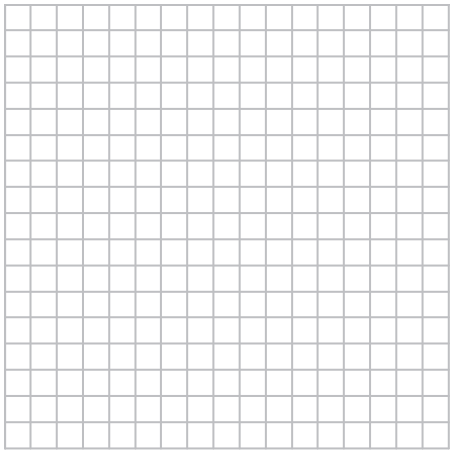
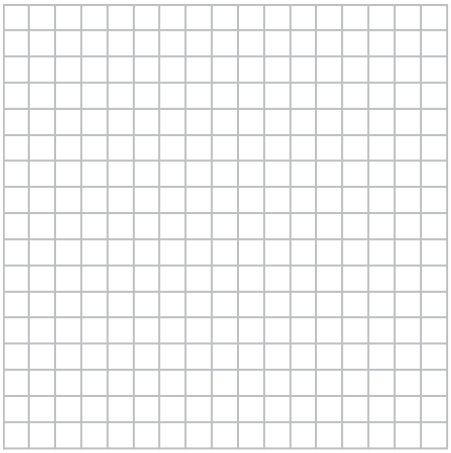
a. $y = (x - 4)^2 - 3$



b. $y = -(x + 2)^2 + 5$



c. $y = 2(x + 1)^2 - 5$



Vocabulary

- **vertex form**

Bold terms are new in this lesson.

Lesson Summary

In this lesson, we learned to graph quadratic functions that have a combination of transformations. We found that the vertex form of the equation of a quadratic function makes it easy to find the vertex and identify the transformations. We wrote equations in vertex form from graphs and tables,

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using our understanding of transformations and the features of parabolas.

Retrieval

The standard form for a quadratic equation is $y = ax^2 + bx + c$. In each of the following equations, identify the values for a, b, and c.

1. $y = 3x^2 - 7x + 12$

$a =$

$b =$

$c =$

2. $f(x) = 9x^2 + 4x - 8$

$a =$

$b =$

$c =$

3. $g(x) = 2x^2 + 11x + 15$

$a =$

$b =$

$c =$

4. $h(x) = -5x^2 + 41x + 36$

$a =$

$b =$

$c =$

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5. Use the table to identify the vertex, the equation for the line of symmetry, and state the number of x-intercept(s) the parabola will have, if any. State whether the vertex will be a minimum or a maximum.

x	y
-4	9
-3	2
-2	-3
-1	-6
0	-7
1	-6
2	-3

a. Vertex: _____

b. Line of symmetry: _____

c. x-int(s): _____

d. Minimum or maximum?

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