1.2 Transformations of Linear and Absolute Value Functions
For use with Exploration 1.2

Essential Question How do the graphs of $y = f(x) + k$, $y = f(x - h)$, and $y = -f(x)$ compare to the graph of the parent function f?

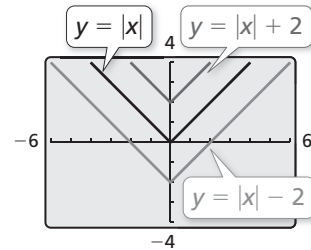## 1 EXPLORATION: Transformations of the Absolute Value Function

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Compare the graph of the function

$$y = |x| + k \qquad \text{Transformation}$$

to the graph of the parent function

$$f(x) = |x|. \qquad \text{Parent function}$$

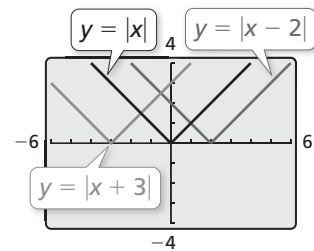## 2 EXPLORATION: Transformations of the Absolute Value Function

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Compare the graph of the function

$$y = |x - h| \qquad \text{Transformation}$$

to the graph of the parent function

$$f(x) = |x|. \qquad \text{Parent function}$$

1.2 **Transformations of Linear and Absolute Value Functions** (continued)

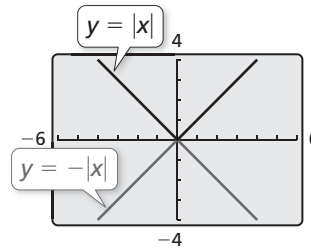**3** **EXPLORATION:** Transformation of the Absolute Value Function

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Compare the graph of the function

$$y = -|x| \qquad \text{Transformation}$$

to the graph of the parent function

$$f(x) = |x|. \qquad \text{Parent function}$$

Communicate Your Answer

4. How do the graphs of $y = f(x) + k$, $y = f(x - h)$, and $y = -f(x)$ compare to the graph of the parent function f?

5. Compare the graph of each function to the graph of its parent function f. Use a graphing calculator to verify your answers are correct.

   a. $y = \sqrt{x} - 4$ **b.** $y = \sqrt{x + 4}$ **c.** $y = -\sqrt{x}$

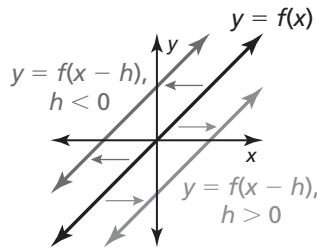   **d.** $y = x^2 + 1$ **e.** $y = (x - 1)^2$ **f.** $y = -x^2$

1.2 Notetaking with Vocabulary
For use after Lesson 1.2

Core Concepts

Horizontal Translations

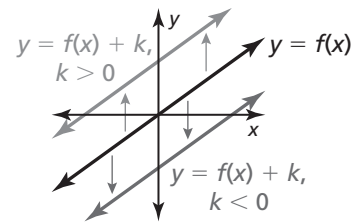The graph of $y = f(x - h)$ is a horizontal translation of the graph of $y = f(x)$, where $h \neq 0$.

Subtracting h from the **inputs** before evaluating the function shifts the graph left when $h < 0$ and right when $h > 0$.
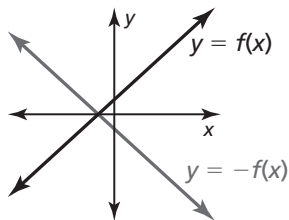
Vertical Translations

The graph of $y = f(x) + k$ is a vertical translation of the graph of $y = f(x)$, where $k \neq 0$.

Adding k to the **outputs** shifts the graph down when $k < 0$ and up when $k > 0$.

Notes:

1.2 Notetaking with Vocabulary (continued)

Reflections in the *x*-axis

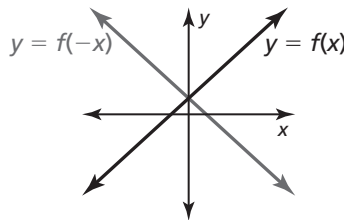The graph of $y = -f(x)$ is a reflection in
the *x*-axis of the graph of $y = f(x)$.

Multiplying the **outputs** by −1 changes their signs.

Reflections in the *y*-axis

The graph of $y = f(-x)$ is a reflection in
the *y*-axis of the graph of $y = f(x)$.

Multiplying the **inputs** by −1 changes their signs.

Notes:

Horizontal Stretches and Shrinks

The graph of $y = f(ax)$ is a horizontal stretch or

shrink by a factor of $\dfrac{1}{a}$ of the graph of $y = f(x)$,

where $a > 0$ and $a \neq 1$.

Multiplying the **inputs** by a before evaluating the
function stretches the graph horizontally (away from
the *y*-axis) when $0 < a < 1$, and shrinks the graph
horizontally (toward the *y*-axis) when $a > 1$.
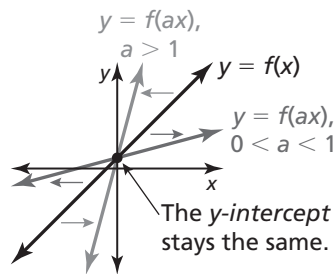
Notes:

1.2 Notetaking with Vocabulary (continued)

Vertical Stretches and Shrinks

The graph of $y = a \bullet f(x)$ is a vertical stretch or shrink by a factor of a of the graph of $y = f(x)$, where $a > 0$ and $a \neq 1$.

Multiplying the **outputs** by a stretches the graph vertically (away from the x-axis) when $a > 1$, and shrinks the graph vertically (toward the x-axis) when $0 < a < 1$.
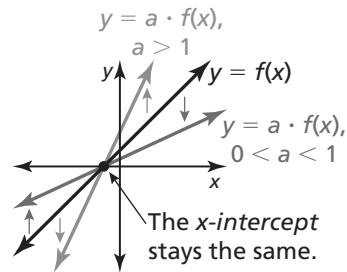
Notes:

Extra Practice

In Exercises 1–9, write a function *g* whose graph represents the indicated transformation of the graph of *f*. Use a graphing calculator to check your answer.

1. $f(x) = \left|\frac{1}{3}x\right|$; translation 2 units to the left

2. $f(x) = -|x + 9| - 1$; translation 6 units down

3. $f(x) = -2x + 2$; translation 7 units down

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1.2 **Notetaking with Vocabulary** (continued)

4. $f(x) = \frac{1}{2}x + 8$; reflection in the *x*-axis

5. $f(x) = 4 + |x + 1|$; reflection in the *y*-axis

6. $f(x) = -5x$; vertical shrink by a factor of $\frac{1}{5}$

7. $f(x) = |x + 3| + 2$; vertical stretch by a factor of 4

8. $f(x) = 3x - 9$; horizontal stretch by a factor of 6

9. $f(x) = -|8x| - 4$; horizontal shrink by a factor of $\frac{1}{4}$

10. Consider the function $f(x) = |x|$. Write a function *g* whose graph represents
a reflection in the *x*-axis followed by a horizontal stretch by a factor of 3 and
a translation 5 units down of the graph of *f*.

11. Which of the transformation(s) in Section 1.2 will *not* change the *y*-intercept
of $f(x) = |x| + 3$?