Chapter 14 Parent Guide
Functions and Transformations

This chapter takes a closer look at functions and their graphs. Chapter 14 is an extension of Lesson 10.1. Topics in this chapter will help students visualize geometric principles and pave the way for future mathematics courses.

This chapter is a study in how changes in the function affect the position and layout of a parabolic curve. Your son or daughter will have ample opportunity to become proficient with the graphics calculator during this chapter.

In Lesson 12.1, your child will identify parent functions of various kinds of functions. In Lesson 12.2, your child will describe how changes to the parent function affects the vertical and horizontal position of its graph.

In Lesson 12.3, your child will see which elements of a parent function can be changed to stretch or compress its graph. Next, in Lesson 14.4, your child will learn how to flip or reflect a function across the *x*- or *y*-axis. Finally, in Lesson 14.5, your child will see how multiple changes to a parent function affects the graph of the function.

By the end of this chapter, your child should have an intuitive notion of what a graph will look like just by looking at an equation. Students who can do this can be among the most successful math, science, or business students.

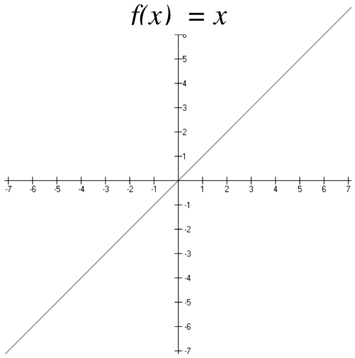
If you do the following activity together, you and your child will see how altering a parent function in one way can change its graph. A graphics calculator will help you.

PROBLEM FOR DISCUSSION (See textbook page 696)

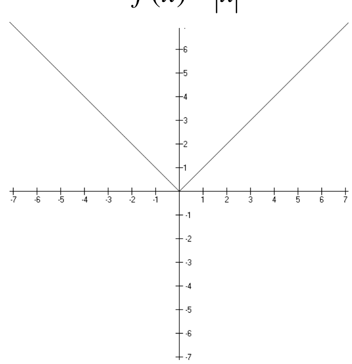
In nature, a mother or a father may have many offspring. In mathematics, a parent function can be transformed into many—in fact, infinitely many—new functions. A family of functions is comprised of these new functions and the parent function. Every function can be classified as a member of a family. Certain functions are identified as parent functions of these families. For example, the functions $f(x) = x^2$ or $y = x^2$ is the parent function of the family of quadratic functions. Use the table on page 696 to identify other parent functions. Consider the exercises below.

1. Graph each parent function.

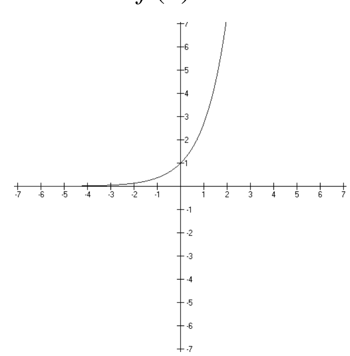
$f(x) = x$

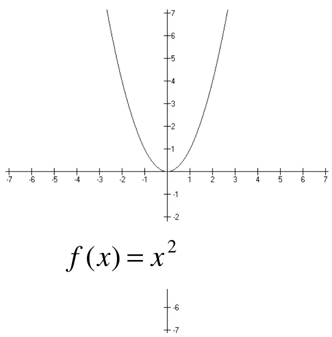


$f(x) = |x|$

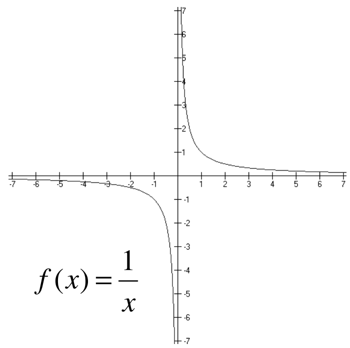


$f(x) = e^x$

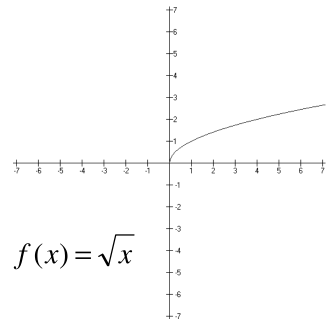




$f(x) = x^2$



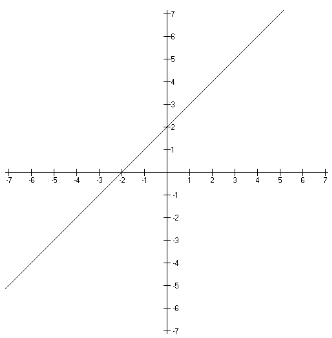
$f(x) = \frac{1}{x}$

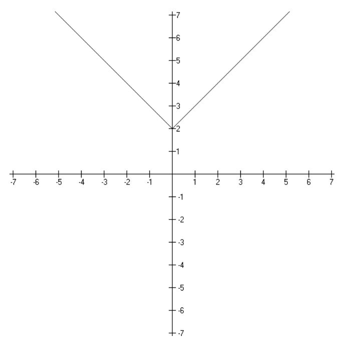


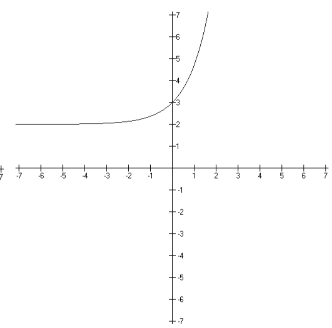
$f(x) = \sqrt{x}$

2. Add 1 to the right side of each parent function. Then graph each new function and describe how adding 2 affects the parent function.

Looking closely at the graphs, you see that the basic shapes are the same. The only thing that changed is that it moves the function up two units.



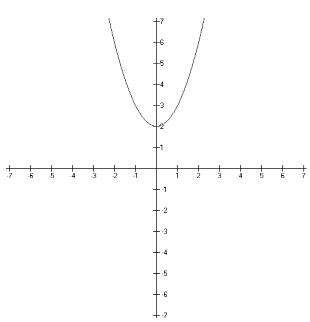


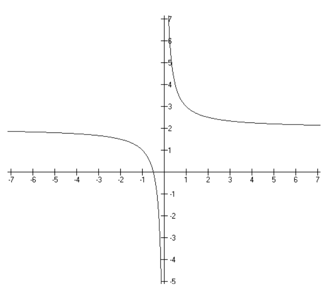


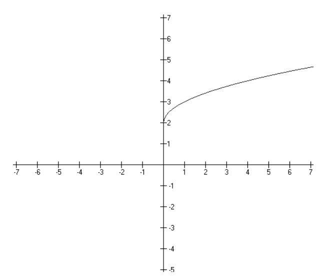
$f(x) = x + 2$

$f(x) = |x| + 2$

$f(x) = e^x + 2$







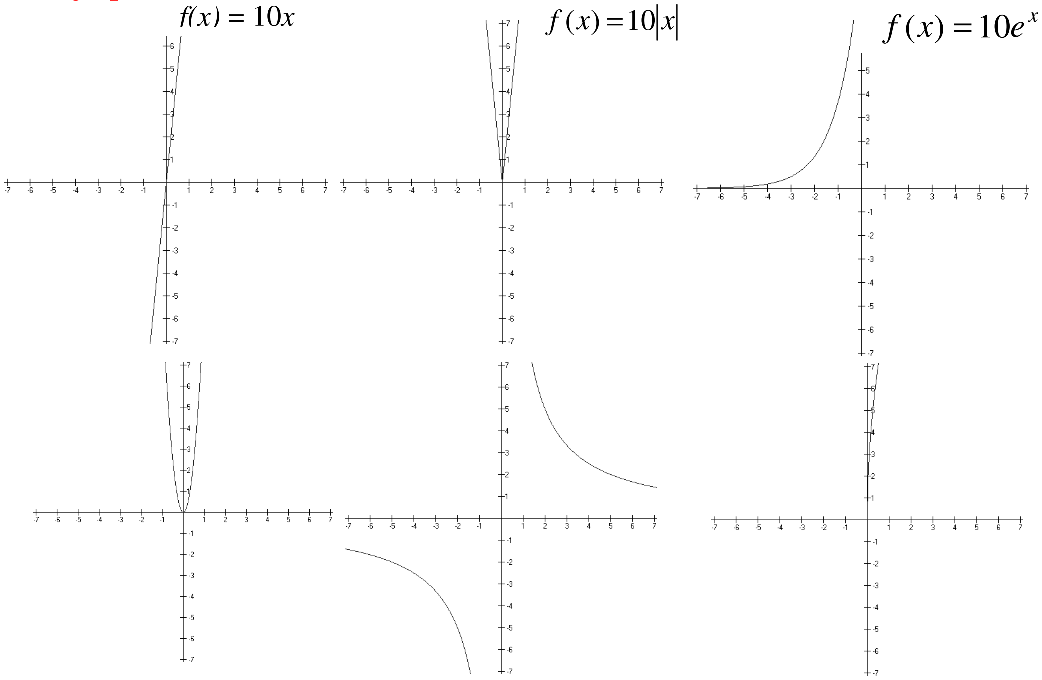
$f(x) = x^2 + 2$

$f(x) = \sqrt{x} + 2$

$f(x) = \frac{1}{x} + 2$

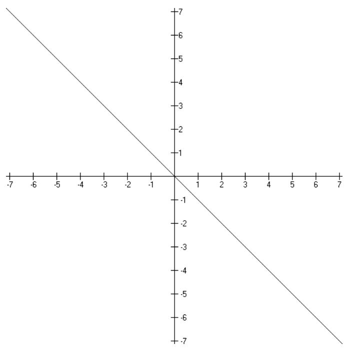
3. Multiply the right side of each parent function by 10. Then graph each new function and describe how multiplying by 10 affects the parent function.
When multiplying by 10 you can see that the graphs all get much narrower. Therefore, multiplying by 10 vertically stretches the graphs.

$f(x) = 10x$ $\quad f(x) = 10|x|$ $\quad f(x) = 10e^x$

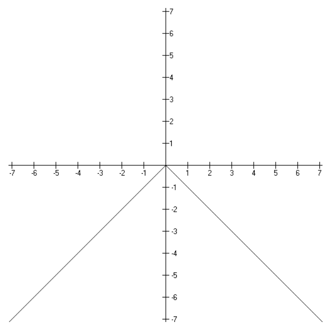


$f(x) = 10x^2$ $\quad f(x) = 10\sqrt{x}$ $\quad f(x) = \frac{10}{x}$

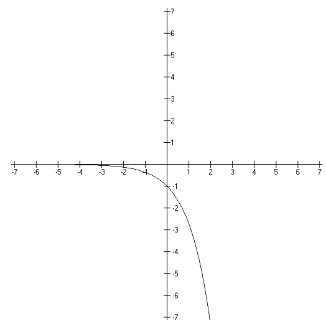
4. Multiply the right side of each parent function by –1. Then graph each new function and describe how multiplying by –1 affects the parent function.
Looking at these, you see that the graphs are the same only they have just been flipped over the x-axis. Therefore, multiplying by -1 reflects the graph over the x-axis.



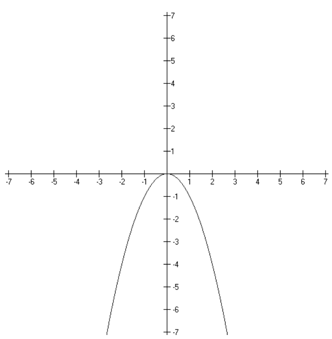
$f(x) = -x$



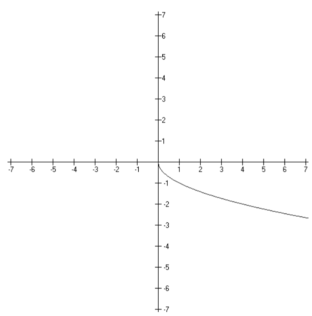
$f(x) = -|x|$



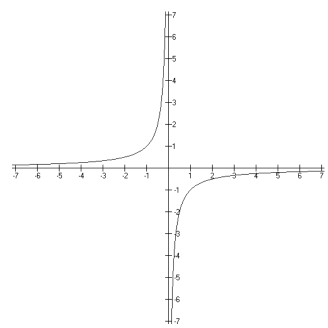
$f(x) = -e^x$



$f(x) = -1x^2$



$f(x) = \frac{-1}{x}$



$f(x) = -\sqrt{x}$

The following are complete worked out solutions to selected exercises in the student textbook. These solutions are provided to you so that you can help your child with their homework. Your child's classroom notes, example problems in the text, and these worked out solutions are all useful tools to help you and your child work through their assignment.

Lesson 14.1

11. $f(x) = |x|$
$f(-3) = |-3| = 3$
$f(-2) = |-2| = 2$
$f(-1) = |-1| = 1$
$f(0) = |0| = 0$
$f(1) = |1| = 1$
$f(2) = |2| = 2$
$f(3) = |3| = 3$
$(-3, 3), (-2, 2), (-1, 1), (0, 0), (1, 1), (2, 2), (3, 3)$

28. domain: $-2, 4, 5$
range: $-7, 1, 6$

35. $h(x) = x + 3$
$h(-8) = -8 + 3 = -5$

42. $f(x) = 2^x$
$f(3) = (2)^3 = 8$

49. independent variable: x
domain: all real numbers
range: $f(x) \leq 0$

58. $y = \sqrt{2x + 5}$
The parent function is $y = \sqrt{x}$.

Lesson 14.2

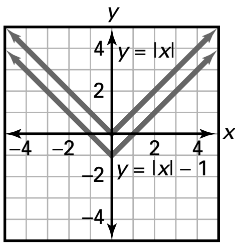
8. $y = (x - 2)^2$
Because 2 is subtracted from x before the quantity is squared, this is a horizontal translation. The graph of the parent function $y = x^2$ is translated 2 units to the right.

15. $y = |x| - 1$

a. The parent function is $y = |x|$.

b. The graph of $y = |x| - 1$ is identical to the graph of the parent function translated 1 unit down.

c.

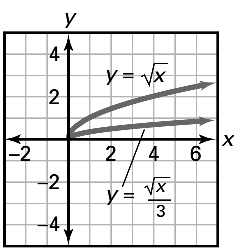


19. The point $(-2, 9)$ is a horizontal translation of the point $(3, 9)$ 5 units to the left. Thus the function $g(x) = (x + 5)^2$ is a horizontal translation of the parent function 5 units to the left.

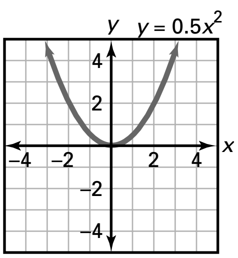
26. A horizontal translation of -1 means the x-value is decreased by 1. Thus the point $(5, 8)$ corresponds to the point $(4, 8)$.

Lesson 14.3

7. Use $y = \sqrt{x}$ to graph $y = \frac{\sqrt{x}}{3}$.

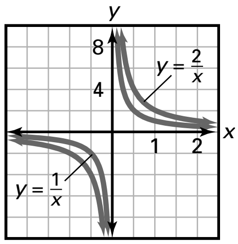


18.



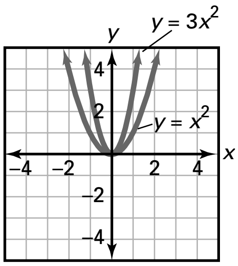
24. a. $y = \frac{1}{x}$

b.



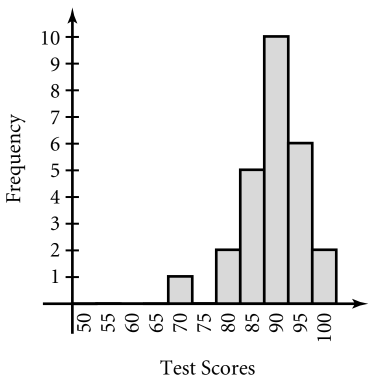
c. Each point (x, y) is transformed to the point $(x, 2y)$ on the new graph.

30. Parent function: $y = x^2$;



The graph of $y = 3x^2$ is a vertical stretch of the parent function by the scale factor 3.

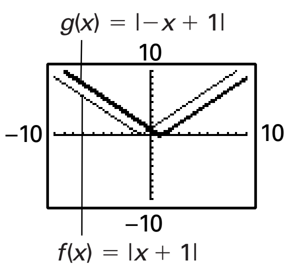
33.



The original graph has been shifted 20 units to the right.

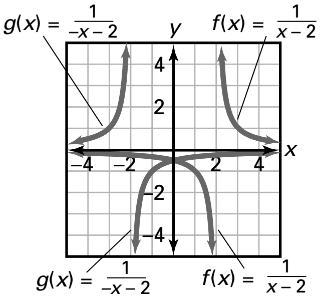
Lesson 14.4

8.



The function $g(x) = |-x + 1|$ is the reflection of f across the y-axis.

14.



The graph of g is a reflection of the graph of f across the y-axis.

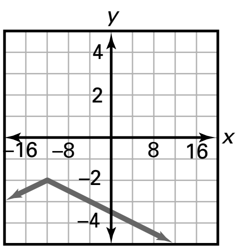
17. $f(x) = 5x + 2$

To reflect the graph of f across the x-axis, graph the function $g(x) = -f(x) = -(5x + 2) = -5x - 2$.

To reflect the graph of f across the y-axis, graph the function $h(x) = f(-x) = 5(-x) + 2 = -5x + 2$.

Lesson 14.5

8. $f(t) = -\frac{1}{2}\left|\frac{1}{4}t + 3\right| - 2$



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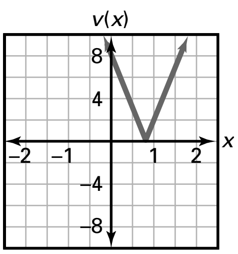

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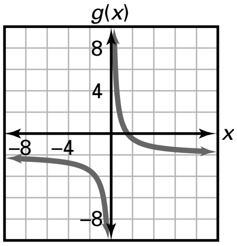
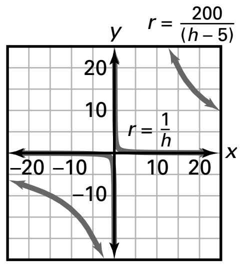


28. **a.** $r = \frac{200}{h-5}$, $h > 5$ related function

b. parent function: $r = \frac{1}{h}$

c.



rate $= \frac{\text{distance}}{\text{time}}$