Name _____ Class _____ Date _____

1-2

Introduction to Parent Functions

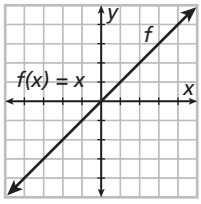
Going Deeper

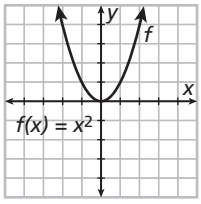
Essential question: *How do parent functions help you visualize the graph of a function?*

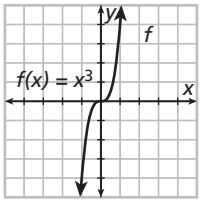
Video Tutor

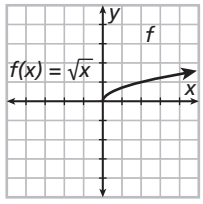
The *parent function* of a family of functions is the simplest function with the defining characteristics of the family. Parent functions help you understand the shape of a graph. You can graph many of the functions you will study by applying one or more transformations to one of the parent graphs.

Commonly used parent functions and their graphs are shown below:









CC.9–12.F.BF.3

1 EXPLORE Translate the Graph of a Function

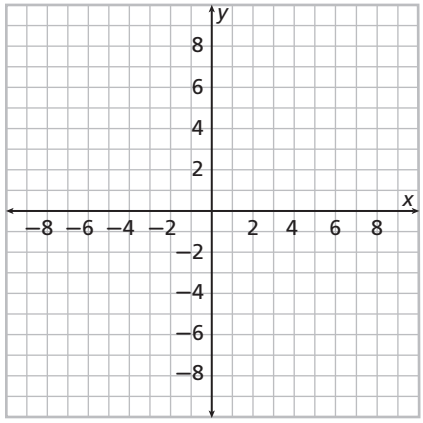
Explore the graph of $f(x) = (x + 4)^3$.

A What is the parent function of this function? How do you know?

B How does the given equation differ from equation of the parent function?

C Predict what this means for the graph.

D Graph the function using your graphing calculator. Sketch your graph in the grid. Was your prediction in part C correct?



REFLECT

1a. How can you change the equation of a parent function if you want to shift it to the left or right?

1b. By replacing x with $x + 4$ in the parent function, you shift it 4 units to the left. Why does adding 4 to x shift the graph in the negative direction? Explain.

When the word 'stretch' is used alone, it refers to a vertical stretch by default.

CC.9–12.F.BF.3

2 EXPLORE Graph the Stretch of a Function

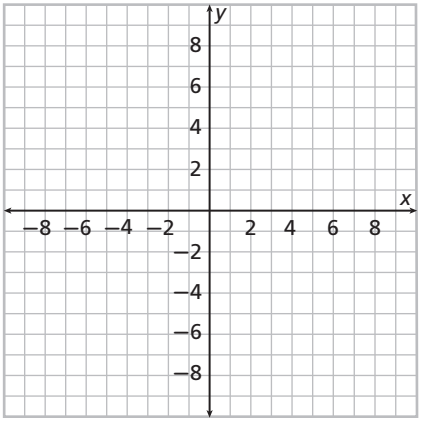
Explore the graph of $f(x) = 3x^2$.

A What is the parent function of this function? How do you know?

B How does the given equation differ from the equation of the parent function?

C Predict what this means for the graph.

D Graph the function using your graphing calculator. Sketch your graph in the grid below. Was your prediction in part C correct?



REFLECT

2a. How does multiplying $f(x)$ in the parent function by a constant change the graph?

2b. How would the graph change if the constant were a number between 0 and 1?

CC.9–12.F.BF.3

3 EXPLORE Graph the Reflection of a Function

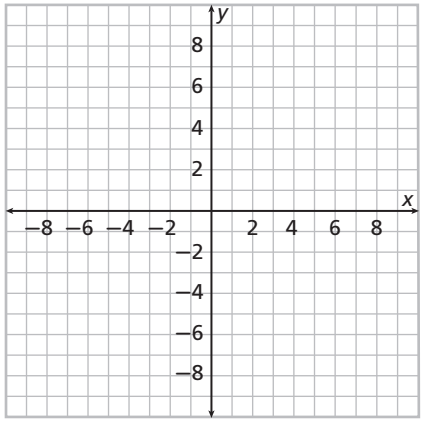
Explore the graph of $f(x) = -\sqrt{x}$.

A What is the parent function of this function? How do you know?

B How does the given equation differ from the equation of the parent function?

C Predict what this means for the graph.

D Graph the function using your graphing calculator. Sketch your graph in the grid below. Was your prediction in part C correct?



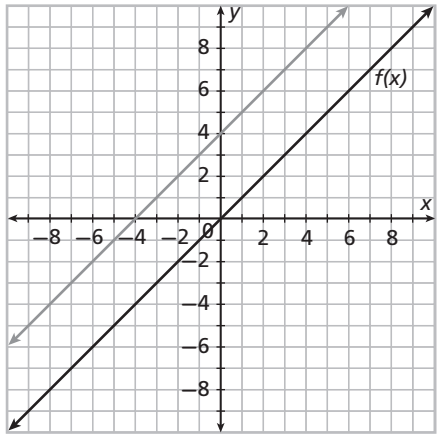
REFLECT

3a. How does multiplying $f(x)$ by -1 affect the graph?

3b. What would happen to the function if x were multiplied by -1 instead of $f(x)$? Why?

PRACTICE

1. The graph shows a translation of the function $f(x) = x$.



a. Describe the translation in two different ways.

b. Explain why the translations are the same.

c. Other parent functions do not have this same feature. Use the parent function $y = x^2$ to explain why.

Identify the parent function from the function rule. Describe the transformation of the parent function that each function represents. Use your graphing calculator to check your answers.

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

3. $g(x) = -x^3$

4. $f(x) = 5x^2$

5. $g(x) = \sqrt{-x}$

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

7. $g(x) = 0.5x^2$

8. $f(x) = 4\sqrt{x}$

9. $g(x) = x + 5$

10. $f(x) = -x$

11. $g(x) = 3x$

12. Why are the graphs of $f(x) = x^2$ and $f(-x) = (-x)^2$ the same graph? Explain algebraically and using the graph.

Additional Practice

Identify the parent function for *h* from its function rule. Then graph *h* on your calculator and describe what transformation of the parent function it represents.

1. $h(x) = \sqrt{x + 4}$

2. $h(x) = (x - 4)^3$

3. $h(x) = 4x^2$

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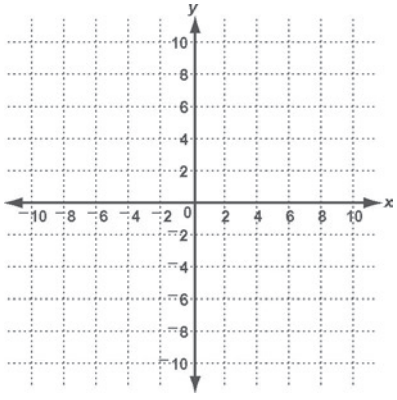
_____ _____ _____

Graph the data from the table. Describe the parent function and the transformation that best approximates the data set.

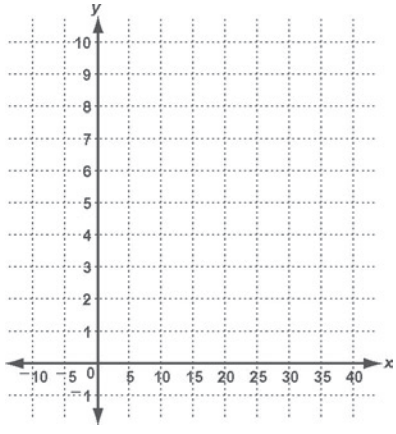
4.

x	–2	–1	0	1	2
y	–9	–2	–1	0	7



5.

x	0	2	8	18	32
y	0	1	2	3	4



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6. Compare the domain and the range for the parent quadratic function to the domain and the range for the parent linear function.

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7. Compare the domain and the range for the parent square-root function to the domain and the range for the parent cubic function.

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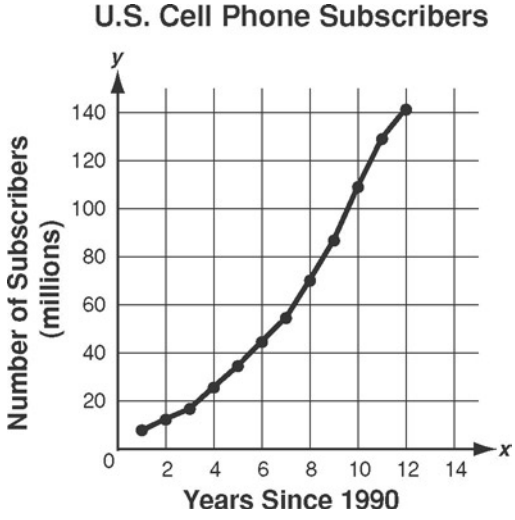
Problem Solving

Katy and Peter are writing a paper about the history and use of cell phones. They make a graph of the data in the table. They want to determine the parent function for the graph.

Cell Phone Subscribers in the United States (estimated in millions)			
1991	7.6	1997	55.3
1992	11.0	1998	69.2
1993	16.0	1999	86.0
1994	24.1	2000	109.5
1995	33.8	2001	128.4
1996	44.0	2002	140.8



1. Peter wants to compare the graph to the function $f(x) = 7x + 2$. How would the graph of $f(x) = 7x + 2$ compare to its parent function $f(x) = x$?

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2. What is the value $f(x) = 7x + 2$ for 1996, when $x = 6$? Does that point fit the graph? Try some other values of x for the function $f(x) = 7x + 2$. How well do the results fit the range of the graph?

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3. Katy wants to compare the graph to the function $f(x) = x^2 + 5$. How would the graph of $f(x) = x^2 + 5$ compare to its parent function $f(x) = x^2$?

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4. Find the value of $f(x) = x^2 + 5$ for 1996, when $x = 6$? Does that point fit the graph? Try some other values of x for the function $f(x) = x^2 + 5$. How well do the results fit the range of the graph?

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5. Which parent function and transformation best models these data?

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