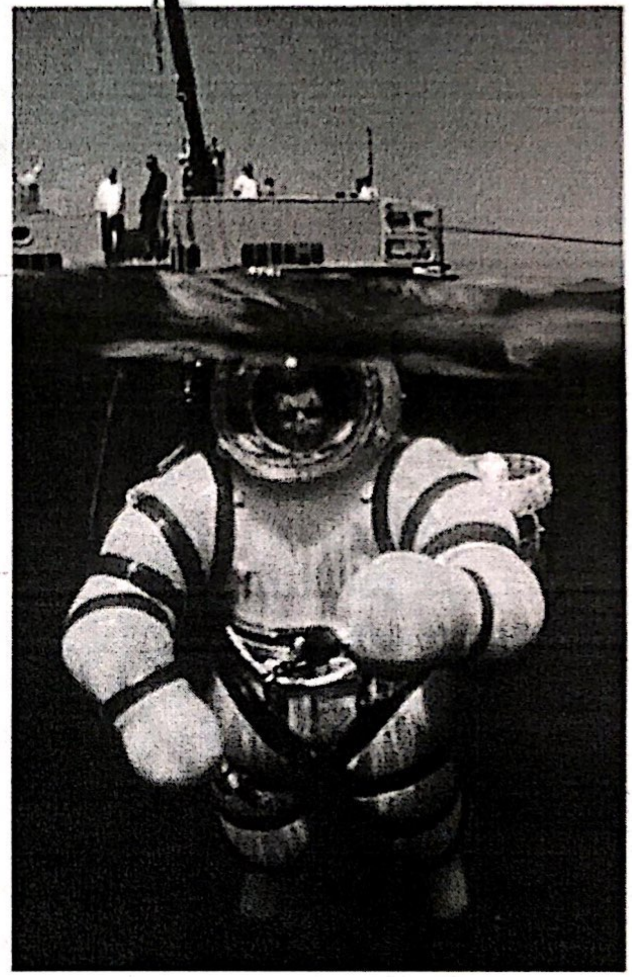
Introduction to Parent Functions

most basic form (no numbers, +, −, etc.)
coefficients
*must leave exponents

Who uses this?

Oceanographers use transformations of parent functions to approximate data sets such as wave height versus wind speed. (See Example 3.)



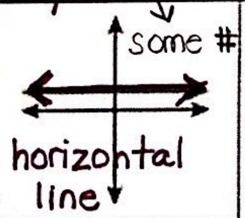
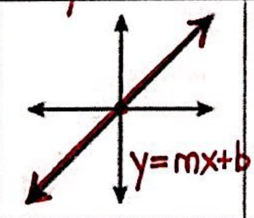
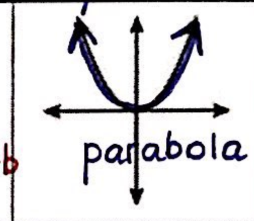
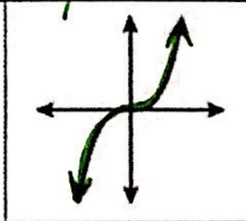
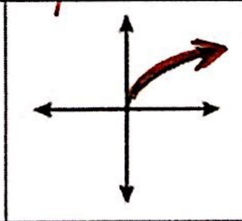
Lesson Objective(s):

- Identify parent functions from graphs and equations.
- Use parent functions to model real-world data and make estimates for unknown values.

Similar to the way that numbers are classified into sets based on common characteristics, functions can be classified into *families of functions*. Parent Function the simplest function with the defining characteristics of the family. Functions in the same family are transformations of their parent function.

parent x family $x+2$, $5x$, $-3x-7$

Parent Functions

	Family	**Constant**	**Linear**	**Quadratic**	**Cubic**	**Square root**
	Rule	$y = c$	$y = x$	$y = x^2$	$y = x^3$	$y = \sqrt{x}$
	Graph	 some # horizontal line	 $y=mx+b$	 parabola		
x	**Domain**	$(-\infty, \infty)$	$(-\infty, \infty)$	$(-\infty, \infty)$	$(-\infty, \infty)$	$[0, \infty)$
y	**Range**	c	$(-\infty, \infty)$	$[0, \infty)$	$(-\infty, \infty)$	$[0, \infty)$
	Intersects *y*-axis	(0, c)	(0, 0)	(0, 0)	(0, 0)	(0, 0)

domain: left, right range: down, up

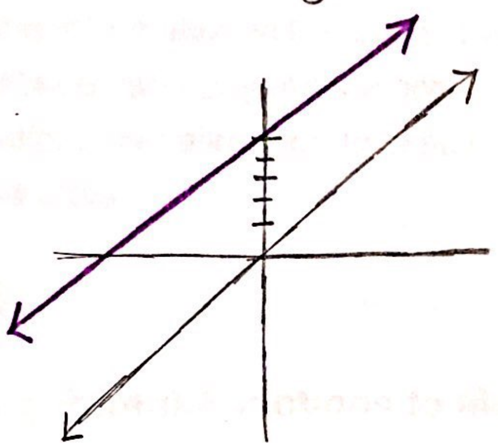
EXAMPLE 1

Identifying Transformations of Parent Functions

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

A $g(x) = x + 5$

$g(x) = x$ linear function

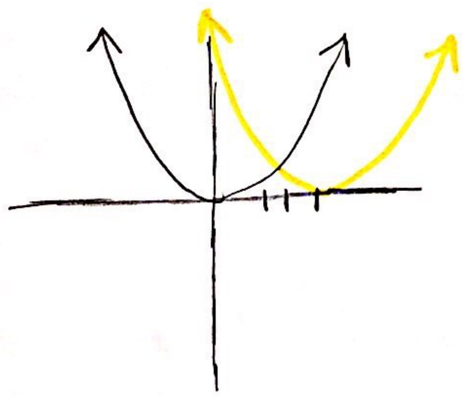


vertical translation up 5

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

B $g(x) = (x - 3)^2$

$g(x) = x^2$ quadratic function



horizontal translation right 3

It is often necessary to work with a set of data points like the ones represented by the table at right.

x					
y					

With only the information in the table, it is impossible to know the exact behavior of the data between and beyond the given points. However, a working knowledge of the parent functions can allow you to sketch a curve to approximate those values not found in the table.

EXAMPLE 2

Identifying Parent Functions to Model Data Sets

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

x	−4	−2	0	2	4
y	8	2	0	2	8

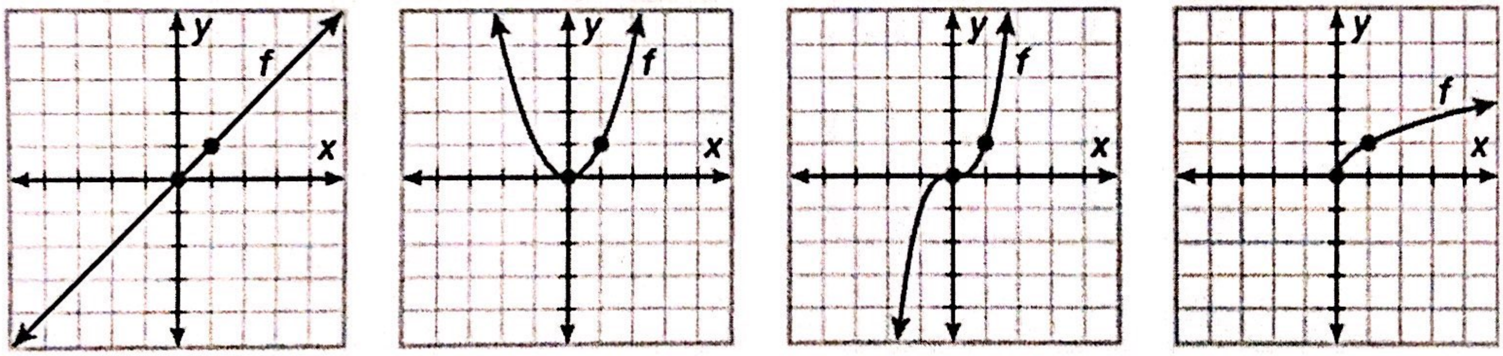
−6 −2 +2 +6

+4 +4 +4

quadratic function

$y = x^2$

Consider the two data points (0, 0) and (1, 1) . If you plot them on a coordinate plane you might very well think that they are part of a linear function. In fact they belong to each of the parent functions below.

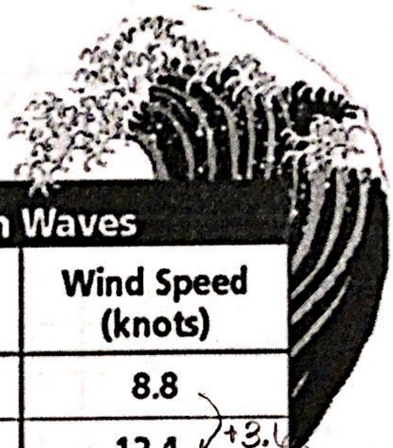


Remember that any parent function you use to approximate a set of data should never be considered exact. However, these function approximations are often useful for estimating unknown values.

EXAMPLE 3

Oceanography Application

An oceanographer wants to determine a model that can be used to estimate wind speed based upon wave height. Graph the relationship from wave height to wind speed and identify which parent function best describes it. Then use the graph to estimate the wave height when the wind speed is 10 knots.



Ocean Waves

Wave Height (ft)	Wind Speed (knots)
2	8.8
4	12.4
6	15.2
8	17.5
10	19.6

+3.6 +2.8 +2.3 +2.1

−0.8 −0.5 −0.2

0.3 0.3

cubic function

$y = x^3$

Name ______________________ Date ______________ Class______________

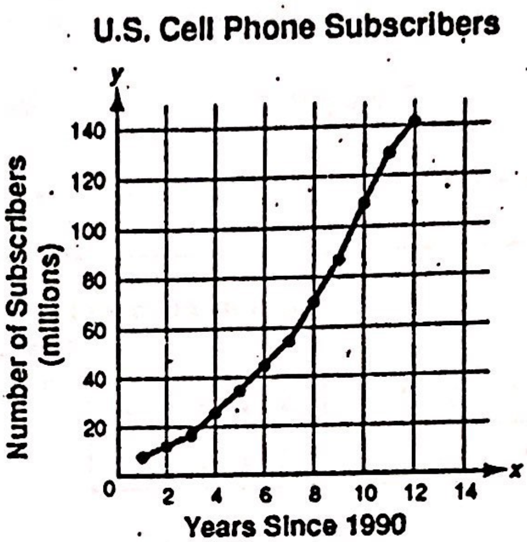
LESSON 1-2

Problem Solving

Introduction to Parent Functions

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 $f(x) = x$?

   vertical translation up 2
   horizontal compression by a factor of 7

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?

   $x=6,\ 7(6)+2=44$
   $x=3,\ 7(3)+2=23$
   $x=8,\ 7(8)+2=58$

   not very well

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 $f(x) = x^2$?

   vertical translation up 5

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?

   $x=6,\ 6^2+5=41$
   $x=3,\ 3^2+5=14$
   $x=8,\ 8^2+5=69$

   decent

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

   quadratic function

Name ______________________ Date ______________ Class ______________

LESSON 1-2

Practice

Introduction to Parent Functions

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

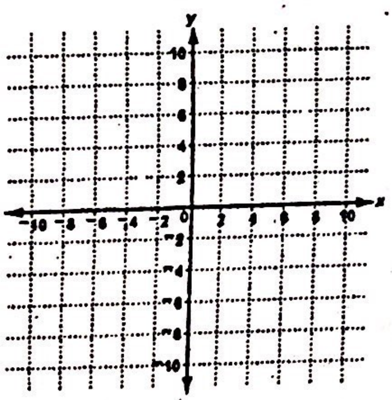
2. $h(x) = (x-4)^3$

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

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

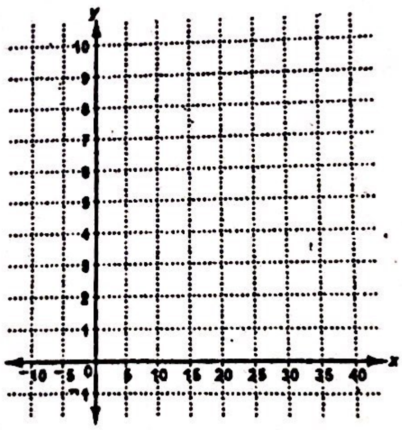
4.

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



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

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