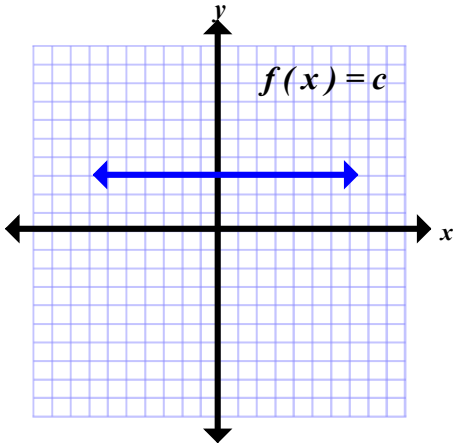
1-4 Shifting, Reflecting, and Stretching Graphs

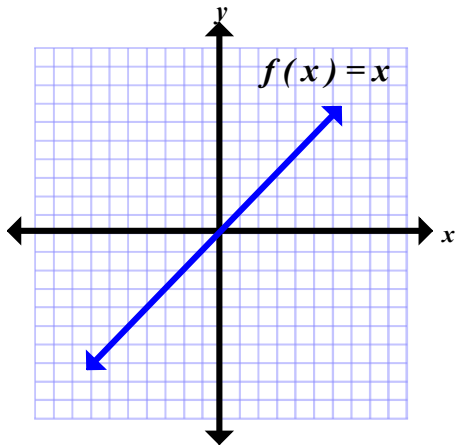
What will you learn?

- To recognize graphs of common functions
- To use vertical and horizontal shifts and reflections to graph functions
- To use nonrigid transformations to graph functions

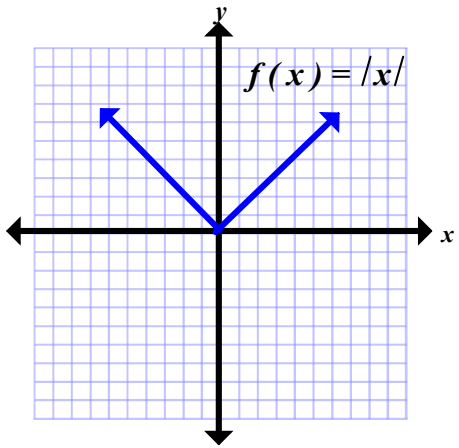
6 Most Commonly Used Graphs in Algebra



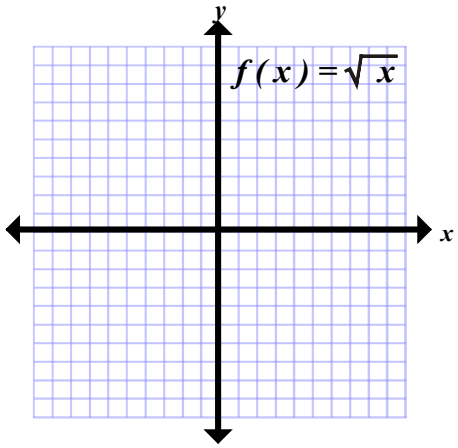
Constant Function



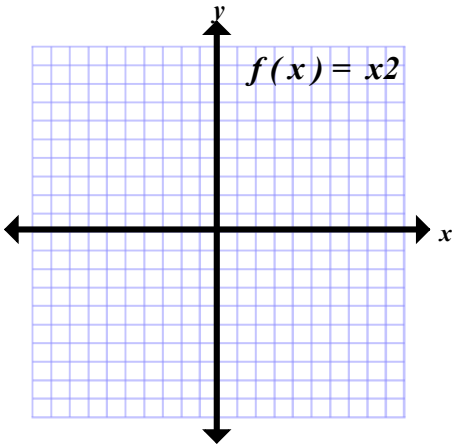
Identity Function



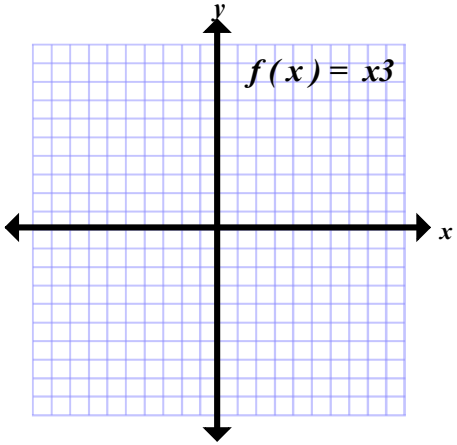
Absolute Value Function



Square Root Function



Quadratic Function



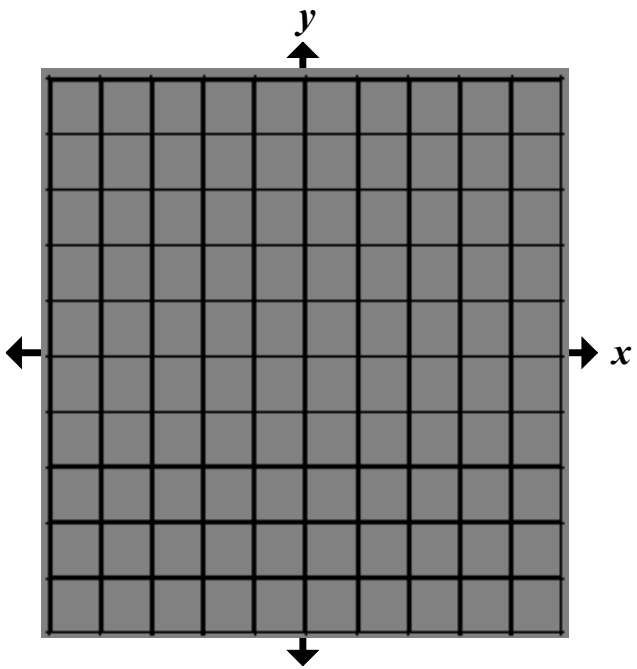
Cubic Function

Vertical Shift

movement ↑ ↓ along the *y*-axis

$f(x) = x2$

$h(x) = x2 + 2$

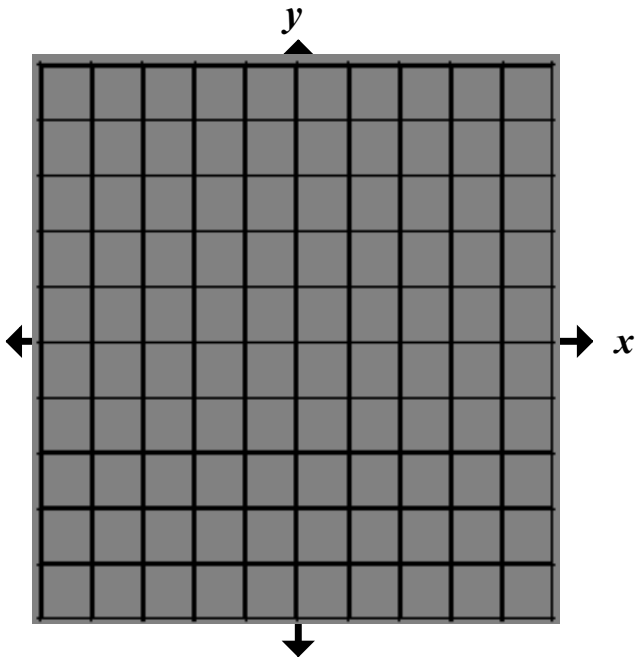


Horizontal Shift

movement ⇄ along the *x* - axis

$f(x) = x2$

$g(x) = (x - 2)2$



$f(x) = x2$

$h(x) = x2 + 2$

substitute

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

x	$f(x)$	$h(x) = f(x) + 2$
-2		
-1		
0		
1		
2		

$f(x) = x2$

substitute

$g(x) = (x - 2)\ 2$

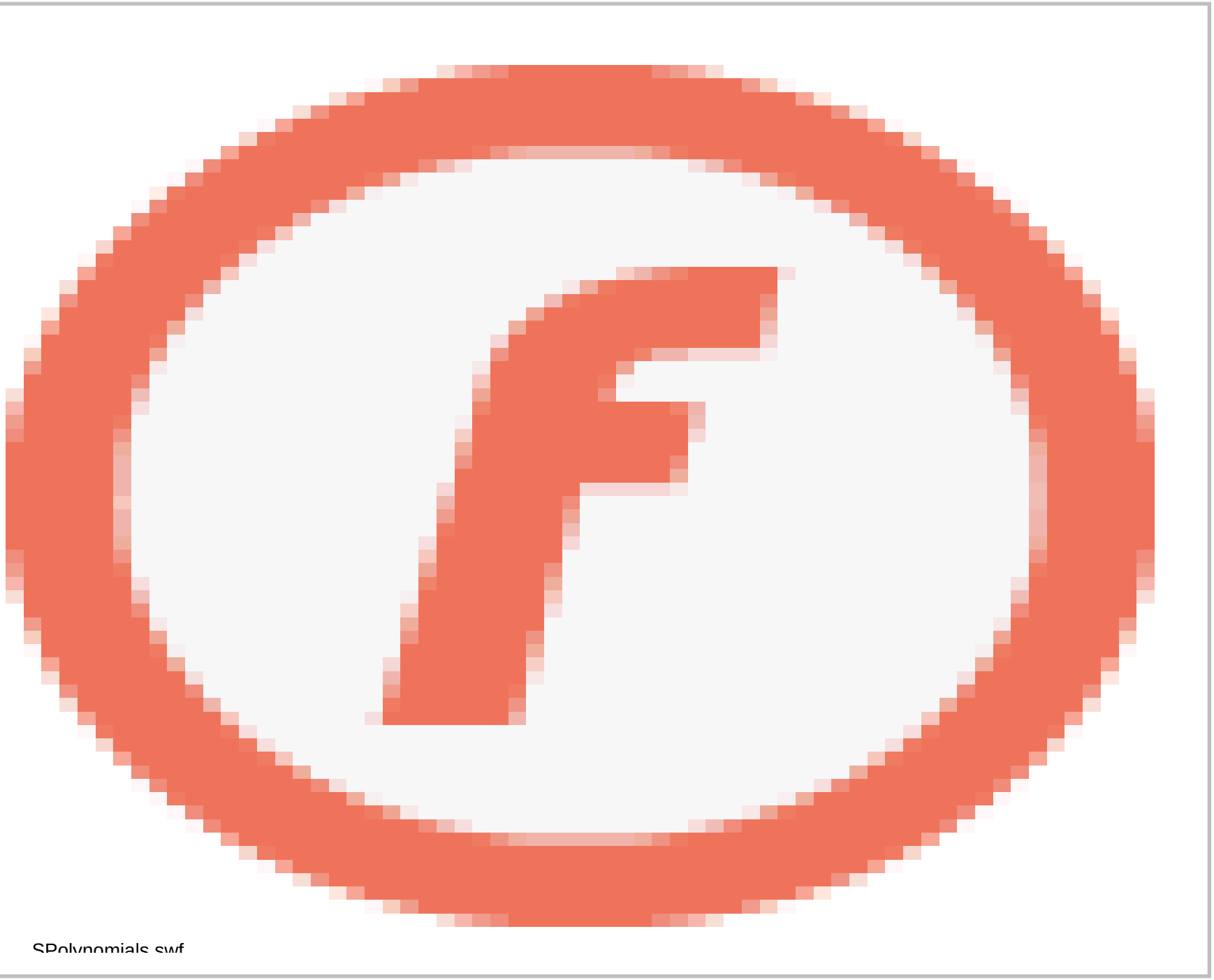
$g(x) = f(x - 2)$

x	$x - 2$	$h(x) = f(x - 2)$
0		
1		
2		
3		
4		

Vertical & Horizontal Shifts

Let *c* be a positive real number.
Vertical and horizontal shifts in the graph of $y = f(x)$ are represented as follows:

1. **Vertical Shift**  _____
2. **Vertical Shift**  _____
3. **Horizontal Shift**  _____
4. **Horizontal Shift**  _____



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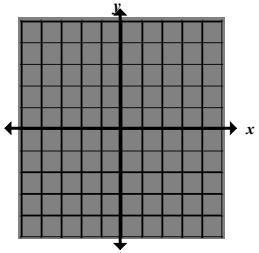
Example 1 - Shifts in the Graph of a Function

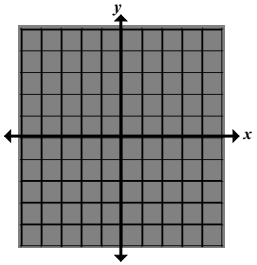
Compare the graph of each function with the graph of

$f(x) = x3$



Before you begin....What do you THINK will happen to the following graphs?????

a.) $g(x) = x3 - 1$



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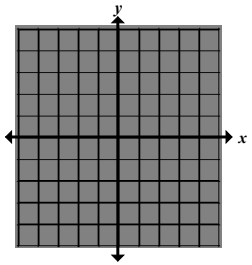
b.) $h(x) = (x - 1)3$



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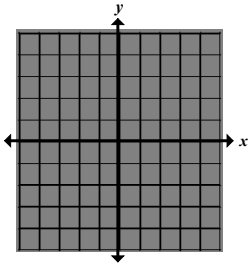
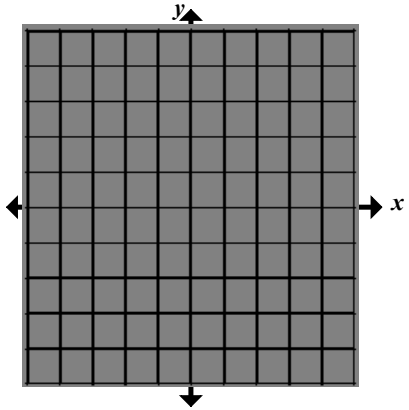
c.) $k(x) = (x + 2)3 + 1$



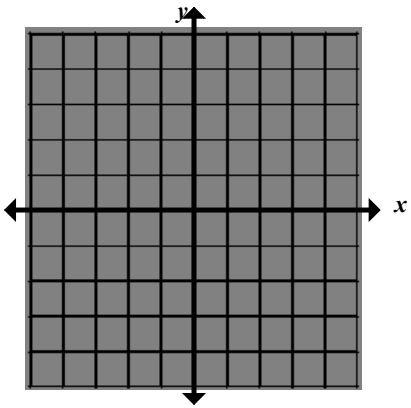
See p. 48; exercise 3

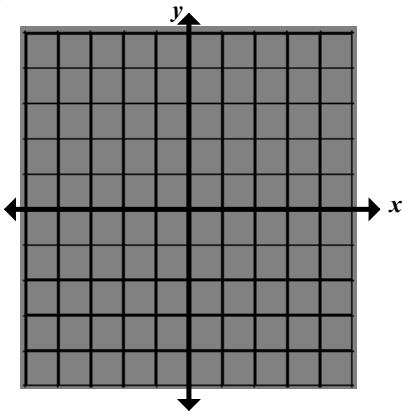
Example 2 - Finding Equations from Graphs

Given the graph for $f(x) = x2$



Find equations for the following graphs :





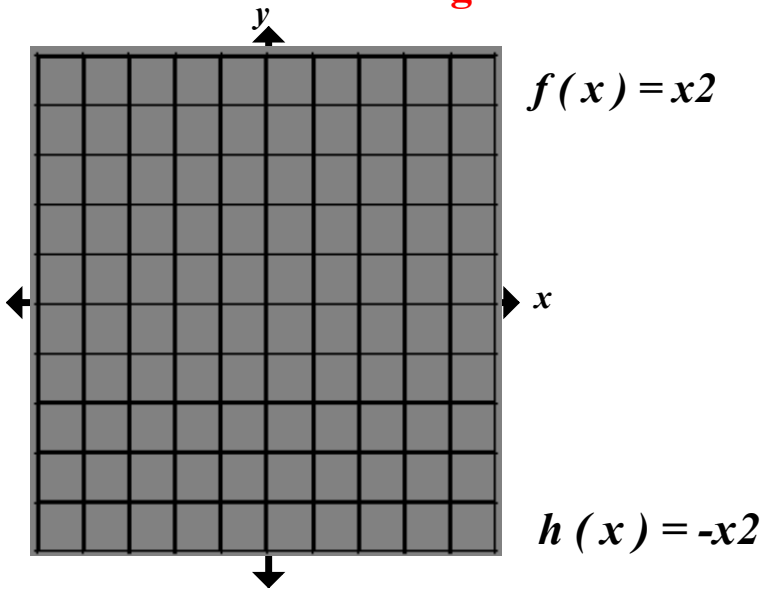
Describe what you see :
How has the graph shifted?

See p. 48; exercise 21

Reflecting Graphs

Think of a mirror image

Consider the x -axis as a mirror



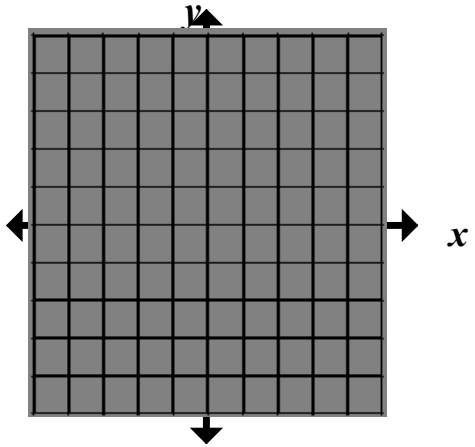
Reflections in the Coordinate Axes

Reflections in the coordinate axes of the graph of $y = f(x)$ are represented as follows :

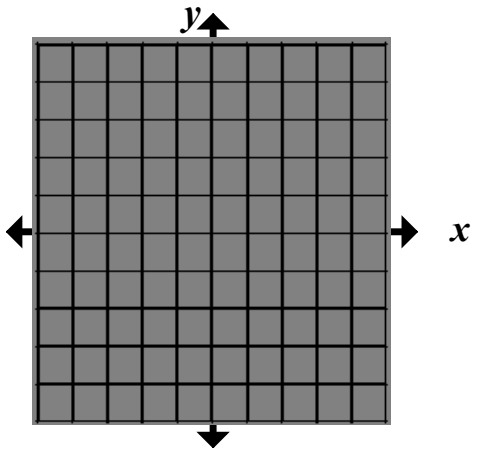
1. **Reflection in the *x*-axis** _____
2. **Reflection in the *y*-axis** _____

Use your graphing calculator to compare the following graphs to

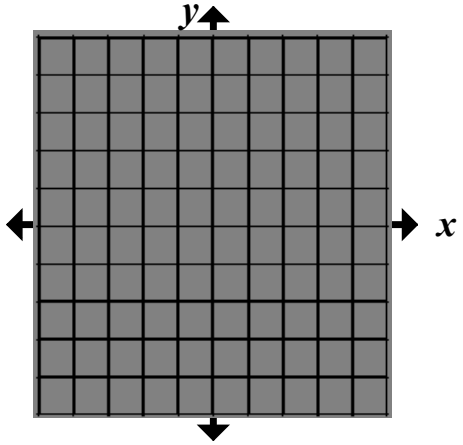
$f(x) = x2$



$g(x) = -x2$



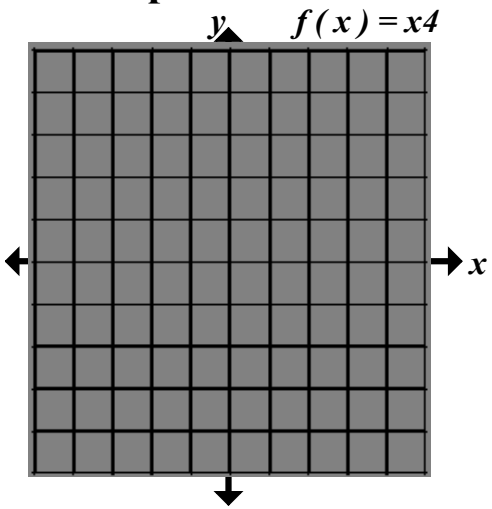
$h(x) = (-x)2$

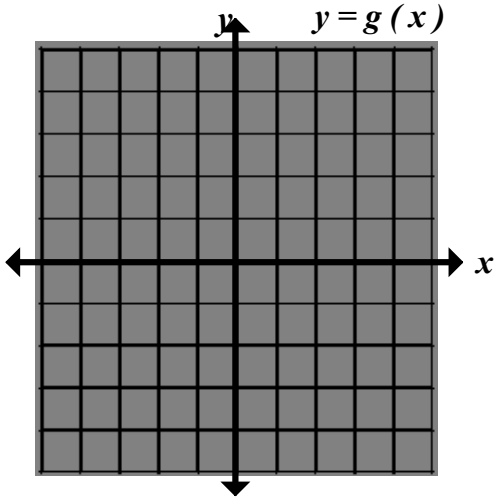


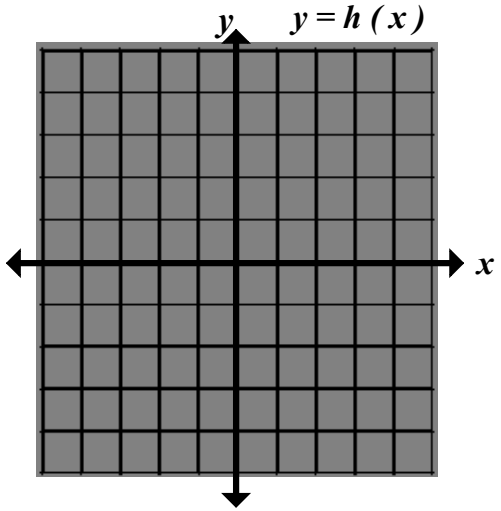
Describe the differences.

Example 3 - Finding Equations from Graphs

Given $f(x) = x4$







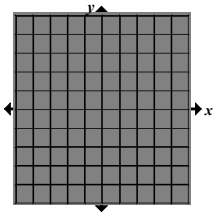
Describe what you see:
Did the graph shift?
Did the graph relect?

See p. 49; exercise 25

Example 4 - Reflections and Shifts

Compare each of the following functions with the graph of

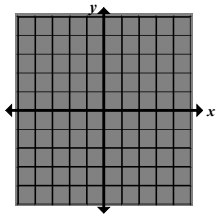
$f(x) = \sqrt{x}$



Before you begin....What do you THINK the graphs will happen to the graphs??????

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

Algebraic



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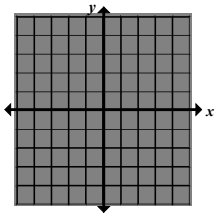
b.) $h(x) = \sqrt{-x}$

Algebraic



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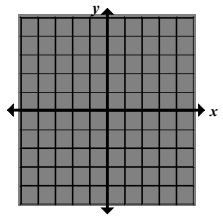
c.) $k(x) = -\sqrt{x+2}$

Algebraic



Remember:
When comparing graphs of functions involving square roots -
The *domain* must be restricted to *exclude negative numbers.*

What are the domains of the functions above?

See p. 49; exercise 27

Activity

Does the graph of

$$f(x) = -(x + 1)3 + 4$$

represent

horizontal shift - 1 unit left
vertical shift - 4 units up
reflection over the *x*-axis **???**

Nonrigid Transformations

Rigid Transformations : _____

Examples:

Nonrigid Transformations: _____

Examples:

Vertical Stretch

Vertical Shrink

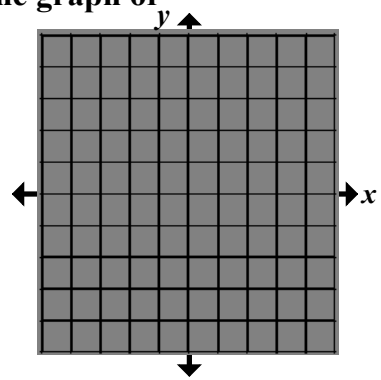
Horizontal Stretch

Horizontal Shrink

Example 5 - Nonrigid Transformations

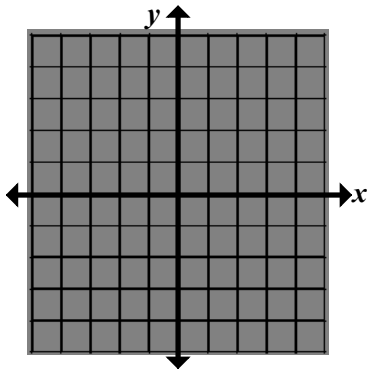
Compare the graph of each function with the graph of

$f(x) = |x|$

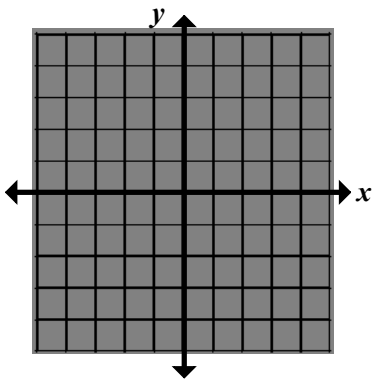


Before you begin...What do you THINK will happen to the graphs???

$h(x) = 3|x|$



$g(x) = \frac{1}{3}|x|$



See p. 49; exercise 37

Example 6 - Nonrigid Transformations

Compare the graph of

$h(x) = f\left(\frac{1}{2}x\right)$ *with the graph of* $f(x) = 2 - x^3$

See p. 49; exercise 43