Math-2A
Lesson 5-1

The Quadratic (Squaring) Function

Squaring Function $\quad f(x) = x^2$

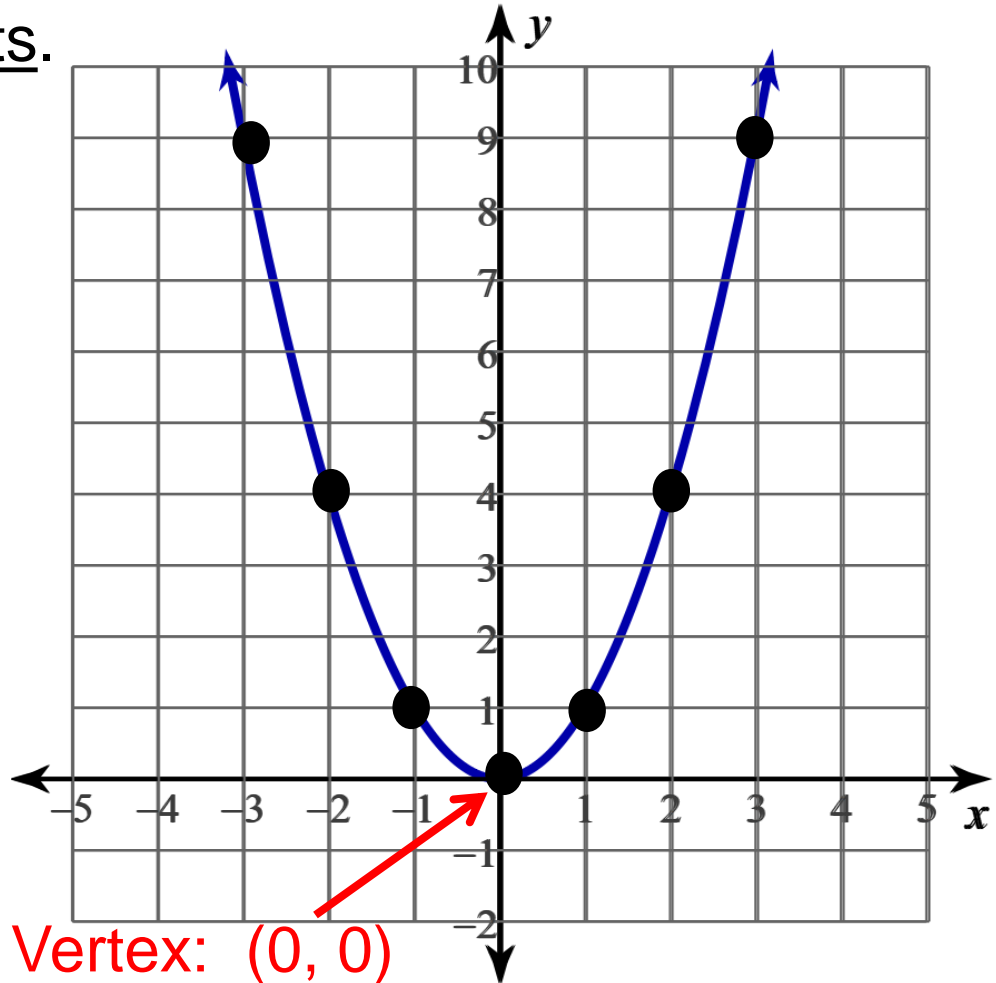Parent Function: The simplest function in a family of functions (linear, quadratic, cubic functions, etc.)

Using the input values and the "parent function" of the quadratic family, calculate the corresponding output values (fill in the table) and graph the points.

x	f(x)
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$f(x) = x^2$

$f(-3) = (-3)^2$

$\rightarrow f(-3) = 9$

Vertex: (0, 0)

Transformation: an <u>adjustment</u> made to the <u>parent function</u> that results in a <u>change to the graph</u> of the parent function.

Changes could include:

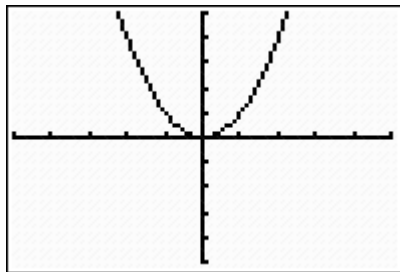<u>shifting</u> the graph <u>up</u> or <u>down</u>,

<u>Shifting </u>the graph <u>left</u> or <u>right</u>

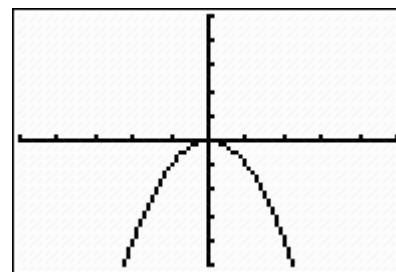<u>vertical stretching</u> or <u>shrinking</u>

<u>Reflecting</u> across x-axis or y-axis

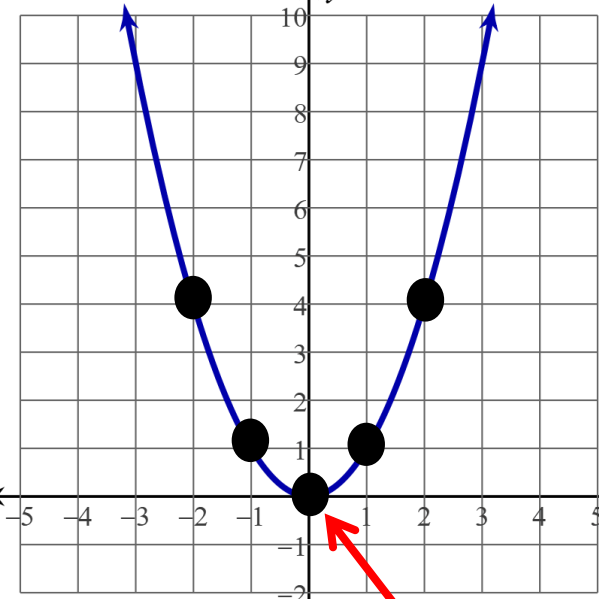We say the function has been <u>reflected across the x-axis</u>.

$$y = x^2$$

$$y = -x^2$$

x	f(x)
-2	4
-1	1
0	0
1	1
2	4

<u>Multiplying</u> the parent function by -1 actually changes the sign of every y-value of the parent function.

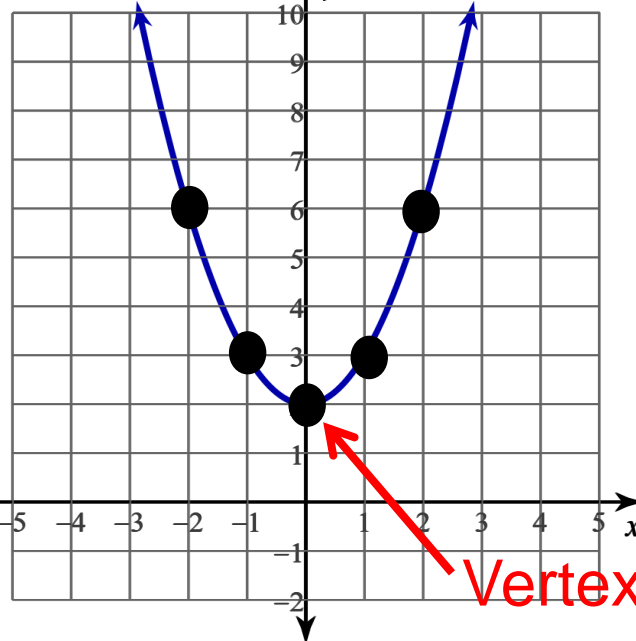| x	f(x)
-2	-4
-1	-1
0	0
1	-1
2	-4

Vertex: (0, 0)

$$y = x^2$$

x	y
-2	4
-1	1
0	0
1	1
2	4

Vertex: (0, 2)

$$y = x^2 + 2$$
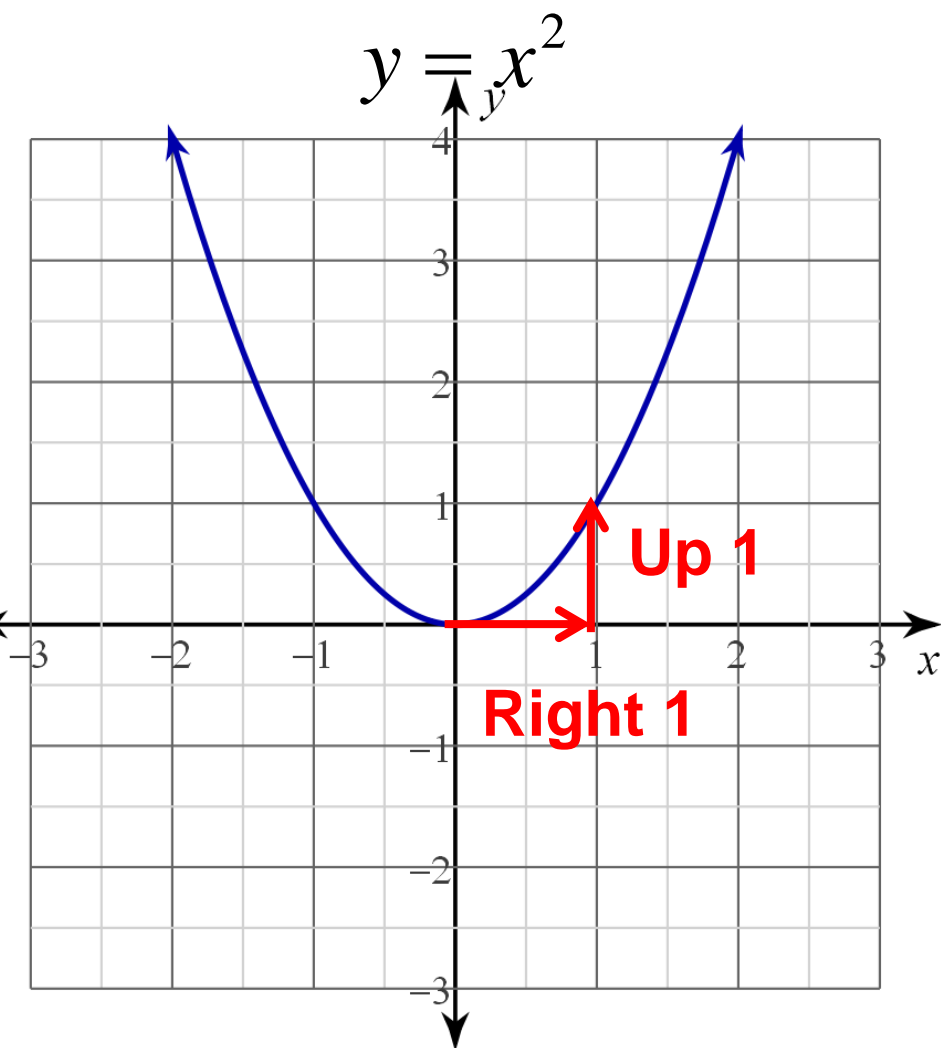
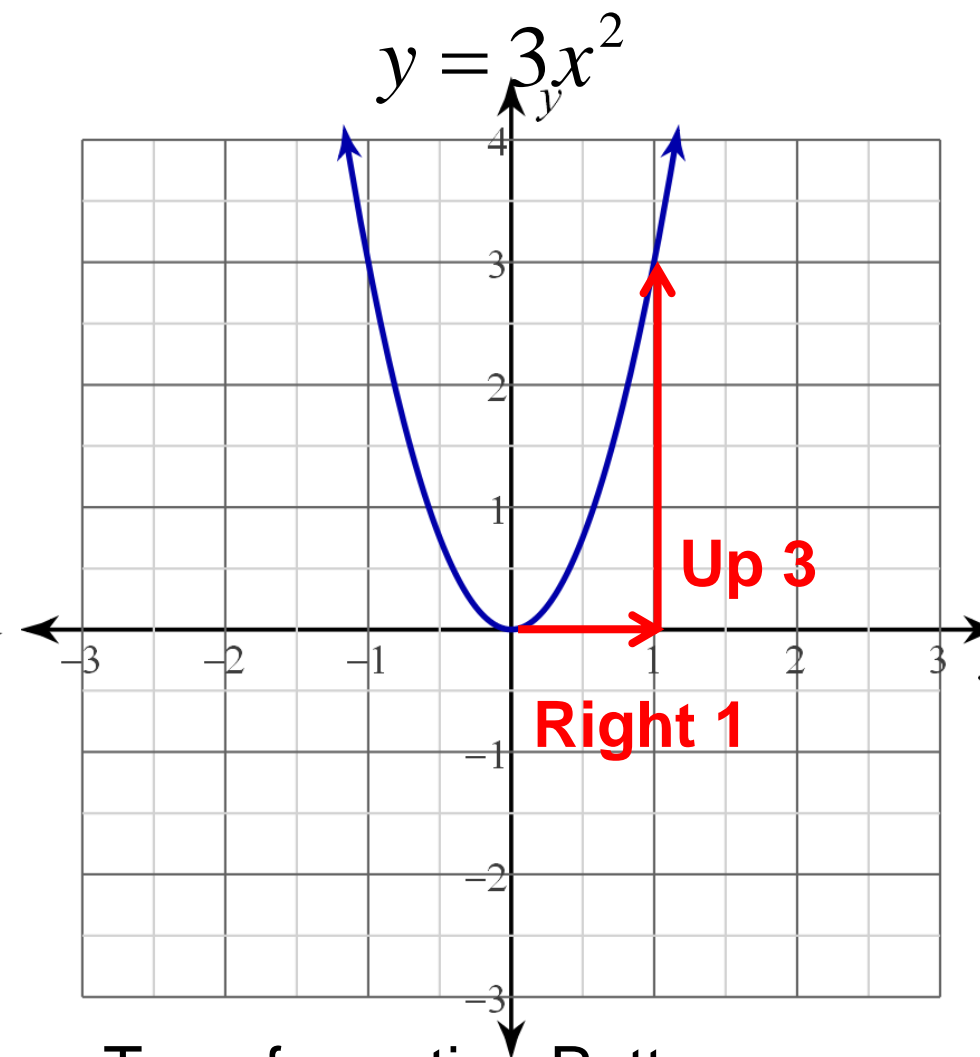| x	y
-2	6
-1	3
0	2
1	3
2	6

Graph: Parent function has been moved up 2.

Fill in the table for the other equation and graph the points.

$$y = x^2 + 5$$ **translated up 5**

$$y = x^2 - 4$$ **translated down 4**

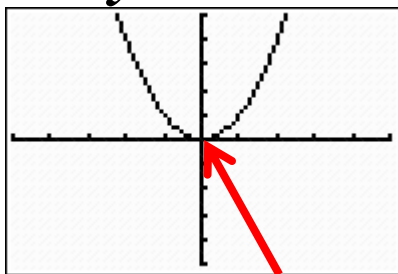Multiplying the parent function by 3, "*vertically stretches*" the parent function *"by a factor of 3"*

$$y = x^2$$

Up 1

Right 1

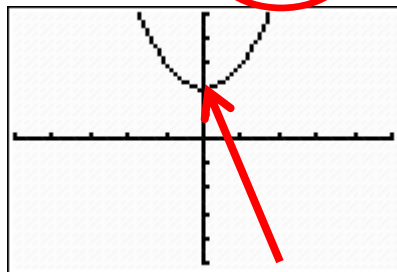Parent Pattern: right 1 Up 1 *from the vertex*.

$$y = 3x^2$$

Up 3

Right 1

Transformation Pattern: right 1 up 3 *from the vertex*.

$$y = x^2$$

$$y = x^2 \boxed{+ 2}$$

Graph: Parent function has been moved up by 2.

Vertex: (0, 0)   Vertex: (0, 2)

x	y
-2	4
-1	1
0	0
1	1
2	4

x	y
-2	6
-1	3
0	2
1	3
2	6

$$y = x^2 - 4$$ **translated down 4**

$$y = x^2 + 5$$ **translated up 5**
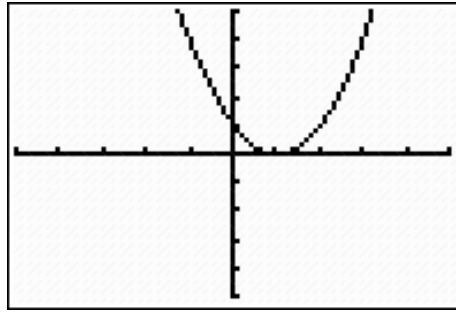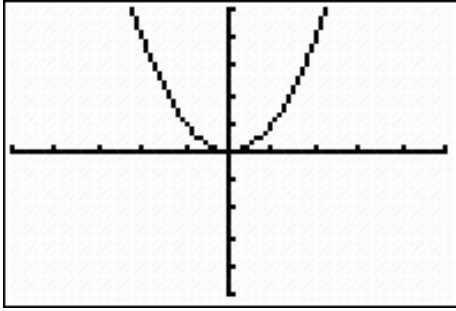
Fill in the 2nd table.

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

x	f(x)
-2	4
-1	1
0	0
1	1
2	4

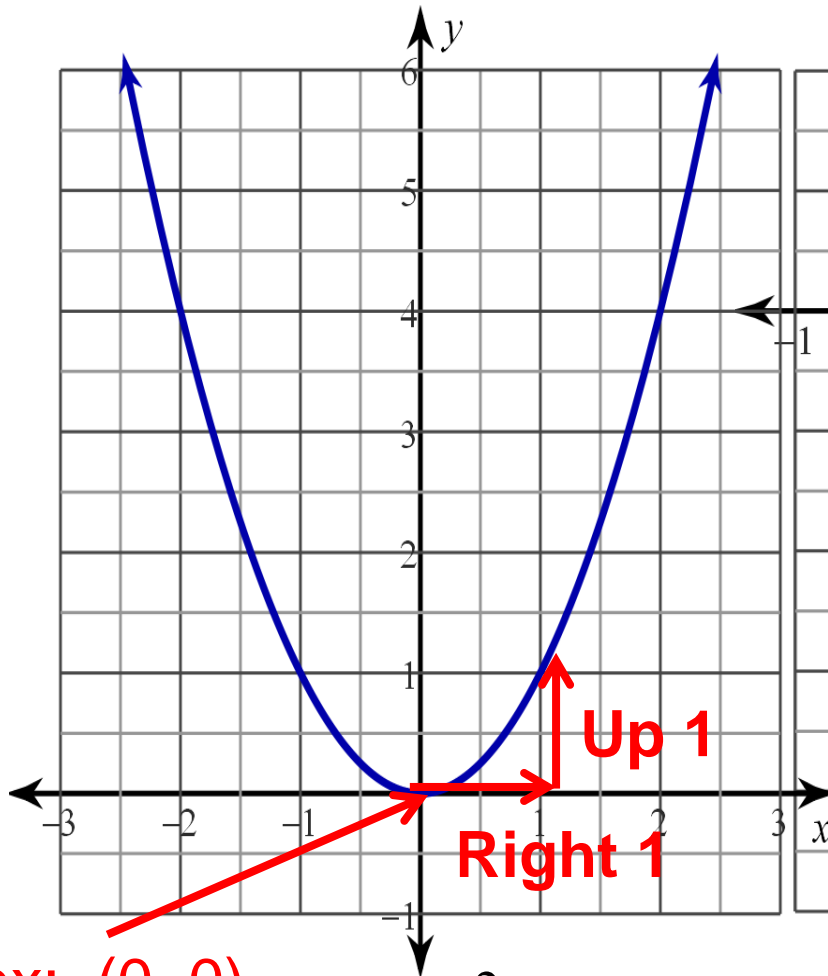| x	g(x)
-2	9
-1	4
0	1
1	0
2	1
3	4

Replacing 'x' in the parent function with 'x – 1' causes the graph to translate *right '1'*
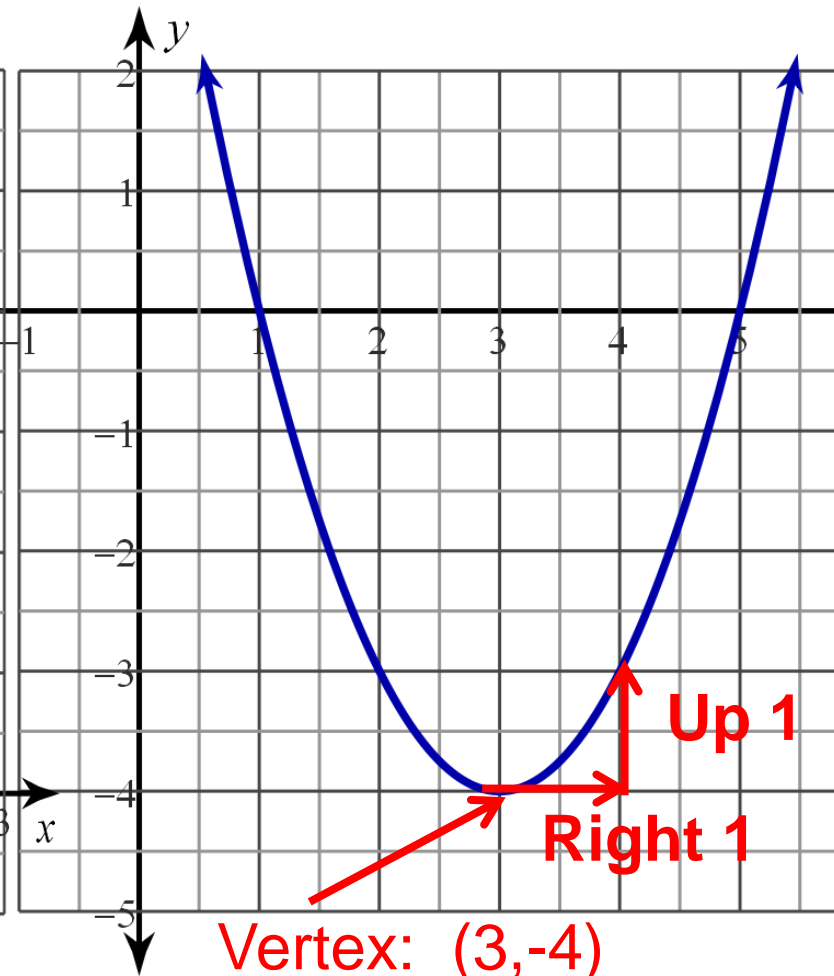
Parent Function: The **simplest** function in a family of functions (lines, parabolas, cubic functions, etc.)

Square Function (quadratic function)

x	y
-2	4
-1	1
0	0
1	1
2	4

Up 1

Right 1

Vertex: (0, 0)

$$y = x^2$$

Up 1

Right 1

Vertex: (3,-4)

$$y = (x-3)^2 - 4$$

Let's generalize the transformations

$$f(x) = x^2 \qquad y = (-1)a(x-h)^2 + k$$

Reflection across x-axis — VSF — left/right — up/down

$$y = -2(x-3)^2 + 4$$

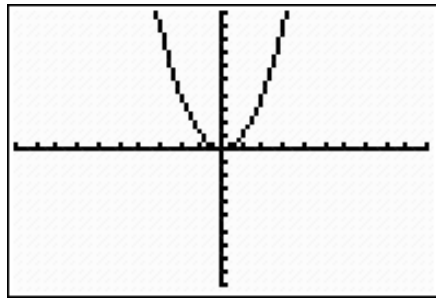Reflected across x-axis, VSF = 2, right 3, up 4

$$y = 3(x+5)^2 - 6$$

VSF = 3, left 5, down 6

In order to graph the equation:

1) Move the vertex left/right and up/down

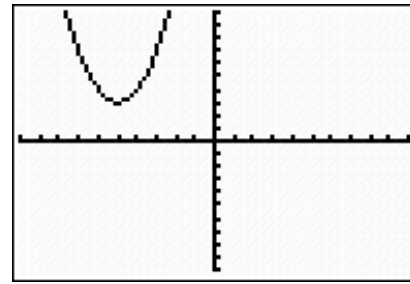2) *From the vertex* move right 1, then up/down by the VSF.

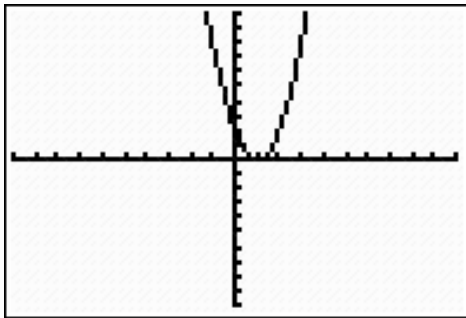Describe the transformation to the parent function:

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

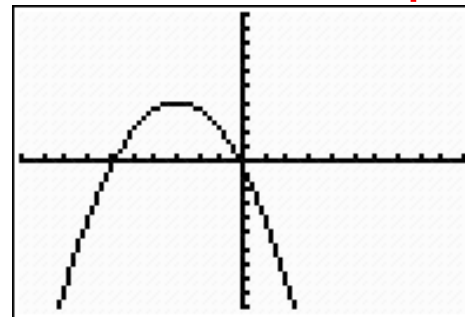$$g(x) = (x + 5)^2 + 3$$

up 3, left 5

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

VSF = 2, right 1
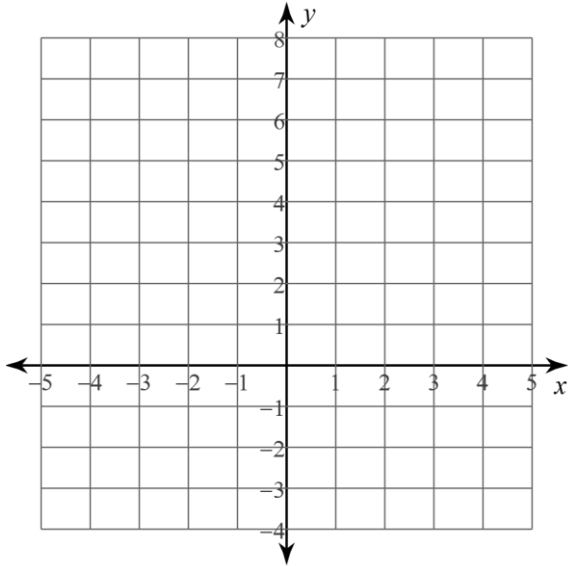
$$j(x) = -\frac{1}{2}(x + 3)^2 + 4$$

Reflected across x-axis
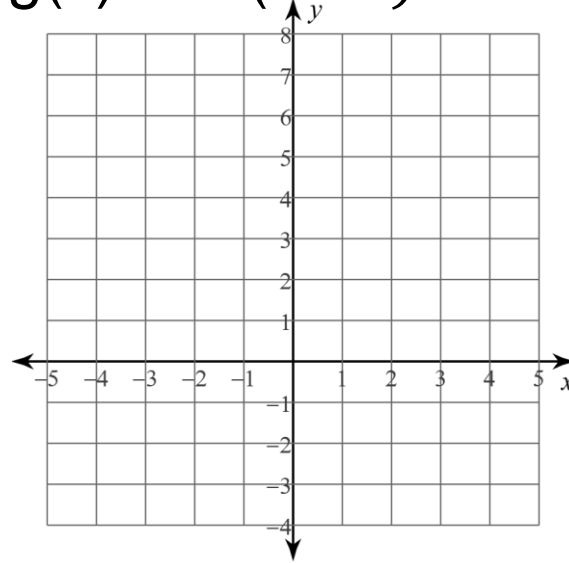VSF = ½, left 3, up 4

Interpret the transformation then graph the function

$k(x) = (x + 2)^2 - 3$

$g(x) = -2(x - 3)^2 + 4$

What is the equation that has been graphed?