Math-3
Lesson 1-2

Quadratic (Squaring) Function

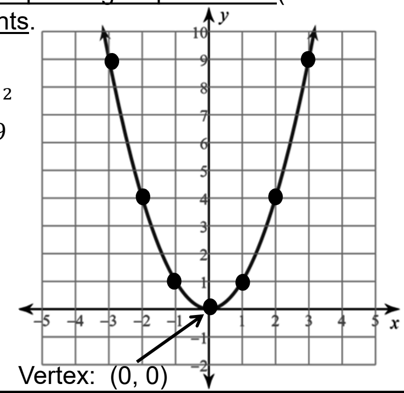
Squaring Function $f(x) = x^2$

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

$f(x) = x^2$
$f(-3) = (-3)^2$
$\rightarrow f(-3) = 9$



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

Changes could include:

shifting ("translating") the graph up or down,

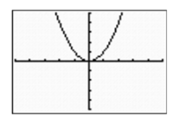
"translating" the graph left or right

vertical stretching

horizontal stretching

Reflecting across x-axis or y-axis

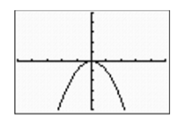
We say the function has been reflected across the x-axis.



$y = x^2$

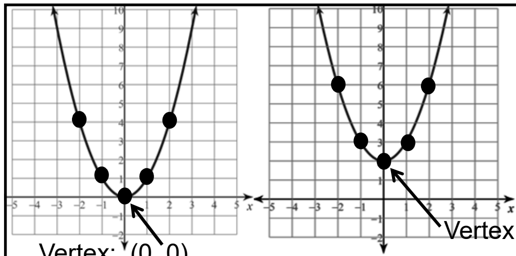
x	f(x)
-2	4
-1	1
0	0
1	1
2	4

Multiplying the parent function by -1 actually changes the sign of every y-value of the parent function.



$y = -x^2$

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



Graph: Parent function has been moved up 2.

$y = x^2$

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

$y = x^2 + 2$

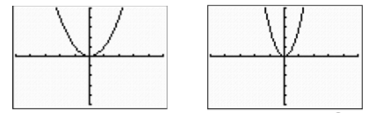
x	y
-2	6
-1	3
0	2
1	3
2	6

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**

Fill in the second table.



$y = x^2$

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

$y = 3x^2$

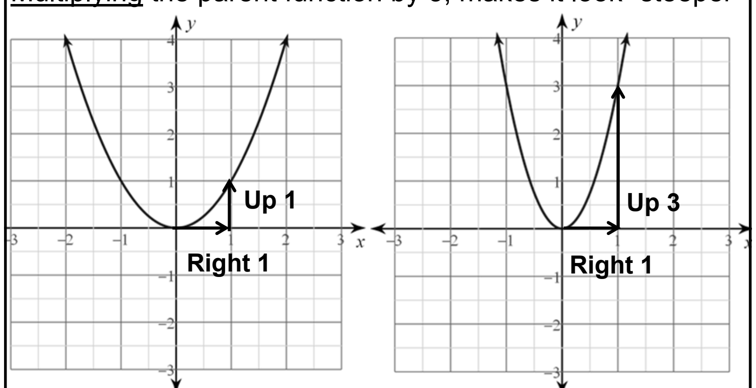
x	y
-2	12
-1	3
0	0
1	3
2	12

For the same input values, the output values have been multiplied by 3.

We say the function has been "vertically stretched" by a factor of 3.

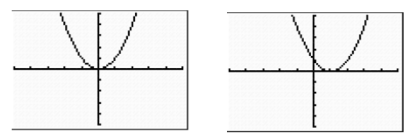
$y = x^2$ $y = 3x^2$

Multiplying the parent function by 3, makes it look "steeper"



Parent: right 1
Up 1 from vertex.

Transformation: right 1 up 3 from vertex.



Fill in the 2nd table.

$f(x) = x^2$

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

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

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'*

Let's generalize the transformations

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

Reflection across x-axis → (-1); VSF → a; left/right → h; up/down → k

$y = -2(x-3)^2 + 4$ Reflected across x-axis, VSF = 2, right 3, up 4

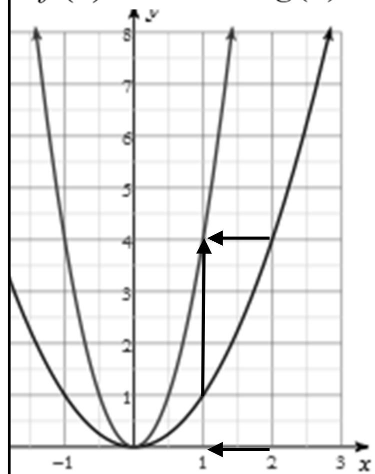
$y = 3(x+5)^2 - 6$ VSF = 3, left 5, down 6

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.

$f(x) = x^2 \qquad g(x) = (2x)^2 = 4x^2$



For the square function:
Horizontal stretch by ½
(multiply x-value of point by ½

Looks like
Vertical stretch by 4
(multiply y-value of point by 4).

Your Turn:

Describe the transformation to the parent function: $y = x^2$

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

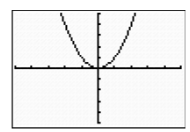
Describe the transformation to the parent function: $y = x^2$

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

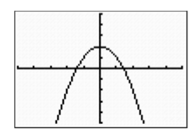
These effects accumulate

Describe the transformation to the parent function:

Reflected across x-axis and translated up 2



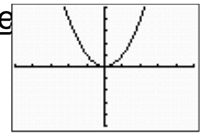
$f(x) = x^2$



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

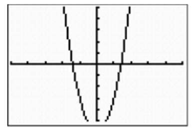
These effects accumulate

Describe the graphical transformation to the parent function:



$f(x) = x^2$

Multiplying the parent function by 3 then subtracting 6…



Vertically stretched by a factor of 3 and translated down 6

$g(x) = 3x^2 - 6$

Let's generalize the transformations

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

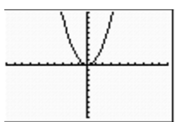
Reflection across x-axis — **vertical stretch factor** — **Translates left/right** — **translating up or down**

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

Reflected across x-axis, twice as steep, translated up 4, translated right 3

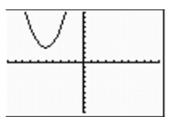
Describe the transformation to the parent function:

$f(x) = x^2$



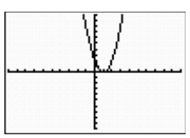
g(x) = $(x + 5)^2 + 3$

up 3, left 5



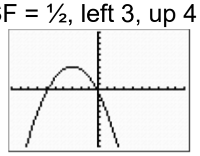
k(x) = $2(x - 1)^2$

VSF = 2, right 1



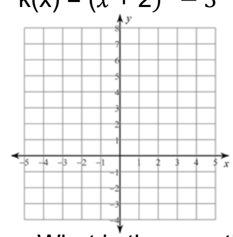
j(x) = $-\frac{1}{2}(x + 3)^2 + 4$

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

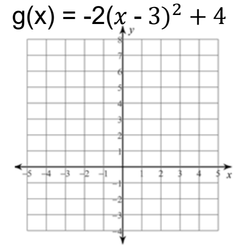


Interpret the transformation then graph the function

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



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



What is the equation that has been graphed?