

Good morning!

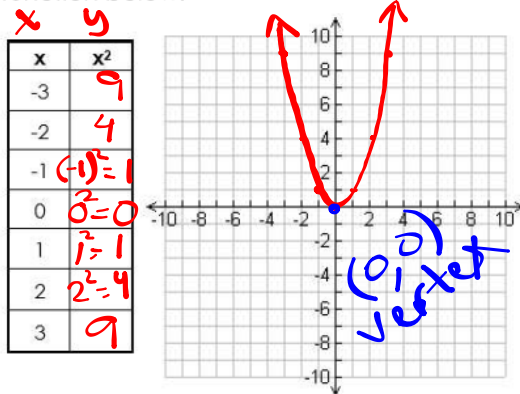
1. "Here"
2. Begin Unit 2 Part 3
3. Notes on Transformations in Vertex Form
4. Upload practice p. 8 to CTLS

Algebra 1
Unit 2 Part 3
 Quadratic Functions

			Thursday, March 11 th	Friday, March 12 th
			Transformations of Quadratic Functions	Graphing in Vertex Form Characteristics
Monday, March 15 th	Tuesday, March 16 th	Wednesday, March 17 th	Thursday, March 18 th	Friday, March 19 th
Graphing in Standard Form Characteristics	Graphing Characteristics Quiz Opens at 3:30 PM	Converting Between Vertex Form and Standard Form Quiz Due By Midnight	Quadratic Word Problems	
Monday, March 22 nd	Tuesday, March 23 rd	Wednesday, March 24 th	Thursday, March 25 th	Friday, March 26 th
Quadratic Word Problems	Review	Unit 2 Part 3 Test (during class)		

Transformations of Quadratic Functions Notes

The **parent function** of a function is the simplest form of a function. The parent function for a quadratic function is $y = x^2$ or $f(x) = x^2$. Complete the table and graph the parent function below.



As you can see, the graph of a quadratic function looks very different from the graph of a linear function.

The U-shaped graph of a quadratic function is called a parabola.

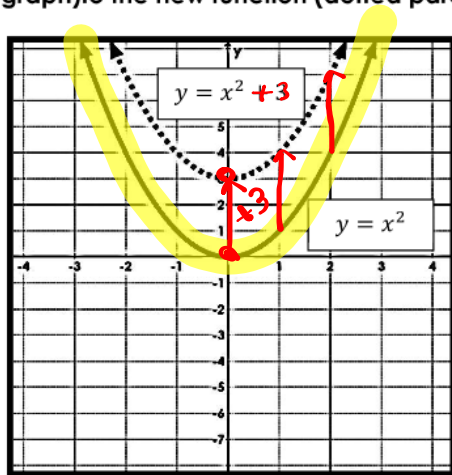
The highest/lowest point (or turning point) on a parabola is called the vertex.

Remember, in order for a function to be a quadratic function, one term must have x^2 .

The graph above is our parent function – it represents a quadratic function that has not been changed in any way. We are going to talk about the transformations of quadratic functions and how those transformations are represented in the equation of a quadratic function.

Exploring the “k”

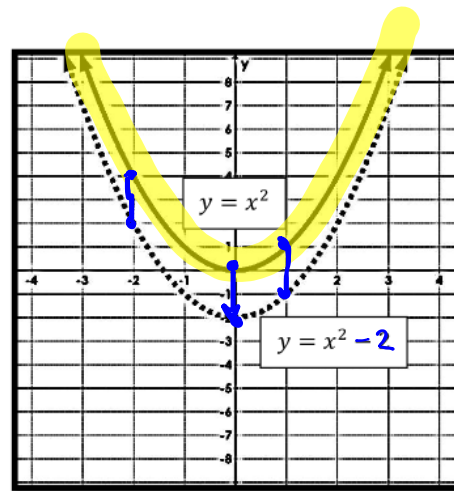
Answer the following questions about the transformation **from the parent graph (solid graph) to the new function (dotted parabola)**.



Describe the transformation: **3 UP**

What is the vertex of the new function?

(0, 3)



Describe the transformation: **2 Down**

What is the vertex of the new function?

(0, -2)

Parents are in charge

* older than children

① Parent ② Child

"boring" plain vanilla yogurt

* determining factors for children



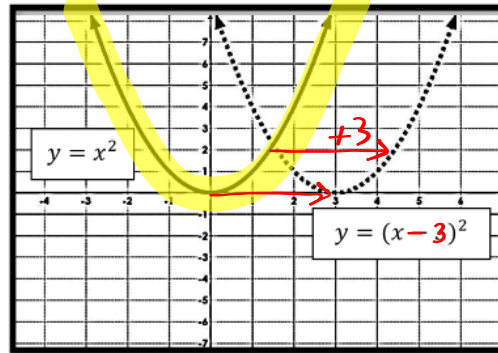
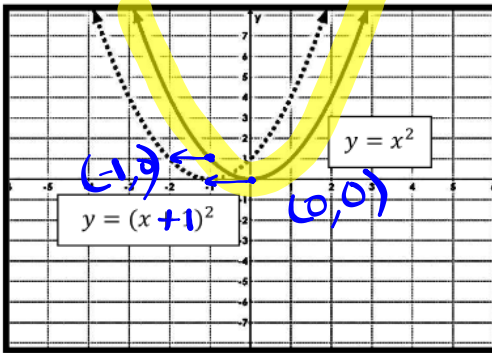
$$ax^2+bx+c$$



$$a(x-h)^2+k$$

Exploring the "h" Value

Answer the following questions about the transformation from the parent graph (solid graph) to the new function (dotted parabola).



Describe the transformation: **Left**

What is the vertex of the new function?

(-1, 0)

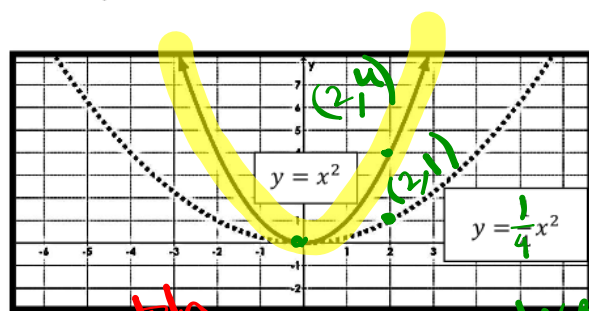
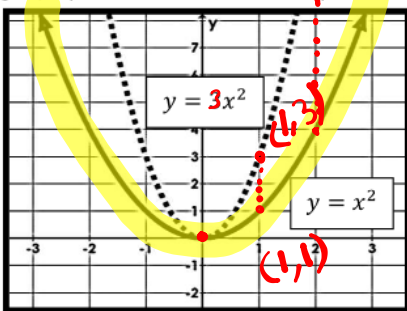
Describe the transformation: **3 Right**

What is the vertex of the new function?

(3, 0)

Exploring the "a" Value

Answer the following questions about the transformation from the parent graph (solid graph) to the new function (dotted parabola).



Describe the transformation: **Vertical stretch**

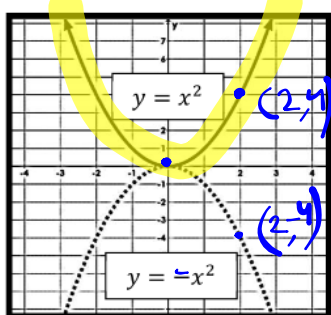
What is the vertex of the new function?

(0, 0)

Describe the transformation: **Vertical Shrink/Compression**

What is the vertex of the new function?

(0, 0)



Describe the transformation: **v. flipped**

What is the vertex of the new function?

(0, 0)

"flip over x-axis"

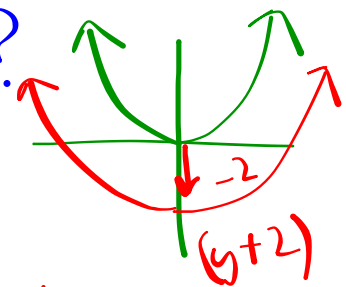
Why does graph go left
 when looks positive?

$$y = x^2 \rightarrow y = (x+1)^2$$

go left 1

$$y = a(x-h)^2 + k$$

-k -k



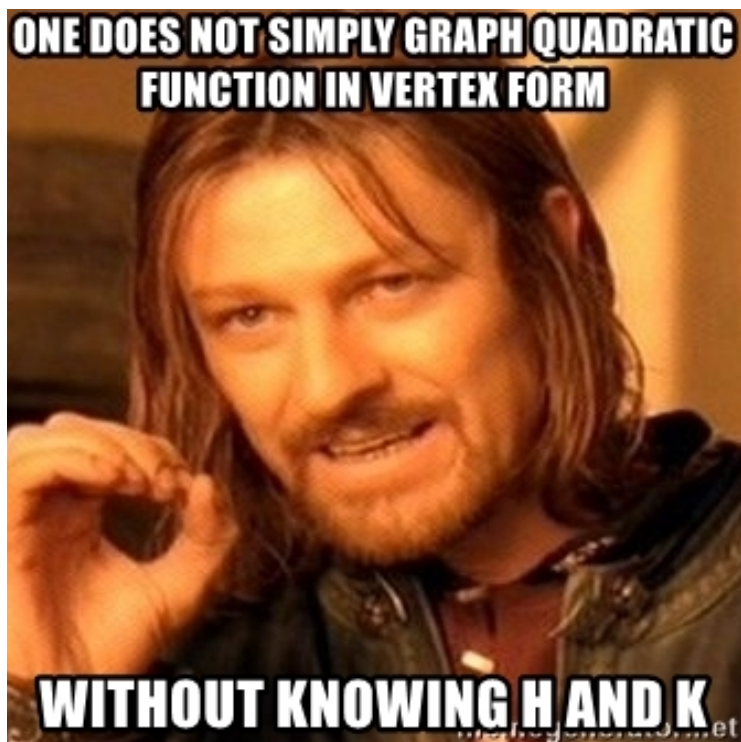
$$(y-k) = a(x-h)^2$$

+k +k

$$y = a(x-h)^2 + k$$

"inside
 opposite"
 horizontal"

outside
 parenthesis
 "SAME"
 vertical



Summary
 Vertex Form: $y = a(x-h)^2 + k$

opposite (green arrow from 'a' to 'h')

same (red arrow from 'a' to 'k')

Variable	Summary of the Effects of the Transformations		
a	<i>V. stretch</i> → $ a > 1$ <i>V. shrink</i> → $ a < 1$ $0 < a < 1$	<i>V. reflection = flip</i>	$a < 0$ " - " on the y-coord.
h	horizontal Shift	$y = (x + \#)^2$ Left # $y = (x - \#)^2$ Right #	<i>opposite</i>
k	Vertical Shift	$y = x^2 + \#$ UP # $y = x^2 - \#$ down #	

vertex: (h, k)

Practice

1) Given the equations below, describe the transformations from the parent function and name the vertex:

a. $y = -1(x-4)^2 + 7$

- ① $a = -1$ $a < 0$
 ↳ v. reflection
- ② $h = 4$
 ↳ 4 right
- ③ $k = 7$ 7 up

b. $y = -2(x+2)^2 + 5$

- ① $a < 0$ v. reflection
- ② $|a| = 2$ v. stretch
- ③ $h = -2$ 2 left
- ④ $k = 5$ 5 up

c. $y = \frac{1}{2}(x-3)^2 - 8$

- ① $a = \frac{1}{2}$ $\frac{1}{2} < 1$ v. shrink
- ② $h = 3$ 3 RIGHT
- ③ $k = -8$ 8 DOWN

2) Create an equation to represent the following transformations:

a. Shifted down 4 units, right 1 unit, and reflected across the x-axis

$k = -4$ $h = 1$

$a < 0$

$$y = a(x-h)^2 + k$$

$$y = -(x-1)^2 - 4$$

b. Shifted up 6 units, reflected across the x-axis, and stretch by a factor of 3

$k = 6$

$a < 0$

$|a| = 3$

$$y = a(x-h)^2 + k$$

$$y = -3x^2 + 6$$

c. Shifted up 2 units, left 4 units, reflected across the x-axis, and shrunk by a factor of $\frac{3}{4}$

$k = 2$ $h = -4$

$a < 0$

$|a| = \frac{3}{4}$

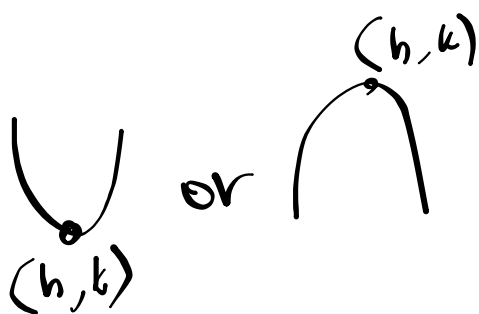
$$y = a(x-h)^2 + k$$

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

$$f(x) = a(x-h)^2 + k$$

wavy $f(x) = a \operatorname{trig}(bx - c) + d$

$$\frac{c}{b}$$





Identifying Transformations Practice

Equation	a, h, k values	^a Reflection?	^a Vertical Stretch or Shrink?	^h Horizontal Translation?	^k Vertical Translation?
$y = -2x^2 + 4$	$a = -2$ $h = 0$ $k = 4$	V.reflect	V.stretch	No	4 up
$y = \frac{3}{2}(x + 1)^2$	$a = 3/2$ $h = -1$ $k = 0$	no	V.stretch	1 LEFT	No
$y = \frac{1}{4}(x - 2)^2 - 5$	$a = 1/4$ $h = 2$ $k = -5$	no	V.shrink	2 RIGHT	5 DOWN
$y = -0.4x^2$	$a = -.4$ $h = 0$ $k = 0$	V.reflect	V.shrink	No	No
$y = \frac{2}{3}(x - 3)^2 + 4$	$a = 2/3$ $h = 3$ $k = 4$	no	V.shrink	3 RIGHT	4 up
$y = 4x^2 - 2$					
$y = (x + 1)^2 - 5$	$a = 1$	no	no		
$y = -3(x - 4)^2 + 1$					
$y = \frac{1}{2}x^2$					
$y = 2(x + 3)^2$					
$y = x^2 + 4$					
$y = (x + 4)^2$					
$y = 1.5x^2 - 9$					
$y = -x^2 + 2$					
$y = -0.8(x - 4)^2$					
$y = -3.2x^2 + 11$					

1.5

Writing Equations in Vertex Form Practice

Write the equation for a quadratic function which has been...

- 1) reflected across the x-axis and translated down 3 units.

- 2) vertically stretched by a factor of 2, and translated right 5 units.

- 3) reflected across the x-axis, vertically stretched by a factor of 1.5, and translated left 1 unit.

- 4) vertically shrunk by a factor of $\frac{1}{2}$, translated right 2 units, and translated down 4 units.

- 5) translated left 3 units, reflected across x-axis, and translated up 2 units.

- 6) translated down 1 unit, translated right 7 units, and vertically shrunk by a factor of 0.3.

- 7) vertically stretched by a factor of 2.5, translated right 1.5 units, translated up 3.3 units, and reflected across the x-axis.

- 8) translated left 6 units, translated down 2 units, and reflected across the x-axis.

- 9) neither stretched nor shrunk but has a vertex at (3, 4).

Transformations of Quadratic Functions - Matching

- | | | |
|----------|---|--------------------------------------|
| 1) ____ | Up 4 and left 2 | a. $f(x) = (x - 2)^2 + 4$ |
| 2) ____ | Reflect across x-axis and up 3 | b. $f(x) = -3(x + 5)^2$ |
| 3) ____ | Vertical stretch by 3 and right 5 | c. $f(x) = \frac{1}{2}(x - 2)^2 + 4$ |
| 4) ____ | Vertical shrink by $\frac{1}{3}$ and right 5 | d. $f(x) = -(x + 3)^2$ |
| 5) ____ | Right 2 and up 4 | e. $f(x) = \frac{1}{3}x^2 - 5$ |
| 6) ____ | Vertical stretch by 3 and down 5 | f. $f(x) = -x^2 - 3$ |
| 7) ____ | Reflect across x-axis and down 3 | g. $f(x) = (x - \frac{1}{2})^2 + 4$ |
| 8) ____ | Vertical shrink of $\frac{1}{3}$ and down 5 | h. $f(x) = \frac{1}{2}x^2 + 4$ |
| 9) ____ | Up 4 and right $\frac{1}{2}$ | i. $f(x) = 3(x - 5)^2$ |
| 10) ____ | Reflect across x-axis and left 3 | j. $f(x) = (x + 2)^2 + 4$ |
| 11) ____ | Vertical stretch of 2, right 4 and up 3 | k. $f(x) = -x^2 + 3$ |
| 12) ____ | Reflect across x-axis, vertical stretch of 3 and left 5 | l. $f(x) = 3x^2 - 5$ |
| 13) ____ | Vertical shrink by $\frac{1}{2}$, right 2 and up 4 | m. $f(x) = 2(x + 3)^2 + 4$ |
| 14) ____ | Vertical shrink by $\frac{1}{2}$ and up 4 | n. $f(x) = 2(x - 4)^2 + 3$ |
| 15) ____ | Vertical stretch of 2, left 3 and up 4 | o. $f(x) = \frac{1}{3}(x - 5)^2$ |