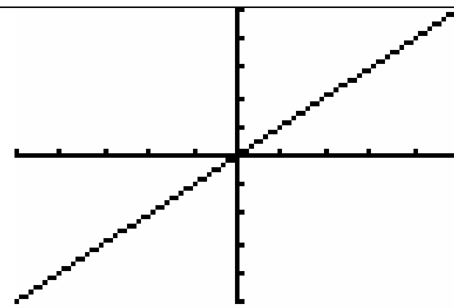
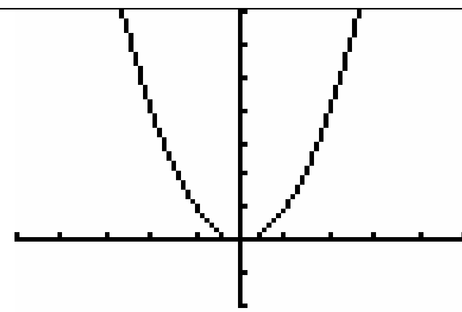
Déjà Vu, It's Algebra 2!

Lesson 11

Quadratic Functions: Graphs & Properties

Degree	Parent Function	Name	Graph
1	$f(x) = x$	Linear	 Slanted Line
2	$f(x) = x^2$	Quadratic	 Parabola

The origin of the term "quadratic" is Latin. It is derived from *quadratus* which is the past participle of *quadrare* which means "to make square." From this it is clear that part of the word is connected to the Latin word for "four," though not a way which one might expect: it refers to squaring, and a square is a regular four-sided figure.

Forms of Quadratic Equations

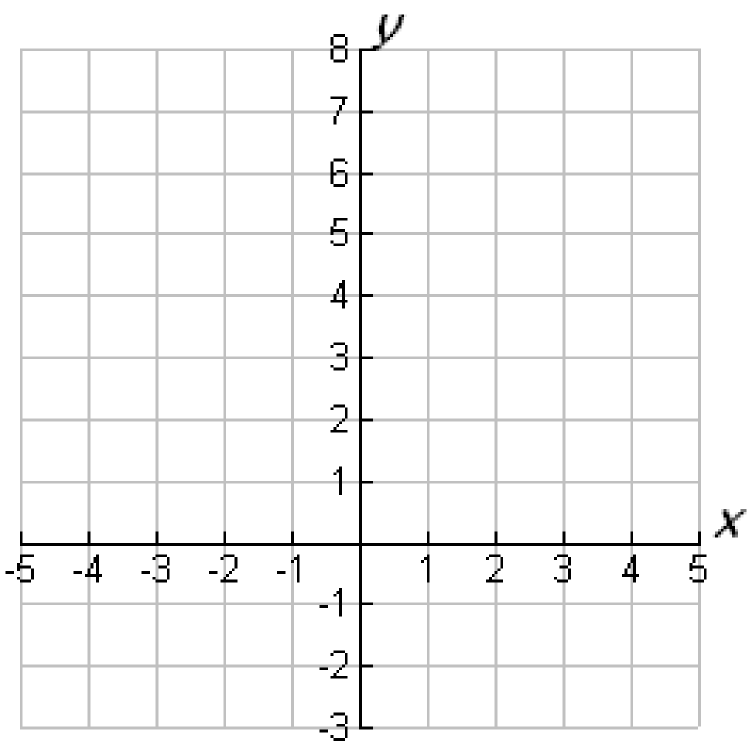
Standard Form: $f(x) = ax^2 + bx + c \qquad a \neq 0$

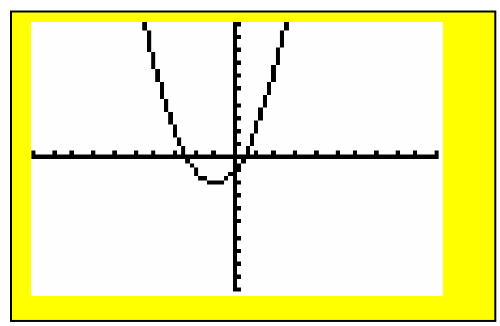
Example:

Graph the following function using a table:

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

x	$f(x) = x^2 + 2x - 1$	$(x, f(x))$
-3	9-6-1 = 2	$(-3, 2)$
-2	4-4-1 = -1	$(-2, -1)$
-1	1-2-1 = -2	$(-1, -2)$
0	0+0-1 = -1	$(0, -1)$
1	1+2-1 = 2	$(1, 2)$
2	4+4-1 = 7	$(2, 7)$





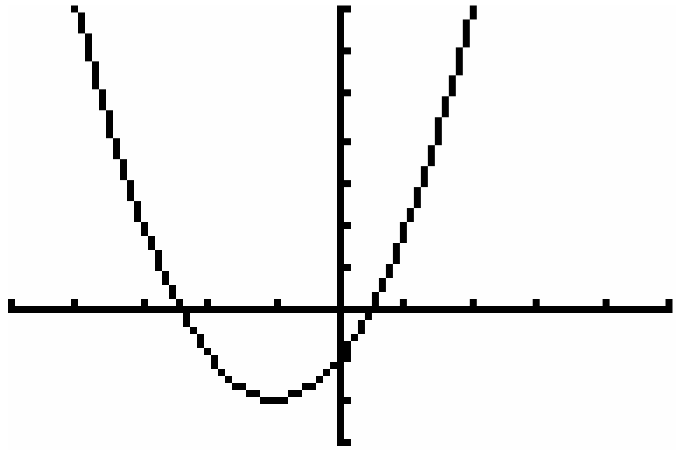
Standard Form

$f(x) = ax^2 + bx + c$

Axis of symmetry: the line $x = -\dfrac{b}{2a}$

Vertex: $\left(-\dfrac{b}{2a}, f\left(-\dfrac{b}{2a}\right)\right)$ **y-intercept:** c

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



Example:

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

Completing the Square

$f(x) = \left(x^2 + 2x + 1\right) - 1 - 1$ add a clever form of zero

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

VERTEX $(-1, -2)$

AXIS OF SYMMETRY : $x = -1$

Vertex Form

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

Axis of symmetry: the line $x = h$

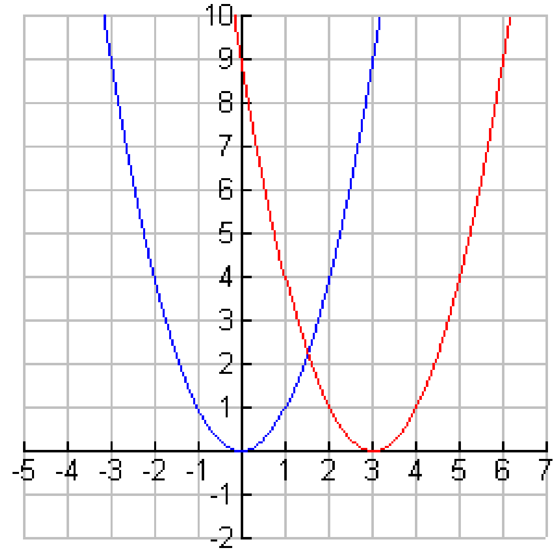
Vertex: (h, k)

Transformations of the parent function

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

TRANSLATIONS or SHIFTS

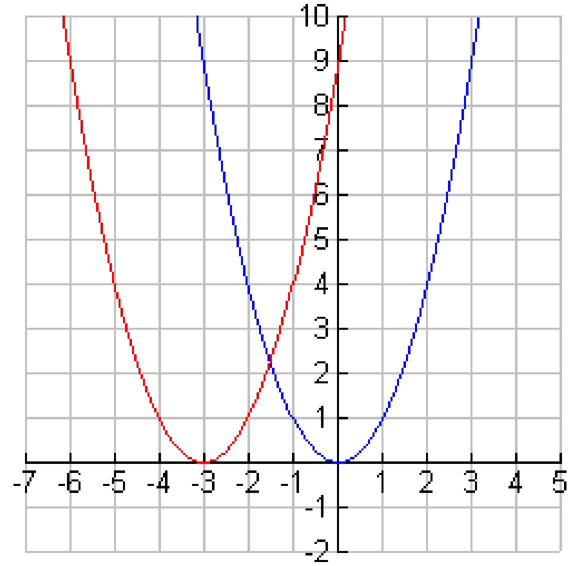
Horizontal shift for $h > 0$



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

moves RIGHT h units

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



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

moves LEFT h units

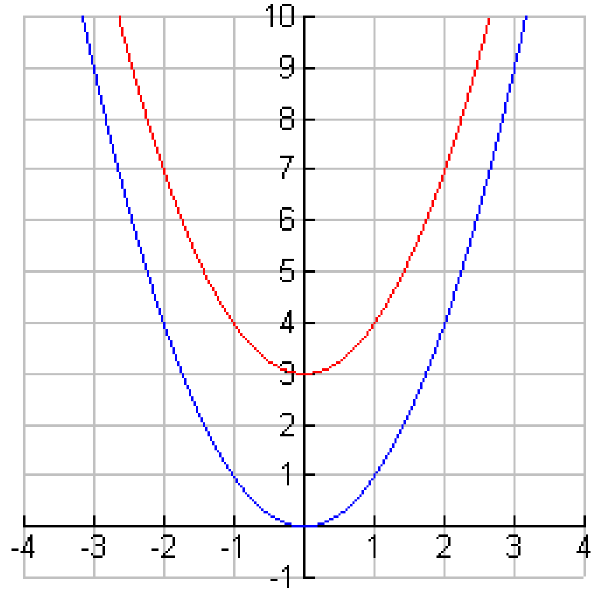
Ex) $g(x) = (x+3)^2$

Vertical Shift for $k > 0$

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

moves UP k units

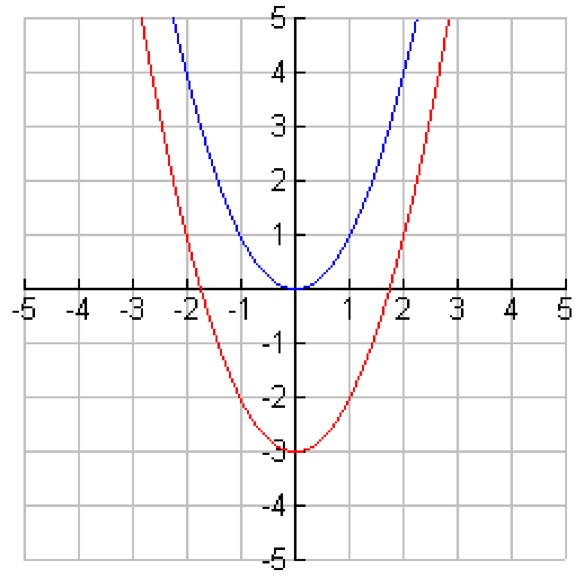
Ex) $g(x) = x^2 + 3$



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

moves DOWN k units

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



Example:

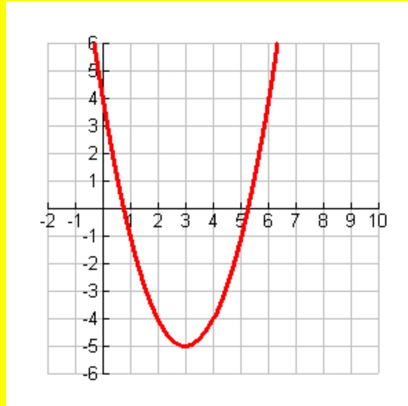
Put the following equation into vertex form, then sketch the graph using transformations.

$$f(x) = x^2 - 6x + 4$$

Vertex Form:

$$f(x) = (x-3)^2 - 5$$

Right 3 units, down 5 units



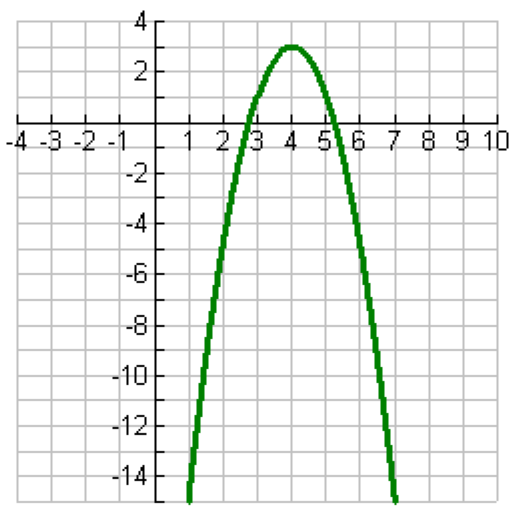
Déjà RE-Vu

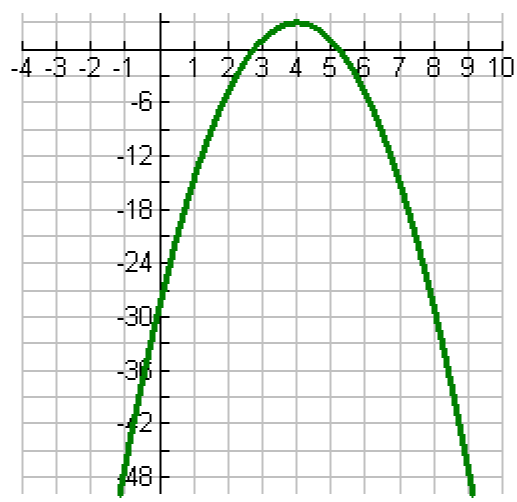
Putting it all together

Put the following equation in vertex form, and then sketch the parabola.

$$h(x) = -2x^2 + 16x - 29$$

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





References:
All images created with TI-Interactive software or TI-83+ calculator

For more information on applications of parabolas, check out the following website:
http://www.pen.k12.va.us/Div/Winchester/jhhs/math/lessons/calc2004/appparab.html