

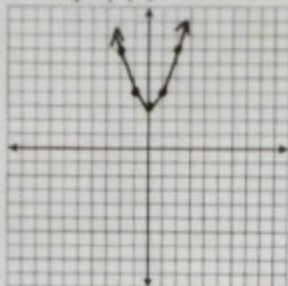
Translation

Shifts the parabola up, down, left or right.

DilationStretches \uparrow or compresses \curvearrowright the parabola.**Reflection**Causes the parabola to open up \curvearrowright or down \curvearrowleft .**Example 1: Vertical Translations**

Graph $f(x) = x^2 + 3$

x	$x^2 + 3$	y
-2	$(-2)^2 + 3$	7
-1	$(-1)^2 + 3$	4
0	$(0)^2 + 3$	3
1	$(1)^2 + 3$	4
2	$(2)^2 + 3$	7

**KEY CONCEPT**

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

$k > 0 \uparrow$

$k < 0 \downarrow$

CharacteristicsVertex: $(0, 3)$ Axis of Symmetry: $x = 0$ y-intercept: $(0, 3)$

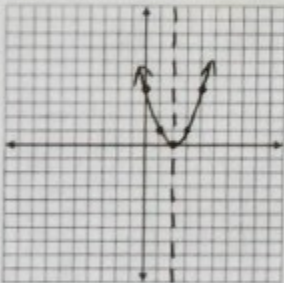
How does this compare to the parent function?

translated up 3 units

Example 2: Horizontal Translations

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

x	$(x - 2)^2$	y
0	$(0 - 2)^2$	4
1	$(1 - 2)^2$	1
2	$(2 - 2)^2$	0
3	$(3 - 2)^2$	1
4	$(4 - 2)^2$	4

**KEY CONCEPT**

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

$h > 0 \rightarrow$

$h < 0 \leftarrow$

CharacteristicsVertex: $(2, 0)$ Axis of Symmetry: $x = 2$ y-intercept: $(0, 4)$

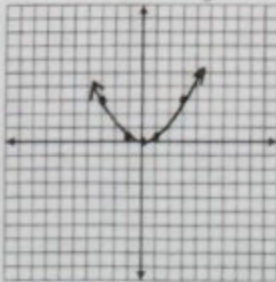
How does this compare to the parent function?

translated right 2 units

Example 3: Dilations/Reflections

Graph $f(x) = \frac{1}{3}x^2$

x	$\frac{1}{3}x^2$	y
-3	$\frac{1}{3}(-3)^2$	3
-1	$\frac{1}{3}(-1)^2$	$\frac{1}{3}$
0	$\frac{1}{3}(0)^2$	0
1	$\frac{1}{3}(1)^2$	$\frac{1}{3}$
3	$\frac{1}{3}(3)^2$	3

**KEY CONCEPT**

$f(x) = ax^2$

OPEN UP

$a > 0$

OPEN DOWN

$a < 0$

STRETCH

$|a| > 1$

COMPRESS

$0 < |a| < 1$

CharacteristicsVertex: $(0, 0)$ Axis of Symmetry: $x = 0$ y-intercept: $(0, 0)$

How does this compare to the parent function?

compressed by factor of $\frac{1}{3}$