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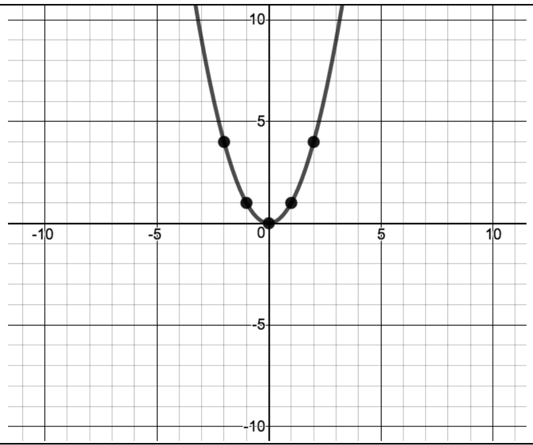
Transforming Quadratic Functions
Vertex Form

There are 3 kinds of transformations that occur in quadratics:
Reflections (R), Dilations (Which I will be calling "**Stretches**" **(S)**), and **Translations (T)**.

First of all, in order to transform something, we need the pre-image where we can begin. For a quadratic, the pre-image is the parent function, $f(x) = x^2$

Quadratic Parent Function: $\boldsymbol{f(x) = x^2}$

$\boldsymbol{x}$	$\boldsymbol{y}$
-2	4
-1	1
0	0
1	1
2	4



Reflections

To reflect a quadratic, simply make it negative. We can either reflect it vertically (over the x-axis) or horizontally (over the y-axis).

Vertical Reflection	Horizontal Reflection
$g(x) = -x^2$	$g(x) = (-x)^2$

There are 2 things that I want you to notice.
1. A reflection happens when the x^2 is, in some way, negative.
2. Vertical reflections happen *outside* and are not squared away, but Horizontal reflections happen *inside* and are squared away.

Stretches (Dilations)

To stretch, or dilate, a quadratic, multiply by a number. We can either stretch it vertically (make it taller/shorter) or horizontally (make it fatter/skinnier).

Vertical Stretch	Horizontal Stretch
$g(x) = Sx^2$	$g(x) = \left(\frac{1}{S}x\right)^2$

There are 3 things that I want you to notice.
1. A stretch happens when the x^2 is, multiplied by something
2. Vertical stretches happen *outside*. Horizontal stretches happen *inside*.
3. The Horizontal stretch is a fraction—instead of multiplying, we're dividing. Horizontals work in opposites.

Translations

To translate a quadratic, all you do is add a number. We can either translate it vertically (move it up or down) or horizontally (move it left or right).

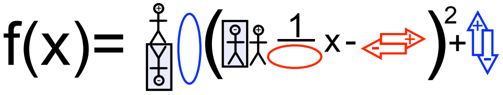
Vertical Translation	Horizontal Translation
$g(x) = x^2 + T$	$g(x) = (x - t)^2$

There are 3 things that I want you to notice.
1. A translation happens when we add by something
2. Vertical reflections happen *outside*. Horizontal reflections happen *inside*.
3. The Horizontal translation is a negative—instead of adding, we're subtracting. Horizontals work in opposites.

I think of the transformation equation in two ways—as an alphabetical list of changes (RST), or as a picture equation.

$$f(x) = \boldsymbol{Reflection}\boldsymbol{Stretch}\left(\boldsymbol{reflection}\frac{1}{\boldsymbol{stretch}}x - \boldsymbol{translation}\right)^2 + \boldsymbol{Translation}$$

$$f(x) = RS\left(r\frac{1}{s}x - t\right)^2 + T$$



Remember, the vertical stretches and translations happen the way they say they do. If it's outside, it can be trusted. However, the **horizontal stretches** and **translations** are the **opposites** of what they say they are.

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For each quadratic, identify the vertical and horizontal transformations. **Remember that horizontals are opposites!**

1. $g(x) = -2(x + 1)^2 + 5$

Vertical *outside ()*	Horizontal *(inside)*

2. $h(x) = (-2x + 5)^2 + 1$

Vertical *outside ()*	Horizontal *(inside)*

3. $k(x) = \frac{1}{2}(-x)^2 + 3$

Vertical *outside ()*	Horizontal *(inside)*

4. $m(x) = -\left(\frac{1}{2}x + 3\right)^2$

Vertical *outside ()*	Horizontal *(inside)*

5. $n(x) = 4(x - 2)^2 - 9$

Vertical *outside ()*	Horizontal *(inside)*

6. $p(x) = (4x - 2)^2 - 9$

Vertical *outside ()*	Horizontal *(inside)*

7. $q(x) = -6(x + 4)^2$

Vertical *outside ()*	Horizontal *(inside)*

8. $r(x) = (-6x)^2 + 4$

Vertical *outside ()*	Horizontal *(inside)*

9. $t(x) = 2x^2 - 9$

Vertical *outside ()*	Horizontal *(inside)*

10. $v(x) = (2x - 9)^2$

Vertical *outside ()*	Horizontal *(inside)*

11. $w(x) = \frac{1}{5}(x - 3)^2 + 4$

Vertical *outside ()*	Horizontal *(inside)*

12. $b(x) = \left(\frac{1}{5}x + 4\right)^2 - 3$

Vertical *outside ()*	Horizontal *(inside)*

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