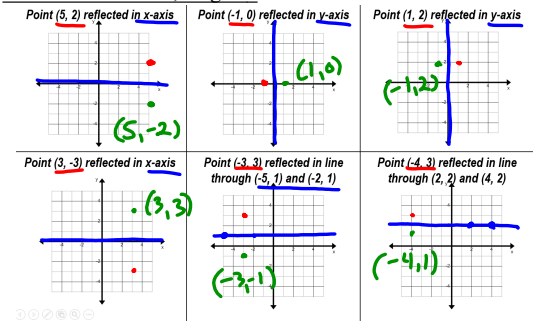# 1.2 - Transformations of Linear and Absolute Value Functions

1.2 - Transformations of Linear and Absolute Value Functions

Goals:
- Write functions representing **translations** and **reflections**
- Write functions representing **stretches** and **shrinks**
- Perform **combinations** of **transformations**

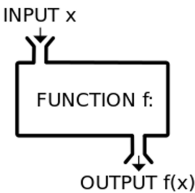| Point (5, 2) reflected in x-axis	Point (-1, 0) reflected in y-axis	Point (1, 2) reflected in y-axis
(5,-2)	(1,0)	(-1,2)
Point (3, -3) reflected in x-axis	Point (-3, 3) reflected in line through (-5, 1) and (-2, 1)	Point (-4, 3) reflected in line through (2, 2) and (4, 2)
(3,3)	(-3,-1)	(-4,1)

Compare the graph of each function to the graph of its parent function *f*. Use a graphing calculator to verify your answers are correct.

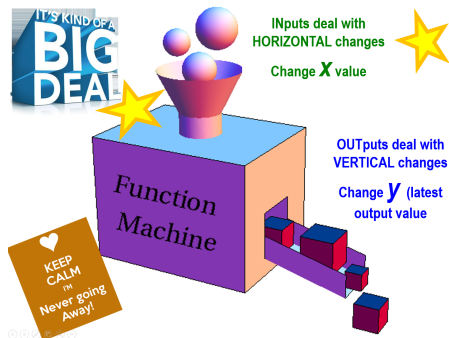**a.** $y = x^2 + 1$

PARENT
$Y = x^2$
UP 1

b. $y = (x - 1)^2$

PARENT
$Y = x^2$
RIGHT 1

c. $y = -x^2$

PARENT
$Y = x^2$
REFLECTED
OVER X-AXIS

Understanding INput vs OUTput

INPUT x
FUNCTION f:
OUTPUT f(x)

NEVER LEAVING

IT'S A BIG DEAL

IT'S KIND OF A BIG DEAL

INputs deal with HORIZONTAL changes

Change **X** value

OUTputs deal with VERTICAL changes

Change **y** (latest output value

Function Machine

KEEP CALM I'M Never going Away!

Seriously, <u>ORDER makes a DIFFERENCE!</u> These are <u>*NOT*</u> the same!

KEEP CALM I'M Never going Away!

We are NEVER GOING AWAY

Part 1 - Translations and Reflections

1.2 - Transformations of Linear and Absolute Value Functions

YES YOU CAN CHANGE	HORIZONTAL	VERTICAL
works with	INput	OUTput Handles on TOP & BOTTOM
moves things	left right Handles on SIDES	up down
reflects over	y-axis	X-axis
stretches	moves away from y-axis	moves away from X-axis
shrinks	moves toward y-axis	moves toward X-axis

$$f(x) = 5x - 4$$

Vertical Changes

" "
-
-
-
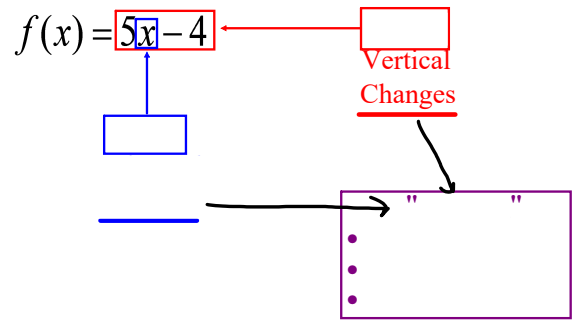
Write a function g whose graph represents the indicated transformation of the graph of f.

$f(x) = 3x$; translation 5 units up

GIVE IT A SHOT

$$y = 3x + 5$$

$f(x) = |x| - 3$; translation 4 units to the right

$$y = |x - 4| - 3$$

THINK... is it VERTICAL (OUTput) or HORIZONTAL (INput)?

EXAMPLE 1   Writing Translations of Functions

Let $f(x) = 2x + 1$.

a. Write a function g whose graph is a translation 3 units down of the graph of f.

Solution

OUTPUT / VERTICAL

$$g(x) = \underset{f(x)}{(2x+1)} - 3$$

$$\boxed{g(x) = 2x - 2}$$

EXAMPLE 1   Writing Translations of Functions

Let $f(x) = 2x + 1$.

b. Write a function h whose graph is a translation 2 units to the left of the graph of f.
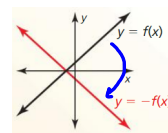
Solution:

INPUT / HORIZONTAL

$$h(x) = 2(x+2) + 1$$
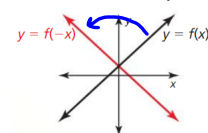$$h(x) = 2x + 4 + 1$$
$$h(x) = 2x + 5$$

Reflections

Reflections in the x-axis

To reflect a function over the x-axis (up/down), you multiply the [____] by -1.

Reflections in the y-axis

To reflect a function over the y-axis (left/right), you multiply the [____] by -1.

Part 1 - Translations and Reflections

1.2 - Transformations of Linear and Absolute Value Functions
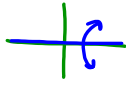
EXAMPLE 2   Writing Reflections of Functions

Let $f(x) = |x + 3| + 1$.

a. Write a function g whose graph is a reflection in the x-axis of the graph of f.

Solution: VERTICAL → OUTPUT

$$g(x) = -\left(|x+3| + 1\right)$$
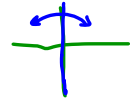
$$g(x) = -|x+3| - 1$$

EXAMPLE 2   Writing Reflections of Functions

Let $f(x) = |x + 3| + 1$.

b. Write a function h whose graph is a reflection in the y-axis of the graph of f.

Solution: HORIZONTAL → INPUT

$$h(x) = |-x+3| + 1$$

Extra Examples:

Rewrite the function $f(x) = 3x - 5$ after each transformation.

a.) Translated 7 units up $y = (3x-5) + 7$

$y = 3x + 2$

b.) Translated 4 units left $y = 3(x+4) - 5$

$y = 3x + 7$

c.) Reflected over the y-axis $y = 3(-x) - 5$

$y = -3x - 5$

d.) Reflected over the x-axis $y = -(3x - 5)$

$y = -3x + 5$

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- #4,6,8,11-14

Part 1 - Translations and Reflections