Function Transformations

To Graph:	Draw the Graph of f and:	Changes in the Equation of $y=f(x)$
Vertical shifts		
$y=f(x) + c$	Raise the graph of f by c units	c is added to $f(x)$
$y=f(x) - c$	Lower the graph of f by c units	c is subtracted from $f(x)$
Horizontal shifts		
$y=f(x+c)$	Shift the graph of f to the left c units	x is replaced with $x + c$
$y=f(x-c)$	Shift the graph of f to the right c units	x is replaced with $x - c$
Reflection about the x-axis		
$y=-f(x)$	Reflect the graph of f about the x-axis	$f(x)$ is multiplied by -1
Reflection about the y-axis		
$y=f(-x)$	Reflect the graph of f about the y-axis	x is replaced with $-x$
Vertical stretching or shrinking		
$y=cf(x), c > 1$ (stretching)	Multiply each y-coordinate of $y=f(x)$ by c, vertically stretching the graph of f	$f(x)$ is multiplied by c, $c>1$
$y=cf(x), 0<c< 1$ (shrinking)	Multiply each y-coordinate of $y=f(x)$ by c, vertically shrinking the graph of f	$f(x)$ is multiplied by c, $0< c <1$
Horizontal stretching or shrinking		
$y=f(cx), c > 1$ (shrinking)	Divide each x-coordinate of $y=f(x)$ by c, horizontally shrinking the graph of f	x is replaced with cx, $c>1$
$y=f(cx), 0<c< 1$ (stretching)	Divide each x-coordinate of $y=f(x)$ by c, horizontally stretching the graph of f	x is replaced with cx, $0<c<1$

1. As this gets <u>bigger (>1)</u> it <u>vertically stretches</u>

2. As this gets <u>smaller (<1)</u> it <u>vertically shrinks</u>

3. <u>Negative</u> value means a <u>reflection about x-axis</u> (y-values change sign)

Vertical Changes

These transformations do what you think they should (do not reverse)

This number causes an <u>up/down shift</u> of the graph (positive =up, negative = down)

$$y = \underline{\quad} f [\underline{\quad} (x+\underline{\quad})]+ \underline{\quad}$$

1. As this gets <u>bigger (>1)</u> it <u>horizontally shrinks</u>

2. As this gets <u>smaller (<1)</u> it <u>horizontally stretches</u>

3. <u>Negative</u> value means a <u>reflection about y-axis</u> (x-values change sign)

This number causes a <u>left/right shift</u> of the graph (positive =left, negative = right)

These transformations do the <u>reverse</u> of what you think they should do

Horizontal Changes

Order of Transformations
1. Horizontal Shift (left/right)
2. Stretches and Shrinks
3. Reflections
4. Vertical Shift (up/down)