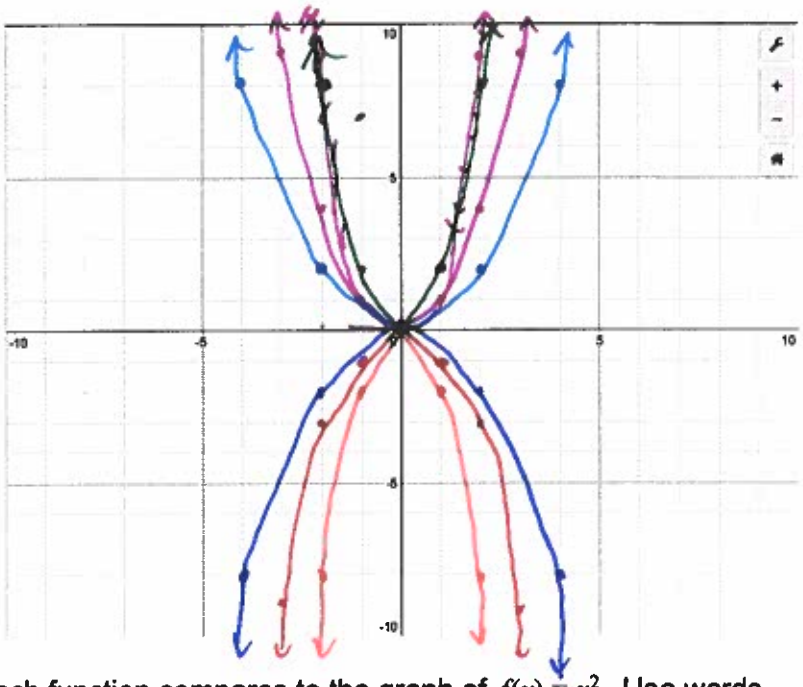
1. Graph the following functions on the same set of coordinate axes using a graphing calculator or the desmos app. Then use different colored crayons/markers and graph each function on the coordinate below.

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

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



a) Describe how the graph of each function compares to the graph of $f(x) = x^2$. Use words such as narrow, wider and reflected.

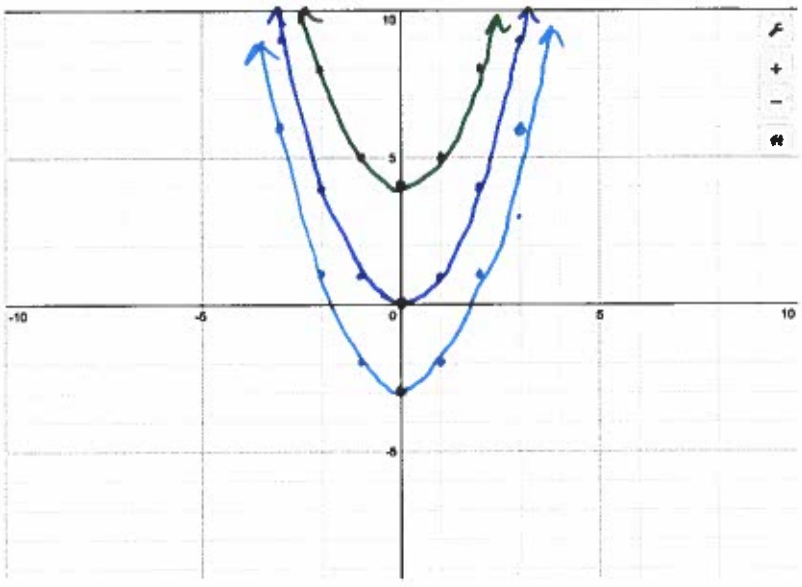
$y = 2x^2$ is narrower
$y = \frac{1}{2}x^2$ is wider
$y = -x^2$ is reflected in the x-axis
$y = -2x^2$ is reflected in the x-axis and narrower
$y = -\frac{1}{2}x^2$ is reflected in the x-axis and wider.

b) Look at each graph and develop 3 rules that describes how the value of a in $f(x) = ax^2$ changes the graph of $f(x) = x^2$.

① If $-1 < a < 1$, then the parabola is wider than $f(x) = x^2$.
② If $a > 0$, then the parabola ~~is narrower than~~ opens upward if $a < 0$, then parabola opens downward.
③ If $a > 1$ or $a < -1$, then the parabola is narrower than $f(x) = x^2$.

2. Graph the following functions on the same set of coordinate axes. Then use different colored crayons/markers and graph each function on the coordinate below.

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



a) Describe how the graph of each function compares to the graph of $f(x) = x^2$.

$y = x^2 + 4$ has been shifted up two units.

$y = x^2 - 3$ has been shifted down three units.

b) Look at each graph and develop 2 rules that describes how the value of q in $f(x) = x^2 + q$ changes the graph of $f(x) = x^2$.

When $q > 0$, the graph shift up q units.

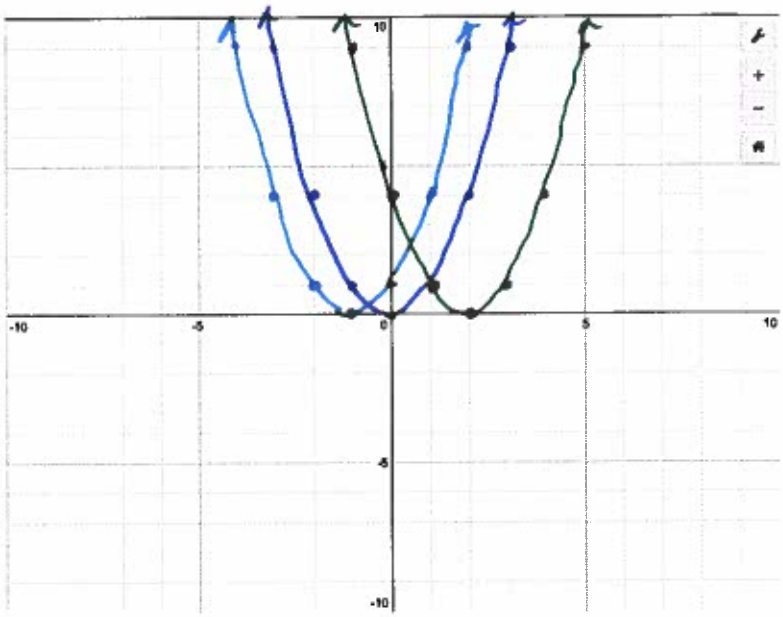
When $q < 0$, the graph shift down q units.

3. Graph the following functions on the same set of coordinate axes. Then use different colored crayons/markers and graph each function on the coordinate below.

$f(x) = x^2$

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

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



a) Describe how the graph of each function compares to the graph of $f(x) = x^2$.

$f(x) = (x-2)^2$ has been shifted right two units.

$f(x) = (x+1)^2$ has been shifted left one unit.

b) Look at each graph and develop 2 rules that describe how the value of p in $f(x) = (x-p)^2$ changes the graph of $f(x) = x^2$.

If $p > 0$, the parabola shifts right p units.

If $p < 0$, the parabola shifts left p units.

Look at page 146 and 147. Use desmos to graph the quadratic functions.