## Algebra 2

Lesson 5-3: Transforming Parabolas
Mrs. Snow, Instructor

## Parent function: $y=x^{2}$

Vertex form $-\boldsymbol{y}=\boldsymbol{a}(\boldsymbol{x}-\boldsymbol{h})^{2}+\boldsymbol{k}$
Vertex: (h, $\boldsymbol{k}$ )

Just as our other functions, the x-element of the vertex translates the parabola horizontally left or right. The y-element translates the parabola vertically up or down.

Note: While we like to graph using the calculator, using the vertex form in some cases may even be faster than using a graphing calculator.

$$
\text { When } y=x^{2} \quad \text { or } \quad y=a(x-h)^{2}+k:
$$

| 1. $y=-a x^{2}$ | reflection across the $x$-axis (flips upside down) <br> Negative is a sad face. |
| :---: | :---: |
| 2. $a>1$ | the graph stretches (gets skinny) |
| 3. $0<a<1$ <br> (a fraction) | the graph will shrink (gets broad or wide) |
| 4. $h>0$ or $h<0$ <br> remember the eqquation form! $\left(x-\sum_{n} h\right)^{2}$ | positive $h$ shift right negative $\mathbf{h}$ graph shifts left |
| 5. $\mathrm{k}>0$ or $\mathrm{k}<0$ | positive $\mathbf{k}$ shift up negative $\mathbf{k}$ shift down |
| 6. vertex $=(\mathrm{h}, \mathrm{k})$ |  |
| 7. axis of symmetry: line $x=h$ |  |


graph each equation, notice what happens with $h$ :

$$
\begin{gathered}
y=(x+3)^{2} \\
y=x^{2} \\
y=(x-5)^{2}
\end{gathered}
$$

Translation:
Graph: $f(x)=(x-2)^{2}+3$
The vertex is:
Notice that the graph has both a vertical and a horizontal shift. The graph moves $\qquad$ 2 units and 3 units.

## Reflection:

Graph: $g(x)=-(x-2)^{2}+3$ ?
The vertex is:
This is called a reflection along the horizontal axis. We can generalize by saying that any quadratic equation
 with a negative sign in front of the $x^{2}$ term will open downward or be upside down.

Leading Coefficient:
Graph $y=3 x^{2}$
Notice the effect of a number in front of a quadratic equation: the graph got skinnier (compressed).

Graph $y=\frac{1}{4} x^{2}$,
The graph gets fatter (stretches).
In general, if the constant, " a ", is larger than 1 the graph will get skinny.

For values between 0 and 1 the graph will get wider.


Write an equation of a parabola in vertex form from a graph

|  |  |
| :---: | :---: |
| Graph, state domain and range $y=2(x+1)^{2}-4$  |  |
| Convert an equation to vertex form: $y=-3 x^{2}+12 x+5$ | $y=x^{2}-8 x+21$ |

