4.1 Quadratic Functions and Transformations

Learning Targets for today

- To be able to graph quadratic functions of the form $y=x^2$.
- To be able to graph a quadratic function in vertex form.
- To be able to identify the vertex of each parabola (minimum / maximum).
- To be able to identify the axis of symmetry.
- To be able to identify the domain and range of each function.

Vocabulary

The Parent Quadratic Function – $y = x^2$

The parent quadratic function is $f(x) = x^2$ Its graph is the parabola shown. The axis of symmetry is $x = 0$. The vertex is $(0, 0)$.
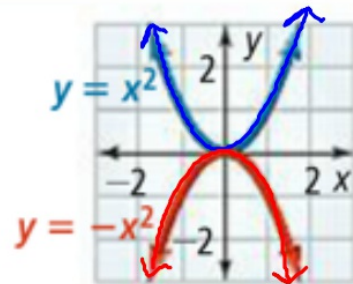
Vertex (0, 0)

Axis of Symmetry
$x = 0$

$x = 0$
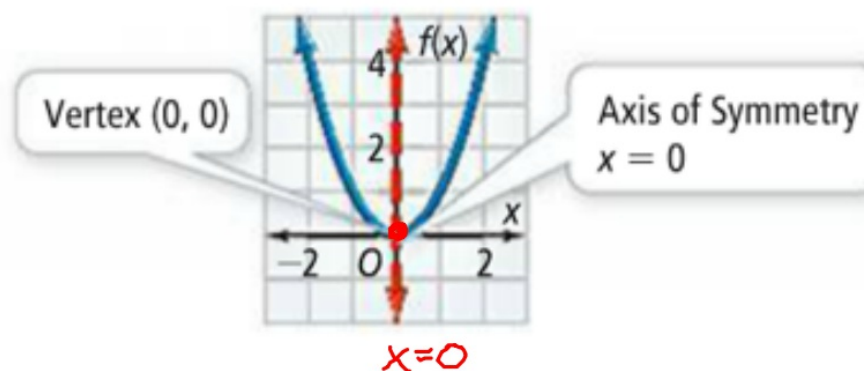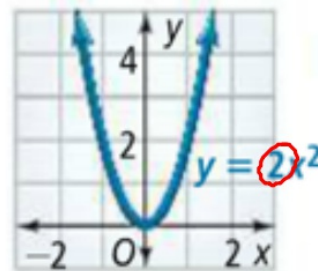
Parabola – U-shaped curved line.

Axis of Symmetry - The fold or line that divides the parabola into two matching halves.

Vertex of a Parabola – The highest and lowest piont of a parabola, depending on whether the parabola opens up or down.
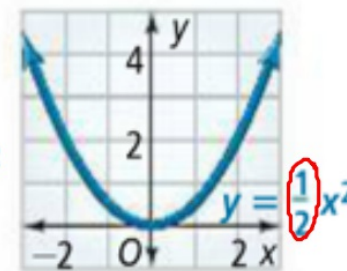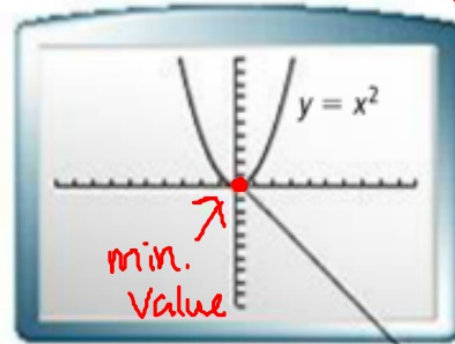
$y = \underline{a}x^2$

$y = x^2$

$y = -x^2$

Reflection,
a and $-a$

$y = 2x^2$

Stretch,
$a > 1$
(narrower)

$y = \frac{1}{2}x^2$

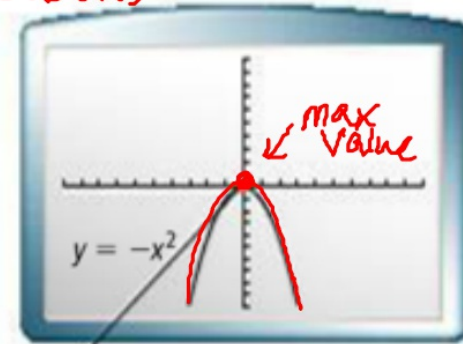Compression,
$0 < a < 1$
(WIDER)

If $a > 0$, the parabola opens upward. The y-coordinate of the vertex is the **minimum value** of the function. If $a < 0$, the parabola opens downward. The y-coordinate of the vertex is the **maximum value** of the function.

Vertex

$y = x^2$

min. Value

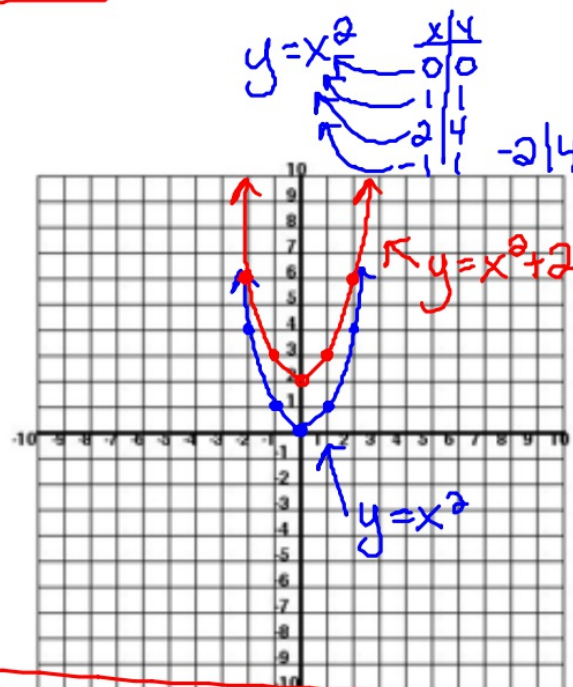Minimum Value   Vertex

max Value

$y = -x^2$

Maximum Value

Graphing Translations ($y = x^2$)

Example for you…	Your turn to try…
1. Graph $y = x^2 + 2$ How is it different from $y = x^2$?	1. Graph $y = (x - 1)^2$. How is it different from $y = x^2$?

Example for you… (left)

$y = x^2$

x	y
0	0
1	1
2	4
-1	1
-2	4

X	Y
-2	6
-1	3
0	2
1	3
2	6

$y = x^2 + 2$

$y = x^2$

translated up 2 units

Your turn to try… (right)

translated to the right 1 unit

X	Y
-2	9
-1	4
0	1
1	0
2	1
3	4
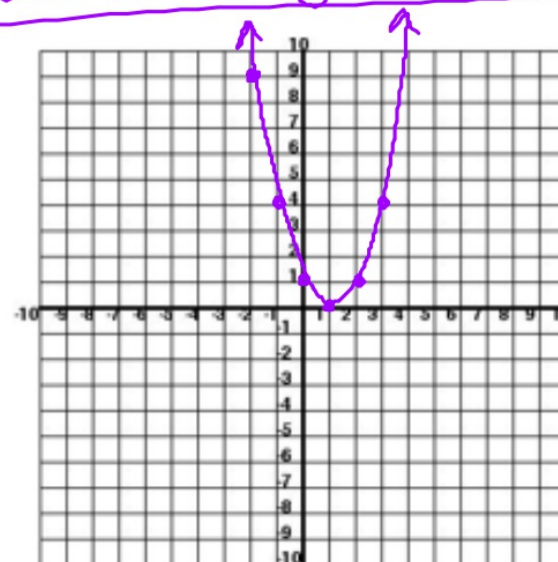
Vocabulary

Vertex Form – $\quad y = \underline{a}(x - \underline{h})^{2} + \underline{k}$

a = tells whether it opens up or down
(h, k) = Vertex!
Axis of symmetry = h

Analyzing Vertex Form!

Example for you…	Your turn to try…
Determine which way the graph opens, the vertex, and the axis of symmetry for the function.	Determine which way the graph opens, the vertex, and the axis of symmetry for the function.
$\overset{a}{\downarrow} \quad \overset{h}{\underline{\ }} \quad \overset{k}{\underline{\ }}$ 1. $y = 3(x - \underline{4})^{2} + \underline{9}$ opens: __UP__ vertex: $(4, 9)$ axis: $X = 4$ Max or (Min)?	1. $y = -(x + \underline{4})^{2} - \underline{4}$ $(-4, -4)$ opens: DOWN vertex: $(-4, -4)$ axis: $X = -4$ (Max) or Min ?

Graphing Quadratic Functions in vertex form. $y = a(x - h)^2 + k$

Example for you…	**Your turn to try…**

Example for you…

1. $y = (x - 3)^2 + 2$

(x)
Domain: ℝ
(y)
Range: ℝ ≥ 2

X	Y
5	6
4	3
3	2
2	3
1	6
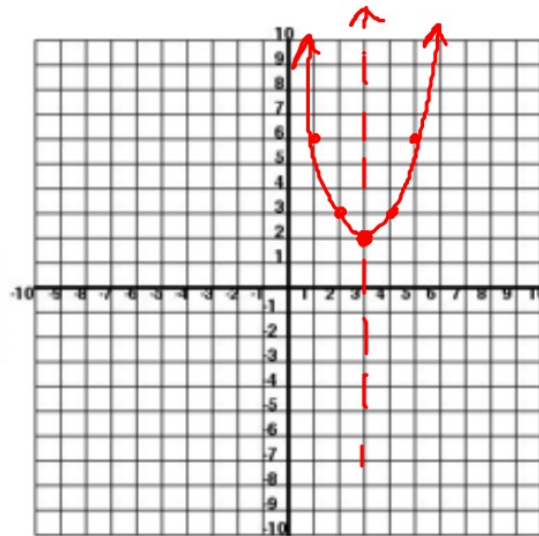
X = 3

Your turn to try…

1. $y = -(x - 4)^2 + 1$

Domain: ℝ
Range: ℝ ≤ 1

X	Y
6	-3
5	0
4	1
3	0
2	-3

X = 4