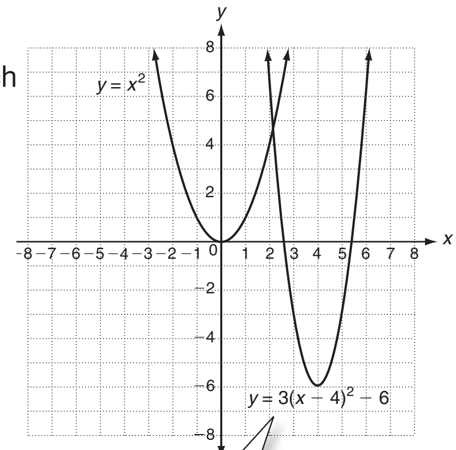
Date ____________________

Dear Family,

In Chapter 5, your child will graph quadratic functions, solve quadratic equations and inequalities, and learn to operate with complex numbers.

A **quadratic function** is one in which the variable is squared. The parent quadratic function is $f(x) = x^2$, which forms as a U-shaped **parabola** with **vertex** $(0, 0)$.



The parent function can be transformed to form a variety of parabolas. **Vertex form** helps you identify transformations.

vertex form: $f(x) = a(x - h)^2 + k$

a indicates a reflection across the *x*-axis and/or a vertical stretch or compression.

h indicates a horizontal translation.

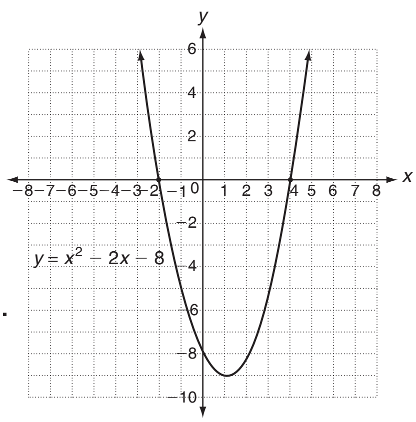
k indicates a vertical translation.

$y = 3(x - 4)^2 - 6$ was stretched vertically by a factor of 3, and the vertex is translated to $(4, -6)$.

A quadratic function may also be in **standard form,** which helps identify other properties of the parabola, such as the *y*-intercept (the coefficient *c*).

standard form: $f(x) = ax^2 + bx + c$

The *x*-intercepts of a parabola are input values of *x* that make the output of $f(x) = ax^2 + bx + c$ equal to *zero*. Hence, the *x*-intercepts are also called **zeros**. You can find the zeros of a function by graphing it.



quadratic function: $f(x) = x^2 - 2x - 8$

From the graph, the zeros are $x = -2$ and $x = 4$.

Closely related to a quadratic function is the quadratic equation $ax^2 + bx + c = 0$. The solutions to a quadratic equation are called **roots**. You can find roots by factoring and using the **Zero Product Property.** The roots are equivalent to the zeros.

quadratic equation: $x^2 - 2x - 8 = 0$

$$(x + 2)(x - 4) = 0$$
$$x + 2 = 0 \text{ or } x - 4 = 0$$
$$x = -2 \text{ or } x = 4$$

Zero Product Property
If two quantities multiply to zero, then at least one is zero.

Many quadratic expressions are **trinomials** (contain three terms) that factor into two **binomials** (contain two terms). If the two binomial factors are identical, the original expression is called a **perfect-square trinomial**.

$$\underbrace{x^2 - 10x + 25}_{\text{perfect-square trinomial}} = (x - 5)(x - 5) = (x - 5)^2$$

Completing the square is a method of solving a quadratic equation by making a perfect-square trinomial. Then you use a square root to solve.

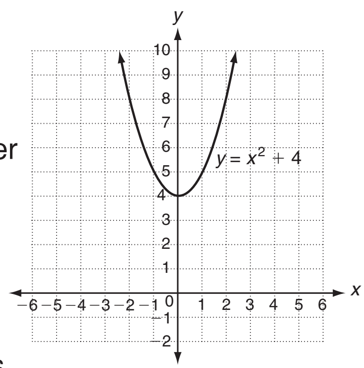
Solve $x^2 + 6x = 1$.

$x^2 + 6x + \boxed{9} = 1 + \boxed{9}$	*9 makes $x^2 + 6x$ a perfect-square.*
$(x + 3)^2 = 10$	*Factor the left side.*
$x + 3 = \pm\sqrt{10}$	*Take the square root of both sides.*
$x = -3 \pm\sqrt{10}$	*Solve for x.*

If you complete the square for the general equation $ax^2 + bx + c = 0$, you get the **Quadratic Formula:**

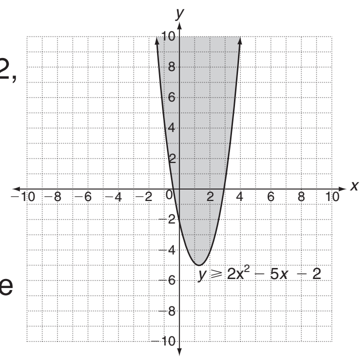
If $ax^2 + bx + c = 0$, then the solutions are $x = \dfrac{-b \pm\sqrt{b^2 - 4ac}}{2a}$.

Some quadratic functions, such as $f(x) = x^2 + 4$, have no x-intercepts. Likewise, the equation $0 = x^2 + 4$ has no *real* roots because you get $x = \pm\sqrt{-4}$. The square root of a negative number is called an **imaginary number**, and the **imaginary unit** is $i = \sqrt{-1}$. So, $0 = x^2 + 4$ does have two *imaginary* roots, $x = \pm 2i$.



A **complex number** is one that can be written in the form $a + bi$. For example, in $7 - 2i$, the **real part** is 7 and the **imaginary part** is $-2i$. Complex numbers can be graphed in the **complex plane** (which has a real axis and an imaginary axis), and they can be added, subtracted, multiplied, divided, or raised to powers.

Quadratic inequalities in *two* variables, such as $y \geq 2x^2 - 5x - 2$, are graphed similar to linear inequalities in two variables: solid or dashed boundary line with shading above or below. Quadratic inequalities in *one* variable are graphed on a number line.



Quadratic equations have many real-world applications, such as the height of a *projectile* (an object that is thrown or launched) as gravity acts on it over time. If the data isn't perfectly quadratic, you might use **regression** to find a best-fit **quadratic model**.

For additional resources, visit go.hrw.com and enter the keyword MB7 Parent.