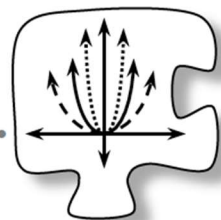# 1.3   How can I shift a parabola?

Parabola Investigation

In Algebra 1 you learned about slope and y-intercept, ideas that allow you to write equations and sketch graphs of any line. During this lesson you will work on developing similar tools for parabolas.

PARABOLA LAB, Part One

What happens to a parabola's graph when you change the numbers in the equation? To get a better sense of the different ways to transform the graph of a parabola, as a team complete the investigation outlined below. As you work, be sure to sketch the graphs you see in your graphing calculator carefully and record the equations you enter.
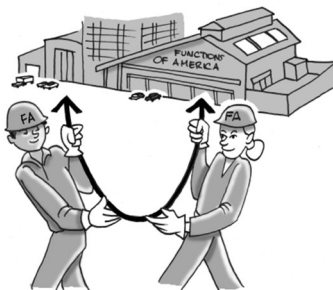
   a. Using www.desmos.com/calculator, graph the equation $y = (x - 2)(x - 2)$. Be sure to locate any important points on the graph, including the lowest point on the graph, called the **vertex**. (If the graph were to open downward, the vertex would be the highest point on the graph.) Sketch the graph in your notebook, label the vertex, write the equation of the line of symmetry, and draw the axis of symmetry on your graph.
   b. Use Desmos to find the equations of two parabolas with *different* graphs that also open upward and still have a vertex at (2,0). Add sketches of these two new graphs to your graph from part (a), along with their equations. As you work, keep track of any ideas you try along with their results, even if they do not answer this question, as they may help you later.
   c. Use Desmos to find the equations of two different parabolas that open *downward*, each with its vertex on the x-axis at $x = 2$. How did you change the equation so that the parabola would open downward? Add sketches of these graphs and their equations to your axes. What are their lines of symmetry?
   d. Use Desmos to find the equation of a parabola that opens downward with a vertex at $(-4,0)$. What is the equation of your parabola's line of symmetry?
   e. Choose a new point on the x-axis and find at least three equations of parabolas that touch the x-axis only at that one point.

PARABOLA LAB, Part Two

Your Task: Using Desmos, work with your team to determine all of the ways you can change the graph of a parabola by changing its equation. Be prepared to share your ideas with the class. As other teams contribute ideas to a class discussion, write down any new ideas.

Whenever you figure out a new transformation, record a clear summary statement before moving on to the next transformation. Be prepared to explain your summary statement to the class.

Type $y = a(x - h)^2 + k$ into the first equation box in Desmos. Choose to add all sliders.

PARABOLA LAB, Part Three

Your Task: Using Desmos, work with your team to explain the following transformations:

$y = -f(x)$	$y = f(x) + k$	$y = a \cdot f(x)$
$y = f(-x)$	$y = f(x - h)$	$y = f(b \cdot x)$