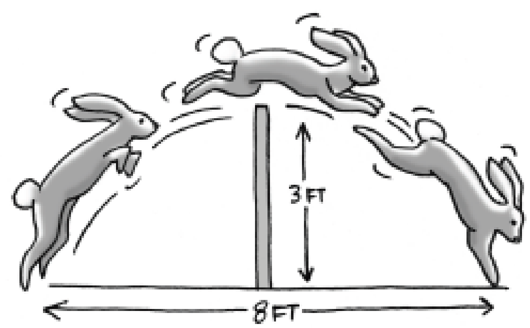
2.1.5 How can I model the data?

Mathematical Modeling with Parabolas

In the past few lessons, you have determined how to move graphs of parabolas around, that is, to transform them, on a set of axes. You have also learned how to write quadratic equations in graphing and in standard form. In this lesson you will put these new skills to work as you use parabolas and their equations to model situations.

2-64.JUMPING JACKRABBITS

The diagram at right shows a jackrabbit jumping over a three-foot-high fence. To just clear the fence, the rabbit must start its jump at a point four feet from the fence.



Sketch the situation and write an equation that models the path of the jackrabbit. Show or explain how you know your sketch and equation fit the situation.

Discussion Points

How can we make a graph fit this situation?

What information do we need in order to find an equation?

How can we be sure that our equation fits the situation?

Further Guidance

2-65. Sketch the path of the jackrabbit on your paper. Choose where to place the x- and y-axes in your diagram so that they make sense and make the problem easier. Label as many points as you can on your sketch. Explore using *2-64 Student eTool* (Geogebra: html5).

a. What is the shape of the path of the jackrabbit? What kind of equation would best model this situation?

b. What point on your graph can tell you about the values of h and k in the equation? Write the values for h and k into the general equation. Is your equation finished?

c. With your team, find a strategy to find the exact value of a. Will any of the points on your diagram help? Be prepared to share your strategy with the class.

d. What are the domain and range for your model?

e. Did any team in your class get a different equation? If so, write down their equation and show how it can also model the path of the jackrabbit. What choices did that team make differently that resulted in the different equation?

Further Guidance section ends here.

2-66. When Ms. Bibbi kicked a soccer ball, it traveled a horizontal distance of 150 feet and reached a height of 100 feet at its highest point. Sketch the path of the soccer ball and find an equation of the parabola that models it.

2-67. At the skateboard park, the hot new attraction is the *U-Dip,* a cement structure embedded into the ground. The cross-sectional view of the *U-Dip* is a parabola that dips 15 feet below the ground. The width at ground level, its widest part, is 40 feet across. Sketch the cross-sectional view of the *U-Dip*, and find an equation of the parabola that models it.

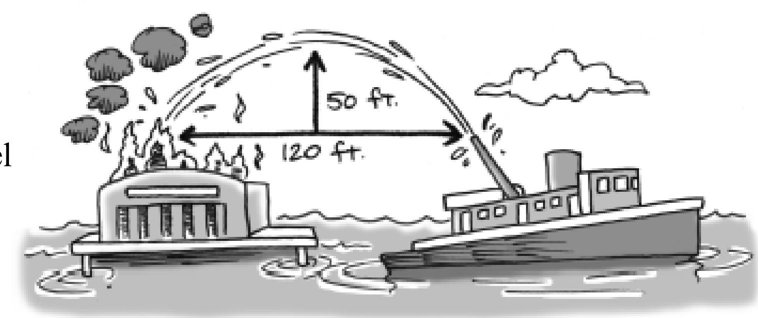
2-68. LEARNING LOG

With your team, discuss all of the different forms you know for the equation of a parabola. In your Learning Log, write down each form, along with a brief explanation of how that form is useful. Title this entry, "Forms of a Quadratic Function" and label it with today's date.

Review & Preview

2-69. FIRE! CALL 9-1-1!

A fireboat in the harbor is helping put out a fire in a warehouse on the pier. The distance from the barrel (end) of the water cannon to the roof of the warehouse is 120 feet, and the water shoots up 50 feet above the barrel of the water cannon.



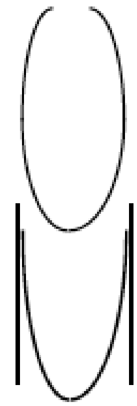
Sketch a graph and find an equation of the parabola that models the path of the water from the fireboat to the fire. Give the domain and range for which the function makes sense in relation to the fireboat. Help (Html5)⇔Help (Java)

2-70. Draw accurate graphs of $y = 2x + 5$, $y = 2x^2 + 5$, $y = \frac{1}{2}x^2 + 5$ on the same set of axes. Label the intercepts. Help (Html5)⇔Help (Java)

a. In the equation $y = 2x + 5$, what does the 2 tell you about the graph?

b. Is the 2 in $y = 2x^2 + 5$ also the slope? Explain.

2-71. Think about how you might sketch a parabola on a graph. Help (Html5)⇔Help (Java)



a. Do the sides of a parabola ever curve back in like the figure at right? Explain your reasoning.

b. Do the sides of the parabola approach straight vertical lines as shown in the figure at right? (In other words, do parabolas have asymptotes?) Give a reason for your answer.

2-72. Find the equation of an exponential function that passes through each pair of points. Help (Html5)⇔Help (Java)

a. $(2, 9)$ and $(4, 324)$

b. $(-1, 40)$ and $(0, 12)$

2-73. Find the x- and y-intercepts of the graphs of the two equations below. Help (Html5)⇔Help (Java)

a. $y = 2x^2 + 3x - 5$

b. $y = \sqrt{2x - 4}$

2-74. The vertex of a parabola, point (h, k) , locates its position on the coordinate graph. The vertex thus serves as a **locator point** for a parabola. Other families of functions that you will be investigating in this course will also have locator points. These points have different names, but the same purpose for each different type of graph. They help you place the graph on the axes.

Sketch graphs for both of the following equations. On each sketch, label the locator point. Help (Html5)⇔Help (Java)

a. $y = 3x^2 + 5$

b. $f(x) = -(x - 3)^2 - 7$

2-75. If $g(x) = x^2 - 5$, find the value(s) of x so that: Help (Html5)⇔Help (Java)

a. $g(x) = 20$

b. $g(x) = 6$