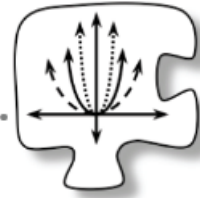# 2.1.2   How can I model the relationship?

Modeling with Parabolas

Previously you have learned to write the equation for a parabola given the coordinates of a few key points. But to create a model for an everyday situation, you often have to identify information that represents the essential features, such as the maximum or minimum point or the intercepts. Today you will put these skills to work as you use parabolas and their equations to model situations.

2-13. 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.
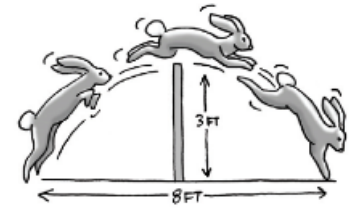
Sketch the situation and write an equation that models the path of the jackrabbit. Show or explain how you know your sketch and equation fit the situation. Explore using the *2-13 Student eTool* (Desmos). Click in the lower right corner of the graph to view it in full-screen mode. Desmos Accessibility
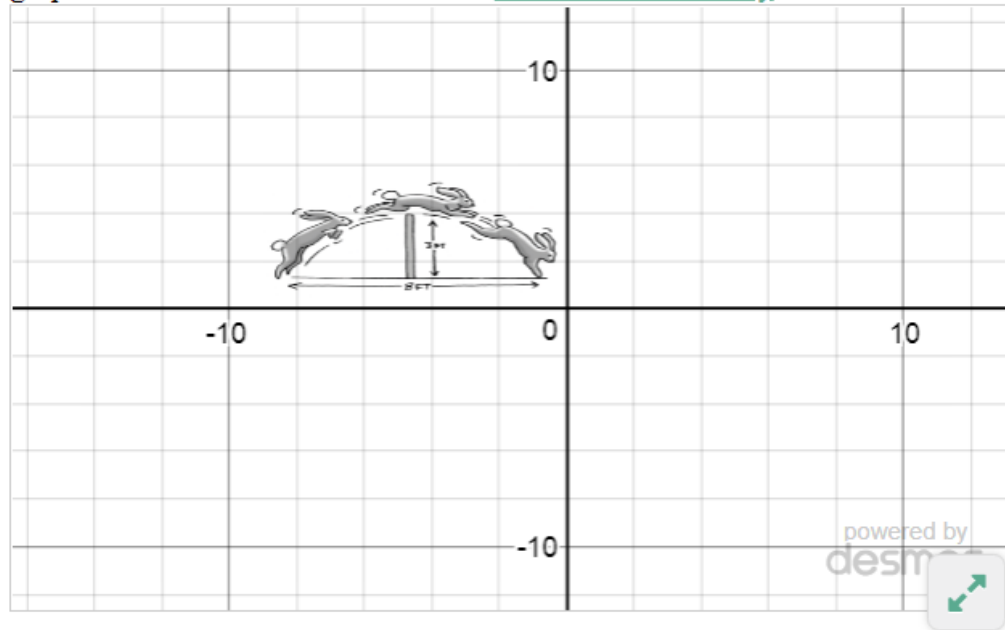
Discussion Points

How can we make a graph fit this situation?

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

How can we be sure that our equation fits the situation?
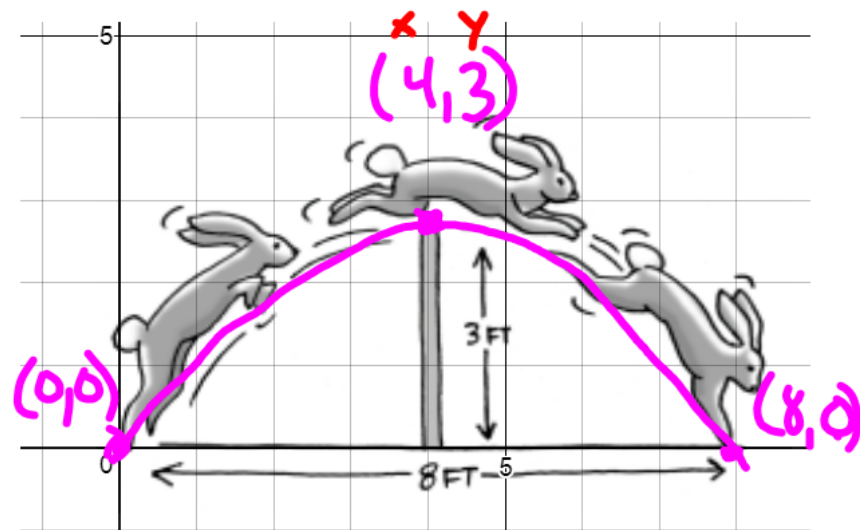
$x=0 \quad x=8$

$a=0 \quad x-0=0 \quad x-8=0$

Z.P.P.

$a[x(x-8]=0$

$a[x^2-8x]=0$

$y=a[x^2-8x] \rightarrow$

$y=-\frac{3}{16}(x^2-8x).$

$(4,3)$

$(0,0)$

3 FT

$(8,0)$

8 FT

$3=a((4)^2-8(4))$

$3=a(16-32)$

$\dfrac{3}{-16}=\dfrac{a(-16)}{-16}$

$-\frac{3}{16}=a$

$$x = -4 \qquad x = 4$$

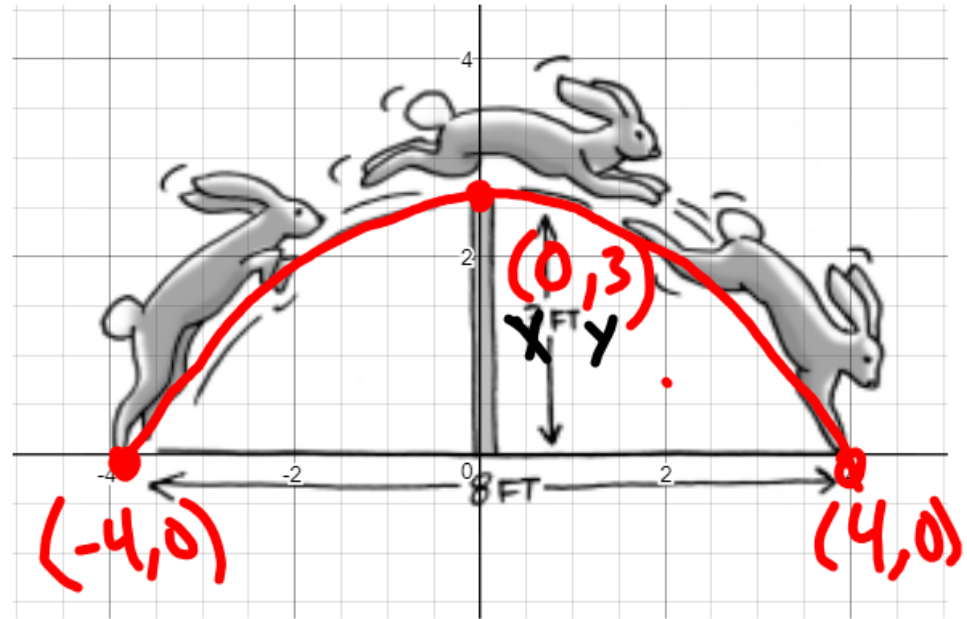$$a \neq 0 \quad x + 4 = 0 \quad \text{or} \quad x - 4 = 0$$

$$\text{Z.P.P.}$$

$$a\left[(x+4)(x-4)\right] = 0$$

$\times$	x	$\cdot 4$
x	x^2	$4x$
-4	$-4x$	-16

$$\boxed{y = a(x^2 - 16)}$$

$$\boxed{y = -\tfrac{3}{16}(x^2 - 16)}$$

(0,3)

X FT Y

(-4,0)

(4,0)

8 FT

$$3 = a\left((0)^2 - 16\right)$$

$$3 = a(0 - 16)$$

$$3 = a(-16)$$

$$\frac{3}{-16} = \frac{a(-16)}{-16}$$

$$-\tfrac{3}{16} = a$$

I

$x = -8$ or $x = 0$

$a \neq 0$ $x + 8 = 0$ or $x + 0 = 0$

Z.P.P.

$a[(x+8)(x+0)] = 0$ x

$a[x(x+8)] = 0$

$y = a(x^2 + 8x)$ → $3 = a((-4)^2 + 8(-4))$

$3 = a(16 - 32)$

$3 = a \cdot (-16)$

$\dfrac{3}{-16} \quad \dfrac{a \cdot (-16)}{-16}$

$-\dfrac{3}{16} = a$

$\boxed{y = -\dfrac{3}{16}(x^2 + 8x)}$

$(-4, 3)$

$(-8, 0)$

$(0, 0)$

8 FT

3 FT
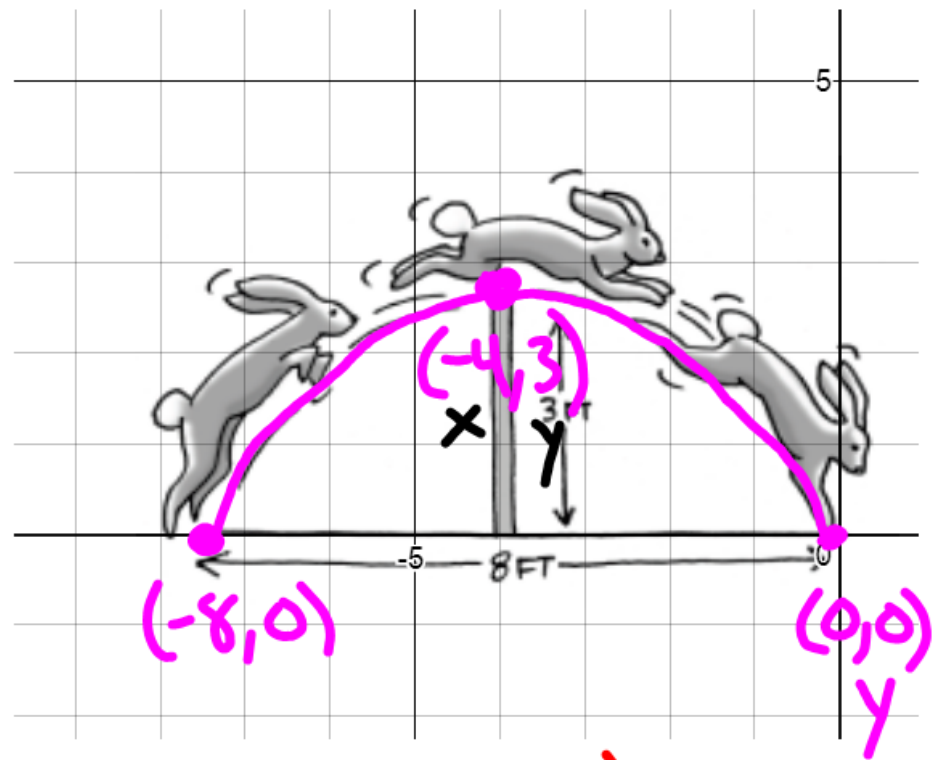
2-15. When Ms. Bibbi kicked a soccer ball, it traveled a horizontal distance of 150 feet and reached a height of 100 feet at its highest point.

    a. Sketch the path of the soccer ball and write an equation for a parabola that models it.

    b. How far (horizontally) is the ball from Ms. Bibbi when it is 25 feet high.