To find the expression that represents a quadratic function based on the graph of a parabola, we need to follow the same procedure that was used to find a quadratic function algebraically. That is, plug the vertex into the standard form of a quadratic function, then use any other point that the parabola passes through to determine the leading coefficient $a$. So using the graph of a parabola, we need to identify the vertex of the graph first, and then identify any other point the parabola passes through.

**Example 1:** Find the standard form $f(x) = a(x - h)^2 + k$ of the quadratic function that represents each of the following parabolas.

a. [Graph of a parabola]

Vertex: (5, 1)

$f(x) = a(x - 5)^2 + 1$

I will use the point (3, −1) to find the value of $a$.

$-1 = a(3 - 5)^2 + 1$

$-2 = a(4)$

$-\frac{1}{2} = a$

$f(x) = -\frac{1}{2}(x - 5)^2 + 1$
When determining the value of the leading coefficient \( a \), be sure that it is consistent with the orientation of the parabola (opening up or opening down). A parabola that opens up (its vertex lies at the bottom of the parabola) should have a positive leading coefficient \( (a > 0) \). A parabola that opens down (its vertex lies at the top of the parabola) should have a negative leading coefficient \( (a < 0) \).

**Example 2:** Find the standard form \( f(x) = a(x - h)^2 + k \) of the quadratic function that represents each of the following parabolas.
**Example 3:** Find the standard form $f(x) = a(x - h)^2 + k$ of the quadratic function that represents each of the following parabolas.

**Answers to Examples:**

1a. $f(x) = -\frac{1}{2}(x - 5)^2 + 1$; 1b. $f(x) = 3(x + 1)^2 + 6$

2a. $f(x) = -\frac{4}{9}(x + 2)^2 + 4$; 2b. $f(x) = (x + 3)^2$

3a. $f(x) = -(x - 2)^2 + 4$; 3b. $f(x) = \frac{5}{9}(x + 1)^2 - 2$