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 with vertex at (5, 1) and another point at (3, -1)]

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.

a.

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

\[ \text{a.} \]

![Graph of a parabola opening upwards with vertex at (5, 1)]

\[ \text{b.} \]

![Graph of a parabola opening downwards with vertex at (-1, 6)]

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. \( f(x) = \frac{5}{9}(x + 1)^2 - 2 \);