EXAMPLE 2 **Graph a function of the form $y = ax^2 + c$**

Graph $y = -\frac{1}{2}x^2 + 3$. **Compare the graph with the graph of $y = x^2$.**

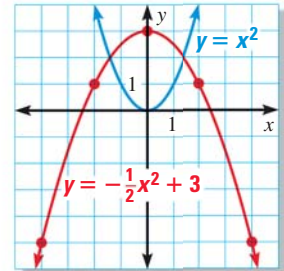**Solution**

STEP 1 **Make** a table of values for $y = -\frac{1}{2}x^2 + 3$.

SKETCH A GRAPH
Choose values of x that are multiples of 2 so that the values of y will be integers.

x	−4	−2	0	2	4
y	−5	1	3	1	−5

STEP 2 **Plot** the points from the table.

STEP 3 **Draw** a smooth curve through the points.

STEP 4 **Compare** the graphs of $y = -\frac{1}{2}x^2 + 3$ and $y = x^2$. Both graphs have the same axis of symmetry. However, the graph of $y = -\frac{1}{2}x^2 + 3$ opens down and is wider than the graph of $y = x^2$. Also, its vertex is 3 units higher.

✓ **GUIDED PRACTICE** for Examples 1 and 2

Graph the function. Compare the graph with the graph of $y = x^2$.

1. $y = -4x^2$

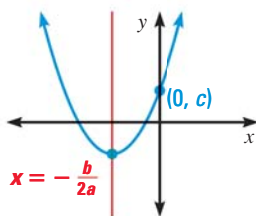**2.** $y = -x^2 - 5$

3. $f(x) = \frac{1}{4}x^2 + 2$

GRAPHING ANY QUADRATIC FUNCTION You can use the following properties to graph *any* quadratic function $y = ax^2 + bx + c$, including a function where $b \neq 0$.
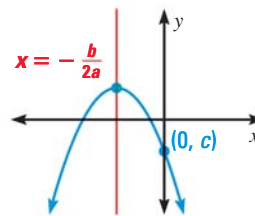
KEY CONCEPT *For Your Notebook*

Properties of the Graph of $y = ax^2 + bx + c$

$y = ax^2 + bx + c, a > 0$

$y = ax^2 + bx + c, a < 0$

Characteristics of the graph of $y = ax^2 + bx + c$:

• The graph opens up if $a > 0$ and opens down if $a < 0$.

• The graph is narrower than the graph of $y = x^2$ if $|a| > 1$ and wider if $|a| < 1$.

• The axis of symmetry is $x = -\frac{b}{2a}$ and the vertex has x-coordinate $-\frac{b}{2a}$.

• The y-intercept is c. So, the point $(0, c)$ is on the parabola.