3.3 Completing the Square
For use with Exploration 3.3

Essential Question How can you complete the square for a quadratic expression?

1 EXPLORATION: Using Algebra Tiles to Complete the Square

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use algebra tiles to complete the square for the expression $x^2 + 6x$.

a. You can model $x^2 + 6x$ using one x^2-tile and six x-tiles. Arrange the tiles in a square. Your arrangement will be incomplete in one of the corners.
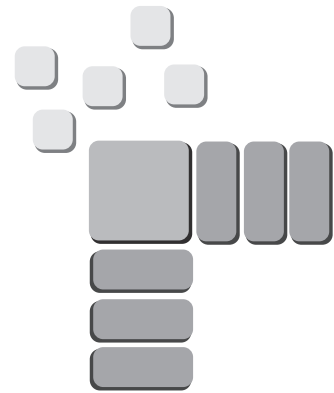
b. How many 1-tiles do you need to complete the square?

c. Find the value of c so that the expression

$$x^2 + 6x + c$$

is a perfect square trinomial.

d. Write the expression in part (c) as the square of a binomial.

3.3 **Completing the Square** (continued)

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2 **EXPLORATION:** Drawing Conclusions

Work with a partner.

a. Use the method outlined in Exploration 1 to complete the table.

Expression	Value of c needed to complete the square	Expression written as a binomial squared
$x^2 + 2x + c$		
$x^2 + 4x + c$		
$x^2 + 8x + c$		
$x^2 + 10x + c$		

b. Look for patterns in the last column of the table. Consider the general statement $x^2 + bx + c = (x + d)^2$. How are d and b related in each case? How are c and d related in each case?

c. How can you obtain the values in the second column directly from the coefficients of x in the first column?

Communicate Your Answer

3. How can you complete the square for a quadratic expression?

4. Describe how you can solve the quadratic equation $x^2 + 6x = 1$ by completing the square.

Name_____ Date_____

Notetaking with Vocabulary
For use after Lesson 3.3

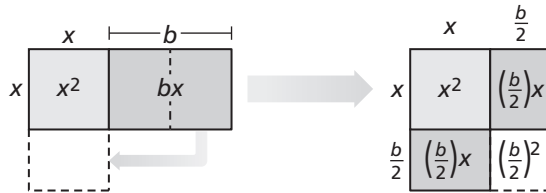**In your own words, write the meaning of each vocabulary term.**

completing the square

Core Concepts

Completing the Square

Words To complete the square for the expression $x^2 + bx$, add $\left(\dfrac{b}{2}\right)^2$.

Diagrams In each diagram, the combined area of the shaded regions is $x^2 + bx$.
Adding $\left(\dfrac{b}{2}\right)^2$ completes the square in the second diagram.

Algebra $x^2 + bx + \left(\dfrac{b}{2}\right)^2 = \left(x + \dfrac{b}{2}\right)\left(x + \dfrac{b}{2}\right) = \left(x + \dfrac{b}{2}\right)^2$

Notes:

3.3 **Notetaking with Vocabulary** (continued)

Extra Practice

In Exercises 1–3, solve the equation using square roots. Check your solution(s).

1. $x^2 + 4x + 4 = 2$

2. $t^2 - 40t + 400 = 300$

3. $9w^2 + 6w + 1 = -18$

In Exercises 4–6, find the value of *c* that makes the expression a perfect square trinomial. Then write the expression as the square of a binomial.

4. $y^2 - 14y + c$

5. $s^2 + 17s + c$

6. $z^2 + 24z + c$

In Exercises 7–12, solve the equation by completing the square.

7. $r^2 - 6r - 2 = 0$

8. $x^2 + 10x + 28 = 0$

9. $y(y + 1) = \frac{3}{4}$

10. $2t^2 + 16t - 6 = 0$

11. $3x(2x + 10) = -24$

12. $4x^2 - 5x + 28 = 3x^2 + x$

13. Explain how the expression $(4p + 1)^2 + 8(4p + 1) + 16$ is a perfect square trinomial. Then write the expression as a square of a binomial.

3.3 Notetaking with Vocabulary (continued)

In Exercises 14–17, determine whether you would use factoring, square roots, or completing the square to solve the equation. Explain your reasoning. Then solve the equation.

14. $x^2 + 7x = 0$

15. $(x - 1)^2 = 35$

16. $x^2 - 225 = 0$

17. $4x^2 + 8x + 12 = 0$

18. The area of the triangle is 30. Find the value of x.

3x

x + 2
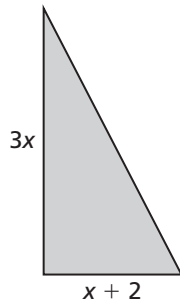
19. Write the quadratic function $f(x) = x^2 + 6x + 22$ in vertex form. Then identify the vertex.

20. A golfer hits a golf ball on the fairway with an initial velocity of 80 feet per second. The height h (in feet) of the golf ball t seconds after it is hit can be modeled by the function $h(t) = -16t^2 + 80t + 0.1$.

a. Find the maximum height of the golf ball.

b. How long does the ball take to hit the ground?