

### Solve & Discuss It!

The school is planning to add a weight room to the gym. If the total area of the gym and weight room should stay under 5,500 square feet, what is one possible length for the new weight room? Show your work. Are there other lengths that would work? Why or why not?

School Gym

Weight Room

**Look for Relationships** What is the relationship between the areas of the gym and weight room?

### Lesson 5-4

## Expand Expressions

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**I can...**  
expand expressions using the Distributive Property.

**Focus on math practices**

**Model with Math** What is an expression using  $x$  that represents the total area of the gym and the weight room?

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### Essential Question

How does the value of an expression change when it is expanded?

### EXAMPLE 1

#### Expand Expressions Using the Distributive Property

A family farm plans to add a blueberry patch to the end of their apple orchard. What is the total area of land that will be covered by the blueberry patch and apple orchard?

**Model with Math** An area model can be used to represent the Distributive Property.

Blueberry Patch

Apple Orchard

Use a diagram to represent the areas of the blueberry patch and apple orchard.

You can add the two lengths and multiply by the width to find the total area.

You can also add the two areas to find the total area.

Write and simplify an expression to represent the total area.

$$1.5(b + 2.5)$$

$$= 1.5b + 1.5(2.5)$$

$$= 1.5b + 3.75$$

The expression that represents the total land area is  $1.5b + 3.75$ .

**Try It!**

What is the expanded form of the expression  $3.6(t + 5)$ ?

$$3.6(t + 5)$$

$$= \square t + \square \cdot 5$$

$$= \square + \square$$

The expanded expression is  $\square$ .

**Convince Me!** If you know the value of  $t$ , would the evaluated expression be different if you added the known value of  $t$  and 5 and then multiplied by 3.6? Explain.

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**EXAMPLE 2** Expand Expressions with a Variable

Use the Distributive Property to expand the expression  $x(-2 - 0.5y)$ .

$$\begin{aligned} &x(-2 - 0.5y) \\ &= (x)(-2) + (x)(-0.5y) \quad \text{Distribute the } x \text{ to both terms} \\ &= -2x + (-0.5xy) \quad \text{inside the parentheses.} \\ &= -2x - 0.5xy \end{aligned}$$

The expanded expression is  $-2x - 0.5xy$ .

**Try It!**

Expand the expression  $t(-1.2w + 3)$ .

**EXAMPLE 3** Expand More Complex Expressions

Simplify the expression  $-\frac{1}{3}(2 - 3x + 3)$ .

**ONE WAY** Use the Distributive Property first to distribute the coefficient  $-\frac{1}{3}$ .

$$\begin{aligned} &-\frac{1}{3}(2 - 3x + 3) \\ &= (-\frac{1}{3} \cdot 2) + (-\frac{1}{3} \cdot -3x) + (-\frac{1}{3} \cdot 3) \\ &= -\frac{2}{3} + x - 1 \\ &= -\frac{5}{3} + x \end{aligned}$$

The simplified expression is  $-\frac{5}{3} + x$ .

**ANOTHER WAY** Simplify within parentheses first. Then distribute the coefficient  $-\frac{1}{3}$ .

$$\begin{aligned} &-\frac{1}{3}(2 - 3x + 3) \\ &= -\frac{1}{3}(5 - 3x) \\ &= (-\frac{1}{3} \cdot 5) + (-\frac{1}{3} \cdot -3x) \\ &= -\frac{5}{3} + x \end{aligned}$$

The simplified expression is  $-\frac{5}{3} + x$ .

**Try It!**

Simplify the expression  $-\frac{2}{5}(10 + 15m - 20n)$ .

**KEY CONCEPT**

You can expand an expression using the Distributive Property.

Multiply, or distribute, the factor outside the parentheses with each term inside the parentheses.

$$\begin{aligned} &-7(3y - 1) \\ &= (-7)(3y) + (-7)(-1) \quad \text{The sign of each term is} \\ &= -21y + 7 \quad \text{included in all calculations.} \end{aligned}$$

**Do You Understand?**

- Essential Question** How does the value of an expression change when it is expanded?
- Use Structure** How does the subtraction part of the expression change when  $a(b - c)$  is expanded?
- Make Sense and Persevere** When does expanding and simplifying  $a(b + c)$  result in a positive value for  $ac$ ?

**Do You Know How?**

- Shoes and hats are on sale. The expression  $\frac{1}{4}(s + 24.80)$  can be used to determine the discount when you buy shoes with a retail price of  $s$  dollars and hats with a total retail price of  $\$24.80$ . Write another expression that can be used to determine the discount.



$$\frac{1}{4}(s + 24.80)$$

$$\text{Hat Total} = \frac{1}{4}(24.80)$$

+

$$\frac{1}{4}(s)$$

- Expand  $x(4 - 3.4y)$ .

- Expand  $-\frac{2}{10}(1 - 2x + 2)$ .

Name: \_\_\_\_\_

**Practice & Problem Solving**

**Leveled Practice** For 7-8, fill in the boxes to expand each expression.

7.  $3(n + 7)$   
 $= (3)(n) + (3)(7)$   
 $= 3n + 21$

8.  $4(x - 3)$   
 $= 4x - 12$

$4(x + 3)$   
 $4(x) + 4(-3)$   
 $4x + -12$   
 ~~$4x - 12$~~

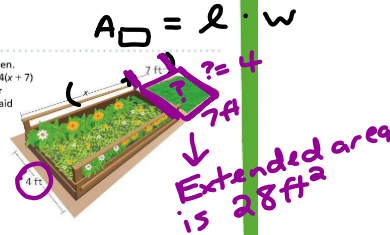
P  
A  
D  
E  
S

For 9-14, write the expanded form of the expression.

- 9.  $y(0.5 + 8)$
- 10.  $4(3 + 4x - 2)$
- 11.  $6(y + x)$
- 12.  $-2.5(-3 + 4n + 8)$
- 13.  $-\frac{1}{3}(y - x)$
- 14.  $8(6x - 4)$

**15. Higher Order Thinking** A grocery store has a 13%-off sale on all bread. You decide to purchase 6 loaves of bread. Let  $b$  be the original price of a loaf of bread. Expand the expression  $6(b - 0.13b)$ . Once the expression is expanded, what do the terms represent?

**16.** A gardener plans to extend the length of a rectangular garden. Let  $x$  represent the garden's original length. The expression  $4(x + 7)$  represents the area of the extended garden. When asked for the area of the extended portion, the gardener incorrectly said it was 11 square feet. Describe the error the gardener made.



**New**  
 $A = 4(x + 7)$   
 $A = 4 \cdot x + 4(7)$   
 $A = (4x + 28) \text{ ft}^2$   
**Total New**

**17.** Find a difference equivalent to the product  $11(x - y)$ .

**18.** Use the Distributive Property to write an expression equivalent to  $0.4(-5 - 7y - 13.8)$ .

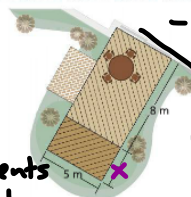
see notes

**19. Make Sense and Persevere** Use the Distributive Property to expand  $7(7x - 3y) - 6$ .

**20.** Use the Distributive Property to write an expression equivalent to  $y(-3 - 8x)$ .

$y(-3 - 8x)$   
 $(y)(-3) + y(-8x)$   
 $-3y + -8xy$

**21.** An architect plans to build an extension to Meiling's rectangular deck. Let  $x$  represent the increase, in meters, of her deck's length. The expression  $5(x + 8)$  represents the area of the deck, where 5 is the width, in meters, and  $(x + 8)$  represents the extended length, in meters. Use the Distributive Property to write an expression that represents the area of Meiling's new deck.



$5(x + 8)$   
 $5x + 5(8)$   
 $(5x + 40) \text{ m}^2$  represents the total area of the expanded deck at Meiling's house.

coefficients -3 and -8  
 $x$  and  $y$  variables

**Assessment Practice**

**22.** Which expressions are equivalent to  $-\frac{1}{2}(4 - 2 + 8x)$ ? Select all that apply.

- $-4x - 1$
- $4x - 1$
- $3x$
- $-2 + 1 - 4x$
- $2 + 1 - 4x$
- $4x + 1$

**23.** Which expression is equivalent to  $\frac{1}{5}(5 - 7y + 10)$ ?

- A  $3 - \frac{7}{5}y$
- B  $3 + \frac{7}{5}y$
- C  $\frac{22}{5}y$
- D  $-\frac{22}{5}y$

18)

$$0.4(-5 + -7y + 13.8)$$

$$0.4(-5 + -13.8 + -7y)$$

$$0.4(-18.8 + -7y)$$

$$0.4(-18.8) + 0.4(-7y)$$

$$\boxed{-7.52 + -2.8y}$$

DISTRIB  
↓

