3 Expressions

Chapter Learning Target:
Understand algebraic expressions.

Chapter Success Criteria:
- I can identify parts of an algebraic expression.
- I can write algebraic expressions.
- I can solve problems using algebraic expressions.
- I can interpret algebraic expressions in real-life problems.

STEAM Video: "Trophic Status"

STEAM Video

Trophic Status

In an ecosystem, energy and nutrients flow between *biotic* and *abiotic* components. Biotic components are the living parts of an ecosystem. Abiotic components are the non-living parts of an ecosystem. What is an example of an ecosystem?

Watch the STEAM video "Trophic Status." Then answer the following questions.

1. Give examples of both biotic and abiotic components in an ecosystem. Explain.

2. When an organism is eaten, its energy flows into the organism that consumes it. Explain how to use an expression to represent the total energy that a person gains from eating each of the items shown.

Performance Task

Chlorophyll in Plants

After completing this chapter, you will be able to use the concepts you learned to answer the questions in the *STEAM Video Performance Task*. You will be given the numbers of atoms found in molecules involved in photosynthesis.

Glucose Molecule

6 carbon atoms

12 hydrogen atoms

6 oxygen atoms

You will be asked to determine the total cost for a model of a molecule given the costs of different types of atom models. How can you find the total cost of purchasing several identical objects?

Getting Ready for Chapter 3

Chapter Exploration

Work with a partner. Rewrite the algebraic expression so that it has fewer symbols but still has the same value when evaluated for any value of x.

Original Expression	Simplified Expression		Original Expression	Simplified Expression
1. $2x + 4 + x$		**2.** $3(x + 1) - 4$		
3. $x - (3 - x)$		**4.** $5 + 2x - 3$		
5. $x + 3 + 2x - 4$		**6.** $2x + 2 - x + 3$		

7. WRITING GUIDELINES Work with a partner. Use your answers in Exercises 1−6 to write guidelines for simplifying an expression.

Simplifying an Algebraic Expression

Key Idea Use the following steps to simplify an algebraic expression.
1.
2.
3.

APPLYING A DEFINITION Work with a partner. Two expressions are equivalent if they have the same value when evaluated for any value of x. Decide which two expressions are equivalent. Explain your reasoning.

	Expression A	Expression B	Expression C
8.	$x - (2x + 1)$	$-x + 1$	$-x - 1$
9.	$2x + 3 - x + 4$	$x + 7$	$x - 1$
10.	$3 + x - 2(x + 1)$	$-x + 1$	$-x + 5$
11.	$2 - 2x - (x + 2)$	$-3x$	$-3x + 4$

Vocabulary

The following vocabulary terms are defined in this chapter. Think about what each term might mean and record your thoughts.

like terms   linear expression   factoring an expression

3.1 Algebraic Expressions

Learning Target: Simplify algebraic expressions.

Success Criteria:
- I can identify terms and like terms of algebraic expressions.
- I can combine like terms to simplify algebraic expressions.
- I can write and simplify algebraic expressions to solve real-life problems.

EXPLORATION 1

Simplifying Algebraic Expressions

Work with a partner.

a. Choose a value of x other than 0 or 1 for the last column in the table. Complete the table by evaluating each algebraic expression for each value of x. What do you notice?

	Expression	Value When $x = 0$	Value When $x = 1$	Value When $x = ?$
A.	$-\dfrac{1}{3} + x + \dfrac{7}{3}$			
B.	$0.5x + 3 - 1.5x - 1$			
C.	$2x + 6$			
D.	$x + 4$			
E.	$-2x + 2$			
F.	$\dfrac{1}{2}x - x + \dfrac{3}{2}x + 4$			
G.	$-4.8x + 2 - x + 3.8x$			
H.	$x + 2$			
I.	$-x + 2$			
J.	$3x + 2 - x + 4$			

Math Practice

Analyze Conjectures

A student says that x and x^3 are equivalent because they have the same value when $x = -1$, $x = 0$, and $x = 1$. Explain why the student is or is not correct.

b. How can you use properties of operations to justify your answers in part (a)? Explain your reasoning.

c. To subtract a number, you can add its opposite. Does a similar rule apply to the terms of an algebraic expression? Explain your reasoning.

3.1 Lesson

In an algebraic expression, **like terms** are terms that have the same variables raised to the same exponents. Constant terms are also like terms. To identify terms and like terms in an expression, first write the expression as a sum of its terms.

EXAMPLE 1 **Identifying Terms and Like Terms**

Identify the terms and like terms in each expression.

a. $9x - 2 + 7 - x$

Rewrite as a sum of terms.

$$9x + (-2) + 7 + (-x)$$

Terms: $9x$, -2, 7, $-x$

Like terms: $9x$ and $-x$, -2 and 7

b. $z^2 + 5z - 3z^2 + z$

Rewrite as a sum of terms.

$$z^2 + 5z + (-3z^2) + z$$

Terms: z^2, $5z$, $-3z^2$, z

Like terms: z^2 and $-3z^2$, $5z$ and z

Try It **Identify the terms and like terms in the expression.**

1. $y + 10 - \dfrac{3}{2}y$ **2.** $2r^2 + 7r - r^2 - 9$ **3.** $7 + 4p - 5 + p + 2q$

An algebraic expression is in **simplest form** when it has no like terms and no parentheses. To *combine* like terms that have variables, use the Distributive Property to add or subtract the coefficients.

EXAMPLE 2 **Simplifying Algebraic Expressions**

💡 **Remember**
The Distributive Property states
$a(b + c) = ab + ac$
and
$a(b - c) = ab - ac$.

a. **Simplify** $6n - 10n$.

$6n - 10n = (6 - 10)n$ Distributive Property

$= -4n$ Subtract.

b. **Simplify** $-8.5w + 5.2w + w$.

$-8.5w + 5.2w + w = -8.5w + 5.2w + 1w$ Multiplication Property of 1

$= (-8.5 + 5.2 + 1)w$ Distributive Property

$= -2.3w$ Add.

Try It **Simplify the expression.**

4. $-10y + 15y$ **5.** $\dfrac{3}{8}b - \dfrac{3}{4}b$ **6.** $2.4g - 2.4g - 9.8g$

EXAMPLE 3 **Simplifying Algebraic Expressions**

a. Simplify $\frac{3}{4}y + 12 - \frac{1}{2}y - 6$.

$$\frac{3}{4}y + 12 - \frac{1}{2}y - 6 = \frac{3}{4}y + 12 + \left(-\frac{1}{2}y\right) + (-6) \quad \text{Rewrite as a sum.}$$

$$= \frac{3}{4}y + \left(-\frac{1}{2}y\right) + 12 + (-6) \quad \text{Commutative Property of Addition}$$

$$= \left[\frac{3}{4} + \left(-\frac{1}{2}\right)\right]y + 12 + (-6) \quad \text{Distributive Property}$$

$$= \frac{1}{4}y + 6 \quad \text{Combine like terms.}$$

b. Simplify $-3y - 5y + 4z + 9z$.

$$-3y - 5y + 4z + 9z = (-3 - 5)y + (4 + 9)z \quad \text{Distributive Property}$$

$$= -8y + 13z \quad \text{Simplify.}$$

Try It **Simplify the expression.**

7. $14 - 3z + 8 + z$ **8.** $2.5x + 4.3x - 5$ **9.** $2s - 9s + 8t - t$

Self-Assessment for *Concepts & Skills*

Solve each exercise. Then rate your understanding of the success criteria in your journal.

10. WRITING Explain how to identify the terms and like terms of $3y - 4 - 5y$.

SIMPLIFYING ALGEBRAIC EXPRESSIONS **Simplify the expression.**

11. $7p + 6p$ **12.** $\frac{4}{5}n - 3 + \frac{7}{10}n$ **13.** $2w - g - 7w + 3g$

14. VOCABULARY Is the expression $3x + 2x - 4$ in simplest form? Explain.

15. WHICH ONE DOESN'T BELONG? Which expression does *not* belong with the other three? Explain your reasoning.

$$-4 + 6 + 3x$$

$$3x + 9 - 7$$

$$5x - 10 - 2x$$

$$5x - 4 + 6 - 2x$$

Modeling Real Life

ROYAL CINEMAS

| Daytime Tickets | $5.00 |
| Evening Tickets | $7.50 |

REFRESHMENTS

Drinks

Small	$1.75
Medium	$2.75
Large	$3.50

Popcorn

| Small | $3.00 |
| Large | $4.00 |

Each person in a group buys an evening ticket, a medium drink, and a large popcorn. How much does the group pay when there are 5 people in the group?

Write an expression that represents the sum of the costs of the items purchased. Use a verbal model.

Verbal Model

Number of tickets	$\cdot$	Cost per ticket	$+$	Number of medium drinks	$\cdot$	Cost per medium drink	$+$	Number of large popcorns	$\cdot$	Cost per large popcorn

Variable The same number of each item is purchased. So, x can represent the number of tickets, the number of medium drinks, and the number of large popcorns.

Expression $\qquad 7.50x \qquad + \qquad 2.75x \qquad + \qquad 4x$

$$7.50x + 2.75x + 4x = (7.50 + 2.75 + 4)x \qquad \text{Distributive Property}$$

$$= 14.25x \qquad \text{Add coefficients.}$$

The expression $14.25x$ indicates that the cost per person is $14.25. To find the cost for a group of 5 people, evaluate the expression when $x = 5$.

$$14.25(5) = 71.25$$

▶ The total cost for a group of 5 people is $71.25.

Remember

Variables can be lowercase or uppercase. Make sure you consistently use the same case for a variable when solving a problem.

Self-Assessment *for Problem Solving*

Solve each exercise. Then rate your understanding of the success criteria in your journal.

16. MODELING REAL LIFE An exercise mat is 3.3 times as long as it is wide. Write expressions in simplest form that represent the perimeter and the area of the exercise mat.

17. DIG DEEPER! A group of friends visits the movie theater in Example 4. Each person buys a daytime ticket and a small drink. The group shares 2 large popcorns. What is the average cost per person when there are 4 people in the group?

▶ Review & Refresh

Find the product or quotient. Write fractions in simplest form.

1. $-\dfrac{2}{7} \times \dfrac{7}{4}$

2. $-\dfrac{2}{3}\left(-\dfrac{9}{10}\right)$

3. $1\dfrac{4}{9} \div \left(-\dfrac{2}{9}\right)$

Order the numbers from least to greatest.

4. $\dfrac{7}{8}, 0.85, 87\%, \dfrac{3}{4}, 78\%$

5. $15\%, 14.8, 15\dfrac{4}{5}, 1450\%$

6. A bird's nest is 12 feet above the ground. A mole's den is 12 inches below the ground. What is the difference in height of these two positions?

    A. 24 in.   **B.** 11 ft   **C.** 13 ft   **D.** 24 ft

▶▶ Concepts, Skills, & Problem Solving

MP REASONING Determine whether the expressions are equivalent. Explain your reasoning. (See Exploration 1, p. 91.)

7.

Expression 1	$3 - 5x$
Expression 2	$4.25 - 5x - 4.25$

8.

Expression 1	$1.25x + 4 + 0.75x - 3$
Expression 2	$2x + 1$

IDENTIFYING TERMS AND LIKE TERMS Identify the terms and like terms in the expression.

9. $t + 8 + 3t$

10. $3z + 4 + 2 + 4z$

11. $2n - n - 4 + 7n$

12. $-x - 9x^2 + 12x^2 + 7$

13. $1.4y + 5 - 4.2 - 5y^2 + z$

14. $\dfrac{1}{2}s - 4 + \dfrac{3}{4}s + \dfrac{1}{8} - s^3$

15. YOU BE THE TEACHER Your friend identifies the terms and like terms in the expression $3x - 5 - 2x + 9x$. Is your friend correct? Explain your reasoning.

> $3x - 5 - 2x + 9x$
>
> Terms: $3x, 5, 2x,$ and $9x$
>
> Like Terms: $3x, 2x,$ and $9x$

SIMPLIFYING ALGEBRAIC EXPRESSIONS Simplify the expression.

16. $12g + 9g$

17. $11x + 9 - 7$

18. $8s - 11s + 6s$

19. $4b - 24 + 19$

20. $4p - 5p - 30p$

21. $4.2v - 5 - 6.5v$

22. $8 + 4a + 6.2 - 9a$

23. $\dfrac{2}{5}y - 4 + 7 - \dfrac{9}{10}y$

24. $-\dfrac{2}{3}c - \dfrac{9}{5} + 14c + \dfrac{3}{10}$

25. **MODELING REAL LIFE** On a hike, each hiker carries the items shown. Write and interpret an expression in simplest form that represents the weight carried by x hikers. How much total weight is carried when there are 4 hikers?

4.6 lb

3.4 lb

2.2 lb

26. **MP STRUCTURE** Evaluate the expression $-8x + 5 - 2x - 4 + 5x$ when $x = 2$ before and after simplifying. Which method do you prefer? Explain.

27. **OPEN-ENDED** Write an expression with five different terms that is equivalent to $8x^2 + 3x^2 + 3y$. Justify your answer.

28. **MP STRUCTURE** Which of the following shows a correct way of simplifying $6 + (3 - 5x)$? Explain the errors made in the other choices.

A. $6 + (3 - 5x) = (6 + 3 - 5)x = 4x$

B. $6 + (3 - 5x) = 6 + (3 - 5)x = 6 + (-2)x = 6 - 2x$

C. $6 + (3 - 5x) = (6 + 3) - 5x = 9 - 5x$

D. $6 + (3 - 5x) = (6 + 3 + 5) - x = 14 - x$

29. **MP PRECISION** Two comets orbit the Sun. One comet travels 30,000 miles per hour and the other comet travels 28,500 miles per hour. What is the most efficient way to calculate the difference of the distances traveled by the comets for any given number of minutes? Justify your answer.

	Car	Truck
Wash	$8	$10
Wax	$12	$15

30. **MODELING REAL LIFE** Find the earnings for washing and waxing 12 cars and 8 trucks. Justify your answer.

31. **CRITICAL THINKING** You apply gold foil to a piece of red poster board to make the design shown.

    a. Find the area of the gold foil when $x = 3$. Justify your answer.

    b. The pattern at the right is called "St. George's Cross." Find a country that uses this pattern as its flag.

    x in.

    x in.

    12 in.

    20 in.
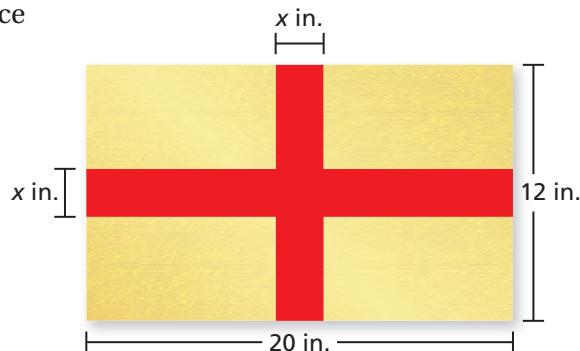
32. **GEOMETRY** Two rectangles have different dimensions. Each rectangle has a perimeter of $(7x + 5)$ inches. Draw and label diagrams that represent possible dimensions of the rectangles.

3.2 Adding and Subtracting Linear Expressions

Learning Target: Find sums and differences of linear expressions.

Success Criteria:
- I can explain the difference between linear and nonlinear expressions.
- I can find opposites of terms that include variables.
- I can apply properties of operations to add and subtract linear expressions.

EXPLORATION 1

Using Algebra Tiles

$+$ = +1
$-$ = −1
$+$ = variable
$-$ = −variable

Work with a partner. You can use the algebra tiles shown at the left to find sums and differences of algebraic expressions.

a. How can you use algebra tiles to model a sum of terms that equals 0? Explain your reasoning.

b. Write each sum or difference modeled below. Then use the algebra tiles to simplify the expression.

Math Practice

Consider Similar Problems

How is using integer counters to find sums and differences of integers similar to using algebra tiles to find sums and differences of algebraic expressions?

c. Write two algebraic expressions of the form $ax + b$, where a and b are rational numbers. Find the sum and difference of the expressions.

EXPLORATION 2

Using Properties of Operations

Work with a partner.

a. Do algebraic expressions, such as $2x$, $-3y$, and $3z + 1$ have additive inverses? How do you know?

b. How can you find the sums and differences modeled in Exploration 1 without using algebra tiles? Explain your reasoning.

3.2 Lesson

A **linear expression** is an algebraic expression in which the exponent of each variable is 1.

Linear Expressions	$-4x$	$3x + 5y$	$5 - \dfrac{1}{6}x$
Nonlinear Expressions	$\dfrac{1}{2}x^2$	$-7x^3 + x$	$x^5 + 1$

You can use either a vertical or a horizontal method to add linear expressions.

EXAMPLE 1 Adding Linear Expressions

Find each sum.

a. $(x - 2) + (3x + 8)$

Vertical method: Align like terms vertically and add.

$$\begin{array}{r} x - 2 \\ + \ 3x + 8 \\ \hline 4x + 6 \end{array}$$

▶ The sum is $4x + 6$.

> Linear expressions are usually written with the variable term first.

b. $(-4y + 3) + (11y - 5)$

Horizontal method: Use properties of operations to group like terms and simplify.

$(-4y + 3) + (11y - 5) = -4y + 3 + 11y - 5$ Rewrite the sum.

$= -4y + 11y + 3 - 5$ Commutative Property of Addition

$= (-4y + 11y) + (3 - 5)$ Group like terms.

$= 7y - 2$ Combine like terms.

▶ The sum is $7y - 2$.

Try It Find the sum.

1. $(x + 3) + (2x - 1)$

2. $(-8z + 4) + (8z - 7)$

3. $(4.5 - n) + (-10n + 6.5)$

4. $\left(\dfrac{1}{2}w - 3\right) + \left(\dfrac{1}{4}w + 3\right)$

◀) Multi-Language Glossary at *BigIdeasMath.com*

To subtract one linear expression from another, add the opposite of each term in the expression. You can use a vertical or a horizontal method.

EXAMPLE 2 **Subtracting Linear Expressions**

Find each difference.

a. $(5x + 6) - (-x + 6)$

Vertical method: Align like terms vertically and subtract.

$$\begin{array}{r} (5x + 6) \\ -(-x + 6) \end{array}$$
Add the opposite.
$$\begin{array}{r} 5x + 6 \\ +\ x - 6 \\ \hline 6x \end{array}$$

▶ The difference is $6x$.

Common Error

When subtracting an expression, make sure you add the opposite of each term in the expression, not just the first term.

b. $(7y + 5) - (8y - 6)$

Horizontal method: Use properties of operations to group like terms and simplify.

$(7y + 5) - (8y - 6) = (7y + 5) + (-8y + 6)$ Add the opposite.

$= 7y + (-8y) + 5 + 6$ Commutative Property of Addition

$= [7y + (-8y)] + (5 + 6)$ Group like terms.

$= -y + 11$ Combine like terms.

▶ The difference is $-y + 11$.

Try It Find the difference.

5. $(m - 3) - (-m + 12)$ **6.** $(-2c + 5) - (6.3c + 20)$

Self-Assessment *for Concepts & Skills*

Solve each exercise. Then rate your understanding of the success criteria in your journal.

7. WRITING Describe how to distinguish a linear expression from a nonlinear expression. Give an example of each.

8. DIFFERENT WORDS, SAME QUESTION Which is different? Find "both" answers.

What is x more than $3x - 1$?   Find $3x - 1$ decreased by x.

What is the difference of $3x - 1$ and x?   Subtract $(x + 1)$ from $3x$.

EXAMPLE 3 **Modeling Real Life**

Skateboard kits cost d dollars and you have a coupon for $2 off each one you buy. After assembly, you sell each skateboard for $(2d - 4)$ dollars. Find and interpret your profit on each skateboard sold.

Understand the problem.

You are given information about purchasing skateboard kits and selling the assembled skateboards. You are asked to find and interpret the profit made on each skateboard sold.

Make a plan.

Find the difference of the expressions representing the selling price and the purchase price. Then simplify and interpret the expression.

Solve and check.

You receive $2 off of d dollars, so you pay $(d - 2)$ dollars for each kit.

Profit (dollars)	=	Selling price (dollars)	−	Purchase price (dollars)

$$= (2d - 4) - (d - 2) \qquad \text{Write the difference.}$$
$$= (2d - 4) + (-d + 2) \qquad \text{Add the opposite.}$$
$$= 2d - d - 4 + 2 \qquad \text{Group like terms.}$$
$$= d - 2 \qquad \text{Combine like terms.}$$

▶ Your profit on each skateboard sold is $(d - 2)$ dollars. You pay $(d - 2)$ dollars for each kit, so you are doubling your money.

Look Back Assume each kit is $40. Verify that you double your money.

When $d = 40$: You pay $d - 2 = 40 - 2 = \$38$.

You sell it for $2d - 4 = 2(40) - 4 = 80 - 4 = \$76$.

Because $\$38 \cdot 2 = \$76$, you double your money. ✔

Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.

9. **DIG DEEPER!** In a basketball game, the home team scores $(2m + 39)$ points and the away team scores $(3m + 40)$ points, where m is the number of minutes since halftime. Who wins the game? What is the difference in the scores m minutes after halftime? Explain.

10. Electric guitar kits originally cost d dollars online. You buy the kits on sale for 50% of the original price, plus a shipping fee of $4.50 per kit. After painting and assembly, you sell each guitar online for $(1.5d + 4.5)$ dollars. Find and interpret your profit on each guitar sold.

▶ Review & Refresh

Simplify the expression.

1. $4f + 11f$

2. $b + 4b - 9b$

3. $-4z - 6 - 7z + 3$

Evaluate the expression when $x = -\dfrac{4}{5}$ and $y = \dfrac{1}{3}$.

4. $x + y$

5. $2x + 6y$

6. $-x + 4y$

7. What is the surface area of a cube that has a side length of 5 feet?

    A. 25 ft^2 **B.** 75 ft^2 **C.** 125 ft^2 **D.** 150 ft^2

▶▶ Concepts, Skills, & Problem Solving

USING ALGEBRA TILES Write the sum or difference modeled by the algebra tiles. Then use the algebra tiles to simplify the expression. (See Exploration 1, p. 97.)

8.

$$\left(\boxed{+}\ \boxed{-}\boxed{-}\boxed{-}\ \boxed{+}\ \boxed{-}\boxed{-}\boxed{-} \right) + \left(\boxed{+}\ \boxed{+}\boxed{+}\boxed{+}\boxed{+} \right)$$

9.

$$\left(\boxed{+}\ \boxed{+}\boxed{+}\boxed{+}\boxed{+}\ \boxed{+}\ \boxed{+}\boxed{+} \right) - \left(\boxed{+}\ \boxed{-}\boxed{-}\boxed{-}\boxed{-}\ \boxed{+} \right)$$

ADDING LINEAR EXPRESSIONS Find the sum.

10. $(n + 8) + (n - 12)$

11. $(7 - b) + (3b + 2)$

12. $(2w - 9) + (-4w - 5)$

13. $(2x - 6) + (4x - 12)$

14. $(-3.4k - 7) + (3k + 21)$

15. $\left(-\dfrac{7}{2}z + 4 \right) + \left(\dfrac{1}{5}z - 15 \right)$

16. $(6 - 2.7h) + (-1.3j - 4)$

17. $\left(\dfrac{7}{4}x - 5 \right) + (2y - 3.5) + \left(-\dfrac{1}{4}x + 5 \right)$

18. MODELING REAL LIFE While catching fireflies, you and a friend decide to have a competition. After m minutes, you have $(3m + 13)$ fireflies and your friend has $(4m + 6)$ fireflies.

    a. How many total fireflies do you and your friend catch? Explain your reasoning.

    b. The competition lasts 3 minutes. Who has more fireflies? Justify your answer.

SUBTRACTING LINEAR EXPRESSIONS **Find the difference.**

19. $(-2g + 7) - (g + 11)$

20. $(6d + 5) - (2 - 3d)$

21. $(4 - 5y) - (2y - 16)$

22. $(2n - 9) - (-2.4n + 4)$

23. $\left(-\dfrac{1}{8}c + 16\right) - \left(\dfrac{3}{8} + 3c\right)$

24. $\left(\dfrac{9}{4}x + 6\right) - \left(-\dfrac{5}{4}x - 24\right)$

25. $\left(\dfrac{1}{3} - 6m\right) - \left(\dfrac{1}{4}n - 8\right)$

26. $(1 - 5q) - (2.5s + 8) - (0.5q + 6)$

27. **YOU BE THE TEACHER** Your friend finds the difference $(4m + 9) - (2m - 5)$. Is your friend correct? Explain your reasoning.

$$(4m + 9) - (2m - 5) = 4m + 9 - 2m - 5$$
$$= 4m - 2m + 9 - 5$$
$$= 2m + 4$$

28. **GEOMETRY** The expression $17n + 11$ represents the perimeter of the triangle. What is the length of the third side? Explain your reasoning.

$5n + 6$ $4n + 5$

29. **MP LOGIC** Your friend says the sum of two linear expressions is always a linear expression. Is your friend correct? Explain.

265
calories burned

🏃 HR 72
BPM

30. **MODELING REAL LIFE** You burn 265 calories running and then 7 calories per minute swimming. Your friend burns 273 calories running and then 11 calories per minute swimming. You each swim for the same number of minutes. Find and interpret the difference in the amounts of calories burned by you and your friend.

31. **DIG DEEPER!** You start a new job. After w weeks, you have $(10w + 120)$ dollars in your savings account and $(45w + 25)$ dollars in your checking account.

 a. What is the total amount of money in the accounts? Explain.

 b. How much money did you have before you started your new job? How much money do you save each week?

 c. You want to buy a new phone for $150, and still have $500 left in your accounts afterwards. Explain how to determine when you can buy the phone.

32. **MP REASONING** Write an expression in simplest form that represents the vertical distance between the two lines shown. What is the distance when $x = 3$? when $x = -3$?

$y = x - 1$

$y = 2x - 4$
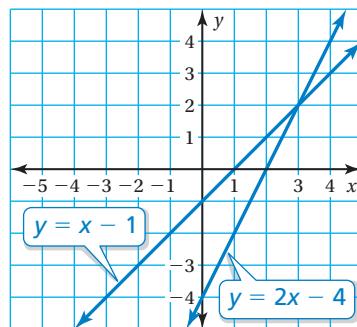
3.3 The Distributive Property

Learning Target: Apply the Distributive Property to generate equivalent expressions.

Success Criteria:
- I can explain how to apply the Distributive Property.
- I can use the Distributive Property to simplify algebraic expressions.

EXPLORATION 1

Using Models to Write Expressions

Work with a partner.

a. Write an expression that represents the area of the shaded region in each figure.
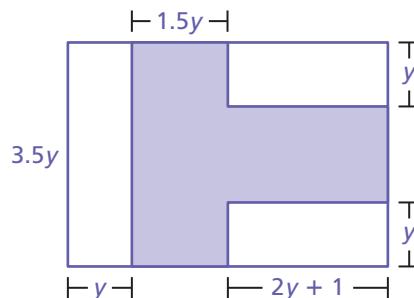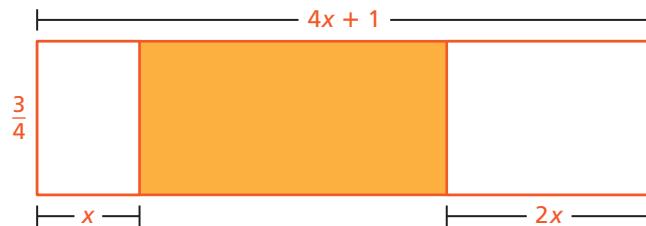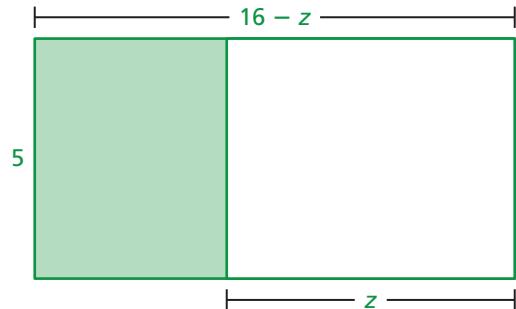
Math Practice

Use Expressions
How can you determine whether expressions that appear to be different are equivalent?

b. Compare your expressions in part (a) with other groups in your class. Did other groups write expressions that look different than yours? If so, determine whether the expressions are equivalent.

3.3 Lesson

You can use the Distributive Property to simplify expressions involving variable terms and rational numbers.

EXAMPLE 1 — Using the Distributive Property

Simplify each expression.

a. $-\frac{1}{3}(3n - 6)$

Remember

The Distributive Property states
$a(b + c) = ab + ac$
and
$a(b - c) = ab - ac$.

$$-\frac{1}{3}(3n - 6) = -\frac{1}{3}(3n) - \left(-\frac{1}{3}\right)(6) \qquad \text{Distributive Property}$$

$$= -n - (-2) \qquad \text{Multiply.}$$

$$= -n + 2 \qquad \text{Add the opposite.}$$

b. $5(-x + 3y)$

$$5(-x + 3y) = 5(-x) + 5(3y) \qquad \text{Distributive Property}$$

$$= -5x + 15y \qquad \text{Multiply.}$$

Try It Simplify the expression.

1. $-1(x + 9)$

2. $\frac{2}{3}(-3z - 6)$

3. $-1.5(8m - n)$

EXAMPLE 2 — Simplifying Expressions

Simplify $-3(-1 + 2x + 7)$.

Common Error

Multiply each term in the sum by -3, not 3.

$-3(-1 + 2x + 7)$

Method 1: Use the Distributive Property before combining like terms.

$$-3(-1 + 2x + 7) = -3(-1) + (-3)(2x) + (-3)(7) \qquad \text{Distributive Property}$$

$$= 3 + (-6x) + (-21) \qquad \text{Multiply.}$$

$$= -6x - 18 \qquad \text{Combine like terms.}$$

Method 2: Combine like terms in parentheses before using the Distributive Property.

$$-3(-1 + 2x + 7) = -3(2x + 6) \qquad \text{Combine like terms.}$$

$$= (-3)(2x) + (-3)(6) \qquad \text{Distributive Property}$$

$$= -6x - 18 \qquad \text{Multiply.}$$

Try It Simplify the expression.

4. $2(-3s + 1 - 5)$

5. $-\frac{3}{2}(a - 4 - 2a)$

Simplifying Expressions

Simplify each expression.

a. $-\dfrac{1}{2}(6n + 4) + 2n$

$$-\dfrac{1}{2}(6n + 4) + 2n = -\dfrac{1}{2}(6n) + \left(-\dfrac{1}{2}\right)(4) + 2n \qquad \text{Distributive Property}$$

$$= -3n + (-2) + 2n \qquad \text{Multiply.}$$

$$= -n - 2 \qquad \text{Combine like terms.}$$

b. $(6d - 5) - 8\left(\dfrac{3}{4}d - 1\right)$

$$(6d - 5) - 8\left(\dfrac{3}{4}d - 1\right) = (6d - 5) - \left[8\left(\dfrac{3}{4}d\right) - 8(1)\right] \qquad \text{Distributive Property}$$

$$= (6d - 5) - (6d - 8) \qquad \text{Multiply.}$$

$$= (6d - 5) + (-6d + 8) \qquad \text{Add the opposite.}$$

$$= [6d + (-6d)] + (-5 + 8) \qquad \text{Group like terms.}$$

$$= 3 \qquad \text{Combine like terms.}$$

> You can multiply an expression by –1 to find the opposite of the expression.

Try It **Simplify the expression.**

6. $3.5m - 1.5(m - 10)$

7. $\dfrac{4}{5}(10w - 5) - 2(w + 9)$

Self-Assessment for Concepts & Skills

Solve each exercise. Then rate your understanding of the success criteria in your journal.

8. **WRITING** Explain how to use the Distributive Property when simplifying an expression.

USING THE DISTRIBUTIVE PROPERTY Simplify the expression.

9. $\dfrac{5}{6}(-2y + 3)$

10. $6(3s - 2.5 - 5s)$

11. $\dfrac{3}{10}(4m - 8) + 9m$

12. $2.25 - 2(7.5 - 4h)$

8	$3x$
$\dfrac{3}{2}$	$4x$

13. **MP STRUCTURE** Use the terms at the left to complete the expression below so that it is equivalent to $9x - 12$. Justify your answer.

$$\boxed{}\left(\boxed{} - \boxed{}\right) + \boxed{}$$

EXAMPLE 4 **Modeling Real Life**

A square pool has a side length of *s* feet. How many 1-foot square tiles does it take to tile the border of the pool?

Understand the problem.

You are given information about a square pool and square tiles. You are asked to find the number of tiles it takes to tile the border of the pool.

Make a plan.

Draw a diagram that represents the situation. Use the diagram to write an expression for the number of tiles needed.

Solve and check.
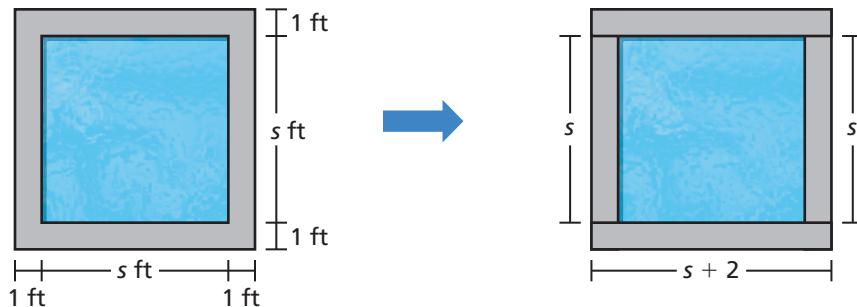
The diagram shows that the tiled border can be divided into two sections that each require $s + 2$ tiles and two sections that each require s tiles. So, the number of tiles can be represented by $2(s + 2) + 2s$. Simplify the expression.

$$2(s + 2) + 2s = 2(s) + 2(2) + 2s \qquad \text{Distributive Property}$$
$$= 4s + 4 \qquad \text{Simplify.}$$

▶ The expression $4s + 4$ represents the number of tiles that are needed.

> **Another Method**
> Draw a different diagram.
> $$4(s + 1) = 4(s) + 4(1)$$
> $$= 4s + 4 \checkmark$$
>
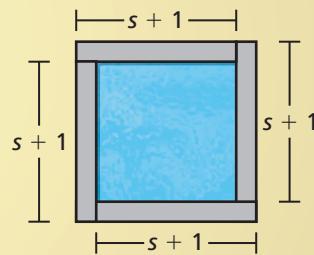
✓ *Self-Assessment* for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.

14. A rectangular room is 10 feet longer than it is wide. How many 1-foot square tiles does it take to tile along the inside walls of the room?

15. How many 2-foot square tiles does it take to tile the border of the pool in Example 4? Explain.

3.3 Practice

? Go to *BigIdeasMath.com* to get HELP with solving the exercises.

▶ Review & Refresh

Find the sum or difference.

1. $(5b - 9) + (b + 8)$

2. $(3m + 5) - (6 - 5m)$

3. $(1 - 9z) + 3(z - 2)$

4. $(7g - 6) - (-3n - 4)$

Evaluate the expression.

5. -6^2

6. $-9^2 \cdot 3$

7. $(-7) \cdot (-2) \cdot (-4)$

Copy and complete the statement using <, >, or =.

8. $11 \boxed{} |-11|$

9. $|3.5| \boxed{} |-5.8|$

10. $|-3.5| \boxed{} \left|\dfrac{17}{5}\right|$

▶ Concepts, Skills, & Problem Solving

USING MODELS Write two different expressions that represent the area of the shaded region. Show that the expressions are equivalent. (See Exploration 1, p. 103.)

11.

12.
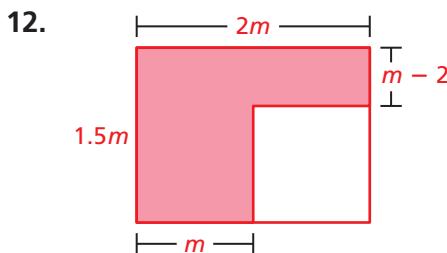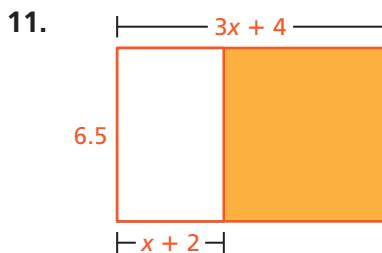
USING THE DISTRIBUTIVE PROPERTY Simplify the expression.

13. $3(a - 7)$

14. $-6(2 + x)$

15. $-5(3m - 4)$

16. $-9(-5 - 4c)$

17. $4.5(3s + 6)$

18. $-1.4(-5 + 7g)$

19. $\dfrac{2}{5}(6 - 5p)$

20. $-\dfrac{4}{3}(3q - 10)$

21. $2(3 + 4y + 5)$

22. $-9(8 + 6n - 4)$

23. $-6(-4d - 8.3 + 3d)$

24. $2.3h(6 - k)$

25. $-\dfrac{3}{8}(-4y + z)$

26. $2(-2w - 1.2 + 7x)$

27. $\dfrac{5}{3}\left(\dfrac{4}{3}a + 9b + \dfrac{2}{3}a\right)$

YOU BE THE TEACHER Your friend simplifies the expression. Is your friend correct? Explain your reasoning.

28.

$-2(h + 8k) = -2(h) + 2(8k)$

$= -2h + 16k$

29.

$-3(4 - 5b + 7) = -3(11 - 5b)$

$= -3(11) + (-3)(5b)$

$= -33 - 15b$

SIMPLIFYING EXPRESSIONS Simplify the expression.

30. $-3(5g + 1) + 8g$

31. $-6a + 7(-2a - 4)$

32. $9 - 3(5 - 4x)$

33. $-\dfrac{3}{4}(5p - 12) + 2\left(8 - \dfrac{1}{4}p\right)$

34. $c(4 + 3c) - 0.75(c + 3)$

35. $-1 - \dfrac{2}{3}\left(\dfrac{6}{7} - \dfrac{3}{7}n\right)$

36. MODELING REAL LIFE The cost (in dollars) of a custom-made sweatshirt is represented by $3.5n + 29.99$, where n is the number of different colors in the design. Write and interpret a simplified expression that represents the cost of 15 sweatshirts.

37. MODELING REAL LIFE A ski resort makes snow using a snow fan that costs \$1200. The fan has an average daily operation cost of \$9.50. Write and interpret a simplified expression that represents the cost to purchase and operate 6 snow fans.

38. MP NUMBER SENSE Predict whether the instructions below will produce equivalent expressions. Then show whether your prediction is correct.

- Subtract 3 from n, add 3 to the result, and then triple that expression.
- Subtract 3 from n, triple the result, and then add 3 to that expression.

USING A MODEL Draw a diagram that shows how the expression can represent the area of a figure. Then simplify the expression.

39. $5(2 + x + 3)$

40. $(4 + 1)(x + 2x)$

41. DIG DEEPER! A square fire pit with a side length of s feet is bordered by 1-foot square stones as shown.

  a. How many stones does it take to border the fire pit with two rows of stones? Use a diagram to justify your answer.

  b. You border the fire pit with n rows of stones. How many stones are in the nth row? Explain your reasoning.

Row 1
Row 2
s ft
s ft
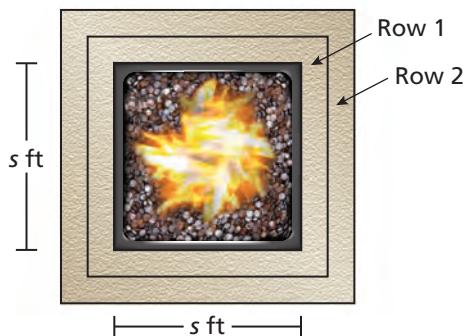
42. PUZZLE Your friend asks you to perform the following steps.

  1) Pick any number except 0.
  2) Add 2 to your number.
  3) Multiply the result by 3.
  4) Subtract 6 from the result.
  5) Divide the result by your original number.

Your friend says, "The final result is 3!" Is your friend correct? If so, explain how your friend knew the final result. If not, explain why not.

3.4 Factoring Expressions

Learning Target: Factor algebraic expressions.

Success Criteria:
- I can identify the greatest common factor of terms, including variable terms.
- I can use the Distributive Property to factor algebraic expressions.
- I can write a term as a product involving a given factor.

EXPLORATION 1

Finding Dimensions

Work with a partner.

a. The models show the areas (in square units) of parts of rectangles. Use the models to find the missing values that complete the expressions. Explain your reasoning.

$$\frac{4}{5} + \frac{8}{5} = ?(? + ?)$$
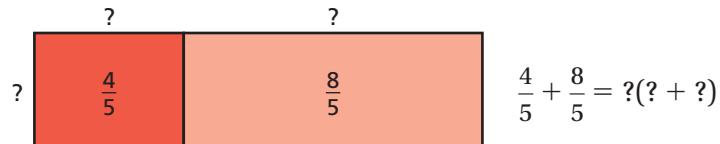
Math Practice

View as Components

How does viewing each rectangle as two distinct parts help you complete the expressions?

$$\frac{3}{2}x + \frac{1}{2} = ?(? + ?)$$

$$2.5x + 3.75y = ?(? + ?)$$
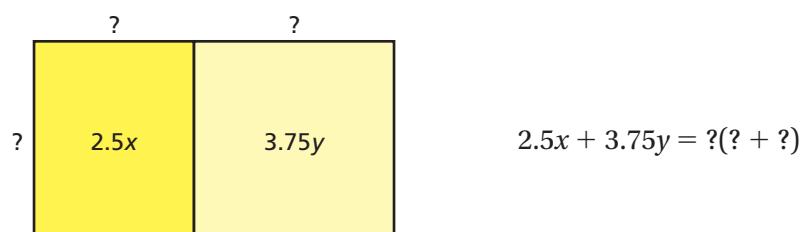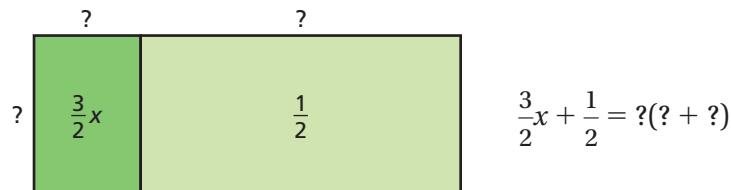
b. Are the expressions you wrote in part (a) equivalent to the original expressions? Explain your reasoning.

c. Explain how you can use the Distributive Property to find rational number factors of an expression.

When **factoring an expression**, you write the expression as a product of factors. You can use the Distributive Property to factor any rational number from an expression.

EXAMPLE 1 Factoring Out the GCF

Factor $24x - 18$ using the GCF.

Find the GCF of $24x$ and 18.

$$24x = 2 \cdot 2 \cdot 2 \cdot 3 \cdot x$$
$$18 = 2 \cdot 3 \cdot 3$$

Circle the common prime factors.

So, the GCF of $24x$ and 18 is $2 \cdot 3 = 6$. Use the GCF to factor the expression.

$$24x - 18 = 6(4x) - 6(3) \qquad \text{Rewrite using GCF.}$$
$$= 6(4x - 3) \qquad \text{Distributive Property}$$

Try It Factor the expression using the GCF.

1. $15x + 25$ **2.** $4y - 20$ **3.** $36c + 24d$

EXAMPLE 2 Factoring Out a Rational Number

Factor $\frac{1}{2}$ out of $\frac{1}{2}x + \frac{3}{2}$.

Write each term as a product of $\frac{1}{2}$ and another factor.

$$\frac{1}{2}x = \frac{1}{2} \cdot x \qquad \text{Think: } \frac{1}{2}x \text{ is } \frac{1}{2} \text{ times what?}$$

$$\frac{3}{2} = \frac{1}{2} \cdot 3 \qquad \text{Think: } \frac{3}{2} \text{ is } \frac{1}{2} \text{ times what?}$$

Use the Distributive Property to factor out $\frac{1}{2}$.

$$\frac{1}{2}x + \frac{3}{2} = \frac{1}{2} \cdot x + \frac{1}{2} \cdot 3 \qquad \text{Rewrite the expression.}$$

$$= \frac{1}{2}(x + 3) \qquad \text{Distributive Property}$$

Try It Factor out the coefficient of the variable term.

4. $\frac{1}{2}n - \frac{1}{2}$ **5.** $\frac{3}{4}p - \frac{3}{2}$ **6.** $5 + 2.5q$

🔊 Multi-Language Glossary at *BigIdeasMath.com*

EXAMPLE 3 **Factoring Out a Negative Number**

Factor -2 out of $-4p + 10$.

Write each term as a product of -2 and another factor.

$$-4p = -2 \cdot 2p \qquad \text{Think: } -4p \text{ is } -2 \text{ times what?}$$

$$10 = -2 \cdot (-5) \qquad \text{Think: } 10 \text{ is } -2 \text{ times what?}$$

Use the Distributive Property to factor out -2.

$$-4p + 10 = -2 \cdot 2p + (-2) \cdot (-5) \qquad \text{Rewrite the expression.}$$

$$= -2[2p + (-5)] \qquad \text{Distributive Property}$$

$$= -2(2p - 5) \qquad \text{Simplify.}$$

▶ So, $-4p + 10 = -2(2p - 5)$.

Try It

7. Factor -5 out of $-5d + 30$.

8. Factor -4 out of $-8k - 12$.

Self-Assessment *for Concepts & Skills*

Solve each exercise. Then rate your understanding of the success criteria in your journal.

FACTORING OUT THE GCF **Factor the expression using the GCF.**

9. $16n - 24$ **10.** $42a + 14b$

FACTORING OUT A RATIONAL NUMBER **Factor out the coefficient of the variable term.**

11. $\dfrac{1}{10}k - \dfrac{7}{10}$ **12.** $42 + 3.5h$

FACTORING OUT A NEGATIVE NUMBER **Factor out the indicated number.**

13. Factor -8 out of $-32d + 56$.

14. Factor -12 out of $-24k + 120$.

15. **WRITING** Describe the relationship between using the Distributive Property to simplify an expression and to factor an expression. Give an example to justify your answer.

EXAMPLE 4 **Modeling Real Life**

A rectangular landing platform for a rocket is 60 yards wide and has an area of $(60x + 3600)$ square yards. Write an expression that represents the perimeter (in yards) of the platform.

Factor the width of 60 yards out of the given area expression to find an expression that represents the length (in yards) of the platform.

$$60x + 3600 = 60 \cdot x + 60 \cdot 60 \qquad \text{Rewrite the expression.}$$
$$= 60(x + 60) \qquad \text{Distributive Property}$$

So, the length (in yards) of the platform can be represented by $x + 60$. Use the perimeter formula to write an expression that represents the perimeter of the platform.
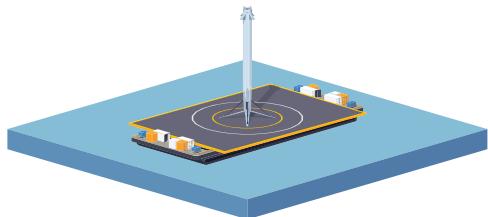
$$P = 2\ell + 2w \qquad \text{Perimeter of a rectangle}$$
$$= 2(x + 60) + 2(60) \qquad \text{Substitute for } \ell \text{ and } w.$$
$$= 2x + 120 + 120 \qquad \text{Multiply.}$$
$$= 2x + 240 \qquad \text{Add.}$$

▶ So, an expression that represents the perimeter (in yards) of the platform is $2x + 240$.

Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.

16. An organization drills 3 wells to provide access to clean drinking water. The cost (in dollars) to drill and maintain the wells for n years is represented by $34{,}500 + 540n$. Write and interpret an expression that represents the cost to drill and maintain one well for n years.

17. A photograph is 16 inches long and has an area of $(16x + 96)$ square inches. A custom-made frame is 2 inches wide and costs \$0.50 per square inch. Write an expression that represents the cost of the frame.

├──16 in.──┤

2 in.
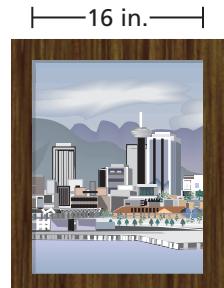
3.4 Practice

? Go to *BigIdeasMath.com* to get HELP with solving the exercises.

▶ Review & Refresh

Simplify the expression.

1. $8(k - 5)$

2. $-4.5(-6 + 2d)$

3. $-\frac{1}{4}(3g - 6 - 5g)$

Find the difference. Write fractions in simplest form.

4. $\frac{2}{3} - \left(-\frac{5}{3}\right)$

5. $-4.7 - 5.6$

6. $-4\frac{3}{8} - \left(-2\frac{1}{4}\right)$

Evaluate the expression when $x = 4$, $y = -6$, and $z = -3$.

7. $y \div z$

8. $\frac{4y}{2x}$

9. $\frac{3x - 2y}{z}$

▶▶ Concepts, Skills, & Problem Solving

FINDING DIMENSIONS The model shows the area (in square units) of each part of a rectangle. Use the model to find the missing values that complete the expression. Explain your reasoning. (See Exploration 1, p. 109.)

10. $2.25x + 3 = $ ⬛$($⬛$ + $⬛$)$

? ?

? | 2.25x | 3

11. $\frac{5}{6}m + \frac{2}{3}n = $ ⬛$($⬛$ + $⬛$)$

? ?

? | $\frac{5}{6}m$ | $\frac{2}{3}n$
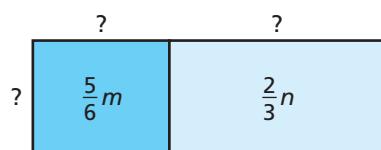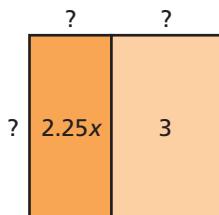
FACTORING OUT THE GCF Factor the expression using the GCF.

12. $9b + 21$

13. $32z - 48$

14. $8x + 2$

15. $3y - 24$

16. $14p - 28$

17. $6 + 16k$

18. $21 - 14d$

19. $20z - 8$

20. $15w + 65$

21. $36a + 16b$

22. $21m - 49n$

23. $12 + 9g - 30h$

FACTORING OUT A RATIONAL NUMBER Factor out the coefficient of the variable term.

24. $\frac{1}{7}a + \frac{1}{7}$

25. $\frac{1}{3}b - \frac{1}{3}$

26. $\frac{3}{8}d + \frac{3}{4}$

27. $2.2x + 4.4$

28. $1.5y - 6$

29. $0.8w + 3.6$

30. $\frac{15}{4} + \frac{3}{8}x$

31. $4h - 3$

32. $0.15c - 0.072$

33. $\frac{3}{8}z + 1$

34. $6s - \frac{3}{4}$

35. $\frac{5}{2}k - 2$

36.

$$16p - 28 = 4(4p - 28)$$

37.

$$\frac{2}{3}y - \frac{14}{3} = \frac{2}{3} \cdot y - \frac{2}{3} \cdot 7$$

$$= \frac{2}{3}(y - 7)$$

FACTORING OUT A NEGATIVE NUMBER Factor out the indicated number.

38. Factor -4 out of $-8d + 20$.

39. Factor -6 out of $18z - 15$.

40. Factor -0.25 out of $7g + 3.5$.

41. Factor $-\dfrac{1}{2}$ out of $-\dfrac{1}{2}x + 6$.

42. Factor -1.75 out of $-14m - 5.25n$.

43. Factor $-\dfrac{1}{4}$ out of $-\dfrac{1}{2}x - \dfrac{5}{4}y$.

44. **MP STRUCTURE** A rectangle has an area of $(4x + 12)$ square units. Write three multiplication expressions that can represent the product of the length and the width of the rectangle.

45. **MODELING REAL LIFE** A square wrestling mat has a perimeter of $(12x - 32)$ feet. Explain how to use the expression to find the length (in feet) of the mat. Justify your answer.

46. **MODELING REAL LIFE** A table is 6 feet long and 3 feet wide. You extend the length of the table by inserting two identical table *leaves*. The extended table is rectangular with an area of $(18 + 6x)$ square feet. Write and interpret an expression that represents the length (in feet) of the extended table.

47. **DIG DEEPER!** A three-dimensional printing pen uses heated plastic to create three-dimensional objects. A kit comes with one 3D-printing pen and p packages of plastic. An art club purchases 6 identical kits for $(180 + 58.5p)$ dollars. Write and interpret an expression that represents the cost of one kit.

48. **MP STRUCTURE** The area of the trapezoid is $\left(\dfrac{3}{4}x - \dfrac{1}{4}\right)$ square centimeters. Write two different pairs of expressions that represent the possible base lengths (in centimeters). Justify your answers.

$\frac{1}{2}$ cm

Connecting Concepts

▷ *Using the Problem-Solving Plan*

1. The runway shown has an area of $(0.05x + 0.125)$ square miles. Write an expression that represents the perimeter (in feet) of the runway.

0.05 mi

Understand the problem.
You know the area of the rectangular runway in square miles and the width of the runway in miles. You want to know the perimeter of the runway in feet.

Make a plan.
Factor the width of 0.05 mile out of the expression that represents the area to find an expression that represents the length of the runway. Then write an expression that represents the perimeter (in miles) of the runway. Finally, use a measurement conversion to write the expression in terms of feet.

Solve and check.
Use the plan to solve the problem. Then check your solution.

2. The populations of two towns after t years can be modeled by $-300t + 7000$ and $-200t + 5500$. What is the combined population of the two towns after t years? The combined population of the towns in Year 10 is what percent of the combined population in Year 0?

FREEDOM
POP   7000
ELEV   5900

Performance Task

Chlorophyll in Plants

At the beginning of this chapter, you watched a STEAM Video called "Tropic Status." You are now ready to complete the performance task related to this video, available at *BigIdeasMath.com*. Be sure to use the problem-solving plan as you work through the performance task.

▶ Review Vocabulary

Write the definition and give an example of each vocabulary term.

like terms, *p. 92*   linear expression, *p. 98*   factoring an expression,
simplest form, *p. 92*   *p. 110*

▶ Graphic Organizers

You can use an **Example and Non-Example Chart** to list examples and non-examples of a concept. Here is an Example and Non-Example Chart for *like terms*.

Like Terms

Examples	Non-Examples
2 and -3	y and 4
$3x$ and $-7x$	$3x$ and $3y$
x^2 and $6x^2$	$4x$ and $-2x^2$
y and $5y$	$2y$ and 5

Choose and complete a graphic organizer to help you study the concept.

1. simplest form

2. equivalent expressions

3. linear expression

4. Distributive Property

5. factoring an expression
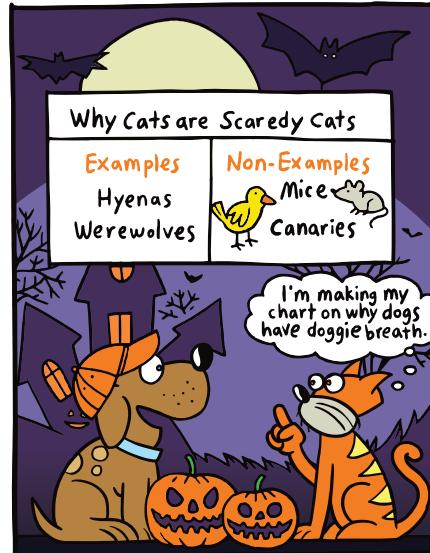
"Here is my Example and Non-Example Chart about things that scare cats."

▶ *Chapter Self-Assessment*

As you complete the exercises, use the scale below to rate your understanding of the success criteria in your journal.

1	**2**	**3**	**4**
I do not understand.	I can do it with help.	I can do it on my own.	I can teach someone else.

3.1 Algebraic Expressions *(pp. 91–96)*

Learning Target: Simplify algebraic expressions.

Identify the terms and like terms in the expression.

1. $z + 8 - 4z$

2. $3n + 7 - n - 3$

3. $10x^2 - y + 12 - 3x^2$

Simplify the expression.

4. $4h - 8h$

5. $6.4r - 7 - 2.9r$

6. $2m - m - 7m$

7. $6y + 9 + 3y - 7$

8. $\dfrac{3}{5}x + 19 - \dfrac{3}{20}x - 7$

9. $\dfrac{2}{3}y + 14 - \dfrac{1}{6}y - 8$

10. Write an expression with 4 different terms that is equivalent to $5x^2 - 8$. Justify your answer.

11. Find the earnings for selling the same number of each type of sandwich. Justify your answer.

	Turkey	Ham
Pretzel Roll	2.25	1.55
Bagel	2.00	1.30

12. You buy the same number of brushes, rollers, and paint cans.

    a. Write and interpret an expression in simplest form that represents the total amount of money you spend on painting supplies.

    b. How much do you spend when you buy one set of supplies for each of 3 painters?

Paint $21.79

Brush $3.99

Paint roller $6.89

3.2 Adding and Subtracting Linear Expressions *(pp. 97–102)*

Learning Target: Find sums and differences of linear expressions.

Find the sum.

13. $(c - 4) + (3c + 9)$

14. $(5z + 4) + (3z - 6)$

15. $(-2.1m - 5) + (3m - 7)$

16. $\left(\frac{5}{4}q + 1\right) + (q - 4) + \left(-\frac{1}{4}q + 2\right)$

Find the difference.

17. $(x - 1) - (3x + 2)$

18. $(4y + 3) - (2y - 9)$

19. $\left(\frac{1}{2}h + 7\right) - \left(\frac{3}{2}h + 9\right)$

20. $(4 - 3.7b) - (-5.4b - 4) - (1.2b + 1)$

21. A basket holds n apples. You pick $(2n - 3)$ apples, and your friend picks $(n + 4)$ apples. How many apples do you and your friend pick together? How many baskets do you need to carry all the apples? Justify your answer.

22. Greenland has a population of x people. Barbados has a population of about 4500 more than 5 times the population of Greenland. Find and interpret the difference in the populations of these two countries.

3.3 The Distributive Property *(pp. 103–108)*

Learning Target: Apply the Distributive Property to generate equivalent expressions.

Simplify the expression.

23. $2(a - 3)$

24. $-3(4x - 10)$

25. $-2.5(8 - b)$

26. $-7(1 - 3d - 5)$

27. $9(-3w - 6.2 + 2w)$

28. $\frac{3}{4}\left(8g - \frac{1}{4} - \frac{2}{3}g\right)$
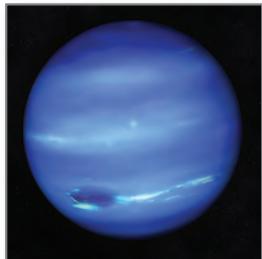
29. Mars has m moons. The number of moons of Pluto is one more than twice the number of moons of Mars. The number of moons of Neptune is one less than 3 times the number of moons of Pluto. Write and interpret a simplified expression that represents the number of moons of Neptune.

Simplify the expression.

30. $3(2 + q) + 15$

31. $\frac{1}{8}(16m - 8) - 17$

32. $-1.5(4 - n) + 2.8$

33. $\frac{2}{5}(d - 10) - \frac{2}{3}(d + 6)$

34. The expression for degrees Fahrenheit is $\frac{9}{5}C + 32$, where C represents degrees Celsius. The temperature today is 5 degrees Celsius more than yesterday. Write and simplify an expression for the difference in degrees Fahrenheit for these two days.

3.4 Factoring Expressions (pp. 109–114)

Learning Target: Factor algebraic expressions.

Factor the expression using GCF.

35. $18a - 12$

36. $2b + 8$

37. $9 - 15x$

Factor out the coefficient of the variable term.

38. $\frac{1}{4}y + \frac{3}{8}$

39. $1.7j - 3.4$

40. $-5p + 20$

41. Factor $-\frac{3}{4}$ out of $\frac{3}{2}x - \frac{9}{4}y$.

42. You and 4 friends are buying tickets for a concert. The cost to buy one ticket is c dollars. If you buy all the tickets together, there is a discount and the cost is $(5c - 12.5)$ dollars. How much do you save per ticket when you buy the tickets together?

43. The rectangular pupil of an octopus is estimated to be 20 millimeters long with an area of $(20x - 200)$ square millimeters. Write an expression that represents the perimeter (in millimeters) of the octopus pupil.

44. A building block has a square base that has a perimeter of $(12x - 9)$ inches. Explain how to use the expression to find the length (in inches) of the wall shown.

1. Identify the terms and like terms in $4x + 9x^2 - 2x + 2$.

Simplify the expression.

2. $8x - 5 + 2x$

3. $2.5w - 3y + 4w$

4. $\dfrac{5}{7}x + 15 - \dfrac{9}{14}x - 9$

5. $(3j + 11) + (8j - 7)$

6. $(2r - 13) - (-6r + 4)$

7. $-2(4 - 3n)$

8. $3(5 - 2n) + 9n$

9. $\dfrac{1}{3}(6x + 9) - 2$

10. $\dfrac{3}{4}(8p + 12) + \dfrac{3}{8}(16p - 8)$

11. $-2.5(2s - 5) - 3(4.5s - 5.2)$

Factor out the coefficient of the variable term.

12. $6n - 24$

13. $\dfrac{1}{2}q + \dfrac{5}{2}$

14. $-4x + 36$

15. Find the earnings for giving a haircut and a shampoo to m men and w women. Justify your answer.

	Women	Men
Haircut	$45	$15
Shampoo	$12	$7

3x + 4

2x + 3   4x − 1
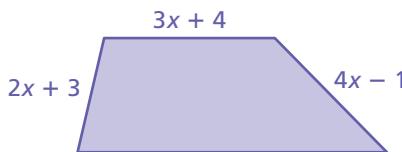
16. The expression $15x + 11$ represents the perimeter of the trapezoid. What is the length of the fourth side? Explain your reasoning.

17. The maximum number of charms that will fit on a bracelet is $3\left(d - \dfrac{2}{3}\right)$, where d is the diameter (in centimeters) of the bracelet.

    a. Write and interpret a simplified expression that represents the maximum number of charms on a bracelet.

    b. What is the maximum number of charms that fit on a bracelet that has a diameter of 6 centimeters?

18. You expand a rectangular garden so the perimeter is now twice the perimeter of the old garden. The expression $12w + 16$ represents the perimeter of the new garden, where w represents the width of the old garden.

    a. Write an expression that represents the perimeter of the old garden. Justify your answer.

    b. Write an expression that represents the area of the old garden.

1. What is the simplified form of the expression?

$$3.7x - 5 - 2.3x$$

A. $-3.6x$

B. $6x - 5$

C. $1.4x - 5$

D. $3.7x - 7.3$

**2.** What is the value of the expression when $c = 0$ and $d = -6$?

$$\frac{cd - d^2}{4}$$

3. What is the value of the expression?

$$-38 - (-14)$$

F. -52

G. -24

H. 24

I. 52

4. The daily low temperatures for a week are shown.
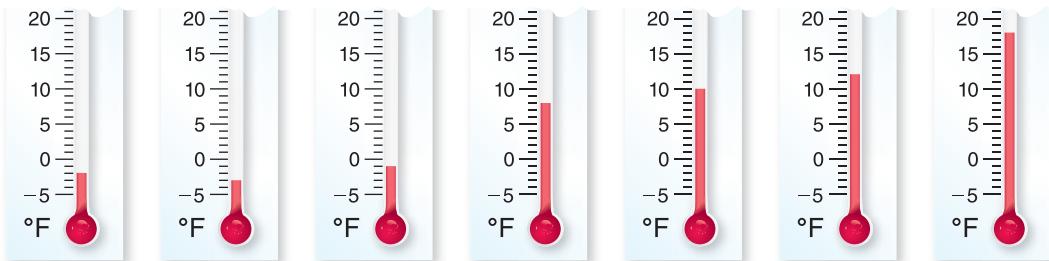
What is the mean low temperature of the week?

A. $-2°F$

B. $6°F$

C. $8°F$

D. $10°F$

Test-Taking Strategy

Answer Easy Questions First

x mummies are added to (x + 2) mummies. How many mummies are there?

Ⓐ 2x + 2   Ⓑ 1 million

Ⓒ 11   Ⓓ 0

Tests about mummies get me all wound up.

"Scan the test and **answer the easy questions first.** Because x must be in the expression, A is correct."

5. You and a friend collect seashells on a beach. After h minutes, you have collected $(11 + 2h)$ seashells and your friend has collected $(5h - 2)$ seashells. How many total seashells have you and your friend collected?

    F. $7h + 9$ **G.** $3h - 13$

    H. $16h$ **I.** $7h + 13$

6. What is the value of the expression?

$$-0.28 \div (-0.07)$$

7. Which list is ordered from least to greatest?

    A. $-\left|\dfrac{3}{4}\right|, -\dfrac{1}{2}, \left|\dfrac{3}{8}\right|, -\dfrac{1}{4}, \left|-\dfrac{7}{8}\right|$ **B.** $-\dfrac{1}{2}, -\dfrac{1}{4}, \left|\dfrac{3}{8}\right|, -\left|\dfrac{3}{4}\right|, \left|-\dfrac{7}{8}\right|$

    C. $\left|-\dfrac{7}{8}\right|, \left|\dfrac{3}{8}\right|, -\dfrac{1}{4}, -\dfrac{1}{2}, -\left|\dfrac{3}{4}\right|$ **D.** $-\left|\dfrac{3}{4}\right|, -\dfrac{1}{2}, -\dfrac{1}{4}, \left|\dfrac{3}{8}\right|, \left|-\dfrac{7}{8}\right|$

8. Which number is equivalent to the expression shown?

$$-2\dfrac{1}{4} - \left(-8\dfrac{3}{8}\right)$$

    F. $-10\dfrac{5}{8}$ **G.** $-10\dfrac{1}{3}$

    H. $6\dfrac{1}{8}$ **I.** $6\dfrac{1}{2}$

9. What is the simplified form of the expression?

$$7x - 2(3x + 6)$$

    A. $15x + 30$ **B.** $x - 12$

    C. $13x + 12$ **D.** $-11x$

10. Which expression is *not* equivalent to the expression?

$$72m - 60$$

F. $6(12m - 10)$ **G.** $4(18m - 15)$

H. $12m$ **I.** $12(6m - 5)$

11. You want to buy a bicycle with your friend. You have $43.50 saved and plan to save an additional $7.25 every week. Your friend has $24.50 saved and plans to save an additional $8.75 every week.

Think Solve Explain

Part A   Simplify and interpret an expression that represents the amount of money you and your friend save after w weeks.

Part B   After 10 weeks, you and your friend use all of the money and buy the bike. How much does the bike cost? Who pays more towards the cost of the bike? Explain your reasoning.

12. Your friend evaluated $3 + x^2 \div y$ when $x = -2$ and $y = 4$.

$$3 + x^2 \div y = 3 + \left(-2^2\right) \div 4$$
$$= 3 - 4 \div 4$$
$$= 3 - 1$$
$$= 2$$

What should your friend do to correct his error?

A. Divide 3 by 4 before subtracting.

B. Square -2, then divide.

C. Divide -2 by 4, then square.

D. Subtract 4 from 3 before dividing.