

Essential Question How can you use algebra tiles to add or subtract algebraic expressions?

Key: = variable = -variable = zero pair
 = 1 = -1 = zero pair

1 ACTIVITY: Writing Algebraic Expressions

Work with a partner. Write an algebraic expression shown by the algebra tiles.

a.

b.

c.

d.

2 ACTIVITY: Adding Algebraic Expressions

Work with a partner. Write the sum of two algebraic expressions modeled by the algebra tiles. Then use the algebra tiles to simplify the expression.

a. $(\text{green } + \text{ tile} + \text{3 yellow } + \text{ tiles}) + (\text{green } + \text{ tile} + \text{4 yellow } + \text{ tiles})$

b. $(\text{green } + \text{ tile} + \text{5 red } - \text{ tiles}) + (\text{green } + \text{ tile} + \text{2 red } - \text{ tiles})$

c. $(\text{green } + \text{ tile} + \text{5 yellow } + \text{ tiles}) + (\text{green } + \text{ tile} + \text{3 red } - \text{ tiles})$

d. $(\text{green } + \text{ tile} + \text{5 red } - \text{ tiles} + \text{2 green } + \text{ tiles}) + (\text{green } + \text{ tile} + \text{3 yellow } + \text{ tiles} + \text{2 green } + \text{ tiles})$



COMMON
CORE

Linear Expressions

In this lesson, you will

- apply properties of operations to add and subtract linear expressions.
- solve real-life problems.

Learning Standards

7.EE.1

7.EE.2

3 ACTIVITY: Subtracting Algebraic Expressions

Math Practice 2

Use Expressions

What do the tiles represent? How does this help you write an expression?

Work with a partner. Write the difference of two algebraic expressions modeled by the algebra tiles. Then use the algebra tiles to simplify the expression.

a. $(\text{green } + \text{ yellow } + \text{ yellow } + \text{ yellow}) - (\text{green } + \text{ yellow})$

b. $(\text{green } + \text{ red } - \text{ red } - \text{ red } - \text{ red}) - (\text{green } - \text{ red } - \text{ red } - \text{ red})$

c. $\left(\begin{array}{c} \text{green } + \text{ yellow } + \text{ yellow } + \text{ yellow } + \text{ yellow } \\ \text{green } + \end{array} \right) - (\text{green } - \text{ red})$

d. $\left(\begin{array}{c} \text{green } + \text{ red } - \text{ red } - \text{ red } - \text{ red } \\ \text{green } + \text{ red } - \text{ red } \\ \text{green } + \end{array} \right) - \left(\begin{array}{c} \text{green } + \text{ yellow } + \text{ yellow } + \text{ yellow } \\ \text{green } + \end{array} \right)$

4 ACTIVITY: Adding and Subtracting Algebraic Expressions

Work with a partner. Use algebra tiles to model the sum or difference. Then use the algebra tiles to simplify the expression.

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

b. $(2x - 6) + (3x + 2)$

c. $(2x + 4) - (x + 2)$

d. $(4x + 3) - (2x - 1)$

What Is Your Answer?

- IN YOUR OWN WORDS** How can you use algebra tiles to add or subtract algebraic expressions?
- Write the difference of two algebraic expressions modeled by the algebra tiles. Then use the algebra tiles to simplify the expression.

$$(\text{red } - \text{ yellow } + \text{ yellow } + \text{ yellow}) - \left(\begin{array}{c} \text{red } - \text{ red } - \text{ red } \\ \text{red } - \end{array} \right)$$

Practice

Use what you learned about adding and subtracting algebraic expressions to complete Exercises 6 and 7 on page 90.

Key Vocabulary

 linear expression,
p. 88

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

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

You can use 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.

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

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

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

$$\begin{aligned} (-4y + 3) + (11y - 5) &= -4y + 3 + 11y - 5 && \text{Rewrite the sum.} \\ &= -4y + 11y + 3 - 5 && \text{Commutative Property of Addition} \\ &= (-4y + 11y) + (3 - 5) && \text{Group like terms.} \\ &= 7y - 2 && \text{Combine like terms.} \end{aligned}$$

EXAMPLE 2 Adding Linear Expressions

Find $2(-7.5z + 3) + (5z - 2)$.

$$\begin{aligned} 2(-7.5z + 3) + (5z - 2) &= -15z + 6 + 5z - 2 && \text{Distributive Property} \\ &= -15z + 5z + 6 - 2 && \text{Commutative Property of Addition} \\ &= -10z + 4 && \text{Combine like terms.} \end{aligned}$$

On Your Own

Find the sum.

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

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

3. $(4 - n) + 2(-5n + 3)$

4. $\frac{1}{2}(w - 6) + \frac{1}{4}(w + 12)$

Now You're Ready
Exercises 8–16

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 3 Subtracting Linear Expressions

Study Tip

To find the opposite of a linear expression, you can multiply the expression by -1 .

Find each difference.

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

b. $(7y + 5) - 2(4y - 3)$

a. **Vertical method:** Align like terms vertically and subtract.

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

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

$$\begin{aligned} (7y + 5) - 2(4y - 3) &= 7y + 5 - 8y + 6 && \text{Distributive Property} \\ &= 7y - 8y + 5 + 6 && \text{Commutative Property of Addition} \\ &= (7y - 8y) + (5 + 6) && \text{Group like terms.} \\ &= -y + 11 && \text{Combine like terms.} \end{aligned}$$

EXAMPLE 4 Real-Life Application

The original price of a cowboy hat is d dollars. You use a coupon and buy the hat for $(d - 2)$ dollars. You decorate the hat and sell it for $(2d - 4)$ dollars. Write an expression that represents your earnings from buying and selling the hat. Interpret the expression.



$$\begin{aligned} \text{earnings} &= \text{selling price} - \text{purchase price} && \text{Use a model.} \\ &= (2d - 4) - (d - 2) && \text{Write the difference.} \\ &= (2d - 4) + (-d + 2) && \text{Add the opposite.} \\ &= 2d - d - 4 + 2 && \text{Group like terms.} \\ &= d - 2 && \text{Combine like terms.} \end{aligned}$$

❖ You earn $(d - 2)$ dollars. You also paid $(d - 2)$ dollars, so you doubled your money by selling the hat for twice as much as you paid for it.

On Your Own

Find the difference.

5. $(m - 3) - (-m + 12)$

6. $-2(c + 2.5) - 5(1.2c + 4)$

7. **WHAT IF?** In Example 4, you sell the hat for $(d + 2)$ dollars. How much do you earn from buying and selling the hat?

Now You're Ready
Exercises 19–24

Vocabulary and Concept Check

VOCABULARY Determine whether the algebraic expression is a linear expression.

Explain.

- $x^2 + x + 1$
- $-2x - 8$
- $x - x^4$
- WRITING** Describe two methods for adding or subtracting linear expressions.
- DIFFERENT WORDS, SAME QUESTION** Which is different? Find “both” answers.

Subtract x from $3x - 1$.

Find $3x - 1$ decreased by x .

What is x more than $3x - 1$?

What is the difference of $3x - 1$ and x ?

Practice and Problem Solving

Write the sum or difference of two algebraic expressions modeled by the algebra tiles. Then use the algebra tiles to simplify the expression.

$$6. \left(\begin{array}{c} + \quad - \quad - \quad - \\ + \quad - \quad - \quad - \end{array} \right) + \left(\begin{array}{c} + \quad + \quad + \quad + \quad + \end{array} \right)$$

$$7. \left(\begin{array}{c} + \quad + \quad + \quad + \quad + \quad + \\ + \quad + \quad + \end{array} \right) - \left(\begin{array}{c} + \quad - \quad - \quad - \quad - \\ + \end{array} \right)$$

Find the sum.

- $(n + 8) + (n - 12)$
- $(7 - b) + (3b + 2)$
- $(2w - 9) + (-4w - 5)$
- $(2x - 6) + 4(x - 3)$
- $5(-3.4k - 7) + (3k + 21)$
- $(1 - 5q) + 2(2.5q + 8)$
- $3(2 - 0.9h) + (-1.3h - 4)$
- $\frac{1}{3}(9 - 6m) + \frac{1}{4}(12m - 8)$
- $-\frac{1}{2}(7z + 4) + \frac{1}{5}(5z - 15)$
- BANKING** 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. Write an expression that represents the total in both accounts.
- FIREFLIES** 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.
 - Write an expression that represents the number of fireflies you and your friend caught together.
 - The competition ends after 5 minutes. Who has more fireflies?



Find the difference.

- 3** 19. $(-2g + 7) - (g + 11)$ 20. $(6d + 5) - (2 - 3d)$ 21. $(4 - 5y) - 2(3.5y - 8)$
 22. $(2n - 9) - 5(-2.4n + 4)$ 23. $\frac{1}{8}(-8c + 16) - \frac{1}{3}(6 + 3c)$ 24. $\frac{3}{4}(3x + 6) - \frac{1}{4}(5x - 24)$
 25. **ERROR ANALYSIS** Describe and correct the error in finding the difference.

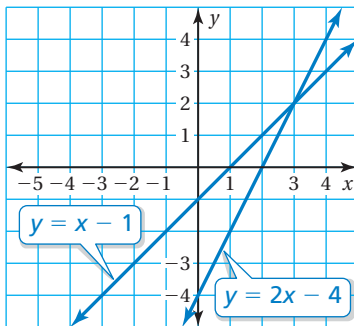
X $(4m + 9) - 3(2m - 5) = 4m + 9 - 6m - 15$
 $= 4m - 6m + 9 - 15$
 $= -2m - 6$

26. **STRUCTURE** Refer to the expressions in Exercise 18.
- How many fireflies are caught each minute during the competition?
 - How many fireflies are caught before the competition starts?
27. **LOGIC** Your friend says the sum of two linear expressions is always a linear expression. Is your friend correct? Explain.

28. **GEOMETRY** The expression $17n + 11$ represents the perimeter (in feet) of the triangle. Write an expression that represents the measure of the third side.



29. **TAXI** Taxi Express charges \$2.60 plus \$3.65 per mile, and Cab Cruiser charges \$2.75 plus \$3.90 per mile. Write an expression that represents how much more Cab Cruiser charges than Taxi Express.



30. **MODELING** A rectangular room is 10 feet longer than it is wide. One-foot-by-one-foot tiles cover the entire floor. Write an expression that represents the number of tiles along the outside of the room.
31. **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 $x = -3$?



Fair Game Review what you learned in previous grades & lessons

Evaluate the expression when $x = -\frac{4}{5}$ and $y = \frac{1}{3}$. (Section 2.2)

32. $x + y$ 33. $2x + 6y$ 34. $-x + 4y$

35. **MULTIPLE CHOICE** What is the surface area of a cube that has a side length of 5 feet? (Skills Review Handbook)

- (A) 25 ft^2 (B) 75 ft^2 (C) 125 ft^2 (D) 150 ft^2