Lesson 7-1

The Distributive Property

Essential Question

Why are algebraic rules useful?

CCS Common Core State Standards

Content Standards
7.NS.2, 7.NS.2c, 7.EE.1 7.EE.2

Mathematical Practices
1, 3, 4, 5

Vocabulary

equivalent expressions
Distributive Property

What You'll Learn

• Use the Distributive Property to write equivalent numerical expressions.
• Use the Distributive Property to write equivalent algebraic expressions.

Real-World Link

Entertainment The Newport Aquarium in Kentucky has acrylic tunnels that allow visitors to walk underneath aquatic life. The cost of admission is $23 per person. The aquarium also offers Behind-the-Scenes Tours for $15 per person and Penguin Encounters for $25 per person.

Numerical Expressions

Expressions are **equivalent expressions** when they have the same value. Example 1 shows how the **Distributive Property** relates to equivalent expressions.

Key Concept — Distributive Property

Words	To multiply a sum or difference by a number, multiply each term inside the parentheses by the number outside the parentheses.
Symbols	$a(b + c) = ab + ac \qquad a(b - c) = ab - ac$
Examples	$5(6 + 7) = 5 \cdot 6 + 5 \cdot 7 \qquad (9 - 3)8 = 9 \cdot 8 - 3 \cdot 8$

Example 1

Use the Distributive Property to write each expression as an equivalent numeric expression. Then evaluate the expression.

a. $5(12 + 4)$

$$5(12 + 4) = 5 \cdot 12 + 5 \cdot 4$$
$$= 60 + 20 \qquad \text{Multiply.}$$
$$= 80 \qquad \text{Add.}$$

b. $(20 - 3)8.2$

$$(20 - 3)8.2 = 20 \cdot 8.2 - 3 \cdot 8.2$$
$$= 164 - 24.6 \qquad \text{Multiply.}$$
$$= 139.4 \qquad \text{Subtract.}$$

Got It? Do these problems to find out.

1a. $(6 + 3)4$

1b. $\frac{3}{4}(9 - 2)$

Handwritten:
$$5(16) =$$
$$5(10 + 6) =$$
$$50 + 30 = 80$$

Digital Zoo/Digital Vision/Getty Images

The Distributive Property allows you to find some products mentally. For example, you can find $7 \cdot 34$ mentally by evaluating $7 \cdot (30 + 4)$.

$$7 \cdot (30 + 4) = 7 \cdot 30 + 7 \cdot 4$$
$$= 210 + 28 \qquad \text{Think:} \quad 7 \cdot 30 = 210$$
$$= 238 \qquad \text{Think:} \quad 210 + 28 = 238$$

Example 2

Tutor

Financial Literacy On a school visit to Washington, D.C., Dichali and his class visited the Smithsonian National Air and Space Museum. Tickets to the IMAX movie cost $8.99. Find the total cost for 20 students to see the IMAX movie.

You can use the Distributive Property and mental math to find the total cost for the movie. To find the total cost mentally, find $20(\$9.00 - \$0.01)$.

$$20(\$9.00 - \$0.01) = 20(\$9.00) - 20(\$0.01) \qquad \text{Distributive Property}$$
$$= \$180 - \$0.20 \qquad \text{Multiply.}$$
$$= \$179.80 \qquad \text{Subtract.}$$

So, the total cost is $179.80.

You can check your result by multiplying $20 \cdot \$9$ to get $180. Since $180 is close to $179.80, the answer is reasonable.

Got It? Do these problems to find out.

2a. A spaghetti dinner at the Italian Village restaurant costs $10.25. Use the Distributive Property and mental math to find the total cost of the dinner for Sherita, her brother, and her parents.

2b. After dinner, they each order gelato for $1.50. What is the new total?

Algebraic Expressions

Vocabulary Link
Distribute
Everyday Use to deliver to each member of a group

Math Use a property that allows you to multiply each member of a sum by a number

You can model the Distributive Property by using algebra tiles and variables.

The model shows $2(x + 4)$. There are 2 groups $(x + 4)$.

Separate the tiles into 2 groups of x and 2 groups of 4.

$$2(x + 4) = 2x + 2 \cdot 4$$
$$2(x) + 2(4) = 2x + 8$$
$$2x + 8$$

The expressions $2(x + 4)$ and $2x + 8$ are equivalent expressions because no matter what the value of x is, these expressions have the same value.

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Example 3

Use the Distributive Property to write each expression as an equivalent algebraic expression.

Watch Out!

Distributive Property
In Example 3a, remember to distribute the 4 to both values inside the parentheses.

a. $4(x + 5)$

$4(x + 5) = 4x + 4 \cdot 5$

$\qquad = 4x + 20$ Simplify.

b. $(y + 10)6$

$(y + 10)6 = y \cdot 6 + 10 \cdot 6$

$\qquad = 6y + 60$ Simplify.

Got It? Do these problems to find out.

3a. $2.4(a + 5)$

$2.4(a) + 2.4(5) = 2.4a + 12$ *FINAL ANSWER*

3b. $(b + 6)3$

$3(b) + 3(6) = 3b + 18$ *FINAL ANSWER*

Example 4

Use the Distributive Property to write each expression as an equivalent algebraic expression.

a. $3(m - 4)$

$3(m - 4) = 3[m + (-4)]$ Rewrite $m - 4$ as $m + (-4)$.

$\qquad = 3 \cdot m + 3 \cdot (-4)$ Distributive Property

$\qquad = 3m + (-12)$ Simplify.

$\qquad = 3m - 12$ Definition of subtraction

b. $-9.5(n - 7)$

$-9.5(n - 7) = -9.5[n + (-7)]$ Rewrite $n - 7$ as $n + (-7)$.

$\qquad = -9.5 \cdot n + (-9.5)(-7)$ Distributive Property

$\qquad = -9.5n + 66.5$ Simplify.

Got It? Do these problems to find out.

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

$\frac{2}{3}(d) - \frac{2}{3}\left(\frac{3}{1}\right) = \frac{2}{3}d - 2$

$\frac{2 \cdot 3}{3 \cdot 1} = \frac{2}{3} \cdot \frac{3}{1} = 2 \cdot 1 = 2$

4b. $-7(e - 4)$

$-7(e) - (-7)(4)$

$-7e - (-28)$

$-7e + 28$

Check ✓

Guided Practice

Use the Distributive Property to write each expression as an equivalent numeric expression. Then evaluate the expression. (Example 1)

1. $7(9 + 3)$

2. $\frac{2}{5}(3 + 5)$

3. $(7 + 8)2.2$

4. $(5 + 6)8$

5. You purchase 3 blue notebooks and 2 red notebooks. Each notebook costs $1.30. Use mental math to find the total cost of the notebooks. Justify your answer by using the Distributive Property. (Example 2)

Use the Distributive Property to write each expression as an equivalent algebraic expression. (Examples 3 and 4)

6. $\frac{3}{4}(m + 4)$

7. $(p + 4)5$

8. $-6(b - 5)$

9. $9.5(a - 10)$

$$-5(3x - 4) \rightarrow -5(3x + {-4})$$

$$-5(3k) - (-5)(4)$$
$$\star \; -15k - (-20) \star$$
$$-15x + 20$$

$$-5(3x) + (-5)(-4)$$
$$-15x + 20$$

$-x$ FOR $x = -7$

$x = 7$

$$-3x + 4$$
$$-x \quad |$$
$$-x \;\; \text{AND} \quad |$$
$$-x \quad |$$
$$|$$

Independent Practice

Use the Distributive Property to write each expression as an equivalent numeric expression. Then evaluate the expression. (Example 1)

10. $-4(8-5)$

11. $4.5(16+8)$

12. $(23-7)6$

13. $12.3(9+4)$

14. $(6+18)\frac{2}{3}$

15. $\frac{5}{8}(20-4)$

16. Martine bought two pairs of jeans that are on sale for $32.85 each. Use mental math to find the total cost of the jeans. Justify your answer by using the Distributive Property. (Example 2)

17. **Financial Literacy** Sarah charges $6.50 per hour to babysit. She babysat for 3 hours on Friday and 5 hours on Saturday. Write two equivalent expressions for her total wages. Then find her total wages. (Example 2)

(handwritten: 6.5×8; $6.5(3+5) = \$52$; $6.5(3) + 6.5(5) = \$52$)

Use the Distributive Property to write each expression as an equivalent algebraic expression. (Examples 3 and 4)

18. $-7.4(10+a)$

19. $\frac{4}{5}(t-15)$

20. $3.7(r-1)$

21. $(b+4)12$

22. $5(x-9)$

23. $-\frac{1}{2}(n+4) = -\frac{1}{2}(n) + (-\frac{1}{2})(4)$

*(handwritten: $-\frac{1}{2}n + (-2)$; $-\frac{1}{2}n - 2$; $-\frac{1}{2}n + {}^-2$)*

24. **CCSS** **Multiple Representations** The volume of seed in a bird feeder is represented by the equation $V = 12(24-h)$.

  a. **Symbols** Use the Distributive Property to write $12(24-h)$ as an equivalent algebraic expression.

  b. **Table** Make a table of ordered pairs (h, V).

  c. **Graph** Graph the ordered pairs on the coordinate plane.

  d. **Words** Explain what happens to the volume as the height increases.

(figure labels: h, 24 in.)
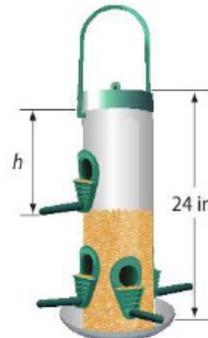
(handwritten multiplication box: 20, 2 across top; 8 down side; 160, 16 inside = 176)

CCSS **Use Math Tools** Find each product mentally. Justify your answer.

25. $8 \cdot 22$

26. $13 \cdot 39$

27. $19 \cdot 41$

28. $29 \cdot 13$

29. $75 \cdot 40$

30. $95 \cdot 38$

(handwritten: $95 \cdot 38$; box with 90, 5 across top; 30, 8 down side; 2700, 150, 120, 40 inside)

Use the Distributive Property to write each expression as an equivalent numeric expression. Then evaluate the expression. $\left(Hint: 3\frac{1}{4} \text{ can be written as the sum } 3 + \frac{1}{4}.\right)$

31. $4\frac{1}{5} \cdot 5 = 20 + 1 = 21$

32. $10 \cdot 5\frac{1}{2}$

33. $6 \cdot 4\frac{2}{3}$

34. $2\frac{2}{7} \cdot 14$

(handwritten: 4.5; $\frac{1}{5} \cdot 5$; box: 5, 4, $\frac{1}{5}$, 8, 1 = 21; $2 \cdot x \cdot x = 2x^2$; $(2x+5)(x+1) = 2x^2 + 7x + 5$; box with $2x + 5$ across top, x and +1 down side, $2x^2$, $+5x$, $+2x$, $+5$ inside; 2)

35. Aiko uses $2\frac{1}{3}$ yards of fabric to make costumes for a play. Use the Distributive Property to find how much fabric she will need if she makes 9 costumes.

36. Admission to Hersheypark Theme Park in Hershey, Pennsylvania, is $52.95 for an adult and $31.95 for children. The Diego family has a coupon for $10 off each admission ticket. Write an expression to find the cost for x adults and y children.

🔥 H.O.T. Problems Higher Order Thinking

37. **CCSS** **Find the Error** Julia is using the Distributive Property to simplify $3(x + 2)$. Find her mistake and correct it.

$$3(x + 2) = 3x + 2$$

[handwritten:] $2.5 (4.5)$

$2(4\frac{1}{2}) + \frac{1}{2}(4\frac{1}{2})$

$9 + 2\frac{1}{4} = 11\frac{1}{4}$

38. **CCSS** **Persevere with Problems** Is $3 + (x \cdot y) = (3 + x) \cdot (3 + y)$ a true statement? If so, explain your reasoning. If not, give a counterexample.

39. **Q** **Building on the Essential Question** Explain how you can use the ~~Distributive Property and mental math~~ to simplify $2\frac{1}{2} \cdot 4\frac{1}{2}$.

[handwritten:] $8\frac{1}{4}$ $\boxed{11\frac{1}{4}}$

$2 \cdot 4 = 8 \qquad \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$

$2 \cdot \frac{1}{2} = 1 \qquad \frac{1}{2} \cdot 4 = 2$

✏️ Standardized Test Practice

40. Admission to a science museum is d dollars and a ticket for the 3-D movie is t dollars. Which expression represents the total cost of admission and a movie for p people?

   A dtp **C** $p(d + t)$

   B $p + (dt)$ **D** $d(p + t)$

41. Which expression represents the total area of the rectangles?

   [handwritten table: x | 7, 2 | 2x + 14]

   F $2 + x + 7 + 2 + x + 7$

   G $2x + 14$ *(circled)*

   H $2x + 7$ *[handwritten:]* AREA = $L \times W$

   J $14x$

42. Which expression can be written as $7(c + d)$?

   A $7c \cdot 7d$

   B $(7 + c) \cdot (7 + d)$

   C $7c + 7d$

   D $(7 + c) + (7 + d)$

43. **Short Response** A car rental company charges $45 per day to rent a car. If you rent the car for more than seven days, the cost will be reduced by $10 per day.

   Write an equation to show the total cost c of renting a car for d days if you rent the car for more than seven days.

   [handwritten:] $c = d(45 - 10)$

   $c = 35d$

CCSS Common Core Review

Find each sum or difference. Write in simplest form. 7.NS.1

44. $-\frac{5}{8} + \frac{3}{4}$ 45. $-2\frac{1}{2} - \frac{2}{3}$ 46. $\frac{2}{5} + \frac{1}{6}$ 47. $-5\frac{6}{7} + \frac{1}{9}$

48. Jessica needs $5\frac{5}{8}$ yards of fabric to make a skirt and $14\frac{1}{2}$ yards to make a coat. How much fabric does she need in all? 7.NS.3

49. Tate's flower garden has a perimeter of 25 feet. He plans to add 2 feet 9 inches to the width and 3 feet 9 inches to the length. What is the new perimeter in feet? 7.NS.3

Evaluate each expression. 7.NS.2

50. $-6h$, if $h = -20$ 51. $-4st$, if $s = -9$ and $t = 3$

52. $\frac{x}{-5}$, if $x = -85$ 53. $\frac{108}{m}$, if $m = -9$

152 × 98

	90	8
100	9000	800
50	4500	400
2	180	16

13500 + 1360 + 16

13500
1360
16
─────
14,896

52 × 26

	50	2
20	1000	40
6	300	12