

3.3

Writing Equivalent Expressions



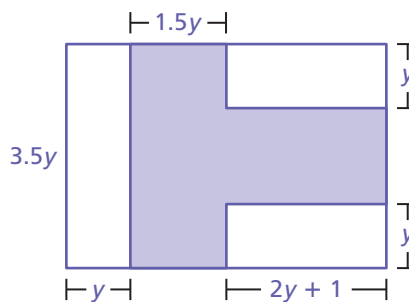
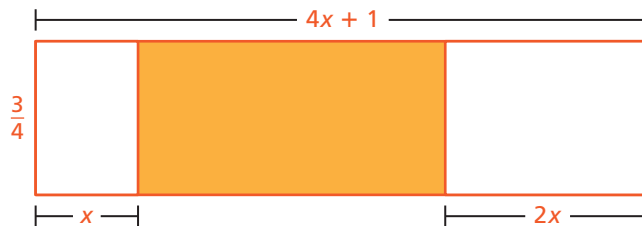
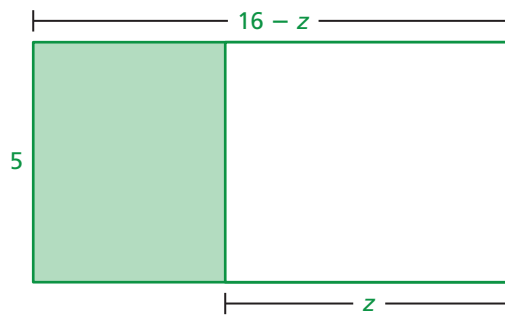
Learning Target: Apply properties of operations to generate equivalent expressions.

- Success Criteria:**
- I can explain how to apply the Distributive Property.
 - I can use properties of operations to simplify algebraic expressions.
 - I can determine whether two expressions are equivalent.

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.



4 MTR COMMUNICATE CLEARLY

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.

Algebraic Reasoning
MA.7.AR.1.2 Determine whether two linear expressions are equivalent.



3.3 Lesson

You can use properties of operations to write equivalent expressions involving variable terms and rational numbers.

Example 1 Using the Distributive Property

Simplify each expression.

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

$$-\frac{1}{3}(3n - 6) = -\frac{1}{3}(3n) - \left(-\frac{1}{3}\right)(6)$$

Distributive Property

$$= -n - (-2)$$

Multiply.

$$= -n + 2$$

Add the opposite.

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

$$5(-x + 3y) = 5(-x) + 5(3y)$$

Distributive Property

$$= -5x + 15y$$

Multiply.

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

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

Distributive Property

$$= 3 + (-6x) + (-21)$$

Multiply.

$$= -6x + 3 + (-21)$$

Comm. Prop. of Add.

$$= -6x + [3 + (-21)]$$

Assoc. Prop. of Add.

$$= -6x + (-18)$$

Add.

$$= -6x - 18$$

Simplify.

Remember

The Distributive Property states

$$a(b + c) = ab + ac$$

and

$$a(b - c) = ab - ac.$$

2 MTR USE ANOTHER METHOD

Can you combine like terms in parentheses before using the Distributive Property in part (c)? Explain your reasoning.

Try It

Simplify the expression.

1. $-1(x + 9)$

2. $12(-7.5 + w)$

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

4. $-1.5(8m - n)$

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

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



Example 2 B.E.S.T. Test Prep: Identifying Equivalent Expressions

Which expression is *not* equivalent to $\frac{3}{2}(-2x + 4) + x$?

- (A) $2(-x - 3)$ (C) $-3\left(\frac{2}{3}x - 2\right)$
 (B) $-x - x + 6$ (D) $-3x + x + 3 + 3$

Simplify the original expression.

$$\frac{3}{2}(-2x + 4) + x = -3x + 6 + x \quad \text{Distributive Property}$$

$$= -3x + x + 6 \quad \text{Comm. Prop. of Add.}$$

$$= -2x + 6 \quad \text{Combine like terms.}$$

Simplifying the expression in Choice A results in $-2x - 6$. Simplifying the expressions in Choices B, C, and D results in $-2x + 6$.

► Because $-2x - 6$ is *not* equivalent to $-2x + 6$, the correct answer is (A).

4 MTR JUSTIFY A RESULT

Show that the expressions in Choices B, C, and D are equivalent to the original expression. Justify each step.

Try It

7. Are $2(-x - 3)$ and $\frac{3}{2}(-2x - 4) + x$ equivalent? Explain.

In-Class Practice

1 I don't understand yet.

2 I can do it with help.

3 I can do it on my own.

4 I can teach someone else.

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

USING THE DISTRIBUTIVE PROPERTY Simplify the expression.

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

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

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11. **STRUCTURE** Use the terms to complete the expression so that it is equivalent to $9x - 12$. Justify your answer.

8

$3x$

$\frac{3}{2}$

$4x$

$$\square \left(\square - \square \right) + \square$$

4 MTR

12. **DISCUSS MATHEMATICAL THINKING** Your friend says that $2x + 1.5$ and $-2x + 1.5$ are equivalent algebraic expressions because they have the same value when x is 0. Is your friend correct? Explain.

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Example 3 Modeling Real Life

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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?

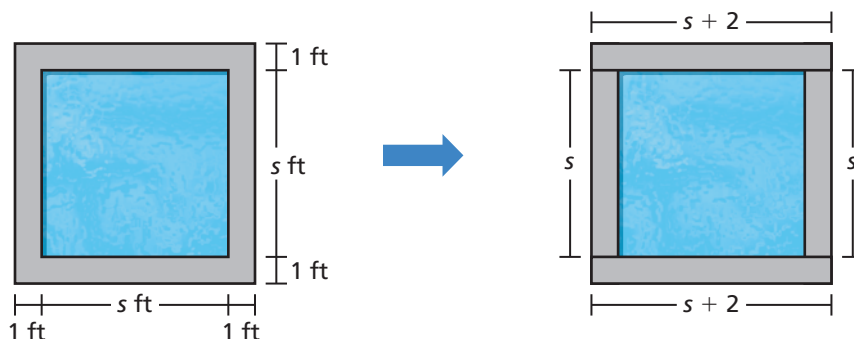
Understand the problem.

Make a plan.

Solve and check.

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.

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



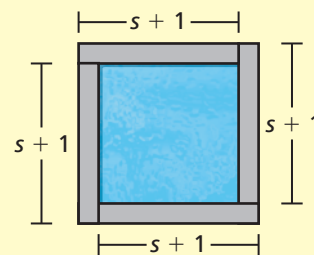
The diagram shows that the tiled border can be divided into two sections that each require $s + 2$ tiles and two sections that each require s tiles. So, the number of tiles can be represented by $2(s + 2) + 2s$. Simplify the expression.

$$\begin{aligned} 2(s + 2) + 2s &= 2(s) + 2(2) + 2s && \text{Distributive Property} \\ &= 4s + 4 && \text{Simplify.} \end{aligned}$$

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

Another Method Draw a different diagram.

$$\begin{aligned} 4(s + 1) &= 4(s) + 4(1) \\ &= 4s + 4 \quad \checkmark \end{aligned}$$



In-Class Practice

1 I don't understand yet.

2 I can do it with help.

3 I can do it on my own.

4 I can teach someone else.



13. How many 2-foot square tiles does it take to tile the border of the pool in Example 3? Explain.

14. **Dig Deeper** The length of a handwoven Peruvian rug is 1 foot greater than its width. The perimeter of the rug is 14 feet. What is the least number of these rugs needed to form a square without any rugs overlapping?



3.3

Practice WITH CalcChat® AND CalcView®

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 $=$.

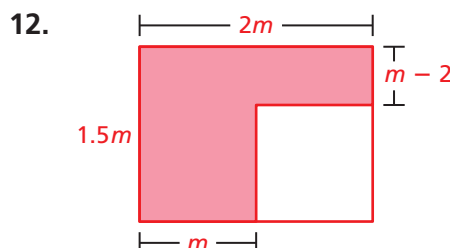
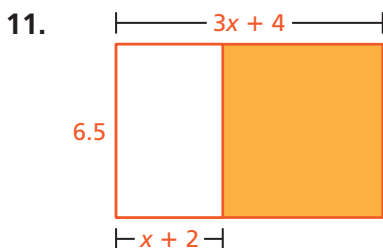
8. $11 \square |-11|$

9. $|3.5| \square |-5.8|$

10. $|-3.5| \square \left| \frac{17}{5} \right|$

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.)



USING THE DISTRIBUTIVE PROPERTY Simplify the expression. (See Example 1.)

13. $3(a - 7)$

14. $-6(2 + x)$

15. $-9(-5 - 4c)$

16. $4.5(3s + 6)$

▶ 17. $-6(-4d - 8.3 + 3d)$

18. $2.3h(6 - k)$

19. $-\frac{3}{8}(-4y + z)$

20. $2(-2w - 1.2 + 7x)$

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

22. $-6a + 7(-2a - 4)$

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

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

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

25.

$$\begin{aligned} -2(h + 8k) &= -2(h) + 2(8k) \\ &= -2h + 16k \end{aligned}$$

26.

$$\begin{aligned} -3(4 - 5b + 7) &= -3(11 - 5b) \\ &= -3(11) + (-3)(5b) \\ &= -33 - 15b \end{aligned}$$

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EQUIVALENT EXPRESSIONS Determine whether the expressions are equivalent. (See Example 2.)

▶ 27. $2(7x - 5) + 8$, $14x + 2$

28. $-8.2 + 3.5(2.2 - 4.1p)$, $-0.5 + 14.35p$

29. $\frac{3}{2}\left(g - \frac{3}{4}\right) + 2$, $2 + \frac{3}{2}g - \frac{9}{8}$

30. $-1 + \frac{7}{6}\left(\frac{1}{3} + \frac{3}{7}m\right)$, $\frac{1}{2}\left(\frac{5}{9} + m\right) - \frac{8}{9}$

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31. **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. (See Example 3.)

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32. **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.

33. **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.

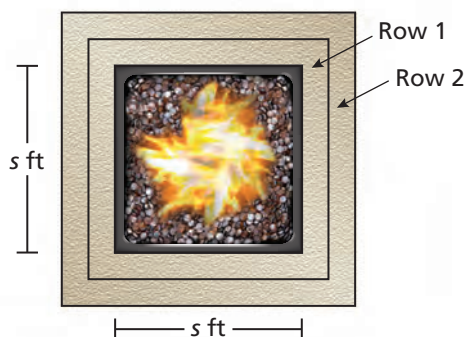
34. $5(2 + x + 3)$

35. $(4 + 1)(x + 2x)$

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36. **STRUCTURE** A wildlife officer observes sea turtles nesting on multiple beaches. The officer estimates t sea turtles lay $5(16t + 4)$ eggs on beach A, $10(9t + 1)$ eggs on beach B, and $7(8t + 6)$ on beach C.

- For what number of sea turtles do beach A and beach B have the same number of eggs?
- When each beach has the same number of sea turtles nesting, which beach has the least number of eggs? Justify your answer.



37. **Dig Deeper** A square firepit with a side length of s feet is bordered by 1-foot square stones as shown.

- How many stones does it take to border the firepit with two rows of stones? Use a diagram to justify your answer.
- You border the firepit with n rows of stones. How many stones are in the n th row? Explain.

