


### Explore It!

A shipment of eggs contains some cartons with a dozen eggs and some cartons with a half-dozen eggs.



#### Lesson 4-2

### Generate Equivalent Expressions

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**I can...**  
write equivalent expressions for given expressions.

**A.** How can you represent the total number of eggs in the shipment using diagrams or images? Explain your diagram.

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**B.** How can you represent the total number of eggs in the shipment using expressions? What variables do you use? What do they represent?

**Focus on math practices**

**Construct Arguments** How do the two representations compare? How are they different?

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### Essential Question

What are equivalent expressions?

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#### EXAMPLE 1

### Use Properties of Operations to Write Equivalent Expressions

The student council has spent \$300 on the supplies needed to sponsor a dance concert fundraiser. Three council members wrote the following expressions to represent the total amount raised for  $t$  tickets sold. Can they all be correct? Explain.

$6t - 300$      $6(t - 50)$      $-300 + 6t$



**Reasoning** How can you use the properties of operations to determine whether the expressions are equivalent?

**STEP 1** Verify that one of the expressions represents the amount raised for  $t$  tickets sold.

$6t - 300$

The amount made selling tickets

The cost of supplies

**STEP 2** Use properties of operations to write equivalent expressions.

$$\begin{aligned}
 6(t - 50) &= 6 \cdot t - 6 \cdot 50 \\
 &= 6t - 300
 \end{aligned}$$

Use the Distributive Property.

$$\begin{aligned}
 -300 + 6t &= 6t + (-300) \\
 &= 6t - 300
 \end{aligned}$$

Use the Commutative Property.

The council members wrote equivalent expressions. They are all correct.

**Try It!**

Nancy wrote the expression  $3x - 12$  to represent the relationship in a table of values. Use properties of operations to write two equivalent expressions.

$3(x - \square)$

$\square + 3x$

**Convince Me!** What property can you use to write an equivalent expression for  $-5(x - 2)$ ? Explain.

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**EXAMPLE 2** Write Equivalent Expressions by Combining Like Terms

Write equivalent expressions by combining like terms.

a.  $-5x + 2y + 3x$   
 $-5x + 3x + 2y$  Use the Commutative Property.  
 $(-5 + 3)x + 2y$  Use the Distributive Property.  
 $-2x + 2y$

b.  $\frac{1}{3}x + (\frac{1}{6}x + y)$   
 $(\frac{1}{3}x + \frac{1}{6}x) + y$  Use the Associative Property.  
 $\frac{2}{6}x + y$

**Look for Relationships**  
 How can you check whether the expressions are equivalent?

**Try It!**  
 Use properties of operations to write two expressions that are equivalent to  $\frac{1}{2}n + (8 + \frac{1}{2}z)$ .

**EXAMPLE 3** Identify Equivalent Expressions

Which of the expressions below are equivalent to  $-\frac{2}{3}x - 2$ ?

$-\frac{2}{3}x + (-2)$   
 $= -\frac{2}{3}x - 2$  Subtract the additive inverse.  
 The expression is equivalent to  $-\frac{2}{3}x - 2$ .

$2 - \frac{2}{3}x$   
 $= -\frac{2}{3}x + 2$  Use the Commutative Property.  
 The expression is NOT equivalent to  $-\frac{2}{3}x - 2$ .

$-x + (\frac{1}{3}x + (-2))$   
 $(-x + \frac{1}{3}x) + (-2)$  Use the Associative Property.  
 $-\frac{2}{3}x + (-2)$   
 $= -\frac{2}{3}x - 2$   
 The expression is equivalent to  $-\frac{2}{3}x - 2$ .

**Try It!**  
 Write two expressions that are equivalent to  $\frac{5}{4}x - \frac{3}{4}$ .

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**KEY CONCEPT**

You can use properties of operations to write equivalent expressions.

$-\frac{1}{2}(x + 8)$   
 $= -\frac{1}{2}x + (-\frac{1}{2}) \cdot 8$  Use the Distributive Property.  
 $= -\frac{1}{2}x + (-4)$   
 $= -4 + (-\frac{1}{2}x)$  Use the Commutative Property.

The expressions  $-\frac{1}{2}(x + 8)$ ,  $-\frac{1}{2}x + (-4)$ , and  $-4 + (-\frac{1}{2}x)$  are equivalent.

- Do You Understand?**
- Essential Question** What are equivalent expressions?
  - Make Sense and Persevere** For which operations is the Commutative Property true?
  - How can the Associative Property be applied when writing equivalent expressions with variables?

- Do You Know How?**
- Write an expression equivalent to  $-3 + \frac{2}{3}y - 4 - \frac{1}{3}y$ .
  - Complete the tables to determine if the expressions are equivalent. If the expressions are equivalent, name the property or properties that make them equivalent.
 

3(x - 5)	
x	Value of Expression
1	<input type="text"/>
2	<input type="text"/>
3	<input type="text"/>

3x - 15	
x	Value of Expression
1	<input type="text"/>
2	<input type="text"/>
3	<input type="text"/>
  - Use the properties of operations to write an expression equivalent to  $4x + \frac{1}{2} + 2x - 3$ .

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

**Practice & Problem Solving**

For 7-9, write an equivalent expression.

7.  $-3(7 + 5g)$       8.  $(x + 7) + 3y$       9.  $\frac{2}{9} - \frac{1}{5} \cdot x$

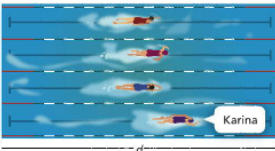
*see notes*

10. Which expression is equivalent to  $t + 4 + 3 - 2t$ ?

(A)  $t + 7$   
 (B)  $-t + 7$   
 (C)  $6t$   
 (D)  $10t$

*Handwritten work for problem 10:*  
 $t + 4 + 3 - 2t$   
 $(+1t + -2t) + (+4 + 3)$   
 $-1t + 7$

11. The distance in feet that Karina swims in a race is represented by  $4d - 4$ , where  $d$  is the distance for each lap. What is an expression equivalent to  $4d - 4$ ?



12. Use the Associative Property to write an expression equivalent to  $(w + 9) + 3$ .

13. Nigel is planning his training schedule for a marathon over a 4-day period. He is uncertain how many miles he will run on two days. One expression for the total miles he will run is  $12 + y + 17 + z$ . Use the Commutative Property to write an equivalent expression.

Day	Miles to Run
1	12
2	$y$
3	17
4	$z$

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7)

$$-3 \cdot (7 + 5g)$$

$$(-3)(7) + -3(5g)$$

$$\underline{-21 + -15g}$$

~~$-36g$~~

P  
 D  
 3  
 A  
 S

↓

14. Maria said the expression  $-4n + 3 + 9n - 4$  is equivalent to  $4n$ . What error did Maria likely make?

15. Write an expression equivalent to  $x - 3y + 4$ .

16. Andre wrote the expression  $-2 + 4x + 3$  to represent the relationship shown in the table.

Write two other expressions that also represent the relationship shown in the table.

x	Value of Expression
0	-2
6	6
12	14

17. **Higher Order Thinking** To rent a car for a trip, four friends are combining their money. The group chat shows the amount of money that each puts in. One expression for their total amount of money is  $189$  plus  $p$  plus  $224$  plus  $q$ .



a. Use the Commutative Property to write two equivalent expressions.

b. If they need \$500 to rent a car, find at least two different pairs of numbers that  $p$  and  $q$  could be.

**Assessment Practice**

18. Which expressions are equivalent to  $\frac{3}{5}x + 3$ ? Select all that apply.

- $\frac{2}{5}x + 3\frac{1}{2}x$
- $\frac{3}{5}x - \frac{1}{5}x + 3$
- $\frac{6}{5}x + 3\frac{3}{5}x - 1$
- $1 + \frac{3}{5}x + 2$
- $1 + \frac{x}{5} + 2$
- $1 + \frac{2}{5}x + 3$

