LESSON 19

Dear Family,

This week your student is learning how to write and identify equivalent expressions. **Equivalent expressions** are expressions in different forms that always represent the same value.

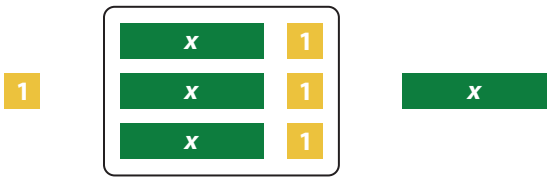
For example, the expression $8 + 12$ is equivalent to the expression $4(2 + 3)$ because both expressions represent the same value, 20.

Your student will be learning to solve problems like the one below.

> Write an expression equivalent to $1 + 3(x + 1) + x$.

➤ **ONE WAY** to write equivalent expressions is to use algebra tiles.

First, represent the given expression with algebra tiles.



Then, rearrange the tiles to write an equivalent expression.

➤ **ANOTHER WAY** is to use properties of operations.

$1 + 3(x + 1) + x$

$1 + 3(x) + 3(1) + x$ ← Distributive property: $a(b + c) = ab + ac$

$1 + 3x + 3 + x$ ← Identify pairs of **like terms**.

$(3x + x) + (1 + 3)$ ← Reorder and regroup so that like terms are together.

$4x + 4$

Using either method, you can see that $4x + 4$ and $1 + 3(x + 1) + x$ are equivalent expressions.

Use the next page to start a conversation about equivalent expressions.

Activity Exploring Equivalent Expressions

➤ **Do this activity together to match equivalent expressions.**

Each expression at the right is equivalent to the expression in either Set 1, Set 2, or Set 3.

Copy each expression into the appropriate box to make three sets of equivalent expressions. Then write your own set of three equivalent expressions.

$5 \cdot 3 + 5 \cdot 2$	$20 + 6$
$2 \cdot 10 + 2 \cdot 3$	$5(6 + 3)$
$5(3 + 2)$	$30 + 15$

SET 1

$15 + 10$

SET 2

$2(10 + 3)$

SET 3

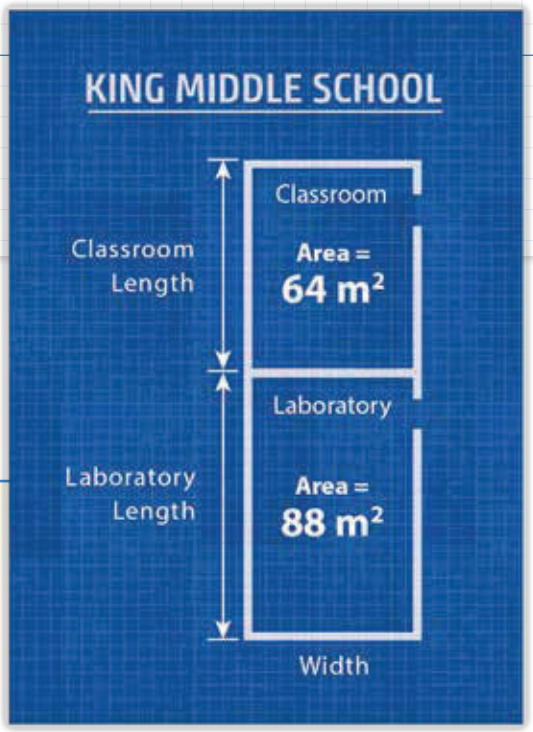
$5 \cdot 6 + 5 \cdot 3$

SET 4

Write your own set of equivalent expressions!

? How do your sets of expressions show examples of the distributive property, $a(b + c) = ab + ac$?

Explore Equivalent Expressions



Previously, you learned how to write and evaluate expressions. In this lesson, you will learn about equivalent expressions.

➤ **Use what you know to try to solve the problem below.**

In the design for a new school, a classroom needs to have the same width as a laboratory. The architect wants the width to be as great as possible. The length and width of each room should be a whole number of meters. What length and width should the architect use for each room?

TRY IT

Math Toolkit grid paper, sticky notes, unit tiles

DISCUSS IT

Ask: How did you determine the greatest possible width of the rooms?

Share: I started by . . . Then I . . .

Learning Targets SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6

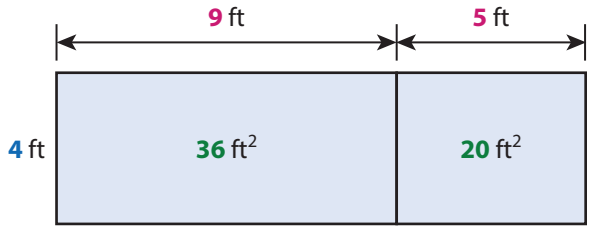
- Apply the properties of operations to generate equivalent expressions.
- Identify when two expressions are equivalent.
- Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor.

CONNECT IT

1 Look Back What length and width should the architect use for the classroom and the laboratory? Explain how you know.

2 Look Ahead When two rectangles share a common side, the areas of the rectangles have a common factor.

a. The expressions 36 + 20 and 4(9 + 5) both represent the area, in square feet, of the outer rectangle. They are **equivalent expressions** because they name the same value. Show that these expressions are equivalent by finding the value of each expression.



36 + 20 = _____ 4(9 + 5) = 4 × _____

= _____

b. You can also use the distributive property to show that the sum 36 + 20 is equivalent to the product 4(9 + 5). To rewrite 36 + 20 as a product, you can use the greatest common factor (GCF) of 36 and 20 as one of the factors.

The GCF of 36 and 20 is _____. 36 + 20

Rewrite each term using the GCF as a factor. _____ × 9 + _____ × 5

Use the distributive property. _____ × (_____ + _____)

c. Rewrite the sum 42 + 35 as a product. Use the GCF of 42 and 35 as one of the factors. Use a sum as the other factor.

3 Reflect How can you use the distributive property to rewrite a sum of two terms as a product of two factors?

 Name:

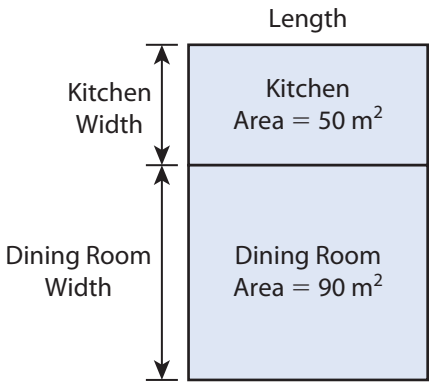
Prepare for Writing and Identifying Equivalent Expressions

1 Think about what you know about expressions. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

Word	In My Own Words	Examples
expression		
term		
coefficient		
distributive property		

2 What is the coefficient of n in the expression $n + 15$? Explain how you know.

3 An architect is designing a sandwich shop, as shown in the diagram. The kitchen and dining room will be the same length. The length needs to be as great as possible. The length and width of each room should be a whole number of meters.



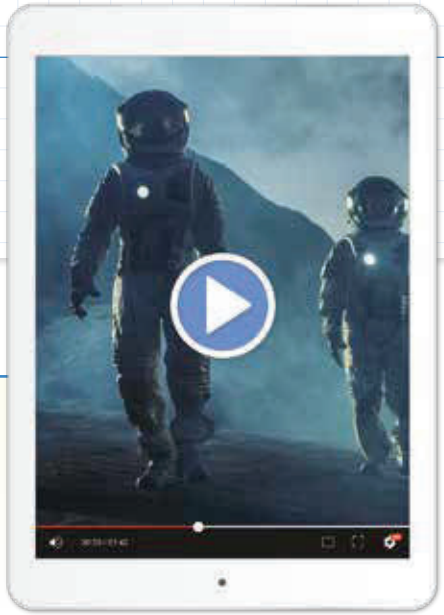
a. What length and width should the architect use for the kitchen and for the dining room? Show your work.

SOLUTION _____

_____

b. Check your answer to problem 3a. Show your work.

Develop Using the Distributive Property to Write Equivalent Expressions



➤ **Read and try to solve the problem below.**

The Romano family pays for a streaming movie service that costs $8 per month. They want to add a second movie service for d dollars per month. Write two expressions for the total cost of both services for 3 months. One expression should be a sum of two terms, and one should be a product of two factors.

TRY IT

Math Toolkit algebra tiles, grid paper

DISCUSS IT

Ask: What does each part of your two expressions represent?

Share: In my first expression, . . . In my second expression, . . .

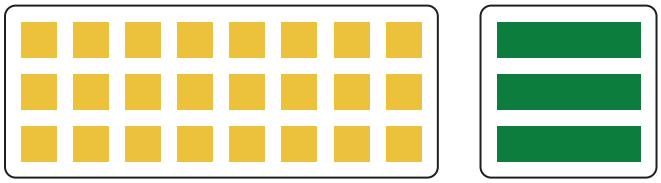
➤ **Explore different ways to understand using the distributive property to write equivalent expressions.**

The Romano family pays for a streaming movie service that costs $8 per month. They want to add a second movie service for *d* dollars per month. Write two expressions for the total cost of both services for 3 months. One expression should be a sum of two terms, and one should be a product of two factors.

Model It

You can use algebra tiles to help you write an algebraic expression.

Each square tile represents $1. Each rectangular tile represents *d* dollars.



The tiles show that the expression $24 + 3d$ represents the total cost of both services for 3 months.

Analyze It

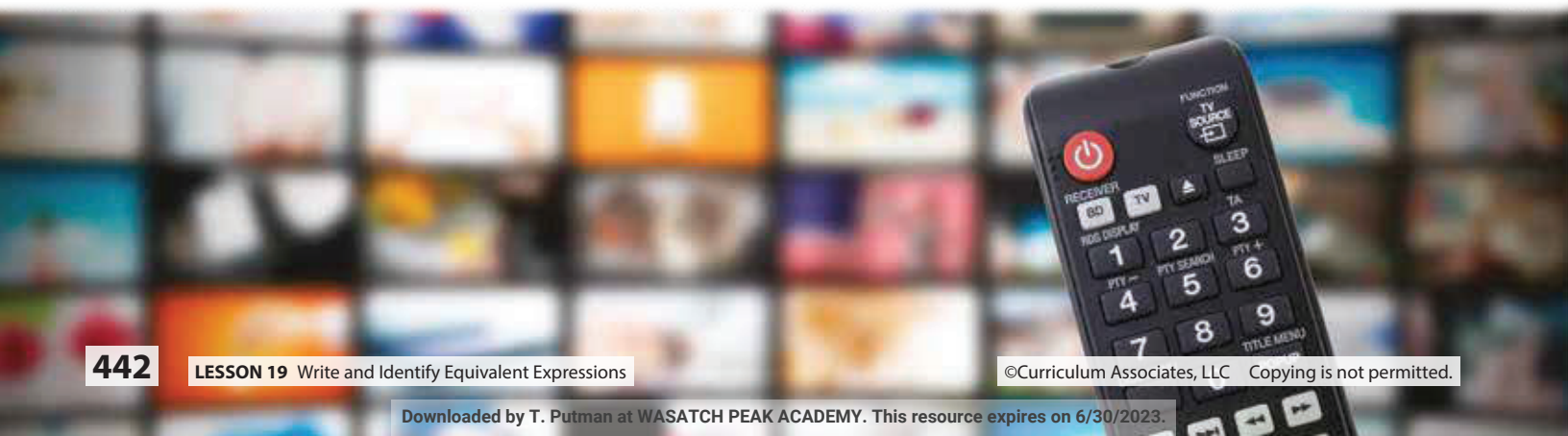
You can use the distributive property to find an equivalent expression.

Rewrite the expression $24 + 3d$ as a product of two factors. One factor is a common factor of the two terms.

$24 + 3d$

$\mathbf{3}(8) + \mathbf{3}(d)$ ← The GCF of 24 and $3d$ is **3**.

$\mathbf{3}(8 + d)$

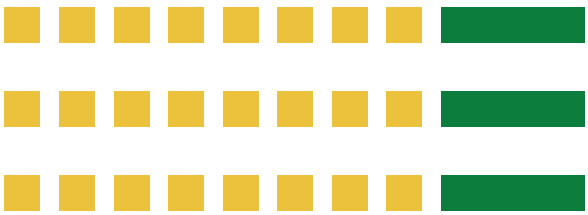


CONNECT IT

Use the problem from the previous page to help you understand how to use the distributive property to write equivalent expressions.

1. Look at the expressions $24 + 3d$ and $3(8 + d)$. Which expression is a sum of two terms? Which expression is a product of two factors?

2. The tiles in **Model It** are grouped to model the expression $24 + 3d$. The same set of tiles is shown at the right. Circle and label groups of tiles to show how the tiles also model the expression $3(8 + d)$.



3. Equivalent expressions always name the same value. How do the algebra tiles show that $24 + 3d$ and $3(8 + d)$ will always have the same value?

4. In **Analyze It**, the distributive property is used to rewrite the sum $24 + 3d$ as the product $3(8 + d)$. How do you use the distributive property to rewrite the product $3(8 + d)$ as the sum $24 + 3d$?

5. What are two ways you can use the distributive property to write equivalent expressions?

6. The distributive property applies to differences as well as sums. How could you use the distributive property to rewrite $6x - 6$ as a product?

7. **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to use the distributive property to write equivalent expressions.

Apply It

➤ **Use what you learned to solve these problems.**

8 **a.** Use the distributive property to rewrite $(5x + 3)(2)$ as a sum of two terms. Show your work.

SOLUTION _____

b. You can use the commutative and associative properties of multiplication to reorder and regroup factors. Explain how you used one or both of these properties in your work for problem 8a.

9 Which expression is equivalent to $63 + 56$?

A $7(9 + 8)$

B $3(60 + 56)$

C $6(3 + 5)$

D $7(9 + 56)$

10 A company sells fruit cups in packs of 4. The packs currently weigh 20 oz. The company plans to reduce the weight of each cup by n oz. The expression $20 - 4n$ represents the new weight, in ounces, of a pack of fruit cups. Rewrite the expression for the new weight as a product of two factors. Show your work.

SOLUTION _____

Practice Using the Distributive Property to Write Equivalent Expressions

➤ **Study the Example showing how to use the distributive property to rewrite a product. Then solve problems 1–6.**

Example

Rewrite the expression $3(7a - 4b)$ as a difference.

You can use the distributive property to rewrite the product.

Multiply $7a$ and $4b$ by 3.	$3(7a - 4b)$
	$3 \cdot 7a - 3 \cdot 4b$
Use the associative property.	$(3 \cdot 7)a - (3 \cdot 4)b$
Multiply inside the parentheses.	$21a - 12b$

The difference $21a - 12b$ is equivalent to $3(7a - 4b)$.

1. You use the associative property of multiplication to change how factors are grouped. In the Example, why are the factors of the term $3 \cdot 7a$ regrouped as $(3 \cdot 7)a$?

2. Jesse says that the expressions $7(2x + 9)$ and $14x + 9$ are equivalent. Do you agree with Jesse? Explain.

3. Use the greatest common factor of 84 and 48 to write the sum $84 + 48$ as a product. Write a whole number in each blank.

$84 + 48$

_____ $\times (7 +$ _____$)$

Vocabulary

distributive property
for any numbers a, b, and c, $a(b + c) = ab + ac$.

equivalent expressions
two or more expressions in different forms that always name the same value.

greatest common factor (GCF)
the greatest factor two or more numbers have in common.

4 Rewrite the expression $2(3 - 4k)$ as a difference. Show your work.

SOLUTION

5 Tell whether each pair of expressions is *Equivalent* or *Not Equivalent*.

	Equivalent	Not Equivalent
a. $5(3t - 6)$ and $15t - 30$	○	○
b. $16 + 72n$ and $(2 + 9n)(8)$	○	○
c. $4(6a + 8b)$ and $10a + 12b$	○	○
d. $7x - 9y$ and $(7x - y)(9)$	○	○

6 Kaley plans to increase the amount of food she feeds her puppy each day by x oz. The expression $3x + 18$ represents the total weight of food, in ounces, Kaley will need for her puppy for the next three days.

a. Rewrite the expression as a product of two factors. Show your work.

SOLUTION

b. How many ounces of food did Kaley feed her puppy each day before she increased the amount? Explain how you know.

Develop Combining Like Terms

Read and try to solve the problem below.

Ryan is making papel picado as decorations for his aunt's wedding. The receipt shows how much tissue paper he bought. Each small package holds *x* sheets, and each large package holds *y* sheets. Write an expression with exactly three terms to represent the total number of sheets of tissue paper Ryan bought.

PAPER PLUS
Art Supply Store
RECEIPT

ITEM	AMOUNT
• gold tissue paper 2 large packages	$4.44
• blue tissue paper 3 small packages	$2.46
• green tissue paper 1 large package	$2.22
• purple tissue paper 2 small packages	$1.64
• pink tissue paper 4 sheets	$0.84

THANK YOU FOR SHOPPING IN OUR STORE!

TRY IT

Math Toolkit algebra tiles, grid paper

DISCUSS IT

Ask: What does each term in your expression represent?

Share: The first term represents . . .

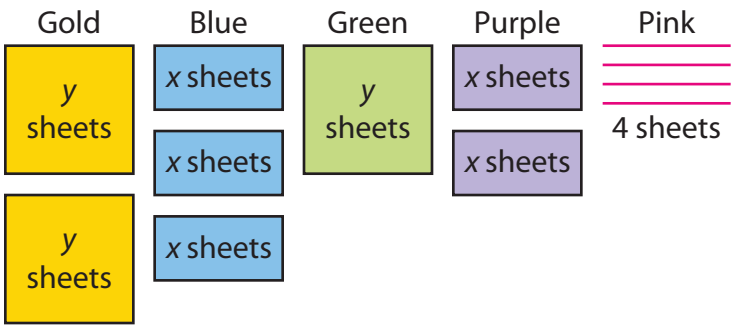
➤ **Explore different ways to combine like terms.**

Ryan is making papel picado as decorations for his aunt's wedding. The table shows how much tissue paper he bought. Each small package holds x sheets, and each large package holds y sheets. Write an expression with exactly three terms to represent the total number of sheets of tissue paper Ryan bought.

Paper Color	Amount
Gold	2 large packages
Blue	3 small packages
Green	1 large package
Purple	2 small packages
Pink	4 sheets

Picture It

You can draw a picture to help you write an algebraic expression.



$2y + 3x + y + 2x + 4$

Analyze It

You can use properties of operations to combine terms with the same variable parts.

Identify the **like terms**.	$2y + 3x + y + 2x + 4$
Reorder and regroup the terms.	$(2y + y) + (3x + 2x) + 4$
Rewrite the term y as $1y$.	$(2y + 1y) + (3x + 2x) + 4$
Use the distributive property with each pair of like terms.	$(2 + 1)y + (3 + 2)x + 4$

Papel picado

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to combine like terms.**

1. Look at **Picture It**. How do the shapes show that an expression for the total number of sheets of tissue paper will have at least three terms?

2. Look at the four equivalent expressions in **Analyze It**.

   a. What are the like terms in the expression $2y + 3x + y + 2x + 4$? Explain.

   b. The commutative property of addition lets you reorder terms. How is this property used to rewrite the expression?

   c. Look at the last expression. Why can you use the distributive property to combine like terms?

3. What expression with exactly three terms can you write to represent the total number of sheets of tissue paper Ryan bought? How are the coefficients of the variable terms related to the coefficients of the variable terms of the original expression?

4. **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to combine like terms of an algebraic expression.

Apply It

➤ **Use what you learned to solve these problems.**

5 Write an expression equivalent to $12g - 3g + 7$ with exactly two terms. Show your work.

SOLUTION

6 Which expressions are equivalent to $6a - a + 4b$? Select all that apply.

A $10b$

B $9ab$

C $6 + 4b$

D $5a + 4b$

E $(6 - 1)a + 4b$

F $(6 \cdot 1)a + 4b$

7 An athletic store receives an order for 8 blue jerseys, 12 pairs of blue shorts, 10 gold jerseys, and 5 pairs of gold shorts. Each jersey weighs j oz, and each pair of shorts weighs s oz. They are packed in a box that weighs 16 oz when empty. Write an expression with exactly three terms for the total weight, in ounces, of the box. Show your work.

Item	Quantity
blue jersey	8
blue shorts	12
gold jersey	10
gold shorts	5

SOLUTION

Practice Combining Like Terms

➤ **Study the Example showing how to combine like terms. Then solve problems 1–6.**

Example

The Woodworking Club is selling picture frames at the school craft fair. The frames sell for $11 each. Materials for each frame cost $6, and renting a booth costs $36. The expression $11f - 6f - 36$ represents the amount of money the club will make for selling f frames. Rewrite the expression with exactly two terms.

You can use the distributive property to combine like terms.

The terms $11f$ and $6f$ are like terms because both have the variable f.

$11f - 6f - 36$

$(11 - 6)f - 36$

$5f - 36$

The terms of $5f - 36$ are not like terms, so they cannot be combined.

The equivalent expression is $5f - 36$.

1 Look at the Example. Suppose the club increases the selling price of a frame to $13. Write an expression with exactly two terms for the amount of money the club will make for selling f frames. Show your work.

SOLUTION _____

2 Which expression is equivalent to $3a + 9a + 7b - b$?

A $12a + 7$

B $12a + 6b$

C $18ab$

D $19a$

Vocabulary

equivalent expressions
two or more expressions in different forms that always name the same value.

like terms
two or more terms that have the same variable factors.

perimeter
the distance around a two-dimensional shape.

3 Neena and Carissa collect trading cards. Neena has 4 packs of castle cards and 5 packs of hero cards. Carissa has 6 packs of castle cards and 4 packs of hero cards. Each castle pack holds c cards, and each hero pack holds h cards. Write an expression with exactly two terms for the total number of cards Neena and Carissa have. Show your work.

SOLUTION

4 Write a whole number in each blank to show an expression that is equivalent to $15x + 10$.

$20x - \_\_\_\_\_ \cdot x + \_\_\_\_\_$

5 Isaiah writes an expression with 5 terms. All 5 terms are like terms. How many terms are in the equivalent expression with the least number of terms? Explain.

6 The length of a rectangle is twice the width w. Which expressions represent the perimeter of the rectangle? Select all that apply.

A $2w + w + 2w + w$

B $2w + 2(2w)$

C $2(w + 2w)$

D $2(2w)$

E $6w$

Develop Identifying Equivalent Expressions

➤ **Read and try to solve the problem below.**

Which of these three expressions are equivalent?

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

TRY IT

Math Toolkit algebra tiles, grid paper

DISCUSS IT

Ask: What is another way you could show which expressions are equivalent?

Share: I could also . . .

➤ **Explore different ways to identify equivalent expressions.**

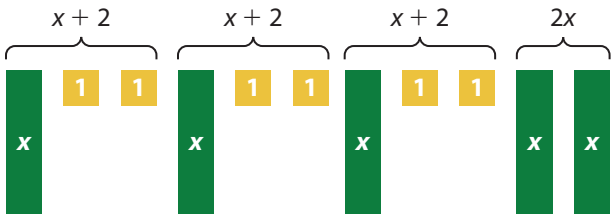
Which of these three expressions are equivalent?

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

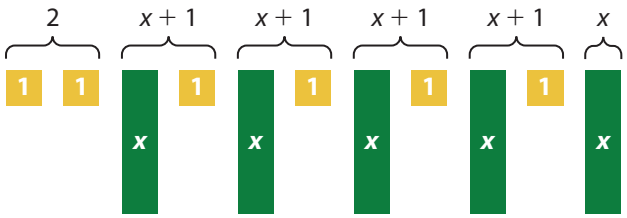
Model It

You can use algebra tiles to model each expression.

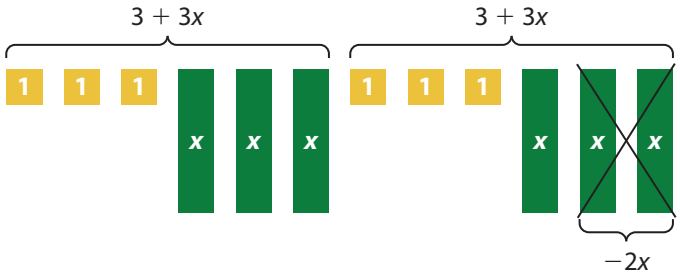
$3(x + 2) + 2x$



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



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



Analyze It

You can use properties of operations to write each expression without parentheses and with the fewest number of terms possible.

$3(x + 2) + 2x$	$2 + 4(x + 1) + x$	$2(3 + 3x) - 2x$
$3 \cdot x + 3 \cdot 2 + 2x$	$2 + 4 \cdot x + 4 \cdot 1 + x$	$2 \cdot 3 + 2 \cdot 3x - 2x$
$3x + 6 + 2x$	$2 + 4x + 4 + x$	$6 + 6x - 2x$
$(3x + 2x) + 6$	$(2 + 4) + (4x + x)$	$6 + (6x - 2x)$
$5x + 6$	$6 + 5x$	$6 + 4x$

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to identify equivalent expressions.**

1. Look at **Model It**. How do you use tiles to model $3(x + 2) + 2x$?

2. How could rearranging the algebra tiles help you determine which expressions are equivalent?

3. Look at the first group of expressions in **Analyze It**. List the properties of operations that are used to rewrite the expression $3(x + 2) + 2x$.

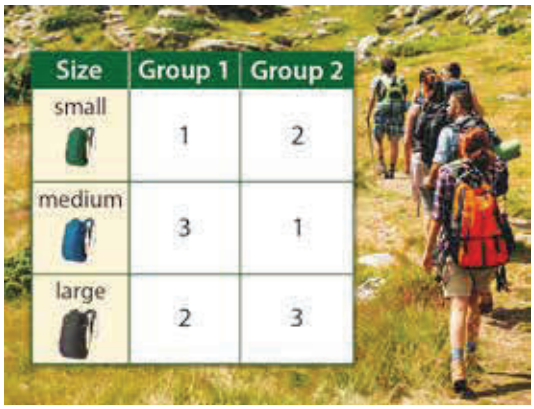
4. Which of the three expressions are equivalent? Explain how you know.

5. How are properties of operations useful for identifying equivalent expressions?

6. **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.



7 Two groups of campers carry their water in reusable packs that come in three sizes. The table shows how many packs each group carries. A medium water pack holds 1 liter more than a small pack holds. A large pack holds 2 liters more than a small pack. Do the two groups carry the same amount of water? If not, which group carries more? Use w to represent the number of liters of water a small pack can hold. Show your work.

SOLUTION

8 Which expressions are equivalent to $8a - 6$? Select all that apply.

A $5a + 6 - 3a$

B $2a + 6(a - 1)$

C $4a + 2(2a - 3)$

D $2 + 3a + 3(a - 2)$

E $11a - a + 2(a - 3)$

9 Are the expressions $3(x + y) + 2y + 10$ and $x + 5y + 2(x + 5)$ equivalent? Show your work.

SOLUTION

Practice Identifying Equivalent Expressions

➤ **Study the Example showing how to determine whether expressions are equivalent. Then solve problems 1–5.**

Example

Are the expressions $4(x + 1) - 1$ and $2(x + 1) + 2x$ equivalent?

You can use properties of operations to rewrite the expressions.

$4(x + 1) - 1$	$2(x + 1) + 2x$
$4 \cdot x + 4 \cdot 1 - 1$	$2 \cdot x + 2 \cdot 1 + 2x$
$4x + 4 - 1$	$2x + 2 + 2x$
$4x + (4 - 1)$	$(2x + 2x) + 2$
$4x + 3$	$4x + 2$

No matter what the value of x is, $4x + 3$ will always be 1 more than $4x + 2$. The expressions $4x + 3$ and $4x + 2$ never name the same value.

The expressions $4(x + 1) - 1$ and $2x + 2(x + 1)$ are not equivalent.

1 Explain how the distributive property and the commutative property of addition are used in the Example to show that $2(x + 1) + 2x$ is equivalent to $4x + 2$.

2 Is each expression equivalent to the expression $48a - 36b$? Select *Yes* or *No* for each expression.

	Yes	No
a. $30(18a - 6b)$	○	○
b. $12a + 36(a - b)$	○	○
c. $12(3a + a - 3b)$	○	○
d. $4(10a + 2a - 9b)$	○	○

Vocabulary

equivalent expressions
two or more expressions in different forms that always name the same value.

term
a number, a variable, or a product of numbers, variables, and/or expressions.

Corn maze

3 An adult ticket to a corn maze costs $4 more than a child ticket. A senior ticket costs $3 more than a child ticket. Amelia's family has 3 children and 2 adults. Manuel's family has 2 children, 1 adult, and 2 seniors. Do the two families pay the same amount for tickets to the maze? If not, who pays more? Use c to represent the cost of a child ticket. Show your work.

SOLUTION

4 You can use the commutative property to reorder the terms of an expression. James says that you can use the commutative property to rewrite $5m + 10$ as $10m + 5$. Is James correct? Explain.

5 Which of these three expressions are equivalent? Show your work.

$7(2 + 3x) - 3x$ $2(6x + 7) + 10x$ $4(3 + 3x) + 2(1 + 3x)$

SOLUTION

Refine Writing and Identifying Equivalent Expressions

➤ **Complete the Example below. Then solve problems 1–10.**

Example

Are the expressions $(3x)(x) + 6$ and $x + x + 6 + x$ equivalent?

Look at how you could rewrite the expressions to compare them.

$(3x)(x) + 6$	$x + x + 6 + x$
$3(x \cdot x) + 6$	$(x + x + x) + 6$
$3x^2 + 6$	$3x + 6$

SOLUTION _____

CONSIDER THIS . . .
Are the terms $3x^2$ and $3x$ like terms? Why or why not?

PAIR/SHARE
Explain how you know whether the expressions are equivalent.

Apply It

1 The fine for an overdue library book is \$0.75 for the first day and \$0.50 for each additional day. Rewrite the expression $0.75 + 0.5(d - 1)$ for the fine as a sum of two terms where d represents the number of days overdue. Show your work.

CONSIDER THIS . . .
How could you use the distributive property to rewrite the expression?

PAIR/SHARE
What would the fine be for a book that is 4 days overdue?

SOLUTION _____

2 Ana and Katrina are buying fruit to bring to their book club meeting. Ana buys 2.4 lb of oranges and 0.8 lb of cherries. Katrina buys 1.8 lb of oranges and 1.3 lb of cherries. Oranges cost r dollars per pound, and cherries cost c dollars per pound. Write an expression with exactly two terms for the total cost of the fruit Ana and Katrina buy. Show your work.

CONSIDER THIS . . .
The cost of Ana's oranges is equal to the weight of her oranges times the cost per pound.

PAIR/SHARE
What does each term in your expression represent?

SOLUTION

3 Which expression is equivalent to $3(2x + 4y) - y$?

A $17xy$

B $6x + 12$

C $3(6xy) - y$

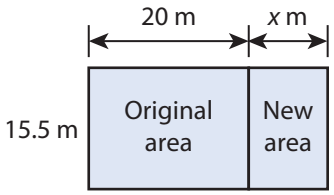
D $6(x + 2y) - y$

Kimani chose C as the correct answer. How might she have gotten that answer?

CONSIDER THIS . . .
How can you use properties of operations to rewrite $3(2x + 4y) - y$ in a different way?

PAIR/SHARE
How could you use $x = 1$ and $y = 2$ to check your answer?

4 A park meadow is planted with wildflowers. The Parks Department plans to extend the length of the rectangular meadow by x meters. Which expressions represent the total area, in square meters, after the meadow's length is increased? Select all that apply.



A $310 + x$

B $15.5(20x)$

C $20x + 15.5$

D $15.5x + 310$

E $15.5(20 + x)$

F $35.5 + x$

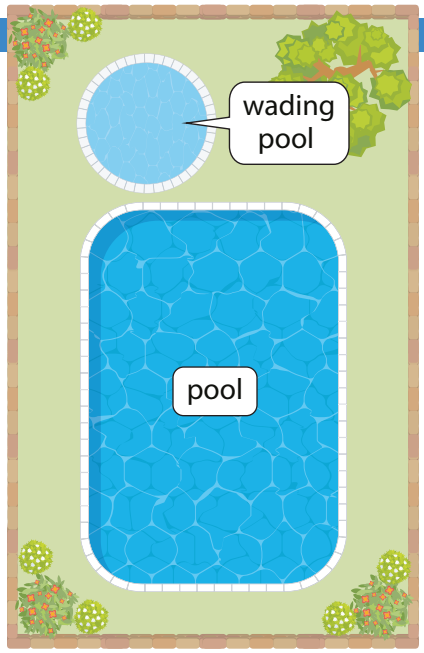
5 Use the distributive property to write two different expressions equal to 72. Each expression should be the product of a number and a sum. Show your work.

SOLUTION

6 Look at each pair of expressions. Select *Equivalent* or *Not Equivalent* for each pair.

	Equivalent	Not Equivalent
a. $f + f + f$ and $3f$	○	○
b. $x^2 + 3y$ and $(x + x) + y \cdot y \cdot y$	○	○
c. $2.5(2n - 4)$ and $5n - 4$	○	○

7 Show how to use the greatest common factor of 84 and 72 to rewrite $84m - 72n$ as a product of two factors. Label the step that shows the distributive property.



8 A wading pool holds g gallons of water. A swimming pool holds 15 times as much water as the wading pool. Which expressions represent the total number of gallons of water in both pools? Select all that apply.

A $15g$

B $16g$

C $15 + g$

D $2g + 15$

E $g + 15g$

9 Are the expressions $\frac{1}{2}(4c + 8) + 3c - 2$ and $4c + 2(0.5c + 1)$ equivalent? Show your work.

SOLUTION

10 **Math Journal** Brian says that the expressions $2(x + 2)$ and $3(x + 1) + 1$ are equivalent because they name the same value when $x = 0$. Is Brian's reasoning correct? Explain.

End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Find the entry for *like terms*. Explain why the terms $5a$ and $5b$ in the expression $5a + 5b + 8$ are not like terms. Label your explanation as a non-example.
- ☐ **SELF CHECK** Go back to the Unit 5 Opener and see what you can check off.