UNIT 4

One-Step Equations and Inequalities

Essential Question

HOW can you communicate mathematical ideas effectively?

Chapter 6

Equations

Variables are used to represent an unknown number in an expression or equation. In this chapter, you will write and solve one-variable addition, subtraction, multiplication, and division equations.

Chapter 7

Functions and Inequalities

Functions can be represented using words, equations, tables, and graphs. In this chapter, you will represent and analyze the relationship between two variables using functions. You will also write, graph, and solve one-variable inequalities.

Chapter 6
Equations

Essential Question

HOW do you determine if two numbers or expressions are equal?

Common Core GPS

Content Standards
MCC6.EE.5, MCC6.EE.7, MCC6.RP.3

Mathematical Practices
1, 2, 3, 4, 5, 7

Math in the Real World

Zip lines can be used for entertainment or to access remote areas such as a rainforest canopy.

The speed differs based on the angle of the cable. On one zip line, the average speed is 44 ft/s. It takes 8 seconds to travel the length of the zip line. Fill in the table to find the distance.

Rate (ft/s)	×	Time (s)	=	Distance (ft)
44	×	1	=	
44	×	2	=	
44	×	3	=	
44	×	4	=	
44	×	5	=	
44	×	6	=	
44	×	7	=	
44	×	8	=	

FOLDABLES® Study Organizer

1. Cut out the correct Foldable from the FL pages in the back of this book.
2. Place your Foldable on the Key Concept page toward the end of this chapter.
3. Use the Foldable throughout this chapter to help you learn about equations.

What Tools Do You Need?

Vocabulary

Addition Property of Equality	inverse operations
Division Property of Equality	Multiplication Property of Equality
equals sign	solution
equation	solve
expressions	Subtraction Property of Equality

Study Skill: Studying Math

Simplify the Problem Read the problem carefully to determine what information is needed to solve the problem.

Step 1 **Read the problem.**

Kylie wants to order several pairs of running shorts from an online store. They cost $14 each, and there is a one-time shipping fee of $7. What is the total cost of buying any number of pairs of shorts?

Step 2 **Rewrite the problem to make it simpler. Keep all of the important information but use fewer words.**

Kylie wants to buy some _____ that cost _____ each plus a shipping fee of _____. What is the total cost for any number of pairs of shorts.

Step 3 **Rewrite the problem using even fewer words. Write a variable for the unknown.**

The total cost of x shorts is _____ + _____.

Step 4 **Translate the words into an expression.**

_____

Use the method above to write an expression for each problem.

1. Akira is saving money to buy a bicycle. He has already saved $80 and plans to save an additional $5 each week. Find the total amount he has saved after any number of weeks.

_____

2. A taxi company charges $1.50 per mile plus a $10 fee. What is the total cost of a taxi ride for any number of miles?

_____

When Will You Use This?

Watch Play it online!

Your Turn! You will solve this problem in the chapter.

Are You Ready?

Try the Quick Check below.
Or, take the Online Readiness Quiz.

Quick Review

Common Core Review MCC5.NBT.7, MCC5.NF.1

Example 1

Find 1.37 − 0.75.

$$\begin{array}{r} {\scriptstyle 1} \\ \cancel{1}.37 \\ -\ 0.75 \\ \hline 0.62 \end{array}$$

Line up the decimal points.

Subtract.

Example 2

Find $\frac{3}{4} - \frac{5}{9}$.

The LCD of $\frac{3}{4}$ and $\frac{5}{9}$ is 36.

Write the problem. Rename using the LCD, 36. Subtract the numerators.

$$\begin{array}{r} \frac{3}{4} \\ -\ \frac{5}{9} \\ \hline \end{array} \rightarrow \begin{array}{r} \frac{3 \times 9}{4 \times 9} \\ \frac{5 \times 4}{9 \times 4} \\ \hline \end{array} = \begin{array}{r} \frac{27}{36} \\ -\ \frac{20}{36} \\ \hline \end{array} \rightarrow \begin{array}{r} \frac{27}{36} \\ -\ \frac{20}{36} \\ \hline \frac{7}{36} \end{array}$$

Quick Check

Subtract Decimals **Find each difference.**

1. 2.34 − 1.23 = _____

2. 1.26 − 0.78 = _____

3. 3.65 − 0.96 = _____

Show your work.

Subtract Fractions **Find each difference. Write in simplest form.**

4. $\frac{7}{8} - \frac{1}{4}$ = _____

5. $\frac{5}{6} - \frac{1}{2}$ = _____

6. $\frac{3}{5} - \frac{2}{7}$ = _____

7. Pamela ran $\frac{7}{10}$ mile on Tuesday and $\frac{3}{8}$ mile on Thursday. How much farther did she run on Tuesday?

_____

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

(1) (2) (3) (4) (5) (6) (7)

Equations

What You'll Learn

Scan the lesson. Predict two things you will learn about equations.

- _____
- _____

Essential Question

HOW do you determine if two numbers or expressions are equal?

Vocabulary

equation
equals sign
solve
solution

Common Core GPS

Content Standards
MCC6.EE.5

Mathematical Practices
1, 2, 3, 4, 7

Vocabulary Start-Up

An **equation** is a mathematical sentence showing two expressions are equal. An equation contains an **equals sign**, =.

Equation	Expression
Definition	Definition
Example	Example

How are an equation and an expression similar?

How are an equation and an expression different?

Real-World Link

Shopping Anna bought a package of 6 pair of socks. She writes the equation below to find how much she paid per pair. Circle the *solution* of the equation.

$$6x = \$9$$

$0.50 $1.50 $2.00

Work Zone

Solve Addition and Subtraction Equations Mentally

When you replace a variable with a value that results in a true sentence, you **solve** the equation. That value for the variable is the **solution** of the equation.

$2 + x = 9$
$2 + 7 = 9$
$9 = 9$

The value for the variable that results in a true sentence is 7. So, 7 is the solution.

This sentence is true.

Examples

Tutor

1. **Is 3, 4, or 5 the solution of the equation $a + 7 = 11$?**

Value of a	$a + 7 \stackrel{?}{=} 11$	Are Both Sides Equal?
3	$3 + 7 \stackrel{?}{=} 11$ $10 \neq 11$	no
4	$4 + 7 \stackrel{?}{=} 11$ $11 = 11$	yes ✓
5	$5 + 7 \stackrel{?}{=} 11$ $12 \neq 11$	no

The solution is 4.

2. **Solve $g - 7 = 3$ mentally.**

$g - 7 = 3$ Think What number minus 7 equals 3?
$10 - 7 = 3$ You know that $10 - 7 = 3$.
$3 = 3$

The solution is 10.

3. **The total cost of a pair of skates and kneepads is $63. The skates cost $45. Use the *guess, check, and revise* strategy to solve the equation $45 + k = 63$ to find k, the cost of the kneepads.**

Use the *guess, check, and revise* strategy.

Try 14.
$45 + k = 63$
$45 + 14 \stackrel{?}{=} 63$
$59 \neq 63$

Try 16.
$45 + k = 63$
$45 + 16 \stackrel{?}{=} 63$
$61 \neq 63$

Try 18.
$45 + k = 63$
$45 + 18 \stackrel{?}{=} 63$
$63 = 63$ ✓

So, the kneepads cost $18.

STOP and Reflect

How can you check if your solution to an equation is correct?

Got It? Do these problems to find out.

a. Is 4, 5, or 6 the solution of the equation $c + 8 = 13$?

b. Solve $9 - x = 2$ mentally.

c. The difference between an ostrich's speed and a chicken's speed is 31 miles per hour. An ostrich can run at a speed of 40 miles per hour. Use mental math or the *guess, check, and revise* strategy to solve the equation $40 - c = 31$ to find c, the speed a chicken can run.

a. _____

b. _____

c. _____

Solve Multiplication and Division Equations Mentally

Multiplication and division equations are solved in a similar way to addition and subtraction equations.

Examples

Tutor

4. **Is 3, 4, or 5 the solution of the equation $18 = 6z$?**

Value of z	$18 \stackrel{?}{=} 6z$	Are Both Sides Equal?
3	$18 \stackrel{?}{=} 6 \cdot 3$ $18 = 18$	yes ✓
4	$18 \stackrel{?}{=} 6 \cdot 4$ $18 \neq 24$	no
5	$18 \stackrel{?}{=} 6 \cdot 5$ $18 \neq 30$	no

The solution is 3.

5. **Solve $16 \div s = 8$ mentally.**

$16 \div s = 8$ Think 16 divided by what number equals 8?

$16 \div 2 = 8$ You know that $16 \div 2 = 8$.

$8 = 8$

The solution is 2.

Got It? Do these problems to find out.

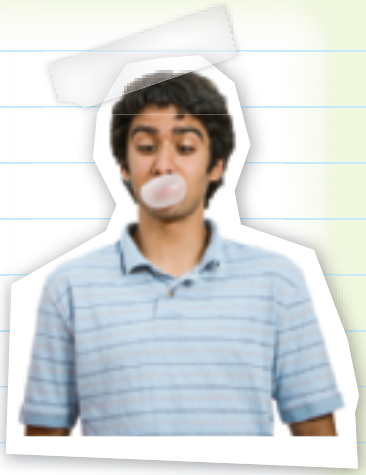
d. Is 2, 3, or 4 the solution of the equation $4n = 16$?

e. Solve $24 \div w = 8$ mentally.

Show your work.

d. _____

e. _____



Example

Tutor

6. **Mason bought 72 sticks of gum. There are 8 sticks of gum in each package. Use the *guess, check, and revise* strategy to solve the equation $8 \cdot p = 72$ to find p, the number of packages Mason bought.**

Use the *guess, check, and revise* strategy.

Try 7.	Try 8.	Try 9.
$8 \cdot p = 72$	$8 \cdot p = 72$	$8 \cdot p = 72$
$8 \cdot 7 \stackrel{?}{=} 72$	$8 \cdot 8 \stackrel{?}{=} 72$	$8 \cdot 9 \stackrel{?}{=} 72$
$56 \neq 72$	$64 \neq 72$	$72 = 72$ ✓

So, Mason bought 9 packages of gum.

Guided Practice

Check

Identify the solution of each equation from the list given. (Examples 1 and 4)

1. $9 + w = 17$; 7, 8, 9 _____

2. $8 \div c = 8$; 0, 1, 2 _____

Show your work.

Solve each equation mentally. (Examples 2 and 5)

3. $x - 11 = 23$

4. $4x = 32$

5. Mississippi and Georgia have a total of 21 electoral votes. Mississippi has 6 electoral votes. Use mental math or the *guess, check, and revise* strategy to solve the equation $6 + g = 21$ to find g, the number of electoral votes Georgia has. (Example 3)

6. Riley and her sister collect stickers. Riley has 220 stickers in her sticker collection. Her sister has 55 stickers in her collection. Riley has how many times as many stickers as her sister? Use mental math or the *guess, check, and revise* strategy to solve the equation $55x = 220$. (Example 6)

7. **Building on the Essential Question** How do you solve an equation? _____

Rate Yourself!

☐ I understand how to solve equations.

Great! You're ready to move on!

☐ I still have some questions about solve equations.

No Problem! Go online to access a Personal Tutor. Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Identify the solution of each equation from the list given. (Examples 1 and 4)

1. $29 + d = 54$; 24, 25, 26 _____

Show your work.

2. $35 = 45 - n$; 10, 11, 12 _____

3. $6w = 30$; 5, 6, 7 _____

4. $x \div 7 = 3$; 20, 21, 22 _____

Solve each equation mentally. (Examples 2 and 5)

5. $m + 4 = 17$

6. $12 = 24 - y$

7. $15 - b = 12$

8. $10t = 90$

9. $22 \div y = 2$

10. $54 = 6b$

CCSPS **Identify Structure** **For Exercises 11–13, solve using mental math or the *guess, check, and revise* strategy.** (Examples 3 and 6)

11. One season, the Cougars won 20 games. They played a total of 25 games. Use the equation $20 + g = 25$ to find g, the number of games the team lost.

12. Five friends earn a total of $50 doing yard work in their neighborhood. Each friend earns the same amount. Use the equation $5f = 50$ to find f, the amount that each friend earns. _____

13. Last year, 700 students attended Walnut Springs Middle School. This year, there are 665 students. Use the equation $700 - d = 665$ to find d, the decrease in the number of students from last year to this year.

H.O.T. Problems Higher Order Thinking

14. **Reason Inductively** What 3 consecutive even numbers added together equal 42? Use the equation $n + (n + 2) + (n + 4) = 42$ to help you solve.

15. **Reason Abstractly** Give an example of an equation that has a solution of 5.

16. **Reason Inductively** Tell whether the statement below is *always, sometimes,* or *never* true.

Equations like $a + 4 = 8$ and $4 - m = 2$ have exactly one solution.

Persevere with Problems **Tell whether each statement is *true* or *false*. Then explain your reasoning.**

17. In $m + 8$, the variable m can have any value.

18. In $m + 8 = 12$, the variable m can have any value and be a solution.

Georgia Test Practice

19. Which of the following statements is true for the equation $6x = 78$?

Ⓐ To find the value of x, subtract 6 from 78.

Ⓑ To find the value of x, multiply 6 by 78.

Ⓒ To find the value of x, add 6 and 78.

Ⓓ To find the value of x, divide 78 by 6.

Name _____ My Homework _____

Extra Practice

Identify the solution of each equation from the list given.

20. $a + 15 = 23$; 6, 7, 8 8

Try 6. $6 + 15 \neq 23$

Try 7. $7 + 15 \neq 23$

Try 8. $8 + 15 = 23$ ✓

Homework Help

21. $19 = p - 12$; 29, 30, 31 _____

22. $63 = 9k$; 6, 7, 8 _____

23. $36 \div s = 4$; 9, 10, 11 _____

Solve each equation mentally.

24. $j + 7 = 13$

25. $22 = 30 - m$

26. $25 - k = 20$

27. $5m = 25$

28. $d \div 3 = 6$

29. $24 = 12k$

Identify Structure **For Exercises 30–32, solve using mental math or the *guess, check, and revise* strategy.**

30. Gabriella made 36 cookies. She gave away 28 cookies. Use the equation $28 + c = 36$ to find c, the number of cookies she kept.

_____

31. The Lee family ate a total of 12 hotdogs at a cookout. Each family member ate 2 hotdogs. Use the equation $2m = 12$ to find m, the number of members in the Lee family. _____

32. A bottlenose dolphin is 96 inches long. There are 12 inches in 1 foot. Use the equation $12d = 96$ to find d, the length of the bottlenose dolphin in feet.

_____

Georgia Test Practice

33. Felipe biked 21 miles in 3 hours. He can find his average number of miles per hour b by solving the equation $3b = 21$. What is the value of b?

Ⓐ 63 Ⓒ 7

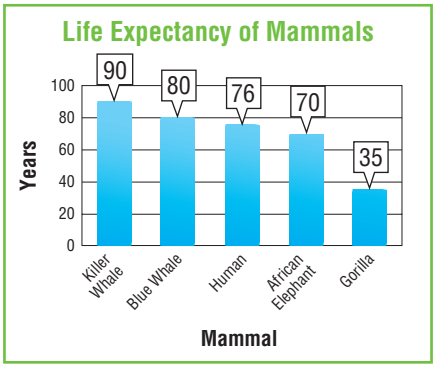
Ⓑ 14 Ⓓ 3

34. Short Response The perimeter of the square shown is 56 units.

The equation $4x = 56$ can be used to find the length of each side. Solve the equation.

_____

35. The graph shows the life expectancy of certain mammals. The difference d between the number of years a blue whale lives and the number of years a gorilla lives is 45. Which equation has a solution of 45?



Ⓕ $d + 35 = 80$ Ⓗ $80 + 35 = d$

Ⓖ $d - 35 = 80$ Ⓘ $d - 80 = 35$

Common Core Review

Add. MCC4.NBT.4

36. $56 + 89 =$ _____

37. $37 + 26 =$ _____

38. $95 + 48 =$ _____

39. $29 + 86 =$ _____

40. $64 + 48 =$ _____

41. $31 + 62 =$ _____

42. The table shows the number of raffle tickets the art club sold during the beginning of the week. On Friday, the art club sold what they sold on Monday and Wednesday together. How many tickets did they sell on Friday? MCC4.NBT.4 _____

Day	Tickets Sold
Monday	42
Tuesday	67
Wednesday	54

43. On a shopping trip, Eliza bought a pack of gum for $1.19, a notebook for $3.55, and a pen for $2.95. How much did Eliza spend on her shopping trip? MCC5.NBT.7 _____

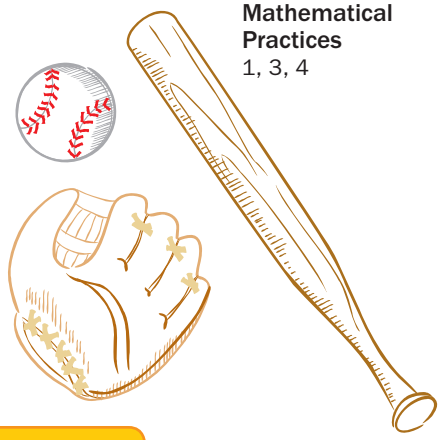
Inquiry Lab

Solve and Write Addition Equations

Inquiry **HOW do you solve addition equations using models?**

Content Standards MCC6.EE.5, MCC6.EE.7

Mathematical Practices 1, 3, 4



Baseball Bryan played two baseball games last weekend. He got 5 hits in all. He had 1 hit in the first game. How many hits did he get in the second game?

What do you know? _____

_____

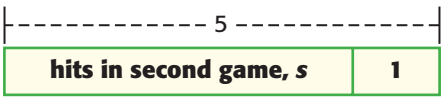
What do you need to find? _____

_____

Investigation 1

Step 1 Define a variable. Use the variable s to represent the number of hits Bryan had in the second game.

Step 2 Use a bar diagram to help write the equation.



The total length of the diagram shows _____.

The 1 represents _____.

☐ + ☐ = ☐

Step 3 Work backward. Rewrite the equation as a subtraction sentence and solve.

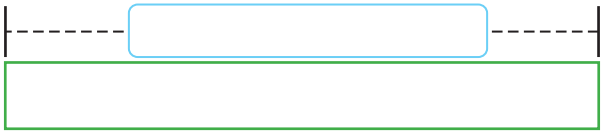
☐ − ☐ = ☐

So, Bryan had ☐ hits in the second game.

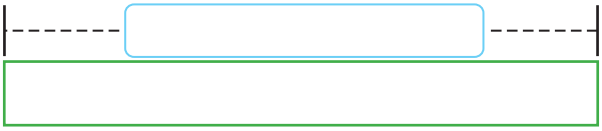
Collaborate

Work with a partner. Write and solve an addition equation using a bar diagram.

1. In the 2008 Summer Olympics, the United States won 11 more medals in swimming than Australia. The United States won a total of 31 medals. Find the number of medals won by Australia.



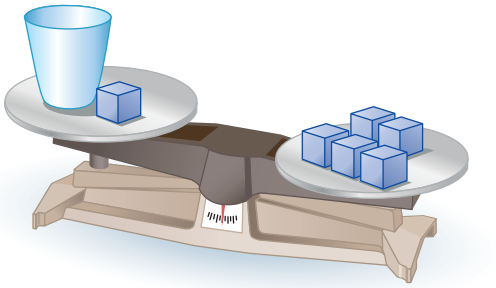
2. A lion can run 50 miles per hour. This is 20 miles per hour faster than a house cat. Find the speed of a house cat.



Investigation 2

Watch Tools

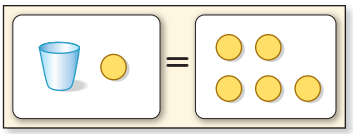
An equation is like a balance. The quantity on the left side of the equals sign is balanced with the quantity on the right.



To solve an addition equation using cups and counters, subtract the same number of counters from each side of the mat so that the equation remains balanced.

Solve $x + 1 = 5$ using cups and counters.

Step 1 Model the equation. Use a cup to represent x.



Step 2 Use the model above. Cross out 1 counter from each side so that the cup is by itself.

Step 3 There are ☐ counters remaining on the right side, so $x =$ ☐.

So, the solution is ☐.

Check $x + 1 = 5$ Write the original equation.

☐ $+ 1 \stackrel{?}{=} 5$ Replace x with your solution.

☐ $= 5$ Is the sentence true? _____

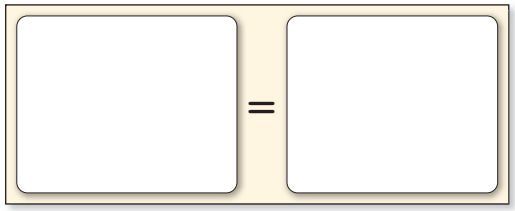
Collaborate

Work with a partner. Solve each equation using cups and counters. Draw cups and counters to show your work.

3. $1 + x = 8$

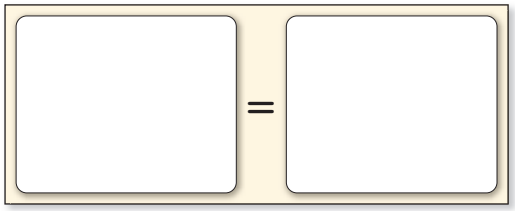
$x =$ _____

Show your work.



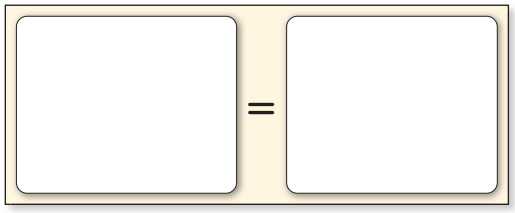
4. $x + 2 = 7$

$x =$ _____



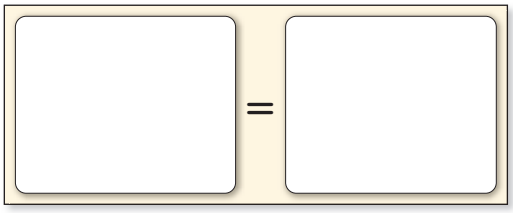
5. $3 + x = 6$

$x =$ _____



6. $x + 5 = 7$

$x =$ _____



Work with a partner. Solve each addition equation using the model of your choice.

7. $9 = x + 3$

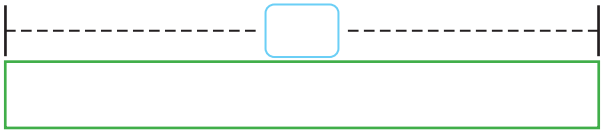
$x =$ _____

8. $4 + x = 6$

$x =$ _____

9. Terrell bought an MP3 player. He spent the rest of his money on an Internet music subscription for $25.95. If he started with $135, how much was the MP3 player? Write and solve an equation using a bar diagram.

_____



Analyze

Work with a partner to complete the table. The first one is done for you.

	Addition Equation	Subtraction Sentence	Solution
	$x + 1 = 3$	$3 - 1 = x$	$x = 2$
10.	$y + 9 = 12$		
11.	$14 = 7 + m$		
12.	$8 + f = 20$		
13.	$47 = 17 + v$		
14.	$100 + c = 129$		
15.	$h + 89.4 = 97.4$		

16. CCSPS **Reason Inductively** Write a rule that you can use to solve an addition equation without using models. _____

_____

_____

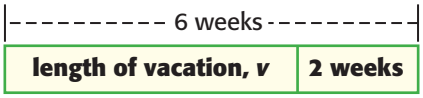
17. How can the number family 3, 4, 7 help you to solve the equation $3 + x = 7$? _____

_____

_____

Reflect

18. CCSPS **Model with Mathematics** Write a real-world problem for the equation modeled below. Then write the equation and solve.



_____

_____

19. Inquiry HOW do you solve addition equations using models?

_____

_____

_____

Lesson 2

Solve and Write Addition Equations

What You'll Learn

Scan the lesson. List two real-world scenarios in which you would use addition equations.

- _____
- _____

Essential Question

HOW do you determine if two numbers or expressions are equal?

Vocabulary

inverse operations
Subtraction Property of Equality

Common Core GPS

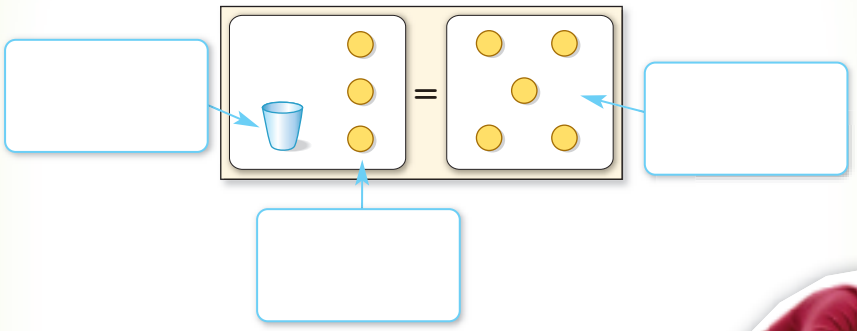
Content Standards
MCC6.EE.5, MCC6.EE.7

Mathematical Practices
1, 2, 3, 4, 5

Real-World Link

Tools

Miniature Golf On the second hole of miniature golf, it took Anne 3 putts to sink the golf ball. Her score is now 5. She represents this situation with cups and counters.



1. Fill in the boxes above using the phrases below:
   - Her score on the first hole is unknown.
   - Her score in now 5.
   - She scored a 3 on the second hole.

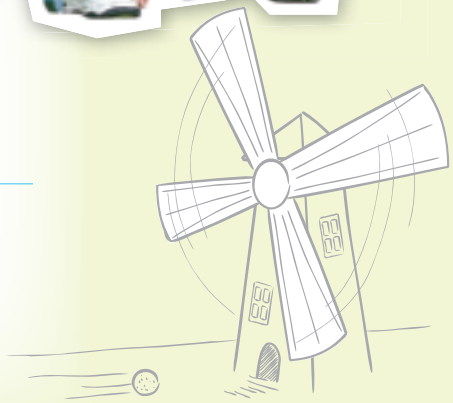
2. Write the addition equation shown in the figure.

   _____

3. Explain how to solve the equation.

   _____

4. What was Anne's score on the first hole? ☐



Work Zone

Solve an Equation By Subtracting

In Lesson 1, you mentally solved equations. Another way is to use **inverse operations**, which *undo* each other. For example, to solve an addition equation, use subtraction.

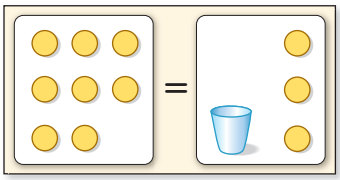
Example

Tutor

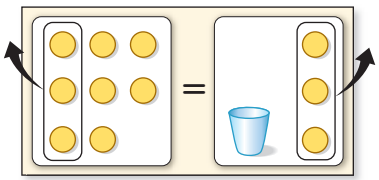
1. **Solve $8 = x + 3$. Check your solution.**

Method 1 **Use models.**

Model the equation using counters for the numbers and a cup for the variable.



Remove 3 counters from each side.



There are 5 counters remaining.

Method 2 **Use symbols.**

$8 = x + 3$ Write the equation.

$-3 = \quad -3$ Subtract 3 from each side to "undo" the addition of 3 on the right.

$5 = x$

Check

$8 = x + 3$ Write the equation.

$8 \stackrel{?}{=} 5 + 3$ Replace x with 5.

$8 = 8$ ✓ This sentence is true.

Using either method, the solution is 5.

Got It? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $c + 2 = 5$ **b.** $6 = x + 5$ **c.** $3.5 + y = 12.75$

Show your work.

a. _____

b. _____

c. _____

Subtraction Property of Equality

Key Concept

Words If you subtract the same number from each side of an equation, the two sides remain equal.

Examples

Numbers	Algebra
$5 = 5$	$x + 2 = 3$
$-3 = -3$	$-2 = -2$
$2 = 2$	$x = 1$

When you solve an equation by subtracting the same number from each side of the equation, you are using the **Subtraction Property of Equality**.

Example

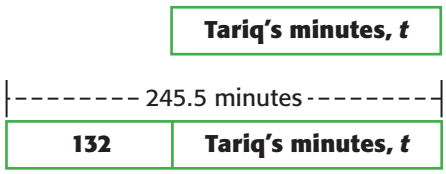
Tutor

2. **Ruben and Tariq have 245.5 downloaded minutes of music. If Ruben has 132 minutes, how many belong to Tariq? Write and solve an addition equation to find how many minutes belong to Tariq.**

Words Ruben and Tariq have 245.5 minutes of music.

Variable Let t represent the number of minutes that belong to Tariq.

Bar Diagram



Equation $132 + t = 245.5$

$132 + t = 245.5$ Write the equation.

$-132 \quad = -132$ Subtract 132 from each side.

$t = 113.5$ Simplify.

So, 113.5 minutes belong to Tariq.

Check $132 + 113.5 = 245.5$ ✓

Got It? **Do this problem to find out.**

d. Suppose Ruben had 147.5 minutes of the 245.5 that were downloaded. Write and solve an addition equation to find how many minutes belong to Tariq.

Checking Solutions

You should always check your solution. You will know immediately whether your solution is correct or not.

Show your work.

d. _____

Example

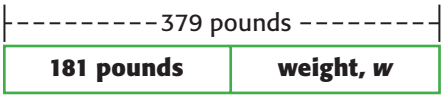
Watch Tutor

3. **A male gorilla weighs 379 pounds on average. This is 181 pounds more than the weight of the average female gorilla. Write and solve an addition equation to find the weight of an average female gorilla.**

Words 181 pounds plus the weight of an average female gorilla is 379 pounds.

Variable Let w represent the weight of an average female gorilla.

Bar Diagram



Equation $181 + w = 379$

$181 + w = 379$ Write the equation.

$-181 \quad = -181$ Subtract 181 from each side.

$w = 198$ $379 - 181 = 198$

So, an average female gorilla weighs 198 pounds.

Check $181 + 198 = 379$ ✓

Guided Practice

Check

Solve each equation. Check your solution. (Example 1)

1. $y + 7 = 10$

2. $10 = 6 + e$

3. A board that measures 19.5 meters in length is cut into two pieces. One piece measures 7.2 meters. Write and solve an equation to find the length of the other piece. (Example 2)

4. It takes 43 facial muscles to frown. This is 26 more muscles than it takes to smile. Write and solve an equation to find the number of muscles it takes to smile. (Example 3)

5. **Building on the Essential Question** How can the Subtraction Property of Equality be used to solve addition equations?

Rate Yourself!

How confident are you about writing and solving addition equations? Check the box that applies.

For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Solve each equation. Check your solution. (Example 1)

1. $c + 3 = 6$

2. $9 = 2 + x$

3. $7 + a = 9$

Show your work.

4. Zacarias and Paz together have $756.80. If Zacarias has $489.50, how much does Paz have? Write and solve an addition equation to find how much money belongs to Paz. (Example 2) _____

5. The average length of a King Cobra is 118 inches, which is 22 inches longer than a Black Mamba. Write and solve an addition equation to find the average length of a Black Mamba. (Example 3) _____

6. CCSPS **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.

Watch Replay it online!

a. If Mei has already earned 30 points, write and solve an addition equation to find the number of points she still needs.

b. Suppose Julie has already earned 36 points. Write and solve an addition equation to find the number of points she still needs to earn the pizza party. _____

Solve each equation. Check your solution.

7. $a + \frac{1}{10} = \frac{5}{10}$

8. $m + \frac{1}{3} = \frac{2}{3}$

9 $\frac{3}{4} = x + \frac{1}{2}$

H.O.T. Problems Higher Order Thinking

10. **Reason Abstractly** Write two different addition equations that have 12 as the solution.

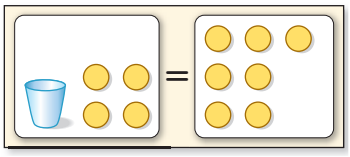
11. **Persevere with Problems** In the equation $x + y = 5$, the value for x is a whole number greater than 2 but less than 6. Determine the possible solutions for y.

12. **Which One Doesn't Belong?** Identify the equation that does not belong with the other three. Explain your reasoning.

$6 + x = 9$	$15 = x + 12$	$x + 9 = 11$	$7 + x = 10$

Georgia Test Practice

13. The model represents the equation $x + 4 = 7$.



What is the first step in finding the value of x?

Ⓐ Add 4 counters to each side.

Ⓑ Subtract 7 counters from each side.

Ⓒ Add 7 counters to each side.

Ⓓ Subtract 4 counters from each side.

Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

14. $x + 5 = 11$

Homework Help

$x + 5 = 11$
$-5 = -5$
$x = 6$

15. $7 = 4 + y$

16. $5 + g = 6$

17. $d + 3 = 8$

18. $x + 4 = 6$

19. $3 + f = 8$

20. Enrique and Levi together have 386 trading cards. If Enrique has 221 trading cards, how many does Levi have? Write and solve an addition equation to find how many trading cards are Levi's.

_____

_____

21. Eliott is 63 inches tall, which is 9 inches taller than his cousin, Jackson. Write and solve an addition equation to find Jackson's height.

_____

_____

22. CCSPS **Use Math Tools** The table shows the heights of three monster trucks. Bigfoot 5 is 4.9 feet taller than Bigfoot 2. Write and solve an addition equation to find the height of Bigfoot 2. _____

_____

_____

Truck	Height (ft)
Bigfoot 5	15.4
Swamp Thing	12.2
Bigfoot 2	■

Solve each equation. Check your solution.

23. $t + \frac{8}{10} = \frac{9}{10}$

24. $\frac{5}{8} + n = \frac{7}{8}$

25. $t + \frac{1}{4} = \frac{3}{4}$

Georgia Test Practice

26. Niko wants to buy a skateboard that costs $85. He has already saved $15. Which equation represents the amount of money Niko still needs to buy the skateboard?

Ⓐ $t - 15 = 85$ Ⓒ $15 - t = 85$

Ⓑ $t + 15 = 85$ Ⓓ $t = 15 + 85$

27. Refer to Exercise 26. How much money does Niko still need to save?

Ⓕ $100 Ⓗ $65

Ⓖ $70 Ⓘ $60

28. **Short Response** The table shows the point values from a bag toss game.

Scoring Toss	Points
went through hole	3
landed on board	1

Before Wes's last toss, he had a score of 15 points. After tossing the bag five more times, he had a score of 24 points. Write and solve an equation to show how many points Wes scored on the five tosses.

_____

Common Core Review

Subtract. MCC4.NBT.4

29. $22 - 8 =$ _____

30. $72 - 34 =$ _____

31. $34 - 19 =$ _____

32. $51 - 32 =$ _____

33. $66 - 14 =$ _____

34. $49 - 32 =$ _____

35. Tyrone ate $\frac{1}{2}$ of a pizza. Jackie ate $\frac{1}{6}$ of a pizza. How much more pizza did Tyrone eat than Jackie? MCC5.NF.1 _____

_____

36. The table shows the distances three friends hiked. How much farther did Isabella hike than Devon? MCC5.NBT.7 _____

_____

Name	Distance Hiked (mi)
Devon	1.85
Franco	2.55
Isabella	2.25

Inquiry Lab

Solve and Write Subtraction Equations

Inquiry HOW do you solve subtraction equations using models?

Content Standards MCC6.EE.5, MCC6.EE.7

Mathematical Practices 1, 3, 4

Trading Cards Zack gave 5 trading cards to his sister. Now he has 41 cards. How many cards did he have originally?

What do you know? _____

_____

What do you need to find? _____

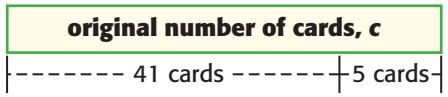
_____

Investigation

Watch

Step 1 Define a variable. Use the variable c to represent the number of cards Zack had originally.

Step 2 Use a bar diagram to help write the equation.



The total length of the diagram shows _____.

The number 41 represents _____.

The number 5 represents _____.

☐ − ☐ = ☐

Step 3 Work backward. Rewrite the equation as an addition sentence and solve.

☐ + ☐ = ☐

So, Zack originally had ☐ trading cards.

Collaborate

Work with a partner. Write and solve a subtraction equation using a bar diagram.

1. Mariska gave her friend Elise 8 beads and was left with 37 beads. How many did she have originally?

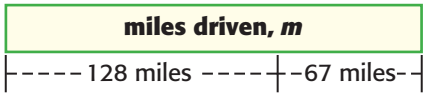
2. Clinton has $12 after buying a snack at the mall. The snack cost $5. How much money did Clinton have originally?

3. The Martin County Cat Shelter placed 8 cats with new owners on Monday. On Tuesday, 31 cats remained at the shelter. How many cats were at the shelter originally?

Reflect

4. **Reason Inductively** Write a rule for solving equations like $x - 4 = 7$.

5. **Model with Mathematics** Write a real-world subtraction problem for the equation modeled below. Then write the equation and solve.



6. HOW do you solve subtraction equations using models?

Lesson 3

Solve and Write Subtraction Equations

What You'll Learn

Scan the lesson. Predict two things you will learn about solving and writing subtraction equations.

- _____
- _____

Essential Question

HOW do you determine if two numbers or expressions are equal?

Vocabulary

Addition Property of Equality

Common Core GPS

Content Standards
MCC6.EE.5, MCC6.EE.7

Mathematical Practices
1, 3, 4, 5

Real-World Link

Watch

Bowling Meghan's bowling score was 39 points less than Charmaine's. Meghan's score was 109.

1. Let s represent Charmaine's score. Write an equation for *39 points less than Charmaine's score is equal to 109.*

_____

_____

2. Use the number line to find Charmaine's score by counting forward.

$s =$ ☐

3. What operation does counting forward suggest?

_____

_____

Work Zone

Solve an Equation by Adding

Because addition and subtraction are inverse operations, you can solve a subtraction equation by adding.

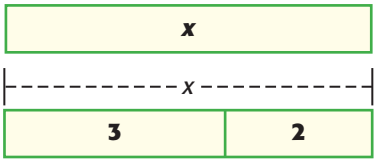
Example

Tutor

1. **Solve $x - 2 = 3$. Check your solution.**

Method 1 **Use models.**

Model the equation.



Work backward to solve the equation.

Rewrite the equation as an addition sentence and solve.

$3 + 2 = 5$

Method 2 **Use symbols.**

$x - 2 = 3$	Write the equation.
$+2 = +2$	Add 2 to each side.
$x = 5$	Simplify.

Check

$x - 2 = 3$	Write the equation.
$5 - 2 \stackrel{?}{=} 3$	Replace x with 5.
$3 = 3$ ✓	This sentence is true.

Using either method, the solution is 5.

Show your work.

Got It? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $x - 7 = 4$ **b.** $y - 6 = 8$ **c.** $9 = a - 5$

a. _____

b. _____

c. _____

Addition Property of Equality

Key Concept

Words If you add the same number to each side of an equation, the two sides remain equal.

Examples

Numbers	Algebra
$5 = 5$	$x - 2 = 3$
$+3 = +3$	$+2 = +2$
$8 = 8$	$x = 5$

When you solve an equation by adding the same number to each side of the equation, you are using the **Addition Property of Equality**.

Example

Tutor

2. STEM **At age 25, Gherman Titov of Russia was the youngest person to travel into space. This is 52 years less than the oldest person to travel in space, John Glenn. How old was John Glenn? Write and solve a subtraction equation.**

Words Oldest age minus youngest age is 52 years.

Variable Let a represent the oldest age in space.

Bar Diagram

age, a	
a years	
25 years	**52 years**

Equation $a - 25 = 52$

$a - 25 = 52$ Write the equation.

$+25 = +25$ Add 25 to each side.

$a = 77$ Simplify.

John Glenn was 77 years old.

Check $77 - 25 = 52$ ✓

Got It? **Do this problem to find out.**

Show your work.

d. Georgia's height is 4 inches less than Sienna's height. Georgia is 58 inches tall. Write and solve a subtraction equation to find Sienna's height.

d. _____

STOP and Reflect

How is solving an addition equation different from solving a subtraction equation? Explain below.

Example

3. **Raheem's rollerblades cost $70.25 less than his bicycle. His rollerblades cost $43.50. How much did his bicycle cost? Write and solve a subtraction equation.**

Words Cost of bicycle minus $70.25 is $43.50.

Variable Let b represent the cost of the bicycle.

Bar Diagram

cost of bicycle, b	
b dollars	
$43.50	**$70.25**

Equation $b - 70.25 = 43.50$

$b - 70.25 = 43.50$ Write the equation.

$+ 70.25 = + 70.25$ Add 70.25 to each side.

$b = 113.75$ Simplify.

The bicycle cost $113.75.

Check $113.75 - 70.25 = 43.50$ ✓

Guided Practice

Solve each equation. Check your solution. (Example 1)

1. $a - 5 = 9$

Show your work.

2. $b - 3 = 7$

3. $4 = y - 8$

4. Catherine studied 1.25 hours for her science test. This was 0.5 hour less than she studied for her algebra test. Write and solve a subtraction equation to find how long she studied for her algebra test. (Examples 2 and 3)

5. **Building on the Essential Question** How can the Addition Property of Equality be used to solve subtraction equations?

Rate Yourself!

Are you ready to move on? Shade the section that applies.

YES ? NO

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Solve each equation. Check your solution. (Examples 1 and 3)

1. $c - 1 = 8$

Show your work.

2. $t - 7 = 2$

3 $1 = g - 3$

4. $a - 2.1 = 5.8$

5. $a - 1.1 = 2.3$

6. $4.6 = e - 3.2$

7. Pete is 15 years old. This is 6 years younger than his sister Victoria. Write and solve a subtraction equation to find Victoria's age. (Example 2)

8. A CD costs $14.95. This is $7.55 less than the cost of a DVD. Write and solve a subtraction equation to find the cost of the DVD. (Example 3)

9. If $b - 10 = 5$, what is the value of $b + 6$? _____

Solve each equation. Check your solution.

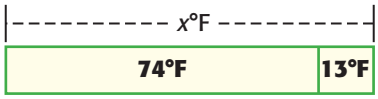
10. $m - \frac{1}{3} = \frac{2}{3}$

11. $n - \frac{1}{4} = \frac{3}{4}$

12. $s - \frac{1}{3} = \frac{7}{9}$

13 Alejandra spent her birthday money on a video game that cost $24, a controller for $13, and a memory card for $16. The total tax was $3. Write and solve a subtraction equation to find how much money Alejandra gave the cashier if she received $4 in change.

14. **Multiple Representations** The bar diagram represents a subtraction equation.



a. Words Write a real-world problem that can be represented by the bar diagram. _____

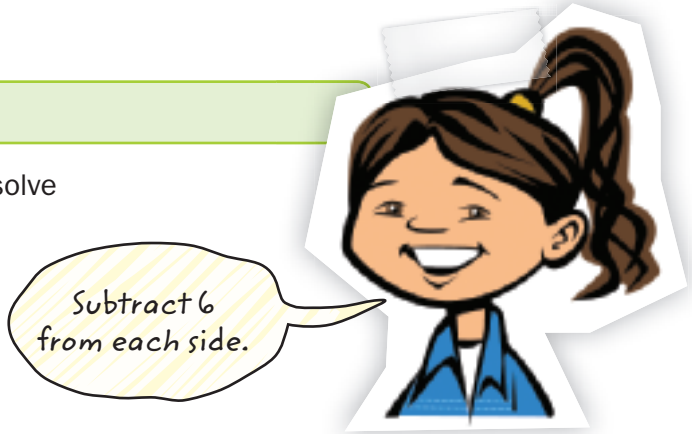
_____

_____

b. Algebra Write a subtraction equation that can be represented by the bar diagram. _____

c. Numbers Solve the equation you wrote in part b. _____

H.O.T. Problems Higher Order Thinking



15. **Find the Error** Elisa is explaining how to solve the equation $d - 6 = 4$. Find her mistake and correct it. _____

_____

_____

16. **Model with Mathematics** Write a real-world problem that could be represented by $d - 32 = 64$. _____

_____

17. **Persevere with Problems** Another type of subtraction equation is $16 - b = 7$. Explain how you would solve this equation then solve it.

_____

_____

Georgia Test Practice

18. Which of the following is true concerning $x - 5 = 13$?

Ⓐ To find the value of x, add 5 to each side.

Ⓑ To find the value of x, subtract 5 from each side.

Ⓒ To find the value of x, add 13 to each side.

Ⓓ To find the value of x, subtract 13 from each side.

Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

19. $f - 1 = 5$

Homework Help

$f - 1 = 5$

$+1 = +1$

$f = 6$

20. $2 = e - 1$

21. $r - 3 = 1$

22. $z - 6.3 = 2.1$

23. $t - 9.25 = 5.45$

24. $k - 32.9 = 16.5$

25. **Use Math Tools** North Carolina has 12 less electoral votes than Florida. Write and solve a subtraction equation to find the number of electoral votes for Florida. _____

Electoral Votes	
State	**Number of Votes**
Florida	■
North Carolina	15

26. Marty's cat weighs 10.4 pounds. This is 24.4 pounds less than the weight of his dog. Write and solve a subtraction equation to find the weight of Marty's dog. _____

27. Find the value of t if $t - 7 = 12$. _____

Solve each equation. Check your solution.

28. $s - \frac{1}{2} = \frac{1}{2}$

29. $h - \frac{1}{4} = \frac{1}{4}$

30. $c - 1 = \frac{3}{4}$

31. At a movie, Angelo bought a medium popcorn for $4, a small drink for $3, and a box of fruit snacks for $5. Write and solve a subtraction equation to find how much money Angelo gave the cashier if he received $3 in change.

Georgia Test Practice

32. Arizona became a state 96 years later than Indiana. Which equation can be used to find the year y Arizona became a state?

State	Year It Became a State
Arizona	■
Indiana	1816

Ⓐ $y = 1816 - 96$ Ⓒ $y - 1816 = 96$

Ⓑ $y + 96 = 1816$ Ⓓ $1816 - y = 96$

33. Xavier's age is 3 less than Paula's age. Xavier is 11 years old. Which subtraction equation represents this situation?

Ⓕ $a + 11 = 3$

Ⓖ $11 - 3 = a$

Ⓗ $a - 3 = 11$

Ⓘ $3 - a = 11$

34. **Short Response** Owen bought a pair of shoes and the shirt shown. The cost of the shirt was $42 less than the price of the shoes. How much did Owen spend on shoes?

Common Core Review

Multiply. MCC4.NBT.5

35. $63 \times 8 =$ _____

36. $19 \times 6 =$ _____

37. $27 \times 5 =$ _____

38. $13 \times 8 =$ _____

39. $36 \times 4 =$ _____

40. $21 \times 3 =$ _____

41. The table shows how much four people earned washing cars. If Gabrielle earns $5 for each car she washes, how many cars did she wash? MCC4.NBT.6 _____

Name	Amount Earned ($)
Eli	70
Gabrielle	80
Marcus	60
Sasha	64

42. The Cozy Cat Shop has 3 calico cats for every gray cat. If they have 9 calico cats available, how many gray cats do they have?

MCC4.NBT.6 _____

Guess, Check, and Revise

Content Standards
MCC6.EE.7

Mathematical Practices
1, 3, 4

Case #1 Smart Money

Damian received $100 for his birthday to pay for guitar lessons. The gift money was in $20 bills and $10 bills. When he paid for his lesson, he gave his teacher 8 bills.

How many $20 bills and how many $10 bills did Damian receive?

1 Understand *What are the facts?*

- Damian received 8 bills that add to $100.
- The money was in $20 bills and $10 bills.

2 Plan *What is your strategy to solve this problem?*

Make a guess until you find an answer that makes sense for the problem.

3 Solve *How can you apply the strategy?*

Use addends that have a sum of 8 to find the number of $20 and $10 bills.

Number of $20 bills	Number of $10 bills	Total Amount	Compare to $100
1	7	$1(\$20) + 7(\$10) = \$$	
2	6	$2(\$20) + 6(\$10) = \$$	
3	5	$3(\$20) + 5(\$10) = \$$	
4	4	$4(\$20) + 4(\$10) = \$$	

4 Check *Does the answer make sense?*

The other combinations are either less than or greater than $100.

Analyze the Strategy

Tutor

Reason Inductively Damian's sister received $100 in $10 and $5 bills, including eight $10 bills. Use the equation $x + 80 = 100$ to find how much money x was given to her in $5 bills. How many $5 bills did she receive?

Case #2 Anime Adventure

A book store sells used graphic novels in packages of 5 and new graphic novels in packages of 3.

If Amy buys a total of 16 graphic novels, how many packages of new and used graphic novels did she buy?

1 Understand

Read the problem. What are you being asked to find?

I need to find _____

_____.

Underline key words and values in the problem.
What information do you know?

The _____ novels come in packages of ☐ and the _____ novels come in packages of ☐. Amy buys ☐ graphic novels.

Is there any information that you do *not* need to know?

I do not need to know _____.

2 Plan

Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Use your problem-solving strategy to solve the problem. Make a guess.

2 used packages and 1 new package ☐(5) + ☐(3); ☐ < 16

3 used packages and 2 new packages ☐(5) + ☐(3); ☐ > 16

2 used packages and 2 new packages ☐(5) + ☐(3); ☐ = 16

So, _____.

4 Check

Use information from the problem to check your answer.

Make a list of multiples of 3 and a list of multiples of 5. Look for a combination of these multiples that add to 16.

_____

_____

Collaborate Work with a small group to solve the following cases. Show your work on a separate piece of paper.

Case #3 Quizzes

On a science quiz, Ivan earned 18 points. There are six problems worth 2 points each and two problems worth 4 points each.

Find the number of problems of each type Ivan answered correctly.

Case #4 Numbers

Kathryn is thinking of four numbers from 1 through 9 with a sum of 18. Each number is used only once.

Find the numbers.

Case #5 Equations

Use the symbols +, −, ×, or ÷ to make the following equation true. Use each symbol only once.

$3 \blacksquare 4 \blacksquare 6 \blacksquare 1 = 18$

Circle a strategy below to solve the problem.

- Look for a pattern.
- Solve a simpler problem.
- Act it out.
- Work backward.

Case #6 Money

Nathaniel is saving money to buy a new graphics card for his computer that costs $250.

If he is saving $20 a month and already has $160, in how many more months will he have enough money for the graphics card?

Mid-Chapter Check

Vocabulary Check

1. Define *equation.* Give an example of a number sentence that is an equation and a number sentence that is not an equation. (Lesson 1)

2. Fill in the blank in the sentence below with the correct term. (Lesson 2)

You can solve equations using _____, which undo each other.

Skills Check and Problem Solving

Circle the solution of the equation from the list given. (Lesson 1)

3. $x + 22 = 27$; 5, 6, 7

4. $17 + n = 24$; 6, 7, 8

Solve each equation. Check your solution. (Lessons 2 and 3)

5. $63 + d = 105$

6. $h + 7.9 = 13$

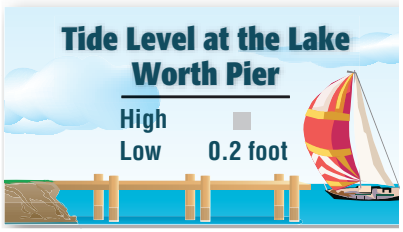
7. $a + 1.6 = 2.1$

8. $p - 13 = 29$

9. $y - 9 = 26$

10. $r - 5\frac{1}{6} = 10$

11. **Use Math Tools** The difference between the water levels for high and low tide was 3.6 feet. Write and solve an equation to find the water level at high tide. (Lesson 3)



12. **Georgia Test Practice** Fonzi spent a total of 90 minutes completing his chores this week. Which of the following equations represents the number of minutes Fonzi spent washing the dishes? (Lesson 2)

Chore	Time (min)
Vacuuming	42
Dishes	■

Ⓐ $m = 42 + 90$

Ⓑ $42 - m = 90$

Ⓒ $m + 42 = 90$

Ⓓ $90 = m - 42$

Inquiry Lab

Solve and Write Multiplication Equations

Inquiry **HOW do you solve multiplication equations using models?**

Content Standards MCC6.EE.5, MCC6.EE.7

Mathematical Practices 1, 3, 4

Running In 5 days, Nicole ran a total of 10 miles. She ran the same amount each day. How much did she run each day?

What do you know? _____

_____

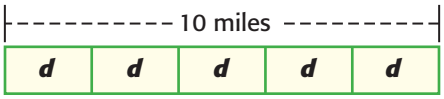
What do you need to find? _____

_____

Investigation 1

Step 1 Define a variable. Use the variable d to represent the distance run in one day.

Step 2 Use a bar diagram to help write the equation.



The total length of the diagram shows _____.

The variable d appears in the diagram ☐ times.

☐ d = ☐

Step 3 Work backward. Rewrite the equation as a division sentence and solve.

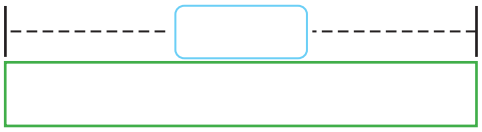
☐ ÷ ☐ = d

So, Nicole ran ☐ miles each day.

Collaborate

Work with a partner. Define the variable. Then write and solve a multiplication equation using a bar diagram.

1. Suppose Nicole ran 12 miles in four days. If she ran the same distance d each day, how many miles did she run in one day?



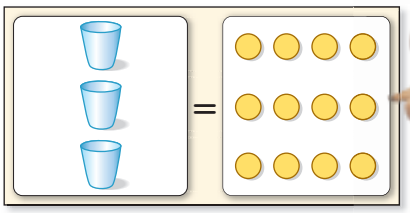
2. Krista has owned her cell phone for 8 months, which is twice as long as her sister Allie has owned her cell phone. How many months m has Allie had her cell phone?

Investigation 2

Tools

Solve $3x = 12$. Check your solution.

Step 1 Model the equation. Use one cup to represent each x.



Step 2 Use the model above. Divide the 12 counters equally by circling 3 groups. There are ☐ counters in each group.

So, the solution is ☐.

Check $3\square = 12$ Write the original equation.

$3(\square) \stackrel{?}{=} 12$ Replace x with your solution.

$\square = 12$ Is the sentence true? _____

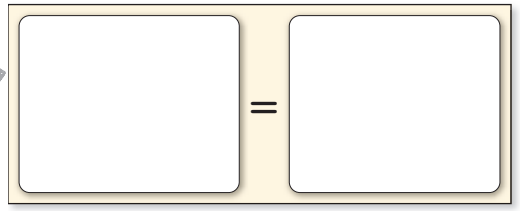
Collaborate

Work with a partner. Solve each equation using cups and counters.

3. $4n = 8$

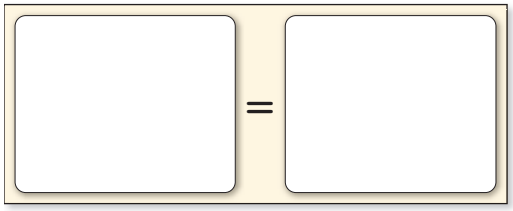
$n =$ _____

Show your work.



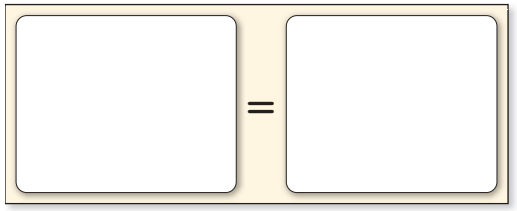
4. $3x = 9$

$x =$ _____



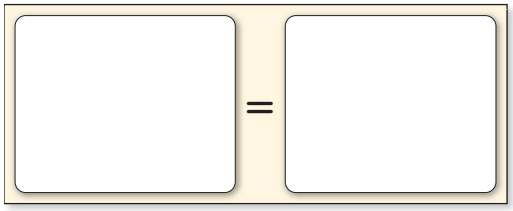
5. $10 = 5x$

$x =$ _____



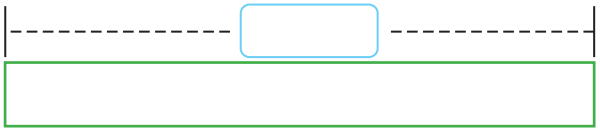
6. $6x = 12$

$x =$ _____



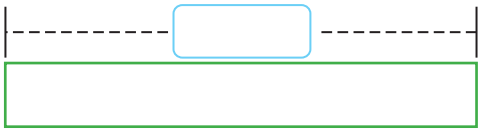
Define a variable. Then write and solve a multiplication equation using a bar diagram.

7. The average lifespan of a horse is 40 years, which is five times longer than the average lifespan of a guinea pig. Use the bar diagram below to find the average lifespan of a guinea pig. Label each section of the diagram. _____



8. Kosumi is saving an equal amount each week for 4 weeks to buy a $40 video game. Use the bar diagram below to find how much he is saving each week. Label each section of the diagram.

_____



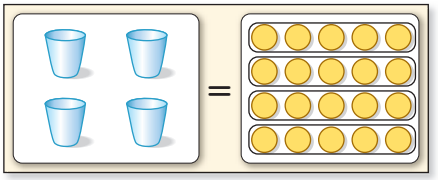
Analyze

Work with a partner to complete the table. The first one is done for you.

	Multiplication Equation	Coefficient	Variable	Product	Division Sentence	Solution
	$7g = 14$	7	g	14	$14 \div 7 = g$	$g = 2$
9.	$21 = 3y$					$y =$
10.	$5m = 45$					$m =$
11.	$48 = 8d$					$d =$
12.	$16f = 32$					$f =$
13.	$39 = 13b$					$b =$

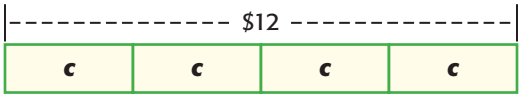
14. **Reason Inductively** Write a rule for solving equations like $2x = 24$ without using models. Use a related division sentence to explain your answer.

15. Write and solve an equation to represent the situation modeled below.



Reflect

16. **Model with Mathematics** Write a real-world problem for the equation modeled below. Then write the equation and solve.



17. HOW do you solve multiplication equations using models?

Lesson 4

Solve and Write Multiplication Equations

What You'll Learn

Scan the lesson. Predict two things you will learn about solving and writing multiplication equations.

- _____
- _____

Essential Question

HOW do you determine if two numbers or expressions are equal?

Vocabulary

Division Property of Equality

Common Core GPS

Content Standards
MCC6.EE.5, MCC6.EE.7, MCC6.RP.3

Mathematical Practices
1, 2, 3, 4, 5

Vocabulary Start-Up

The equation $3x = 9$ is a multiplication equation. In $3x$, 3 is the coefficient of x because it is the number by which x is multiplied.

Fill in the table. The first one is done for you.

Prefix	Root Word	New Word	Meaning
co-	pilot	copilot	the second pilot that flies with the primary pilot of the plane
co-	author		
co-	operate		
co-	efficient		

Real-World Link

Ringtones Matthew is downloading ringtones. The cost to download each ringtone is $2. When Matthew is finished he has spent a total of $10. Let x represent the number of ringtones. What does the expression $2x$ represent?

_____

Work Zone

Solve a Multiplication Equation

A multiplication equation is an equation like $2x = 10$ because the variable x is multiplied by 2. Multiplication and division are inverse operations. So, to solve a multiplication equation, use division.

Examples

Watch Tutor

1. **Solve $2x = 10$. Check your solution.**

$2x = 10$ Write the equation.

$\frac{2x}{2} = \frac{10}{2}$ Divide each side by the coefficient 2.

$x = 5$

Check $2x = 10$ Write the original equation.

$2(5) \stackrel{?}{=} 10$ Replace x with 5.

$10 = 10$ This sentence is true. ✓

2. **Solve $3x = 6$. Check your solution.**

Fill in the boxes below.

$3x = 6$ Write the equation.

$\frac{3x}{\square} = \frac{6}{\square}$ Divide each side by the coefficient $\square$.

$x = \square$

Check $3\square = 6$ Write the original equation.

$3(\square) \stackrel{?}{=} 6$ Replace x with $\square$.

$\square = 6$ This sentence is $\square$. ✓

Show your work.

a. _____

b. _____

c. _____

Got It? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $3x = 15$ **b.** $8 = 4x$ **c.** $2x = 14$

Division Property of Equality

Key Concept

Words If you divide each side of an equation by the same nonzero number, the two sides remain equal.

Examples

Numbers	Algebra
$18 = 18$	$3x = 12$
$\frac{18}{6} = \frac{18}{6}$	$\frac{3x}{3} = \frac{12}{3}$
$3 = 3$	$x = 4$

When you solve an equation by dividing both sides of the equation by the same number, you are using the **Division Property of Equality**.

Example

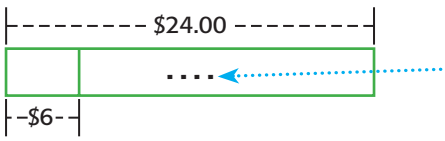
Tutor

3. **Vicente and some friends shared the cost of a package of blank CDs. The package cost $24 and each person contributed $6. How many people shared the cost of the CDs?**

Words Amount each contributed times number of people equals cost of CDs.

Variable Let x represent the number of people that contributed money.

Bar Diagram



The number of sections is unknown, but each section represents $6.

Equation $6 \cdot x = 24$

$6x = 24$ Write the equation.

$\frac{6x}{6} = \frac{24}{6}$ Divide each side by 6.

$x = 4$ Simplify.

Check $6 \times 4 = 24$ ✓

There were 4 people who split the cost of the CDs.

STOP and Reflect

What is the coeffienct in the equation in Example 3?

Got It? **Do this problem to find out.**

Show your work.

d. In 2004, Pen Hadow and Simon Murray walked 680 miles to the South Pole. The trip took 58 days. Suppose they traveled the same distance each day. Write and solve a multiplication equation to find about how many miles they traveled each day.

d. _____

Example

4. **Solve $3.28x = 19.68$. Check your solution.**

$3.28x = 19.68$ Write the equation.

$\frac{3.28x}{3.28} = \frac{19.68}{3.28}$ Divide each side by 3.28.

$x = 6$

Check $3.28x = 19.68$ Write the original equation.

$3.28(6) \stackrel{?}{=} 19.68$ Replace x with 6.

$19.68 = 19.68$ This sentence is true. ✓

Got It? **Do these problems to find out.**

Solve each equation. Check your solution.

e. $2.25n = 6.75$ **f.** $1.7b = 8.5$ **g.** $6.15y = 55.35$

Show your work.

e. _____

f. _____

g. _____

Guided Practice

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $2a = 6$

2. $20 = 4c$

3. $9.4g = 28.2$

Show your work.

4. The length of an object in feet is equal to 3 times its length in yards. The length of a waterslide is 48 feet. Write and solve a multiplication equation to find the length of the waterslide in yards. (Example 3)

5. The total time to burn a CD is 18 minutes. Last weekend, Demitri spent 90 minutes burning CDs. Write and solve a multiplication equation to find the number of CDs Demitri burned last weekend. Explain how you can check your solution. (Example 3)

6. **Building on the Essential Question** How can the Division Property of Equality be used to solve multiplication equations?

Rate Yourself!

How well do you understand solving and writing multiplication equations? Circle the image that applies.

Clear Somewhat Clear Not So Clear

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $4g = 24$

Show your work.

2. $5d = 30$

3. $36 = 6e$

4. $1.5x = 3$

5. $2.5y = 5$

6. $8.1 = 0.9a$

7. A jewelry store is selling a set of 4 pairs of gemstone earrings for $58, including tax. Neva and three of her friends want to buy the set so each could have one pair of earrings. Write and solve a multiplication equation to find how much each person should pay. (Example 3)

Solve each equation. Check your solution.

8. $39 = 1\frac{3}{10}b$

9. $\frac{1}{2}e = \frac{1}{4}$

10. $\frac{2}{5}g = \frac{3}{5}$

11 CCSS **Use Math Tools** Use the table that shows football data.

a. George Blanda played in the NFL for 26 years. Write and solve an equation to find how many points he averaged each year.

b. Norm Johnson played in the NFL for 16 years. Write and solve an equation to find how many points he averaged each year.

Top NFL Kickers	
Player	**Career Points**
Gary Anderson	2,434
Morten Andersen	2,437
George Blanda	2,002
John Carney	1,749
Norm Johnson	1,736

12. STEM An average person's heart beats about 103,680 times a day. Write and solve an equation to find about how many times the average person's heart beats in one minute.

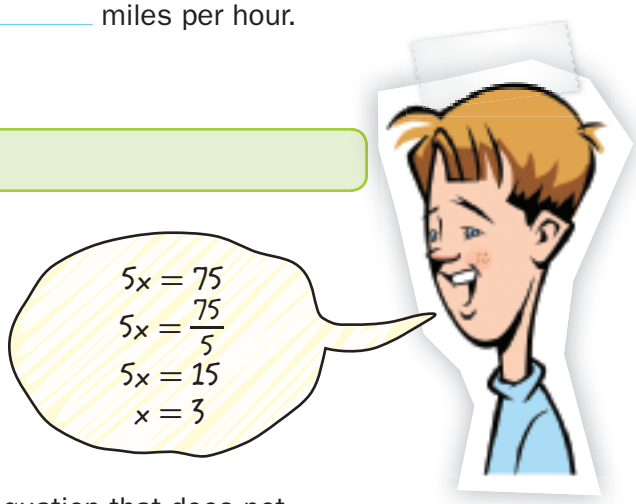
13. **Model with Mathematics** Problems involving constant speed can be solved by the formula distance = rate × time. Fernando's family traveled 272 miles on a road trip last weekend. They drove for 4 hours. What was the rate at which Fernando's family traveled? Write and solve a multiplication equation.

distance	=	rate	×	time

Fernando's family traveled an average rate of _____ miles per hour.

H.O.T. Problems Higher Order Thinking

14. **Find the Error** Noah is solving $5x = 75$. Find his mistake and correct it.



15. **Which One Doesn't Belong?** Identify the equation that does not belong with the other three. Explain your reasoning.

$5x = 20$	$4b = 7$	$8w = 32$	$12y = 48$

16. **Persevere with Problems** Explain how you know that the equations $\frac{1}{4} = 2x$ and $\frac{1}{4} \div x = 2$ have the same solution. Then, find the solution.

Georgia Test Practice

17. The Walkers traveled 182 miles in $3\frac{1}{2}$ hours. The equation $3.5m = 182$ can be used to find their mean rate of travel. What is the value of m?

Ⓐ 60 Ⓑ 52 Ⓒ 50 Ⓓ 48

Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

18. $4c = 16$

Homework Help

$4c = 16$

$\frac{4c}{4} = \frac{16}{4}$

$c = 4$

19. $5t = 25$

20. $5a = 15$

21. $3f = 12$

22. $21 = 3g$

23. $6x = 12$

24. $5.9q = 23.6$

25. $2.55d = 17.85$

26. $6.5a = 32.5$

27. The Raimonde family drove 1,764 miles across the United States on their vacation. If it took a total of 28 hours, write and solve a multiplication equation to find their average speed in miles per hour.

_____

28. CCSPS **Reason Abstractly** Four friends went bowling one afternoon. Use the table that shows the bowling data.

Player	Score
Bryan	320
Carson	366
Jana	522
Pilar	488

a. Carson bowled 3 games. Write and solve an equation to find how many points he averaged each game. _____

b. Jana bowled 5 games. Write and solve an equation to find how many points she averaged each game. _____

Copy and Solve **Solve each equation. Show your work on a separate piece of paper.**

29. $1\frac{2}{5}x = 7$

30. $3\frac{1}{2}r = 28$

31. $2\frac{1}{4}w = 6\frac{3}{4}$

32. $2\frac{3}{4}a = 19\frac{1}{4}$

33. $1\frac{1}{2}c = 6$

34. $3\frac{3}{4}m = 33\frac{3}{4}$

Georgia Test Practice

35. If a horse could maintain its average speed for 4 hours, it could travel 120 miles. What is the average speed of the horse?

Ⓐ 30 miles per hour

Ⓑ 33 miles per hour

Ⓒ 120 miles per hour

Ⓓ 480 miles per hour

36. If Mr. Solomon bikes at a constant speed of 12 miles per hour, which method can be used to find the number of hours it will take him to bike 54 miles?

Ⓕ Add 12 to 54.

Ⓖ Subtract 12 from 54.

Ⓗ Multiply 54 by 12.

Ⓘ Divide 54 by 12.

37. Short Response Marguerite's bottle of iced tea has this label. The equation $2c = 64$, where c represents the amount of sugar in each serving, can be used to find the amount of sugar in one serving. How many grams of sugar are in each serving?

_____

Nutrition Facts

Servings per container about 2

Calories	80
Total Fat	0g
Sodium	50mg
Total Carbohydrate	64g
Sugars	64g

Common Core Review

Divide. MCC5.NTB.6

38. 138 ÷ 6 = _____

39. 80 ÷ 5 = _____

40. 208 ÷ 4 = _____

41. 217 ÷ 7 = _____

42. 216 ÷ 24 = _____

43. 378 ÷ 6 = _____

44. The table shows the cost of concessions at a concert. Evan spent $31.50 buying popcorn for his class. How many bags of popcorn did Evan buy? MCC5.NTB.7

_____

Item	Cost ($)
Nachos	$3.00
Popcorn	$1.50
Water	$2.00

45. After dinner, $\frac{3}{4}$ of a pie remains. If Tasha eats $\frac{1}{6}$ of the remaining pie, how much of the total pie does Tasha eat? MCC6.NS.1

_____

Inquiry Lab

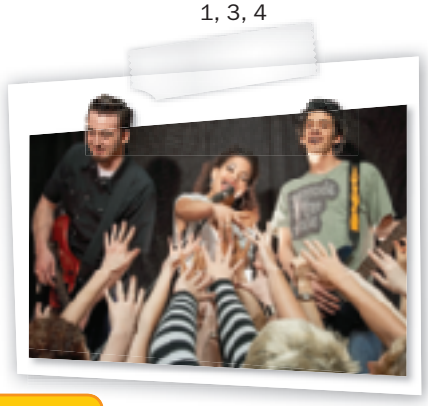
Solve and Write Division Equations

Inquiry **HOW do you solve division equations using models?**

Content Standards MCC6.EE.5, MCC6.EE.7

Mathematical Practices 1, 3, 4

Concerts Four friends decided to split the cost of season concert tickets equally. Each person paid $35. Find the total cost of the season concert tickets.



What do you know? _____

_____

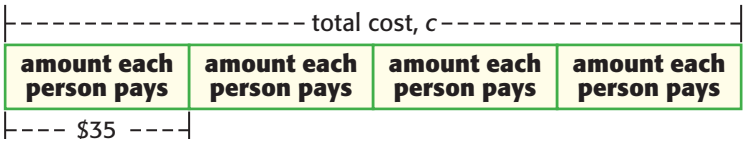
What do you need to find? _____

_____

Investigation

Step 1 Define a variable. Use the variable c to represent the total cost of the tickets.

Step 2 Use a bar diagram to help write the equation.



The total length of the diagram shows _____.

The number 35 represents _____.

There are four equal sections because _____.

$\square \div \square = \square$

Step 3 Work backward. Rewrite the equation as a multiplication sentence and solve.

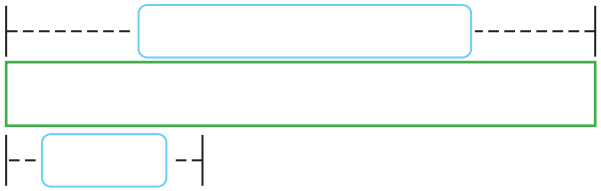
$\square \times \square = c$

So, the total cost of the season tickets was $\$\square$.

Collaborate

Model with Mathematics **Work with a partner. Write and solve a division equation using a bar diagram.**

1. Three teachers went to a conference. They shared the cost of gasoline g equally. Each teacher paid $38.50. Draw a bar diagram to find the total cost of gasoline.



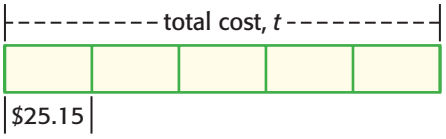
2. Silvia has completed 8 math exercises e. This is one fourth of the assignment. How many exercises were assigned?

3. Antonio bought a shirt for $\frac{1}{2}$ off. He paid $21.75 for the shirt s. Draw a bar diagram to find the original cost of the shirt.

4. Six friends are sharing the cost for a pizza party p equally. Each person paid $15.25. Find the total cost of the pizza party.

Reflect

5. **Model with Mathematics** Write a real-world subtraction problem for the equation modeled below. Then write the equation and solve.



6. inquiry HOW do you solve division equations using models?

Solve and Write Division Equations

What You'll Learn

Scan the lesson. List two real-world scenarios in which you would use division equations.

- _____
- _____

Essential Question

HOW do you determine if two numbers or expressions are equal?

Vocabulary

Multiplication Property of Equality

Common Core GPS

Content Standards
MCC6.EE.5, MCC6.EE.7

Mathematical Practices
1, 2, 3, 4, 7

Real-World Link

Allowances Leslie spends $5 a month on snacks at school, which is one fourth of her monthly allowance. Complete the questions below to find Leslie's monthly allowance.

1. Draw a bar diagram to represent $5 as one fourth of Leslie's monthly allowance.

2. What is Leslie's monthly allowance? ☐

3. What operation did you use to find Leslie's allowance?

_____

4. How can you check your answer to determine if it is accurate? _____

_____

_____

Work Zone

Solve Division Equations

In the situation on the previous page, equation $\frac{a}{4} = 5$, where a represents the monthly allowance, means the monthly allowance *divided by* 4 equals \$5. Since multiplication and division are inverse operations, use multiplication to solve division equations.

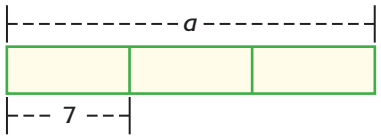
Example

Tutor

1. **Solve $\frac{a}{3} = 7$. Check your solution.**

Method 1 **Use models.**

Model the equation.



Solve the equation. Work backward.

Since $\frac{a}{3} = 7$, $7 \times 3 = a$. So, $a = 21$.

Method 2 **Use symbols.**

$\frac{a}{3} = 7$ Write the equation.

$\frac{a}{3}(3) = 7(3)$ Multiply each side by 3.

$a = 21$ Simplify.

Check $\frac{a}{3} = 7$ Write the original equation.

$\frac{21}{3} \stackrel{?}{=} 7$ Replace a with 21.

$7 = 7$ This is a true sentence. ✓

Using either method, the solution is 21.

Got It? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $\frac{x}{8} = 9$ **b.** $\frac{y}{4} = 8$

c. $\frac{m}{5} = 9$ **d.** $30 = \frac{b}{2}$

Show your work.

a. _____

b. _____

c. _____

d. _____

Multiplication Property of Equality

Key Concept

Words If you multiply each side of an equation by the same nonzero number, the two sides remain equal.

Examples

Numbers	Algebra
$3 = 3$	$\frac{x}{4} = 7$
$3(6) = 3(6)$	$\frac{x}{4}(4) = 7(4)$
$18 = 18$	$x = 28$

STOP and Reflect

How is solving a multiplication equation similar to solving a division equation? How is it different? Explain below.

When you solve an equation by multiplying each side of the equation by the same number, you are using the **Multiplication Property of Equality**.

Example

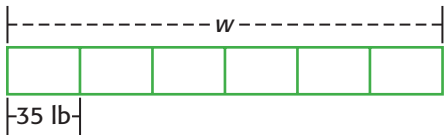
Tutor

2. **The weight of an object on the Moon is one sixth that of its weight on Earth. If an object weighs 35 pounds on the Moon, write and solve a division equation to find its weight on Earth.**

Words Weight of object on Earth divided by 6 equals weight on Moon.

Variable Let w represent the weight of the object on Earth.

Bar Diagram



Equation $\frac{w}{6} = 35$

$\frac{w}{6} = 35$ Write the equation.

$\frac{w}{6}(6) = 35(6)$ Multiply each side by 6.

$w = 210$ $6 \times 35 = 210$

The object weighs 210 pounds on Earth.

Got It? **Do this problem to find out.**

Show your work.

e. Nathan picked a total of 60 apples in $\frac{1}{3}$ hour. Write and solve a division equation to find how many apples Nathan could pick in 1 hour.

e. _____

Example

3. **Carla is buying ribbon for costumes. She wants to divide the ribbon into 8.5 inch pieces for 16 costumes. Write and solve a division equation to find the length of ribbon Carla should buy.**

Let r represent the length of ribbon Carla should buy.

$\frac{r}{8.5} = 16$ Write the equation.

$\frac{r}{8.5}(8.5) = 16(8.5)$ Multiply each side by 8.5.

$r = 136$ $8.5 \times 16 = 136$

Carla should buy 136 inches of ribbon.

Show your work.

Got It? **Do this problem to find out.**

f. _____

f. Allison is baking a pie. She wants 4.5 strawberries in each serving for 8 people. Write and solve a division equation to find how many strawberries Alison will need.

Guided Practice

Solve each equation. Check your solution. (Example 1)

1. $\frac{m}{6} = 10$

Show your work.

2. $\frac{k}{5} = 11$

3. $\frac{v}{13} = 14$

4. Kerry and Tya are sharing a pack of stickers. Each girl gets 11 stickers. Write and solve a division equation to find how many total stickers there are. (Example 2)

_____

5. Chen is buying a ham. He wants to divide it into 6.5-ounce servings for 12 people. Write and solve a division equation to find what size ham Chen should buy. (Example 3) _____

6. **Building on the Essential Question** When solving an equation, why is it necessary to perform the same operation on each side of the equals sign?

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

Solve each equation. Check your solution. (Examples 1 and 3)

1 $5 = \frac{p}{4}$

2. $17 = \frac{w}{6}$

3 $4.7 = \frac{g}{3.2}$

Show your work.

Write and solve a division equation to solve each problem. (Examples 2 and 3)

4. Sophia is buying party favors. She has a budget of $2.75 a person for 6 people. How much can Sophia spend on party favors?

_____

5 Caroline baked 3 dozen oatmeal raisin cookies for the bake sale at school. This is one fourth the number of dozens of cookies she baked in all. How many dozens of cookies did she bake in all?

_____

6. CCSPS **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.

Watch Replay it online!

a. If Mei has earned 30 points, write and solve a multiplication equation to find how many books she needs to read. _____

b. Suppose Mei has read 7 books. Write and solve a division equation to find the number of points she has earned. _____

7. **Identify Structure** Write the property used to solve each type of equation.

+	−
×	÷

H.O.T. Problems Higher Order Thinking

8. **Reason Abstractly** Write a division equation that has a solution of 42.

9. **Reason Inductively** *True* or *false:* $\frac{x}{3}$ is equivalent to $\frac{1}{3}x$. Explain your reasoning.

10. **Persevere with Problems** Explain how you would solve $\frac{16}{c} = 8$. Then solve the equation.

Georgia Test Practice

11. Which value of x makes this equation true?

$$\frac{x}{7} = 14$$

Ⓐ 98
Ⓑ 21
Ⓒ 2
Ⓓ 0.5

Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

12. $4 = \frac{r}{8}$

Homework Help

$4 = \frac{r}{8}$

$4(8) = \frac{r}{8}(8)$

$32 = r$

13. $12 = \frac{q}{7}$

14. $18 = \frac{r}{2}$

15. $\frac{h}{13} = 13$

16. $\frac{j}{12} = 11$

17. $\frac{z}{7} = 8$

18. $\frac{c}{0.2} = 7$

19. $\frac{d}{12} = 0.25$

20. $\frac{m}{16} = 0.5$

CCSPS **Identify Structure** **Write and solve a division equation to solve each problem.**

21. One third of a bird's eggs hatched. If 2 eggs hatched, how many eggs did the bird lay? _____

22. Marcel is purchasing a board to build a bookcase. He wants to divide the board into 1.75-foot sections. He needs 6 sections. What size board does Marcel need? _____

23. Blake is cutting a piece of rope into fourths. If each piece is 16 inches long, what is the length of the entire rope? _____

24. CCSPS **Justify Conclusions** A model plane is $\frac{1}{48}$ the size of the actual plane. If the model plane is 28 inches long, how long is the actual plane? Explain your reasoning to a classmate. _____

Georgia Test Practice

25. Alfred does chores to earn money in the summer. The table shows the amount he earns per chore.

Chore	Amount Earned ($)
mow lawn	$10
wash car	$5
weed garden	$8

Suppose Alfred weeded the garden 6 times in the summer. How much did he earn weeding?

Ⓐ $30 Ⓒ $60

Ⓑ $48 Ⓓ $75

26. Devon is saving his allowance to purchase the telescope shown.

If he saves $7 a week for 14 weeks, which of the following equations can be used to find the total cost of the telescope?

Ⓕ $7 + x = 14$ Ⓗ $\frac{x}{14} = 7$

Ⓖ $x - 7 = 14$ Ⓘ $7x = 14$

27. **Short Response** Shana ran 6 miles in one week. This was one third of what she ran in the month. Write and solve a division equation to find how far she ran in the month. _____

Common Core Review

Fill in each ◯ with <, >, or = to make a true sentence. MCC4.NF.7

28. 6.5 ◯ 5.2

29. 1.9 ◯ 1.7

30. 2.2 ◯ 2.2

31. 5.6 ◯ 6.5

32. 4.2 ◯ 3.9

33. 5.5 ◯ 5.7

34. The table shows the number of inches in different number of feet. How many inches are in 5 feet? MCC4.OA.5

Feet	Inches
1	12
2	24
3	36
4	48

_____

_____

35. What is the next number in the pattern below? MCC4.OA.5

4, 8, 12, 16, 20, 24. . .

_____

21ST CENTURY CAREER in Music

Sound Engineer

Do you enjoy using electronics to make music sound better? If so, you might want to explore a career in sound engineering. Sound engineers, or audio technicians, prepare the sound equipment for recording sessions and live concert performances. They are responsible for operating consoles and other equipment to control, replay, and mix sound from various sources. Sound engineers adjust the microphones, amplifiers, and levels of various instrument and voice tones so that everything sounds great together.

College & Career READINESS

Explore college and careers at ccr.mcgraw-hill.com

Is This the Career for You?

Are you interested in a career as a sound engineer? Take some of the following courses in high school.

- Algebra
- Electronic Technology
- Music and Computers
- Physics
- Sound Engineering

Find out how math relates to a career in Music.

Amping the Band!

Use the information in the table and the diagram to solve each problem.

1. In the diagram, the distance between the microphones is 6 feet. This is 3 times the distance d from each microphone to the sound source. Write an equation that represents this situation. _____

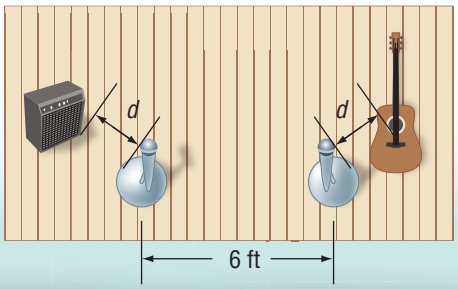
2. Solve the equation that you wrote in Exercise 1. Explain the solution. _____

3. The distance from the microphone to the acoustic guitar sound hole is about 11 inches less than what it should be. Write an equation that models this situation. _____

4. Solve the equation that you wrote in Exercise 3. Explain the solution. _____

5. The microphone is about 9 times farther from the electric guitar amplifier than it should be to produce a natural, well-balanced sound. Write and solve an equation to find how far from the amplifier the microphone should be placed. _____

Microphone Mistakes		
Sound Source	**Location of Microphone**	**Resulting Sound**
Acoustic guitar	3 inches from sound hole	very bassy
Electric guitar amplifier	36 inches from amp	thin, reduced bass



Career Project

It's time to update your career portfolio! Go to the *Occupational Outlook Handbook* online and research careers in sound engineering. Make a list of the advantages and disadvantages of working in that field.

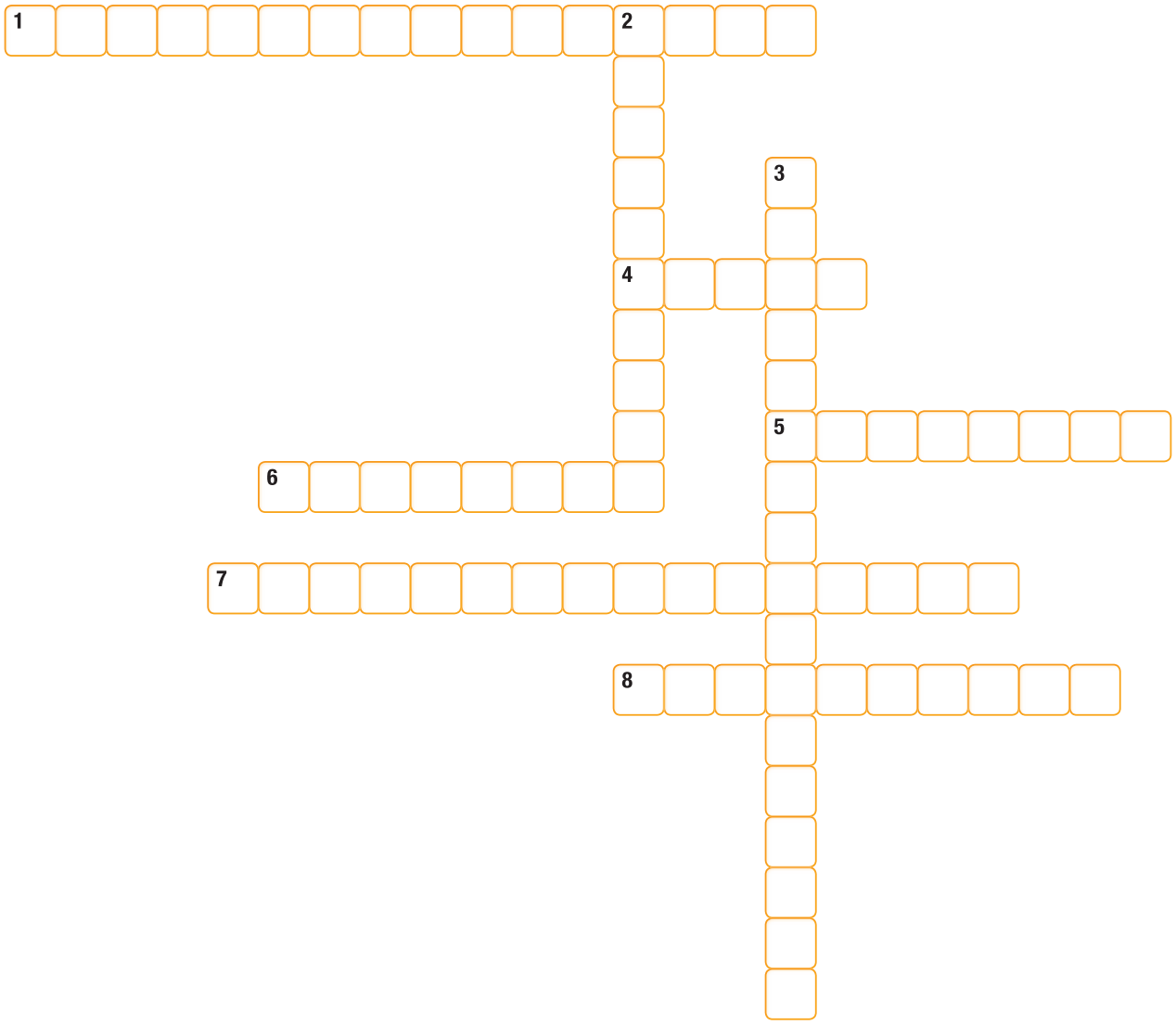
List several challenges associated with this career.

- _____
- _____
- _____
- _____
- _____

Chapter Review

Vocabulary Check

Write the correct term for each clue in the crossword puzzle.



Across

1. property of equality used to solve multiplication equations
4. replace a variable with a value that results in a true sentence
5. the value of a variable that makes an equation true
6. mathematical sentence showing two expressions are equal
7. property of equality used to solve subtraction equations
8. a combination of numbers, variables, and at least one operation

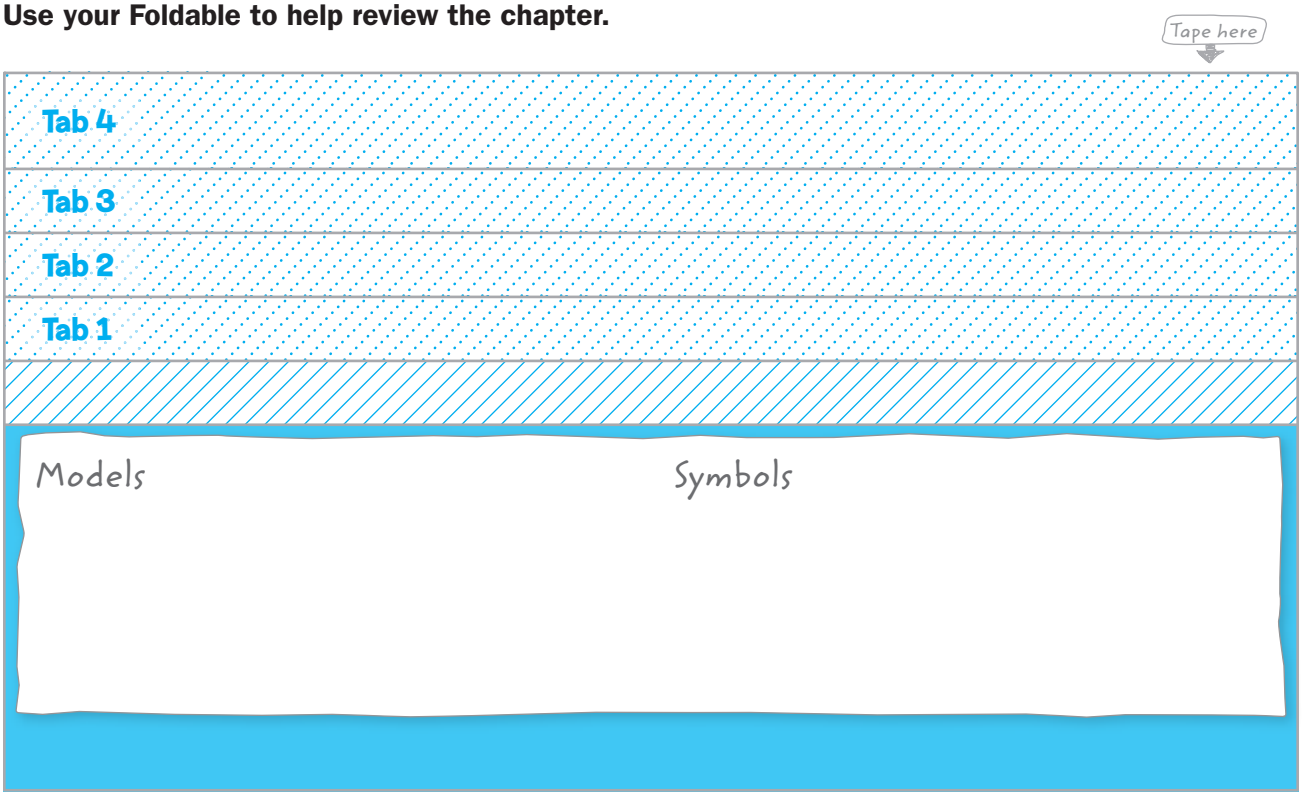
Down

2. a symbol of equality
3. operations which undo each other

Key Concept Check

Use Your FOLDABLES

Use your Foldable to help review the chapter.



Got it?

Match each equation with its solution.

1. $8x = 128$

2. $13 + x = 29$

3. $72 = 3x$

4. $x - 22 = 17$

5. $\frac{x}{4} = 17$

6. $x - 18 = 33$

a. $x = 68$

b. $x = 39$

c. $x = 18$

d. $x = 16$

e. $x = 24$

f. $x = 51$

Problem Solving

1. The equation $7h = 63$ can be used to find how many hours h a person needs to work to earn \$63 at \$7 per hour. How many hours does a person need to work to earn \$63? (Lesson 1)

2. The equation $18 + p = 34$ represents the sum of Reese's and Ana's ages, where p represents Reese's age. How old is Reese? (Lesson 1)

3. When Sean stands on a box, he is 10 feet tall. If the box is 4 feet tall, write and solve an addition equation to find Sean's height. (Lesson 2)

4. **Use Math Tools** The amount of money Felise has in her account is shown. She has \$8 less than her brother. Write and solve a subtraction equation to find how much money her brother has. (Lesson 3)

BANK STATEMENT

Felise Smith
1234 Street
Town, US 00200

CHECKING ACCOUNT

Previous Balance:	\$0.00
Checks:	\$0.00
Withdrawals:	\$0.00
Deposits:	\$39.00
Current Balance:	\$39.00

5. A store is selling blank CDs in packages of 25 for \$5. Write and solve a multiplication equation to find the cost of one blank CD. (Lesson 4)

6. The speed limit in front of Meadowbrook Middle School is shown. It is one third the speed limit of a major street two blocks away. Write and solve a division equation to find the speed limit of the major street. (Lesson 5)

7. Milo is baking chicken and the preparation time is 10 minutes, which is one fourth of the baking time. Write and solve a division equation to find the baking time. (Lesson 5)

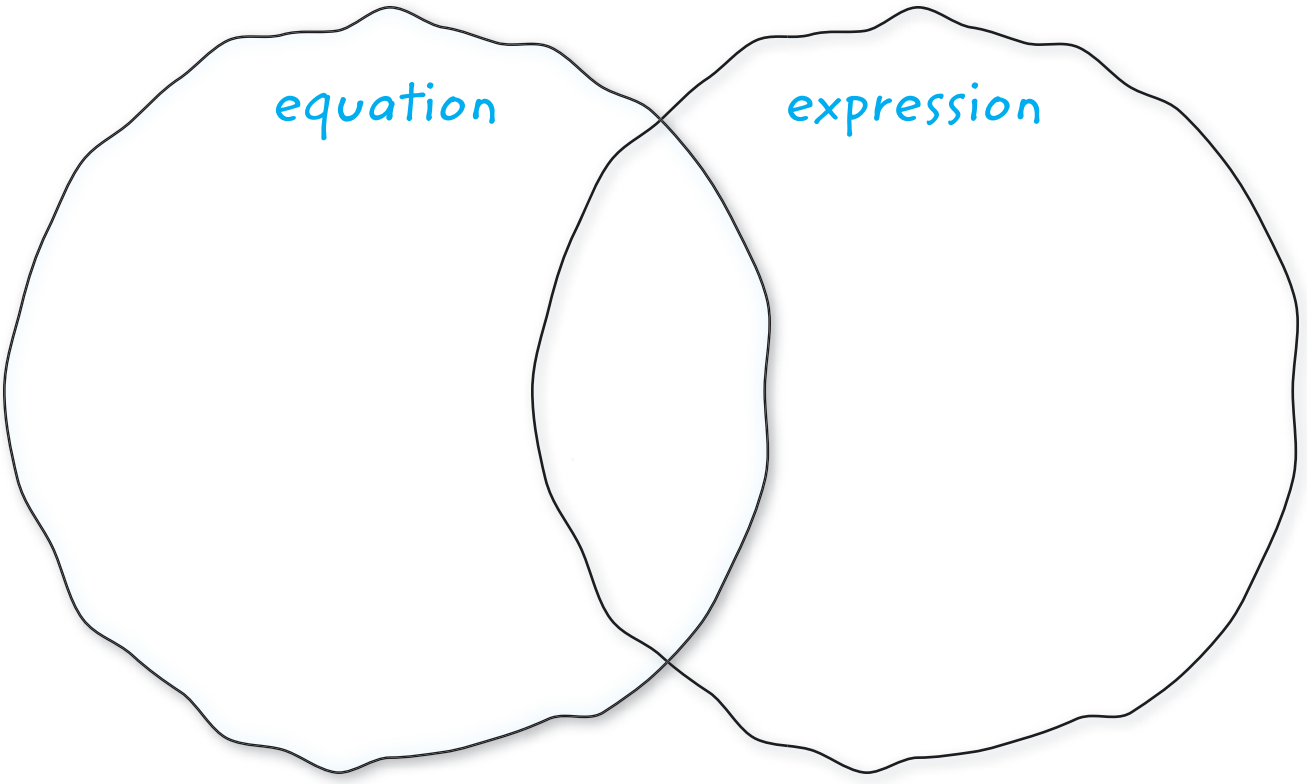
Reflect

Answering the Essential Question

Use what you learned about expressions and equations to complete the graphic organizer.

Essential Question

HOW do you determine if two numbers or expressions are equal?



Answer the Essential Question. HOW do you determine if two numbers or expressions are equal?