

## 3.2 Writing Expressions

**Essential Question** How can you write an expression that represents an unknown quantity?

### 1 ACTIVITY: Ordering Lunch

Work with a partner.  
You use a \$20 bill to buy lunch at a café.  
You order a sandwich from the menu board shown.



- a. Complete the table. In the last column, write a numerical expression for the amount of change received.

Sandwich	Price (dollars)	Change Received (dollars)
Reuben		
BLT		
Egg salad		
Roast beef		

- b. **REPEATED REASONING** Write an expression for the amount of change you receive when you order any sandwich from the menu board.

- c. Compare the expression you wrote in part (b) with the expressions in the last column of the table in part (a).

- d. The café offers several side dishes, each at the same price. You order a chicken salad sandwich and two side dishes. Write an expression for the total amount of money you spend. Explain how you wrote your expression.

- e. The expression  $20 - 4.65s$  represents the amount of change one customer receives after ordering from the menu board. Explain what each part of the expression represents. Do you know what the customer ordered? Explain your reasoning.

#### Algebraic Expressions

In this lesson, you will

- use variables to represent numbers in algebraic expressions.
- write algebraic expressions.

## 2 ACTIVITY: Words That Imply Addition or Subtraction

### Math Practice

#### Use Expressions

How do the key words in the phrase help you write the given relationship as an expression?

Work with a partner.

- a. Complete the table.

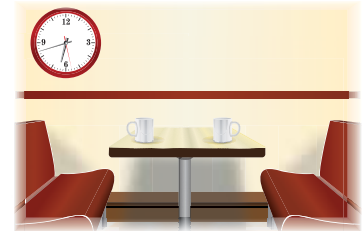
Variable	Phrase	Expression
$n$	4 <b>more than</b> a number	
$m$	the <b>difference</b> of a number and 3	
$x$	the <b>sum</b> of a number and 8	
$p$	10 <b>less than</b> a number	
$n$	7 units <b>farther</b> away	
$t$	8 minutes <b>sooner</b>	
$w$	12 minutes <b>later</b>	
$y$	a number <b>increased</b> by 9	

- b. Here is a word problem that uses one of the expressions in the table.

*You arrive at the café 8 minutes sooner than your friend. Your friend arrives at 6:42 P.M. When did you arrive?*

Which expression from the table can you use to solve the problem?

- c. Write a problem that uses a different expression from the table.



## 3 ACTIVITY: Words That Imply Multiplication or Division

Work with a partner. Match each phrase with an expression.

the product of a number and 3	$n \div 3$
the quotient of 3 and a number	$4p$
4 times a number	$n \cdot 3$
a number divided by 3	$2m$
twice a number	$3 \div n$

### What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you write an expression that represents an unknown quantity? Give examples to support your explanation.

### Practice

Use what you learned about writing expressions to complete Exercises 9–12 on page 122.

Some words imply math operations.

Operation	Addition	Subtraction	Multiplication	Division
Key Words and Phrases	added to plus sum of more than increased by total of and	subtracted from minus difference of less than decreased by fewer than take away	multiplied by times product of twice of	divided by quotient of

### EXAMPLE 1 Writing Numerical Expressions

Write the phrase as an expression.

- a. 8 **fewer than** 21

$$21 - 8$$

The phrase *fewer than* means *subtraction*.

- b. the **product of** 30 and 9

$$30 \times 9, \text{ or } 30 \cdot 9$$

The phrase *product of* means *multiplication*.

### EXAMPLE 2 Writing Algebraic Expressions

Write the phrase as an expression.

- a. 14 **more than** a number  $x$

$$x + 14$$

The phrase *more than* means *addition*.

- b. a number  $y$  **minus** 75

$$y - 75$$

The word *minus* means *subtraction*.

- c. the **quotient of** 3 and a number  $z$

$$3 \div z, \text{ or } \frac{3}{z}$$

The phrase *quotient of* means *division*.

#### Common Error



When writing expressions involving subtraction or division, order is important. For example, the quotient of a number  $x$  and 2 means

$$x \div 2, \text{ not } 2 \div x.$$

### On Your Own

Write the phrase as an expression.

- the sum of 18 and 35
- 6 times 50
- 25 less than a number  $b$
- a number  $x$  divided by 4
- the total of a number  $t$  and 11
- 100 decreased by a number  $k$

Now You're Ready  
Exercises 3–18

### EXAMPLE 3 Writing an Algebraic Expression

The length of Interstate 90 from the West Coast to the East Coast is 153.5 miles more than 2 times the length of Interstate 15 from southern California to northern Montana. Let  $m$  be the length of Interstate 15. Which expression can you use to represent the length of Interstate 90?

- (A)  $2m + 153.5$  (B)  $2m - 153.5$  (C)  $153.5 - 2m$  (D)  $153.5m + 2$

The word *times* means multiplication. So, multiply 2 and  $m$ .

The phrase *more than* means addition. So, add  $2m$  and 153.5.

$$2m + 153.5$$

∴ The correct answer is (A).

### EXAMPLE 4 Real-Life Application



You plant a cypress tree that is 10 inches tall. Each year, its height increases by 15 inches.

- Make a table that shows the height of the tree for 4 years. Then write an expression for the height after  $t$  years.
- What is the height after 9 years?

a. The height is *increasing*, so *add* 15 each year as shown in the table.

Year, $t$	Height (inches)
0	10
1	$10 + 15(1) = 25$
2	$10 + 15(2) = 40$
3	$10 + 15(3) = 55$
4	$10 + 15(4) = 70$

When  $t$  is 0, the height is 10 inches.

You can see that an expression is  $10 + 15t$ .

∴ So, the height after year  $t$  is  $10 + 15t$ .

- Evaluate  $10 + 15t$  when  $t = 9$ .

$$10 + 15t = 10 + 15(9) = 145$$

∴ After 9 years, the height of the tree is 145 inches.

### On Your Own

- Your friend has 5 more than twice as many game tokens as your sister. Let  $t$  be the number of game tokens your sister has. Write an expression for the number of game tokens your friend has.
- WHAT IF?** In Example 4, what is the height of the cypress tree after 16 years?

### Study Tip

Sometimes, like in Example 3, a variable represents a single value. Other times, like in Example 4, a variable can represent more than one value.

**Now You're Ready**  
Exercises 27–30



## Vocabulary and Concept Check

1. **DIFFERENT WORDS, SAME QUESTION** Which is different? Write “both” expressions.

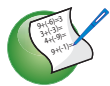
12 more than  $x$

$x$  increased by 12

$x$  take away 12

the sum of  $x$  and 12

2. **REASONING** You pay  $0.25p$  dollars to print  $p$  photos. What does the coefficient represent?



## Practice and Problem Solving

Write the phrase as an expression.


- 1 2 3. 5 less than 8                      4. the product of 3 and 12                      5. 28 divided by 7  
6. the total of 6 and 10                      7. 3 fewer than 18                      8. 17 added to 15  
9. 13 subtracted from a number  $x$                       10. 5 times a number  $d$   
11. the quotient of 18 and a number  $a$                       12. the difference of a number  $s$  and 6  
13. 7 increased by a number  $w$                       14. a number  $b$  squared  
15. the sum of a number  $y$  and 4                      16. the difference of 12 and a number  $x$   
17. twice a number  $z$                       18. a number  $t$  cubed

**ERROR ANALYSIS** Describe and correct the error in writing the phrase as an expression.

19. the quotient of 8 and a number  $y$

  $\frac{y}{8}$

20. 16 decreased by a number  $x$

  $x - 16$

21. **DINNER** Five friends share the cost of a dinner equally.  
a. Write an expression for the cost per person.  
b. Make up a total cost and test your expression. Is the result reasonable?

22. **TV SHOW** A television show has 19 episodes per season.

- a. Copy and complete the table.  
b. Write an expression for the number of episodes in  $n$  seasons.

Seasons	1	2	3	4	5
Episodes					

Give two ways to write the expression as a phrase.

23.  $n + 6$

24.  $4w$

25.  $15 - b$

26.  $14 - 3z$

**3 4** Write the phrase as an expression. Then evaluate when  $x = 5$  and  $y = 20$ .

27. 3 less than the quotient of a number  $y$  and 4
28. the sum of a number  $x$  and 4, all divided by 3
29. 6 more than the product of 8 and a number  $x$
30. the quotient of 40 and the difference of a number  $y$  and 16



**31. MODELING** It costs \$3 to bowl a game and \$2 for shoe rental.

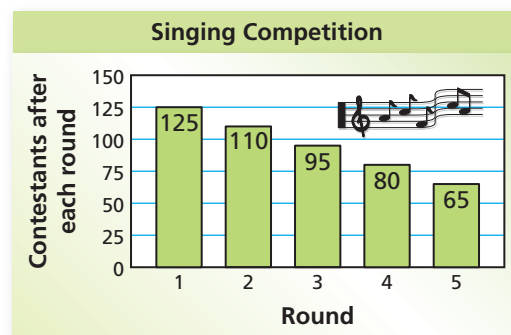
- a. Make a table for the cost of up to 5 games.
- b. Write an expression for the cost of  $g$  games.
- c. Use your expression to find the cost of 8 games.

**32. PUZZLE** Florida has 8 less than 5 times the number of counties in Arizona. Georgia has 25 more than twice the number of counties in Florida.

- a. Write an expression for the number of counties in Florida.
- b. Write an expression for the number of counties in Georgia.
- c. Arizona has 15 counties. How many do Florida and Georgia have?

**33. PATTERNS** There are 140 people in a singing competition. The graph shows the results for the first five rounds.

- a. Write an expression for the number of people after each round.
- b. How many people compete in the ninth round? Explain your reasoning.



**34. NUMBER SENSE** The difference between two numbers is 8. The lesser number is  $a$ . Write an expression for the greater number.

**35. Reasoning** One number is four times another. The greater number is  $x$ . Write an expression for the lesser number.



## Fair Game Review what you learned in previous grades & lessons

Evaluate the expression. (*Skills Review Handbook*)

36.  $8 + (22 + 15)$     37.  $(13 + 9) + 37$     38.  $(13 \times 6) \times 5$     39.  $4 \times (7 \times 5)$

**40. MULTIPLE CHOICE** A grocery store is making fruit baskets using 144 apples, 108 oranges, and 90 pears. Each basket will be identical. What is the greatest number of fruit baskets the store can make using all the fruit? (*Section 1.5*)

- (A) 6                      (B) 9                      (C) 16                      (D) 18