

2.1 Modeling with Expressions



Resource Locker

Essential Question: How do you interpret algebraic expressions in terms of their context?

Explore Interpreting Parts of an Expression

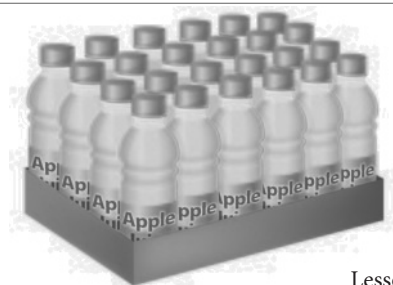
An **expression** is a mathematical phrase that contains operations, numbers, and/or variables. The **terms** of an expression are the parts that are being added. A **coefficient** is the numerical factor of a variable term. There are both *numerical expressions* and *algebraic expressions*. A **numerical expression** contains only numbers while an **algebraic expression** contains at least one variable.

- (A) Identify the terms and the coefficients of the expression $8p + 2q + 7r$.
terms: _____ ; coefficients: _____
- (B) Identify the terms and coefficients of the expression $18 - 2x - 4y$. Since the expression involves _____ rather than addition, rewrite the expression as the _____ of the terms:
 $18 - 2x - 4y =$ _____. So, the terms of the expression are _____ and the coefficients are _____.
- (C) Identify the terms and coefficients in the expression $2x + 3y - 4z + 10$. Since the expression involves both _____ and addition, rewrite the expression as the _____ of the terms: $2x + 3y - 4z + 10 =$ _____. So, the terms of the expression are _____ and the coefficients are _____.

Tickets to an amusement park are \$60 for adults and \$30 for children. If a is the number of adults and c is the number of children, then the cost for a adults and c children is $60a + 30c$.

- (D) What are the terms of the expression? _____
- (E) What are the factors of $60a$? _____
- (F) What are the factors of $30c$? _____
- (G) What are the coefficients of the expression? _____
- (H) Interpret the meaning of the two terms of the expression. _____

The price of a case of juice is \$15.00. Fred has a coupon for 20 cents off each bottle in the case. The expression to find the final cost of the case of juice is $15 - 0.2b$, wherein b is the number of bottles.



- (I) What are the terms of the expression? _____

- J** What are the factors of each term? _____ is the only factor of the _____ term and _____ and _____ are the factors of the _____ term.
- K** Do both terms have coefficients? Explain. _____
 _____ What are the coefficients? _____
- L** What does the expression $15 - 0.2b$ mean in the given situation?

Reflect

1. Sally identified the terms of the expression $9a + 4b - 18$ as $9a$, $4b$, and 18 . Explain her error.

2. What is the coefficient of b in the expression $b + 10$? Explain. _____

Explain 1 Interpreting Algebraic Expressions in Context

In many cases, real-world situations and algebraic expressions can be related. The coefficients, variables, and operations represent the given real-world context.

Interpret the algebraic expression corresponding to the given context.

Example 1

- A** Curtis is buying supplies for his school. He buys p packages of crayons at \$1.49 per package and q packages of markers at \$3.49 per package. What does the expression $1.49p + 3.49q$ represent?
- Interpret the meaning of the term $1.49p$. What does the coefficient 1.49 represent?
- The term $1.49p$ represents the cost of p packages of crayons. The coefficient represents the cost of one package of crayons, \$1.49.
- Interpret the meaning of the term $3.49q$. What does the coefficient 3.49 represent?
- The term $3.49q$ represents the cost of q packages of markers. The coefficient represents the cost of one package of markers, \$3.49.
- Interpret the meaning of the entire expression.
- The expression $1.49p + 3.49q$ represents the total cost of p packages of crayons and q packages of markers.
- B** Jill is buying ink jet paper and laser jet paper for her business. She buys 8 more packages of ink jet paper than p packages of laser jet paper. Ink jet paper costs \$6.95 per package and laser jet paper costs \$8 per package. What does the expression $8p + 6.95(p + 8)$ represent?
- Interpret the meaning of the first term, $8p$. What does the coefficient 8 represent?
- The term $8p$ represents the cost of _____. The coefficient represents _____, \$8.
- Interpret the meaning of the second expression, $6.95(p + 8)$. What do the factors 6.95 and $(p + 8)$ represent?

The term $6.95(p + 8)$ represents _____. 6.95 represents the cost of _____. $(p + 8)$ represents _____ that Jill bought.

Interpret the expression $8p + 6.95(p + 8)$.

The expression represents _____ that Jill bought.

Your Turn

Interpret the algebraic expression corresponding to the given context.

- George is buying watermelons and pineapples to make fruit salad. He buys w watermelons at \$4.49 each and p pineapples at \$5 each. What does the expression $4.49w + 5p$ represent?
- Sandi buys 5 fewer packages of pencils than p packages of pens. Pencils costs \$2.25 per package and pens costs \$3 per package. What does the expression $3p + 2.25(p - 5)$ represent?

Explain 2 Comparing Algebraic Expressions

Given two algebraic expressions involving two variables, we can compare whether one is greater or less than the other. We can denote the inequality between the expressions by using $<$ or $>$ symbols. If the expressions are the same, or **equivalent expressions**, we denote this equality by using $=$.

Suppose x and y give the populations of two different cities where $x > y$. Compare the expressions and tell which of the given pair is greater.

Example 1

(A) $x + y$ and $2x$

The expression $2x$ is greater.

- Putting the lesser population, y , together with the greater population, x , gives a population that is less than double the greater population.

(B) $\frac{x}{y}$ and $\frac{y}{x}$

Since $x > y$, $\frac{x}{y}$ will be _____ than 1 and $\frac{y}{x}$ will be _____ than 1.

So $\frac{x}{y}$ _____ $\frac{y}{x}$.

Your Turn

Suppose x and y give the populations of two different cities where $x > y$ and $y > 0$. Compare the expressions and tell which of the given pair is greater.

5. $\frac{x}{x + y}$ and $\frac{x + y}{x}$

6. $2(x + y)$ and $(x + y)^2$

Explain 3 Modeling Expressions in Context

The table shows some words and phrases associated with the four basic arithmetic operations. These words and phrases can help you translate a real-world situation into an algebraic expression.

Operation	Words	Examples
Addition	the sum of, added to, plus, more than, increased by, total, altogether, and	1. A number increased by 2 2. The sum of n and 2 3. $n + 2$
Subtraction	less than, minus, subtracted from, the difference of, take away, taken from, reduced by	1. The difference of a number and 2 2. 2 less than a number 3. $n - 2$
Multiplication	times, multiplied by, the product of, percent of	1. The product of 0.6 and a number 2. 60% of a number 3. $0.6n$
Division	divided by, division of, quotient of, divided into, ratio of,	1. The quotient of a number and 5 2. A number divided by 5 3. $n \div 5$ or $\frac{n}{5}$

Example 3 Write an algebraic expression to model the given context. Give your answer in simplest form.

A the price of an item plus 6% sales tax

Price of an item + 6% sales tax

p + $0.06p$

The algebraic expression is $p + 0.06p$, or $1.06p$.

B the price of a car plus 8.5% sales tax

The price of a car + _____

_____ + _____

The algebraic expression is _____,

or _____.

Reflect

7. Use the Distributive Property to show why $p + 0.06p = 1.06p$.

8. What could the expression $3(p + 0.06p)$ represent? Explain.

Your Turn

Write an algebraic expression to model the given context. Give your answer in simplest form.

9. the number of gallons of water in a tank, that already has 300 gallons in it, after being filled at 35 gallons per minute for m minutes

10. the original price p of an item less a discount of 15%

Elaborate

- 11. When given an algebraic expression involving subtraction, why is it best to rewrite the expression using addition before identifying the terms?

- 12. How do you interpret algebraic expressions in terms of their context?

- 13. How do you simplify algebraic expressions?

- 14. **Essential Question Check In** How do you write algebraic expressions to model quantities?

Evaluate: Homework and Practice



- Online Homework
- Hints and Help
- Extra Practice

Identify the terms and the coefficients of the expression.

- 1. $-20 + 5p - 7z$
- 2. $8x - 20y - 10$

Identify the factors of the terms of the expression.

- 3. $5 + 6a + 11b$
- 4. $13m - 2n$
- 5. Erin is buying produce at a store. She buys c cucumbers at \$0.99 each and a apples at \$0.79 each. What does the expression $0.99c + 0.79a$ represent?
- 6. The number of bees that visit a plant is 500 times the number of years the plant is alive, where t represents the number of years the plant is alive. What does the expression $500t$ represent?

© Houghton Mifflin Harcourt Publishing Company

7. Lorenzo buys 3 shirts at s dollars apiece and 2 pairs of pants at p dollars a pair. What does the expression $3s + 2p$ represent?
8. If a car travels at a speed of 25 mi/h for t hours, then travels 45 mi/h for m hours, what does the expression $25t + 45m$ represent?
9. The price of a sandwich is \$1.50 more than the price of a smoothie, which is d dollars. What does the expression $d + 1.5$ represent?
10. A bicyclist travels 1 mile in 5 minutes. If m represents minutes, what does the expression $\frac{m}{5}$ represent?
11. What are the factors of the expression $(y - 2)(x + 3)$?
12. **Explain the Error** A student wrote that there are two terms in the expression $3p - (7 - 4q)$. Explain the student's error.
13. Yolanda is buying supplies for school. She buys n packages of pencils at \$1.40 per package and m pads of paper at \$1.20 each. What does each term in the expression $1.4n + 1.2m$ represent? What does the entire expression represent?
14. Chris buys p pairs of pants and 4 more shirts than pairs of pants. Shirts cost \$18 each and pair of pants cost \$25 each. What does each term in the expression $25p + 18(p + 4)$ represent? What does the entire expression represent?



Suppose a and b give the populations of two states where $a > b$. Compare the expressions and tell which of the given pair is greater or if the expressions are equal.

15. $\frac{b}{a+b}$ and 0.5

16. $a + 13c$ and $b + 13c$, where c is the population of a third state

17. $\frac{a-b}{2}$ and $a - \frac{b}{2}$

18. $a + b$ and $2b$

19. $5(a + b)$ and $(a + b)5$

Write an algebraic expression to model the given context. Give your answer in simplest form.

20. the price s of a pair of shoes plus 5% sales tax. 21. the original price p of an item less a discount of 20%

22. the price h of a recently bought house plus 10% property tax

23. the principal amount P originally deposited in a bank account plus 0.3% interest



24. Match each statement with the algebraic expression that models it.

A. the price of a winter coat and a 20% discount _____ $x + 0.02x = 1.02x$

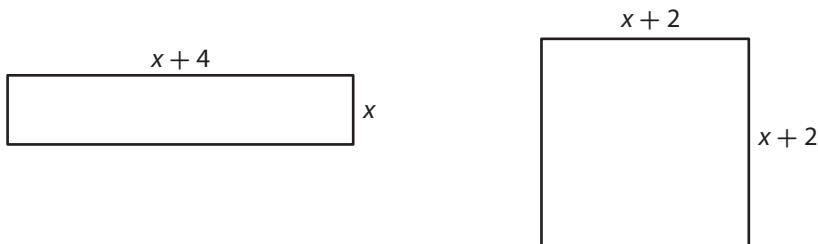
B. the base salary of an employee and a 2% salary increase _____ $x - 0.20x = 0.80x$

C. the cost of groceries and a 2% discount with coupons _____ $x + 0.20x = 1.20x$

D. the number of students attending school last year
and a 20% increase from last year _____ $x - 0.02x = 0.98x$

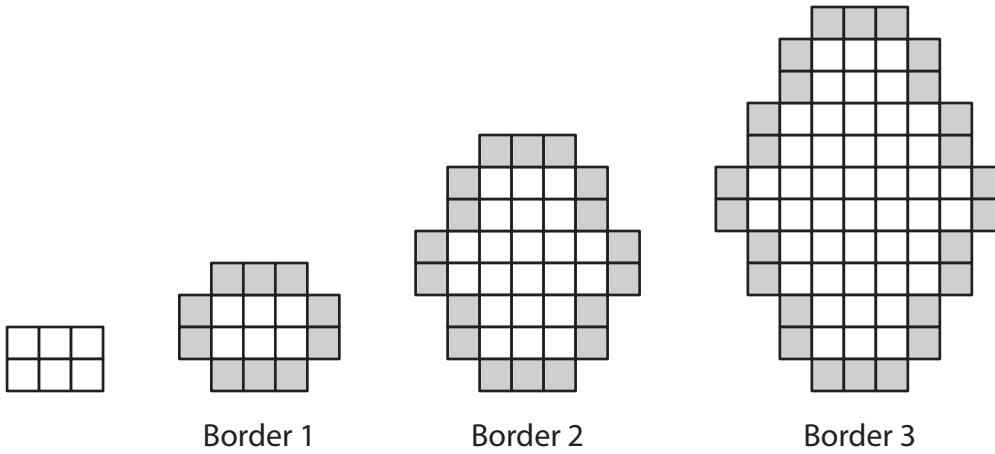
H.O.T. Focus on Higher Order Thinking

25. **Critique Reasoning** A student is given the rectangle and the square shown. The student states that the two figures have the same perimeter. Is the student correct? Explain your reasoning.



26. **Multi-Step** Yon buys tickets to a concert for himself and a friend. There is a tax of 6% on the price of the tickets and an additional booking fee of \$20 for the transaction. Write an algebraic expression to represent the price per person. Simplify the expression if possible.

- 27. Persevere in Problem Solving** Jerry is planting white daisies and red tulips in his garden and he wants to choose a pattern in which the tulips surround the daisies. He uses tiles to generate patterns starting with two rows of three daisies. He surrounds these daisies with a border of tulips. The design continues as shown.



- a. Jerry writes the expression $8(b - 1) + 10$ for the number of tulips in each border, wherein b is the border number and $b \geq 1$. Explain why Jerry's expression is correct.
- b. Elaine wants to start with two rows of four daisies. Her reasoning is that Jerry started with two rows of three daisies and his expression was $8(b - 1) + 10$, so if she starts with two rows of four daisies, her expression will be $10(b - 1) + 10$. Is Elaine's statement correct? Explain.

Lesson Performance Task

Becky and Michele are both shopping for a new car at two different dealerships. Dealership A is offering \$500 cash back on any purchase, while Dealership B is offering \$1000 cash back. The tax rate is 5% at Dealership A but 8% at Dealership B. Becky wants to buy a car that is \$15,000, and Michele is planning to buy a car that costs \$20,000. Use algebraic expressions to help you answer the following questions.



- a. At which dealership will Becky get the better deal? How much does she save?
- b. At which dealership will Michele get the better deal? How much does she save?
- c. What generalization can you make that would help any shopper know which dealership has the better deal? [Hint: At what price point would the two deals be equal?]