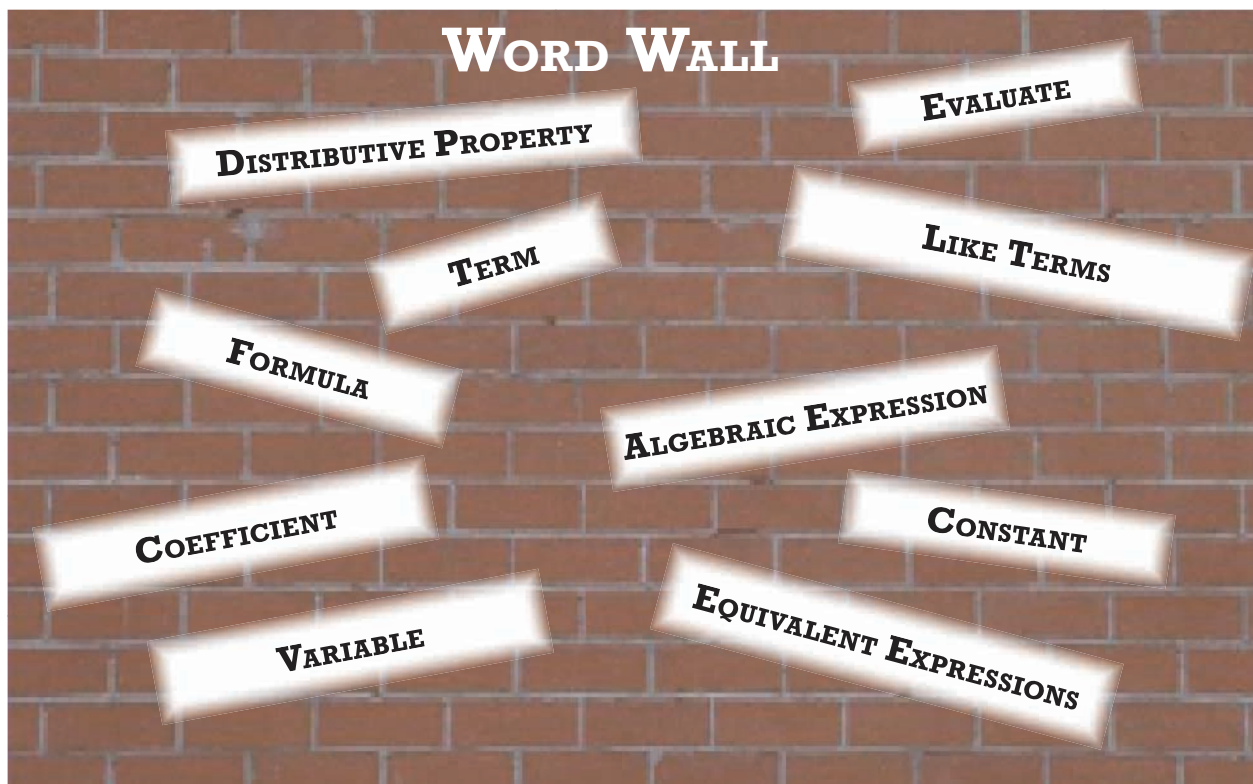


BLOCK 2 ~ INTRODUCTORY ALGEBRA

ALGEBRAIC EXPRESSIONS

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BLOCK 2 ~ ALGEBRAIC EXPRESSIONS

TIC - TAC - TOE

POPULATION DENSITY

Determine the population density of different areas of the world.



See page 52 for details.

DREAM SCHOOL

Create a floor plan for a one-story school. Find the area of each room and the total square footage of the school.



See page 47 for details.

EXPRESSIONS GAME

Create a matching game by creating game cards with equivalent expressions.



See page 61 for details.

BANK INTEREST

Find the interest rate for a savings account at local banks. Use the compound interest formula to determine the amount of interest you could earn.



See page 48 for details.

WRITING EXPRESSIONS

Write complex algebraic expressions which include powers and grouping symbols. Evaluate the expressions.



See page 37 for details.

GROCERY SHOPPING

Take a shopping list to the grocery store and use the Distributive Property to determine the total cost for the items on the list.



See page 57 for details.

CHILDREN'S BOOK

Write a children's story about variables. Use one formula from Lesson 9 in your story.



See page 48 for details.

OPERATIONS VOCABULARY

Make a poster of vocabulary that is used for each of the four operations (+, -, ×, ÷).



See page 32 for details.

GEOMETRY FORMULAS

Research formulas for geometric shapes such as a rhombus, trapezoid and parallelograms. Determine the areas of given shapes.



See page 42 for details.

VARIABLES AND EXPRESSIONS

LESSON 6



Write expressions involving variables.

Jenny bought a package of sandwich cookies to share with her friends. Each cookie contained 55 calories. The chart below shows the number of cookies each friend ate and the calories each friend consumed.

Friend's Name	Number of Cookies Eaten	Calculation	Calories Consumed
Sam	4	4×55	220
Jake	7	7×55	385
Mia	2	2×55	110
Julie	9	9×55	495
Chris	c	$c \times 55$	$c \times 55$



Chris did not remember how many cookies he ate. A **variable** is a letter that stands for a number. In this case, the variable stands for the number of cookies Chris consumed. An **algebraic expression** is a mathematical expression that contains numbers, operations (such as add, subtract, multiply or divide) and variables. The algebraic expression that represents the number of cookies Chris ate is $c \times 55$.

In order to write algebraic expressions you must be able to translate mathematical words into symbols.

EXPLORE!

TRANSLATE THOSE WORDS

Step 1: Fold a piece of paper in half vertically. Open up your paper and then fold your paper in half horizontally. Open the paper up and lay it flat on your desk.

Step 2: Label each section of your paper as shown.

Step 3: Place each word or phrase from the list below into one of the sections on your paper. Be prepared to explain your placement of each word or phrase.

less than	sum	decreased by
quotient	more than	divided by
times	difference	increased by
minus	product	fewer than

Addition	Subtraction
Multiplication	Division

Step 4: Draw the mathematical symbol used to represent each operation at the bottom corner of each box.

(Continued on next page)

Step 5: Eight algebraic expressions are listed below. There are two representing each operation. Place the algebraic expressions into the box that describes each operation.

$x - 4$

$6 \div p$

$5 \times w$

$14 + m$

$30 - g$

$10k$

$y + 11$

$\frac{h}{2}$

Step 6: In each box, write your own algebraic expression that uses the operation listed at the top of that box. Compare your expressions with a classmate. Are the expressions exactly the same? Should they be?

Variables are an important part of mathematics. One of the most commonly used variables is the letter x . Because the letter x looks so much like the multiplication sign \times , you will not use \times to represent multiplication when working with variables. For the rest of this book and in future math classes, you will show multiplication by using one of the methods below. Each one shows $4 \times y$:



METHODS FOR SHOWING MULTIPLICATION

Dot: $4 \cdot y$

Parentheses: $4(y)$

Number and adjacent variable: $4y$



EXAMPLE 1

Write an algebraic expression for each phrase.

- five times k
- seven more than x
- f divided by two
- a number y decreased by seventeen
- eleven plus four times w

SOLUTIONS

a. $5k$ or $5(k)$ or $5 \cdot k$

b. $x + 7$

c. $f \div 2$ or $\frac{f}{2}$

d. $y - 17$

e. $11 + 4w$ or $11 + 4(w)$ or $11 + 4 \cdot w$

When multiplying a number and variable, write the number first.

EXAMPLE 2

Write a phrase for each algebraic expression.

a. $12 + t$

b. $8x$

c. $u - 5$

d. $3x - 2$

SOLUTIONS

- a. the sum of twelve and t
 b. the product of eight and x
 c. five less than u
 d. three times x minus two

Answers may vary. Can you think of other answers for each part of this example?

EXERCISES

1. Michael's allowance is always \$3 less than his older brother Keith's allowance. Copy the table and fill in the missing boxes.



Keith's Allowance	Calculation	Michael's Allowance
\$14	$14 - 3$	\$11
\$20	$20 - 3$	
	$25 - 3$	
\$31		
x		→

2. Which of the following is not an appropriate way of writing "six times x " as an algebraic expression? Why?

$6x$ $6 \times x$ $6 \cdot x$ $6(x)$

Write an algebraic expression for each phrase.

3. the sum of y and eleven4. nine times m 5. the product of z and seven6. the quotient of c divided by three7. five more than x 8. four subtracted from p 9. thirty-one less than w 10. fourteen divided by b 11. a number n decreased by thirteen12. five times a number x

Write a phrase for each algebraic expression.

13. $y - 2$

14. $3 \cdot d$

15. $60 - x$

16. $p + 16$

17. $\frac{r}{5}$

18. $2w + 1$

19. Write three different phrases for $x + 5$.20. Write three different phrases for $10 - p$.



- 21.** A horse's heart rate is about 38 beats per minute.
- How many times will a horse's heart beat in 3 minutes?
 - How many times will a horse's heart beat in 10 minutes?
 - How many times will a horse's heart beat in b minutes?
- 22.** Yoshi gets half as many tardy slips as Ryan gets.
- If Ryan got 12 tardy slips in March, how many did Yoshi get?
 - If Ryan got 26 tardy slips in the first semester, how many did Yoshi get?
 - Ryan got t tardy slips all year. Write an algebraic expression that shows how many tardy slips Yoshi received.

- 23.** Francine's Fruit Stand sells apples and pears by the pound. The pears cost \$1.25 per pound more than the apples.
- The apples cost \$0.75 per pound. How much do the pears cost per pound?
 - The apples cost x dollars per pound. What algebraic expression represents the cost of a pound of pears?
 - The pears cost y dollars per pound. What algebraic expression represents the cost of a pound of apples?



REVIEW

Write each power in expanded form and find the value.

24. 11^2

25. 1^6

26. 4^3

27. 20^2

28. 2^4

29. 0^5

Determine if the expression in Column A is equal to the expression in Column B. If the expressions are equal, identify the property shown.

COLUMN A
30. 4×15

COLUMN B
 15×4

31. $80 \div (8 \div 4)$

$(80 \div 8) \div 4$

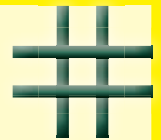
32. $(3 + 7) + 10$

$3 + (7 + 10)$

TIC-TAC-TOE ~ OPERATIONS VOCABULARY



There are many different vocabulary words which can be used for the four basic mathematical operations (+, -, \times , \div). Design a poster that lists as many words as you can find for each operation. Research each operation to find more vocabulary than just the words given in this book. Include both mathematical expressions and word phrases on your poster as examples of each operation.



EVALUATING EXPRESSIONS

LESSON 7



Evaluate algebraic expressions.

Gary delivers newspapers every morning. Each day he delivers papers to his customers he earns \$14. The algebraic expression that represents his total earnings based on the number of days (d) he has delivered papers is $14d$.

You can **evaluate** an algebraic expression by substituting a number for the variable to find its value. Some algebraic expressions will have more than one variable. If this is the case, you will replace each variable with a given number. After replacing the variable, or variables, with numbers, you will use the order of operations to find the value of the expression. The value of an algebraic expression changes depending on the value of the variable.



EVALUATING AN EXPRESSION

1. Rewrite the expression by replacing the variable(s) with the given value(s).
2. Follow the order of operations to find the value of the expression.

Gary delivered newspapers for eight days. Substitute the number 8 in the algebraic expression for the letter d .

$$14d \rightarrow 14(8) = \$112$$

The value of the algebraic expression, \$112, represents how much money Gary has made after delivering the paper for eight days.

EXAMPLE 1

Evaluate each algebraic expression.

a. $p + 4$ when $p = 7$

b. $9x$ when $x = 3$

c. $\frac{y}{3} + 1$ when $y = 24$

SOLUTIONS

a. Rewrite the expression with 7 in the place of p .
Compute the value of the expression.

$$\begin{aligned} p + 4 &\rightarrow 7 + 4 \\ 7 + 4 &= 11 \end{aligned}$$

b. Rewrite the expression by substituting 3 for x .
Compute the value of the expression.

$$\begin{aligned} 9x &\rightarrow 9(3) \\ 9(3) &= 27 \end{aligned}$$

c. Substitute 24 for y .

$$\frac{y}{3} + 1 \rightarrow \frac{24}{3} + 1$$

Use the order of operations to evaluate.

$$\frac{24}{3} + 1 = 8 + 1 = 9$$

It is possible for algebraic expressions to include multiple variables. Follow the same process by substituting the value of each variable in the correct places and then find the value of the expression.

EXAMPLE 2

Evaluate each algebraic expression when $x = 3$, $y = 10$ and $z = 5$.

a. $4x - y$

b. $\frac{y}{2z} + x$

SOLUTIONS

a. Substitute 3 for x and 10 for y . $4x - y \rightarrow 4(3) - 10$
 Evaluate using the order of operations. $4(3) - 10 = 12 - 10 = 2$

b. Substitute 10 for y , 5 for z and 3 for x . $\frac{y}{2z} + x \rightarrow \frac{10}{2(5)} + 3$

Use the order of operations to evaluate. $\frac{10}{2(5)} + 3 = \frac{10}{10} + 3 = 1 + 3 = 4$

Different values can be substituted for the variable in an expression. A table is used to organize mathematical computations. The substituted values are called the input values.

INPUT VALUES **ALGEBRAIC EXPRESSION**

x	$2x + 5$
1	$2(1) + 5 = 7$
$2\frac{1}{2}$	$2(2\frac{1}{2}) + 5 = 10$
4	$2(4) + 5 = 13$
12	$2(12) + 5 = 29$

EXAMPLE 3

Shari's Taxi Service charges customers an initial fee of \$5 plus \$0.50 per mile driven for each ride in Portland, Oregon. The algebraic expression representing this fee is $5 + 0.50m$, where m is the total number of miles driven during one ride. Use a table to show how much rides of 6 miles, 15 miles and 24 miles would cost Shari's customers.



SOLUTION

Miles driven (m)	$\$5 + 0.50m$
6	$5 + 0.50(6) = 5 + 3 = \$8.00$
15	$5 + 0.50(15) = 5 + 7.50 = \12.50
24	$5 + 0.50(24) = 5 + 12 = \17.00

EXERCISES

Evaluate each expression.

1. $x - 7$ when $x = 18$

2. $12b$ when $b = 4$

3. $4y - 1$ when $y = 5$

4. $50 - 3k$ when $k = 10$

5. $\frac{1}{2} + f$ when $f = 18$

6. $36 \div w$ when $w = 9$

7. $5d + 12$ when $d = 2$

8. $0.5h + 2$ when $h = 8$

9. $\frac{v}{5} + 7$ when $v = 40$



10. Julius starts with \$40 in his savings account. Each week he adds \$6 to his account. The algebraic expression that represents the total money Julius has in his account is $40 + 6w$ where w represents the number of weeks he has been adding money to his account.

- How much money will Julius have in his account after 3 weeks?
- How much money will Julius have in his account after 12 weeks?
- After a year (52 weeks), how much money should Julius have in his savings account?



11. Most teenagers take approximately 21 breaths per minute.
- How many breaths does the typical teenager take in 20 minutes?
 - How many breaths does a typical teenager take in an hour?
 - How many breaths does the typical teenager take in m minutes?

12. Johanna is going to the State Fair this summer. The fair charges a \$9 admission fee plus \$4 per ride.
- Write an algebraic expression that represents Johanna's total cost to attend the State Fair when she goes on r rides.
 - Copy the table and evaluate the total cost for Johanna to go to the fair if she were to go on the given number of rides.

Number of Rides r	Cost
2	
5	
11	



Evaluate each expression when $a = 6$, $b = 2$ and $c = 30$.

13. $2b + c$

14. $3(a + b)$

15. $\frac{c}{a} + b$

16. $\frac{12 + a}{b}$

17. $a - 2b + 3c$

18. $5ab$

Copy each table. Complete each table by evaluating the given expression for the values listed.

19.

x	$6x + 3$
0	
$\frac{1}{2}$	
3	
8	
20	

20.

x	$\frac{5x - 3}{2}$
1	
5	
6	
9	

- 21.** James is planning an ice cream social. He needs to purchase containers of ice cream and packages of cones. The ice cream costs \$2.50 per container and the packages of cones cost \$1.00 each. James uses the algebraic expression $2.50x + 1.00y$ to calculate his total expenses.
- What does the x variable stand for? The y variable?
 - James ends up buying 6 containers of ice cream and 5 packages of cones. How much will he spend?



REVIEW

Insert one set of parentheses in each numerical expression so that it equals the stated amount. Rewrite the problem with the parentheses in the appropriate places.

22. $2 \cdot 6 + 3 = 18$

23. $4 \cdot 5 + 20 \div 10 = 10$

24. $1 + 30 \div 5 \cdot 2 - 1 = 7$

Find the value of each expression.

25. $\frac{13 + 5}{(4 - 3)^2}$

26. $4 \cdot 6 + (12 - 3)^2$

27. $(2 + 5)^2 - (1 + 4)^2$

TIC-TAC-TOE ~ WRITING EXPRESSIONS



Word phrases for algebraic expressions get more difficult as expressions get more complex. The expressions in this Block only use the four basic operations: add, subtract, multiply and divide. As you have learned, mathematical expressions may also contain powers and grouping symbols such as parentheses and fraction bars.

When grouping symbols are used, the word phrase for the expression should contain “the quantity of”. When exponents are used in an expression, the word phrase may contain words such as “squared”, “cubed” or “to the power of...”

Examples:

Expression	Possible Phrase
$4(x + 3)$	four times the quantity of x plus 3
$x^3 - 9$	nine less than x cubed
$(x + 7)^2$	the quantity of x plus seven squared
$\frac{x - 1}{8}$	the quantity of x minus 1 divided by eight

Write a word phrase for each algebraic expression.

- | | | |
|-----------------------|---------------------|---------------------|
| 1. $(x + 5)^2$ | 2. $8(x - 11)$ | 3. $4 + x^4$ |
| 4. $\frac{10}{x + 1}$ | 5. $2(x + 5) + x^3$ | 6. $(x - 6)^2 + 5x$ |

Write an algebraic expression for each word phrase.

- the quantity of x minus four squared
- nine times the quantity of x minus six
- seventy-two divided by the quantity of x plus one
- the quantity of seventy divided by x decreased by the quantity of x minus six cubed
- Evaluate #7 - 10 when $x = 7$. If completed correctly, all answers should be the same.

EVALUATING GEOMETRIC FORMULAS

LESSON 8

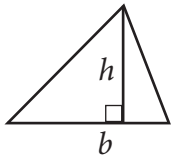


Use geometric formulas to find area, perimeter and volume.

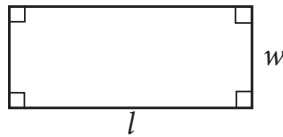
A **formula** is an algebraic equation that shows the relationship among specific quantities. Geometric formulas are used to evaluate quantities such as perimeter, area or volume. In past grades, you learned that the area of a rectangle is equal to the length of the rectangle times the width. This can be written as the geometric formula $\text{Area} = lw$. In this lesson you will examine and evaluate a variety of different geometric formulas.



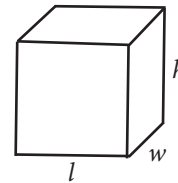
EXPLORE!



$$\text{Area} = \frac{1}{2}bh$$



$$\begin{aligned}\text{Area} &= lw \\ \text{Perimeter} &= 2l + 2w\end{aligned}$$



$$\begin{aligned}\text{Volume} &= lwh \\ \text{Surface Area} &= 2(lw + wh + hl)\end{aligned}$$

USING FORMULAS

Step 1: Look at the three shapes above. Can you name the shapes? Identify what you think the variables in each of the geometric formulas represent. Compare with your classmates.

Step 2: On the rectangle above, let $l = 6$ and $w = 2$. Use the given geometric formula to find the area of this rectangle.

Step 3: Using the values of l and w from **Step 2**, find the perimeter of the rectangle using the perimeter formula.

Step 4: Find the area of the triangle when $b = 10$ and $h = 3$.

Step 5: Find the volume of the rectangular prism above when $l = 5$, $w = 4$ and $h = 3$.

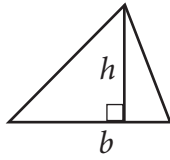
Step 6: Find the surface area of the rectangular prism using the values for l , w and h in **Step 5**.

Many people calculate area and perimeter in their jobs. A carpet layer must know the area of the floor he is covering in order to bring the right amount of carpet. A fence-builder must know how to calculate perimeter in order to charge the right price for building a fence. When someone wants to paint a house, he or she must know the surface area in order to know how much paint to buy.

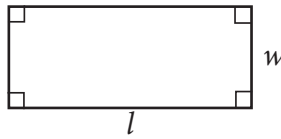
Can you think of other careers that would require using geometric formulas?



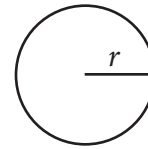
EXAMPLE 1



$$\text{Area} = \frac{1}{2}bh$$



$$\begin{aligned}\text{Area} &= lw \\ \text{Perimeter} &= 2l + 2w\end{aligned}$$



$$\begin{aligned}\text{Area} &= \pi r^2 \\ \text{Circumference} &= 2\pi r\end{aligned}$$

Evaluate each formula when given the values for the variables.

- Find the area of a triangle when $b = 12$ and $h = 4$.
- Find the area and perimeter of a rectangle when $l = 9$ cm and $w = 5$ cm.
- Find the area and circumference of a circle when $r = 3$ inches. Use 3.14 for π .

SOLUTIONS

- a. Use the formula for the area of a triangle.

$$\begin{aligned}\text{Area} &= \frac{1}{2}bh \\ &= \frac{1}{2}(12)(4) \\ &= \frac{1}{2}(48) \\ &= 24 \text{ square units}\end{aligned}$$

Area is labeled with square units. The units on perimeter are not squared.

- b. Use the formula for the area of a rectangle.

$$\begin{aligned}\text{Area} &= lw \\ &= (9)(5) \\ &= 45 \text{ square centimeters}\end{aligned}$$

Use the formula for the perimeter of a rectangle.

$$\begin{aligned}\text{Perimeter} &= 2l + 2w \\ &= 2(9) + 2(5) \\ &= 18 + 10 \\ &= 28 \text{ centimeters}\end{aligned}$$

- c. Use the formula for the area of a circle.

$$\begin{aligned}\text{Area} &= \pi r^2 \\ &= (3.14)(3^2) \\ &= (3.14)(9) \\ &= 28.26 \text{ square inches}\end{aligned}$$

Use the formula for the circumference of a circle.

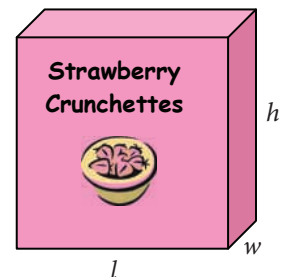
$$\begin{aligned}\text{Circumference} &= 2\pi r \\ &= 2(3.14)(3) \\ &= 2(9.42) \\ &= 18.84 \text{ inches}\end{aligned}$$

EXAMPLE 2

A cereal manufacturer is introducing its new breakfast cereal, Strawberry Crunchettes. The box the cereal will be sold in has a length of 12 inches, a width of 4 inches and a height of 15 inches.

- a. Find the volume of the box using the volume formula:
 $V = lwh$. This represents how much cereal the box can hold in cubic inches.

- b. Find the surface area of the box using the surface area formula: $\text{Surface Area} = 2(lw + wh + hl)$. This represents the amount of cardboard needed to make the cereal box in square inches.



EXAMPLE 2

SOLUTIONS

- a. The volume of the box is found by substituting 12 for l , 4 for w and 15 for h .

$$\begin{aligned}V &= lwh \\ &= (12)(4)(15) \\ &= 720 \text{ cubic inches}\end{aligned}$$

- b. The surface area of the box is found by substituting the same numbers into the surface area formula.

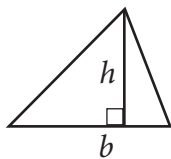
$$\begin{aligned}\text{Surface Area} &= 2(lw + wh + hl) \\ &= 2(12 \cdot 4 + 4 \cdot 15 + 15 \cdot 12) \\ &= 2(48 + 60 + 180) \\ &= 2(288) \\ &= 576 \text{ square inches}\end{aligned}$$

EXERCISES

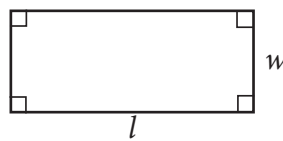
1. The area of a rectangle is found using the geometric formula $\text{Area} = lw$. The perimeter of a rectangle is found using the geometric formula $P = 2l + 2w$.
- Find the area and perimeter of a rectangle when $l = 5$ and $w = 3$.
 - Find the area and perimeter of a rectangle when $l = 2$ and $w = 0.5$.
 - Find the area and perimeter of a rectangle when $l = 24$ and $w = 10$.
2. The front and back walls of an A-Frame cabin are triangular in shape. A painter wants to determine the area of the triangular front of the house in order to know how much paint to buy. The base of the triangle (b) is 16 feet. The height of the triangle (h) is 20 feet. Find the area of the front of the A-Frame cabin. (Area of a triangle = $\frac{1}{2}bh$)



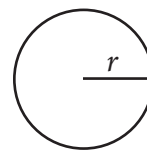
Evaluate each area, perimeter or circumference using the geometric formulas below.



$$\text{Area} = \frac{1}{2}bh$$



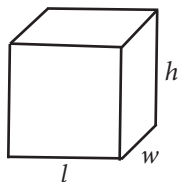
$$\begin{aligned}\text{Area} &= lw \\ \text{Perimeter} &= 2l + 2w\end{aligned}$$



$$\begin{aligned}\text{Area} &= \pi r^2 \\ \text{Circumference} &= 2\pi r\end{aligned}$$

- area of a triangle when $b = 6 \text{ m}$ and $h = 7 \text{ m}$
- area of a circle when $r = 5 \text{ cm}$ (Use 3.14 for π .)
- perimeter of a rectangle when $l = 11$ and $w = 3$
- area of a triangle when $b = 50 \text{ ft}$ and $h = 10 \text{ ft}$
- area of a rectangle when $l = 11$ and $w = 3$
- perimeter of a rectangle when $l = 32$ and $w = 14$
- circumference of a circle when $r = 10$ inches (Use 3.14 for π .)

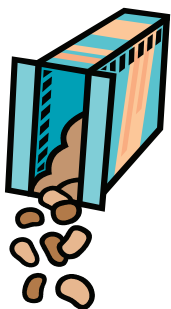
Evaluate the surface area or volume of a rectangular prism using the geometric formulas below.



$$\text{Volume} = lwh$$

$$\text{Surface Area} = 2(lw + wh + hl)$$

- 10.** volume of a rectangular prism when $l = 4 \text{ in}$, $w = 3 \text{ in}$ and $h = 5 \text{ in}$
- 11.** volume of a rectangular prism when $l = 6$, $w = 6$ and $h = 6$
- 12.** surface area of a rectangular prism when $l = 2$, $w = \frac{1}{2}$ and $h = 2$
- 13.** surface area of a rectangular prism when $l = 3 \text{ cm}$, $w = 2 \text{ cm}$ and $h = 7 \text{ cm}$



- 14.** MegaMakers Candy Company is creating a new box for their top-selling candy, Choco Chunks. The box the company has created has a length (l) of 4 inches, a width (w) of 2 inches and a height (h) of 5 inches.
- Find the volume of the box (how much space is inside the box) in cubic inches.
 - Find the surface area of the box (how much cardboard is needed to make the box) in square inches.
 - Each piece of the Choco Chunks candy is 0.5 cubic inches. How many pieces of Choco Chunks will fit in the new box?

- 15.** Kyle and his friends race around a circular track. The radius of the track is 40 meters.
- Find the distance around the track using the formula $\text{Circumference} = 2\pi r$. Use 3.14 for π .
 - Kyle wants to race 1,500 meters. Approximately how many times will he need to go around the track?



REVIEW

Evaluate each expression when $x = 1$, $y = 15$ and $z = 5$.

16. $x + y + z$

17. $2(y - x)$

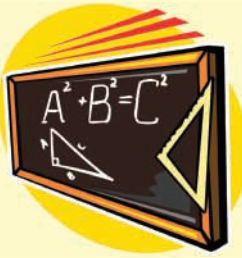
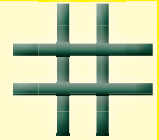
18. $\frac{y}{z}$

19. $14 + 2y - z$

20. $5(x + z) + y$

21. $3z + 2y$

TIC-TAC-TOE ~ GEOMETRY FORMULAS

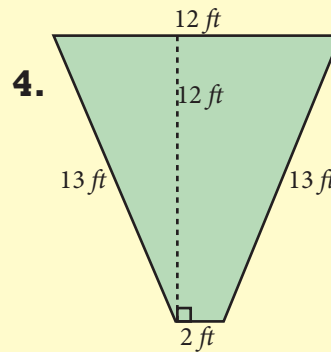
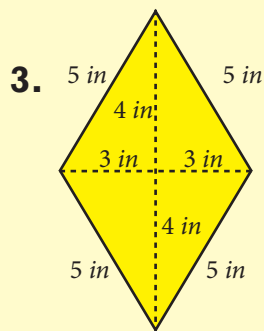
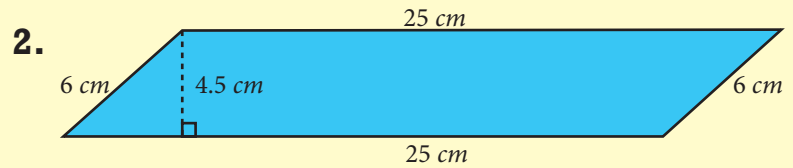
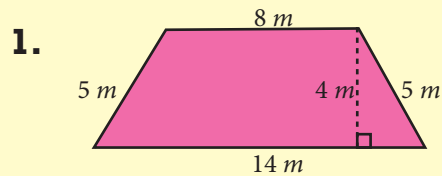


Mathematicians have developed formulas to find the areas of many different geometric shapes. Quadrilaterals are geometric shapes which have four sides. Three types of quadrilaterals are trapezoids, rhombuses and parallelograms.

Step 1: Find the definition for a trapezoid, rhombus and parallelogram. Draw an example.

Step 2: Find the formulas used to calculate the area of a trapezoid, rhombus and parallelogram.

Step 3: Copy each shape below onto paper. Write the name for each shape. Find the area of each shape.



Step 4: Draw a new rhombus, parallelogram and trapezoid. Find the length of each side, height or diagonal to the nearest tenth of a centimeter. Find the area of each of your quadrilaterals.

EVALUATING MORE FORMULAS

LESSON 9



Use formulas in a variety of situations.

Formulas are equations that show relationships between variables. In **Lesson 8** you saw how formulas are used in geometry. In this lesson you will see how formulas are used in all types of situations in real life. For example, formulas can be used to determine distance traveled, calculate interest earned in a savings account and calculate batting averages.



EXPLORE!

EARNING INTEREST

Money deposited into a bank account is called the principal. The bank pays interest on the money for as long as it is in the bank. Simple interest is calculated based on the principal. The formula used to calculate the amount of simple interest earned is $I = prt$. The interest is represented by I , p is the principal, r is the interest rate per year and t is the time in years.

Step 1: Nicholas deposited \$400 in an account and left it there for 3 years. His account earns 5% per year. Match each number to a variable in the simple interest formula:

$$p = \quad r = \quad t =$$

Step 2: The rate must be converted from a percent to a decimal before it is put into the formula. What is 5% as a decimal?

Step 3: Substitute the values for p , t , and the decimal value of r into the equation $I = prt$. Evaluate the equation. How much interest did Nicholas earn?

Step 4: Tracey found a savings account that earns 6% per year. She deposited \$200 in an account and left the money there for 5 years. How much did she earn? How much total money does she have after 5 years?

Step 5: Ian was given \$500. He invested it in a savings account for 6 months at 8% per year. To calculate his interest, he substituted the values into the equation. Look at his calculation below. Did he calculate correctly? If not, how much money did he really earn?

$$I = prt = (500)(0.08)(6) = \$240$$



Another formula used in math and science is $d = rt$. The variable d represents distance, r is rate (or speed), and t is time. This formula can be used to determine the distance a car travels over a certain amount of time or the distance a jogger runs in a specific amount of time.

EXAMPLE 1

A family traveled from Medford, Oregon to Salem, Oregon in a small sedan. They traveled for 4 hours at a speed of 58 miles per hour. How many miles did they drive from Medford to Salem?



SOLUTION

Identify which number to substitute for each variable in the formula.

$$\begin{aligned} \text{distance} &= d = ? \\ \text{rate (speed)} &= r = 58 \\ \text{time} &= t = 4 \end{aligned}$$

Substitute the values into the formula $d = rt$.

$$\begin{aligned} d &= rt \\ d &= (58)(4) \\ d &= 232 \text{ miles} \end{aligned}$$

The family traveled 232 miles.

EXAMPLE 2

Petrik jogs at a speed of 7 miles per hour. He jogs for 30 minutes. How far has he traveled?

SOLUTION

Petrik's speed is in miles per hour. The amount of time is in minutes. Convert the minutes to hours before substituting values into the formula.

$$\begin{aligned} 60 \text{ minutes} &= 1 \text{ hour} \\ \text{so} \\ 30 \text{ minutes} &= \frac{1}{2} \text{ hour} \end{aligned}$$

Identify which number to substitute for each variable in the formula.

$$\begin{aligned} \text{distance} &= d = ? \\ \text{rate (speed)} &= r = 7 \\ \text{time} &= t = \frac{1}{2} \end{aligned}$$

Substitute the values into the formula $d = rt$.

$$\begin{aligned} d &= rt \\ d &= (7)\left(\frac{1}{2}\right) \\ d &= 3\frac{1}{2} \end{aligned}$$

Petrik jogged $3\frac{1}{2}$ miles.



In baseball, each batter has a batting average. The batting average is defined as the ratio of hits to 'at bats'. The formula used to calculate the batting average is: $B = \frac{h}{a}$, where B is the batting average, h is the number of hits and a is the number of 'at bats'.

EXAMPLE 3

A professional baseball player had 555 'at bats' in one season. He had a total of 189 hits during that season. What was his batting average?

SOLUTION

Identify which number to substitute for each variable in the formula.

batting average = $B = ?$

hits = $h = 189$

'at bats' = $a = 555$

Substitute the values into the formula $B = \frac{h}{a}$.

$$B = \frac{h}{a}$$

$$B = \frac{189}{555} \approx 0.341$$

The baseball player had a batting average of 0.341.

Round batting averages to the nearest thousandth.

EXERCISES



Use the simple interest formula, $I = prt$, to evaluate the amount of interest earned.

1. Find the amount of interest when $p = \$100$, $r = 4\%$ and $t = 6$ years.
2. Find the amount of interest when $p = \$2000$, $r = 7\%$ and $t = 2$ years.
3. Vinny deposited \$1,400 in an account for 3 years at 9% interest. How much money did he earn?
4. Jackie deposited \$500 in an account for 10 years at 6% interest.
 - a. How much money did she earn?
 - b. She added the interest she earned to the money in her savings account. She left the money in the account for one more year at 6%. How much additional money will she earn in the last year?
5. David left \$300 in an account that earns 5% interest. When he collected his interest, he had earned \$60 in interest. Did he leave his money in the account for 2, 4 or 6 years?
6. Loans are CHARGED interest. Justin took out a student loan for his first year of college. He borrowed \$6,000 for 4 years. He was charged an interest rate of 4.5%. How much simple interest will Justin have to pay back on his loan?



Use the formula $d = rt$ to evaluate distances.

7. Find the distance traveled when $r = 10$ miles per hour and $t = 4$ hours.
8. Irina drives at a speed of 55 miles per hour. She drives for 3 hours before having to stop for gas. How far has she traveled so far?
9. Matthew runs 9 miles per hour for 1.5 hours. How far did he run?

10. Kirsten walked for 30 minutes at a speed of 5 miles per hour. How many miles did she walk?



11. The Gonzalez family lives in Milton-Freewater, Oregon. They drove to Denver, Colorado for summer vacation. On the first day they drove 9 hours at an average speed of 62 miles per hour. They stopped for the night in Salt Lake City. The next day they drove on to Denver at an average speed of 55 miles per hour for 9.75 hours.

- How far did the Gonzalez family travel on the first day? The second day?
- What is the total distance traveled by the Gonzalez family from Milton-Freewater to Denver AND BACK?



Use the formula $B = \frac{h}{a}$ to find batting averages. Round to the nearest thousandth.

12. Find the batting average when $h = 16$ and $a = 43$.

13. Willie has been up to bat 74 times this season. He has 21 hits. What is his batting average?

14. Half-way through the season, Jerry had 17 hits in 45 'at bats'. The second half of the season, Jerry had 16 hits in 38 'at bats'. Was his batting average better during the first half of the season or the second half? Explain your answer.

15. In 2006, Alex Rodriguez of the New York Yankees had a total of 572 'at bats'. He had 166 hits during that season. What was his batting average?



REVIEW

Use the order of operations to evaluate.

16. $25 \div 5 + 7 \cdot 2$

17. $(27 - 3) \div 7 \cdot 2$

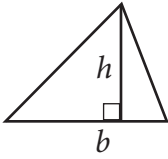
18. $(2 + 4)^2 - 10$

19. $3 \cdot 7 + 5^2 - 16$

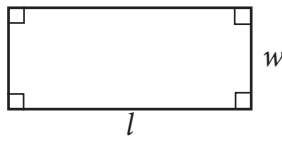
20. $\frac{4 + 28}{6 - 2}$

21. $\frac{20(7 - 3)}{2 \cdot 5} - 7$

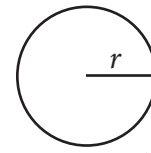
Evaluate each area, perimeter or circumference using the geometric formulas below.



$$\text{Area} = \frac{1}{2}bh$$



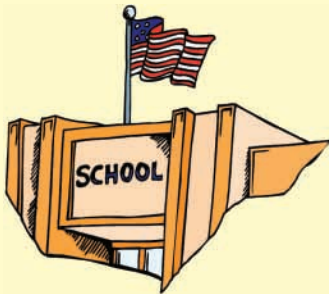
$$\begin{aligned}\text{Area} &= lw \\ \text{Perimeter} &= 2l + 2w\end{aligned}$$



$$\begin{aligned}\text{Area} &= \pi r^2 \\ \text{Circumference} &= 2\pi r\end{aligned}$$

22. area of a circle when $r = 5 \text{ m}$ (Use 3.14 for π .)
23. area of a rectangle when $l = 6$ and $w = 9$
24. perimeter of a rectangle when $l = 10 \text{ cm}$ and $w = 4 \text{ cm}$
25. area of a triangle when $b = 28 \text{ ft}$ and $h = 5 \text{ ft}$
26. circumference of a circle when $r = 9$ (Use 3.14 for π .)

TIC-TAC-TOE ~ DREAM SCHOOL



Your town is considering building a new elementary school. The school board asked for possible floor plans to consider. Draw a “dream school” floor plan that meets the following criteria.

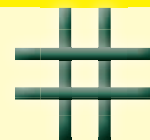
1. The school can only be one story.
2. Each room in the school should be triangular, rectangular or circular. You may also create rooms in your school that are any combination of those shapes.

Example:

Library
with Bay Window

3. The school must contain one classroom for each grade, kindergarten through fifth grade. You should also include a gym, cafeteria and library. Include any additional rooms you would like.
4. Create a scale which you will use for your floor plan. Let 1 inch equal a set amount of feet. Check with an adult to determine if this is a reasonably sized school.
5. Draw your floor plan on a blank sheet of paper using a ruler. Write the real-life dimensions for each room on your floor plan. Record your scale on your building plan.
6. On a separate sheet of paper, determine the area (or square footage) of each room as they would be built in real-life.
7. Determine the overall square footage of your dream school.

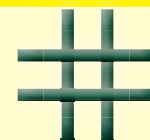
TIC-TAC-TOE ~ CHILDREN'S BOOK



Math is used in many real-world experiences. Create a children's book that incorporates the concept of variables and at least one of the formulas listed below. Your book should have a cover, illustrations and a story line that is appropriate for children.

Use the simple interest formula $I = prt$ to evaluate the amount of interest earned.
Use the formula $d = rt$ to evaluate distances.
Use the formula $B = \frac{h}{a}$ to evaluate batting averages.

TIC-TAC-TOE ~ BANK INTEREST



Many financial calculations involve interest. Interest is the money you pay to the bank (in the case of a loan) or the bank pays you (in the case of a savings account). In **Lesson 9**, you learned to use the simple interest formula $I = prt$ where I is the interest, p is the principal, r is the interest rate per year and t is the time in years. Most banks do not use simple interest for savings accounts. They use a type of interest called compound interest.

Simple interest only earns interest based on the original deposit made. With compound interest, you earn interest on the original deposit as well as on the interest you have already received. To calculate *annual* (or yearly) compound interest, use the formula $A = p(1 + r)^t$ where A represents the ending balance in the account.

Example: Susan invested \$2,000 in an account where interest is compounded yearly. She leaves the money in the account which earns 4% interest. How much will she have in five years?

$$\begin{aligned} p &= 2,000 \\ r &= 0.04 \\ t &= 5 \end{aligned}$$



$$\begin{aligned} A &= 2,000(1 + 0.04)^5 \\ A &= 2,000(1.04)^5 \\ A &= \$2,433.31 \end{aligned}$$

Find the total amount of money in an account that is compounded annually based on the information below.

1. \$1,000 for three years in an account earning 3% interest
2. \$8,000 for ten years in an account earning 4.5% interest
3. \$500 in an account earning 7% interest for five years

Pretend you have been given \$5,000 to place in a savings account for six years.

4. Research a minimum of four banks to determine the current savings account interest rate. Print a copy of the bank's web site or attach a brochure from the bank that shows the current interest rate.
5. Determine how much you would have in six years if you invested your money in each bank (assume the bank compounds annually).
6. At which bank would you open up a savings account?
7. What is the total difference, in dollars, of the best option to the worst option?

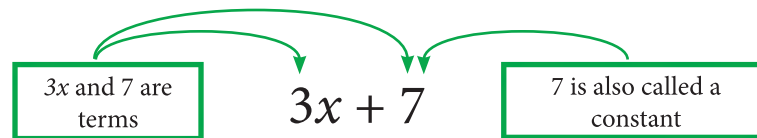
SIMPLIFYING ALGEBRAIC EXPRESSIONS

LESSON 10



Recognize and combine like terms to simplify algebraic expressions.

Every algebraic expression has at least one **term**. A term is a number or is the product of a number and a variable. Terms are separated by addition and subtraction signs. A **constant** is a term that has no variable.



Algebraic expressions often have **like terms** that can be combined. Like terms are terms that have the same variable. All constants are like terms. The **coefficient**, the number multiplied by a variable in a term, does not need to be the same in order for the terms to be like terms.

EXAMPLE 1

Match pairs of like terms.

$6x$

$2y$

$3m$

x

x can also be written $1x$

9

$3m$

5

$14y$

SOLUTION

There are four pairs of like terms. Each pair of like terms has the same variable or no variable.

$6x$ and x

$2y$ and $14y$

9 and 5

$3m$ and $3m$



In order to simplify an algebraic expression you must combine all like terms. When combining like terms you must remember that the operation in front of the term (addition or subtraction) must stay attached to the term. Rewrite the expression by grouping like terms together before adding or subtracting the coefficients to simplify.

EXAMPLE 2

Simplify each algebraic expression by combining like terms.

- a. $4x + 3x + 5x$
 b. $8y + 6 + 3 + 4y + 1$
 c. $9m + 10p - 3p - 2m + 4m$
 d. $4d + 12 + d - 12$

SOLUTIONS

- a. All terms are alike so add the coefficients together.

$$4x + 3x + 5x = 12x$$

- b. There are two types of like terms in this algebraic expression. There are constants and terms that have the y variable. Rewrite the expression so the like terms are next to each other.

$$\begin{array}{ccccccc} 8y & + & 6 & + & 3 & + & 4y & + & 1 \\ \downarrow & & & & & & \downarrow & & \\ 8y & + & 4y & + & 6 & + & 3 & + & 1 \\ \downarrow & & \downarrow & & \downarrow & & \downarrow & & \\ 12y & + & 10 & & & & & & \end{array}$$

Add the coefficient of the like terms together.

- c. Group the like terms together. The addition or subtraction sign must stay attached to the term.

$$\begin{array}{ccccccc} 9m & + & 10p & - & 3p & - & 2m & + & 4m \\ \downarrow & & & & & & \downarrow & & \\ 9m & - & 2m & + & 4m & + & 10p & - & 3p \\ \downarrow & & \downarrow & & \downarrow & & \downarrow & & \\ 11m & + & 7p & & & & & & \end{array}$$

Add or subtract the coefficients of the like terms.

- d. Group like terms together. If a variable does not have a coefficient written in front of it, then the coefficient is 1.

$$\begin{array}{ccccccc} 4d & + & 12 & + & d & - & 12 \\ \downarrow & & & & \downarrow & & \\ 4d & + & d & + & 12 & - & 12 \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ 5d & + & 0 & = & 5d & & \end{array}$$

Add or subtract the coefficients of the like terms.

Zero does not need to be written.



EXERCISES

Simplify each algebraic expression by combining like terms.

1. $4y + 2y + 3y$

2. $8x + x - 5x$

3. $10m - 4m + 2m - 3m$

4. $5x + 9y + 3x - 2y$

5. $14p + 8 + 1 - 14p$

6. $11 + 5d - 3d - 4$

7. $22u - 6u + 4t + 4t - 8u$

8. $x + y + x + x + 2y - x$

9. $15 + 8n + 3n - 2 - 13$

10. $23m + 4n - 3m$

11. $5 + 13 + 4f - f + 1$

12. $2x + 1 - x + 6x - 1$

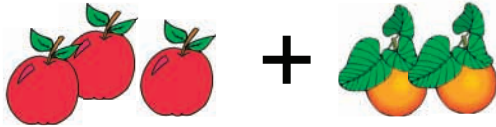
13. $4g + 5k + 2g + 8h + k + 2h$

14. $3 + 10y + 14 - 10y - 17$

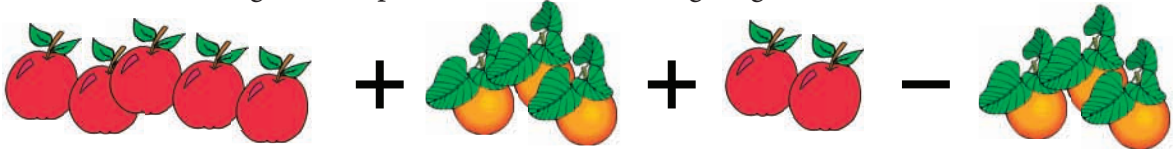
15. $a + 4b + c - a + 3c - 3b$

16. Let each apple = x and each orange = y .

a. Write an algebraic expression that represents the following diagram.



b. Write a four-term algebraic expression for the following diagram:



c. Simplify the algebraic expression from part b. How many terms does this expression have?

17. In your own words explain how you can tell when terms are like terms.

18. Write an algebraic expression that has terms that can be combined. Simplify your algebraic expression.

REVIEW

Evaluate each algebraic expression when $x = 3$.

19. $2x - 1$

20. $\frac{2x + 2}{9}$

21. $\frac{1}{3}x + 5$

22. $(x + 3)^2$

23. $(x + 2)^2$

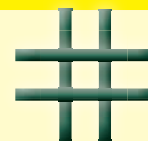
24. $20 - 5x$

25. $\frac{x}{3} + 2$

26. $4(x + 7)$

27. $\frac{x}{6} + \frac{1}{3}$

TIC-TAC-TOE ~ POPULATION DENSITY



The human population of different areas of the world can be studied by examining population density. Population density most often describes the number of people per square mile. You can calculate population density by using a formula.

$$\text{Population Density} = \frac{\text{population}}{\text{area in square miles}}$$

Example: Oregon's population in 2006 was about 3.7 million. The State of Oregon is approximately 96,000 square miles. The population density of Oregon in 2006 was:

$$\text{Population Density} = \frac{3700000}{96000} \approx 39 \text{ people per square mile.}$$

1. Approximately 36 million people lived in the State of California in 2006. California is approximately 156,000 square miles. Find the population density.
2. About 128 million people live in Japan. The entire country of Japan is only 146,000 square miles. Find the population density of Japan.
3. One of the most populated areas in the United States is Washington DC. The size of Washington DC is approximately 61 square miles. The population of Washington DC was 582,000 in the year 2006. What was the population density of Washington DC in 2006? Would you like to live in a place this densely populated?
4. Which state do you think has the lowest population density? Research that state to find the most recent population count and the size of the state in square miles. Calculate the population density.
5. There are approximately 6.6 billion humans on earth. There are 58 million square miles on Earth where humans can live. What is the population density of the Earth?
6. Find the population and size (in square miles) of your county on the internet. What is the population density of your county?
7. Do you think the population density of your county will increase or decrease in the next ten years? Explain your answer.

THE DISTRIBUTIVE PROPERTY

LESSON 11



Use the Distributive Property to perform calculations.

Davis High School sold coupon books as a fundraiser. Each coupon book cost \$12. One student sold 8 coupon books. Another student sold 14 coupon books.

To figure out how much money these two students brought in for the fundraiser, multiply the cost per coupon book times the total number of books sold.



METHOD 1	METHOD 2
Cost per book \times books sold by Student #1 $+$ Cost per book \times books sold by Student #2 $\$12 \cdot 8 = \96 $+ \$12 \cdot 14 = \168 TOTAL = \$264	Cost per book \times total number of books sold $= \$12 (8 + 14)$ $= \$12(8) + \$12(14)$ $= \$96 + \168 $= \$264$

The coupon book example illustrates the **Distributive Property**. The Distributive Property is an important property that allows you to simplify computations or algebraic expressions that include parentheses.

EXAMPLES OF THE DISTRIBUTIVE PROPERTY

$$5(3 + 6) = 5(3) + 5(6)$$
$$7(9 - 4) = 7(9) - 7(4)$$

EXAMPLE 1

Rewrite each expression using the Distributive Property. Evaluate.

a. $7(11 + 3)$

b. $6(8 - 2)$

c. $3(2.2 + 4)$

SOLUTIONS

a. $7(11 + 3) = 7(11) + 7(3) = 77 + 21 = 98$

b. $6(8 - 2) = 6(8) - 6(2) = 48 - 12 = 36$

c. $3(2.2 + 4) = 3(2.2) + 3(4) = 6.6 + 12 = 18.6$

The Distributive Property is very useful when doing mental math calculations. Certain numbers are easier to multiply together than others. In the next example, notice how you can rewrite a number as a sum or difference of two other numbers. If you choose numbers that are easier to work with, you will be able to do the math mentally.

EXAMPLE 2

Find the product by using the Distributive Property and mental math.

a. $3(102)$

b. $5(197)$

c. $6(4.1)$

SOLUTIONS

- a. Rewrite 102 as $100 + 2$.
Distribute.
Add.

$$\begin{aligned} &= 3(100 + 2) \\ 3(100 + 2) &= 3(100) + 3(2) \\ &= 300 + 6 \\ &= 306 \end{aligned}$$

- b. Rewrite 197 as $200 - 3$.
Distribute.
Subtract.

$$\begin{aligned} &= 5(200 - 3) \\ 5(200 - 3) &= 5(200) - 5(3) \\ &= 1000 - 15 \\ &= 985 \end{aligned}$$

- c. Rewrite 4.1 as $4 + 0.1$.
Distribute.
Add.

$$\begin{aligned} &= 6(4 + 0.1) \\ 6(4 + 0.1) &= 6(4) + 6(0.1) \\ &= 24 + 0.6 \\ &= 24.6 \end{aligned}$$

EXPLORE!**SHOPPING SPREE**

You just won a \$5,000 shopping spree at the mall. Determine if you have any money left after purchasing items for you and your friends during the first day of your shopping spree.

Step 1: You purchased four MP3 players for \$198 each. Use the Distributive Property to rewrite the expression. Choose whether to use + or – between the numbers in the parentheses. Evaluate your expression.

$$4(\$198) = 4(\underline{\quad} \pm \underline{\quad})$$

Step 2: You also purchased eight shirts for \$9.25 each. Use the Distributive Property to rewrite the expression. Evaluate the expression.

$$8(\$9.25) = 8(\underline{\quad} \pm \underline{\quad})$$

Step 3: Next, you purchased seven bottles of perfume for \$104 each. Use the Distributive Property to rewrite the expression. Evaluate the expression.

$$7(\$104) = 7(\underline{\quad} \pm \underline{\quad})$$

Step 4: Finally, you splurged and bought three flat-screen televisions at a cost of \$997 each. Use the Distributive Property to rewrite the expression. Evaluate the expression.

$$3(\$997) = 3(\underline{\quad} \pm \underline{\quad})$$

Step 5: Find the amount of money you have spent. How much money is left of your \$5,000 shopping spree?



EXERCISES

Copy each statement. Fill in the blanks using the Distributive Property.

1. $4(5 + 7) = 4(\underline{\quad}) + \underline{\quad}(7)$

2. $8(12 - 9) = \underline{\quad}(12) - \underline{\quad}(9)$

3. $5(6 + 2) = 5(\underline{\quad}) + \underline{\quad}(\underline{\quad})$

4. $\frac{1}{2}(11 + 4) = \frac{1}{2}(\underline{\quad}) + \underline{\quad}(4)$

5. Jackson works during the summer as a babysitter for the neighbor kids. He earns \$6 for each hour he babysits. On the first day of summer, he works for 4 hours. He babysits for 7 hours on the second day.

- Explain in words how to determine the total amount of money Jackson made during his first two days of babysitting.
- Write an expression and evaluate the total amount of money Jackson earned in two days.



Rewrite each expression using the Distributive Property. Evaluate each expression.

6. $5(6 + 8)$

7. $3(20 + 4)$

8. $6(30 - 1)$

9. $7(6 - 0.2)$

10. $9(3 + 1.2)$

11. $2(60 + 8)$

12. $12(3 + 0.1)$

13. $5(6 + 0.3)$

14. $11(9 - 4)$

15. Explain how the Distributive Property helps in using mental math to find a product.

Find the product by using the Distributive Property.

16. $4(201)$

17. $7(99)$

18. $3(9.2)$

19. $5(1003)$

20. $2(12.98)$

21. $8(305)$



22. Shasta finds six CDs she wants to purchase at the music store. Each CD costs \$14.95.

- Show how Shasta could use the Distributive Property to help mentally calculate the total cost of the CDs.
- How much will she pay for the six CDs?

23. The formula $P = 2(l + w)$ can be used to find the perimeter of a rectangle. Find the perimeter of a rectangular garden with a length of 20 feet and a width of 16 feet.

- 24.** Drew went to the grocery store with \$20. He mentally calculated his total as he put items in his cart so that he would not overspend. Compute the value of the items he put in the cart using the Distributive Property.
- first item: 5 cans of soup for \$0.95 each
 - second item: 3 frozen pizzas for \$3.09 each
 - third item: 4 king-sized candy bars for \$1.05 each
 - What was the total amount for all the items above?
Did Drew have enough money to pay for it all?



- 25.** Susan's entire family took the train to watch a baseball game. The admission to the game was \$8.00 per person. The round-trip pass for the train cost \$4.25 per person. There are 6 people in Susan's family. How much was the total cost of the outing?

Use the Distributive Property to evaluate.

26. $4(5 + 8) + 3(10 + 2)$

27. $3(10 - 3) + 8(20 + 1)$

REVIEW

Evaluate each expression when $x = 2$.

28. $5(x + 1.4)$

29. $(x + 5)^2 + 2x$

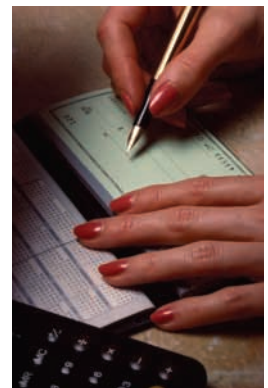
30. $\frac{3x - 2}{6}$

31. $16\left(\frac{1}{2}x + 1\right)$

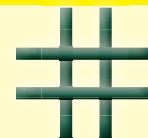


Use the simple interest formula, $I = prt$, to evaluate the amount of interest earned.

- 32.** Find the amount of interest earned when $p = \$200$, $r = 2\%$ and $t = 12$ years.
- 33.** Find the amount of interest earned when $p = \$10,000$, $r = 6\%$ and $t = 2$ years.
- 34.** Peter deposited \$400 in an account for 1 year at 7% interest. How much money did he earn?
- 35.** Lindsey deposited \$150 in an account for 3 years with an interest rate of 10%. J.R. deposited \$400 in an account for 3 years with an interest rate of 4%.
- Predict who will have made more in interest at the end of three years?
 - Calculate how much interest Lindsey and J.R. will have earned at the end of three years. Were you correct?



Tic-Tac-Toe ~ GROCERY SHOPPING



The Distributive Property can help you calculate the cost of items mentally. Prices at grocery stores are rarely in whole dollar amounts, except for sale items. To do this activity, take a trip to a grocery store. Remember that you **DO NOT** need to buy the items on the list, only find the prices.

1. Copy the following table and take it to a local grocery store.
2. Record the normal price per item. **DO NOT USE SALE PRICES.**
3. Determine whether you will use the Distributive Property to calculate the expenses for each item. Write *yes* or *no* in the “Use the Distributive Property” column. Use the Distributive Property for at least 3 items.
4. If you use the Distributive Property, record your expression in the “calculations” column. If you do not use the Distributive Property, record the operations used.
5. Determine the total cost for each item on the list.
6. Determine the total cost of the shopping trip.
7. Explain how you chose when to use the Distributive Property and when not to.

GROCERY STORE:				
Items	Cost Per Item	Use the Distributive Property?	Calculations	Total Cost
3 Boxes of Macaroni & Cheese				
7 Cans of Chili				
6 Containers of Ice Cream				
5 Gallons of Milk				
9 Bags of Pretzels				

USING THE DISTRIBUTIVE PROPERTY WITH VARIABLES

LESSON 12



Simplify expressions with variables.

Many algebraic expressions have parentheses. In order to simplify algebraic expressions with parentheses, the Distributive Property must be used.

THE DISTRIBUTIVE PROPERTY

For any numbers a , b , and c :

$$a(b + c) = a(b) + a(c) \text{ or } ab + ac$$

$$a(b - c) = a(b) - a(c) \text{ or } ab - ac$$

EXAMPLE 1

Use the Distributive Property to simplify each expression.

a. $2(x + 6)$

b. $5(y - 8)$

c. $4(3x - 2)$

SOLUTIONS

a. $2(x + 6) = 2(x) + 2(6) = 2x + 12$

b. $5(y - 8) = 5(y) - 5(8) = 5y - 40$

c. $4(3x - 2) = 4(3x) - 4(2) = 12x - 8$

Only multiply the two coefficients together.
Think of it as 4 groups of $(3x)$.

Algebraic expressions or equations often have like terms that can be combined. If there are parentheses involved in the expression, the Distributive Property must be used **FIRST** before combining like terms.

EXAMPLE 2

Simplify by distributing and combining like terms.

$$5(x + 4) + 3x + 3$$

SOLUTIONS

Distribute first.

$$5(x + 4) + 3x + 3 = 5x + 20 + 3x + 3$$

Use the Commutative Property to group like terms.

$$5x + 3x + 20 + 3$$

Combine like terms.

$$8x + 23$$

$$5(x + 4) + 3x + 3 = 8x + 23$$

EXPLORE!**EQUIVALENT EXPRESSIONS**

Two algebraic expressions are **equivalent expressions** if they represent the same simplified algebraic expression.

In this matching game, each card in the deck has an algebraic expression on it. The goal of the game is to match the six LETTER Expression Cards (A, B, C...) to their equivalent NUMBER Expression Cards (1, 2, 3...).

Step 1: Simplify each LETTER Expression Card.

Step 2: Match each LETTER Expression Card to its equivalent NUMBER Expression Card.

Step 3: Create two more LETTER Expression Cards and the corresponding NUMBER Expression Cards to be used in a future matching game.

LETTER Expression Cards (A-F):

- A: $3(x + 4)$
- B: $2(5x - 3)$
- C: $2(x + 7) + 4x - 4$
- D: $4(x - 2) + 3x$
- E: $10(x + 1) - 7x$
- F: $3(2x + 3) + 8$

NUMBER Expression Cards (1-6):

- 1: $3x + 10$
- 2: $6x + 10$
- 3: $6x + 17$
- 4: $10x - 6$
- 5: $3x + 12$
- 6: $7x - 8$



EXERCISES

Use the Distributive Property to simplify.

1. $5(x + 7)$

2. $3(y - 4)$

3. $6(m + 1)$

4. $7(x - 0.1)$

5. $4(3p + 2)$

6. $2(5x - 6)$

7. $3(20 - x)$

8. $5(2y + 10)$

9. $11(2m - 4)$

10. Use words to explain the steps needed to simplify the following expression.

$$3(x + 6) + 2x + 1$$

11. Write two equivalent expressions. Explain or show how you know the two expressions are equivalent.

Simplify each expression.

12. $6(x + 2) + 4x$

13. $2(3x + 5) - 7$

14. $3(x - 10) - x$

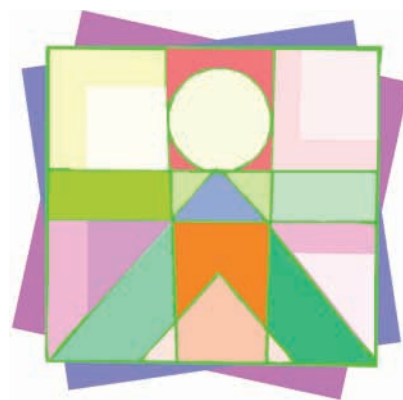
15. $10(x - 2) - 5x$

16. $2(5x + 2) + 3x + 5$

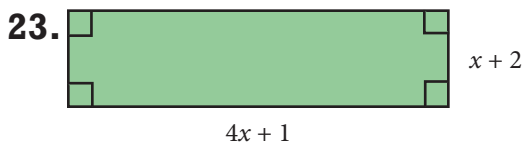
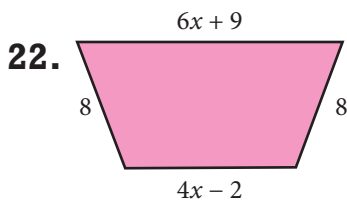
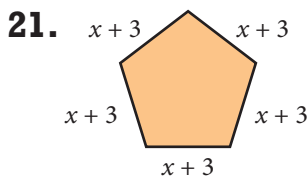
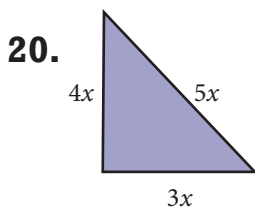
17. $5(x + 4) + x - 8$

18. $3 + 2x + 4(x + 1)$

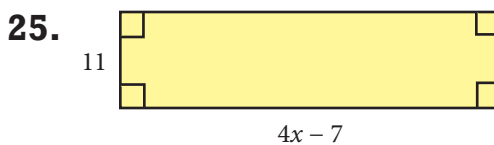
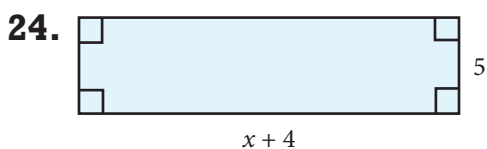
19. $7(2x + 3) - 10$



Write and simplify an expression for the perimeter of each figure.



Write and simplify an expression for the area of each figure.



In each set of three expressions, two are equivalent. Simplify each expression to find the two equivalent expressions.

- 26.** i. $2(x + 7)$
ii. $2(x + 4)$
iii. $2(x + 1) + 6$

- 27.** i. $3(2x + 1)$
ii. $6(x + 1)$
iii. $6(x + 2) - 9$

Use the Distributive Property to simplify.

28. $4(x + 5) + 3(x + 2)$

29. $3(x + 8) + 4(x - 1)$

- 30.** Jeremy states that $4(x + 2)$ is equivalent to $4(2 + x)$. Do you agree with him? Why or why not?

REVIEW

Write an algebraic expression for each phrase.

- 31.** the sum of x and twelve

- 32.** six times x

- 33.** the product of x and seven

- 34.** the quotient of x divided by five

- 35.** Evaluate Exercises 31 - 34 when $x = 25$.

- 36.** A cheetah traveling at full speed covers 1.2 miles per minute.
a. How far will the cheetah travel in 3 minutes?
b. How far will the cheetah travel in 8 minutes?
c. How far will the cheetah travel in m minutes?



TIC-TAC-TOE ~ EXPRESSIONS GAME

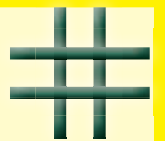


Create a memory card game using equivalent expressions. Create pairs of cards that have expressions that, when simplified, are equivalent. The cards should be made on thicker paper (such as card stock, construction paper, index cards, or poster board). The game must have a minimum of 24 cards.

Below is an example of two cards with equivalent expressions.

$$3x + 7 + 5x + 2$$

$$8x + 9$$



Play the game with a friend, parent or classmate. List each player's name on a sheet of paper. Record each pair of equivalent expressions under the name of the player who won each set.



Vocabulary



algebraic expression
coefficient
constant

Distributive Property
equivalent expressions
evaluate
formula

like terms
term
variable



- Write expressions involving variables.
- Evaluate algebraic expressions.
- Use geometric formulas to find area, perimeter and volume.
- Use formulas in a variety of situations.
- Recognize and combine like terms to simplify algebraic expressions.
- Use the Distributive Property to perform calculations.
- Simplify expressions with variables.

Lesson 6 ~ Variables and Expressions

Write an algebraic expression for each phrase.

- | | |
|----------------------------------|------------------------------|
| 1. nine more than d | 2. one subtracted from p |
| 3. forty less than w | 4. twenty-two divided by m |
| 5. a number y decreased by ten | 6. three times a number x |

Write a phrase for each algebraic expression.

- | | |
|----------------|-------------|
| 7. $6y$ | 8. $d - 9$ |
| 9. $12 \div x$ | 10. $m + 3$ |
11. Gina's Candy Shack sells fudge and caramel apples. A piece of fudge costs \$0.75 less than a caramel apple.
- a. A caramel apple costs \$2.75. How much does a piece of fudge cost?
 - b. A caramel apple costs y dollars. What algebraic expression represents the cost of a piece of fudge?



Lesson 7 ~ Evaluating Expressions

Evaluate each expression.

12. $x - 6$ when $x = 29$

13. $5b + c$ when $b = 4$ and $c = 2$

14. $3y + 2$ when $y = 5$

15. $42 - 2x$ when $x = 20$

16. $\frac{1}{2}m + 6$ when $m = 10$

17. $\frac{w}{7}$ when $w = 7$

Copy each table. Complete each table by evaluating the given expression for the values listed.

18.

x	$5x + 2$
0	
1	
4	
7	

19.

x	$\frac{1}{2}x - 1$
2	
6	
9	
14	

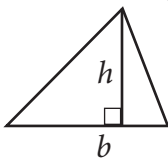
20. Elderberry Elementary School is having a hot dog feed. The staff needs to purchase packages of hot dogs and buns. Each package of hot dogs costs \$2.00 and the packages of buns cost \$1.50 each. The staff uses the algebraic expression $2.00x + 1.50y$ to calculate their total expenses.

- What does the x variable stand for? y variable?
- They end up buying 15 packages of hot dogs and 20 packages of buns. How much will they spend altogether?

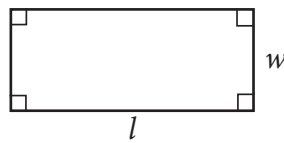


Lesson 8 ~ Evaluating Geometric Formulas

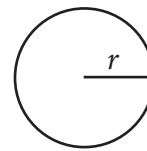
Evaluate each area, perimeter or circumference using the geometric formulas below.



$$\text{Area} = \frac{1}{2}bh$$



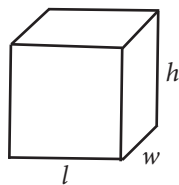
$$\begin{aligned} \text{Area} &= lw \\ \text{Perimeter} &= 2l + 2w \end{aligned}$$



$$\begin{aligned} \text{Area} &= \pi r^2 \\ \text{Circumference} &= 2\pi r \end{aligned}$$

- area of a triangle when $b = 10$ in and $h = 4$ in
- area of a circle when $r = 2$ m (Use 3.14 for π .)
- perimeter of a rectangle when $l = 14$ and $w = 5$
- area of a rectangle when $l = 7$ ft and $w = 6$ ft
- circumference of a circle when $r = 4$ (Use 3.14 for π .)

Evaluate each surface area or volume of a rectangular prism using the geometric formulas below.



$$\text{Volume} = lwh$$
$$\text{Surface Area} = 2(lw + wh + hl)$$

- 26.** volume of a rectangular prism when $l = 6$, $w = 2$ and $h = 5$
- 27.** surface area of a rectangular prism when $l = 2 \text{ cm}$, $w = 1 \text{ cm}$ and $h = 7 \text{ cm}$

Lesson 9 ~ Evaluating More Formulas



Use the simple interest formula, $I = prt$, to evaluate the amount of interest earned.

- 28.** Find the amount of interest earned when $p = \$1,000$, $r = 5\%$ and $t = 4$ years.
- 29.** Abe put \$100 in an account for one year at 6% interest. How much interest did he earn?
- 30.** When Kisha was born, her parents deposited \$2,000 in an account for college. The money was there for 18 years at 8% interest. Use the simple interest formula. How much interest did Kisha's college account earn in 18 years?

Use the formula $d = rt$ to evaluate distances.

- 31.** Find the distance traveled when $r = 8$ miles per hour and $t = 5$ hours.
- 32.** Clint drives at a speed of 62 miles per hour. He drives 4 hours before stopping at a rest stop. How far has he traveled?

Use the formula $B = \frac{h}{a}$ to evaluate batting averages. Round to the nearest thousandth.

- 33.** Find the batting average when $h = 28$ and $a = 88$.
- 34.** Zurina has been up to bat 25 times this season. She has 12 hits. What is her batting average?



Lesson 10 ~ Simplifying Algebraic Expressions

Simplify each algebraic expression by combining like terms.

- 35.** $8x + 2x + 5x$ **36.** $3y + 2 + 6y + 1$ **37.** $11m - 2m + m$
- 38.** $4x + 3y + x - 2y$ **39.** $5y + 10 + 4y - 10$ **40.** $x + y + x + x - x - y$

Lesson 11 ~ The Distributive Property

Rewrite each expression using the Distributive Property and evaluate.

41. $3(20 + 2)$

42. $7(8 + 3)$

43. $4(5 - 0.1)$

44. $10(9 + 0.3)$

Find the product by using the Distributive Property.

45. $5(201)$

46. $8(98)$

47. $4(2005)$

48. $7(10.9)$

49. Melanie buys 8 bags of trail mix. Each bag costs \$1.97.

- Show how Melanie could use the Distributive Property to mentally calculate the total cost of the eight bags of trail mix.
- How much will she pay for all 8 bags of trail mix?



Lesson 12 ~ Using the Distributive Property with Variables

Use the Distributive Property to simplify.

50. $7(x - 3)$

51. $4(x + 10)$

52. $6(2x + 5)$

Simplify each expression.

53. $6(x + 1) + 4x$

54. $2(9x + 10) + 4x - 7$

55. $4(x + 3) + 2x + 5$

56. $10(x - 2) - x$

In each set of three expressions, two are equivalent. Simplify each expression to find the two equivalent expressions.

57. i. $5(x + 2) + 4$

ii. $5(x + 3)$

iii. $5(x + 4) - 5$

58. i. $4(x + 6) - 4$

ii. $2(2x + 10) + 10$

iii. $6(x + 2) - 2x + 8$

CAREER FOCUS

CHRIS
DIGITAL ARCHIVIST
CORVALLIS, OREGON



I am a digital archivist in the library of a University. My job is to create digital objects of historical documents to place on the web. I help oversee all of the scanning, formatting and description writing of the items that we put on the internet for people to see and use. I work every day with important documents and artifacts that are part of our school library. My job is to make sure that these items are accessible to as many people as possible.

I use math in the formatting and scanning of materials that go onto websites. Geometry helps me determine the sizes and shapes of the items that will go on a page. I also use percentages and other mathematical calculations to determine how to get the best quality of photo into a format that people will be able to see. There are many different types of computers and monitors that people use. Math helps me make sure that my websites will look good on any type of equipment.

Most people who want to be digital archivists need to go to college to get an undergraduate degree. After that, they usually need to get a master's degree in library science. To get both degrees takes about six years. There are now many schools in the United States that offer programs for digital archiving.

A good starting salary in this career would be around \$40,000 per year. Most archivists start at a salary around \$30,000 per year. Digital archivists can eventually earn close to \$80,000 per year. There are extra skills you need to have to become a digital archivist. Because of the extra skills, digital archivists tend to make a bit more than other archivists.

There are two things about my job I find especially rewarding. One is the opportunity to work with the writings of historical figures on a daily basis. The second is making these priceless materials available to a wide audience through the digital products I help create.