Lesson 10: Writing and Expanding Multiplication Expressions

Student Outcomes

- Students identify parts of an expression using mathematical terms for multiplication. They view one or more parts of an expression as a single entity.

Classwork

Discussion (4 minutes)

- When we want to show multiplication of two numbers, like 5 and 7, we typically write 5×7, using the "$\times$" to show the operation. When we start to use variables with multiplication, we can use other forms.

  $a \times b$
  $a \cdot b$
  ab
  $(a)(b)$

- Why might we want to use a form other than the $\times$ when variables are involved?
  - *The $\times$ can be confused for a variable instead of a symbol for an operation.*
- Which of the three models can be used to show multiplication where there are no variables involved?
  - 5×7, $5 \cdot 7$ *and* $(5)(7)$*, but not* 57 *because it looks like the number fifty-seven and not five times seven.*

Example 1 (10 minutes)

- When writing expressions using the fewest number of symbols, we will have to refrain from using the symbols $\times$, $\cdot$, or ( ).
- We will also be using math terms to describe expressions and the parts of an expression. We will be using words like factor, product, quotient, coefficient, and term.

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- A term is a part of an expression that can be added to or subtracted from the rest of the expression. In the expression $7g + 8h + 3$, what are examples of terms?
  - $7g$*,* $8h$*, and* 3 *are all terms.*
- A coefficient is a constant factor in a variable term. For example, in the term $4m$, 4 is the coefficient, and it is multiplied with m.

Example 1

Write each expression using the fewest number of symbols and characters. Use math terms to describe the expressions and parts of the expressions.

a. $6 \times b$

$6b$, the 6 is the coefficient and a factor, the b is the variable and a factor. We can call $6b$ the product, and we can also call it a term.

b. $4 \cdot 3 \cdot h$

$12h$, the 12 is the coefficient and a factor, the h is the variable and a factor. We can call $12h$ the product, and we can also call it a term.

c. $2 \times 2 \times 2 \times a \times b$

$8ab$, 8 is the coefficient and a factor; a and b are both variables and factors, and $8ab$ is the product and also a term.

- Variables always follow the numbers and should be written in alphabetical order. Apply this knowledge to the examples below.

d. $5 \times m \times 3 \times p$

$15mp$, 15 is the coefficient and factor; m and p are the variables and factors; $15mp$ is the product and also a term.

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- If it is helpful, you can gather the numbers together and the variables together. You can do this because of the commutative property of multiplication.
  - $5 \times 3 \times m \times p$

e. $1 \times g \times w$

$1gw$ or gw, g and w are the variables and factors, 1 is the coefficient and factor if it is included, and gw is the product and also a term.

- What happens when you multiply by 1?
  - *Multiplying by 1 is an example of the identity property. Any number times 1 is equal to that number. Therefore, we don't always need to write the one because $1 \times gw = gw$.*

Example 2 (5 minutes)

Example 2

To expand multiplication expressions, we will rewrite the expressions by including the " · " back into the expressions.

a. $5g$

$5 \cdot g$

b. $7abc$

$7 \cdot a \cdot b \cdot c$

c. $12g$

$12 \cdot g$ *or* $2 \cdot 2 \cdot 3 \cdot g$

d. $3h \cdot 8$

$3 \cdot h \cdot 8$

e. $7g \cdot 9h$

$7 \cdot g \cdot 9 \cdot h$ *or* $7 \cdot g \cdot 3 \cdot 3 \cdot h$

Example 3 (5 minutes)

Example 3

a. **Find the product of $4f \cdot 7g$.**

- It may be easier to see how we will use the fewest number of symbols and characters by expanding the expression first.

$4 \cdot f \cdot 7 \cdot g$

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- Now, we can multiply the numbers and then multiply the variables.

$4 \cdot 7 \cdot f \cdot g$

$28fg$

b. **Multiply $3de \cdot 9yz$.**

- Let's start again by expanding the expression. Then, we can rewrite the expression by multiplying the numbers and then multiplying the variables.

$3 \cdot d \cdot e \cdot 9 \cdot y \cdot z$

$3 \cdot 9 \cdot d \cdot e \cdot y \cdot z$

$27deyz$

c. **Double the product of $6y$ and $3bc$.**

- We can start by finding the product of $6y$ and $3bc$.

$6 \cdot y \cdot 3 \cdot b \cdot c$

$6 \cdot 3 \cdot b \cdot c \cdot y$

$18bcy$

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- What does it mean to double something?
  - It means to multiply by 2.

$2 \cdot 18bcy$

$36bcy$

Exercises (14 minutes)

Students will be matching expressions on a BINGO board. Some of the expressions will be simplified, and some will be expanded. To save time, provide students with a BINGO board with some of the squares already filled in. Have the remaining answers written on a smart board, chalkboard, or overhead projector so that students can randomly place them on the BINGO board. If there is not enough time for the BINGO game, you can also use these questions on white boards, chalkboards, or some form of personal boards.

Here are the clues to be given during the game, followed by the answers that will be on the board.

Questions/Clues	Answers
1. $10m$	$2 \cdot 5 \cdot \mathrm{m}$
2. $8 \cdot 3 \cdot m$	$24m$
3. Has a coefficient of 11	$11mp$
4. $14mp$	$2 \cdot 7 \cdot m \cdot p$
5. $(3m)(9p)$	$27mp$
6. $11m \cdot 2p$	$22mp$
7. $36m$	$2 \cdot 2 \cdot 3 \cdot 3 \cdot m$
8. $2 \cdot 2 \cdot 2 \cdot 5 \cdot p$	$40p$
9. $7mp \cdot 5t$	$35mpt$
10. $18pt$	$2 \cdot 3 \cdot 3 \cdot p \cdot t$
11. $7 \cdot 2 \cdot t \cdot 2 \cdot p$	$28pt$
12. Has a coefficient of 5	$5mpt$
13. $3 \cdot 3 \cdot 5 \cdot m \cdot p$	$45mp$
14. $5m \cdot 9pt$	$45mpt$
15. $10mp \cdot 4t$	$40mpt$
16. $1mpt$	mpt
17. $45mp$	$3 \cdot 3 \cdot 5 \cdot m \cdot p$
18. $(4mp)(11)$	$44mp$
19. $54mpt$	$3 \cdot 3 \cdot 3 \cdot 2 \cdot m \cdot p \cdot t$
20. Has a coefficient of 3	$3m$

These answers have already been included on pre-made BINGO boards to save time. The other answers can be randomly placed in the remaining spaces.

21. $2 \cdot 2 \cdot 2 \cdot 3 \cdot m \cdot p$	$24mp$
22. $(5m)(3p)(2t)$	$30mpt$
23. $13mp$	$(1mp)(13)$
24. Has a coefficient of 2	$2p$

Closing (3 minutes)

- What is the difference between standard form and expanded form?
  - *When we write an expression in standard form, we get rid of the operation symbol(s) for multiplication, and we write the factors next to each other. Sometimes we might have to multiply numbers together before writing it next to the variable(s). When we write an expression in expanded form, we write the expression as a product of the factors using the "·" symbol for multiplication.*
- How would you describe the following terms?
  1. Factor
     - *A number or variable that is multiplied to get a product.*
  2. Variable
     - *A letter used to represent a number.*
  3. Product
     - *The solution when two factors are multiplied.*
  4. Coefficient
     - *The numerical factor that multiplies the variable.*

Lesson Summary

AN EXPRESSION IN EXPANDED FORM: An expression that is written as sums (and/or differences) of products whose factors are numbers, variables, or variables raised to whole number powers is said to be in *expanded form*. A single number, variable, or a single product of numbers and/or variables is also considered to be in expanded form.

Note: Each summand of an expression in expanded form is called a *term*, and the number found by multiplying just the numbers in a term together is called the *coefficient of the term.* After the word "term" is defined, students can be shown what it means to "collect like terms" using the distributive property.

Expressions in expanded form are analogous to polynomial expressions that are written as a sum of monomials. There are two reasons for introducing this term instead of the word polynomial. (1) In the Common Core State Standards, the word "polynomial" cannot be formally defined before high school, but we need the idea behind the word much sooner. (2) The progressions are very clear about not asking problems that state, "Simplify." However, they do describe "standard form" in the progressions, so we may ask students to put their answers in standard form. To get to standard form, we ask students to expand the expression and then collect like terms.

AN EXPRESSION IN STANDARD FORM: An expression that is in expanded form where all like terms have been collected is said to be in *standard form.*

Note: We cannot ask students to "Simplify," but we can ask them to "Put an expression in standard form," or "Expand the expression and collect all like terms."

Exit Ticket (4 minutes)

Name _____ Date _____

Lesson 10: Writing and Expanding Multiplication Expressions

Exit Ticket

1. Rewrite the expression in standard form (use the fewest number of symbols and characters possible).
   a. $5g \cdot 7h$

   b. $3 \cdot 4 \cdot 5 \cdot m \cdot n$

2. Name the parts of the expression. Then, write in expanded form.
   a. $14b$

   b. $30jk$

Exit Ticket Sample Solutions

1. Rewrite the expression in standard form (use the fewest number of symbols and characters possible).
   a. $5g \cdot 7h$

      $35gh$

   b. $3 \cdot 4 \cdot 5 \cdot m \cdot n$

      $60mn$

2. Name the parts of the expression. Then, write it in expanded form.
   a. $14b$

      $14 \cdot b$ *or* $2 \cdot 7 \cdot b$

      14 is the coefficient, b is the variable, and $14b$ *is a term and the product of* $14 \times b$.

   b. $30jk$

      $30 \cdot j \cdot k$ *or* $2 \cdot 3 \cdot 5 \cdot j \cdot k$

      30 is the coefficient, j and k are the variables, and $30jk$ *is a term and the product of* $30 \cdot j \cdot k$.

Problem Set Sample Solutions

1. Rewrite the expression in standard form (use the fewest number of symbols and characters possible).
   a. $5 \cdot y$

      $5y$

   b. $7 \cdot d \cdot e$

      $7de$

   c. $5 \cdot 2 \cdot 2 \cdot y \cdot z$

      $20yz$

   d. $3 \cdot 3 \cdot 2 \cdot 5 \cdot d$

      $90d$

2. Write the following expressions in expanded form.
   a. $3g$

      $3 \cdot g$

   b. $11mp$

      $11 \cdot m \cdot p$

c. $20yz$

$20 \cdot y \cdot z$ *or* $2 \cdot 2 \cdot 5 \cdot y \cdot z$

d. $15abc$

$15 \cdot a \cdot b \cdot c$ *or* $3 \cdot 5 \cdot a \cdot b \cdot c$

3. **Find the product.**

a. $5d \cdot 7g$

$35dg$

b. $12ab \cdot 3cd$

$36abcd$

$2 \bullet 5 \bullet m$				$35mpt$
$45mp$	$40p$		$24m$	$2 \bullet 3 \bullet 3 \bullet p \bullet t$
	$2 \bullet 7 \bullet m \bullet p$			$11mp$
$28pt$			$22mp$	$2 \bullet 2 \bullet 3 \bullet 3 \bullet m$
$27mp$		$5mpt$		$45mpt$

$22mp$		$40p$		
	$28pt$		$2 \bullet 5 \bullet m$	$2 \bullet 2 \bullet 3 \bullet 3 \bullet m$
	$45mp$			$35mpt$
$24m$			$45mpt$	$27mp$
$2 \bullet 7 \bullet m \bullet p$	$5mpt$		$11mp$	$2 \bullet 3 \bullet 3 \bullet p \bullet t$

$45mp$	$40p$			$24m$
$2 \bullet 3 \bullet 3 \bullet p \bullet t$	$5mpt$	$22mp$		
$11mp$			$45mpt$	$2 \bullet 2 \bullet 3 \bullet 3 \bullet m$
	$27mp$	$2 \bullet 7 \bullet m \bullet p$		$28pt$
	$2 \bullet 5 \bullet m$		$35mpt$	