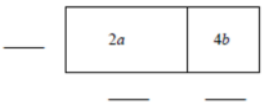
GRADE 7 - MODULE 6 - EXPRESSIONS

Big Idea
The properties of operations can be used to generate equivalent expressions in supporting adding, subtracting, factoring and expanding linear expressions.
Vocabulary
coefficients, like terms, associative, commutative and distributive properties, factor, numeric expressions, algebraic expressions, simplify, evaluate, substitute, verbal expressions, variable, constant, equivalent expressions, term, prime factorization
Prior Learning
Students in Grade 6 worked with order of operations and properties of operations to rewrite equivalent numerical expressions, and read, write and evaluate expressions involving variables.
Essential Questions
• How can applying the properties of operations help us add and subtract with linear expressions? • How can applying the properties of operations help us factor and expand linear expressions? • What is the difference between an algebraic expression and a verbal expression? • How can rewriting an expression help us to solve real-world problems? • What rules and properties do you follow when simplifying expressions? • Explain how you can determine if two expressions are equivalent. • Describe the process of factoring an expression. • Describe the process of expanding an expression.
Competencies
• Write algebraic expressions from mathematical and real-world situations. • Create a situation or word problem matching an algebraic expression • Write an expression in simplest form (combining like terms) • Evaluate and simplify expressions using addition, subtraction, factoring and expansion.
Misconceptions
• Students may confuse the order of operations when variables are introduced. • Students may incorrectly factor or expand linear expressions based on former experience with the properties.
Resources from The Key Elements to Mathematics Success - KEMS Grade 7 for Building the Conceptual Understanding of this Module
KEMS LESSON 16: PROPERTIES OF OPERATIONS WITH EXPRESSIONS Additional Activities: Quiz – T389-T390, Chain Reaction T967 KEMS LESSON 17: WRITING EQUIVALENT EXPRESSIONS FOR REAL WORLD APPLICATIONS Additional Activities: Quiz – T411-T412, Scavenger Hunt T968-T969

Mathematics Content Standards	Examples
7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.	Students will apply properties of operations and combining like terms with rational numbers (integers and positive / negative fractions and decimals) to write equivalent expressions. Example 1: What is the length and width of the rectangle?  Solution: The Greatest Common Factor (GCF) is 2, which will be the width because the width is in common to both rectangles. To get the area 2a multiply by a, which is the length of the first rectangles. To get the area of 4b, multiply by 2b, which will be the length of the second rectangle. The final answer will be 2(a + 2b) Example 2: Write an equivalent expression for $3(x+5)-2$. Solution: $3x+15-2$ Distribute the 3 $3x+13$ Combine like terms Example 3: Suzanne says the two expressions $2(3a-2)+4a$ and $10a-2$ are equivalent? Is she correct? Explain why or why not? Solution: The expressions are not equivalent. One way to prove this is to distribute and combine like terms in the first expression to get $10a-4$, which is not equivalent to the second expression. A second explanation is to substitute a value for the variable and perform the calculations. For example, if 2 is substituted for a then the value of the first expression is 16 while the value of the second expression is 18. Example 4: Write equivalent expressions for: $3a+12$. Solution: Possible solutions might include factoring as in $3(a+4)$, or other expressions such as Example 5: A rectangle is twice as long as its width. One way to write an expression to find the perimeter would be $w+w+2w+2w$. Write the expression in two other ways. Solution: $6w$ or $2(3w)$ Example 6: An equilateral triangle has a perimeter of $6x+15$. What is the length of each side of the triangle? Solution: $3(2x+5)$, therefore each side is $2x+5$ units long.

Questions for 7.EE.1

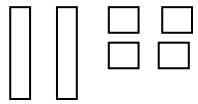
1. Evaluate the algebraic expression. $2a + b$, if $a = 3$ and $b = 4$

Show and explain your work.

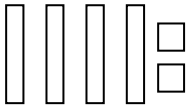
2. Brandon and Jason were using algebra tiles to represent algebraic expressions.

The expression they were working on was $2x + 4$. Look at the two representations and determine which one is correct. Explain your answer.

Brandon



Jason



3. A triangle has three sides with the following measures:

Side 1: $x + 3$ Side 2: $2x - 1$ Side 3: $3x + 2$

Write an expression to represent the perimeter of the triangle.

Use the properties of equality to complete the following statement.

$(x + 3) + (2x - 1) + (3x + 2) =$ _____

4. Explain how to factor the expression $10x + 25$ using the box method.

5. Write an equivalent expression for $4(x + 7) - 9$

A. $4x + 19$ B. $4x - 2$ C. $4x - 63$ D. $4x + 28$

6. A rectangle is seven times as long as its width. One way to write an expression to find the perimeter would be $m + 7m + m + 7m$. Write the expression in two other ways.

Answer Key for Questions for 7.EE.1

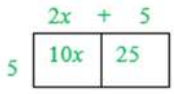
1. Evaluate: $2a + b$ = if $a = 3$ and $b = 4$

Substitute in the values of 3 for a and 4 for b and simplify the expression $2(3) + 4 = 6 + 4 = 10$

2. Brandon's representation is correct. Each of the long tiles represents x so two long tiles represent 2x. Each square tile represents a unit so four of them represent 4.

3. $(x + 3) + (2x - 1) + (3x + 2) = 6x + 4$

4. $10x + 25$ Write the expression in a box. Find the GCF of 10x and 25. Place that value to the left of the box. Divide each of the parts of the expression by the GCF.



5. $4(x + 7) - 9$ $4x + 28 - 9$ A. $4x + 19$

6. $2(m + 7m)$ $16m$

Tasks for 7.EE.1

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Miles to Kilometers

https://tasks.illustrativemathematics.org/content-standards/7/EE/A/tasks/433

Illustrative Math Task: Equivalent Expressions?

https://tasks.illustrativemathematics.org/content-standards/7/EE/A/tasks/543

Illustrative Math Task: Writing Expressions
https://tasks.illustrativemathematics.org/content-standards/7/EE/A/1/tasks/541

Extra Questions for Warm-ups and Homework for 7.EE.1

1. Draw a representation of the following expressions using algebra tiles:

$4x + 2$ $3x - 1$ $2x + 6$

2. There is a rectangle that has a width that is x units. The length of the rectangle is three times the width. Write an algebraic expression that can be used to represent the perimeter of the rectangle.

3. Use a pictorial representation to explain whether or not the following expressions are equivalent:

$3x + 2 + x$ and $4x + 4 - 2$

4. A rectangle has an area of $4x + 24$. If the length of the rectangle is $2x + 12$, what is the width?

5. Draw a rectangle that has an area of $6x + 36$ and give possible dimensions for the length and width.

6. There is a rectangle with a length of $5.6x$ and a width of 3. What is the area of the triangle?

Mathematics Content Standards	**Examples**
7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*	Students write an expression in terms of a contextual situation. For example, students understand that a 20% discount is the same as finding 80% of the cost, c $(0.80c)$. Example 1: All varieties of a certain brand of cookies are $3.50. A person buys peanut butter cookies and chocolate chip cookies. Write an expression that represents the total cost, T, of the cookies if p represents the number of peanut butter cookies and c represents the number of chocolate chip cookies Solution: Students could find the cost of each variety of cookies and then add to find the total. $T = 3.50p + 3.50c$ Or students could recognize that multiplying 3.50 by the total number of boxes (regardless of variety) will give the same total. $T = 3.50(p + c)$ Example 2: Jamie and Ted both get paid an equal hourly wage of $9 per hour. This week, Ted made an additional $27 dollars in overtime. Write an expression that represents the weekly wages of both if J = the number of hours that Jamie worked this week and T = the number of hours Ted worked this week? What is another way to write the expression? Solution: Students may create several different expressions depending upon how they group the quantities in the problem. Possible student responses are: Response 1: To find the total wage, first multiply the number of hours Jamie worked by 9. Then, multiply the number of hours Ted worked by 9. Add these two values with the $27 overtime to find the total wages for the week. The student would write the expression $9J + 9T + 27$. Response 2: To find the total wages, add the number of hours that Ted and Jamie worked. Then, multiply the total number of hours worked by 9. Add the overtime to that value to get the total wages for the week. The student would write the expression $9(J + T) + 27$. Response 3: To find the total wages, find out how much Jamie made and add that to how much Ted made for the week. To figure out Jamie's wages, multiply the number of hours she worked by 9. To figure out Ted's wages, multiply the

number of hours he worked by 9 and then add the $27 he earned in overtime. My final step would be to add Jamie and Ted wages for the week to find their combined total wages. The student would write the expression $(9J)+(9T+27)$.

Example 3: Given a square pool as shown in the picture, write four different expressions to find the total number of tiles in the border. Explain how each of the expressions relates to the diagram and demonstrate that the expressions are equivalent. Which expression is most useful? Explain.

Questions for 7.EE.2

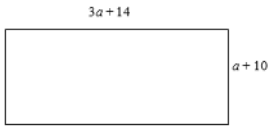
1.

Find an equivalent expression by combining like terms:	**Factor the expression:**
$5x + 7 - 4x + 13$	**$12b + 18$**

2. David has a lawn moving business. He is trying to figure out how much money he will make this week. He charges $20 per lawn and an additional $15 fee for trimming the edges of each lawn. Write an expression that can be used to determine how much money he will earn for mowing any number of lawns.

Is there a way that you can rewrite the expression by using the distributive property?

3. Find the perimeter of the rectangle below. Write the expression two different ways by applying the distributive property.



4. Paul has been saving his money to buy a new video game system. When he went to purchase the game system, it was on sale for 15% off the regular price. Write the expression that can be used to determine the sale price of the game system in two different ways.

5. Victoria has a dog. The dog's tail is 2 inches long. Every year his tail grows by 5%. Write an equation and use it to determine what will be his tail's length next year.

A. $2 + (2 \cdot 0.05) = 21$ inches B. $2 + (2 \cdot 0.05) = 2.21$ inches

C. $2 + (2 \cdot 0.05) = 2.1$ inches D. $2 + (2 \cdot 0.05) = 2.11$ inches

6. Joe weighs 105 pounds. Every year his weight increases by 3 pounds. What will be his weight next year?

7. Rachel fills 13 water bottles per hour. Alyssa fills 15 bottles of water per hour. This week Alyssa filled an additional 5 bottles of water. Write an expression that represents the weekly number of water bottles filled.

r = the number of hours that Rachel filled bottles this week

a = the number of hours Alyssa filled the bottles this week
Answer Key for Questions for 7.EE.2
1. $5x + 7 – 4x + 13 = x + 20$ $12b + 18 = 6(2b + 3)$ **2. $20x + 15$ $5(4x + 3)$** **3. $3a + 14 + a + 10 + 3a + 14 + a + 10$; $2(3a + 14) + 2(a + 10)$; $6a + 28 + 2a + 20$; $8a + 48$** **4. $G = 0.85x$; $G = 1 – 0.15x$** **5. C. $2 + (2 \cdot 0.05) = 2.1$ inches** **6. Joe will weigh 108 pounds next year** **7. $13r + (15a + 5)$**
Tasks for 7.EE.2 *Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.
Illustrative Math Task: Miles to Kilometers https://tasks.illustrativemathematics.org/content-standards/7/EE/A/tasks/433 Illustrative Math Task: Ticket to https://tasks.illustrativemathematics.org/content-standards/7/EE/A/2/tasks/1450 Illustrative Math Task: Equivalent Expressions? https://tasks.illustrativemathematics.org/content-standards/7/EE/A/tasks/543
Extra Questions for Warm-ups and Homework for 7.EE.2
1. Write two different expressions for the following real-world situation by applying the distributive property. Jenny and her friend Kianda are making bracelets. They each have 4 boxes of beads and Kianda has 50 extra beads. **2.** Linda is purchasing a pair of sneakers that are on sale for 20% the regular price. Write two expressions that can be used to determine the cost of any pair of sneakers that are on sale for 20% off the regular price. **3**. Susan found the perimeter of a rectangle to be 12x + 14. She wrote the answer as 14 + 12x. Are the two expressions equivalent? Explain your answer using what you know about properties.

Works Referenced in the Development of the Module	
Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parcconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	