Grade 7 Algebraic Expressions

VSC Standard 1.0 Knowledge of Algebra, Patterns, and Functions: Students will algebraically represent, model, analyze, or solve mathematical or real-world problems involving patterns or functional relationships.
VSC Topic B. Expressions, Equations, and Inequalities
VSC Indicator 1. Write and evaluate expressions
VSC Objectives: a. Write an algebraic expression to represent unknown quantities **b.** Evaluate algebraic expressions
Clarification: The clarification is an explanation of the indicator and objective and how these math concepts appear in the puzzle.
Materials and/or Set Up: ***Interactive Resource 1, Interactive Resource 2, Interactive Resource 3, Assessment,*** *a* clean empty soup can labeled 15 ounces, a clean empty tuna can labeled 6 ounces, 5 markers, and 5 pencils
Math Discussion Terms: numerical expression, algebraic expression, variable
Note to Teacher: Students should have attempted Level 1 of the Lab Puzzles (Product Development Testing Lab 1) before this lesson seed is implemented. In the implementation of this lesson, it is recommended that the *Interactive Resources* be projected to encourage a rich and active discussion of math strategies and concepts.
Activities: **1.** After students have played level 1 of the Lab puzzle (Product Development Testing Lab 1), discuss students' experiences. Have them explain how they were able to follow the recipe and what happened as a result of their trials. **2.** Illustrate this scenario to students: You are making a batch of your grandmother's cookies, but you have run into a problem. You only have two measuring cups, one which holds 6 ounces and one which holds 15 ounces. (Hold up the two labeled cans.) Your grandmother was very clear about following the recipe and cautioned you that putting the wrong amount of ingredients into the batter would yield poor results. The recipe calls for 12 ounces of flour, 9 ounces of sugar and 3 ounces of milk. Using the measuring cups that you have, how could you measure out exactly 12 ounces? *(You could use the 6 ounces can twice to get a total of 12 ounces.)* What about 9 ounces of sugar? *(Fill up the 15 ounce can, and then pour sugar into the 6 ounce can until it is full. This will leave 9 ounces in the 15 ounce can.)* What about 3 ounces of milk? *(Fill the 15 ounce can then pour milk into the 6 ounce can two times, which leaves you with 3 ounces in the 15 ounce can.)* **3.** Use ***Interactive Resource 1*** and discuss with students how to develop **numerical**

expressions for the four ingredients in the formula using the given buckets of 15, 7, and 4. Post students' examples.

[Possible solution: $14\ eyes = 7+7$

$9\ carrots = (7-4)+(7-4)+(7-4)$

$5\ flowers = 4+4+4-7$

$2\ bugs = (7-4)+(7-4)-4$ **or** $(15-7-7)+(15-7-7)$]

4. Discuss how some of the ingredient amounts could be obtained in more than one way. Share the two solutions for the 2 bugs with the students. Ask the students which solution they would choose and why? *(Point out that in the game, players want to minimize waste so it might be more efficient to use the first solution.)*
5. Introduce the term **algebraic expression** and have students work together to come up with a definition. (*Possible definition:* An expression that contains sums and/or products of numbers and **variables**.) Hold up 2 markers and 3 pencils. Explain that we can use **variables**, m and p, to represent the markers and pencils. An **algebraic expression** representing the 2 markers and 3 pencils could be 2m + 3p. Ask students what would happen to the expression if 2 more markers are added. (*2m + 3p + 2m = 4m + 3p).* Continue holding up various combinations of markers and pencils and have the students provide the **algebraic expressions** that represent the amounts. Using an **algebraic expression** such as 4m + 2p, have students explain what that means.
6. Return the students' attention to ***Interactive Resource 1***. Discuss the idea of assigning variables to the buckets as follows:
   a = 15 (*the capacity of bucket 1)*
   b = 7 (*the capacity of bucket 2*)
   c = 4 (*the capacity of bucket 3)*
7. Using the variables, suggest that a related **algebraic expression** can be written for each of the **numerical expressions**. For example, 14 eyes = $7+7 = b+b$
   Discuss how "$2b$" is another way of writing "$b+b$" so that $b+b = 2b$.
8. Have students discuss and determine possible **algebraic expressions** for the other three ingredients on ***Interactive Resource 1.***

   [Possible answers:

   $9\ carrots = (b-c)+(b-c)+(b-c) = 3b-3c$

   $5\ flowers = 3c-b$

   $2\ bugs = (b-c)+(b-c)-c$]
9. Pair students and use ***Interactive Resource 2*** to have students discuss and develop **numerical expressions** and then **algebraic expressions** for the four ingredients (*Use a, b, and c as the variables for buckets 1, 2, 3 respectively*)

[Possible solutions:

$14\ eyes = 7+7 = 2b$

$13\ carrots = 7+3+3 = b+2c$

$1\ flower = 7-3-3 = 7-2c$

$8\ bugs = 18-7-3 = a-b-c$] **or** $(b-c)+(b-c)$

10. Have student pairs compare their algebraic expressions (For example the two ways to get 8 bugs) and determine which way is least wasteful. (In the example above, *18-7-3 wastes 10 units and (7-3) + (7-3) wastes 6 units.)*

11. Using ***Interactive Resource 2***, ask students to evaluate the expression 2b + c. Explain how to plug the numbers into the expression to get a solution. Discuss that 2b + c means to add b twice then add c, or in other words add 7 + 7 + 3 to get 17. Have students discuss several additional examples before moving on.

Possible examples:
a – b – c (8)
a – c (15)
2b + 2c (20)

12. Use ***Interactive Resource 3*** and ask students to discuss and evaluate the given expressions below to decide if they are correct. If they are not correct, have students write a new correct expression. Share responses.

a. 13 eyes = 2b+c	*(correct)*
b. 5 carrots=4c-b	*(incorrect; ; possible expression: b – c)*
c. 2 flowers=b-2c	*(correct)*
d. 4 bugs=5c-a	*(incorrect; possible expression: a-b)*

Differentiation Suggestions:

- Students having trouble evaluating expressions can be pulled into a small group and given manipulatives to work with to represent each **algebraic expression**. Show students how to use physical objects to simplify expressions such as:

$$8a + 3b + 4c - 4a - 2b = 4a + b + 4c$$

- Have students play the game *Challenge 24* in homogeneous groups of 3 to 4 students. In this game, students look at 4 numbers on a card and try to use addition, subtraction, multiplication and division to get a total of 24 (*For example given 2, 2, 4, and 9 the student could say 9 + 4 = 13, 13 x 2 = 26, 26 – 2 = 24)*. Struggling students will learn strategies for manipulating numbers to come up with a given total, 24. This activity mirrors what the students must do to gather the correct amount of ingredients in the Lab puzzle. Stronger students can move on to tackle the *Challenge 24* game with fractions.
- For students needing an extra challenge, have students represent the numbers 1 through 10 using four 4's and any available mathematical operation.

Possible Solutions:

$$1 = 4 - 4 + \frac{4}{4};\ 2 = \frac{4}{4} + \frac{4}{4};\ 3 = \frac{4+4+4}{4};\ 4 = (4-4)^4 + 4;\ 5 = \frac{4(4)+4}{4};$$

1. $$6 = \frac{4+4}{4} + 4;\ 7 = \frac{44}{4} - 4;\ 8 = 4+4+4-4;\ 9 = \frac{4}{4} + 4 + 4;\ 10 = \frac{44-4}{4}$$

Assessment:

- Distribute the ***Assessment*** resource sheet

Answers:

1. *2b – a = 2(5) – 6 = 10 – 6 = 4*

2. Part A *3a + 5b + 8c*

Part B *No, Isabelle will not have enough pieces of fruit. Eddie's Fruit Market has 3 boxes of apples, 5 boxes of bananas and 8 boxes of coconuts. The total number of pieces of fruit is 3a + 5b + 8c = 3(12) + 5(20) + 8(6) = 36 + 100 + 48 = 184 pieces of fruit.*

Follow Up:

1. Have students return to the puzzle to apply what they learned in the lesson. Ask: Did the lesson help you to clarify the math in the puzzle? How so? What other strategies could you have used to help you solve the puzzle? Additionally, check student game progress through the Administrator's Tool to determine students' level of understanding.
2. Provide students with the following scenario:

   You are going to bake a cake at your Aunt Sandy's house. The problem is, Aunt Sandy only has two measuring scoops, a 3 oz. scoop and an 8 ounce scoop. The cake recipe you are using is very complicated and must be followed precisely. The recipe calls for between 1 ounce and 12 ounces of various ingredients (milk, orange juice, egg whites and so on). You don't have time to buy more measuring scoops, so you will need to use the ones that you have. The 3 ounce scoop is *a* and the 8 ounce scoop is *b*. Write an expression for each amount (1 ounce through 12 ounces) using the 3 ounce and 8 ounces scoop. Complete the table below:

Desired Measure	Expression
1 ounce	

2 ounces	
3 ounces	
4 ounces	
5 ounces	
6 ounces	
7 ounces	
8 ounces	
9 ounces	
10 ounces	
11 ounces	
12 ounces	

Possible Solutions:

Desired Measure	**Expression**
1 ounce	$a + a + a – b = 3a - b$
2 ounces	$b – a – a = b – 2a$
3 ounces	a
4 ounces	$a + a + a + a – b = 4a - b$
5 ounces	$b – a$
6 ounces	$b + b = 2b$
7 ounces	$a + a + a + a + a – b = 5a - b$
8 ounces	b
9 ounces	$a + a + a$

10 ounces	$b - a + b - a = 2b - 2a$
11 ounces	$a + b$
12 ounces	$a + a + a + a$

Real World Connection:

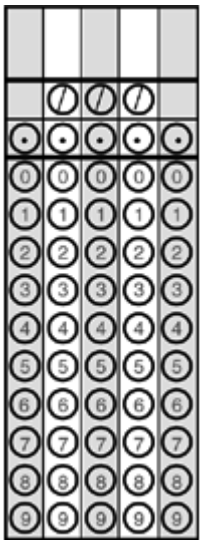
- Provide students with the following scenario:

  You are in charge of buying hot dogs, buns, and napkins to sell at a refreshment stand. The buns you want to buy come in packages of 12; the hot dogs come in packages of 8, and the napkins come in packages of 72. How many packages of each should you buy to be able to sell 288 hot dogs, each on a bun and served in a napkin? *(24 packages of buns, 36 packages of hot dogs, and 4 packages of napkins.)*

Interactive Resource 1

Assessment

1. Evaluate the following expression, $2b - a$, given that $a = 5$, $b = 6$



2. **Part A**

Eddie's Market has 3 boxes of apples, 5 boxes of bananas and 8 boxes of coconuts for sale in the fruit department. Write an expression for the total number of pieces of fruit for sale if a = number of apples in one box, b = number of bananas in one box and c = number of coconuts in one box.

Part B

Isabelle is preparing a large fruit tray for a birthday party. The tray holds 200 pieces of fruit. At Eddie's Market, the apples come 12 to a box, the bananas come 20 to a box and the coconuts come 6 to a box. If she buys all of the fruit at Eddie's Market, will she have enough fruit to cover the tray? Use numbers, symbols and or words to explain your answer.