PBS Lesson Series

Math: Grade 7, Lesson 2, Use Properties of Operations to Generate Equivalent Expressions

Lesson objective: Students will use manipulatives to comprehend how equivalent expressions can be created with a focus on simplifying expressions and understanding why they are equal.
Lesson Focus: This lesson focuses on how to generate equivalent expressions given manipulatives to represent variables. Students will explore how even though two expressions may look different they actually mathematically represent the same value.
TN Standards: 7.EE.A.1 and 7.EE.A.2
Teacher Materials:

- 4 triangles and 4 quadrilaterals (Cut from paper is fine)

Student Materials:

- Student packet for Math, Grade 7, Lesson 2
- Paper and a pencil, and a surface to write on

Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 7th graders out there, though all children are welcome to tune in. This lesson is the second in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!** **If you didn't see our previous lesson, you can find it at www.tn.gov/education. You can still tune in to today's lesson if you haven't see any of our others. But, it might be more fun if you first go back and watch our other lessons since we'll be talking about things we learned previously.** **Today we will be learning about properties of operations to generate equivalent expressions in mathematics! Before we get started, to participate fully in our lesson today, you will need:** • Possible one page student practice material • Paper and a pencil, and a surface to write on • Student packet for math, grade 7, lesson 2, which can be found at www.tn.gov/education **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (5 minutes) **Remember that we can represent situations involving unknowns by using numbers and variables. Today we will discuss how to represent this situation:**	

Tyler and Amy are both given an envelope containing two quadrilaterals and four triangles. The teacher asks them to write an expression that represents the total number of sides in their envelopes. Use *t* for the number of triangles and *q* for the number of quadrilaterals. **Think of a way to represent this situation using numbers and the variables *t* and *q*.** [Allow time for students to think about their reasoning or write down an expression]	Students think of way to write expression to represent total number of sides.
Teacher Model (5 minutes) **Amy says that they have 3*t* + 4*q* + 3*t* + 4*q*** **Tyler says that they have 6*t* + 8*q*** **Who is correct?** Pause. **They are both Correct! Even though the two expressions do not look the same they represent the same quantity. Amy notices that there are three sides on each triangle and since there are two triangles she is able to place two 3*t* terms in her expression. She then does a similar process for the quadrilaterals by adding two 4*q* terms. Tyler on the other hand notices that with the two triangles there are 6 sides all together thus the 6*t* term. By a similar process, he calculates that there are 8 total sides for the two quadrilaterals thus the 8*q* term. So even though Amy's and Tyler's answers look different they still represent the total number of sides.** [Allow time for students to think about their reasoning]	Student responds to question.
Guided Practice (10-15 minutes) **Think of another way to describe the total number of sides in your envelopes.** [Allow time for students to think and write down ideas] **Amy and Tyler look over and notice that another group has written 2(3*t* + 4*q*).** **Is this correct?**	Students think and write down other ways to represent. Students respond to question

What does the "3" represent? Pause. **Right! It appears that the 3 comes from the triangle having 3 sides. What does *4* represent?** Pause. **Good job! A rectangle has 4 sides so the *4* represents the number of sides of the rectangle.** **What does the *2* stand for?** Pause. **The 2 is placed strategically since there are two of each shape.** **How can you prove that all of these expressions are equivalent?** [Allow time for students to think of how to prove] **We can do this by simplifying expressions!** **Let's substitute for *t* and *q* in each expression. If the expressions are equivalent, they should all result in the same number.** **We are going to choose a number for *t* and a number for *q* and determine if the expressions are equivalent.** **Assume we have 8 triangles and 10 quadrilaterals.** **3*t* + 4*q* + 3*t* + 4*q* becomes 3(8) + 4(10) + 3(8) + 4(10) which is 128.** **6*t* + 8*q* becomes 6(8) + 8(10) which is 128.** **2(3*t* + 4*q*) becomes 2(3(8) + 4(10)) which is 128.** **So all of the expressions are equivalent.** **Is there another way to determine equivalence?** [Allow time for students to respond] **Can we rewrite 3*t* + 4*q* + 3*t* + 4*q* so that it looks like 6*t* + 8*q*?** [Allow time for students to respond.] **If we move terms from the 3*t* + 4*q* + 3*t* + 4*q* expression to form 3*t* + 3*t* + 4*q* + 4*q* then we can combine like terms to form 6*t* + 8*q*!** **Can we rewrite 2(3*t* + 4*q*) so that it looks like 6*t* + 8*q*?** [Allow time for students to respond]	Students respond to question. Students respond to question. Students respond to question. Student answers question. Student answers question. Student answers question. Student answers question.

By using the distributive property we can distribute the 2 to the inside the parentheses and rewrite 2(3*t* + 4*q*) as 6t + 8q. **Since all three of these expressions can be simplified to 6t+8q they are all equal.**	
Independent Practice (5 minutes) **Great work, boys and girls! Today, we saw how even though expressions can look different they are actually the same! I hope you're able to make the connections and thank you so much for helping Amy and Tyler out! You sure did a great job! After the video, you will have some problems to practice on your own. Good luck and do your best!**	
Closing (1 min) **I enjoyed doing some mathematics with you today! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series! Bye!**	