

Math: Grade 6, Lesson 1, Evaluating Numerical Expressions

Lesson Focus: Write and evaluate expressions including exponents.

Practice Focus: Evaluating numerical expressions including exponents.

Objective: Students will use the order of operations to evaluate expressions with a focus on exponents.

Key Vocabulary: Expression, exponent, and order of operations

TN Standards: 6.EE.A.1

Teacher Materials:

- Whiteboard and markers

Student Materials:

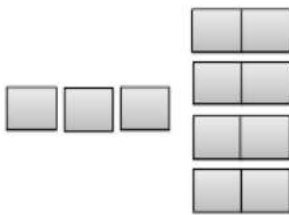
- Paper and a pencil, and a surface to write on
- Calculator, if available

Teacher Do	Student Do
<p>Opening (1 min)</p> <p>Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the first in our series.</p> <p>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!</p> <p>Today we will be learning about evaluating expressions with exponents using the order of operations in mathematics! Before we get started, to participate fully in our lesson today, you will need:</p> <ul style="list-style-type: none"> • Paper and a pencil, and a surface to write on • Calculator, if available <p>Ok, let's begin!</p>	<p>Students get materials ready for the lesson.</p>
<p>Intro (7 minutes)</p> <p>Students evaluate this expression $3 + 4 \times 2$ (Post the following expression on the board)</p> <p>How did you evaluate the expression $3 + 4 \times 2$? (Pause)</p> <p>You probably got 14 or 11 depending on how you solved it. Only one of these answers can be correct. When we evaluate expressions, we must agree to use one set of rules so that everyone arrives at the same correct answer.</p> <p>Let's think about the order mathematicians chose to order operations. What operations did you learn how to solve first? (Pause for students to think.)</p>	<p>Student write and solves the problem.</p> <p>Student answers.</p>

Right - addition and subtraction. Those are the least complicated operations, so they are solved last. After you learned how to add and subtract, you learned how to multiply and divide since they are repeated addition and repeated subtraction. Multiplication and division are more powerful than addition and subtraction, which led mathematicians to develop the order of operations in this way. When we evaluate expressions that have any of these four operations, we always calculate multiplication and division before doing any addition or subtraction. Since multiplication and division are equally powerful, we simply evaluate these two operations as they are written in the expression, from left to right.

Addition and subtraction are at the same level in the order of operations and are evaluated from left to right in an expression. Now that these rules of order of operations are clear, can you go back and evaluate the expression $3 + 4 \times 2$?

[Draw this diagram on the board]



This models the expression. We need to multiply the 4×2 first, then add 3. Therefore, the answer is 11.

Teacher Model (10 minutes)

Let's try a problem with an exponent. Write this problem on your paper. [Write the problem on the board.]

$$90 - 5^2 \times 3$$

Let's see how to solve the problem. What should we solve first? [Pause]

Exponents first, so five squared is five times five which equals 25. [Rewrite the problem to read $90 - 25 \times 3$.] Now, what do you solve next? [Pause]

Students write the problem on their paper.

Students respond.

Students respond.

<p>Correct, the multiplication is solved next, so 25×3 which equals 75. [Rewrite the problem as 90-75.]</p> <p>Finally, we solve 90 minus 75 equals. [Pause]</p> <p>15.</p> <p>Let's take a look at how parentheses and exponents work together. Sometimes a problem will have parentheses, and the values inside the parentheses have an exponent. Let's evaluate the following expression. Write this problem on your paper as I write it on the board.</p> $2 \times (3 + 4^2)$ <p>Which value will we evaluate first within the parentheses? [Pause]</p> <p>First, evaluate four squared, which is 16; then, add 3. The value of the parentheses is 19. [Write the following on the board as you discuss the problem.]</p> $2 \times (3 + 16)$ $2 \times 19]$ <p>Evaluate the rest of the expression. 2 times 19 equals 38.</p> <p>Let's try one more together. Write the following problem on your paper as I write it on the board.</p> $\frac{1}{2}^2 \times 4 + 3$ <p>First, evaluate the one-half squared, so one-half time one-half is one-fourth. Remember when we multiply fractions we multiply the numerators together and multiply the denominators together.</p> $\frac{1}{4} \times 4 + 3$ <p>Next, evaluate one-fourth times four - that equals one. [Continue to work the problem on the board.] Then evaluate $1+3$ equals 4.</p>	<p>Students write the problem on their paper.</p>
<p><u>Guided Practice</u> (10 minutes)</p> <p>Let's evaluate some more expressions. Write this problem on your paper while I write it on the board.</p> $4 + 9^2 \div 3 \times 2 - 2$	<p>Student writes and works the problem.</p>

<p>What operation is evaluated first? [Pause] Exponents. So nine squared equals nine times nine or 81. [Rewrite the problem on the board.]</p> <p>4 + 81 ÷ 3 × 2 – 2</p> <p>What operations are evaluated next? [Pause] Multiplication and division, from left to right. So 81 ÷ 3 = 27, 27 x 2 = 54 [Rewrite the problem]</p> <p>4 + 54 – 2 What operations are always evaluated last? [Pause] Addition and subtraction, from left to right</p> <p>4 + 54 = 56; 56 - 2 = 54</p> <p>What is the final answer? 54</p> <p>Let's do another problem together. Write this problem on your paper while I write it on the board.</p> <p>3 × ½³ + 2</p> <p>What operation is solved first? [Pause] Exponents, so 1/2 × 1/2 × 1/2 = 1/8</p> <p>3 × 1/8 + 2 What operation is solved next? [Pause] That's right – multiplication and division, left to right. So 3 times 1/8 = 3/8</p> <p>3/8 + 2 = 2 3/8</p> <p>Write this problem on your paper as I write it on the board.</p> <p>2 x (3 + 4)²</p> <p>What do you think will happen when the exponent is outside the parenthesis? What should we evaluate first? [Pause] Yes, we add 3 + 4 because it is in the parenthesis. [Rewrite the problem]</p> <p>2 x 7² What do we do next? Exponents – so seven squared or 7 x 7 is 49.</p> <p>2 x 49 = 98</p> <p>You try this one, and then we'll go over it. [Write the problem on the board, and give the student a few minutes to work it.]</p>	<p>Student writes and works the problem.</p> <p>Students write the problem on their paper.</p> <p>Student solves the problem.</p>
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<p>$7 + (12 - 8)^3$</p> <p>We'll solve the parenthesis first. Twelve minus eight equals four. Let's rewrite the problem.</p> <p>$7 + 4^3$</p> <p>We'll do the exponent next. That is $4 \times 4 \times 4 = 64$</p> <p>$7 + 64 = 71$</p>	
<p><u>Independent Practice</u> (1 minute)</p> <p>Great work today! Today, we learned that when we evaluate expressions, we use one set of rules so that everyone arrives at the same correct answer. Grouping symbols, like parentheses, tell us to evaluate whatever is inside them before moving on. These rules are based on doing the most powerful operations first (exponents), then the less powerful ones (multiplication and division, going from left to right), and finally the least powerful ones last (addition and subtraction, going from left to right). We practiced working with exponents to solve expressions. After the video, you will have some problems to practice on your own. Good luck and do your best!</p>	<p>Students will solve the problems after the show.</p>
<p><u>Closing</u> (1 min)</p> <ul style="list-style-type: none"> I enjoyed learning about evaluating numerical expressions 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! 	

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