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| **GRADE: 6** | | |
| **Unit Title: “Let’s Express Ourselves”**  **Lesson Title:** Introduction to Exponents  **Estimated Duration: 60 minutes** | | **Real-World Purpose:**  One example of how exponents do connect with our everyday lives: square feet, square meters, square inches, square miles, square kilometers and any other square units — and cubic feet, cubic meters, cubic centimeters plus any other cubic units actually use exponents in disguise. |
| ***I Can:*** **Standard(s): 6.EE.1:** Write and evaluate numerical expressions involving whole-number exponents. | | |
| **Performance Objective: (Evidence of Learning)**  Students will write and evaluate numerical expressions involving whole-number exponents in exponential form, expanded form, and standard form with 75% accuracy. | | |
| **Prerequisite Skills:**   * Evaluate expressions by solving within parentheses first. * Follow order of operations complete the problem. * Use mathematical symbols appropriately to organize numerical expressions. | | |
| **Materials/Resources:**        • Copy paper for Exponent Vocabulary 6-Door Foldable or vocabulary notebook  • 1 red dot cube and 1 green dot cube per pair of students  • Personal white boards-1 per student • Dry erase markers-1 per student  [• Handout 2.1: Exponents](http://www.mde.k12.ms.us/docs/elementary-education-and-reading-library/math-grade-6-lesson-2_20170612.pdf?sfvrsn=2)  [• Handout 2.2: Exploring Squares](http://www.mde.k12.ms.us/docs/elementary-education-and-reading-library/math-grade-6-lesson-2_20170612.pdf?sfvrsn=2)  • Write Numerical Expressions Involving Whole Number Exponents:  <https://learnzillion.com/lesson_plans/8408-writenumerical-expressions> | | **Key Vocabulary:**   * Numerical expression * Power * Squared * Base * Cubed * Exponent |
| **Elements of Rigor:**   * **Conceptual understanding of key concepts** * **Procedural skill and fluency** | | |
| **Lesson Introduction** | | |
| **Student Exploration Activity**  Display this numeric expression on the board before students arrive: + 2 x 2.5  Instruct students to use prior knowledge of order of operations to find its value. Give students 5 minutes to work. Have students  share solutions with other members of their group. In their group, students compare answers and approaches for solving the  problem (SMP.3). One student from each group records the answer on the board. Discuss student answers and address any  misconceptions that became present in the activity.  Note: Students should be able to defend the method they used to solve the expression, and groups should be able to agree upon  a final solution. | | |
| **Lesson Activities** | | |
| **Activity 1**: Exponent Vocabulary Foldable: Distribute copy paper for vocabulary foldable. Model for students how to fold the paper and how it is used for organizing the vocabulary words. Encourage students to restate the definitions in their own words.    T: Turn your paper landscape style. Fold the paper in half, hamburger style (see dotted lines).  Open the paper up and fold the outer edges to the center fold (see long dashed lines).  Cut as indicated by the solid lines.  You have created 6 flaps, one for each vocabulary word.  Write one vocabulary word on the outside of one flap.  On the inside of each flap, write the corresponding definition.  In the center section, write an example of the vocabulary word.  **\*\*For students who are EL, have disabilities, or perform well below the grade-level:**  • Students begin the activity by working with a partner or small group.  • Students use notes from previous lessons regarding exponents.  **\*\* Extensions for students with high interest or working above grade level:**  • Students thoroughly explain the reason for applying the exponent first in this equation.  Vocabulary Words:  • **Numeric expression**: a mathematical phrase involving only numbers and one or more operational symbols. • **Base**: a number that is to be raised to a power; the factor in the repeated multiplication problem. • **Exponent**: number above the base; tells you how many times the base is being used as a factor. **• Power**: an action in multiplication given the power to multiply a duplicate value times another value. • **Squared**: when you multiply a number by itself. •**Cubed:** when a number is used as factor three times in a multiplication problem.  **Activity 2**: Evaluating Numerical Expressions with Exponents: Highlight the part of the numeric expression in the warm-up problem that has the same number being multiplied by itself five times: 2 x 2 x 2 x 2 x 2.  **T**: Writing repeated multiplication like this uses a lot of paper.  Instead, we can write an expression with an Exponent, 2 x 2 x 2 x2 x 2 can be written as and read as ‘two raised to the fifth power.’  The parts of this term are as follows: 2 is the base and 5 is the exponent or power to which the base is being raised.  The base is the number that is being multiplied by itself repeatedly.  The exponent is the number of times that the base is being multiplied by itself.  Instruct students to use dry erase boards to write examples of repeated multiplication in exponential notation (SMP.8). Record examples on the board. Discuss several examples and ask students to determine if the examples are written correctly in exponential notation. Prompt students to look at their vocabulary foldable and identify the vocabulary term that relates to each component of the term.  Create an anchor chart, labeling each part of the term with the appropriate vocabulary word. This will remain on display for the remainder of the unit. Students critique the examples and identify if any mistakes have been made (SMP.3). Display . Instruct students to write this expression in expanded form on their personal white boards. () Check for accuracy and discuss any misconceptions.  Note: A common misconception students make in this lesson is that is equal to 2 x 3, rather than 2 x 2 x 2 or()2 is equal to x 2 because they multiply the base and the exponent. Provide the students with several examples to help them understand the purpose of the exponent.  **\*\*For students who are EL, have disabilities, or perform well below the grade-level**:  • Provide students with paper that is already folded if the activity of creating the foldable will cause delays for the students  **Activity 3**: Rolling the Dice with Exponents:  Distribute Handout 2.1: Exponents and a set of red and green dot cubes (SMP.5).  Note: If you do not have red and green dot cubes, use one of these alternatives:  1. use any 2 different colored dot cubes  2. use 1 cube – first roll is the base and the second roll is the exponent  3. one partner rolls the base number and the other partner rolls the exponent  T: You and a partner need a red and a green dot cube. The red cube will be the base and the green cube will be the exponent. Take turns rolling the cubes. Record the base and the exponent and then write the exponential expression. After you have recorded 10 numbers, find the expanded form of each exponential expression and calculate the value. Have students roll the cubes to create exponential expressions and calculate the values of the exponential expressions (SMP.6). When students finish the table, they discuss their findings within their groups (SMP.7).  **\*\*For students who are EL, have disabilities, or perform well below the grade-level:**  • Students create a second foldable to reinforce concepts of exponents. Students use the foldable as a study tool.  **\*\*Extensions for students with high interest or working above grade level:**  • Students look to explain a quick way to apply an exponent to the fraction, without repeated multiplication. | | |
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| **Reflection/Closing:**  TTW discuss the student results and highlight the following points by asking:  1. What was the largest value each team generated? The lowest value?  2. Which makes an exponential expression grow faster: a large base or a large exponent?  3. How does 32 compare to 3 x 2?  TTW the close the lesson by restating the objective. | | **Essential Questions:**  • What is the difference between an algebraic expression and a numerical expression?  • How are standard form and exponential form related? |
| **Standards for Mathematical Practice** (select all that apply) | | |
| * Make sense of problems and persevere in solving them. * Reason abstractly and quantitatively. * Construct viable arguments and critique the reasoning of others. * Model with mathematics. * Use appropriate tools strategically. * Attend to precision. * Look for and make use of structure.   * Look for and express regularity in repeated reasoning. | | |
| **Supplemental Activities** | | |
| **Intervention**  • Students begin the activity by working with a partner or small group    • Students use notes from previous lessons regarding exponents.    • Provide students with paper that is already folded if the activity of creating  the foldable will cause delays for the students.    • Students create a second foldable to reinforce concepts of exponents. Students use the foldable as a study tool. | | **Enrichment**  • Students thoroughly explain the reason for applying the exponent first in equations.  • Students look to explain a quick way to apply an exponent to  the fraction, without repeated multiplication. |
| **Performance Based Assessment Task** | | |
| **Math Task**  **Task**  [• Handout 2.2: Exploring Squares](http://www.mde.k12.ms.us/docs/elementary-education-and-reading-library/math-grade-6-lesson-2_20170612.pdf?sfvrsn=2) | **Rubric/ Plausible Student Response(s)**  [• Handout 2.2: Exploring Squares](http://www.mde.k12.ms.us/docs/elementary-education-and-reading-library/math-grade-6-lesson-2_20170612.pdf?sfvrsn=2) | |