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MISSISSIPPI
EXEMPLAR
Units & Lessons
MATHEMATICS

Grade 6

W.K. KELLOGG FOUNDATION

Lesson 2: Introduction to Exponents

Focus Standard(s): 6.EE.1

Additional Standard(s): 6.EE.2c

Standards for Mathematical Practice: SMP.3, SMP.5, SMP.6, SMP.7, SMP.8

Estimated Time: 60 minutes

Resources and Materials:

- 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
- Handout 2.2: Exploring Squares
- Write Numerical Expressions Involving Whole Number Exponents: https://learnzillion.com/lesson_plans/8408-write-numerical-expressions-involving-whole-number-exponents

Learning Target(s):
Students will write and evaluate numerical expressions involving whole-number exponents.

Guiding Questions(s):

- What is the difference between an algebraic expression and a numerical expression?
- How are standard form and exponential form related?

Vocabulary

Academic Vocabulary:	**Instructional Strategies for Academic Vocabulary:**
• Base	☐ Introduce words in a mathematical context.

• Cubed • Exponent • Numeric expression • Power • Repeated multiplication • Squared	☐ Model how to use the words in discussion. ☐ Read and discuss the meaning of word in a mathematical context

Symbol	Type of Text and Interpretation of Symbol
	Instructional support and/or extension suggestions for students who are EL, have disabilities, or perform well below the grade level and/or for students who perform well above grade level.
✓	Assessment (Pre-assessment, Formative, Self, or Summative)

Instructional Plan

Understanding Lesson Purpose and Student Outcomes: Students will create a foldable graphic organizer as they are introduced to new vocabulary. Students will write and evaluate numerical expressions involving whole-number exponents.

Anticipatory Set/Introduction to the Lesson

Display this numeric expression on the board before students arrive: $2^5 + 2 \times 2.5$

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.

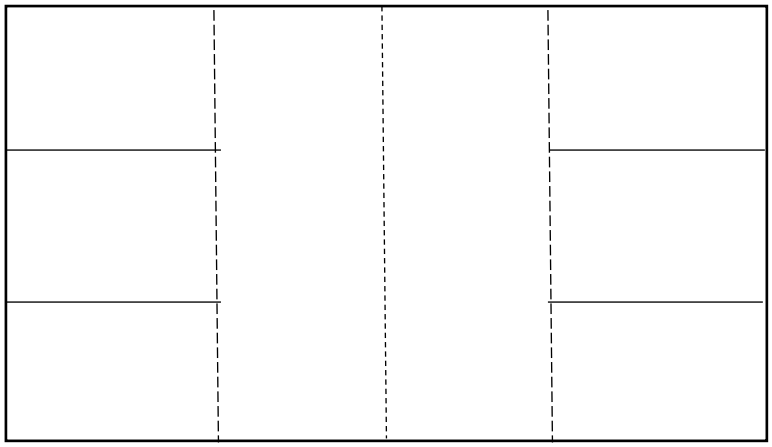
For students who are EL, have disabilities, or perform well below the grade-level:

- 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.

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.

Note: Teacher can use the foldable technique with other vocabulary words throughout the unit or use a vocabulary notebook.

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 student.

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 2^5 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.

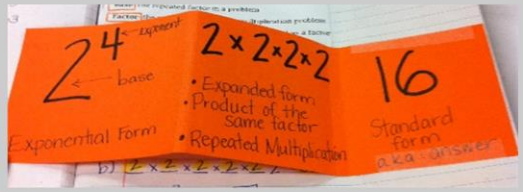
Create an anchor chart, labeling each part of the term with the appropriate vocabulary word. This will remain on display for the remainder of the unit. Students critique the examples and identify if any mistakes have been made (SMP.3).

Display $(\frac{1}{2})^2$. Instruct students to write this expression in expanded form on their personal white boards. $(\frac{1}{2} \times \frac{1}{2})$ Check for accuracy and discuss any misconceptions.

Note: A common misconception students make in this lesson is that 2^3 is equal to 2 x 3, rather than 2 x 2 x 2 or $(\frac{1}{2})^2$ is equal to $\frac{1}{2}$ 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:

- Students create a second foldable to reinforce concepts of exponents. Students use the foldable as a study tool, as shown below.



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.

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).

Reflection and Closing:

Discuss the student results and highlight the following points by asking:

- What was the largest value each team generated? The lowest value?
- Which makes an exponential expression grow faster: a large base or a large exponent?
- How does 3^2 compare to 3 x 2?

Revisit new vocabulary and add new words to word wall for the unit.

- ✓ Instruct students to review the definitions from Activity #1 with a partner and complete this exit ticket **Handout 2.2: Exit Ticket** (SMP.7).

What is the value of 6^3 = ____

What is the missing exponent in this expression: 4^{-} = 256

What is the missing base in this expression: $\_\_^6$ = 729

Key: 6^3 = 216 4^4 = 256 3^6 = 243

Homework

Students complete **Handout 2.3: Homework Squares**.

For students who are EL, have disabilities, or perform well below the grade-level:

- Students use graph paper to illustrate the animal pens – one square equals one unit.

Handout 2.1: Exponents

Name: _____ Date: _____

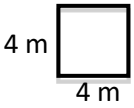
Partners need a red and a green dot cube. The red cube will be the base and the green cube will be the exponent. Take turns rolling the cubes. Record the base and the exponent and then write the exponential expression. After you have recorded 10 numbers, find the standard form of each exponential expression and calculate the value.

Base (red cube)	Exponent (green cube)	Exponential Form	Expanded Form	Value

Handout 2.2: Exploring Squares

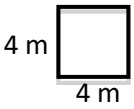
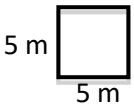
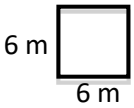
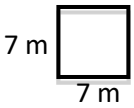
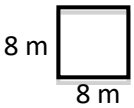
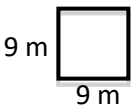
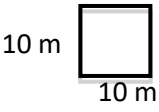
Name: _____ Date: _____

Minia knows that square animal pens are the most economical for the space they provide. Can you provide a table for Minia that shows the areas of square pens that have between 4 meters and 10 meters of fence on each side?

Side Length	Pen Picture	Equation	Area
4 meters		$4 \times 4 = 4^2$	$16m^2$
5 meters			
6 meters			
7 meters			
8 meters			
9 meters			
10 meters			

Exploring Squares Answer Key

Minia knows that square animal pens are the most economical for the space they provide. Can you provide a table for Minia that shows the areas of square pens that have between 4 meters and 10 meters of fence on each side?

Side Length	Pen Picture	Equation	Area
4 meters		$4 \times 4 = 4^2$	$16m^2$
5 meters		$5 \times 5 = 5^2$	$25m^2$
6 meters		$6 \times 6 = 6^2$	$36m^2$
7 meters		$7 \times 7 = 7^2$	$49m^2$
8 meters		$8 \times 8 = 8^2$	$64m^2$
9 meters		$9 \times 9 = 9^2$	$81m^2$
10 meters $100m^2$		$10 \times 10 = 10^2$	$100m^2$

For training or questions regarding this unit,
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