

Core Content

Cluster Title: Apply and extend previous understandings of arithmetic to algebraic expressions.**Standard 1:** Write and evaluate numerical expressions involving whole-number exponents.**MASTERY Patterns of Reasoning****Conceptual:**

Understand the meaning of exponents.

Understand exponential notation (e.g., $3^4 = 3^4$ and $3^4 = 3 \times 3 \times 3 \times 3$).

Understand that exponential notation represents multiplication where the base always remains the same.

Procedural:

Find the value of an expression using exponential notation (e.g., $3^4 = 81$).

Write exponential notation (e.g., $3^4 = 3^4$ and $3^4 = 3 \times 3 \times 3 \times 3$).

Representational:

Use multiple representations that illustrate geometric dimensions and collections of quantities such as:

Represent the power of 1 as a linear model. This results in a one dimensional representation.

Represent the power of 2 as area with square units. This results in a two dimensional representation.

Represent the power of 3 as volume with cubic units. This results in a three dimensional representation.

Represent the accumulation of quantities.

Show that an exponent is notation representing repeated multiplication.

Supports for Teachers**Critical Background Knowledge****Conceptual:**

Repeated multiplication of similar “base” quantities (e.g., $2 \times 2 = 4$, $2 \times 4 = 8$, $2 \times 8 = 16$)

Procedural:

Skip counting

Multiplication facts

Representational: Model repeated multiplication with manipulatives, arrays, and number lines.	
Academic Vocabulary and Notation	
^, base number, expressions, exponents, power, superscripted numbers	
Instructional Strategies Used	Resources Used
<p>1. Have the students use manipulatives to show the number 3 after it has been doubled, which would represent $3^2=9$ square units. Then have them show $3^3 = 27$ cubic units with the manipulatives.</p> <p>2. Play memory games with matching numerical expressions. Example: 2^3 matches with 2^3, which matches with $2 \times 2 \times 2$, which matches with 8.</p> <p>3. "I Have, Who Has?" game. Example: The first student says: "I have 2^3." The second student says: "I have 8. Who has 4^2?" The third student says: "I have 16. Who has the expression equal to 27?" Etc...</p> <p>Extension: Every positive integer can be expressed as the sum of four or fewer squared numbers (Note: You can use the same integer more than once.)</p> <p>Examples:</p> $5 = 1^2 + 2^2$ $101 = 4^2 + 6^2 + 7^2$ $170 = 2^2 + 6^2 + 7^2 + 9^2$ <p>Write 83 as the sum of three square numbers.</p>	<p><i>The King's Chessboard</i>, by David Burch</p> <p><i>One Grain of Rice</i>, by Demi</p> <p>http://jwilson.coe.uga.edu/EMT668/EMAT6680.F99/Martin/instructional%20unit/day4.exponential/excel/grainofrice.html</p> <p><i>Minnie's Diner</i>, by Dale Ann Dodds</p> <p>http://www.wimp.com/makingnoodles</p>

Assessment Tasks Used	
Skill-based Task: Evaluate: 3^2 Write five cubed times four as a numerical expression.	Problem Task: Certain biological cells quadruple each hour. Start with one cell at 2:00 and find out how many cells there will be by 5:00. Create a diagram to represent the cell growth. Include an equation using exponential notation.

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