

Unit 6, Lesson 14: Evaluating Expressions with Exponents

Lesson Goals

- Evaluate expressions that have an exponent and one other operation by carrying out operations in the conventional order.

Required Materials

14.1: Revisiting the Cube (10 minutes)

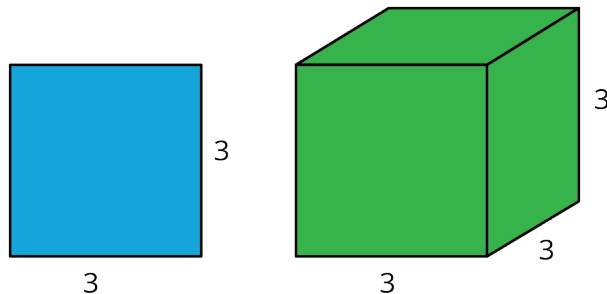
Setup: Students in groups of 2. 1 minute of quiet think time, followed by a whole-group discussion. Display and complete the table.

Student task statement

Based on the given information, what other measurements of the square and cube could we find?

Possible responses

See lesson plan for sample responses.



14.2: Calculating Surface Area (10 minutes)

Setup: 10 minutes of quiet work time, followed by a whole-class discussion.

Student task statement

A cube has side length 10 inches. Jada says the surface area of the cube is 600 in^2 , and Noah says the surface area of the cube is $3,600 \text{ in}^2$. Here is how each of them reasoned:

Jada's Method:

$$6 \cdot 10^2$$

$$6 \cdot 100$$

$$600$$

Noah's Method:

$$6 \cdot 10^2$$

$$60^2$$

$$3,600$$

Do you agree with either of them? Explain your reasoning.

Possible responses

Jada's solution is correct. Explanations vary. Sample explanation: The cube has 6 faces and each has an area of 10^2 or 100. The area calculation comes before multiplying by 6.

14.3: Expression Explosion (15 minutes)

Setup: Students in groups of 2. 10 minutes of partner work, followed by a whole-class discussion.

Student task statement

Evaluate the expressions in one of the columns. Your partner will work on the other column. Check with your partner after you finish each row. Your answers in each row should be the same. If your answers aren't the same, work together to find the error.

$5^2 + 4$

$2^2 + 25$

$2^4 \cdot 5$

$2^3 \cdot 10$

$3 \cdot 4^2$

$12 \cdot 2^2$

$20 + 2^3$

$1 + 3^3$

$9 \cdot 2^1$

$3 \cdot 6^1$

$\frac{1}{9} \cdot \left(\frac{1}{2}\right)^3$

$\frac{1}{8} \cdot \left(\frac{1}{3}\right)^2$

Possible responses

- 29

- 80

- 48

- 28

- 18

- $\frac{1}{72}$

Are you ready for more?

1. Consider this equation: $\square^2 + \square^2 = \square^2$. An example of 3 different whole numbers that could go in the boxes are 3, 4, and 5, since

$$3^2 + 4^2 = 5^2$$

(That is, $9 + 16 = 25$). Can you find a different set of 3 different whole numbers that make the equation true?

2. How many sets of 3 different whole numbers can you find?

3. Can you find a set of 3 different whole numbers that make this equation true? $\square^3 + \square^3 = \square^3$

4. How about this one? $\square^4 + \square^4 = \square^4$

5. Once you have worked on this a little while, you can understand a problem that is famous in the history of math. (Alas, this space is too small to contain it.) If you are interested, consider doing some further research on *Fermat's Last Theorem*.

Possible Responses

- Sample responses: {6, 8, 10}, {5, 12, 13}
- Answers vary. There are an infinite number of these triples.
- No. (No such triple exists.)
- No. (No such triple exists.)
- (Ha!)

Lesson Synthesis (5 minutes)

Give students an opportunity to write their own numerical expression with an exponent and one other operation, and then to evaluate it. Highlight that to evaluate expressions involving exponents, we continue to follow the order that we have agreed upon for operations. When an exponent occurs in the same expression as multiplication or division, we evaluate the exponent first, unless brackets say otherwise.

14.5: Calculating Volumes (Cool-down, 5 minutes)

Setup: None.

Student task statement

Jada and Noah wanted to find the total volume of a cube and a rectangular prism. They know the prism's volume is 20 cubic units, and they know the cube has side lengths of 10 units. Jada says the total volume is 27,000 cubic units. Noah says it is 1,020 cubic units. Here is how each of them reasoned:

Jada's Method:

$$20 + 10^3$$

$$30^3$$

$$27,000$$

Noah's Method:

$$20 + 10^3$$

$$20 + 1,000$$

$$1,020$$

Do you agree with either of them? Explain your reasoning.

Possible responses

Noah's solution is correct. Sample reasoning: The cube has a volume of 1,000 cubic units and the additional 20 cubic units from the prism makes the total volume 1,020 cubic units. The exponent calculation comes before addition.