

Powers of Ten

Strand: Number and Number Sense

Topic: Describing the concept of negative exponents for powers of 10

Primary SOL: 7.1 The student will
a) investigate and describe the concept of negative exponents for powers of ten

Related SOL: 7.1b, 7.1c

Materials

- Powers of Ten Chart (attached)
- Scientific calculators
- Powers of Ten Cards (attached)
- Powers of Ten Exit Ticket (attached)
- Scissors
- Colored pencils (differentiated lesson)

Vocabulary

base, exponent, negative number, power (earlier grades)

negative exponent, power of ten

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Start with a discussion about place value to activate prior knowledge. Provide a visual chart as students recall and discuss place values.
2. Review powers and exponents. Then, distribute the Powers of Ten Chart and guide a group discussion to complete the chart. Ask students to look for a pattern.
3. Have students work with a partner to answer the five questions following the chart. When they have finished, check the answers through a group conversation.
4. Conclude the discussion with a review of negative exponents for powers of ten.
5. Demonstrate the use of the exponent button on the calculator.
6. Cut the Powers of Ten cards apart and give one card to each student. Ask students to order themselves from least to greatest without talking. Some powers of ten cards have multiple representations. Students with equivalent representations should all stand in a row in the correct order.
7. Ask students to complete the Powers of Ten Exit Ticket and turn it in before leaving. The data collected can be used to plan the upcoming lesson.

Assessment

- **Questions**
 - What information do you know when the exponent is positive for a power of ten?
 - What information do you know when the exponent is negative for a power of ten?
 - How do you represent a negative power of ten as a fraction and as a decimal?

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- **Journal/writing prompts**
 - Explain patterns noticed with the powers of ten.
 - Explain what a negative exponent means when the base is ten.
 - Explain why 10^0 does not equal zero.
- **Other Assessments (include informal assessment ideas)**
 - Teacher observation of the number line activity (step 6).
 - Grade the exit ticket for accuracy.

Extensions and Connections (for all students)

- Have students use the internet or other reference material to locate examples of powers of ten with negative exponents.

Strategies for Differentiation

- Create a sort including powers of ten, expanded forms, and products. Have students complete the sort before filling in the Powers of Ten Chart.
- Ask the students to use the internet to find scenarios where the powers of ten appear in the real world.
- Preteach the relevant vocabulary for this lesson.
- Allow the students to use the powers of ten chart to complete the exit ticket.
- Have the students to create their own chart with additional powers of ten examples.
- Have the students order (ascending) and color code the cards according to their equivalency as an alternate to participating in the group activity.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

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Powers of Ten Chart

Name _____ Date _____

1. Complete the chart.

Power of Ten	Expanded Form	Standard Form	
10^5	$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	100,000	
		10,000	
	$10 \cdot 10 \cdot 10$		
		100	
	10		
10^0			
		Fraction	Decimal
10^{-1}	$\frac{1}{10} = \frac{1}{10^1}$	$\frac{1}{10}$	0.1
	$\frac{1}{10} \cdot \frac{1}{10} = \frac{1}{10^2}$		
10^{-3}			
			0.0001
10^{-5}		$\frac{1}{100,000}$	

2. What patterns do you see?

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3. What would 10^6 be?

4. Predict what 10^9 would be.

5. Based on this pattern, what do you predict that 10^{-7} would be?

6. What are two different ways to represent 10^{-6} ?

Powers of Ten Cards

Print on card stock and cut out.

10^5	$\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10}$	10^{-3}	10^{-2}
0.001	10^4	10	1,000
10^1	$\frac{1}{10}$	10^3	$\frac{1}{100}$
10^{-1}	$\frac{10 \cdot 10 \cdot 10 \cdot 10}{10 \cdot 10}$	$10 \cdot 10 \cdot 10$	10^2
10^{-5}	0.0001	$\frac{1}{10} \cdot \frac{1}{10}$	1
10^0	$10 \cdot 10$	10^{-4}	100

Mathematics Instructional Plan – Grade 7

0.01	$\frac{1}{1,000}$	10,000	$\frac{1}{10,000}$
$\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10}$	$\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10}$	0.1	$\frac{1}{100,000}$
$10 \cdot 10 \cdot 10 \cdot 10$	100,000	0.00001	

Powers of Ten Exit Ticket

1. Which power of ten is always equal to 1? _____
2. Provide two different ways to represent 10^3 .

3. Negative exponents for powers of ten are meant to represent numbers between _____ and _____.
4. Provide two different ways to represent 10^{-4} .

5. Write 10^5 in expanded form.

6. Write 10^{-5} in expanded form.

7. How would you represent $10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$ as a power of ten?

8. How would you represent $\frac{1}{1000}$ as a power of ten?

9. Which power of ten would 0.01 represent?

10. How would you represent $\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10}$ as a power of ten?
