Scientific Notation

STRAND: Number and Number Sense

STRAND CONCEPT: Rational Numbers- Compare and Order

SOL 7.1a, b

Remediation Plan Summary

Students will be writing very large and very small numbers in scientific notation. Students will not be comparing numbers but will be working to understand how to change numbers from standard form to scientific form and from the scientific form to the standard form.

Common Errors and Misconceptions

- Students may not write the decimal part of the number correctly by writing a decimal smaller than one or greater than 10.
- Students may count the number of zeros at the end of the number to use for the exponent.
- Students may have difficulty converting to scientific notation if the number they are converting from has a zero not at the end of the number, for example 89,060,000. Students may incorrectly drop the extra digits when converting, for example 8.9×10^7 instead of 8.906×10^7.
- Students have difficulty with the negative sign in the power of ten. They think it means the number is negative and do not understand that the number is a decimal number, example 0.0089 is written as 8.9×10^{-3}.

Materials

- Number Notation Table recording sheet
- Decimal Notation Table recording sheet
- Planet Distance Table with Small Object Table recording sheet

Introductory Activity

1. Write the following on the board: "There are approximately 6,000,000,000 people on Earth. *Can you explain how many people this is? Do you think there is room for 6,000,000,000 more people?"* Allow students to share their thoughts.
2. Tell students to assume that every person on Earth has 10 fingers and 10 toes. Have students figure out how many human fingers and toes there are. (20 × 6,000,000,000 = 120,000,000,000) Allow students to share their answers and the techniques they used to arrive at their answers to see if any students solved the problem in a way other than standard multiplication—e.g., multiply 6 times 20 and add 9 zeros. Ask, "*Why might you add 9 zeros? What does adding 9 zeros mean?*"

Plan for Instruction

1. Distribute the "Number Notation Table" recording sheet. Lead the class in completing the first few rows of the table together. Discuss the pattern that emerges.

2. Distribute the "Decimal Notation Table" recording sheet. After you have discussed the pattern with larger numbers, look at the pattern using decimal numbers. "*Why do you think the exponent is a negative number?"*
3. Give each student a copy of the "Planet Distance Table" with the "Small Object Table" handout. Demonstrate how to change the distance Mercury is from the sun, 35,000,000 miles, into scientific notation. (3.5×10^7)
4. Discuss how the number was changed, and have students compare the pattern they discovered in the warm-up to the number. Ask students how the exponent is related to the decimal shift. Students may assume that the exponent number equals the number of zeroes; however, the exponent number (power of ten) equals the number of places the decimal moves, e.g., $1{,}400 = 1.4 \times 10^3$: the decimal moves three places to the left. Ask, "*Why does the decimal move three places to the left?*" Demonstrate this decimal move by multiplying $1.4 \times 1{,}000$ on the board.
5. Demonstrate on the board the process in the previous step. Multiply 3.6×100, 3.6×1000, and 3.6×10. Show all steps. Let the students discover how the decimal point moves. Discuss whether your number is greater than or less than 1. Change 3.5×10^7 back to standard form.
6. Explain to students that scientific notation can also be used to write very small numbers. Write 0.0000046 on the board. Review the steps below:
    - Determine the new number greater than or equal to 1 and less than 10: Move the decimal point in the original number so that the new number is between 1 and 10. (4.6)
    - Determine the power of 10: Count the number of places you moved the decimal point. (−6) This number equals the exponent. Write the power of 10 that you would need to multiply the new number by in order to get the original number. (10^{-6})
    - Write the two parts as a multiplication expression. (4.6×10^{-6})
    - Demonstrate how multiplication of $4.6 \times 0.000001 = 0.0000046$.
1. Have students complete the "Planet Distance Table," and the object table. Review the answers with the students. Stress that the sign of the exponent in a power of 10 tells whether the number is less than or greater than 1. Have students write the following rules on their scientific notation handouts:
    - A power of 10 with a **positive exponent,** such as 10^5, means the decimal is greater than 1.
    - A power of 10 with a **negative exponent,** such as 10^{-5}, means the decimal is less than 1.

Pulling It All Together (Reflection)

Conduct a class discussion around the following questions:

- *Why is scientific notation used?*
- *What are some careers or professions is which scientific notation is regularly used?*
- *In what professions would very large numbers be used?*
- *In what professions would very small numbers be used?*

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

Name:

Number Notation Table

Number Spelled Out	Number in Standard Notation	Number in Scientific Notation
One		
Ten		
One hundred		
One thousand		
Ten thousand		
One hundred thousand		
One million		
Ten million		
One hundred million		
One billion		
Ten billion		
One hundred billion		
One trillion		

Name:

Decimal Number Notation Table

Number Spelled Out	Number in Standard Notation	Number in Scientific Notation
One Tenth		
One hundredth		
One thousandth		
One Ten thousandth		
One hundred thousandth		

Name:

Planet Distance Table

Complete the table below.

Planet	Miles from the Sun in Standard Notation	Miles from the Sun in Scientific Notation
Mercury	35,000,000	
Venus		6.5×10^7
Earth		9.3×10^7
Mars	137,000,000	
Jupiter	467,000,000	
Saturn	850,000,000	
Uranus		1.7×10^9
Neptune		2.7×10^9
(dwarf planet) Pluto	3,500,000,000	

Small Object Table

Object	Standard Form	Scientific Notation
Width of a grain of salt		4.331×10^{-3} inches
Length of a grain of rice	0.3937 inches	
Width of a grain of sand		5.9×10^{-2} inches
Diameter of a nitrogen atom		3.28×10^{-12} inches
Width of an ameoba	0.02244 inches	
Diameter of a bowling ball		8.5×10^0 inches
Width of world's largest ball of paint		9.0×10^1 inches
Diameter of World's largest soccer ball	432 inches	