

Number Shorthand: Scientific Notation

Grades 5 - 6

Overview

Students will use patterns created on the calculator with the constant operation ($\boxed{Op1}$ or $\boxed{Op2}$) to develop an understanding of scientific notation.

Math Concepts

- multiplication
- powers of 10
- exponents

Materials

- TI-15
- pencil
- student activity (page 18)

Introduction

1. Have students review the pattern created when using 10 as a factor.

Example:

$$1 \times 10 = 10$$

$$2 \times 10 = 20$$

$$3 \times 10 = 30$$

$$10 \times 10 = 100$$

2. Ask students:


Based on this pattern, what do you think happens when we multiply by 10 over and over again?

3. After students share their conjectures, have them use $\boxed{Op1}$ to test their conjectures. As students press $\boxed{Op1}$, have them record the resulting displays on the Student Activity page.

4. When students reach the point where the left-hand counter is no longer displayed, ask them what they think has happened to the calculator. (The product has become so large that there is not room to display both the product and the counter, so the counter has been dropped.)

Have students continue to record the counter data, even though it no longer shows on the calculator.

5. When the left-hand counter reappears, have students describe what has happened to the display of the product. (It has been replaced with a right-hand display of scientific notation: for example, 1×10^{11} .)

 To multiply repeatedly by 10, enter:

1. $\boxed{Op1} \times 10 \boxed{Op1}$

This “programs” the constant operation.

2. Enter **1** as the starting factor.

3. Press $\boxed{Op1}$.

When you press $\boxed{Op1}$ the first time, the calculator performs the operation 1×10 and the display shows:

1x10

1 10

The **1** represents using **x 10** one time.

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6. Have students continue to press $\boxed{0p}$ and record the results.
7. Have students analyze their data and make some conclusions about the scientific notation display.

For example, 1×10^{11} represents the product:
 $1 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$.

Explain to students that exponential or scientific notation is a shorthand for repeated factors:
 1×10^{11} .

8. Have students continue to explore the use of scientific notation to represent repeated multiplication by 10 with other starting factors. (For example, using 2 as the starting factor, the display 2×10^{11} represents multiplying 2 by 10 eleven times, or 2×10^{11} .)

Collecting and Organizing Data

To focus students' attention on the relevant changes in the calculator's display, ask questions such as:

- *What does the display **3 1000** mean?*
- *When did the counter on the left disappear? Why do you think that happened?*
- *When did the counter on the left reappear? What else has changed?*

The product looks different. It changed from 1000000000 to 1×10^{10} .

- *What do the displays look like after this change takes place?*

The 1×10 stays the same, but the right-hand number (the exponent) goes up one each time $\boxed{0p}$ is pressed, and it matches the left-hand counter.

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(Continued)

Analyzing Data and Drawing Conclusions

To focus students' attention on the connection between the repeated factors of 10 and the scientific notation display, ask questions such as:

- *What patterns do you see in your products before the counter disappears?*

They all have a 1 followed by the same number of zeroes as factors of 10 that were used in the product.

- *If you continued this pattern, what would the product be at the point where the display of the product changed? How is the product related to the new display?*

For example, 1×10^{11} is in the place where the product should be 100,000,000,000. The display 1×10^{11} represents the product 1×10^{11} .

- *What happens if you use 2 as the starting factor and multiply by 10 repeatedly?*

The displays are the same, except the first number in all the products is 2. The display 2×10^{11} represents the product 2×10^{11} .

Continuing the Investigation

Students can use other powers of 10 as the repeating factor, record the results in the table, and look for patterns. For example, using 100 as the repeating factor causes the exponent part of the scientific notation display to increase by 2 every time $\boxed{00}$ is pressed.

Students can use a starting factor of 10 or greater, record the results in the table, and look for patterns. For example, using 12 as the starting factor soon results in a display like $12 \quad 1.2 \times 10^{13}$, where the exponent part of the display is one more than the number of times 10 has been used as a factor.

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Name _____

Date _____



Collecting and Organizing Data

Program the constant operation feature on your calculator to multiply by 10. Record the results in the table below for each time you press **[Op]**.

Number of Times Used as a Factor	Display
0	(starting factor)
1	
2	
3	
4	

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Name _____

Date _____



Analyzing Data and Drawing Conclusions

1. What patterns do you see?

2. What does it mean when the right-hand display changes?
(For example, 1×10^{15} .)

3. Try the activity again with another multiple of 10 and compare your results.
