## Unit 1 - Lesson 9 - Part 1

## Scientific Notation

Focus Standard: 8.EE.A. 3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as $3 \times 10^{8}$ and the population of the world as $7 \times 10^{9}$, and determine that the world population is more than 20 times larger.
8.EE.A. $4 \quad$ Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

## Student Outcomes

- Students write, add, and subtract numbers in scientific notation and understand what is meant by the term leading digit.

A positive, finite decimal $s$ is said to be written in scientific notation if it is expressed as a product $d \times 10^{n}$, where $d$ is a finite decimal so that $1 \leq d<10$, and $n$ is an integer.

The integer $n$ is called the order of magnitude of the decimal $d \times 10^{n}$.

Convert the following values into scientific notation:

1. -235.532
2. 0.0004326

Convert the following values into standard form:
3. $5.893 \times 10^{-5}$
4. $-7.8927 \times 10^{5}$

Example 1: The finite decimal 234.567 is equal to every one of the following:
Only one of these is written in scientific notation. Identify the proper format and explain why it is correct.

| $2.34567 \times 10^{2}$ | $0.234567 \times 10^{3}$ | $23.4567 \times 10$ |
| :--- | :--- | :--- |
| $234.567 \times 10^{0}$ | $234567 \times 10^{-8}$ | $234567000 \times 10^{-6}$ |

Identify if the following numbers are written in scientific notation. If not, explain why?

## Exercise 1

$1.908 \times 10^{17}$

## Exercise 4

$4.0701+10^{7}$

## Exercise 2

$0.325 \times 10^{-2}$

## Exercise 5

$18.432 \times 5^{8}$

## Exercise 3

$7.99 \times 10^{32}$

## Exercise 6

$8 \times 10^{-11}$

Example 2: Let's say we need to determine the difference in the populations of Texas and North Dakota. In 2012, Texas had a population of about 26 million people, and North Dakota had a population of about $6.9 \times 10^{4}$. Before comparing the values, let's write both in scientific notation.

Example 3: Let's say that we need to find the combined mass of two hydrogen atoms and one oxygen atom, which is normally written as $\mathrm{H}_{2} \mathrm{O}$ or otherwise known as water. To appreciate the value of scientific notation, the mass of each atom will be given in standard notation:

- One hydrogen atom is approximately 0.0000000000000000000000000017 kilograms.
- One oxygen atom is approximately 0.000000000000000000000000027 kilograms.

Convert both hydrogen and oxygen into scientific notation.

## Exercises:

1. Earth's circumference at the equator is $24,901.55$ miles.

Write this number written in scientific notation.

## Standard Form

Product Form
Scientific Notation

24,901.55
2. The thickness of the human retina is 0.00012 meters.

Write this number written in scientific notation.

## Standard Form

Product Form
Scientific Notation
0.00012

## Problem Set

1. Write the number $68,127,000,000,000,000$ in scientific notation. Which of the two representations of this number do you prefer? Explain.
2. Earth's diameter at the equator is $7.92628 \times 10^{3}$ miles.

Write this number in standard form.

## Scientific Notation Product Form

$7.92628 \times 10^{3}$
3. Time for light to travel 1 meter is $3.34 \times 10^{-10}$ seconds.

Write this number in standard form.

Scientific Notation
Product Form
$3.34 \times 10^{-10}$

Write the number in scientific notation.

## Product Form

4. $-9,180,000$
5. 0.0000062
6. 100

Write the number in standard form.

## Product Form

7. $2.78 \times 10^{7}$
8. $-5.67 \times 10^{-3}$
9. $1 \times 10^{-5}$
