Unit 1 – Lesson 11 **Name:** ____

Efficiency of Scientific Notation **Date:** _________________________ **Period:** _____________

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 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.*
	8.EE.A.4	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 continue to practice working with very small and very large numbers expressed in scientific notation.
- Students read, write, and perform operations on numbers expressed in scientific notation.

Simplify the following problems, leave your answer in scientific notation.

1. $2 \times 10^3 + 1.9 \times 10^2$

2. $6.2 \times 10^5 - 9.7 \times 10^1$

Classwork

Exercise 1

The mass of a proton is

0.000 000 000 000 000 000 000 000 001 672 622 kg.

In scientific notation it is

Exercise 2

The mass of an electron is

0.000 000 000 000 000 000 000 000 000 000 910 938 291 kg.

In scientific notation it is

Exercise 3

Write the ratio that compares the mass of a proton to the mass of an electron.

Exercise 4

Compute how many times heavier a proton is than an electron (i.e., find the value of the ratio). Round your final answer to the nearest one.

Example 2

The U.S. national debt as of March 23, 2013, rounded to the nearest dollar, is $\$16{,}755{,}133{,}009{,}522$. According to the 2012 U.S. census, there are about $313{,}914{,}040$ U.S. citizens. What is each citizen's approximate share of the debt?

$$\frac{1.6755 \times 10^{13}}{3.14 \times 10^{8}} = \frac{1.6755}{3.14} \times \frac{10^{13}}{10^{8}}$$

$$= \frac{1.6755}{3.14} \times 10^{5}$$

$$= 0.533598\ldots \times 10^{5}$$

$$\approx 0.5336 \times 10^{5}$$

$$= 53360$$

Each U.S. citizen's share of the national debt is about $\$53{,}360$.

Exercise 5

The geographic area of California is $163{,}696 \text{ sq. mi.}$, and the geographic area of the U.S. is $3{,}794{,}101 \text{ sq. mi.}$ Let's round off these figures to 1.637×10^{5} and 3.794×10^{6}. In terms of area, roughly estimate how many Californias would make up one U.S. Then compute the answer to the nearest ones.

Exercise 6

The average distance from Earth to the moon is about 3.84×10^5 km, and the distance from Earth to Mars is approximately 9.24×10^7 km in year 2014. On this simplistic level, how much farther is traveling from Earth to Mars than from Earth to the moon?

Problem Set

1. There are approximately 7.5×10^{18} grains of sand on Earth. There are approximately 7×10^{27} atoms in an average human body. Are there more grains of sand on Earth or atoms in an average human body? How do you know?

2. About how many times more atoms are in a human body compared to grains of sand on Earth?

3. Suppose the geographic areas of California and the U.S. are 1.637×10^5 and 3.794×10^6 $\mathrm{sq.\,mi.}$, respectively. California's population (as of 2012) is approximately 3.804×10^7 people. If population were proportional to area, what would be the U.S. population?

4. The actual population of the U.S. (as of 2012) is approximately 3.14×10^8. How does the population density of California (i.e., the number of people per square mile) compare with the population density of the U.S.?