Mathematics Curriculum

Topic B

Magnitude and Scientific Notation

8.EE.A.3, 8.EE.A.4

Focus Standards:	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	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.
Instructional Days:	7	
Lesson 7:	Magnitude (P)[1]	
Lesson 8:	Estimating Quantities (P)	
Lesson 9:	Scientific Notation (P)	
Lesson 10:	Operations with Numbers in Scientific Notation (P)	
Lesson 11:	Efficacy of Scientific Notation (S)	
Lesson 12:	Choice of Unit (E)	
Lesson 13:	Comparison of Numbers Written in Scientific Notation and Interpreting Scientific Notation Using Technology (E)	

[1]Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson.

In Topic B, students' understanding of integer exponents is expanded to include the concept of magnitude as a measurement. Students learn to estimate how big or how small a number is using magnitude. In Lesson 7, students learn that positive powers of 10 are large numbers and negative powers of 10 are very small numbers. In Lesson 8, students express large numbers in the form of a single digit times a positive power of 10 and express how many times as much one of these numbers is compared to another. Students estimate and compare national to household debt and use estimates of the number of stars in the universe to compare with the number of stars an average human can see.

Lessons 9–13 immerse students in scientific notation. Each lesson demonstrates the need for such a notation and then how to compare and compute with numbers in scientific notation. In Lesson 9, students learn how to write numbers in scientific notation and the importance of the exponent with respect to magnitude. The number line is used to illustrate different magnitudes of 10, and students estimate where a particular number, written in scientific notation, belongs on the number line. Also, in this set of lessons, students use what they know about exponential notation, properties of exponents, and scientific notation to interpret results that have been generated by technology.

Continuing with magnitude, Lesson 10 shows students how to operate with numbers in scientific notation by making numbers have the same magnitude. In Lessons 11–13, students reason quantitatively with scientific notation to understand several instances of how the notation is used in science. For example, students compare masses of protons and electrons written in scientific notation and then compute how many times heavier one is than the other by using their knowledge of ratio and properties of exponents. Students use the population of California and their knowledge of proportions to estimate the population of the U.S. assuming population density is the same. Students calculate the average lifetime of subatomic particles and rewrite very small quantities (e.g., 1.6×10^{-27} kg) in a power-of-ten unit of kilograms that supports easier comparisons of the mass.

It is the direct relationship to science in Lesson 12 that provides an opportunity for students to understand why certain units were developed, like the gigaelectronvolt. Given a list of very large numbers, students choose a unit of appropriate size and then rewrite numbers in the new unit to make comparisons easier. In Lesson 13, students combine all the skills of Module 1 as they compare numbers written in scientific notation by rewriting the given numbers as numbers with the same magnitude, using the properties of exponents. By the end of this topic, students are able to compare and perform operations on numbers given in both decimal and scientific notation.