NAME:_____ Math_____, Period_____

Mr. Rogove Date:_____

LEARNING OBJECTIVE: We will write numbers in scientific notation and add/subtract numbers written in scientific notation. (G8M1L9)

CONCEPT DEVELOPMENT:

Scientific Notation and Precision:

Fact: As of June 30, 2015, the national debt was $18,158,300,000,000.

First Estimate: The debt is more than $\$10^{13}$ but less than $\$10^{14}$.

Better Estimate: The debt is more than $\$1\times10^{13}$ but less than $\$2\times10^{13}$

Even Better Estimate: The debt is more than $\$1.8\times10^{13}$ but less than $\$1.9\times10^{13}$

Exact number: The debt is $\$1.81583\times10^{13}$

Scientific Notation is used to describe numbers that are either really BIG or really small. Scientific Notation is expressed as $d \times 10^n$, where d is a finite decimal so that $1 \leq d < 10$ and n is an integer. n is the **order of magnitude**.

Examples:

3.4×10^6 — integer ✓ — $1 \leq 3.4 < 10$

4.24×10^{14} → integer — between 1–10 — Base

2.7×10^{-16} — 1–10 — Base

Non-Examples:

31.4×10^5 — $31.4 > 10$

3×4^6 — should be 10!

0.01×10^{-5} — $.01 < 1$

GUIDED PRACTICE:

Steps to Writing Numbers in Correct Scientific Notation ($d \times 10^n$)

1. Move the decimal to the left or right in order to get $1 \leq d < 10$.
2. Count the number of decimal places you've moved to identify the magnitude (use negative numbers if you've moved the decimal place to the left).

98,765.43 $9,876.543 \times 10^1$ 987.6543×10^2 98.76543×10^3 9.876543×10^4 9.876543×10^4	100,903.48 1.0090348×10^5
0.0010004 $.010004 \times 10^{-1}$ $.10004 \times 10^{-2}$ 1.0004×10^{-3}	0.0000040323 4.0323×10^{-6}

$\frac{1}{10} = 10^{-1}$

$\frac{1}{100} = 10^{-2}$

NAME:_____ Math_____, Period_____

Mr. Rogove Date:_____

Adding Numbers in Scientific Notation (The Scientific Notation Game)

How many different ways can we write the following expression:

$$900{,}000{,}000 + 10{,}000{,}000 + 3{,}000{,}000$$

1. Use powers of ten:

$9\times10^{8} + 1\times10^{7} + 3\times10^{6}$

13×10^{21}

WRONG!! DON'T DO THIS!

2. Just add the numbers:

$$\begin{array}{r} 900{,}000{,}000 \\ 10{,}000{,}000 \\ +\ 3{,}000{,}000 \\ \hline 913{,}000{,}000 \end{array}$$

3. Write the expression in scientific notation:

9.13×10^{8}

Before **Adding and Subtracting numbers** written in Scientific Notation, you need to make the order of magnitude equal.

Examples:

$3.4\times10^{4} + 5.3\times10^{5}$

① SAME MAGNITUDE

② ADD NUMBERS & KEEP MAGNITUDE

$3.4\times10{,}000 = 34{,}000$

$5.3\times100{,}000 = 530{,}000$

$564{,}000 = 5.64\times10^{5}$

③

$5.3\times10^{5} = 53\times10^{4}$

$5.3\times10\times10^{4}$

$5.3\times10^{5} = (5.3\times10)\times(10^{5}\div10)$

$$\begin{array}{r} 53\times10^{4} \\ +\ 3.4\times10^{4} \\ \hline 56.4\times10^{4+1} \end{array}$$

5.64×10^{5}

$(2\times10^{-3}) + (3.4\times10^{-5})$

20×10^{-4}

200×10^{-5}

$$\begin{array}{r} 200\times10^{-5} \\ +\ 3.4\times10^{-5} \\ \hline 203.4\times10^{-5} \end{array}$$

2.034×10^{-3}

NAME:_____ Math_____, Period_____

Mr. Rogove Date:_____

Steps to Adding or Subtracting Numbers Written in Scientific Notation

1. Make the order of magnitude equal for each number.
2. Use the distributive property to factor out the common 10^n.
3. Add or subtract accordingly.
4. As needed, convert to proper scientific notation ($d \times 10^n$)

Answer the questions below based on the table below that shows the debt for the three most and three least populous states.

State	Debt (in dollars)	Population (2012)
California	407,000,000,000	38,000,000
New York	337,000,000,000	19,000,000
Texas	276,000,000,000	26,000,000
North Dakota	4,000,000,000	690,000
Vermont	4,000,000,000	626,000
Wyoming	2,000,000,000	576,000

What is the sum of the debts for the 3 most populous states expressed in scientific notation?

4.07×10^{11}
3.37×10^{11}
2.76×10^{11}
10.20×10^{11} $\quad 1.02 \times 10^{12}$

What is the combined population of the 3 most populous states expressed in scientific notation?

What is the sum of the debt for the 3 three least populous states expressed in scientific notation?

4×10^9
4×10^9
$+ \ 2 \times 10^9$
$10 \times 10^9 = 1 \times 10^{10}$

What is the combined population of the 3 least populous states expressed in scientific notation?

How much larger is the combined debt of the three most populous states than that of the three least populous states?

$1.02 \times 10^{12} - 1 \times 10^{10}$

1.02×10^{12}
$- .01 \times 10^{12}$
1.01×10^{12}

$.01 \times 10^{12}$ $\Longleftrightarrow$

102×10^{10}
$- \ 1 \times 10^{10}$
101×10^{10}
1.01×10^{12}

How much larger is the population of the three most populous states than that of the three least populous states?

NAME:_____ Math_____, Period_____

Mr. Rogove Date:_____

Independent Practice:

Here are the masses of the so-called inner planets of the solar system:

Mercury: $3.3022 \times 10^{23} kg$ Earth: $5.9722 \times 10^{24} kg$

Venus: $4.8685 \times 10^{24} kg$ Mars: $6.4185 \times 10^{23} kg$

1. What is the average mass of the inner planets?

2. How much larger (in kg) is the largest of these planets from the smallest?

3. The mass of the moon is approximately 73,000,000,000,000,000,000,000 kg. How much larger is earth than the moon?

NAME:_____ Math_____, Period_____

Mr. Rogove Date:_____

Activating Prior Knowledge:

We know that magnitude is used to express how large a number is.

10^9 is a large number. What is the number that is 100 times larger?	2×10^5 is another large number. But what number is 30,000 larger than that?

Closure:

Give out exit ticket (allow 5 minutes) from lesson 9.

Teacher Notes:

Homework is "Scientific Notation" from Khan? Should be easy!