NAME:_____ Math _____, Period_____

Mr. Rogove Date:_____

Learning Objective: We will learn how to express really big numbers and really small numbers. (G8M1L7)

Concept Development:

Magnitude: Using exponential notation to describe measurements that are either very large or very small. This is expressed in integer powers of 10.

10^n or 10^{-n}

FACT#1: The numbers 10^n for arbitrarily large positive integers n are big numbers; given a number M (no matter how big it is) there is a power of 10 that exceeds M.

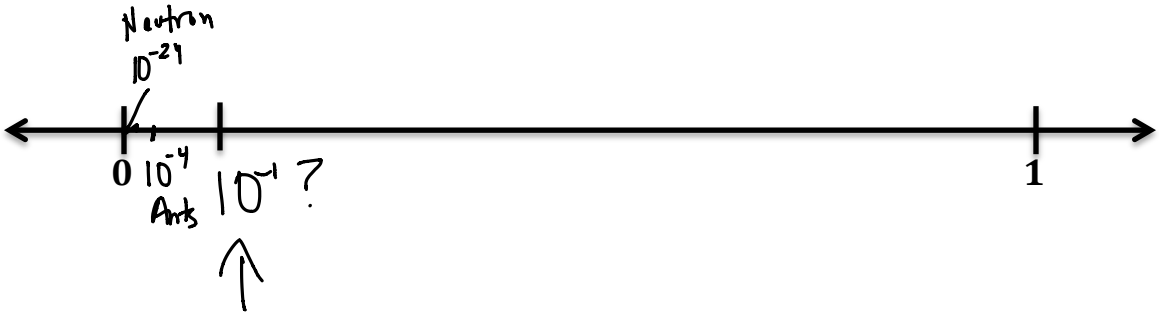
Example: If M is the world's population as of March, 2013. $M = 7{,}073{,}981{,}143$. M has 10 digits and will be smaller than any whole number with 11 digits, such as 10,000,000,000. But $10{,}000{,}000{,}000 = 10^{10}$, so $M < 10^{10}$.

$10^{17} < 279{,}000{,}000{,}000{,}000{,}000 < 10^{18}$

FACT #2: Numbers with a value less than 1 but greater than 0 can be expressed using a negative power of 10. The closer the number is to 0, the smaller the power of 10 that will be needed to express it.

$10^{-17} > \frac{1}{1{,}000{,}000{,}000{,}000{,}000{,}000} = 10^{-18} > 10^{-19}$

Example: The average ant does not weigh very much—approximately 0.0001 grams. This can be rewritten as $10^{-4}\ g$.
The mass of a neutron is approximately 0.000 000 000 000 000 000 000 001 grams. This can be rewritten as $10^{-24} g$. The mass of a neutron is closer to 0 than the mass of an ant.



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Guided Practice:

Steps for Finding the Magnitude of Large Numbers *(M)*
1. Identify how many digits are to the left of the decimal point in the large number.
2. Express this as smaller than the next highest power of 10.

987,654,321,098 $< 1,000,000,000,000$ 12 digits 10^{12}	99,999,999,911 $< 10^{11}$ 100,000,000,000
13,567,234,432,109 $< 10^{8}$ 8 digits	3,345,987,5201 $< 10^{7}$ 7 digits $10,000,000$

Steps for Finding the Magnitude of Small Numbers *(S)*
1. Identify how many digits are to the right of the decimal point in the small number.
2. Express this number as larger than the next smallest (negative) power of 10.

10^{-5}

0.000003 > 0.000001 10^{-6}	0.00000000005 $> 10^{-11}$
0.00000143567 $> 10^{-7}$ > 0.0000001	0.0000349876 $> 10^{-5}$ 0.00001
The chance of winning the lottery is about 10^{-8}. The chance of being hit by lightning is 0.000001. Which are you more likely to experience? $10^{-8} < 10^{-6}$ $0.00000001 < 0.000001$	The average dust mite is 0.0004 meters long. The width of the average piece of human hair is 10^{-4} meters wide. Which is smaller? dust mite hair $.0004 > .0001$ 10^{-4}

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Independent Practice:

What is the next smallest power of 10? 0.00032	What is the next smallest power of 10? 0.0000000001
What is the next largest power of 10? 9,999,923,123,456,789	What is the next largest power of 10? 786,453,098.54654789876546
The area of Alaska is approximately 10^6 square kilometers. The area of California is approximately 423,970 square kilometers. Which is bigger?	According the 2013 census, the state of Georgia has approximately 9,992,167 residents. What is the nearest power of 10 that is larger than this number?
The chance of you becoming a movie star is approximately 10^{-6}. The chance of you being drafted in the NBA or WNBA is 0.0000001. Which is more likely?	The diameter of the sun is 1,392,000,000 meters. The distance from the earth to the sun is approximately 10^{11} meters. Which is a shorter distance?

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Activating Prior Knowledge:

We know about things that are really big and really small.
Think about something that smaller than the width of a human hair.

Closure:

Delia said that 0.09 was bigger than 0.1. Use powers of 10 to prove she's wrong.

Teacher Notes:

Hand out lesson 7 problem set for homework.