Name:_____Date:_____Period:_____

Powers of Minus Ten

1. What is the **largest** thing you can think of anywhere?

2. What is the **smallest** thing you can think of anywhere?

Watch the film Powers of Ten at http://powersof10.com/film and answer the questions below while you are watching.

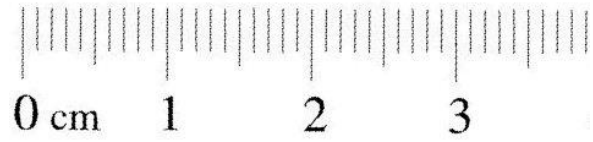
3. Every ten seconds of video, what happens to the field of view? What happens to the distance from the camera to the picnic?

4. What is the difference between "powers of ten" and "powers of **minus** ten"?

5. Below is a list of items, rank them 1-14 for size (1 is the smallest and 14 is the largest).

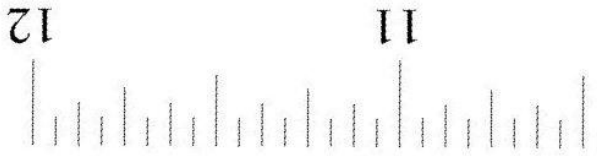
_____Whale
_____Carbon atom
_____Grain of rice
_____Salt
_____Sesame seed
_____Chicken egg
_____Human egg
_____Human sperm
_____Skin cell
_____Blood cell
_____Baker's yeast
_____*E. coli* bacterium
_____HIV
_____Chromosome

Measuring Distances in Metric



1. Count the number of lines starting after the 0 cm mark and including the 1. How many did you count?

2. Do those marks represent millimeters or centimeters?



3. What do the numbers 1, 2, 3, etc. represent? Millimeters? Centimeters? Meters?

4. How many millimeters are in 1 centimeter? How many centimeters are in 1 meter?

(Do you know the word in "ciento" in Spanish or "cent" French? What do they mean? Notice any similarities?)

The table below shows commonly used metric units and how they are related to each other.

Unit	**Symbol**	**Length in Meters**	**In Scientific Notation**
Kilometer	km	1,000 m	1×10^{3} m
Meter	m	1 m	1×10^{0} m
Centimeter	cm	0.01 m	1×10^{-2} m
Millimeter	mm	0.001 m	1×10^{-3} m
Micrometer	um	0.000001 m	1×10^{-6} m
Nanometer	nm	0.000000001 m	1×10^{-9} m

5. What would be the best unit to use for measuring the distance from Seattle to Chicago?

6. What would be the best unit for measuring the distance between your wrist and your elbow?

7. What would be the best unit for measuring the size of a grain of rice?

8. What would be the best unit for measuring the size of a cell?

What is Scientific Notation?

The earth is 4.6 billion years old. If you wanted to write that in scientific notation, you would write it as **4.6 x 10^9**. If you wrote out the number with all of the zeros, it would be written as:

4,600,000,000

1. How many "places" are there after the 4? _____
2. What is the exponent on the number ten in bold above?_____(notice any similarities?)

Scientific notation is a way of writing VERY LARGE or VERY SMALL numbers in shorthand.

Scientific notation is based on powers of the base number 10 and the exponent tells how many zeros are "attached" to the number.

So again, the age of the earth is 4,600,000,000. As written in scientific notation, the earth is:

4.6 x 10^9 years old

*The first number **4.6** is called the **coefficient**.* It must be greater than or equal to 1 and less than 10. The second number is called the **base**. The base number 10 is always written in exponent form. In the second part of the number above, 10^9, the "9' is the exponent of power of ten. It's the same as saying 10 x 10 x 10 x 10 x 10 x10 x 10 x 10 x 10.

3. According to www.nasa.gov, the mass of the Earth is 5,973,600,000,000,000,000,000,000 kg. Write the Earth's mass in scientific notation below.

4. According to www.nasa.gov, the mass of the moon is 7.349 x 10^{22} kg. Write the mass of the moon as a regular number below.

5. Which has more mass, the Earth or the moon? How do you know?

Review

To write a number in scientific notation, put a decimal point after the first number and drop the zeros. Count the number of "places" after the decimal point and write that as an exponent of 10.

4,600,000,000 ⟶ 4.600000000 ⟶ 4.6 x 10^9

Powers of MINUS Ten

An influenza virus is about 130 nanometers, which is the same as 0.00000013 meters. An influenza virus is VERY SMALL, so if you wanted to compare the size of the influenza virus with something else as measured in meters, you could write it's science in meters in scientific notation to eliminate the need for so many zeros.

It would be written like this:

$$1.3 \times 10^{-7} \text{ meters}$$

1. What is different about this method of writing in scientific notation compared to the previous problems where you were examining the age of the Earth, which is a VERY BIG number?

If you are dealing with very small things, the power of ten will be negative. A negative exponent after the 10 means that you count the number of zeros BEFORE the decimal point (instead of after).

30 micrometers are equal 0.00003 meters. If you were to move the decimal place behind the 3, how many "places" are there? I count that there are 5 places.

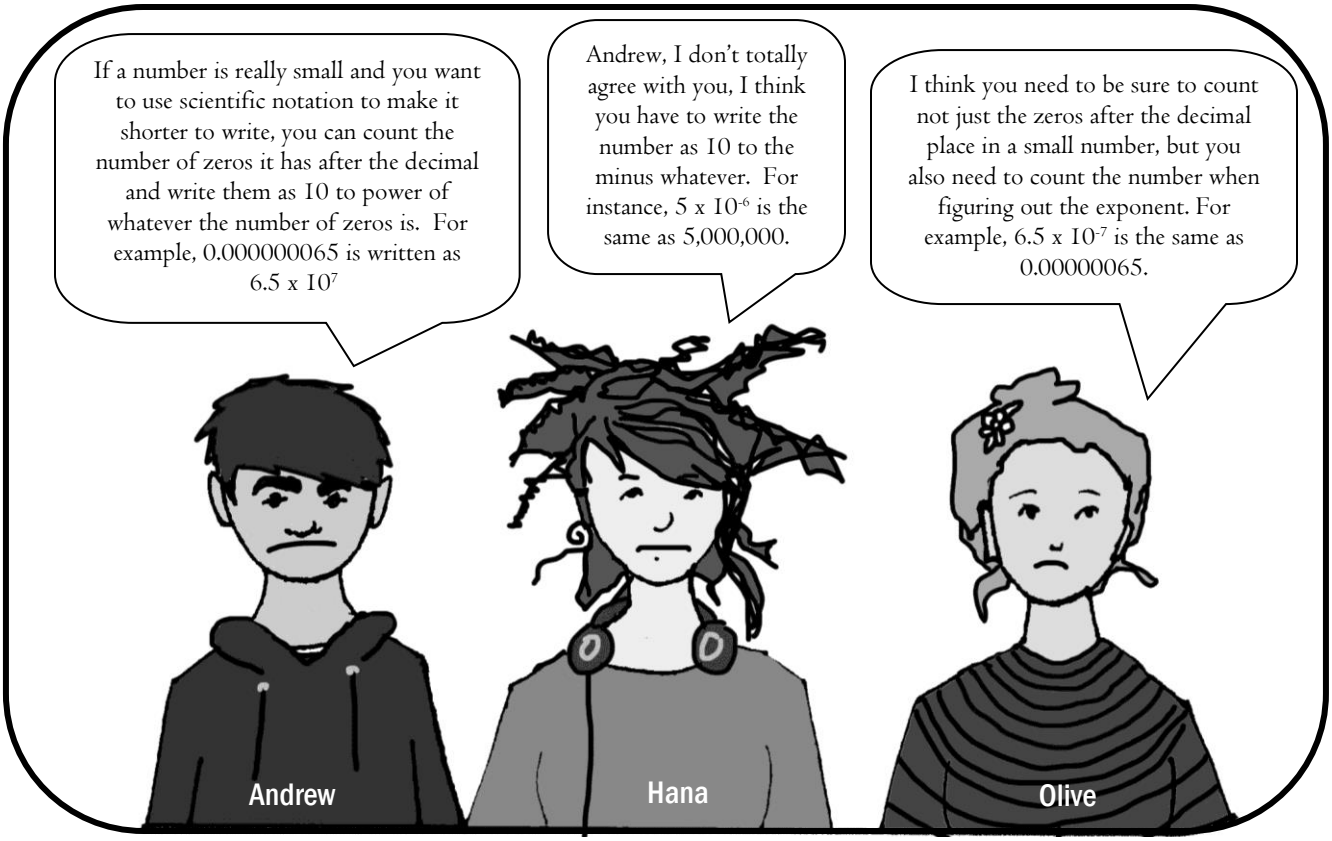
0.00003
1 2 3 4 5

Therefore, the number can be written in scientific notation as 3.0×10^{-5}.

2. The measles virus is about 220 nanometers (0.00000022 meters). Write the size in meters using scientific notation.

3. The hepatitus virus is about 4.5×10^{-8} meters in size. Write this as a regular number in meters.

Scientific Notation: A Discussion Among Friends

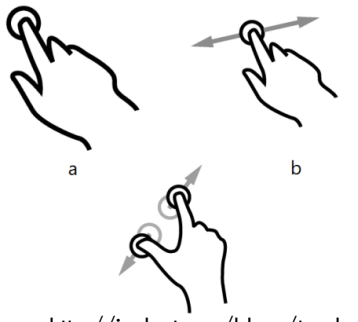


Read the discussion between the three friends (Andrew, Hana, and Olive) above. Who is correct? Write a statement below that explains who you think is correct (or the most correct) and describe why you think so. If the students are partially correct, be sure to explain how in your answer.

Using the Application: Powers of Minus Ten

1. Choose POMT off of the desktop
2. Enter your first and last name as one word (i.e. alberteinstein) and choose SINGLE PLAYER.
3. If the screen for entering your name doesn't appear when you start the app, go the **?** icon at the lower right and select "Main Menu". This will bring you back to the start screen.

Exploration



http://i.zdnet.com/blogs/touch-

Hint: Pinch to zoom in or use the scale bar on the left

4. **Record the power of minus ten for each of the following screens (pinch out to zoom in to find the next screen):**

   Hand:____**3 cm or 3 x 10^{-2} m**_____

   "This is the SKIN": _____

   "You are IN THE SKIN": _____

   Hint: Tap the measuring tool at the bottom of the screen and watch how something is written in scientific notation.

5. Move around the field that shows the inside of the skin. What do you think you are looking at on this level?

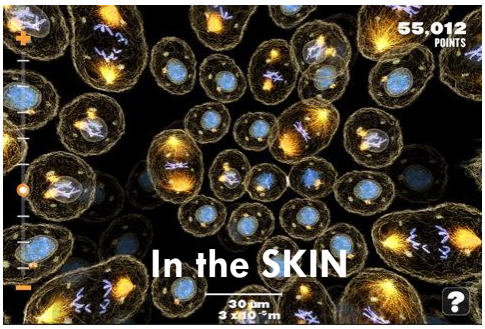
6. Tap items that look different, when you find the items listed in the table below (and on the next page) write the definitions in the spaces below.

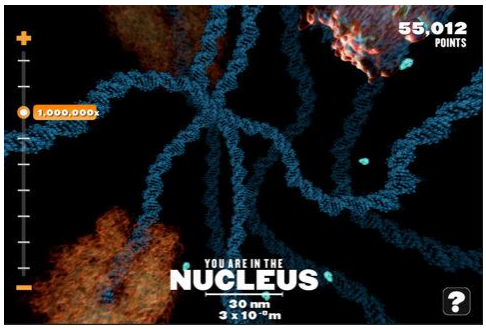
Item	Definition
Skin cell	
Prophase	
Prometaphase	

Item	Definition
Metaphase	
Anaphase	
Telophase	
Stem cell	

Notice that when you tap the items, you earn points!

You will be alerted when you have unlocked a challenge – but at any time, you can tap the LAB button at the top right and view the items you have collected as well as their definitions.





Explore

When you are in the SKIN zoom into a cell and take a look around. Explore the field that you see by dragging your finger across the screen and try to look for the differences that you see.

Click on various items and try to find the items in the table below. When you find them, write their definitions and sizes in the appropriate spaces. In order to find ALL of the items below, you are going to have to keep zooming! You will need to zoom into the cytoplasm and into the nucleus to get them all.

Item	Size	Description
Cell Nucleus		
Sister Chromatid		
Mitotic Spindle		
Mitochondrion		
Golgi Apparatus		
Lysosome		
Endoplasmic Reticulum		
Vacuole		
Centriole		

Item	Size	Description
Ribosome		
RNA Polymerase		
Guanine		
DNA Polymerase		
Helicase		
tRNA		
DNA		
Polypeptide		
Thymine		
mRNA		

Now that you have collected all of the items in the LAB, you should have a few challenges unlocked. Before you complete the MITOSIS challenge, do this:

Go to **LAB** and sort by size (click the "size" tab).

What's the largest item?_____

What's the smallest item?_____

Now tap "challenges" in the top right corner. You will see a star next to the challenges you have unlocked. Play the MITOSIS challenge.

1. When you unlock the video and watch the process, how long does it take for a cell to divide?

2. What this more or less time than you thought? Explain.

Scale Activity

Complete the scale activity at:
http://learn.genetics.utah.edu/content/begin/cells/scale/

1. What surprised you?
2. Which is bigger - human sperm cell or egg cell?
3. Which is bigger a chromosome or a skin cell?
4. Which is the smallest, a molecule of glucose, water, or a carbon atom? Write the chemical formulas for each. Does this surprise you?
5. What is one item that was way smaller than you expected it to be?

Reflection

Summarize your learning experience in the table below.

What I used to know...	What I know now...	What I still want to know...

Mitosis Steps

Draw the different phases of mitosis in the spaces below and write a "silly" caption to remind of what's happening in each phase. Label each picture.

Comic Relief: Summarize Mitosis

In the frames below, write captions for the characters, in which one character tells the other character about the phases of mitosis.