Life Science

Let's Get Small :: Scale and measuring - Student Lab

6-8

PROBLEM QUESTION:

How does the size of a bacterium relate to the width of your hair?
What is the advantage to using models in science?

HYPOTHESIS:

???????

BACKGROUND CONTENT:

While diseases caused by microbes are very important, there are many microbes that are useful and even beneficial to our everyday lives. Many microbes produce the oxygen we breathe. For example, pond water is full of these organisms. People could not survive without intestinal bacteria creating essential vitamins and helping digest the food we eat. We would not have cheese, wine, or antibiotics without microbes. However, can you see organisms as small as bacteria and viruses? Most often you cannot. Sometimes, though, they live in large colonies that we are able to see. These microbial mats can be seen in the hot springs found in Yellowstone National Park. Generally, we use millimeters to measure "small" things. You learn in this activity that microscopic microbes are ultra- small, so millimeters are actually too big to measure them. Scientists measure microbes by using micrometers (microns) or nanometers. One micrometer is six times smaller than a meter, it is written as 0.000001 m. A micrometer is a thousand times smaller than a millimeter and a nanometer is one million times smaller than a millimeter. Because these microbes are so small, scientists often use models to help us study and understand them. In this activity, you will use a model to help you "see" the size of viruses and bacteria.

MATERIALS:

Meter stick
Sidewalk chalk
Microbe reference chart
Magnifying glass or microscope
Long measuring tape

PROCEDURE:

1. Carefully pull a piece of your hair out of your head. Examine it under the microscope or with the magnifying glass. Does it look larger? _____ _____ Examine a piece of hair from another group member. Compare its thickness to your own hair. _____ _____ _____

If you were going to make a model of a piece of human hair, would you make it larger or smaller than a real piece of hair? _____ Do you think microbes are smaller than a real piece of hair? _____

If you needed to make a model of a microbe, would you make it larger or smaller than the original? _____ _____

2. Lay your meter stick or ruler out in front of you. What kinds of things would you measure in meters? _____ _____ Viruses, bacteria, and protozoa are so small that we use much smaller measurements for them. They are even so small that we cannot use any sort of "stick" to measure them.

3. Obtain a prepared slide from your instructor and look at an example of a bacterial cell and a paramecium. Draw what you see and estimate how big you think the bacterial cell and the paramecium are in real life.

4. Move to the area your instructor has set aside for you to create your model to compare the sizes of viruses, bacteria, and protozoa with the width of a human hair and a human blood cell. The marked off area is 50 meters. It represents the width of a piece of hair. That would be the tiny space between your fingers where you held the piece of your hair earlier. Use the microbes your instructor has assigned you from the first column of the Microbe Reference Chart.

5. Determine the size your microbe should be by setting up a ratio of actual size to scaled size. Show your work and answer in the space provided below.

Example:

$$\frac{\text{actual size of microbe}}{\text{actual size of hair}} = \frac{\text{scale size of microbe}}{\text{scale size of hair}}$$

$$\frac{10 \text{ microns}}{100 \text{ microns}} = \frac{X \text{ m (red blood cell)}}{50 \text{ m (hair)}}$$

$$.01 = Xm/50m$$

$$50*.01 = Xm$$

$$5 \text{ m (meters)} = X$$

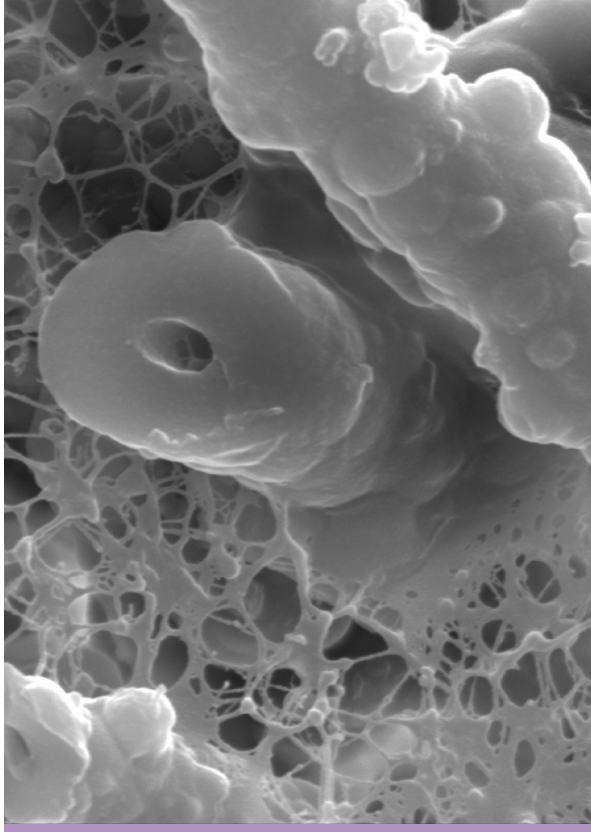
6. Draw what you think it might look like in comparison to a human hair in the marked off area. In other words, draw it to scale. Remember, the marked off area represents the size of the hair that you looked through the microscope earlier.

7. Is your drawing drawn to scale? In other words, is the size of your drawing correct if the size of a human hair were really 50 m thick? If you need to, redraw your microbe so that it is correctly sized compared to the hair.

8. Place your drawing in the area designated by your teacher.

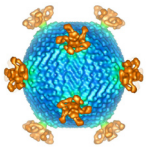
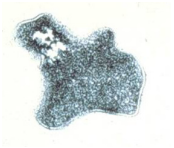
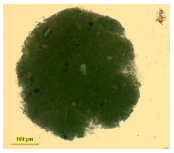
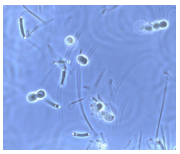
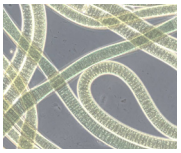
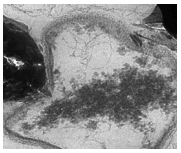
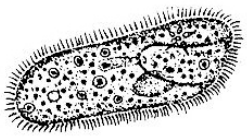
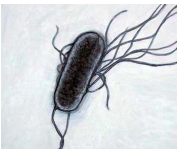
9. Circulate among the groups and look at their drawings.

10. Answer the following questions.



QUESTIONS:

1. How many times larger was your drawing than the actual microbe?
2. Did you create a good model of the microbe's size?
3. Why do viruses, bacteria and protozoa all have such different shapes?
4. How many of your microbes could fit into a teaspoon?
5. Why do scientists need to use models?
6. How are models a useful tool for studying microbes?
7. Explain three ways that bacteria have been useful to you today.

MICROBE	HABITAT OR FUNCTION	ACTUAL SIZE	SHAPE
STIV	High temp. virus that infects Sulfolobus	0.070-0.090 microns	
Sulfolobus	High temp. Archaea pH 2-3 Temp. 80-90°C	1.5 microns	
Cyanidia	Acidophilic algae pH 2-3 Temp. 45-57°C	7 microns	
Synechococcus	High temp. cyanobacteria pH 6-9 Temp. 45-72°C	1 - 5 microns	
Oscillatoria	High temp. cyanobacteria pH 5-9 Temp. 37-54° C	7 - 18 microns	
Metallosphaera	Iron oxidizing high temp. archaea pH 1-5 Temp. 50-80°C	1 micron	
Paramecium	Common protozoa important in the food chain	200 microns (you can almost see it)	
Escherichia coli **(E. coli)**	Causes diseases and helps digestion	3 microns	
Human red blood cell	Carries oxygen in our bodies	10 microns	
Human hair	Protects our bodies from the elements	100 microns