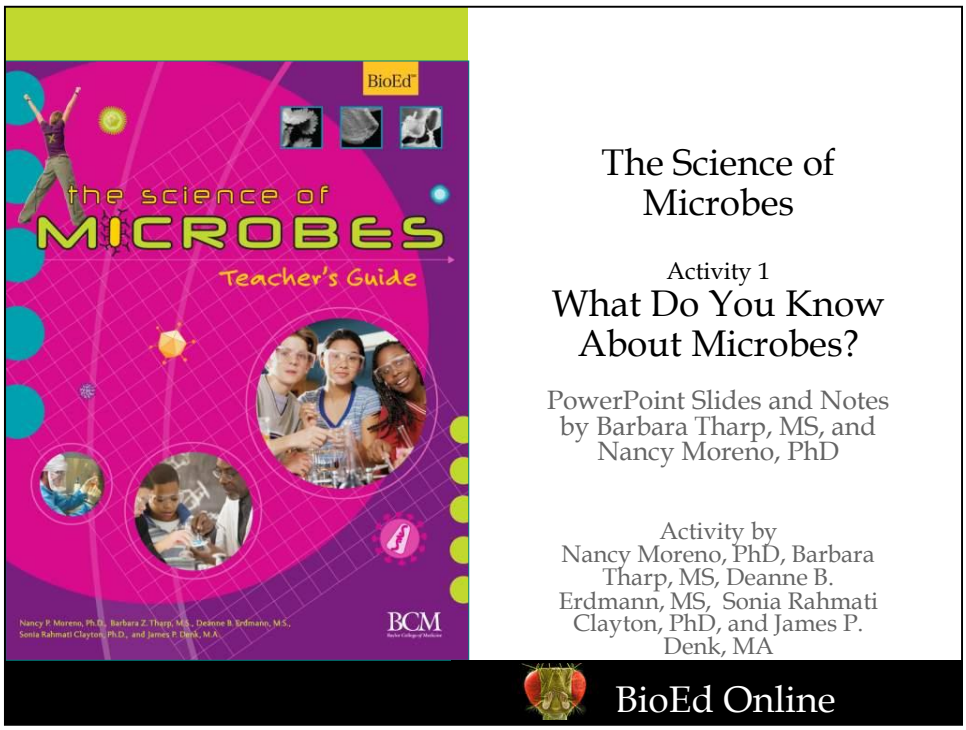

The Science of Microbes—Activity One: What Do You Know About Microbes?

What Do You Know About Microbes is the first lesson in the unit, The Science of Microbes. It addresses the National Science Education Content Standards in two areas: Inquiry and Life Science. This lesson begins with a student pre-assessment that allows you, the teacher, to evaluate student knowledge levels before beginning the activity. After students have completed the pre-assessment, discuss any questions they may have, but do not provide direct answers to the pre-assessment questions. Students will revisit their answers to these questions at the end of the unit.

During this lesson, students will consider the mass of microbes in the body and learn about the prevalence of microbes in our world. They will begin a concept map that will help them to organize knowledge, concepts and ideas encountered over the course of The Science of Microbes unit.

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Materials for a Group of Four Students
You will need Glo Germ™ powder and a black light to conduct What Do You Know About Microbes? Non-toxic Glo Germ is invisible under normal lighting conditions, but will glow brightly under a black light. You may order Glo Germ power or a Glo Germ Kit (includes a black light) online at www.GloGerm.com or www.Sciencekit.com.

In addition, this lesson requires the following set-up.

- Make copies of the pre-assessment, What About Microbes, for all students.
- For each group of students, fill one plastic liter-sized bottle with water. Dry the outside surface of the bottle. Place 1 cup of Glo Germ powder in a large plastic bag. Coat the outside of each group's bottle with powder by placing it in the bag and shaking gently. Bottles will look slightly dusty, but the Glo Germ powder will be visible to students only under a black light. The specks of powder will model microbes.
- Students will need access to one balance scale (may be shared by all students).

Place the following materials on a tray in a central location for each group of students.
- 8 small sticky notes (2 per student)
- 4 hand lenses
- 4 small paper clips
- Markers
- 1-liter plastic bottle (coated with Glo Germ)
- Poster board or chart paper and markers, or access to computer with drawing software
- Stopwatch or clock with second hand

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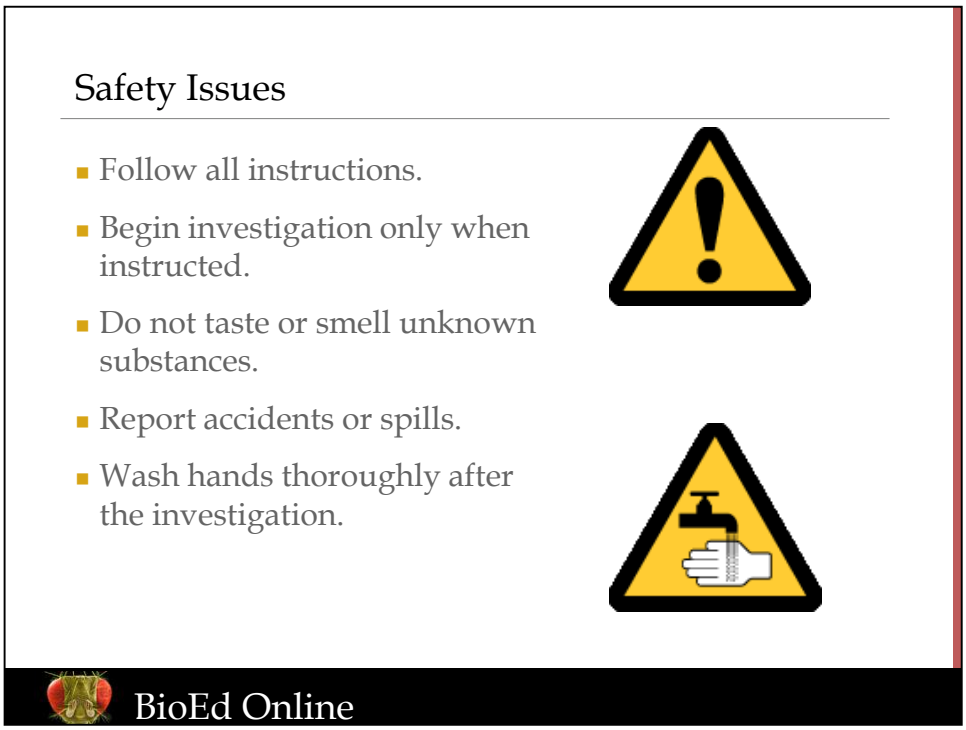

Safety Considerations

It is important that students always think about safety when conducting a science investigation, and this slide may be used to review safety with your class before starting the activity. Also, keep the following points in mind.

- Always follow your district and school safety guidelines.
- Have a clear understanding of the investigation in advance (practice any investigation with which you are not familiar).
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.

Glo Germ™ powder is nontoxic. However, it should not be ingested. Safety goggles should be worn by all students. Have students wash hands with soap and water after handling Glo Germ powder.

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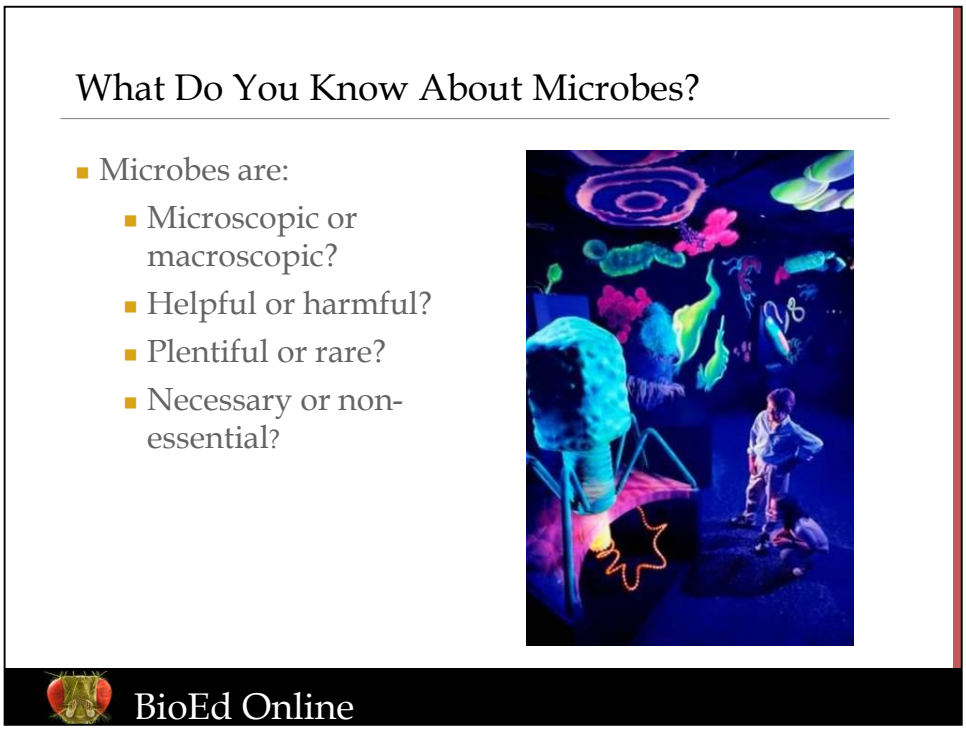

What Do You Know About Microbes?

Before students begin the lesson, explain that they will be learning about microbes (also called microorganisms), the most numerous organisms on Earth. Make and distribute copies of the pre-assessment, entitled What About Microbes, for students to complete independently. Collect students' completed assessments and ask if there are any questions, but do not provide answers to items on the pre-assessment (this will be part of the last lesson in the unit). Encourage students to ask questions or discuss observations they may have about microbes. You may want to show students the slide above to encourage more questions and discussion. This dialogue should produce more questions than answers. Hopefully, it will spark students' curiosity about the world of microbes. Make a list of things students want to learn. Record questions and observations on a class chart to be revisited at the end of the unit.

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Image Reference:

Evergreen exhibitions. *Robotic microbe in the microbial universe*. Retrieved 01-09-2008, by

permission from http://www.evergreenexhibitions.com/exhibits/microbes/photopress.asp.

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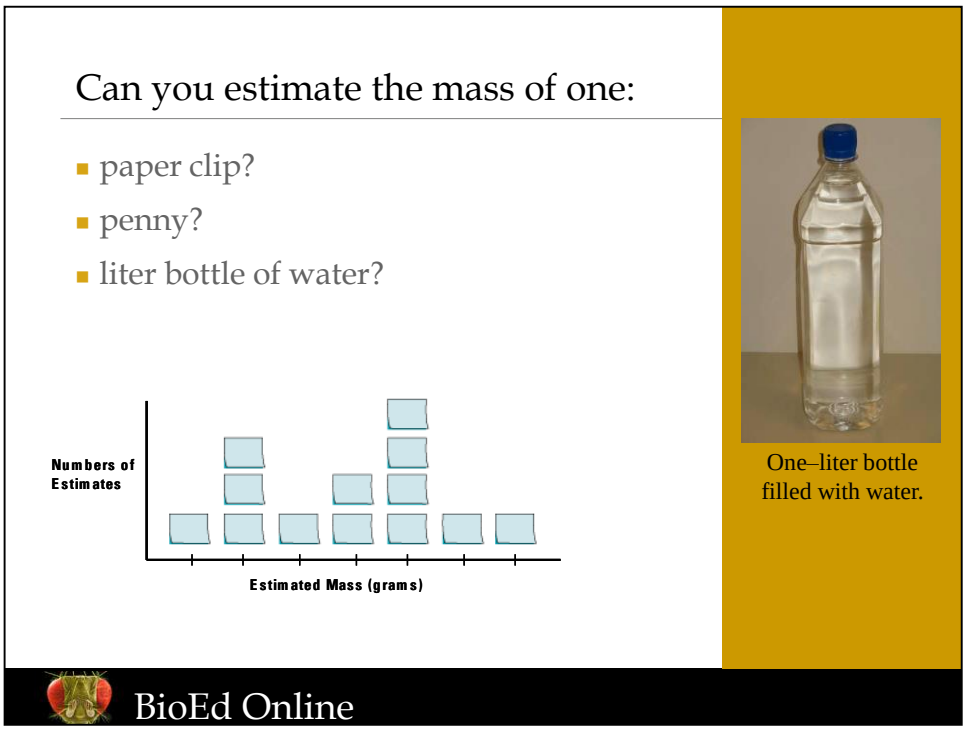

Can you estimate mass?

This portion of the activity is designed to focus students' attention on the large quantity of microbes normally found inside and on a healthy person's body. To establish a point of comparison, have students examine a paper clip and then estimate its mass (weight). Explain that the mass (weight) of one paper clip is 1 gram.

This might be a good time to explain the difference between mass and weight, since the terms are often used interchangeably. In classical physics, mass is a measure of an object's resistance to changing its state of motion when a force is applied. It corresponds conceptually to "how much matter" is in an object. Weight is a measure of the effect of gravity (such as the Earth's gravitational field) on an object. Technically, a beam balance measures mass, whereas a spring scale (which examines how much gravity pulls on an object) measures weight. The distinction between mass and weight is not important in everyday circumstances, because the strength of gravity hardly varies from location to location on Earth, making weight uniformly proportional to mass.

If time allows, you might want to have students measure other common items. For instance, a penny has a mass of 3 grams. Next, tell students to take turns holding the 1-liter water bottle to estimate its mass. Have students record their estimates on a small sticky notes. Direct students to create a class graph by placing their estimate notes on the board in ascending order, with estimates of the same value stacked above each other in vertical columns (see illustration above).

Ask students to examine the class bar graph. While analyzing the information on the graph and discussing students' estimates, you could introduce the measures of central tendency (mean, median, mode and outliers). Inform students that the actual mass of the water-filled bottle is 1,000 gm. Ask, "*Was anyone's estimate close?"* Explain that the mass of microbes found in and on a person's body also is approximately 1,000 grams!

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Where are the microbes?

Now, turn students' attention toward their hands. The Glo Germ™ powder is barely visible under normal lighting conditions, but when students handled the liter bottles, some powder was transferred to their hands. With the small amount of magnification provided by a hand lens, the powder is slightly more visible. When students place their hands under a black light, the Glo Germ powder becomes fluorescent and easy to observe.

In this activity, the Glo Germ powder models microbes in the environment. Microbes are the most prevalent life forms on earth, both in mass and number. They are too tiny to be seen without magnification (in most cases, a microscope is required), yet microbes impact every human's entire life.

Students may think all microbes are harmful, but most are not. Explain that microbes produce most of the Earth's oxygen and are essential parts of all ecosystems. In addition, microorganisms are responsible for meeting many of the most vital human needs—such as aiding in digestion; protecting against other harmful microbes in the nose, skin and other body systems that might cause disease; and enabling the production of foods, such as sandwich bread and yogurt. Of course, some microbes are dangerous, cause illness, and are responsible for diseases that range from the common cold to malaria.

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Image Reference:

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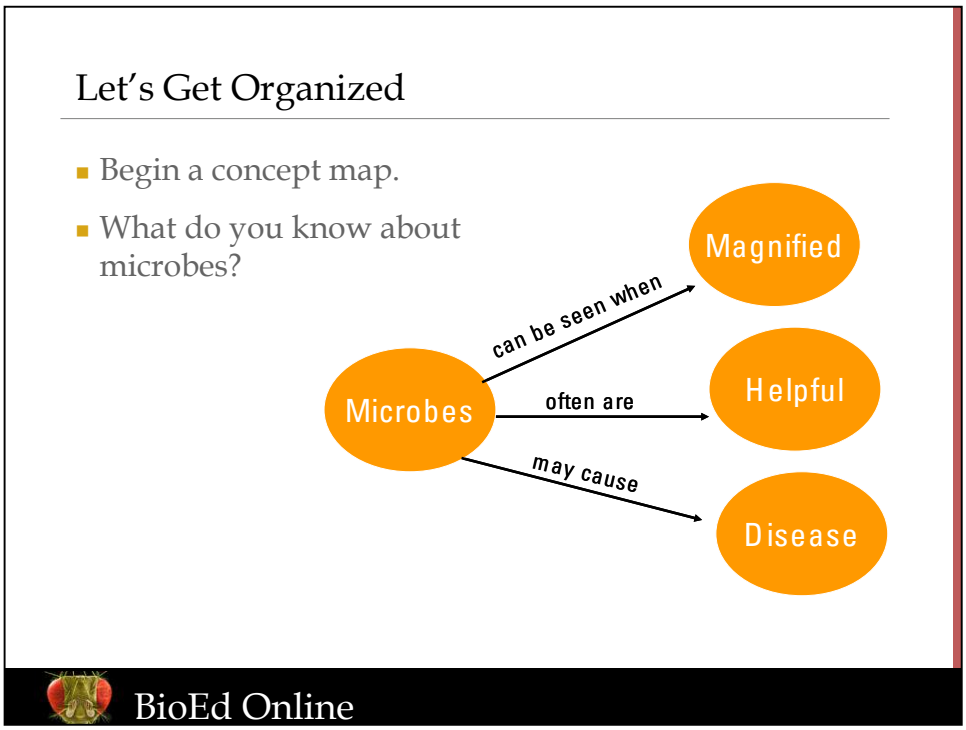

Let's Get Organized

Students probably do not know much about microbes yet. However, they should be begin to form some general understandings, such as what microbes are, microbe sizes and locations, and why microbes might be important to life on Earth. Explain to students that they will learn more about microbes throughout this unit.

At this point, each group of students will create a concept map, to which they will add information over the course of the unit. You may want to review the procedure for creating a concept map before they begin. Concept maps are web-like representations of knowledge, thoughts and ideas. Concepts are expressed as words or phrases, connected by lines or arrows, and often linked by words that describe relationships between two concepts. You may want students to use sticky notes to position and reposition concepts on their maps as they progress through the unit. Computer-based graphics software also may be used to create concept maps.

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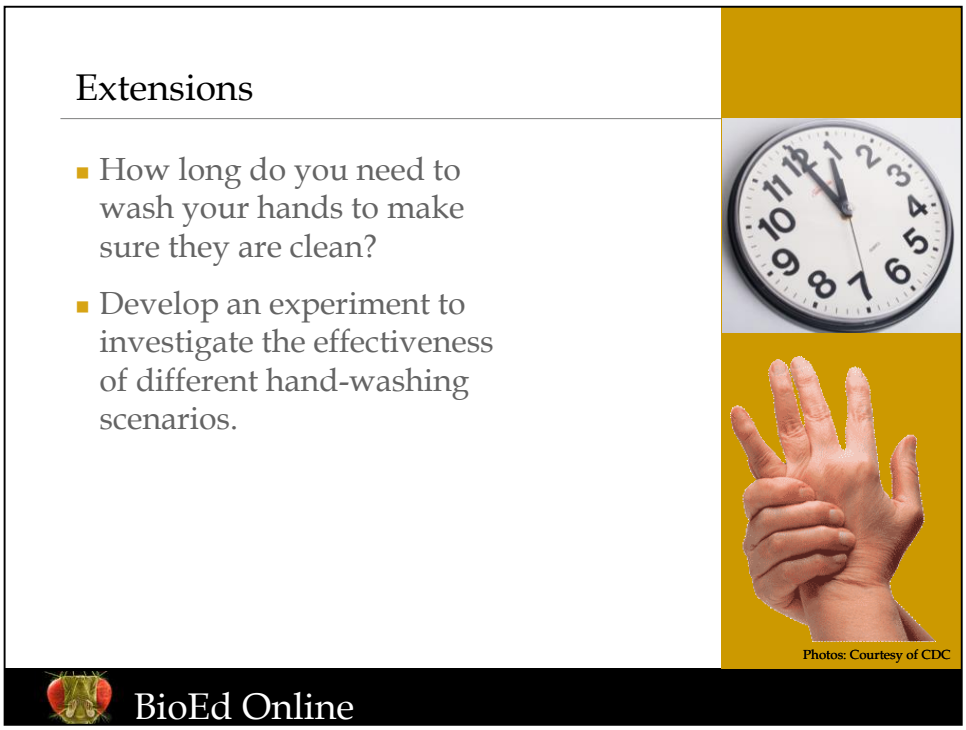

Extensions

This activity offers several opportunities to extend student learning. Consider having students address one or both of the questions on the slide by designing their own investigations.

Students could begin by estimating the length of time one must wash his or her hands to be sure they are clean and free of harmful microbes. You might have students record their estimates on sticky notes to create a class bar graph of data.

Next, ask students to plan experiments that involve several different variables, such as water temperature, type of soap (including anti-bacterial), and length of time washing hands under the water. If it is not mentioned, make sure students develop and agree upon a uniform method for "contaminating" hands with Glo Germ. Then have each group record and implement its plan. Results should be presented to the class.

As an alternative, you may wish to follow a pre-set plan, such as the example below.

Six groups of students. All use the same technique for contaminating hands with Glo Germ powder and follow the same basic hand-washing method. The variables are the presence (or absence) of soap and the time spent washing.

Group 1. Wash 10 seconds without soap.
Group 2. Wash 20 seconds without soap.
Group 3. Wash 30 seconds without soap.
Group 4. Wash 10 seconds with soap.
Group 5. Wash 20 seconds with soap.
Group 6. Wash 30 seconds with soap.

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