BioEd℠

the science of MICROBES

Activity: Magnifying and Observing Cells

from *The Science of Microbes Teacher's Guide*

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RESOURCES

Free, online presentations of each activity, downloadable activities in PDF format, and annotated slide sets for classroom use are available at www.bioedonline.org/ or www.k8science.org/.

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USDA NATURAL RESOURCES CONSERVATION SERVICE
www.plants.usda.gov

HIV virus particle. L. Howard, C. Daghlian, Dartmouth College.

INTRODUCTION

Microbial Challenges

Infectious diseases have plagued humans throughout history. Sometimes, they even have shaped history. Ancient plagues, the Black Death of the Middle Ages, and the "Spanish flu" pandemic of 1918 are but a few examples.

Epidemics and pandemics always have had major social and economic impacts on affected populations, but in our current interconnected world, the outcomes can be truly global. Consider the SARS outbreak of early 2003. This epidemic demonstrated that new infectious diseases are just a plane trip away, as the disease was spread rapidly to Canada, the U.S. and Europe by air travelers. Even though the SARS outbreak was relatively short-lived and geographically contained, fear inspired by the epidemic led to travel restrictions and the closing of schools, stores, factories and airports. The economic loss to Asian countries was estimated at $18 billion.

The HIV/AIDS viral epidemic, particularly in Africa, illustrates the economic and social effects of a prolonged and widespread infection. The disproportionate loss of the most economically productive individuals within the population has reduced workforces and economic growth in many countries, especially those with high infection rates. This affects the health care, education, and political stability of these nations. In the southern regions of Africa, where the infection rate is highest, life expectancy has plummeted in a single decade, from 62 years in 1990–95 to 48 years in 2000–05. By 2003, 12 million children under the age of 18 were orphaned by HIV/AIDS in this region.

> For an emerging disease to become established, at least two events must occur: 1) the infectious agent has to be introduced into a vulnerable population, and 2) the agent has to have the ability to spread readily from person to person and cause disease. The infection also must be able to sustain itself within the population and continue to infect more people.

Despite significant advances in infectious disease research and treatment, control and eradication of diseases are slowed by the following challenges.

- The emergence of new infectious diseases
- An increase in the incidence or geographical distribution of old infectious diseases
- The re-emergence of old infectious diseases
- The potential for intentional introduction of infectious agents by bioterrorists
- The increasing resistance of pathogens to current antimicrobial drugs
- Breakdowns in public health systems

Baylor College of Medicine, Department of Molecular Virology and Microbiology, www.bcm.edu/molvir/.

Using Cooperative Groups In The Classroom

Cooperative learning is a systematic way for students to work together in groups of two to four. It provides organized group interaction and enables students to share ideas and to learn from one another. Students in such an environment are more likely to take responsibility for their own learning. Cooperative groups enable the teacher to conduct hands-on investigations with fewer materials.

Organization is essential for cooperative learning to occur in a hands-on science classroom. Materials must be managed, investigations conducted, results recorded, and clean-up directed and carried out. Each student must have a specific role, or chaos may result.

The Teaming Up! model* provides an efficient system for cooperative learning. Four "jobs" entail specific duties. Students wear job badges that describe their duties. Tasks are rotated within each group for different activities so that each student has a chance to experience all roles. For groups with fewer than four students, job assignments can be combined.

Once a model for learning is established in the classroom, students are able to conduct science activities in an organized and effective manner. Suggested job titles and duties follow.

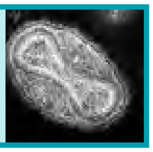
Principal Investigator
- Reads the directions
- Asks the questions
- Checks the work

Maintenance Director
- Follows the safety rules
- Directs the cleanup
- Asks others to help

Reporter
- Records observations and results
- Explains the results
- Tells the teacher when the group is finished

Materials Manager
- Picks up the materials
- Uses the equipment
- Returns the materials

* Jones, R.M. 1990. *Teaming Up!* LaPorte, Texas: ITGROUP.



Smallpox virus particle. CDC\1849 F. Murphy, S. Whitfield.

TIME

Setup: 20 minutes

Activity: 45–60 minutes

SCIENCE EDUCATION CONTENT STANDARDS

Grades 5–8

Inquiry

- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.
- Develop descriptions, explanations, predictions, and models using evidence.
- Use appropriate tools and techniques to gather, analyze, and interpret data.

Life Science

- Living systems at all levels of organization demonstrate the complementary nature of structure and function.
- All organisms are composed of cells—the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular.
- Cells carry on many functions needed to sustain life.

TEACHING RESOURCES

Color versions of the “Magnifying Cells” page, as well as other color images of cells used in this guide may be viewed or downloaded from the BioEd Online website at www.bioedonline.org.

Overview

Students will learn that all organisms are composed of cells, the building blocks of life. Most cells are microscopic and must be magnified to be observed. Students will make slides of cells from an onion skin and *Elodea* (American or Canadian waterweed) to observe under a microscope.

MAGNIFYING AND

Observing Cells

Every living thing is composed of cells, the microscopic building blocks of life. In fact, most life forms exist as single cells that carry out all functions needed for their own independent existence. Examples of common single-celled organisms are bacteria (tiny organisms found in almost every habitat on Earth), diatoms (algae that are common components of phytoplankton), and yeast (a kind of fungus). Multicellular organisms consist of several to many cells. Single-celled and small multicellular organisms, which must be magnified to be observed, are called microbes or microorganisms.

Plants and animals are examples of multicellular organisms visible to the naked eye. These macroscopic multicellular organisms can have up to trillions of cells that carry out specialized functions.

This activity uses plant cells, because many of these are relatively easy to see. Students will observe onion cells (in the thin membrane around each onion “ring”) and a leaf from *Elodea*. With these examples, students will be able to see basic parts of cells, including the nucleus (structure in the center of the cell that holds hereditary information), cytoplasm (gel that fills the cell), cell wall (rigid outer boundary of plant and other kinds of cells), and chloroplasts (large green structures in which photosynthesis occurs).

MATERIALS

Teacher (see Setup)

- 6 sheets of card stock
- Overhead projector
- Pair of scissors or a paper cutter
- Safety goggles
- Sharp knife
- Transparency of *Magnifying Cells* sheet

Per Group of Students

- 4 pairs of safety goggles
- 2 plastic cover slips
- 2 plastic microscope slides
- 2 pairs of forceps
- 1/6 of an onion, vertical slice
- Small stalk of *Elodea* leaves
- Iodine solution and pipette (dropper)
- Water and pipette (dropper)
- Microscope (one or more per group)
- Science notebooks or drawing paper
- Set of *Preparing & Viewing Slides* cards
- Group concept map (ongoing)

SETUP

Make copies of the *Preparing & Viewing Slides* page on cardstock, and cut out one set of cards per group.

Make a transparency of *Magnifying Cells* page or download images (see Teaching Resources, left sidebar).

Prepare a tray for each group with all materials listed above and place trays in a central location.

Have students work in groups of two or four, depending on resources.

Optional: If *Elodea* is not available, new growth celery leaves may be substituted. As an alternative to science notebooks or drawing paper, make and distribute clean copies (one per group) of the *Magnification Observations* student sheet.

SAFETY ISSUES

See sidebar, right.

PROCEDURE

1. Begin by showing students a transparency of the *Magnifying Cells* sheet. Explain that the structures visible in each frame cannot be seen without magnification. Let students ask questions about what is visible in the images. Tell students that they will be making their own slides to observe the tiny structures, called "cells."
2. Point out the labeled parts of the cells on the transparency. Help students understand that they will look for similar structures in their specimens.
3. If necessary, review microscope use with all students (Activity 2). If available, use a micro projector or video attachment on a microscope to demonstrate how to view cells, change magnifications and make observations.
4. Have students work in groups. Tell them to follow the instructions on their *Preparing & Viewing Slides* cards to prepare their slides.
5. After each group has created both slides, have students take turns observing and drawing their specimens (noting the magnification being used). Have students first examine the cells using low power and then refocus using a higher power objective. Instruct students to make detailed drawings and to label any cell parts that are recognizable. Tell students that some parts of a cell may not be visible when viewed under a microscope. Allow 10–20 minutes for this step.

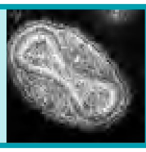
   Note: Have students determine the total magnification by multiplying the power stamped on the eyepiece (for example, 10x) by the power of the objective.
6. Students usually will be able to observe the cell nuclei in the stained onion skin cells. They also should be able to observe cell walls and cytoplasm in both kinds of cells, and to identify chloroplasts in the *Elodea* cells.
7. Display the *Magnifying Cells* transparency for students. Encourage groups to discuss among themselves what they observed. Ask, *Are all the cells about the same size? Could you see a dot* (nucleus) *inside all the cells? If not, why?*
8. Explain the names and functions of the cell structures that students observed and drew.
9. As an assessment, ask students, *What are the major parts of the cells you observed?* (Structures most likely to be identified include cell wall, nucleus, chloroplasts and cytoplasm.) You also might ask, *What similarities and differences did you observe between the two kinds of cells?* Students can record responses in their science notebooks or turn in their answers as assignments. You also may question each group individually.
10. Allow students time to add information to their concept maps. Explain that while the class has examined some cell structures of multicelled organisms, many organisms consist of only one cell. Students will have opportunities to learn more about single-celled microorganisms in later activities.

Canadian waterweed (*Elodea),* is an important part of lake ecosystems. It provides a good habitat for many aquatic organisms, and is an important food source for waterfowl. It also is a hardy aquarium plant. USDA Natural Resources Conservation Service\R. Mohlenbrock © PLANTS Database.

SAFETY ISSUES

Have students wear goggles when working with iodine, which is poisonous if ingested and will stain clothing permanently. Some students may be allergic to iodine. Methylene blue may be used instead of iodine, but it also can cause skin or eye irritation and should not be ingested. If skin is exposed to either stain, wash with soap and water. If stain gets into the eyes, rinse eyes with water for at least 15 minutes.

Have students wash their hands before and after any lab activity.



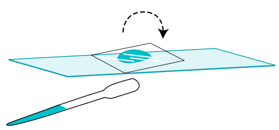
Smallpox virus particle. CDC\1849 F. Murphy, S. Whitfield.

Preparing & Viewing Slides

Onion Skin

A. Follow steps 1–3 below to prepare the slide for viewing.

1. Using a pipette or dropper, place one drop each of water and iodine in the center of a slide.
2. Carefully remove a small, thin, transparent section of skin from the onion's inside layer. Use forceps to place the skin on top of the drops.



3. Slowly place the cover slip over the skin and drops, trying not to squeeze any liquid out from under the cover slip.

B. To examine the onion skin with a compound microscope, follow the steps below.

1. Place the slide on the microscope stage.
2. Focus the low-power objective to find an area of the slide that has some of your sample. Avoid bubbles (clear circles with heavy black borders).
3. Once you have found a section with onion skin, examine the cells. Center the object in the field of view. Rotate to the medium-power or high-power objective.
4. Refocus the microscope using just the fine adjustment.

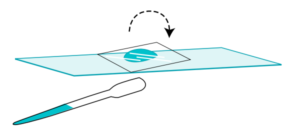
C. Draw what you observe and label any parts you recognize.

D. Record the magnification at which you made your observations.

Elodea Leaf

A. Follow steps 1–3 below to prepare the slide for viewing.

1. Using a pipette or dropper, place one drop of water in the center of a slide.
2. Carefully remove a small, thin leaf from the plant. Use forceps to place the leaf on top of the drop.



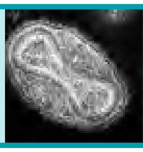
3. Slowly place the cover slip over the leaf and drop, trying not to squeeze any liquid out from under the cover slip.

B. To examine the leaf using the microscope, follow the steps below.

1. Place the slide on the microscope stage.
2. Focus the low-power objective to find an area of the slide that has some of your sample. Avoid bubbles (clear circles with heavy black borders).
3. Once you have found a section with leaf sample, examine the cells. Center the object in the field of view. Rotate to the medium-power or high-power objective.
4. Refocus the microscope using just the fine adjustment.

C. Draw what you observe and label any parts you recognize. (**Note:** The *Elodea* leaf has two layers that can be observed separately by slowly changing the focus, using the fine adjustment knob.)

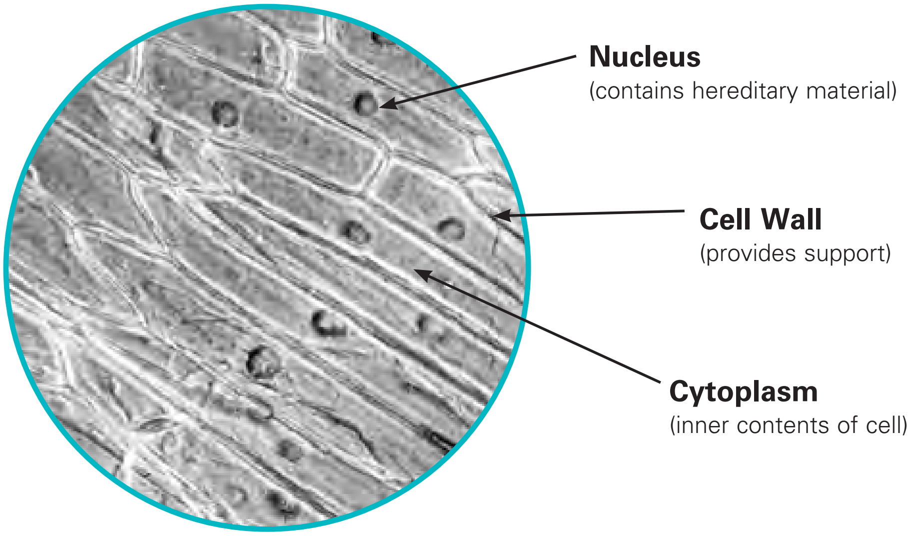
D. Record the magnification at which you made your observations.



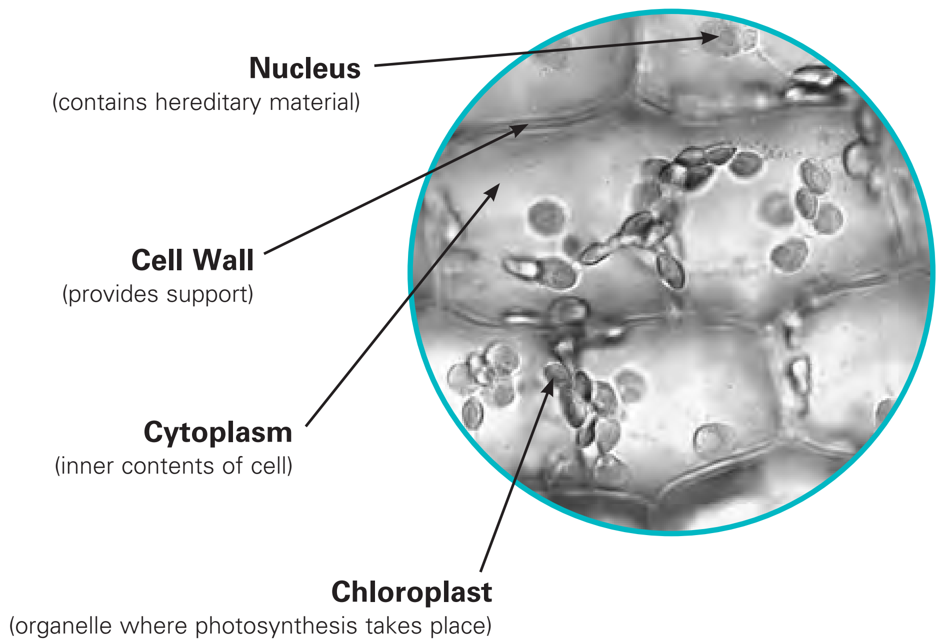
Smallpox virus particle. CDC\1849 F. Murphy, S. Whitfield.

Magnifying Cells

Onion Skin



Elodea Leaf



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