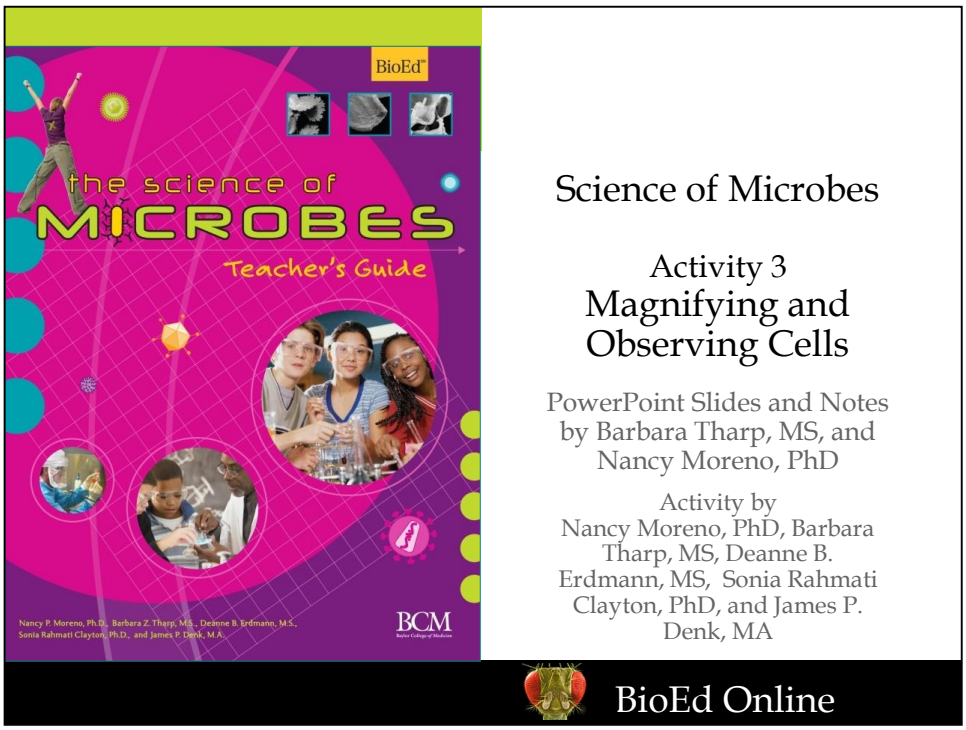


Science of Microbes

Magnifying and Observing Cells is the third lesson in the unit, *The Science of Microbes*. The lesson addresses National Science Education Content Standards related to Inquiry and Life Science. See the downloadable lesson PDF (web address below) for a complete list of the standards addressed.

In this activity, students will learn that all organisms are composed of cells, the building blocks of life. Almost all cells are microscopic and must be magnified to be observed. Students will make wet mount slides of small pieces of onion skin and *Elodea* leaf (water weed) to observe and compare.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number

5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.

Materials for Each Group of Four Students

BioEd Online

Materials for Each Group of Four Students
This activity requires some advance preparation. Purchase or bring to class one onion, which will be sliced into six vertical sections (one for each student group). Also, purchase a section of *Elodea* (water weed) from an aquarium supply store. Finally, make six copies of the student sheet, Preparing and Viewing Slides (pp. 12), on card stock.

Have one or more microscopes available for each group of four students. Before class, prepare trays with the following items for student groups.

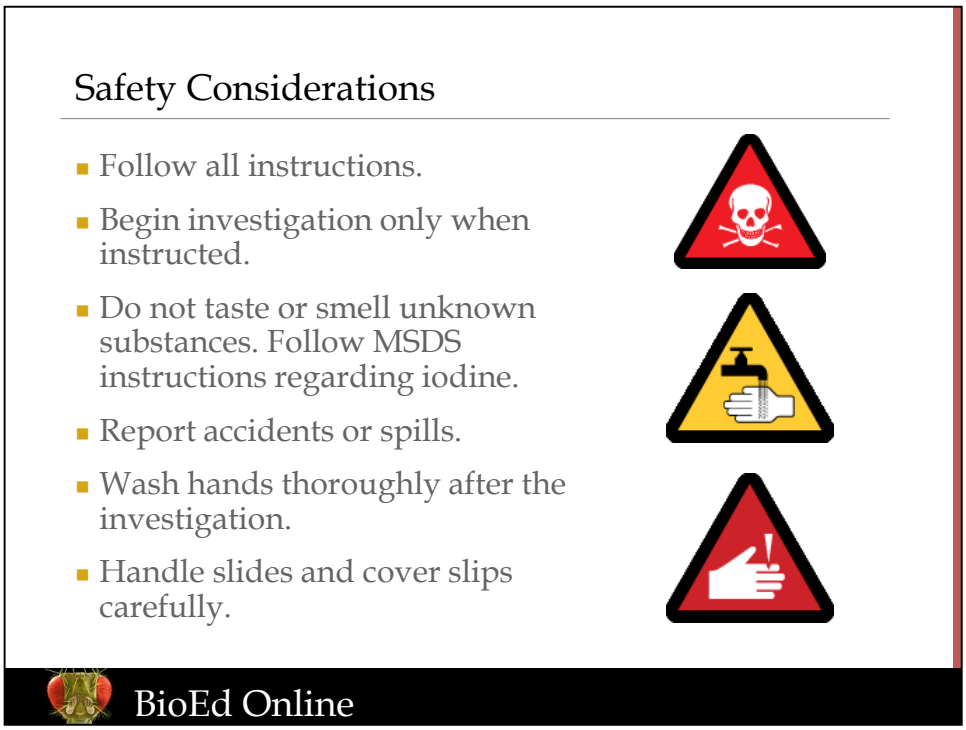
- Iodine solution* and dropper or pipette
- Water and dropper or pipette
- 2 plastic cover slips
- 2 plastic microscope slides
- 2 toothpicks
- 1/6 of an onion, vertical slice
- Small length of *Elodea* stem with leaves attached
- Drawing paper (or students' lab notebooks or science journals)
- Copy of student sheet entitled Preparing and Viewing Slides
- Group concept map (ongoing)

* Iodine Solution is toxic if ingested. Read the Materials Safety Data Sheet (MSDS) carefully. Iodine will stain clothing permanently. Be aware that some people are allergic to iodine.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:
Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.



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.

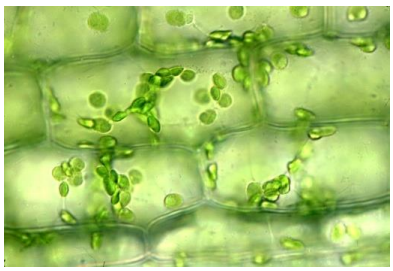
- Always follow your district and school safety guidelines.
- Have a clear understanding of the investigation in advance (practice any investigation with which you are not familiar).
- Make sure appropriate safety equipment, such as safety goggles, is available.
- Continually monitor the area where the investigation is being conducted.
- Glass slides should be discarded in separate containers designed for glass and sharps disposal.
- Iodine is toxic if ingested. Certain people are allergic to iodine. Be certain to read the information on the Materials Safety Data Sheet (MSDS), which should be available in the classroom during the activity. Caution: Iodine will stain the skin, but will gradually wash off. Iodine will permanently stain clothing and some table surfaces. (Materials Safety Data Sheets generally are provided by the supply company. Information also is readily available via the Internet.)

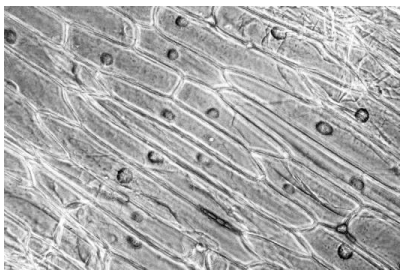
Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:
Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.

What Are These?





J. Walsh © Micrographia.com,www.micrographia.com

BioEd Online

What Are These?

Begin the activity by showing students photographs of two different kinds of plant cells. Let students talk about the images and offer their opinions about what the images represent. Explain that the images represent cells from two different plants and structures (*Elodea* leaf on the left; epidermis, or "skin," from an onion bulb on the right).

Explain to students that they will be creating slides and examining these same type of cells using microscopes. The activity uses plant cells because many are large and relatively easy to handle and observe.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

Image References:

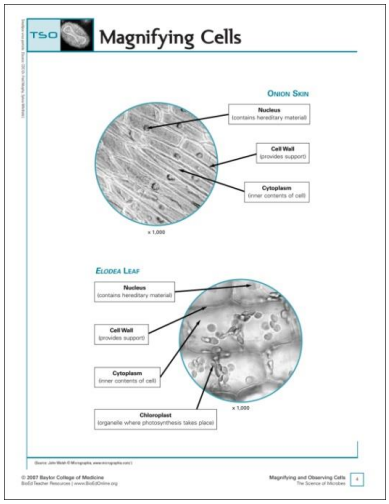
Walsh, J. Cells in *Elodea* leaf, showing plastids, elodea00. *Micrographia*, www.micrographia.com.

Walsh, J. Onion epidermis. *Micrographia*, www.micrographia.com.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.

Typical Parts of Plant Cells

- Identify the following structures in the photographs to the right.
  - Nucleus
  - Cell Wall
  - Cytoplasm
  - Chloroplast



BioEd Online

Typical Parts of Plant Cells

Show students the Magnifying Cells page. Explain that they will be using a microscope to examine onion epidermis ("skin") and a leaf from an *Elodea* (water weed) plant. Before beginning, students will need to know a little about what they might see. Explain that the components they will be identifying are very tiny and visible only under magnification. Not all components will be visible in all cells, but students will be able to be able to see some or all of the following structures: nucleus, cytoplasm, cell wall, and chloroplasts (visible only in the *Elodea* leaves).

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

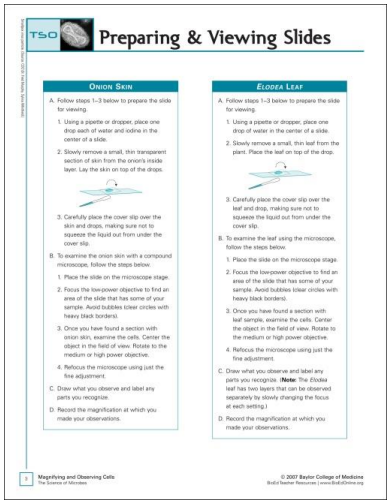
Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program

(AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.

Preparing Wet Mount Slides of Plant Cells

- Follow the instructions provided on cards to create slides.
- Observe the slides under a microscope and record your observations as detailed drawings.



BioEd Online

Preparing Wet Mount Slides of Plant Cells

Have students follow the instructions on the cards provided to prepare slides with wet mounts of onion and *Elodea* tissue. On its inner surface, each section of onion has a thin sheet of skin that is easy to peel off. Deeper layers are far more difficult to remove as a single sheet. Students will use iodine to stain the onion skin cells, so that the somewhat transparent cells and nuclei are easier to observe. Remember to review safety precautions when using iodine. Certain people are allergic to iodine. It will not be necessary to stain the *Elodea* cells.

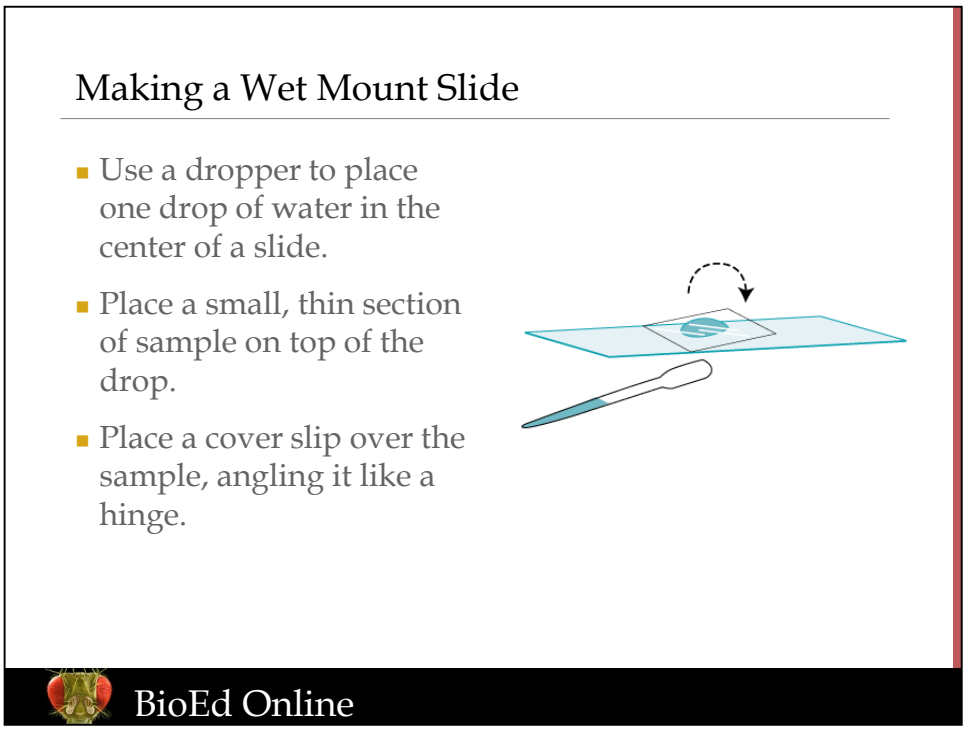
The onion tissue will not have chloroplasts. This absence could be predicted from the lack of green coloration. The onion itself is a bulb, comprised of the bases of overlapping leaves that originate at the bottom of the plant. And technically, an onion is a specialized stem, not a root. The onion "skin" that students will observe is the epidermis of the overlapping leaf bases. If students have questions about the structure of an onion, show them a scallion or green onion with the leaves attached.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.



Making a Wet Mount Slide

Have students follow these simple instructions to create wet mounts (temporary slides in which the material to be observed is placed on a drop of water and covered with a cover slip). You may want to provide iodine or methylene blue stain for students to use to make cell structures more easily visible.

Iodine and methylene blue are toxic if ingested. Some people are allergic to iodine. Be certain to read the Materials Safety Data Sheets (MSDS), which should be available in the classroom during the activity. Caution: Iodine and methylene blue will stain the skin, but will gradually wash off. Both solutions will permanently stain clothing and some table surfaces.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

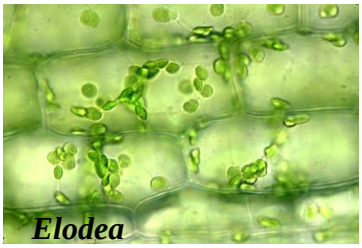
Reference:

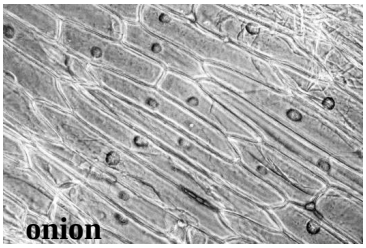
Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes

of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.

Comparing Onion and *Elodea* Cells





Look for similarities or differences in:

- Size
- Shape
- Visible structures

J. Walsh © Micrographia.com,www.micrographia.com

BioEd Online

Comparing Onion and *Elodea* Cells

Guide students as they observe the cells. Ask questions that will encourage them to look at relative sizes and shapes of cells. Help students to identify visible structures: cell walls in both kinds of cells; chloroplasts in *Elodea* leaf; and nuclei (one per cell) in onion epidermis.

Cell nuclei usually are easy to observe in the onion samples, but they will not be visible in all cells. Students also may notice one or more vacuoles within the onion cell cytoplasm, and tiny perforations, or pits, in the onion cell walls that connect the cytoplasm of adjacent cells. Nuclei are much less visible in the *Elodea* cells, which have abundant green chloroplasts.

Encourage students to make detailed drawings of their observations. Also, have students use the fine focus knob of the microscope to focus down through the layers of cells. Ask students to think about whether cells are flat or three-dimensional structures.

The cell membrane in *Elodea* cells can be observed if a sample is prepared in a drop of salt water. The movement of water out of the cell in the presence of saline solution will cause the cell membrane (also called plasma membrane or plasmalemma) to pull away slightly from the cell wall.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

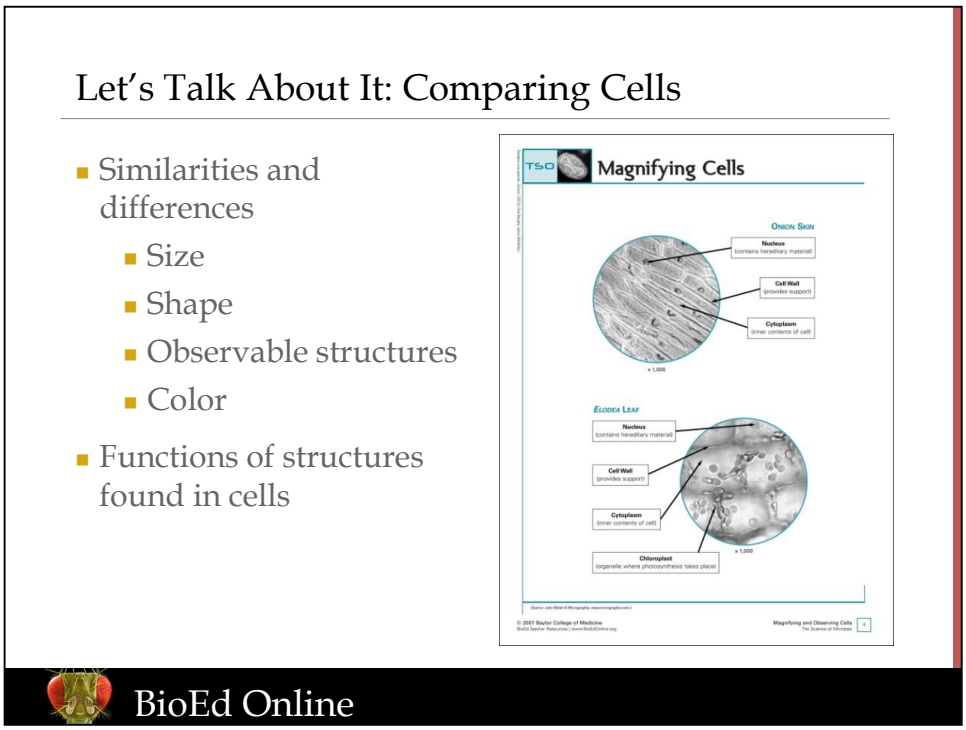
Reference:
Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

Image References:

Walsh, J. Cells in *Elodea* leaf, showing plastids, elodea00. *Micrographia*, www.micrographia.com.

Walsh, J. Onion epidermis. *Micrographia*, www.micrographia.com.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.



Let's Talk About It: Comparing Cells

Once students have completed their observations, either have them discuss their observations in small groups or conduct a class discussion. Help students to understand the functions of each structure they have located in the cells. Students should have been able to observe the following structures in one or both samples.

- Nucleus - structure in cell that holds hereditary information and is bounded by a membrane. Nuclei are found in plant, animal and protist cells. Usually, they are not usually visible in *Elodea* samples.
- Cytoplasm – all of the contents that fill the cell between the cell membrane and the nucleus. Plant cells often have a large sac surrounded by a membrane, called the central vacuole, within the cytoplasm. A large central vacuole sometimes causes the nucleus to appear pressed against the cell wall.
- Cell wall - strong wall outside the cell membrane (or plasma membrane) of some cells, such as those of plants. Animal cells do not have cell walls.
- Chloroplasts - Green structures, located within the cytoplasm, in which photosynthesis takes place. Chloroplasts are a kind of organelle, a specialized subunit within a cell that has a specific function and is surrounded by a membrane. Chloroplasts will be present only in the *Elodea* leaves.

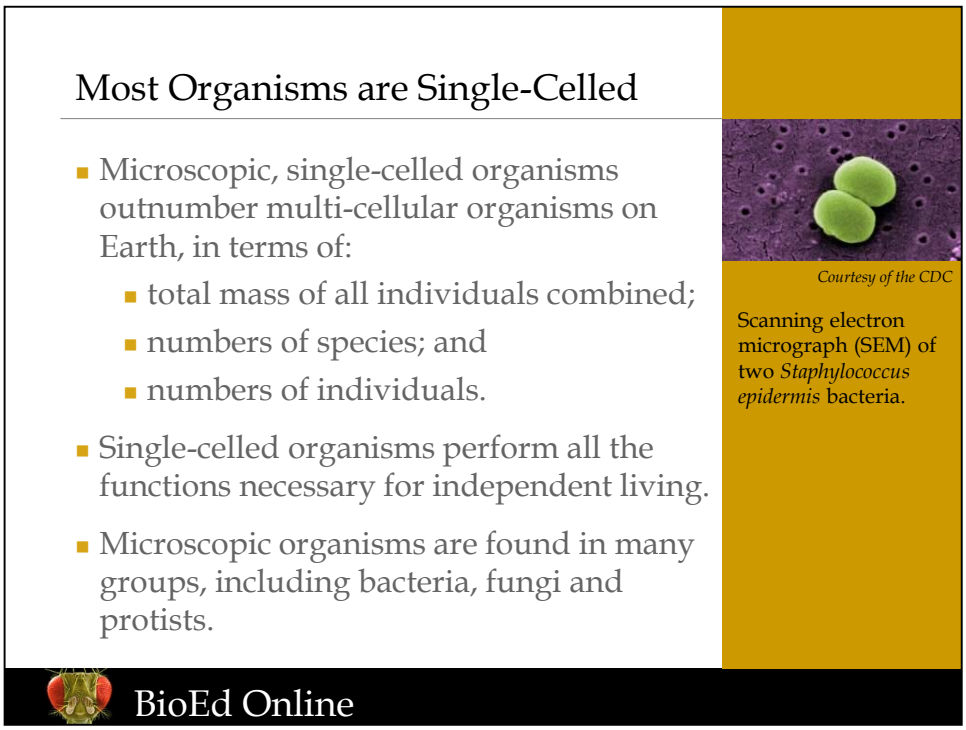
As an assessment, ask students to record the similarities and differences they observed between the two cell samples.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.



Most Organisms are Single-Celled

Help students to make connections between the plant cells they just observed and other kinds of cells. Ask for examples of other organisms that consist of many cells (multicellular organisms). Like plants, animals are multicellular and have specialized cell types for different functions. Members of other groups, such as fungi and protists, may be single-celled (unicellular) or multicellular. Bacteria and related groups are exclusively unicellular.

Most organisms on Earth are unicellular and microscopic. Each tiny cell is capable of independent life and exhibits the following properties of living things: specialized structure; hereditary information that is passed to the next generation; adaptation to the environment as a result of natural selection; responsiveness to the environment; ability to process energy; regulation of an internal environment that is different from external environment; growth and development; and reproduction.

Have student groups revisit their concept maps and add information.

Viewing this presentation fulfills part of the requirements for completing the short course on *The Science of Microbes*, offered on BioEd Online for professional development contact hours. *The Science of Microbes* Teacher's Guide may be obtained in its entirety from the Center for Educational Outreach at Baylor College of Medicine (1-800-798-8244). You can download a PDF of this lesson and other lessons from the Science of Microbes unit (including a unit pre/post assessment) from www.BioEdOnline.org or www.K8Science.org.

Reference:

Moreno, N., Tharp, B., Erdmann, D., Rahmati Clayton, S., Denk, J. (2008). *The Science of Microbes Teacher's Guide.* Houston, TX: BioEd.

PHOTO REFERENCE?

The Science of Microbes and accompanying online professional development content were supported, in part, by Science Education Partnership Award number 5R25RR018605 from the National Center for Research Resources, National Institutes of Health (NIH) to Baylor College of Medicine. The unit was developed in partnership with the Baylor-UT Houston Center for AIDS Research, an NIH-funded program (AI036211). The opinions, findings, and conclusions expressed in this presentation are solely those of the authors and do not necessarily reflect the views of Baylor College of Medicine or the sponsoring agencies.