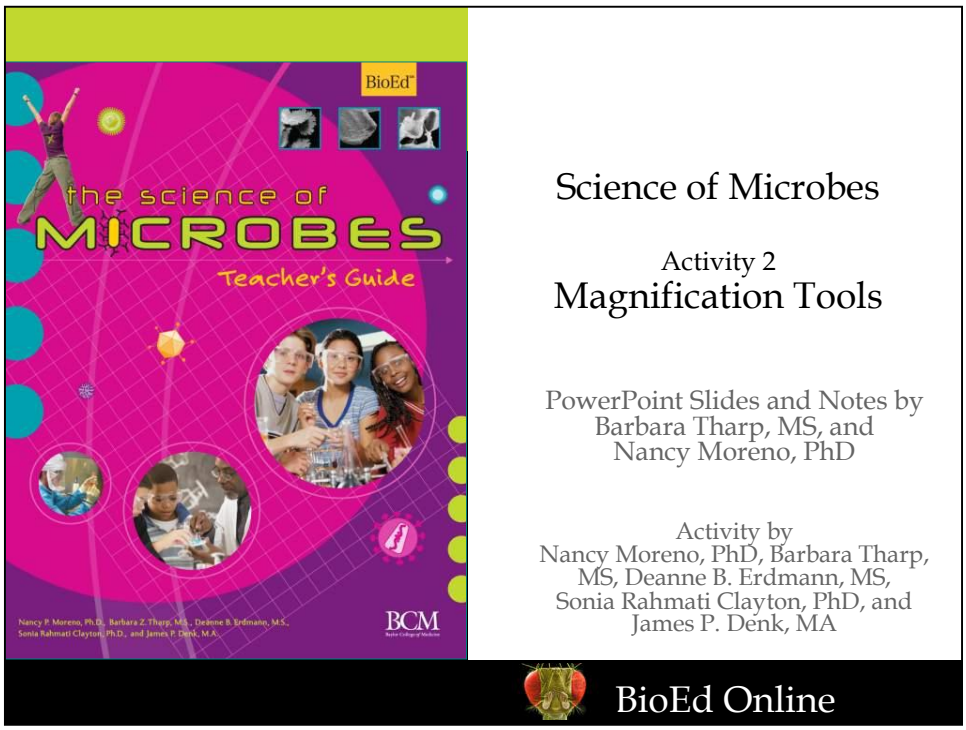

The Science of Microbes—Activity Two: Magnification Tools

Magnification Tools, the second lesson in the unit, The Science of Microbes, addresses the National Science Education Content Standards in two areas: Inquiry and Science and Technology. In this lesson, students will be introduced to magnification. They will create a "lens" with a drop of water and will examine and compare newsprint viewed through a water drop and a hand lens. Finally, students will be introduced to the microscope. They will learn general functions of the parts of a microscope, create a "wet mount" slide and observe newsprint under the microscope. By the end of the activity, students will know that these common magnification tools rely on convex lenses made of transparent materials.

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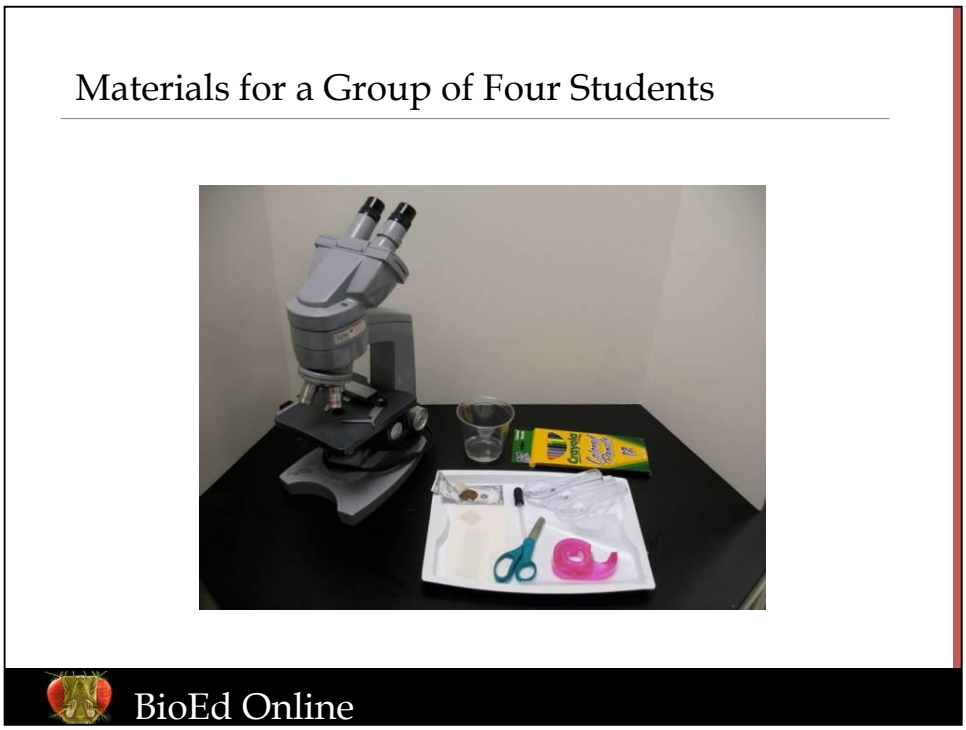

Materials for a Group of Four Students

Some set-up is necessary for this activity. Make a copy of the two student sheets (Magnification Observations and The Compound Microscope) for each student. Place the materials for each group (listed below) on trays in a central location. Before allowing students to carry microscopes to their work areas, demonstrate how to carry a microscope by placing one hand on the microscope stand (arm) and the other under the base (foot).

Each of group of four students will need the following materials.

TO CREATE AND USE A SIMPLE MAGNIFIER:
- 4 index cards (or similarly sized sections of cardstock)
- Sheet of wax paper (approximately 6 cm in length)
- Dropper or pipette
- Pair of scissors
- Small container of tap water
- Transparent tape
- 4 small (approximately 2 cm x 10 cm) pieces of color newsprint. Select sections of paper that do not have printing on the back, so that colors will not show through under the microscope.
- Other objects to observe, such as a leaf, coin, dollar bill, etc.

STUDENTS ALSO WILL NEED:
- 4 hand lenses or magnifiers
- 4 plastic cover slips
- 4 plastic or glass microscope slides
- Set of colored pencils or markers
- Microscope

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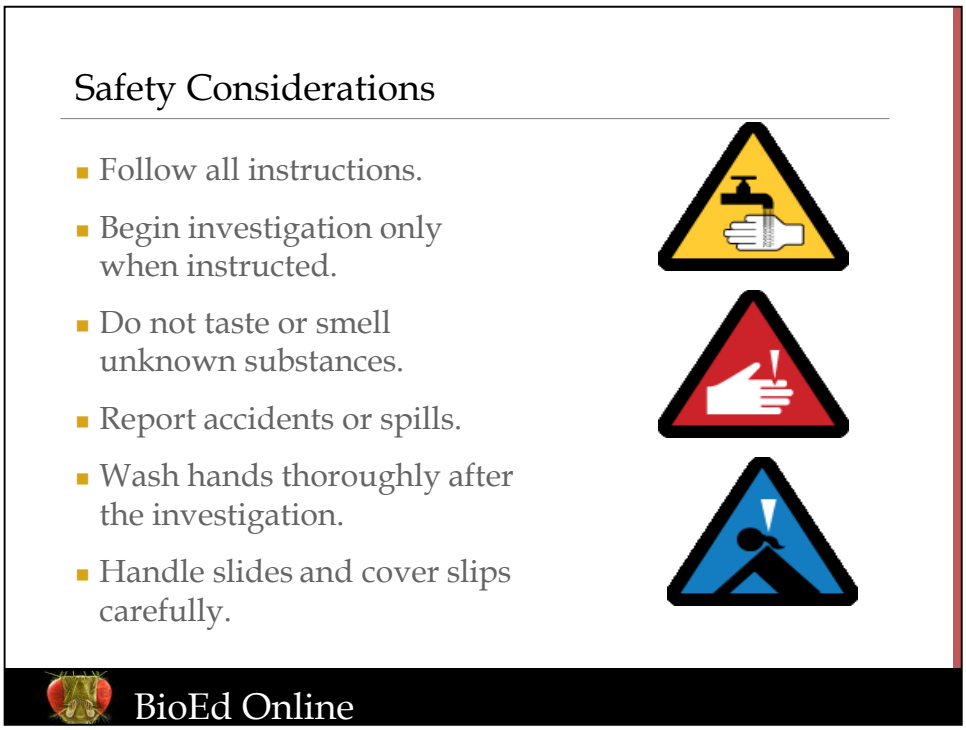

Safety Considerations

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 goggles, is available.
- Continually monitor the area where the investigation is being conducted.
- Glass slides should be discarded in separate containers designed for disposal of glass and sharp items.

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What Does a Hand Lens Do?

In this activity, students will use appropriate tools and techniques to gather, analyze and interpret data. Hold up a magnifier (hand lens) and ask the students, "*How many of you have used this tool before?" What can it be used for?* Have students examine several items that you have provided—first without, and then with a magnifier. Discuss the differences in the appearance of each item with and without the magnifier. Discuss features or characteristics of the items that were observable only with the aid of magnifier.

Students will learn that scientific progress often is tied to the development of new tools and technologies. For example, until magnifying lenses were developed, people were able only to see as much of the world as their naked eyes would allow. The development of high quality magnifiers and microscopes opened up the world of cells and microorganisms for exploration by generations of scientists.

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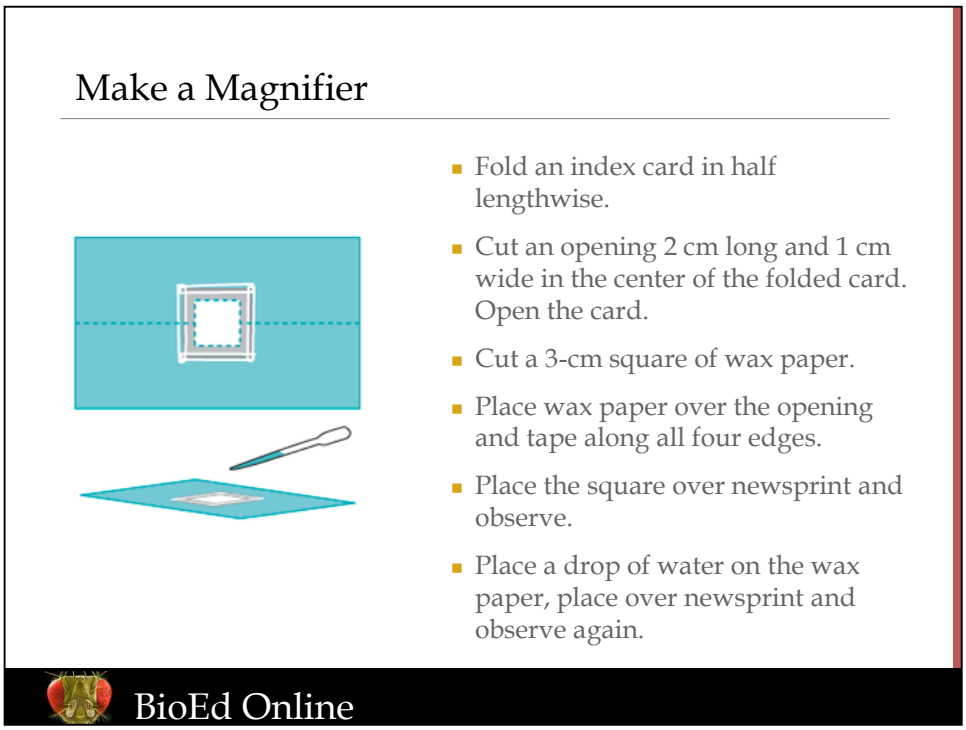

Make a Magnifier

To begin exploring magnification, students will use a hand lens (magnifier) and then create their own magnifier using a single drop of water. This activity will give students an opportunity to discover some of the behaviors of light passing through convex lenses.

Direct students to observe each of several different items (newsprint, coin, etc.) that you have placed on a tray for each group. They should make their observations, first with the naked eye and then with a magnifier or hand lens. Encourage students to experiment with the distance between the lens and the object, and to discuss their observations. Ask, "*Did the items look different under the magnifier?" "Did you observe anything on any of the objects that you had never noticed before?"*

Next, students will make their own magnifier, as described on the slide above, using card stock, wax paper, and a drop of water. Instruct students to observe the newsprint through the wax paper window they have created. Students will find the size of the newsprint is unchanged when looking through the wax paper alone. Then tell students to use the dropper to place one drop of water in the center of the wax paper window and again observe the newsprint. Ask again, "*How does the newsprint appear?" Students will indicate that newsprint is* magnified by the drop of water.

Discuss student observations. Ask, "*How are the magnifier and the drop of water similar?" Both* the magnifier and water drop are clear and transparent, and have a convex or outwardly curved surface. Ask, "*Are the results from the two different tools similar or different?"* Help them understand that the convex or curved surface of the hand lens and water drop is responsible for the magnification.

See the BioEd Slide and notes at the following link for additional information on how lenses work: http://www.bioedonline.org/slides/slide01.cfm?tk=35&dpg=4.

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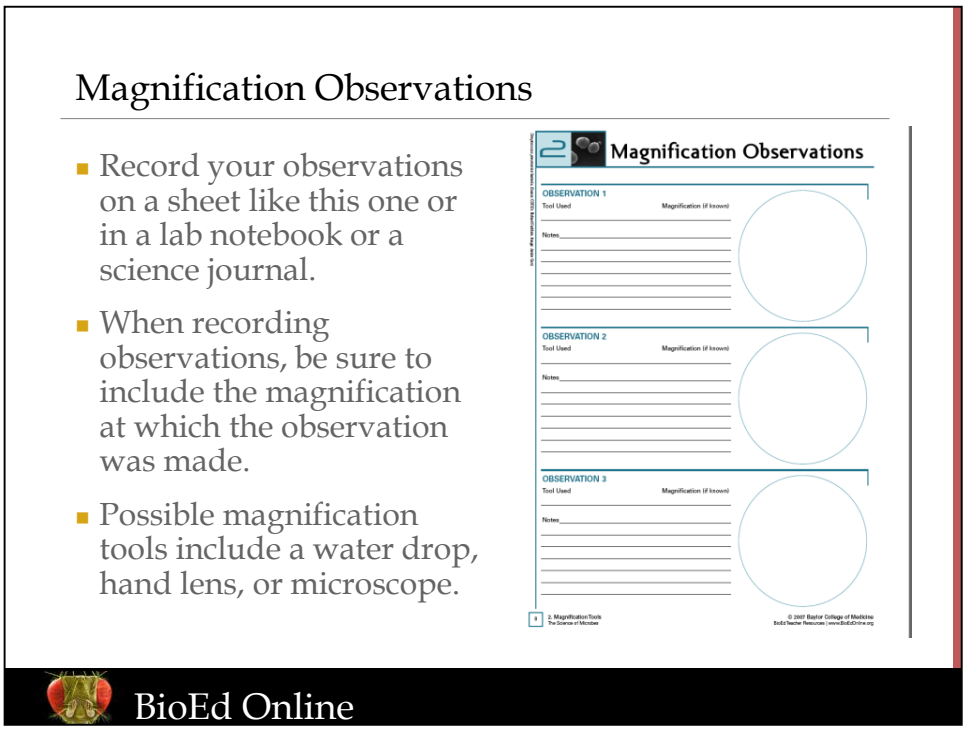

Magnification Observations

During this activity, students will have opportunities to draw and describe items they observe using different magnification tools. Download the form shown in this slide for students, or have them record the requested information in their science notebooks.

Point out that a microscope's magnification rating is determined by multiplying the power of the lens in the eyepiece by the power of the objective lens. For example, a microscope with an eyepiece of 10x and an objective of 4x will magnify an image 40 times (10 x 4 = 40).

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How Could We Obtain More Magnification?

Students now have observed newsprint and other materials using a hand magnifier and a drop of water. Ask students, "*What could we use to magnify the materials further?"*

Each group of students should have access to a microscope. Allow each group to examine its microscope for a few minutes. Then ask students to locate basic parts as you name and describe the function of each one (eyepiece, arm, stage, lenses, light source, etc.). Tell students, "*The stage is the part of the microscope that holds a slide. It is similar to a stage for a performance. Can you find it?"* It is important for students to notice that the microscope has more than one lens. This is why we call it a "compound" microscope. Be sure students notice the curvature of each lens. Help students relate the lens shape to the observations they made about the water drop and hand lens used earlier in the activity.

The sides of the eyepiece and objectives containing the lenses are marked with a number and the letter "X." Ask students what "X" usually means in mathematics (multiplication or times). This would be a good time to explain how the total magnification is calculated for a compound microscope. Point out that a microscope's magnification rating is determined by multiplying (not adding, as some students may guess) the power of the top lens (on the eyepiece) by the power of the bottom lens (on the objective being used). For example, a microscope with an eyepiece of 10x and an objective of 4x will magnify an image 40 times (10 x 4 = 40). You may wish to ask students how the compound microscope and the hand lens compare.

Have students use The Compound Microscope sheet to find to review the microscope parts and functions you have discussed as a class. Also, have students locate components not yet mentioned so far. You may have a microscope with a condenser to intensify the light, for example, and/or a microscope with a diaphragm aperture to adjust the amount of light passing from the light source up through the object. Discuss the importance of each part.

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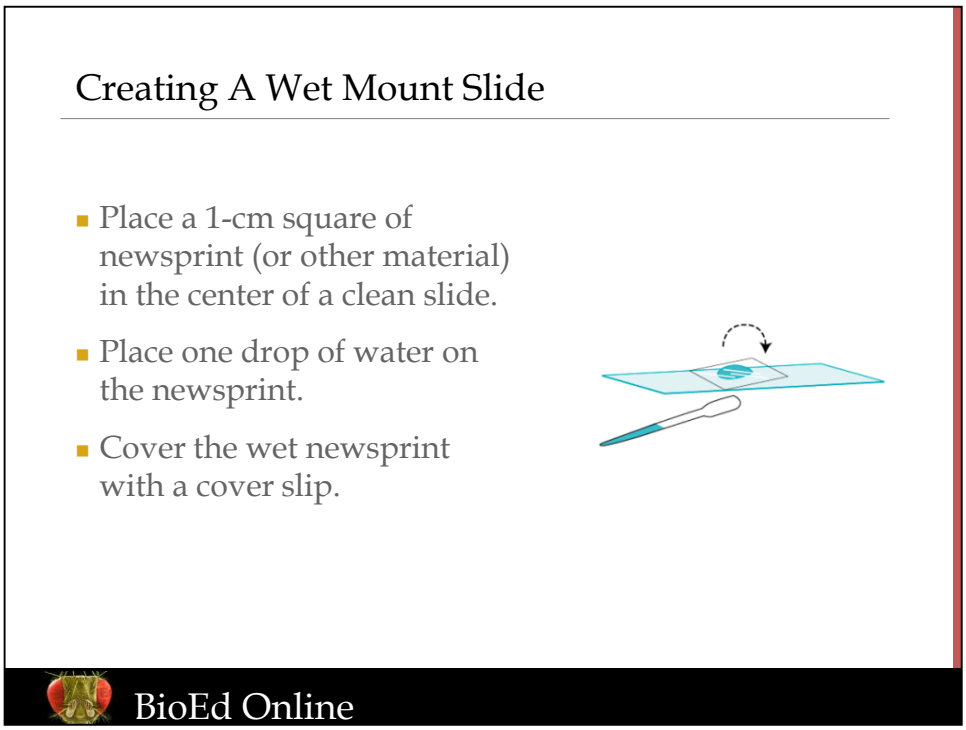

Creating A Wet Mount Slide

Many samples are easier to observe under a microscope if they are placed in a drop of water on a slide. This common slide preparation is called a wet mount. The cover slip used in a wet mount helps to protect the lenses in the objectives. For this activity, students will create a wet mount of a small piece of newsprint.

Students will need a slide, cover slip, sample, water and dropper. Have them follow the steps below to prepare their slides.

1. Place a 1-cm square piece of printed newspaper in the center of a clean microscope slide. Newsprint that is printed only on one side works best. Place the paper on the slide, with the printed side facing upward.
2. Place a drop of water on the paper and gently cover it with a cover slip. The cover slip should be held at an angle and lowered like a hinge over the sample. Adhesive forces between the glass cover slip and surface of the water will hold the cover slip in place.
3. Finally, place the slide on the stage of the microscope. If the stage has clips, place the clips over the slide to hold it in place.

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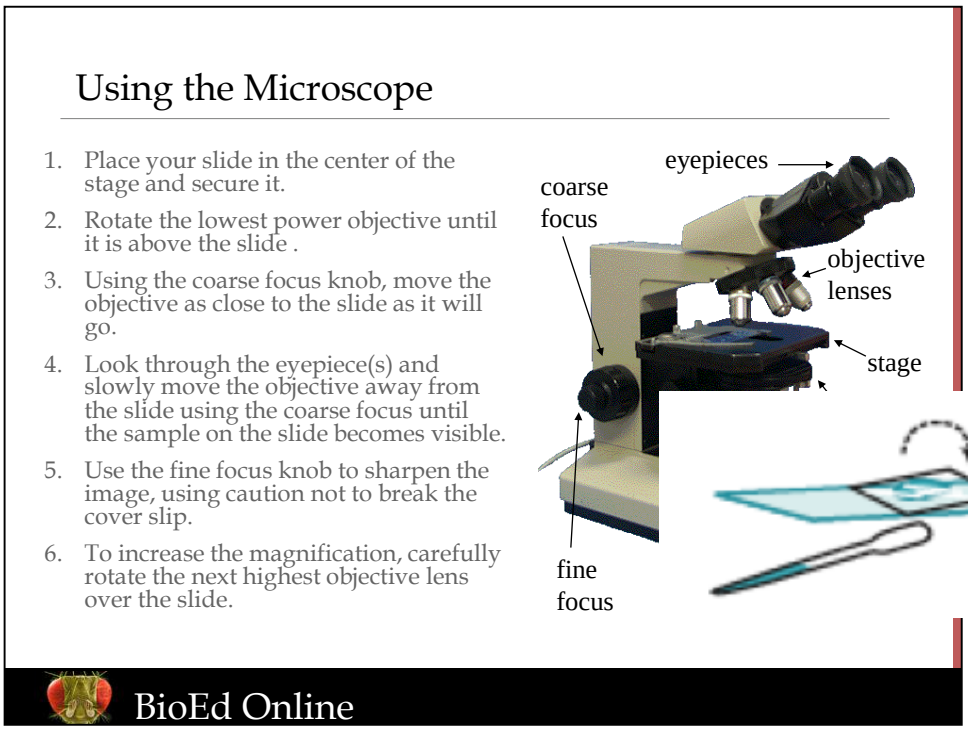

Using the Microscope

Students should begin the focusing procedure by moving the low power objective into place. Then, each student should center his or her slide over the opening in the microscope stage and secure the slide with the clips on the stage. If the microscope has a light source, be sure students have the light aimed up through the paper in the slide. Initially, the diaphragm should be adjusted to its largest opening. Delicate objects require less intense light than more dense objects and materials, and if the image is too bright (seems washed out) when viewed through the microscope, help students reduce the amount of light by partially closing the diaphragm. **Note:** low-power dissecting type microscopes may not have a light source below the stage.

With the lowest power objective in place above the print material on the slide (not all microscopes have multiple objectives), have students use the coarse focus knob to move the tip of the objective as close to the cover slip as possible. Instruct students to look through the eyepiece and use the coarse focus (depending on the microscope) knob to move the objective gradually away from the paper until the print comes into view. Remind students that the sample will come into focus when the objective is very close to the stage. Tell students to use the fine focus knob to sharpen the appearance of the image further. The newsprint on the slide should be centered in the field of view. Each student should have an opportunity to adjust and focus the microscope.

After drawing their observations of the printed material on the Magnification Observations sheet, some students may wish to study the newsprint at a higher magnification. Instruct students to gently rotate the middle magnification objective into position over the slide and adjust the focus using the fine focus knob only. This objective is longer and will come closer to touching the surface of the cover slip, so students must use caution not to break the cover slip.

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Let's Talk About It
Review the lesson by discussing the different ways that the newsprint was magnified, including the water drop, hand lens and microscope. The microscope provided the most magnification, followed by the hand magnifier and water drop, which gave the least magnification. All of the tools relied on one or more convex lenses.

The "Magnification and Orientation II" slide and notes on BioEd Online (http://www.bioedonline.org/slides/slide01.cfm?tk=35&dpg=5) provide additional explanation about how convex lenses used at close range work as magnifiers by spreading the light reflected off an object so that it appears larger to our eyes and brain. (*MAYBE PUT THIS LINK ON THE NEXT SLIDE, WITH THE OTHER BIOED LINKS?*)

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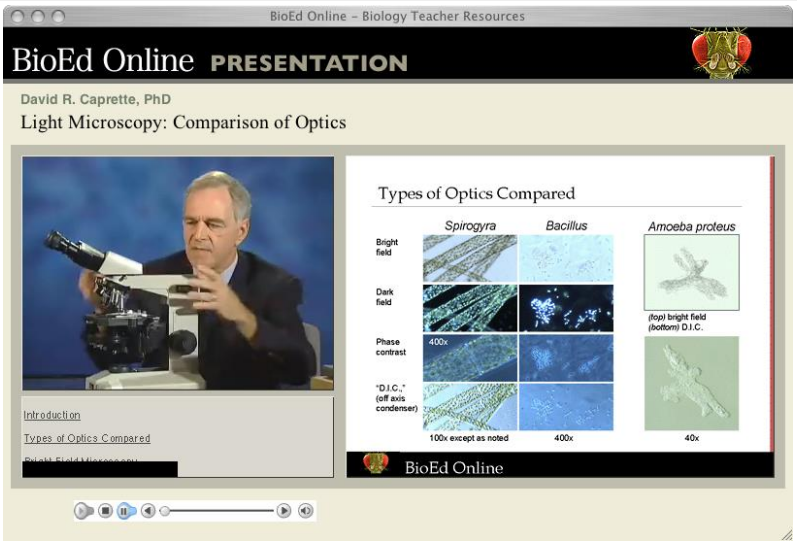

BioEd Online

To learn more about microscopy, visit the following presentations and slide sets on BioEd Online (www.bioedonline.org).

Measuring and Counting with a Light Microscope (http://www.bioedonline.org/slides/slide01.cfm?tk=41)

Using a Bright Field Light Microscope (http://www.bioedonline.org/slides/slide01.cfm?tk=38)

Light Microscopy: Instrumentation and Principles (http://www.bioedonline.org/slides/slide01.cfm?tk=35)

Light Microscopy: Comparison of Optics (http://www.bioedonline.org/slides/slide01.cfm?tk=36)

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