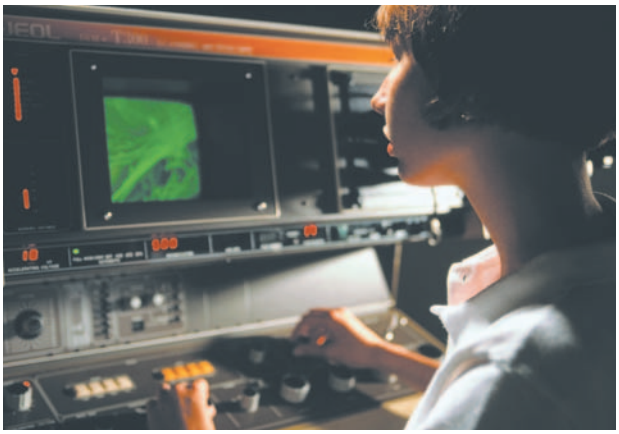
35 A License to Learn

Scientific discoveries often follow the development of new tools and technologies. This is certainly true in the case of infectious diseases. In the 1890s, researchers Alexandre Yersin and Shibasaburo Kitasato independently used the microscope to identify the cause of the bubonic plague. Compound microscopes—microscopes that use more than one lens—had been invented around 1595. These first microscopes usually magnified objects only 20–30 times their original size. But as you will learn in the next few activities, even this level of magnification was enough to discover a world of new scientific ideas.

By 1840, Italian physicist Giovanni Amici (a-MEE-chee) had invented the oil-immersion microscope which could magnify objects 6,000 times. In most middle schools, the highest level of magnification is usually about 400 times. Today, the transmission electron and scanning electron microscopes can magnify objects over 40,000 times!

CHALLENGE **What is the correct way to use a microscope?**



The photograph on the left shows a scanning electron microscope, which shows the surfaces of objects. In the photograph on the right, you can see the head of a ladybug as seen through this type of microscope magnified 23 times.

MATERIALS

For each group of four students

- 1 cup of water
- 1 dropper
- 1 pair of scissors (optional)

For each pair of students

- 1 microscope slide
- 1 coverslip
- 1 microscope
- lens paper
- various materials, such as a comic strip, human hair, leaf, etc.

For each student

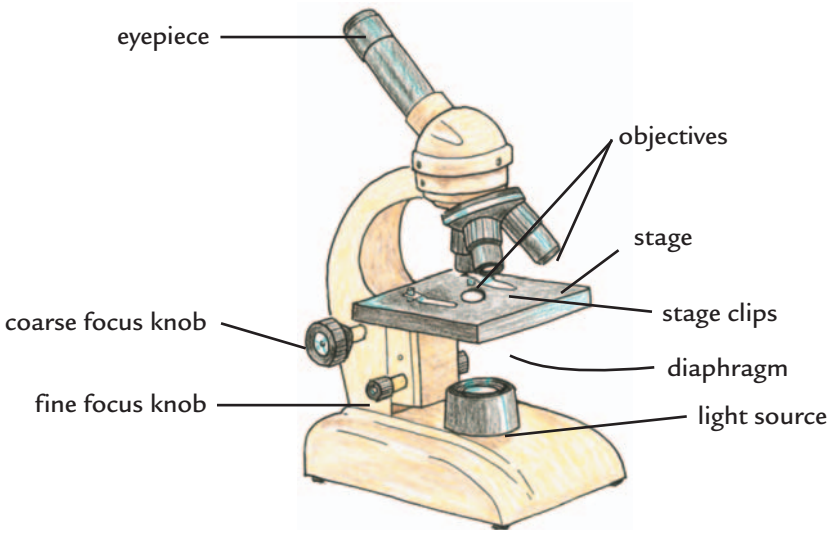
- 1 Student Sheet 35.1, "Microscope Review"
- 1 Student Sheet 35.3, "Microscopy Drawings"
- 1 compass

PROCEDURE

Part A: Earning a License

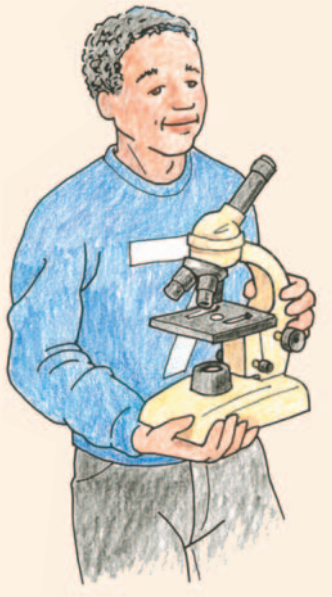
1. Your teacher will demonstrate the different parts of a microscope, as shown in the drawing below.

PARTS OF A MICROSCOPE



Rules for Handling a Microscope

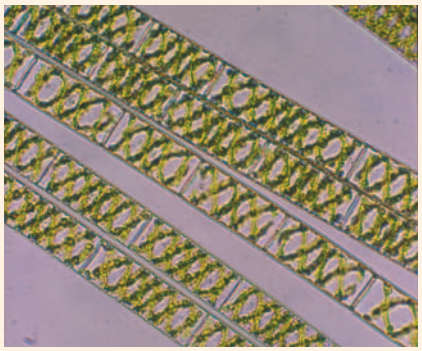
- Always carry a microscope using two hands, as shown in the picture to the right.
- Rotate the objectives carefully. Do not allow them to touch the stage or anything placed on the stage, such as a slide. This can damage the microscope.
- When using the coarse focus knob, begin with the stage in its highest position and always focus by lowering the stage (away from the objective).
- Use only lens paper to clean the eyepiece or the objectives.
- When you have finished using a microscope, remember to turn off the microscope light and set the microscope back to low power (the shortest objective, usually 4x).



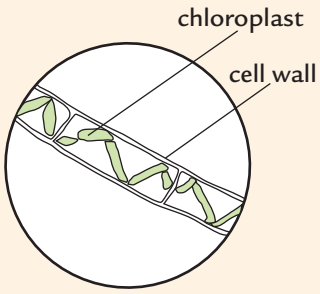
2. As a class, discuss the rules for handling a microscope.
3. Demonstrate your knowledge of the microscope, as required by your teacher.
4. Collect your microscope license! You are now ready to begin using a microscope.

Part B: Microscopy Drawing Made Easy

Below is a picture taken through a microscope of the alga *Spirogyra*. The diagram to the right shows what a biologist or biological illustrator might draw and how he or she would label the drawing. Did you know that some artists draw only scientific illustrations?



SPIROGYRA (ALGAE) X 400



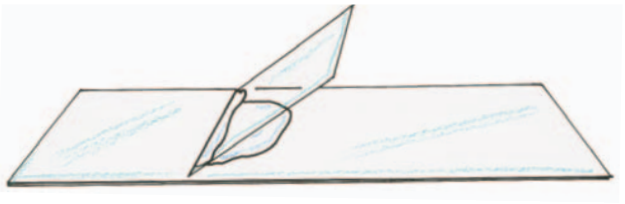
Some tips for better drawings:

- Use a sharp pencil and have a good eraser handy.
- Try to relax your eyes when looking through the eyepiece. You can cover one eye or learn to look with both eyes open. Try not to squint.
- Use a compass to draw a circle on your paper. Everything that you see on your slide will go in the circle.
- Look through your microscope at the same time as you do your drawing. Look through the microscope *more* than you look at your paper.
- Don't draw every small thing on your slide. Just concentrate on one or two of the most common or interesting things.
- You can draw things larger than you actually see them. This helps you show all of the details you see.
- Keep written words outside the circle.
- Use a ruler to draw the lines for your labels. Keep lines parallel—do not cross one line over another.
- Remember to record the level of magnification next to your drawing.

Part C: Using the Microscope

5. Clean your microscope slide and coverslip by rinsing them with water and gently wiping them dry.

6. With your partner, look at the materials list posted by your teacher and decide what you will examine under the microscope.



PLACING THE COVERSLIP

7. Place the material (or a small piece of the material) flat on the center of your microscope slide.

8. Use a dropper to place a drop of water directly onto your material. Carefully touch one edge of the coverslip to the water at an angle (as shown in the figure above). Slowly allow the coverslip to drop into place.

9. Be sure that your microscope is set on the lowest power (shortest objective) before placing your slide onto the microscope stage. Center the slide so that the material is directly over the light opening and adjust the microscope settings as necessary.

   Hint: To check that you are focused on the material that is on the slide, move the slide slightly while you look through the eyepiece—the material that you are focused on should move at the same time you move the slide.

10. Begin by observing the sample with low power (usually the 4x objective). On Student Sheet 35.3, "Microscopy Drawings," draw what you observe. When you find an area you would like to explore at higher magnification, use the stage clips to secure the slide.

    Hint: If material on the slide is too bright to see, reduce the amount of light on the slide by slightly closing the diaphragm under the stage.

11. Without moving the slide, switch to medium power (usually the 10x objective). Adjust the microscope settings as necessary, and prepare another drawing of what you observe.

    Hint: If material on the slide is too dark to see, increase the amount of light on the slide by slightly opening the diaphragm under the stage.

12. When you have finished using the microscope, turn off the microscope light and set the microscope back to low power (usually the 4x objective).

ANALYSIS

1. How does the microscope change the image you see?

   Hint: Compare the material you placed on the stage with what you see through the eyepiece.

2. Describe how the material(s) that you observed looked under low as compared to medium power. What differences did you observe? How did this compare to what you saw with your eyes?

3. List three hints to help you make microscopy drawings easier.

4. The microscope is one important tool used by scientists to study living things. What other tools are used by life scientists? Think about tools used by doctors and in laboratory and field research. List three tools used by life scientists and describe the kind of information they can help scientists collect.