

# Laboratory Investigation 4B

Chapter 4: Cell Structure

## The Microscope: A Tool of the Scientist

You may refer to pages 66-67, 72-73 in your textbook for a general discussion of microscopes.  
Time required: 120 minutes

### Background Information

One of the most important tools of a life scientist is the microscope. The development of the microscope has made possible the identification of thousands of different organisms and parts of organisms that are invisible to the unaided eye. The microscope you will probably be using is a *compound* microscope. That is, it contains more than one lens. The lenses are the parts of the microscope that are responsible for magnifying the object being viewed.

In this investigation you will learn how to correctly handle a microscope. The compound microscope that you are using may not look exactly like the one pictured in this investigation. However, the parts of most compound microscopes are the same and have the same names.

### Problem

What are the parts of a microscope? What are the functions of these parts? What is the correct method for handling a microscope?

### Materials (per group)

microscope  
prepared slide



blank slides  
coverslips



dropping pipette  
newsprint

scissors  
other printed materials

### Procedure

#### Part A: Examining a Microscope

1. Become familiar with the names of the various parts of the microscope. Look at the labeled diagram of a microscope in Figure 1 and identify each part of the microscope.

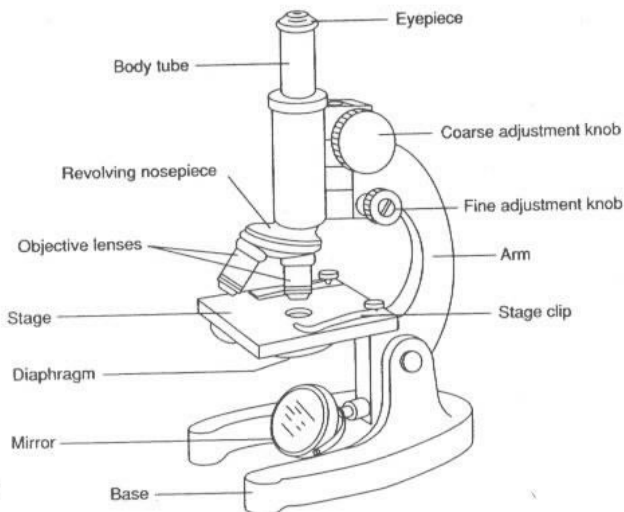


Figure 1

2. Obtain a microscope. Keep in mind that a microscope is a very delicate instrument and should be handled with care. Always use two hands to pick up and carry a microscope. Hold the arm of the microscope in one hand, and place your other hand under the base for support. When using the microscope, be sure that the arm faces toward you.
3. Compare the microscope you are using to the one shown in Figure 1. Your microscope may not look exactly like the one shown. However, the basic parts of all microscopes are similar. Locate the parts on your microscope that correspond to the labeled parts in the diagram.
4. Following is a list of the parts of the microscope and their functions. Learn the name and function of each part so that you can properly use the microscope.

a. The **arm** supports the body tube and is used for carrying the microscope. The base supports the microscope and is also used for carrying the microscope. Always carry the microscope by holding the arm with one hand and place your other hand under the base. Locate the arm and base of your microscope.

b. The **mirror** collects light and directs it through the opening in the stage. By turning the mirror, you can control the amount of light being reflected through the stage opening. **CAUTION:** *Never use direct sunlight as a source of light. Direct sunlight reflected off the mirror can damage the eye.* Some microscopes have a built-in light source and therefore do not have a mirror. Locate the mirror on your microscope. Notice how it moves.

c. The **eyepiece (Ocular lens)** is the part of the microscope that you look through to view an object placed on the stage. The eyepiece contains the ocular lens and usually has a magnification power of 10x. This means that the lens enables you to see the object ten times larger than it actually is. Locate the eyepiece on your microscope.

d. The **body tube** maintains the proper distance between the eyepiece and the objective lenses. It is the part of the microscope that allows light to pass upward and through to the eyepiece. Locate the body tube on your microscope.

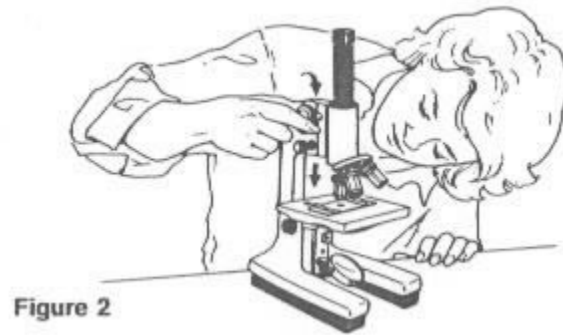
e. The **stage** supports the slide being viewed, and the stage clips hold the slide in place on the stage. In the middle of the stage is an opening that allows light from below to pass through the object being viewed. **CAUTION:** *Never allow the clips to come in contact with the opening in the stage because they will scratch the glass and interfere with viewing objects.* To place a microscope slide under the clips, gently lift the clips and move the slide under and across the clips. Never force the clips open with your fingers. Practice placing a microscope slide under the clips.

f. The **diaphragm** is located under the stage and has several small openings of various sizes. By turning the diaphragm, you can increase or decrease the amount of light entering through the stage opening to see the object you are viewing more clearly. Look through the eyepiece and move the diaphragm settings to see the varying amounts of light that can enter the microscope.

g. The **revolving nosepiece** holds the low- and high-power objective lenses and can be rotated to change magnification. Turn the revolving nosepiece on your microscope and listen closely for the “click”. If the objective lens is not in place, there will be no light visible through the nosepiece.

h. The **objective lenses**, called the low- and high-power lenses, add to the magnification of the object you are viewing. The low-power objective lens usually has a magnification power of 10x. The high-power objective lens usually has a magnification power of 40X. To find the total magnification power of the microscope, multiply the magnification power of the eyepiece lens by the magnification power of the objective lens in use. For example: eyepiece (10X) X low-power lens (10X) = total magnification (100x). With the body tube in the uppermost position, turn the revolving nosepiece to the low-power objective. Notice how it “clicks” into place. Very slowly and carefully turn to the high-power objective. Notice how close it comes to the stage of the microscope. **CAUTION:** *When turning to the high-power objective, you*

*should always look at the objective from the side of your microscope so that the objective does not hit or damage the slide. See Figure 2.*



i. The **coarse adjustment knob** moves the body tube up and down to bring the object into view. It is usually located on the top part of the arm. Turn the knob, and you should notice that the body tube moves up and down.

Use the coarse adjustment knob when focusing with the low-power objective. **CAUTION:** *Do not use the coarser adjustment knob when focusing the high-power objective lens.* This could break your slide or damage the lens.

Practice moving the coarse adjustment knob to see the movement that is allowed with each turn.

j. The **fine adjustment knob** is usually located below the coarse adjustment knob. The fine adjustment knob is used to bring objects into clear, sharp focus. It moves the body tube very slightly. Use this knob when you are focusing with the high-power lens. Never use the fine adjustment knob for large adjustments. If the object is properly focused with the coarse adjustment knob, then it should take only one fourth of a turn of the fine adjustment knob to obtain a clear, sharp image.

#### Part B: Handling a Microscope

1. Holding the prepared slide by its edges, place it on the stage of the microscope.
2. Turn the revolving nosepiece until the low-power objective lens clicks into place.
3. Looking through the eyepiece, adjust the diaphragm to permit sufficient light to enter the microscope. If your microscope has a mirror, adjust it for proper lighting.
4. Looking from the side of the microscope, turn the coarse adjustment knob so that the body tube is at its lowest position just over the opening in the stage.
5. Looking through the eyepiece, slowly raise the body tube with the coarse adjustment knob until the object on the slide comes into focus.
6. Looking from the side of the microscope again, slowly move the revolving nosepiece until the high-power objective lens clicks into place. Be careful not to touch the slide with the high-power objective lens.
7. Turn the fine adjustment knob no more than one fourth of a turn to bring the object on the slide into clear, sharp focus.
8. If the image of the object is not clear and sharp, do not continue to turn the fine adjustment knob. In this case, return to the low-power objective lens and refocus. Then try the high-power objective lens again, following the procedure in steps 6 and 7.

## Rules for Using Microscopes

Carry the microscope properly. Excessive jarring and bumping may bring the lenses out of adjustment. To avoid damaging the microscope, observe the following rules:

1. When taking a microscope out of the cabinet or cupboard, be careful not to bang the microscope against the sides of the cabinet.
2. Carry the instrument with one hand underneath the base and the other on the arm of the microscope.
3. Be sure to keep the microscope close to your body in an upright position so that the ocular does not slip out of the body tube.
4. Place the microscope gently on the table and position it about 10 centimeters (3 ½ in.) from the edge.

### Prepare the microscope properly.

You may need to clean your microscope before you begin to use it. Observe these rules while you clean it.

1. Use lens paper to clean the lens surfaces and the mirror. Wipe the lenses in one direction across the diameter of each lens.
2. Consult your instructor if any material remains on your eyepiece or objectives.
3. Under no circumstances should you attempt to take your microscope apart.

### Return the microscope properly.

When you have finished using a microscope, you should observe the following rules:

1. Make sure the microscope (including lenses) is clean.
2. Make sure the body tube is straight up and down.
3. Put the low-power objective directly under the body tube.
4. Adjust the body tube to its lowest position.
5. Carefully return the microscope to the place where you obtained it.

## Observations

1. Label the parts of the microscope in Figure 3.

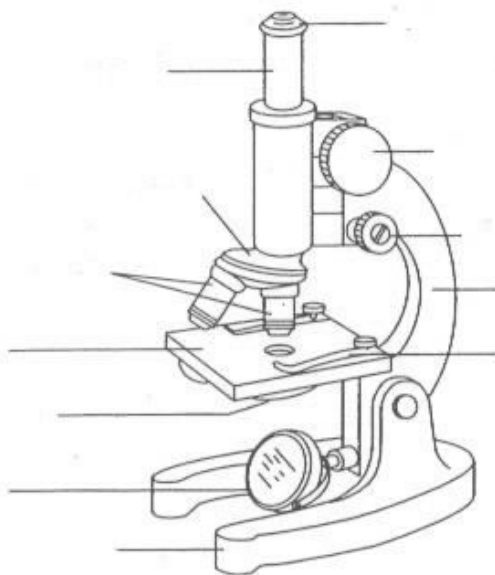


Figure 3

2. What is the magnification power of each objective?

	<b>Objective Lens Power</b>		<b>Ocular Lens Power</b>		<b>Total Magnification</b>
Objective 1	_____	times	_____	equals	_____
Objective 2	_____	times	_____	equals	_____
Objective 3	_____	times	_____	equals	_____
Objective 4	_____	times	_____	equals	_____

3. What is the highest magnification power of the microscope? \_\_\_\_\_

4. How should you carry a microscope? \_\_\_\_\_

\_\_\_\_\_

5. Give the function of each part of a microscope.

a. Objective lenses: \_\_\_\_\_

b. Eyepiece: \_\_\_\_\_

c. Stage: \_\_\_\_\_

d. Mirror: \_\_\_\_\_

e. Diaphragm: \_\_\_\_\_

f. Coarse adjustment knob: \_\_\_\_\_

g. Fine adjustment knob: \_\_\_\_\_

6. What kind of light source do you have on your microscope? \_\_\_\_\_

#### **Prepare your microscope for viewing.**

- Open the diaphragm on your microscope to its largest setting.
- If your microscope has an electric light, plug it in and turn it on.
- If your microscope has a mirror, adjust it until you are able to see a bright light through the ocular. You should try to use the brightest light source available, but you should not use direct sunlight.

#### **Prepare a microscope slide for viewing.**

- Carefully clean and dry a glass slide and a coverslip. Once you have cleaned them, handle the slide and coverslip only by the edges. This will prevent your viewing fingerprints by mistake.
- Place a single drop of water on the center of your slide.
- Tear a letter *e* from a piece of newspaper and place it on the drop of water.
- Carefully lay the coverslip on top of the drop of water. If air bubbles appear near the piece of paper, tap the coverslip with a pencil. If too many bubbles remain, take the slide apart and start over.

- Place the slide on the stage of your microscope and position it so that the newspaper is in the middle of the hole in the stage. Clip the slide in place.

**Focus the microscope on low power.**

- Position the low-power objective so that it is directly under the body tube of your microscope.
- While looking at the side of your microscope, turn the coarse adjustment knob until the objective almost touches the coverslip.
- Look through the objective and SLOWLY turn the coarse adjustment knob so that the body tube goes **UP** until you are able to see the newspaper.

**NOTE: Never turn the coarse adjustment knob so that the body tube goes down while you are looking through the ocular! You could cause the objective to push into the slide and break it.**

- If you have raised your objective more than an inch from the coverslip, you have raised it too far. Look at the side of your microscope and turn the coarse adjustment knob until the objective almost touches the coverslip. Then look through the ocular and start raising the body tube again.
- If you are still unable to see the newspaper, try the following:
  1. Adjust the diaphragm to a slightly smaller setting and then try to focus the microscope again.
  2. Check to make sure the newspaper is in the center of the hole in the stage and directly under the objective.
- If you still cannot see the newspaper, ask your teacher for help.
- Once you have found the newspaper by using the coarse adjustment knob, use the fine adjustment knob to obtain a clear image. You can adjust the fine adjustment knob either direction, but you should never have to turn it more than a full turn in either direction.
- Often you will need to readjust your fine adjustment knob while you are viewing something through the microscope.

Note what happens when you move your slide.

- While looking through the objective, move your slide slightly to the left. What happens to the image that you are viewing?

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- Move your slide slightly to the right. What happens to the image that you are viewing?

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- Move your slide so that it goes away from you slightly. What happens to the image when you do this?

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- Move your slide so that it comes toward you slightly. What happens to the image when you do this?

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Describe what the newspaper and the printed *e* look like under the low power of a microscope.

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**Focus your microscope on high power.**

- Move your slide so that an edge of the newspaper crosses the center of the area you see through the microscope. Be sure this is in the very center!
  - Carefully rotate the objectives so that the high-power objective is below the body tube.
  - Adjust the fine adjustment knob. The image should be in focus when you turn the knob less than a full turn.
  - If necessary, adjust the amount of light coming through the diaphragm.
- If you cannot see a good image through your microscope, return to low power and focus again. Make sure that your newspaper is in the center of the area you are viewing through the microscope. Try to focus on high power again.
  - If you still have problems, ask your teacher for help.  
Move the slide around and observe the newspaper and the letter on high power.
  - What is the difference between the image you see under low power and the image you see under high power?

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Make slides of printed letter *e*'s from magazines and other sources. Typed letters are interesting. What differences do you notice between different kinds of paper and between different forms of printing?

**Analysis and Conclusions**

1. Calculate the total magnification for each pair of lenses.

<i>Ocular Lens</i>	<i>Objective Lens</i>	<i>Total Magnification</i>
a. 5x	10x	_____
b. 10x	10x	_____
c. 10x	43x	_____
d. 20x	10x	_____
e. 20x	50x	_____

2. Why must you be careful when you are focusing with the high-power lens? What precautions should you take?

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3. Describe the procedure for focusing a microscope using the coarse and fine adjustment knobs.

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### Critical Thinking and Application

1. Why is it a good idea to place your microscope at least 10 cm from the edge of the table?

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2. Why should you always use the low-power objective lens to locate objects mounted on the slide first, even if you want to observe them with the high-power objective lens?

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3. Why should a microscope slide be held by its edges?

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4. When switching from the low-power objective to the high-power objective should you open or close the diaphragm? Explain your answer.

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### Going Further

Observe cells under the low- and high-power objective lenses of a microscope. Compare what you see under both objective lenses. Which objective lens allows you to see more detail? Which objective lens allows you to see more of the cell? Each person needs to draw and label two different cells. Be sure to include on each drawing the title of the slide, whether it was a cs or ls or wm, and the power used to make the drawing.

### ?Who Am I Riddles?

- Pick a cytoplasmic organelle to write a “Who Am I” riddle.
- The riddle must contain 5 lines – the 5<sup>th</sup> line must be “Who Am I?”
- Lines 2 and 4 must rhyme.
- The actual name of the organelle must not be in the riddle.

Example: Found only in plant cells,  
I’m green as can be.  
I make food for the plant  
Using the sun’s energy  
Who Am I?