Name _____ Class _____ Date _____

Investigative Lab 1

Kingdom Exploration

Observing Organisms With a Microscope

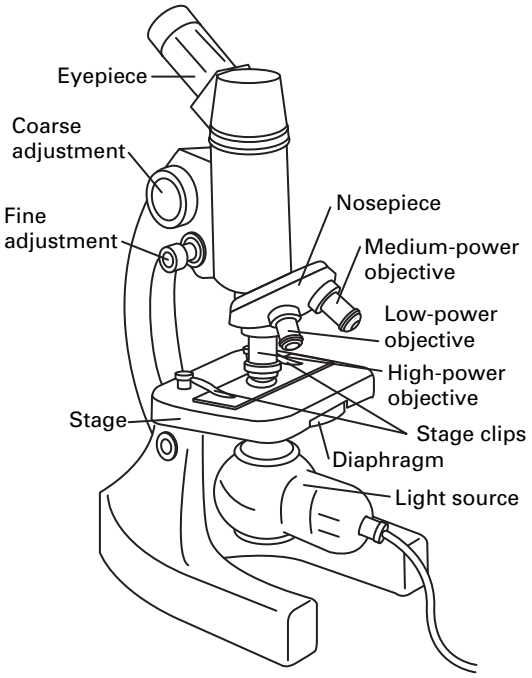
Question How do microscopes help biologists explore the diversity of life?

Lab Overview In this investigation, you will use a microscope to observe representatives of each of the four kingdoms of organisms in domain Eukarya. You will sketch them as you observe them, then make a final drawing of each that indicates their relative sizes.

Introduction In this lab, you will observe one type of organism from each of the four kingdoms in domain Eukarya: plants, animals, protists, and fungi. Although these organisms are all very different, one characteristic they share is that they all consist of one or more eukaryotic cells. A eukaryotic cell contains a membrane-enclosed nucleus that separates genetic material from the rest of the cell. In contrast, prokaryotic cells do not contain a membrane-enclosed nucleus.

A microscope enables you to see cells and cell structures at different magnifications. To start your investigation, you will identify the basic parts of a microscope and learn how the different objective lenses are used to obtain focused images of various magnifications. You will also practice using the diameter of the microscope's field of view to estimate the general size of the objects you are looking at.

Prelab Activity Study the diagram below of the basic parts of a microscope, and then read about its parts on the next page.



The eyepiece of a microscope usually has a magnification of 10×. To calculate the total magnification of each power of a microscope, multiply the magnification of the eyepiece by the magnification of the objective lens. For example, if the medium-power objective lens is 10× and the eyepiece is 10×, the total medium-power magnification of the microscope is 100×. In Table 1, record the magnifications available on your microscope.

Data Table 1

Objective	Magnification of Objective	Magnification of Eyepiece	Total Magnification
Low power			
Medium power			
High power			
Other			

When you look into the eyepiece of a microscope, the brightly lit circle you see is called the field of view. When you look through the high-power objective lens, the field of view has a much smaller diameter than the field of view when you look through the low-power objective lens. In the lab, you will measure or calculate the diameter of the field of view seen through each objective lens. This information will help you estimate the sizes of the objects you observe with the microscope. To observe organisms with a microscope, follow the basic steps described below for each objective lens. Always start with the low-power lens first.

Low Power Make sure that the low-power lens is in place. Focus only with the coarse focus knob (large knob), and use the diaphragm to adjust the incoming light so that you can see details. Move the slide slightly to make sure that what you see through the eyepiece is actually on the slide (not just the glass of the lens). When you locate what you want to look at, position it in the middle of the field of view. Then adjust the focus with the fine focus knob (small knob).

Medium Power Switch to medium power by swinging the middle-sized lens into place. Adjust the focus with the fine focus knob. **CAUTION:** *Never use the coarse adjustment when focusing the medium- or high-power objective lenses. You could break the slide or damage the lens.* Adjust the lighting. In general, you will need to let in more light as you increase magnification. Again, move the slide slightly until the object you are observing is in the middle of the field of view.

High Power Switch to high power by moving the longer lens into place. Adjust the focus only with the fine focus knob. If this doesn't work, switch back to medium power and repeat the steps above. If

you can't see the object on medium power, switch to low power and start over.

Estimating Field of View To model the circular field of view you see when you look into a microscope, draw a circle with a diameter of 10 cm on a piece of white paper. Put a penny in the circle to represent a cell. By comparing the known size of the circle with the size of the penny, you can estimate the penny's diameter in centimeters. Write your first estimate in the space provided. Follow the steps below to make a second estimate and then answer the Prelab Questions.

First estimated diameter of a penny: _____ cm

1. How many pennies fit along the diameter of the circle?

_____

2. Estimate the diameter of one penny again, based on what you know about the circle's diameter and your answer to Question 1. Record your estimate below.

Second estimated diameter of a penny: _____ cm

3. Measure a penny with a ruler to check how close your estimates were. Record your measurement in the space below.

Actual diameter of penny: _____ cm

Prelab Questions

1. When do you use the coarse focus knob on a microscope?

_____

_____

2. Suppose you are looking at protists under the microscope and cannot see anything on low power. What adjustment could you make to the microscope that might help you see the protists, without switching to a higher magnification?

_____

_____

3. Suppose you focused on an organism using medium power, but then cannot see the organism after switching to high power. What should you do?

_____

_____

4. Which of your estimates of a penny's diameter was more accurate? Suggest an explanation.

_____

_____

Materials

- plant
- animal
- cultures of fungal and protist cells
- microscope
- transparent metric ruler
- microscope slides and cover slips
- well slides
- 6 transfer pipettes (one cut short)
- colored pencils

Procedure

Part A: Determining Size of Microscope Field of View

1. Place a transparent metric ruler on the microscope stage so that the millimeter marks fall across the diameter of the circular opening where the light comes through.
2. Look through the low-power lens. Focus on the millimeter marks. Move the ruler so that one mark lines up at one side of the field of view. Measure the diameter of the field of view. Write your measurement in the space provided.

   Diameter of low-power field of view = _____ mm
3. Calculate the diameter of the field of view for the medium-power objective lens using the formula below. Write the result of your calculation in the space provided. (*Hint:* To find the power of each objective lens, look at the number written on it, usually after a few letters. For example, a lens marked DIN40 has a power of 40×.)

$$\text{Diameter of medium-power field of view} = \frac{(\text{diameter of low-power field of view}) \times (\text{power of low-power objective})}{\text{power of medium-power objective}}$$

   Diameter of medium-power field of view = _____ mm
4. Calculate the diameter of the field of view for the high-power objective lens using the formula below. Write the result of your calculation in the space provided.

$$\text{Diameter of high-power field of view} = \frac{(\text{diameter of low-power field of view}) \times (\text{power of low-power objective})}{\text{power of high-power objective}}$$

   Diameter of high-power field of view = _____ mm

Name _____ Class _____ Date_____

Part B: Observing a Plant

1. Write the name of the plant you will observe in the space below.

   Plant name: _____

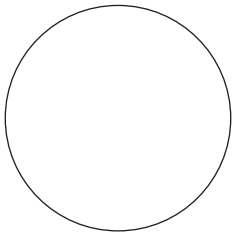
2. Measure the length of the plant with a metric ruler, and record the length below.

   Length of plant: _____ cm

3. As directed by your teacher, place a leaf or a portion of a leaf on a microscope slide. Add a drop of water. Slowly place a cover slip over the leaf and the drop of water, making sure that no air bubbles are trapped between the cover slip and the leaf. The type of slide you just made is called a *wet mount*.

4. Place the slide on the slide stage. Focus on the plant cells at low power, then switch to medium power to get a closer look inside the cells. Use the space below to draw a sketch of what the plant cells look like through the microscope. On the lines provided, write a description of the cells. Label your sketch with the plant name and the magnification.

   Sketch and Description of Plant Cells



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Part C: Observing an Animal

1. Write the name of the animal you will observe in the space below.

   Name of animal: _____

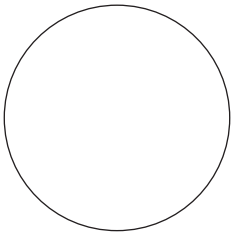
2. With the short transfer pipette, draw up the animal (or one drop of a culture) and place it on the indented area of a well slide. Add water to fill the well and cover with a cover slip.

3. Measure or estimate the length of one animal. Use a metric ruler if the animal is large enough. If not, focus on the animal at low power and estimate its size based on the diameter of the low-power field of view determined in Part A. Write your measurement, or estimate, in the space below.

   Size of animal: _____ mm

4. Use the space below to draw a sketch of the animal as seen through the microscope. On the lines provided, write a description of the animal. Label your sketch with the name of the animal and the magnification.

   Sketch and Description of Animal



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Part D: Observing a Protist

1. Write the name of the protist you will observe in the space below.

   Name of protist: _____

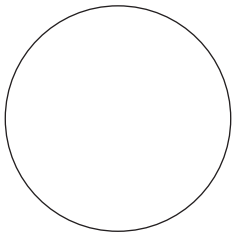
2. As directed by your teacher, add one drop of protist-slowing solution (or a bit of cotton fibers) to the slide.
3. With a transfer pipette, draw up one drop of protist culture, making sure to draw the liquid from the bottom of the culture container where there is visible debris. Place one drop of the culture in the well of a clean well slide. Add water to fill the well, if needed. Cover with a cover slip.
4. Focus on one protist at low or medium power. Estimate its size based on the diameter of the appropriate field of view (see Part A). Write your estimate in the space below.

   Approximate size of protist: _____ mm

5. Use the space on the next page to draw a sketch of the protist as seen through the microscope. On the rules provided, write a description of the protist. Label the sketch with the name of the protist and the magnification you are using.

Name _____ Class _____ Date_____

Sketch and Description of Protist



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Part E: Observing Fungi

1. You will observe one of the many species of fungi known as yeasts. If available, write the scientific name of the yeast you will observe in the space below.

   Name of fungi: _____

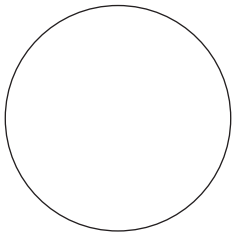
2. With a transfer pipette, draw up one drop of yeast culture. Place the drop on a clean flat slide. Cover with a cover slip.

3. Observe the yeast cells at low and medium power. In order to estimate the size of a yeast cell, you will need to switch to high power. Focus on one individual yeast cell at high power. Estimate its size based on the diameter of the high-power field of view (see Part A). Write your estimate in the space below.

   Approximate size of yeast cell: _____ mm

4. Use the space below to draw a sketch of the fungi as seen through the microscope. On the rules provided, write a description of the fungi. Label the sketch with the name of the fungi and the magnification.

   Sketch and Description of Fungi



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_____

Analysis and Conclusions

1. Which of the organisms you observed were unicellular (consist of only one cell)? On what observations do you base your answer?

_____

_____

_____

2. Which of the organisms you observed were multicellular? On what observations do you base your answer?

_____

_____

_____

3. List the organisms that you observed according to their relative size from largest to smallest.

_____

_____

_____

4. Although the organisms you observed all look very different, each is classified in a kingdom that is part of domain Eukarya. What evidence suggests that these diverse organisms belong to the same domain?

_____

_____

_____

Extension

Make a mini-mural comparing the organisms you observed representing the four kingdoms in domain Eukarya. On one sheet of paper, sketch all four organisms you observed to scale, indicating their relative sizes. Draw a scale bar at the bottom of the mural to show the relative size of a millimeter in your mural.