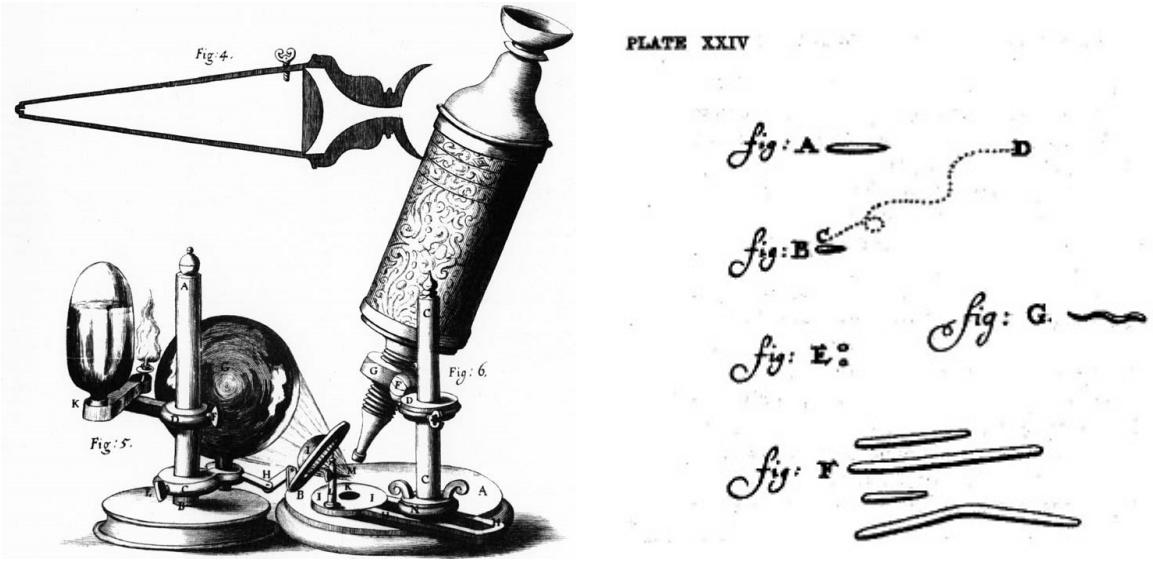
1. A MICROSCOPIC VIEW OF LIFE



Objectives

The student should be able to:

1. Identify, locate, and give the functions of the major parts of the compound microscope
2. Properly carry, care for, and put away the microscope.
3. Calculate the total magnification of each lens combination.
4. Demonstrate proficiency in the use of the microscope by selecting the best objective for subject being viewed.
5. Identify the fundamental differences between prokaryotic and eukaryotic cells.
6. Identify the fundamental differences between plant and animal cells.
7. List and identify parts or structures of the *Amoeba*, *Paramecium*, and *Euglena* as shown in drawings.
8. Identify, from a prepared or wet-mount microscope slide, cells and organelles observed in this exercise.

Materials

lens paper	glass slides	cover slips
250 ml beakers	pipettes	forceps
toluidine blue solution	Protoslo	
prepared slides:	micrometer slide	letter "e" slides
	Amoeba	*Paramecium*
	Euglena	bacterial shapes
Live material:	*Elodea*	*Amoeba*
	Paramecium	*Euglena*
	pond water/ algae mixture/ protist mixture	

Introduction

The microscope has been exceedingly important in the study of biology since 1665 when Robert Hooke saw cork cells. According to Hooke the cork seemed to be perforated and porous, and it had the appearance of honeycomb. The pores or cells in this nonliving material were not very deep but were numerous.

In 1836, the French biologist Dujardin viewed living cells and saw unknown materials within the cell. He called this material sarcode, and later the name was changed to protoplasm. Although Hooke saw dead plant cell walls, and Dujardin discovered life within cells, the cell theory was not proposed until later. In 1839 Schleiden and Schwann, two German biologists, stated that all living things are composed of cells that act independently and function together.

The microscope made these discoveries possible. Microscopy was and is of great importance in many areas of biology, and your mastery of this lab exercise is essential for success in several other laboratory experiences in your biology sequence. In this lab, we will use the light (or compound) microscope

Although cells vary in a great many respects, they possess certain characteristics in common. The types of living cells which you will study in this exercise will demonstrate some of these characteristics. You will examine the structure of cells, both as they occur as complete unicellular organisms and as basic components of multicellular organisms.

In this exercise, guide your thinking along the following lines:

- What ***visible*** structural features are common to the different cells observed? What ***visible*** structural features are unique to each type of cell?

- What are the various functions carried out by each cell? In what way are those functions particularly suited to aid in survival? In what different ways are the functions performed by different cells?

The cell is the fundamental unit of life. There are two fundamentally different types of cells: **prokaryotic** and **eukaryotic**. Bacteria (both the true bacteria and the archaea) are the only Prokaryotic organisms (including cyanobacteria or the blue-green algae). All other organisms are Eukaryotic.

Table 1-1. Differences between the fundamental cell types.

	bacteria/ prokaryotic	plant	animal	fungal
cell wall composition	peptidoglycan (when present)	cellulose	absent	chitin – large pores present (coenocytic)
plasma membrane	present	present	present	present
cytosol	present	present	present	present
nucleus	absent (nuclear region)	present	present	present
ribosomes	present	present	present	present
chromosomes	single circular	multiple linear	multiple linear	multiple linear
chloroplast	absent	present	absent	absent
membrane-bound organelles	absent	present	present	present

Prokaryotic organisms are the simplest of the living cell types. Notice the size and distinguishable characteristics of the Prokaryotic organisms when you look at them. They are much smaller (generally 1-10 μm) than Eukaryotic cells (generally 10-100 μm), and they have fewer distinguishing characteristics (what are they?).

Eukaryotic cells can generally be divided into 3 fundamental types based on presence/absence of the cell wall (and its composition) and organelles that are present. We will, however, only look at 2 of them – plant and animal. (Fungal cells have cell walls made of chitin, and the cell walls are often incomplete allowing the cell contents to flow readily between cells). Because the differences between fungal cells and other cells are not readily apparent under a light microscope, we will not examine them in this lab.

There are three primary types of microscopes used by biologists; you will use one of them in this class. The **Compound Microscope,** also called a **light microscope**, works by passing light through an object and then through a series of glass lenses that bend (or **refract)** the light to magnify the object. It is intended to aid in the examination of thin or watery materials that light can easily penetrate. Compound microscopes are considered "compound" because they use more than one set of lenses to magnify an object. **Stereomicroscopes** (or **Dissecting Microscopes**) are another type of light microscope that is used to examine larger specimens that are too big for light to pass through. The Dissecting Microscope can also be used to prepare material for viewing under a Compound Microscope. The **Electron Microscope** uses a beam of electrons instead of light to create a highly magnified image of the exterior (**Scanning Electron Microscope**) or interior (**Transmission Electron Microscope**) of objects. The object is generally coated with some sort of precious metal; and, therefore, must be dead to observe under this type of microscope.

Parts of the Compound Microscope

The compound microscopes are stored in the cabinet located on the end wall of the laboratory. Remove your assigned compound microscope from its cabinet by the arm. Holding it upright and supporting the base with your free hand, place the instrument gently on your desk, arm toward you. Microscopes should always be carried in this fashion, with *both hands*. Remove the dust cover and put it on the shelf under the table. Uncoil the electrical cord from the coil sitting on the side of the base and plug it in.

Before you begin to use your microscope, examine it carefully using Fig. 1-1 for assistance.

The ***arm*** supports an inclined body tube, which in turn supports the magnifying system of your microscope. At the top of the body tube is the ***ocular*****, or eyepiece,** and the ***objective lenses*** are attached to a **revolving *nose-piece*** at the bottom. Your microscope has 3 different objective lenses; each magnifies a specimen by a different amount. Together the ocular and objectives constitute the magnifying system of your microscope. The total magnification of a lens system may be determined by multiplying the magnification of the objective by the magnification of the ocular. The ocular of most microscopes has a magnification of 10X.

Total Magnification

The objective lens with the lowest magnification is the 4X objective or scanning power lens. **The 4X objective should always be used *first* when examining a specimen.** The objective with the next higher level of magnification is the 10X or **low power objective.** The **high power lens** (40X) provides the highest level of magnification that you will use in this course.
Remember the **total magnification** of a compound microscope is determined by the magnifying power of the lenses, i.e., the objective lens first magnifies and then the eyepiece (ocular) magnifies that image. The total magnification, therefore, is the product of the magnifying power of the two lenses.

For Example:	**eyepiece**	**X**	**objective**	=	**TOTAL MAGNIFICATION**	
	10X	X	4X	=	40X	(scanning lens)
	10X	X	10X	=	100X	(low power lens)
	10X	X	40X	=	400X	(high power lens)

Keep in mind that magnification is not necessarily one of the parameters determining the quality of a microscope. **Resolution** (or resolving power) is a measure of the sharpness of the image; it's the closest that two points can be to each other and still be separable or visible as two separate points. **Contrast** is the property of the microscope to accentuate different parts of the subject being viewed. Adjusting the *iris diaphragm* (see below) can improve contrast in living unstained specimens.

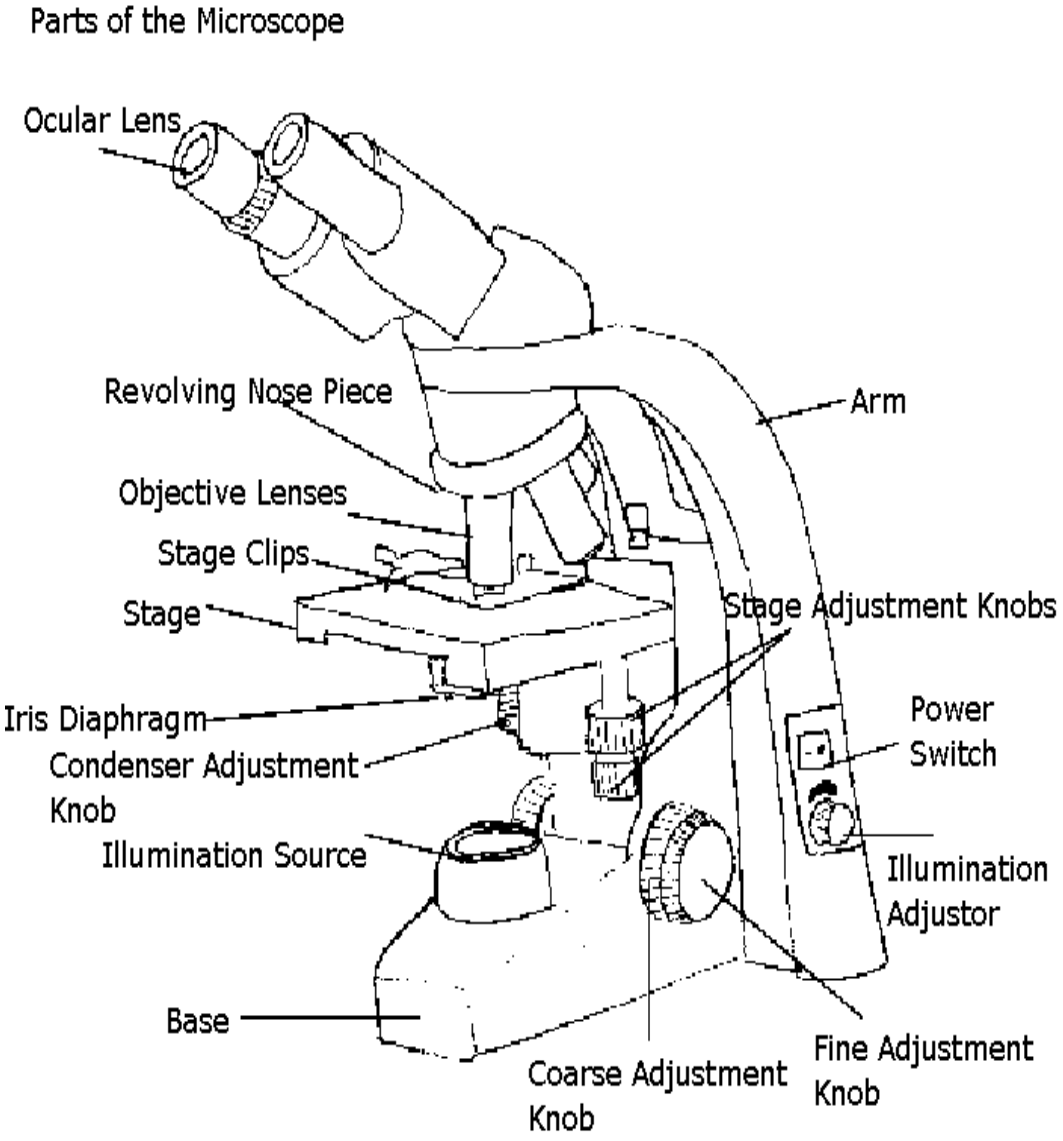


Figure 1-1. Generic Compound Microscope.

Table 1-1. Microscope Vital Statistics.

Objectives	Magnification	Working Distance	Diameter of Field	Resolving Power
4X	40X	13 mm	4.0 mm	3.29 μm
10X	100X	10 mm	2.0 mm	1.32 μm
40X	400X	1 mm	0.5 mm	0.5 μm

Below the objectives is a flat plate, the ***stage***, upon which objects to be examined are placed. Attached to the stage is **a spring-loaded slide holder (mechanical stage)**. When used correctly the mechanical stage can make observations and movement of the slide easy and convenient. Open the jaws of the mechanical stage (or **stage clips**) and see where you will place the slide on the stage. When the stage clip is released, it will secure the slide in place. There are two *stage* adjustment knobs for moving the mechanical stage. The lower control (horizontal) will move the slide left and right, and the upper control (vertical) will move the slide toward or away from the observer. Find these controls and practice moving the slide with them.

In the center of the stage, you will find a hole. The **condenser** is located in this hole. It focuses light to the specimen and extends it in a wide cone to completely fill the aperture of the objective.

The **iris diaphragm** is attached to the bottom of the stage and has a small lever by which the angle of the solid cone of illumination presented to a specimen and entering the objective is controlled. Resolution, definition (or clarity), and contrast of parts of the specimen significantly depend upon the proper setting of the iris diaphragm.

The **objective lens**, just as with a magnifying glass, must be a certain specified distance from a specimen for a sharp image to be observed. That distance is a property of the lens system and is constant for any particular objective; it is called the ***working distance***. When the objective is exactly at its working distance from an object, that object will be in exact focus. One can move the objectives up and down to obtain sharp focus by using the ***coarse* and *fine* adjustment** knobs. These knobs are coaxial and are located on the arm near the base. The coarse adjustment knobs are large and when rotated cause a rapid and easily visible motion of the objectives. You should always begin with the coarse adjustment to reach approximate focus, and then you can obtain an exact focus by using the fine focus. ***You should ONLY use the coarse focus adjustment with the 4X objective!***

In the base of the microscope, you will find the **illuminator**; the switch and brightness control are located on the bottom of the arm. The illuminator provides light for the microscope. Always check the operation of the light and switch when you begin to use the microscope.

Other Microscopes Commonly used in Biology Labs: The Stereomicroscope (Dissecting Microscope)

The stereomicroscope is used to observe large opaque specimens which cannot be observed with the compound microscopes. The stereomicroscope has a very large working distance and relatively low magnification, which makes it ideal for observing many whole or dissected specimens (Fig. 1-2).

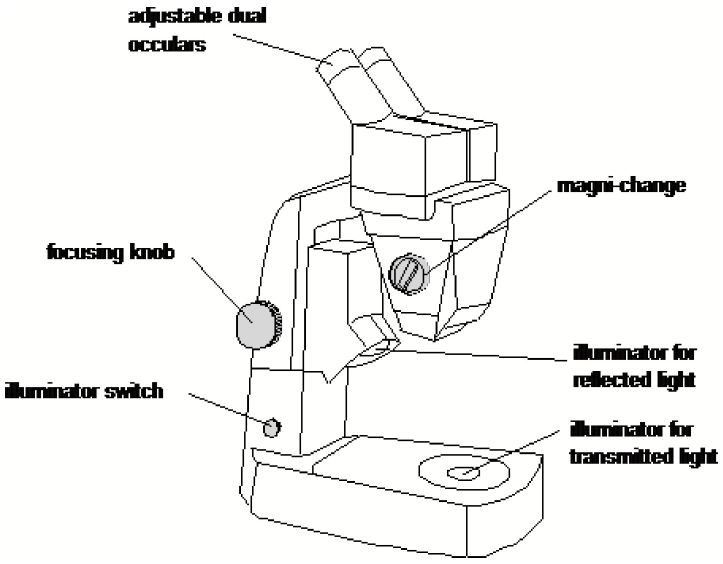


Figure 1-2. Stereomicroscope or dissecting microscope.

The stereomicroscope is equipped with two light sources, one for illumination from below (transmitted light) and one for illumination from above (reflected light). These two lights may be used in combination or individually.

Other Microscopes Commonly used in Biology Labs: The Electron Microscope

An electron microscope is needed to study molecular structure and extremely small structures, e.g., cellular parts. In most cases, material observed under electron microscopes is first killed and fixed in a condition as close to the living one as possible. Extremely thin sections of the material are made for viewing under the transmission electron microscope, which is able to increase magnification and resolution (clarity) by passing electrons, rather than light rays, through the specimen. Huge electromagnets are used to spread the electrons, in place of glass lenses used to spread light rays. Small organisms or groups of cells may be observed by using the scanning electron microscope, which uses a moving beam of electrons to bounce electrons off the specimen. These are detected electronically and an image is produced on a viewing screen.

Use of the Compound Microscope

Before using a microscope, it is important to adjust the eyepieces to match the distance between your eyes and to correct for differences between the vision in each eye. To adjust your microscope eyepieces to match the differences in visual acuity in your eyes.

i bring a specimen into focus using the 4X objective
ii adjust the distances so that you see ***one*** image with both eyes
iii using the ***right eye ONLY***, look through the right eyepiece and adjust the focus until the specimen is clearly visible
iv look through the left eyepiece with the ***left eye ONLY*** and adjust the eyepiece adjustment ring on the ocular until the image is clearly visible
v look through the microscope with both eyes; the image should be sharp and clearly visible

The focusing of each of the ocular lenses to each of your eyes compensates for most common eye defects. Therefore, eyeglasses can be removed; but if not, be careful not to push them against the ocular lens cups.

Cleaning the Microscope

Dirt, dust, and water are the worst enemies of a precision instrument. Try to keep the microscopes clean and dry at all times.

If a lens should become soiled, use *lens paper* to clean the lens. Never use paper towels or cloth to clean a lens. All lens are coated, and this coating might be damaged by cleaning with anything other than lens paper.

To clean a lens, wipe gently with clean, dry lens paper. The ocular is particularly susceptible to accumulating grease from the area of the eye. This will make frequent cleaning a necessity. Your microscope should always be clean and dry before you store it.

If you have difficulty cleaning your microscope, consult your instructor.

Basic Rules for Microscope Use

A. Place the slide with the object to be studied in the center of the opening in the stage.

B. Select the proper setting on the substage condenser turret for the type specimen to be viewed.

C. **Always start with the scanning or *lowest* power objective**. Adjust the light and iris diaphragm as you look through the eyepiece.

D. Lower the low power objective lens to about 1 cm from the slide, and gradually raise it with the coarse adjustment while looking through the eyepiece. Stop when the object is in focus. The fine adjustment may be used for sharper focus. Control the amount of light with the diaphragm.

E. If more magnification is needed, swing the high power objective lens into position, being careful not to hit the slide. Use **only** the fine adjustment for focusing when using the high power lens. Control the amount of light with the diaphragm.

F. Focus continuously with the fine adjustment to change the planes that are in focus, and thus bring out the fine detail and 3-dimensional structure of the object.

G. Use both eyes when looking through the microscope to avoid the strain of keeping one eye closed. It takes practice, but you will soon learn to ignore what the eye not looking through the scope is seeing.

Basic Rules for Microscope Care

★ Always carry the microscope upright by its arm and support it by placing one hand under the base.

★ At the beginning and end of each laboratory period, clean the lenses with lens paper. (note: lens paper can also be used to clean permanent mount slides!)

★ Always have the scanning or lowest power lens in position when the microscope is not being used or is in storage.

★ Always be sure the scanning or lowest power lens is in position when slides are removed from or put on the stage.

★ Do not allow the lens to touch the slides or materials on the slides.

★ Treat the microscope with the care and respect an expensive precision instrument merits.

Basic Rules for Care of Microscope Slides

★ Always handle slides by the edge to prevent getting finger prints on them

★ If the slide is dirty, clean it carefully with a piece of lens paper.

★ Do not stack slides on top of each other.

I. Observing Slides with the Microscope

Your first observation with the compound microscope will be of the letter "e." This slide is in the tray at your station. **These are permanent mount (or prepared) slides**. In contrast, a **wet mount slide** is a slide that you make by placing the (typically) living specimen in a drop of water and covering with a coverslip. Before you observe the slide with the microscope, examine it with your naked eye. Note that the slide has a label on the left of the slide. On the label you will find considerable information, including what is on the slide and the condition of the material. This label should read Letter "e" W.M. This means that on the slide you can expect to see a whole mount (W.M.) of a letter "e." On other slides you may find indications such as X.S., C.S., or L.S. The X.S. and C.S. refer to cross sections of material, i.e., a section cut perpendicular to the length of an object, and L.S. refers to longitudinal section, i.e., a section cut parallel to the length of an object.

Step 1: Locate the “e” slide in your slide tray. Examine the letter "e” slide by looking at the "e” with your naked eye and then with the assistance of the compound microscope. What differences do you notice? Record your observations in the write up section of this exercise.

Step 2: Place the slide on the stage of the microscope with the “e” above the center of the condenser.

Step 3: Turn the scanning power (4X) objective into position. **Be sure the objective clicks firmly into position**.

Step 4: Rotate the coarse adjustment knob to move the objective to its highest position; ***this is the ONLY time you will raise the stage with the coarse focus knob!*** Look through the ocular and with the coarse adjustment knob, move the objective very slowly down. The "e" should come into focus right away.

If the “e” does not come into focus, then one or more of the following things could be wrong:

★ The "e" might not be centered under the objective.
★ The objective might not be clicked into position.
★ The objective, ocular, or slide might be dirty.
★ You might need to focus down slightly with the fine focus.
★ The objective may be too far from the stage.
★ The iris diaphragm setting needs adjusting.

After you check and correct the situation, you should have your "e" in focus on scanning power. If you have difficulty, the instructor will gladly assist you.

Inversion refers to the fact that the image is inverted and reversed. Move the slide to the right. Which way does the image appear to move? Move the slide away from you. Which way does the image appear to move?

All optical instruments in this lab are ***parfocal***. That means only a slight adjustment is needed when one power is substituted for another. To observe the "e" on the high power, simply rotate the high power objective into position. **Never try to locate or focus an object on high power without first focusing and centering the object on scanning or low power**.

1. In the space, draw the letter "e" as it appears on the slide ***before*** you place it on the microscope stage.

2. In the space, draw the letter "e" as it appears when you look through the eyepiece. Make sure that the slide is in the same orientation as in question 1.

3. What differences did you notice about the orientation of the letter "e"?

4. In which direction does the "e" appear to move when you move the slide:

   to the right?_____ to the left?_____

   away from you?_____ toward you?_____

II. Diameter of Field

Understanding diameter of the **field of view** (the area seen through the microscope) can help you understand the actual size of the specimens you are viewing. For example, if the microscope you are using allows you to view 2 millimeters of space (2000 micrometers or μm) with the 10X objective, and the specimen you are viewing is taking up one quarter of the field of view, then the specimen must be 0.5 millimeters (500 μm) across.

To Observe Diameter of Field:

Step 1: Obtain a micrometer slide; look at it before you put it on the stage so you can be aware of the different measurements available; note that you are looking not at millimeters, but at ***tenths*** of a millimeter and ***hundredths*** of a millimeter. With the 4X objective in place, center the micrometer in the field of view.

5. Does the 2 millimeter "ruler" fill the field of view?

Step 2: Increase the magnification to 10X. Re-center the ruler in the field of view if necessary.

6. How much of the 2mm ruler do you see now?

Step 3: Increase the magnification to 40X.

7. How much of the 2mm ruler do you see now? Are you looking at 0.1 or 0.01 of a millimeter? How can you tell?

III. Air Bubble

Make a wet mount slide using a drop of water. Drop the coverslip straight down onto the liquid to create an air bubble. Draw an air bubble and describe its appearance. Normally, when you make a wet mount slide, you will place the edge of the coverslip into the liquid, and lower it onto the specimen. This minimizes your risk of air bubbles. You need to be able to tell the difference between a sample and an air bubble.

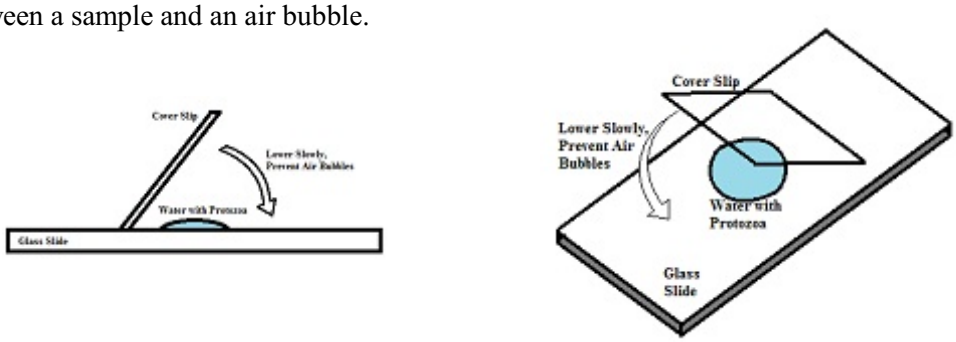


Figure 1-3. Illustration of the correct way to position a coverslip.

8. Draw and describe the appearance of the air bubble.

IV. Prokaryotic Organisms (bacteria)

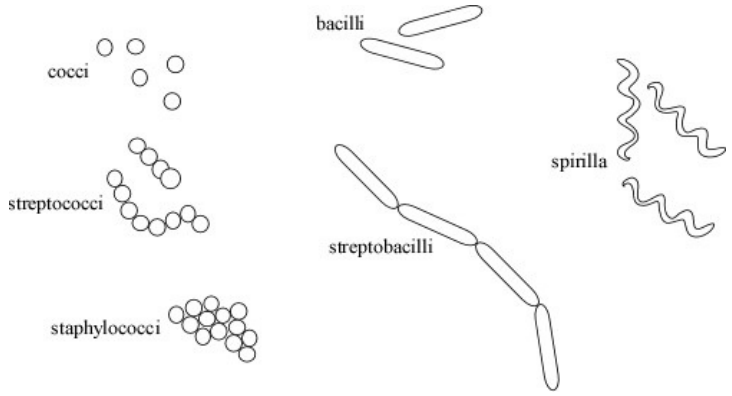


Figure 1-4. Bacterial Shapes and Growth Habits.

Step 1: Get a slide of the 3 bacterial shapes from the tray at you lab station.
Step 2: Starting with the scanning objective lens, get the bacterial sample in focus, then move up to the low and high power objectives to see more detail. (You will need to use the 40X lens!)

9. How many different shapes can you see (use Fig 1-4 as a guide.)?

9. What shapes did you see?

10. Why did you have to use the 40X lens? How much detail could you see in the different bacterial cells? Why?

V. Animal Cells (Cheek or Epithelial Cells)

Step 1: Obtain a clean slide, a clean cover slip, an applicator stick, and a pipette.
Step 2: Place a single drop of water on the center of the slide using the pipette.
Step 3: GENTLY scrape the inner surface of your cheek several times with the applicator stick.
Step 4: Mix the material on the applicator stick with the water on the slide.
Step 5: Carefully ease the cover slip over the material on the slide.

11. Describe what you see.

12. Adjust the iris diaphragm; what difference does that make in how the cells look?

Step 6: Now, place a drop of methylene blue at the edge of the coverslip and observe the visibility as the stain diffuses through the preparation.

13. Does the stain affect the visibility of the cells? How?

14. What organelles and structures were visible?

VI. Plant Cells

Cells from the leaf of *Elodea* (Fig. 1-5). *Elodea* is a flowering water plant which is suitable for cell study because its leaf is of simple design. A leaf from the growing tip is best for study because more activity can be observed and fewer chloroplasts are present to obstruct your view of other parts. The chloroplast is the organelle that is the site of photosynthesis. Chloroplasts move within the leaf cell, orienting their surfaces which are often lens-shaped so that they catch the light.

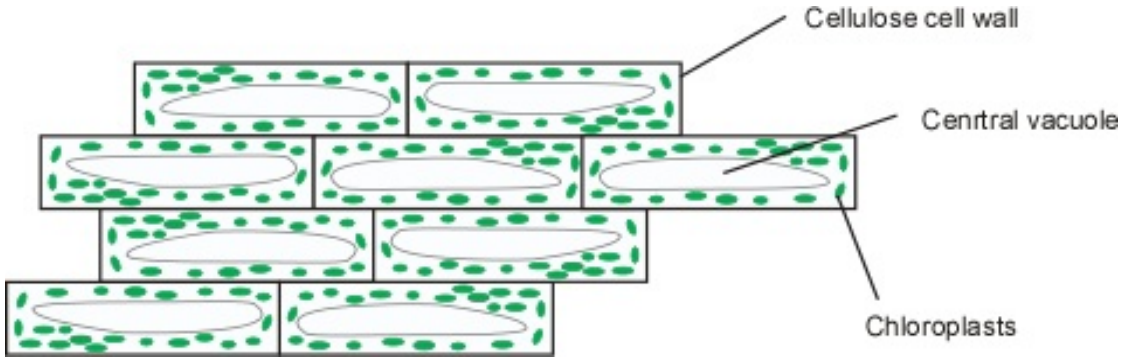


Figure 1-5. *Elodea* leaf.

Step 1: Obtain a clean slide, a clean cover slip, and a pipette.
Step 2: Place a small drop of water on the center of the slide using the pipette.
Step 3: Take a small, healthy, ***green*** leaf from near the growing tip of a dark green specimen and place it in the drop of water. *The leaf should be mounted with the upper surface facing up!*
Step 4: Carefully ease the cover slips over the material on the slides.
Step 5: Place the wet mount slide on the stage and bring the sample into focus.

Observe the leaf under low power first and notice the cellular arrangement. Focus downward with the fine adjustment until the leaf is out of focus. Now focus upward slowly until the top of the leaf is out of focus. The fact that you can see different layers of cells illustrates how shallow the depth of field (or depth of focus) is under a microscope.

15. How many layers of cells do you see? Does this change with higher magnifications?

16. What structure(s) and organelles is/are present in the plant cells but not in animal cells (e.g., the epithelial cells)?

VII. Single Cell Organisms (protists)

Protists are not considered to be animals or plants, but members of the Protist Kingdom. Even though this is not a single lineage of organisms, the term ***protist*** is still a useful one. Some protists are animal like (the *Amoeba* and the *Paramecium*), others are plant like (the *Euglena*), and still others are fungal-like (water molds). Animal-like protists have no cell wall; plant-like protists often have cell walls composed of cellulose like plant cells. Fungal-like protists, unlike fungi, generally have a cell wall composed of cellulose. Since we are not looking at fungal cells in general, we will not look at fungal-like protists, either. As you look at live material, and collect material from the culture pots, collect from the bottom of the pot around the food grain.

Amoeba **(Fig. 1-6).** The *Amoeba*, at first glance a shapeless blob of protoplasm, is actually a highly differentiated one-celled organism (protist). Like nearly all cells, the *Amoeba* has a cell membrane, a **nucleus**, and a large volume of cytoplasm, in which are suspended granules, crystals, vacuoles, and smaller structures visible only with an electron microscope. Locomotion results from cytoplasmic streaming into a **pseudopod** ("false foot") when some part of the cell surface is attached to the sub-stratum. The first sign of pseudopod formation is the appearance of the clear **hyaline cap**, into which granular cytoplasm then bursts forward. The inner cytoplasm (endoplasm) streams forward to the tip of the pseudopod, where it everts to become the relatively rigid **ectoplasmic tube** (the outer stationary area). A conspicuous feature is the **contractile vacuole**. Excess water entering the cell by osmosis is actively "pumped" into this vacuole from the surrounding cytoplasm and then expelled from the cell. A layer of **mitochondria** (tiny dark granules) lies around the contractile vacuole. Mitochondria contain enzymes which catalyze the synthesis of ATP which provides energy for movement, growth, excretion, reproduction, etc.

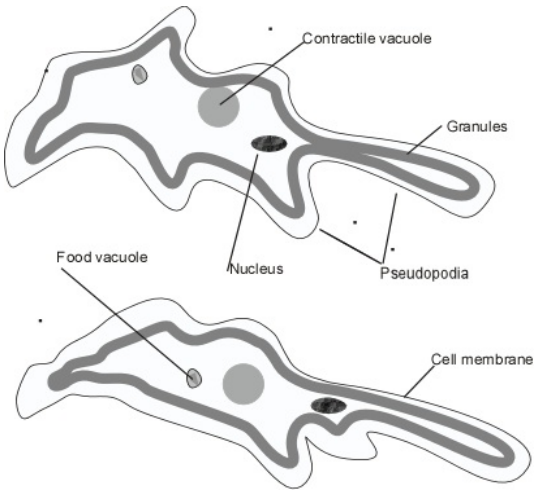


Figure 1-6. *Amoeba.*

The *Amoeba* is small enough to exchange gases and excrete some soluble waste products by diffusion across the cell membrane. Insoluble nitrogen excretion products are condensed into bi-pyramidal and plate-like crystals. *Amoeba* feed on smaller protists, especially ciliates, and flagellates. In the presence of food it forms pseudopods which trap the prey. Pseudopodial membranes then fuse the enclosed prey in a **food vacuole**. After a period varying from hours to days, undigested contents of the food vacuoles are egested by being "left behind" as the *Amoeba* advances. Products of food digestion diffuse from the vacuole into the cytoplasm, where they serve as building blocks for new protoplasm or for the synthesis of new molecules of energy-rich ATP. Well-fed *Amoeba* reproduce by cell division about once every 24 hours. The nucleus first divides (mitosis), making the cell temporarily binucleate until the cytoplasm divides (cytokinesis) by sending pseudopods in opposite directions.

Prepare a wet mount of *Amoeba* by putting a drop of the culture on a clean microscope slide. Gently place a clean coverslip over the drop. Observe the movement of this organism. Notice the movement of the cytoplasm: nucleus, contractile vacuole, and granules. Compare the living material to the prepared slide.

Paramecium **(Fig. 1-7).** Make a wet mount of *Paramecium* by mixing a drop of Protoslo with material from the culture on a slide (Protoslo is a viscous substance that slows the animal's swimming). Mix thoroughly with a toothpick, and add a coverslip. Examine the slide under low power, and locate several protists. Two contractile vacuoles are visible. These rosette-like structures beat rhythmically, pumping excess water out of the cell body. When you examine the prepared slide, see if you can find a contractile vacuoles; there may also be several associated food vacuoles. You should also be able to see the oral groove into which food particles are driven by the beating cilia. *Paramecium* and other ciliates differ from all other cells in that they have a macronucleus and one or more micronuclei. These nuclei appear to be necessary for the control of the unusually large and complex cell structure typical of this group. The body of the protist is completely covered by cilia, although only a relatively few are shown here.

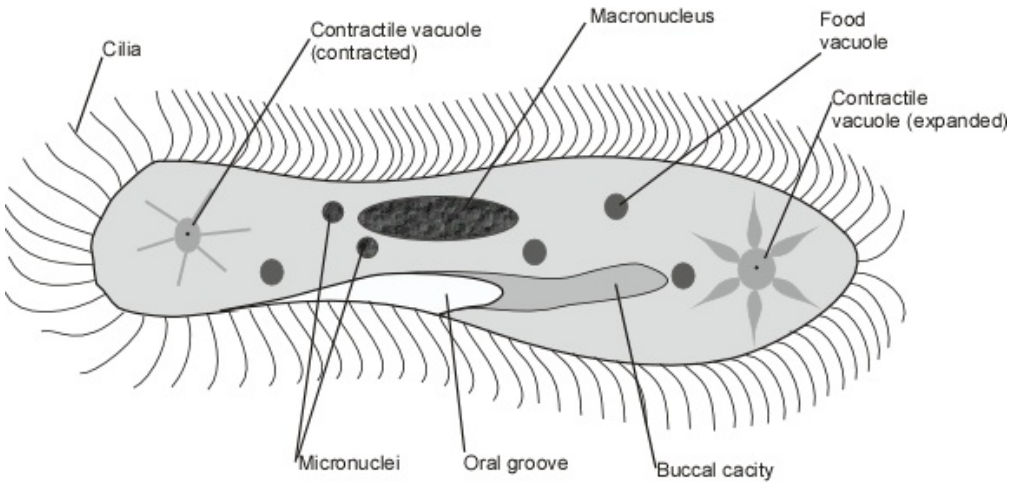


Figure 1-7. *Paramecium.*

***Euglena* (Fig. 1-8).** Make a wet mount of *Euglena* by mixing a drop of culture and a drop of protoslo on a slide. Mix with a toothpick and add a coverslip. *Euglena* are common in our freshwater ponds and frequently are so abundant as to give the water a greenish tinge. As stated above, *Euglena* are plant-like protists, even though not all euglenoid organisms are photosynthetic. The smaller organisms you may find in with the live *Paramecium* and *Amoeba*, *Phacus*, are also euglenoid organisms which serve as a food source for the protists. *Euglena* are very small compared with *Amoeba* and *Paramecium*.

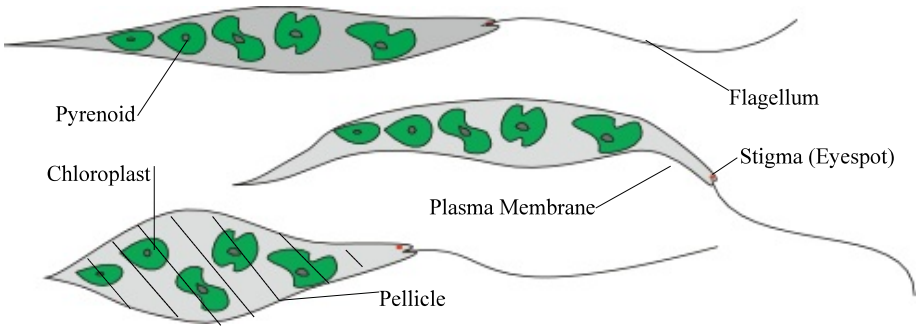


Figure 1-8. *Euglena.*

Locomotion in the most active individuals is primarily by means of the flagellum which undergoes wave-like motion and pulls the organism forward. There are other body movements known as euglenoid movements. These are produced by the movement of the pellicle. Use Fig. 1-8 to help identify the pellicle, pyrenoid, flagellum, stigma, nucleus and chloroplasts.

Pellicle: more or less flexible proteinaceous strip just below the plasma membrane spirally wound around the body of the organism. The pellicle flexes producing what is known as Euglenoid movement. As it flexes, the organism changes shape which also

propels them through the water. It is often considered to be analogous to the cell wall, but it lies ***inside*** the plasma membrane, not outside it.

Pyrenoid: Protein-rich region that is the site of starch formation.

Flagellum: whip-like locomotor structure emerging from the reservoir; difficult to observe in *Euglena* unless examined with only dim lighting from below or phase contrast. One flagellum does not emerge from the reservoir.

Stigma: red eye spot or pigment spot; sensitive to light.

Chloroplasts: containing chlorophyll which makes it possible for *Euglena* to manufacture or synthesize food in the presence of sunlight.

Nucleus: usually near the middle of the cell; sometimes visible only as a clear area with poorly defined outlined.

17. For each type of protist that you looked at (*Amoeba, Paramecium,* and *Euglena*), describe how it moves ***(including the structures involved)***!

    Euglena:

    Amoeba:

    Paramecium:

18. Which protist is photosynthetic? How do you know?

VIII. Pond Water (just for fun!)

Make a wet mount slide using pond water, water from one of the fish tanks, or the supplied algal/protist mixture to look for protists (the best viewing will be from water at the bottom of the tank!). Use the space below to draw some of what you see in the pond water.

19. Can you find either of the *Paramecium*, *Euglena*, or *Amoeba* in the pond water? Which one(s)?

20. What do you see in the pond water? Is/Are they unicellular or multicellular? How can you tell?

IX. Fill-in (Questions refer to compound microscope)

21. _____ What magnification is the eyepiece or ocular of your microscope?

22. _____ What is the part of the microscope to which the objectives are attached?

23. _____ How do you calculate the total magnification for a particular lens?

24. _____ What part of the substage assembly focuses light on the specimen and extends it in a wide cone of light to completely fill the aperture of the objectives?

25. _____ What kind of slide includes a specimen that has been stained, glued and permanently mounted to a slide?

26. _____ What is a temporary slide where the specimen is placed in a drop of water called?

27. _____ What would the total magnification be for the high power objective of a compound microscope if it had a 15X ocular instead of 10X?

28. _____ What part of a microscope regulates resolution and definition of the specimen?

29. _____ What part of a microscope is used if a small focusing adjustment is needed with high power?

X. Matching

Which type microscope or microscope setting would be the best choice for viewing the following materials:

30. _____ Molecular Structure of DNA
31. _____ Grasshopper
32. _____ Fungal Tissue
33. _____ Living Cells
34. _____ The cellular parts, such as the chromosomes and mitochondria
35. _____ Counting the number of cheek cells or protists

A. Compound Microscope
B. Electron Microscope
C. Dissecting Microscope

XI. Short Answer

36. Why do you always begin looking at an object through the scanning power objective?

37. Which objective should be in place when you put the microscope away? Why?

38. How should the microscope go into the cabinet? Handle in or handle out? Why?

39. Should the light be turned up or down before you turn the microscope off? Why?

XII. General Questions about Living Cells

40. What characteristics/structures are common to ***all*** cells?

41. Which characteristics are common to all ***Eukaryotic*** cells?

42. What characteristics can you actually see in the cells that you looked at?

43. Is there a characteristic that is present in the plant cells that is absent in the protist cells *that you looked at?* If so, what is it?

XIII. Parts of the Microscope