Lab 2 Name _____

CELL DIVERSITY

OBJECTIVES

- To explore cell structure and morphology in prokaryotes and eukaryotes.
- To gain more experience using the microscope.
- To obtain a better understanding of these terms: prokaryote, eukaryote, cell, cell membrane, cell wall, nucleus, plastids (chloroplast, leucoplast, and chromoplast)
- Distinguish among the three morphological types of bacteria.
- Identify cellular structures of a typical plant cell.
- Identify cellular structures of a typical animal cell.

Understanding the nature of cell structure and function is important to an understanding of organisms. All organisms are composed of cells, whether they exist as single cells, colonies of cells, or in multicellular form. Cells are usually very small, and for this reason, a thorough understanding of subcellular structure and function has been possible only through advances in electron microscopy and molecular biology.

There are two general types of cells: **prokaryotic** and **eukaryotic.** These two words have their root in the Greek word *karyon* (nut), which refers to a cell's nucleus. The prefix pro- means "before" or "prior to." Thus *prokaryotic* means "before having a nucleus." Prokaryotic cells do not have a membrane-bound nucleus and their genetic material (DNA) is only loosely confined to a nuclear area within the cell. Bacteria and Archaea are prokaryotes. All other organisms are eukaryotes. The prefix eu- means "true." The cells of eukaryotes have true, membrane-bound nuclei containing their genetic material.

Prokaryotic and eukaryotic cells also differ in several other ways. Eukaryotic cells are generally larger and contain additional specialized compartments **(membrane-bounded organelles)** in which cell functions such as energy production may occur. Prokaryotic cells lack membrane-bound organelles; their cell functions are carried out in the cytoplasm, or at invaginations of the plasma membrane.

During this laboratory you will investigate some of the structural features of prokaryotic and eukaryotic cells. We are going to focus on the simple differences between eukaryotes and prokaryotes.

PROCEDURE

Part A: Prokaryotic Cells

Part 1: Observing Bacteria

Most prokaryotic cells are extremely small (approximately 1 to 2 μm in diameter). Most are heterotrophic, depending on preformed food, but some are autotrophic and make their own food. Morphologically, bacteria are either round **(coccus),** rod-shaped **(bacillus),** or spiral-shaped **(spirillum).** To view them with the compound microscope, you must use an oil-immersion lens (100x objective). Even then, not much more than their basic shapes will be visible. With the aid of the electron microscope, however, one could study these prokaryotic cells more closely. Special staining techniques are also employed to learn about their structure.

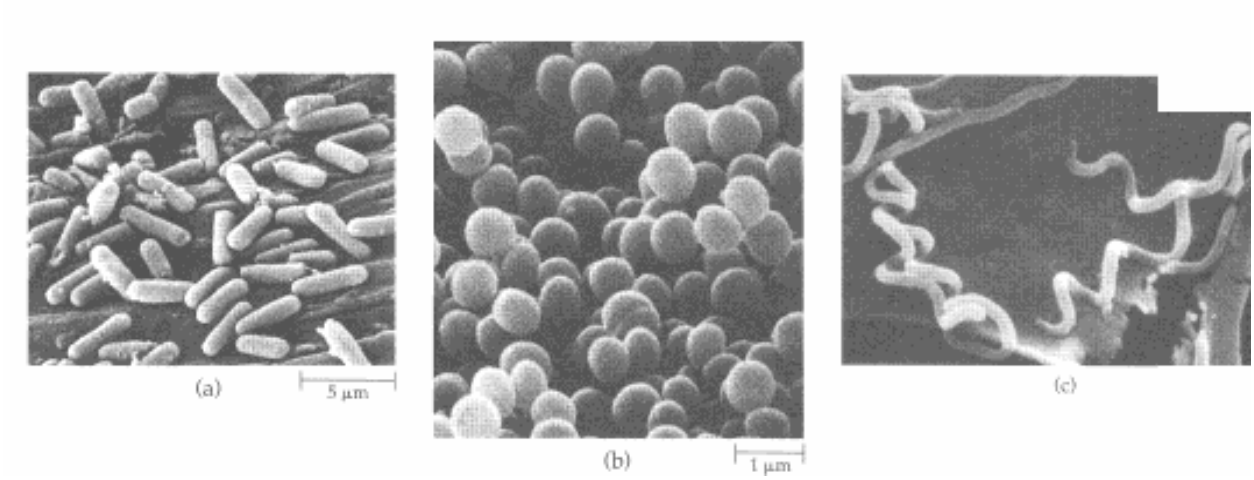
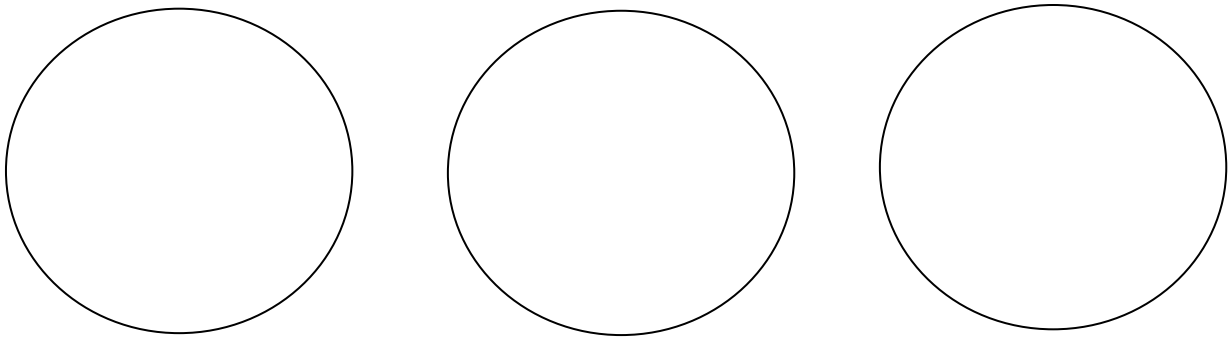


Figure 2-1. *The cells of many familiar genera of bacteria include the (a) rod-shaped bacillus, (b) spherical coccus, and (c) helical spirillum.*

You can use the compound microscope to study bacteria, but only their external features will be distinguishable. It is possible to identify the three morphological types of bacteria (coccus, spirillum, and bacillus) by observing their shape (Figure 2-1). You will also note that bacteria are often found in clusters or in chains.

1. Examine the prepared slides of the bacterial specimens, or make a wet mount from the **dilute yogurt**.
2. Draw simple sketches of these prokaryotes (choose three) and focus on the shapes of the cells. Make the sketches in the spaces below. For each, note whether the bacterium is spherical (coccus), rod-shaped, (bacilus), or spiral-shaped (spirillum). Don't forget to write in the magnification.



Specimen _____ _____ _____

Magnification _____ _____ _____

Shape _____ _____ _____

Part B: Eukaryotic Cells

All eukaryotic organisms are composed of cells, whether they exist as single cells, colonies of cells, or in multicellular form. Your body is composed of billions of cells, most of which are very small, with specialized structures that allow for a diversity of functions.

All eukaryotic cells have their genetic material enclosed by a nuclear membrane, the nuclear envelope. In addition, a variety of subcellular membrane-bound organelles are present. These include plastids, mitochondria, lysosomes, vacuoles, vesicles, and Golgi complexes. Internal membrane systems divide the cell into specialized compartments. Non-membrane-bound organelles, such as ribosomes and centrioles,

and a cytoskeleton including microtubules, intermediate filaments, and microfilaments are also present in eukaryotic cells.

During this laboratory you will investigate the structures of plant and animal cells.

Part 1: Examining Plant Cells

The cells of plants are eukaryotic, containing both a membrane-bounded nucleus and membrane-bounded organelles. A **cell wall** composed of cellulose surrounds the plant cell. A large central **vacuole** surrounded by a membrane (the **tonoplast**) is used for storing water, pigments, and wastes. Within the cytoplasm are membrane-bound organelles unique to plants called **plastids**. In this lab, you will look at various ***types*** of **plastids** responsible for photosynthesis (**chloroplasts**), for storing starch (**leucoplasts**) or for storing accessory pigments (**chromoplasts**). Chromoplasts contain several types of pigment including carotenoids, which give plants an orange or yellow color.

1. **Prepare a wet-mount slide of an *Elodea* leaf**. Observe the thick cell wall, thinner cell membrane (sometimes difficult to see), cytoplasm, nucleus, and chloroplasts. A large central vacuole should be apparent (remember that its contents are mostly colorless). These structures characterize a generalized plant cell.

2. Sketch a representative *Elodea* cell as observed under high power, and label its parts.

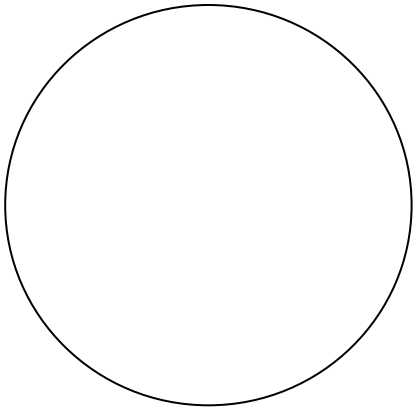
Specimen: _____

Magnification: _____

Shape and Description: _____

_____

_____



3. Do the chloroplasts appear to move? _____ If you answered yes, describe their movement.

Prepare a wet-mount slide of onion epidermal tissue. Onions *(Allium)* have layers of modified leaves (scales) that can easily be separated from one another. Peel off a portion of one layer and examine the concave side of the piece you have obtained. The surface is covered by a thin layer of cells, the epidermis.

1. Remove a small piece of the epidermis (approximately 3 x 8 mm) by breaking the scale gently, leaving the epidermis intact. Peel the epidermis from one of the halves of the scale.
2. Prepare a wet-mount slide of the isolated epidermis. NOTE, add a very small drop of Lugol's solution (I_2KI) to the water of your wet-mount slide. This iodine containing stain is rust-like in color. When this stain reacts with starch, a dark blue/purple color appears.
3. Observe the onion cells using low power (10X objective) and then high power (40X objective).

4. Does this solution seem to strongly stain cellular organelles?

5. Sketch a representative onion cell as observed under high power, and label its parts.

Specimen: _____

Magnification: _____

Shape and Description: _____

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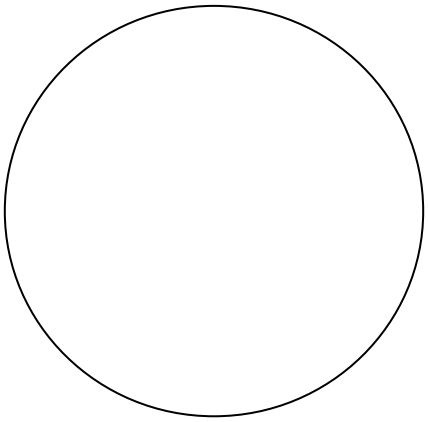

Compare the onion cell with the *Elodea* cell. Since they are both plant cells, they should be similar. You will note that onion cells lack one structure (organelle) that is very conspicuous in *Elodea* cells.

6. What is this organelle missing in the onion cells?

7. List ***the similarities and differences*** *between Elodea cells and onion cells.*

Similarities	Differences

Prepare a wet mount slide of a potato. Use a razor blade to slice a piece of tissue, <u>as thin as possible</u>, from a potato. Be careful not to cut your fingers. Prepare a wet-mount slide; use a drop of water and a very small drop of Lugol's solution (I_2KI).

1. Study the slide at low power (10X objective) and then at high power (40X objective).
2. Sketch a representative onion cell as observed under high power, and label its parts.

Specimen: _____

Magnification: _____

Shape and Description: _____

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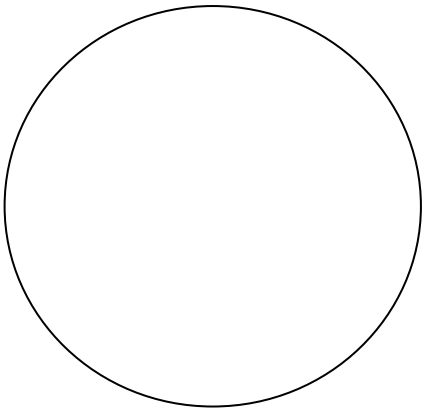
_____



3. *How does the reaction of iodine with the potato cells compare with what you observed in your onion epidermis preparation?*

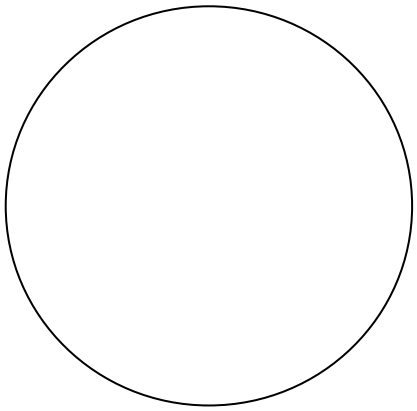
4. *What does this tell you about the differences between the storage products in onions and potatoes?*

5. *Do you see any chloroplasts?* _____ *Why or why not?*

6. *You will probably see some small oval-shaped blue-black structures. These* ***amyloplasts*** *store starch. Why did they turn blue?*

Prepare a wet mount slide of carrot or red pepper. Use a razor blade to slice a piece of tissue, as thin as possible, from the outer portion of a peeled carrot, or scrape some tissue from a red pepper. Prepare a wet-mount slide using water.

Can you see the chromoplasts? Sketch them.



Specimen: _____

Magnification: _____

Shape and Description: _____

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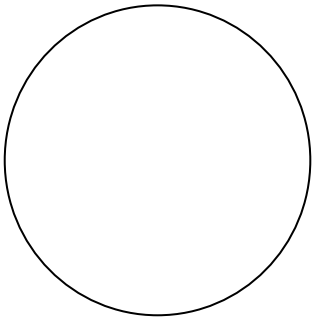
7. *What do you think might be the function of chromoplasts and their stored pigments?*

Part 1: Examining Animal Cells

Animal cells can be studied using the light microscope, but most of the cellular organelles within the cytoplasm are not visible without the use of special staining techniques. The **nucleus** and **nucleolus,** where ribosomes are manufactured, are usually apparent in most cells.

Lab 2 Cells

Prepare a wet mount slide of your cheek cells. You will examine cheek cells obtained from your mouth. Instructions for obtaining and staining the cheek cells will be provided by your instructor. Sketch a few cells, at different magnifctions (you may choose the magnifications) and label the plasma membrane, nucleus, and cytoplasm



Specimen: _____

Magnification: _____

Shape and Description: _____

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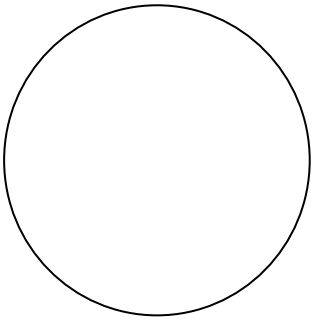

Specimen: _____

Magnification: _____

Shape and Description: _____

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1. Are human cheek cells **prokaryotic** or **eukaryotic**? How do you know?

2. What cellular macromolecule does **Methylene blue** bind to most strongly? Because of what it binds to, what organelle does Methylene blue 'highlight' or stain?

3. Do the cells you observe have a cell wall? _____ Plastids? _____ Chlorophyll? _____

4. List the similarities and differences between the plant cells and the animal cells you have observed.

Similarities	Differences

REVIEW: For the lab quiz, be able to recognize, describe, and label the different types of cells we have examined today. Emphasize the similarities and differences between the different cell types.