Biology 13A Lab #3: Cells and Tissues

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Expected Learning Outcomes
At the end of this lab, you will be able to
- list the major components of a eukaryotic cell;
- explain the functions of organelles;
- explain how tissues are prepared and viewed under the microscope;
- identify and draw examples of the four main tissue categories; and
- explain features and functions of main tissue groups.

Figure 3.1 Eukaryotic Cell
Introduction

All living beings are composed of cells, from bacteria, to seaweed and redwood trees, to humans. The unity of life has been resoundingly demonstrated by observations that all cells function in remarkably similar ways. They all contain DNA, the hereditary information that determines cellular structure and function.

There are two main divisions in the living world—prokaryotic cells and eukaryotic cells. Prokaryotic organisms are bacteria; most other organisms including protists, plants, animals, and fungi (e.g. molds and mushrooms) are composed of eukaryotic cells. Eukaryotic cells are larger and more complex, containing compartmentalized structures, organelles, which carry out specific functions.

Multicellular organisms have groups of eukaryotic cells that work together to perform complex functions—these are tissues. Thus, cells and tissues are the fundamental structures of complex creatures like ourselves. We will explore cells and tissues in lab today.

Check Your Understanding: Answer the following questions based on your reading of the introduction.

1. What do all living things have in common?
2. What kinds of organisms are composed of prokaryotic cells? Eukaryotic cells? What kinds of cells do humans have?
3. What are tissues?

Activity 1: Eukaryotic Cell Structure

The three main geographical features of a eukaryotic cell are the plasma membrane, the cytoplasm, and the organelles. The plasma membrane is the boundary of the cell, composed primarily of phospholipids. The membrane limits what may go in and out of the cell. The specific functions and characteristics of cells are determined partly by the proteins found in their plasma membrane.

The cytoplasm is the material between the nucleus and the plasma membrane and contains the membrane-bounded organelles. The organelles are suspended in a gel-like substance called the cytosol. In a picture such as the one below, the structures seem static but when the cell is alive, literally billions of reactions and processes are occurring every minute. Molecules are being transported in and out of the cell, components are being assembled, and the cytoskeleton is a series of
highways that material races along.

Work in groups of two to three to identify the following structures on the cell model. Use your textbook to help you identify the organelles. You may also use the web to visit the Cells Alive web page (http://www.cellsalive.com/) Once there, select Cell Biology; select Plant and Animal Cell Models, then select Animal Cell. Click on cell structures in the drawing or click on the name of the structure to view information for that structure.

- Plasma membrane
- Nucleus
- Chromatin
- Nucleolus
- Mitochondria
- Smooth Endoplasmic Reticulum
- Rough Endoplasmic Reticulum
- Ribosome
- Golgi Apparatus
- Centriole
- Intermediate filaments; Microtubules
- Lysosome
Now your group has been shrunk to a size that is much smaller than a red blood cell. You are in a vehicle that enables you to travel through the blood stream and actually enter into a body cell and tour it! (A cross between the Magic School Bus and Isaac Asimov’s The Incredible Journey.) Start at #1 and end at #13. What are the structures?

Animal (Eukaryotic) Cell
Parts of the Animal Cell:

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**Answer the following questions about your journey.**

1. How do you think your vehicle entered the cell (e.g. how did you get across the plasma membrane?)
2. What is happening in #5?
3. How did you get into the area of #13?
4. What might be in #3?
5. What is produced by #4?
6. Why is #2 continuous with #1?

**Activity 2: Perspectives on Tissue Preparations**

Remember last week we made jello with pasta? This week we will use the pans of jello to visualize how tissue sections are made, and to understand the different perspectives seen in tissue sections under the microscope. Observe the sections made by
the kitchen knife. How do the different types of pasta look when they are cut in different ways?

Define **oblique**, **longitudinal**, and **transverse**. Draw examples.

### Activity 3: Tissue Drawings

**Histology** is the study of tissues and requires using a microscope. **Tissues** consist of groups of cells that perform a specific function in the body. They are like fabrics that, when woven together, form a complete body. Some tissues are specialized for support of weight, such as bone and cartilage. Others act as barriers to keep out foreign material and to retain moisture. Muscle tissues allow movement.

Each tissue has unique features that underlie its function. It is important to note the shapes of cells and how they are arranged in relation to each other. In some tissues, the cells themselves are less important for function than the material around the cells, the **matrix**. The matrix is the extracellular material. Proteins produced by tissue cells determine its characteristics. For example, the matrix of cartilage is jellylike; this means that it provides both flexibility and support.

There are four principal tissue types: **epithelial**, **connective**, **muscle**, and **nervous**.

- **Epithelial tissues** consist almost entirely of cells; that is, they have very little extracellular material. They are sheets of cells that may be only one cell deep, or may have several layers of cells. They are microscopically thin and always lie on top of connective tissue, like a thin layer of butter on a slice of bread. They have nerve endings but lack blood vessels. They form the surface of the body and line the tubes and cavities. They provide barriers against pathogens but are thin enough to allow molecules to pass through them, so are found wherever anything is secreted or absorbed or exchanged. Examples of locations include the surfaces of the lungs where O2 and CO2 are exchanged, the lining of the small intestine where nutrients are absorbed, the lining of the mouth, esophagus, vagina, and anus, and the outer layer of the skin.

- **Connective tissues** are varied. They may be very hard (e.g., bone) or liquid (e.g., blood). Connective tissues have few cells sprinkled in lots of matrix—that is, they consist mostly of extracellular material. The matrix is the main determinant of the function of the tissue. For example, bone supports weight because the matrix is mineralized. Blood transports cells and other material because the matrix is mostly water, enabling it to flow through vessels. Connective tissues that provide support include bone, cartilage, and...
dense regular connective tissue that forms ligaments and tendons. In addition, dense irregular and loose areolar connective tissues are found supporting epithelial tissues and surround organs such as blood vessels, nerves, intestines, etc. Adipose tissue is specialized for energy storage but also supports organs.

- **Muscle** tissues consist of cells that are able to shorten, or contract, to produce movement. There are three muscle tissues: **skeletal muscle**, **cardiac muscle**, and **smooth muscle**. The most abundant is skeletal muscle, the type that attaches to bone and produces typical body movements—for example, the biceps brachii in your arm allows you to flex your elbow. Cardiac muscle is found in the heart. Smooth muscle is mostly involuntary, and is found in the tubes of the body such as the digestive tract and blood vessels. It helps to move food along in the digestive process, and constricts blood vessels to help regulate blood pressure, for example.

- **Nervous tissue** is specialized to send and receive messages. 99% of nervous tissue is found in the brain and spinal cord, the rest is in the spaghetti-like nerves that extend to the periphery of the body and provide sensation and ability to move remote muscles in the hands and feet. The main feature of nervous tissue is **neurons**, cells that have extensions that reach out to gather information and send messages to other cells. In addition to neurons, various **neuroglial cells** are present. We will examine examples of the four principal tissue types.

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**Check Your Understanding:** Answer the following questions based on your reading of the introduction.

1. List the four principal tissue types.

2. Which is true?
   a. Epithelial tissues are well supplied with blood vessels.
   b. Connective tissues consist mostly of cells with little extracellular matrix.
   c. Blood is a connective tissue.

3. What category of tissue would you find lining the ear canal?
Use unlined paper to draw the following tissues. There should be four drawings per page. Label the structures that are in bold letters.

**EPITHELIAL TISSUES**

1. **Simple Columnar Epithelial Tissue**

Examine the tissue under 400X magnification. Draw 6-10 columnar cells. Locate a **nucleus, cell membrane, goblet cell, columnar cell** and label them on your drawing.

2. **Stratified Squamous Epithelial Tissue**

Examine the tissue under high power (400X). Draw the layers, including the underlying connective tissue. Locate the **squamous cell layer** at the top and the **germinating layer**. Label them.

**CONNECTIVE TISSUE**

**Osseus (Bone) Tissue**

The only example of connective tissue we will draw is osseous (bone) tissue. Examine the tissue under high power (400X). Draw a complete Haversion System (one section of concentric rings). Locate and label the following: **Lacuna, Haversian Canal, Matrix.**

**MUSCLE TISSUE**

**Skeletal Muscle Tissue**

Identify several skeletal muscle fibers under high power (400X). Note the striations. Draw 2-3 fibers. Label the **muscle fiber, nucleus, and striations.**

**NERVOUS TISSUE**

Examine the tissue under medium power (100X) and identify a neuron. At either medium (100X magnification) or high power (400X), draw a neuron and locate and label the **nucleus, cell body, and cytoplasmic extension.** The cytoplasmic extensions are either axons or dendrites but we cannot distinguish them at this level of magnification.

A useful website for examining tissues:

http://www.meddean.luc.edu/lumen/index.html