Cells- Size, Transport & Cell Reproduction Lab

Name:_____

Goal

To describe the process of diffusion. To study the phases of mitosis & meiosis and understand why these processes occur. To investigate surface to volume ratio and its impact on cell size.

Introduction

As viewed from a human perspective, nature has done some ingenious engineering to overcome some of the obstacles it has faced. Take the evolution of sex, for instance. To make the move from asexual to sexual reproduction, nature took a system by which parent cells reproduced simply by dividing (asexual reproduction) and altered it to allow two parent cells to combine to create offspring (sexual reproduction). It met this challenge by devising (again, speaking from a human perspective) a system by which parent cells incorporate genetic information from both of its parents but contain half the amount of DNA. With only half the DNA, when the parent cell combines with another parent cell, the proper amount of DNA is maintained. This solution is called meiosis.

Mitosis describes the process by which the nucleus of a cell divides to create two new nuclei, each containing an identical copy of DNA. (Cytokinesis describes the division of the rest of the cell.) Almost all of the DNA duplication in your body is carried out through mitosis. Meiosis, as described above, is the process by which certain sex cells are created. If you're male, your body uses meiosis to create sperm cells; if you're female, it uses meiosis to create egg cells. Others cells in your body contain 46 chromosomes: 23 from your father and 23 from your mother. Your egg (or sperm) cells contain only half that number -- a total of 23 chromosomes. When an egg and sperm unite to make a fertilized egg, the chromosomes add up to equal 46. During the first part of this lab you will examine the tip of an onion root and record how many cells can be seen in the different stages of mitosis.

Pre-laboratory Questions

1. On a separate, attached sheet of paper create a diagram that shows the difference between mitosis and meiosis. Label the stages of each process and identify what is happening in the cell during each stage.

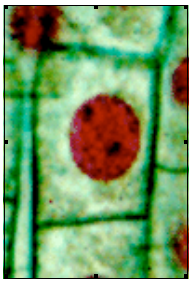
2. What cell types undergo mitosis and why does the process occur in these cells?

3. What is the purpose of meiosis? What types of cells undergo this process?

Examining Mitosis in Onion Root Tips

1. Observe every cell in one high power field of view and determine which phase of the cell cycle it is in. This is best done in pairs. The partner observing the slide calls out the phase of each cell while the other partner records. Then switch so the recorder becomes the observer and vice versa. Count at least two full fields of view. If you have not counted at least 200 cells, then count a third field of view. Record your data below.

	Field 1	**Field 2**	**Field 3**	**Total**	**Percent of Total Cells**
Interphase					
Prophase					
Metaphase					
Anaphase					
Telophase					

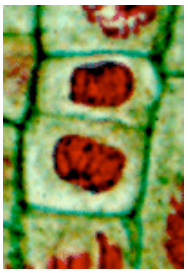


Interphase

Prophase

Metaphase

Anaphase



Telophase

Crossing the Plasma Membrane- Diffusion

Adapted from: http://biology.arizona.edu/sciconn/lessons/mccandless/

Introduction

All living things have certain requirements they must satisfy in order to remain alive. These include exchanging gases (usually CO_2 and O_2), taking in water, minerals, and food, and eliminating wastes. These tasks ultimately occur at the cellular level, and require that molecules move through the membrane that surrounds the cell. This membrane is a complex structure that is responsible for separating the contents of the cell from its surroundings, for controlling the movement of materials into and out of the cell, and for interacting with the environment surrounding the cell.

There are two ways that the molecules move through the membrane: passive transport and active transport. Active transport requires that the cell use energy that it has obtained from food to move the molecules (or larger particles) through the cell membrane. Passive transport does not require such an energy expenditure, and occurs spontaneously.

The principle means of passive transport is diffusion. Diffusion is the movement of molecules from a region in which they are highly concentrated to a region in which they are less concentrated. It depends on the motion of the molecules and continues until the system in which the molecules are found reaches a state of equilibrium, which means that the molecules are randomly distributed throughout the system.

Diffusion occurs when a system is not at equilibrium. As an example, suppose you put one drop of ink into a glass of water. At first, all of the ink molecules are in a small space and they are moving around in a random way. They move in straight lines and change direction only when they collide with each other or the surrounding water molecules. Some of the ink molecules near the edge of the drop move away from the center of the drop and spread out among the water molecules. Eventually, the ink particles will spread evently throughout the liquid, and no subvolume will be more highly concentrated with ink than any other subvolume.

Diffusion can occur through a cell membrane. The membrane allows small molecules like water (H_2O), oxygen (O_2), carbon dioxide (CO_2), and others to pass through easily. It is said to be permeable to these molecules. If a cell is floating in a water solution (like the ocean) that has some oxygen dissolved in it, the oxygen molecules will move into the cell. They will also move out of the cell at the same rate, and a dynamic equilibrium will exist. However, if the cell uses some of the oxygen as it comes into the cell, more oxygen will move into the cell than out of the cell.

So the oxygen effectively moves from a region of high concentration (the seawater) to a region of low concentration (the cell), and diffusion occurs. Likewise, as the chemical reactions in the cell use up oxygen they produce carbon dioxide. The concentration of carbon dioxide inside the cell increases so that more CO_2 molecules strike the inside of the cell and move out than strike the outside of the cell and move in. So the overall effect is that the CO_2 moves out of the cell.

Osmosis is a special case of diffusion. In this case, a large molecule like starch is dissolved in water. The starch molecule is too large to pass through the pores in the cell membrane, so it cannot diffuse from one side of the membrane to the other. The water molecules can, and do, pass through the membrane. Hence the membrane is said to be semipermeable, since it allows some molecules to pass through but not others. However, on the side of the membrane with the starch, the starch molecules interfere with the movement of the water molecules, preventing them from leaving as rapidly as they enter. Thus, more water flows into the side with the starch than flows out, and the starch gets diluted.

If the starch (or some other large molecule like a protein) is in a cell, the water moves into the cell faster than it leaves, and the cell swells. The cell membrane acts somewhat like a balloon, and if too much water enters the cell, the cell can burst, which kills the cell. So cells usually have some kind of mechanism for preventing too much water from entering or pumping the water out or simply making a tough outer coat that will not rupture.

Things are more difficult when the starch or other large molecule is on the outside of the cell. Then the cell loses water faster than it comes in, and the cell shrinks, which might not be too bad except that the cell needs the water for the chemical reactions that take place inside that keep it alive. In fact, this principle is used in food preservation. Foods that are packed in salt or sugar prevent bacterial growth by essentially sucking the water out of the bacterial cells (or, more properly, preventing water from entering the cells) and preventing their growth.

There are other ways that cells use to move materials across the cell membrane, most of which involve active transport, requiring the use of energy. The cell membrane also has other functions besides controlling the movement of materials into and out of the cell, and the membranes of specialized cells have very complex functions. So we see that the cell membrane is a very intricate and important component of the cell.

In this lab, we are going to simulate diffusion into and out of a cell using dialysis tubing and then look at the process in plant cells from the aquatic freshwater plant, *Elodea*.

Diffusion in *Elodea*

1. Prepare a wet mount of an Elodea leaf with tap water. To do this, place a drop ofwater towards one end of the slide. Using forceps, remove a small leaf from thetip of an Elodea plant and lay it flat in the drop of water. Cover with a cover slip.

2. Observe the leaf at 40X and record your observations below.

3. Repeat the procedure above with 10% salt solution.

4. Observe the cells at 40X. Record your observations.

Investigating Cell Size

Formulas:

Volume (mm^3) = length x width x height

Surface area (mm^2) = (length x width) x (6 sides)

Procedure:

1. Cut three potato cubes of the following sizes: .5 cm , 1 cm, and 2 cm.

2. Calculate the following for each potato cube using the formulas above:

	.5 cm cell	1 cm cell	2 cm cell
Surface area (cm^2)			
Volume (cm^3)			
Surface area to volume ratio			

3. **Submerge the potatoes in the iodine solution for 20 minutes.**

4. **Carefully remove the potatoes and place them on a paper towel.**

5. **Cut the potatoes in half and examine the center. Draw your observations below.**

Human Body Tissues Lab

Adapted from Human Biology, 9th Edition, Sylvia Mader

Goals

To examine various types of tissues, including: epithelium, connective, muscular, to nervous. To identify various tissues types on a prepared slide of skin and intestinal wall.

Introduction

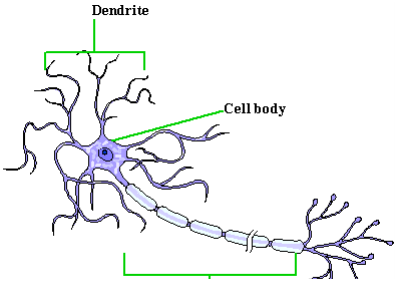
Atoms join to create molecules. Biomolecules such as protein, carbohydrates, lipids and nucleic acids join to make cells. There is a variety of cell types that have a variety of functions in your body, from protecting you from invading organisms to transmitting signals and transporting oxygen throughout your body. These cells come together to make tissues, which in turn form the organs of your body. Today in lab we are going to examine prepared slides of the four types of tissues found in the human body: epithelial tissue, connective tissue, nervous tissue and muscular tissue.

Epithelial tissue, or epithelium, is a tissue composed of cells that line the cavities and surfaces of structures throughout the body. Epithelium lines both the outside and the inside cavities and lumen of bodies. The outermost layer of our skin is composed of dead stratified squamous keratinized epithelial cells. Tissues that line the inside of the mouth, the esophagus, and part of the rectum are composed of stratified squamous epithelium. Other epithelial cells line the insides of the lungs, the gastrointestinal tract the reproductive and urinary tracts, and make up the exocrine and endocrine glands. The outer surface of the cornea is covered with fast-growing, easily-regenerated epithelial cells. Functions of epithelial cells include secretion, absorption, protection, transcellular transport, sensation detection, and selective permeability. The name of an epithelial tissue includes two descriptive terms: the shape of the cells and the number of layers. There are three possible shapes: squamous, cuboidal or columnar. With regard to the number of layers, epithelial tissue may be simple (only one layer of cells) or stratified (cell layers are placed on top of each other).

Connective tissue joins different parts of the body together. There are four general classes of connective tissue: connective tissue proper, cartilage, bone and blood. All types of connective tissue consist of cells surrounded by a matrix that usually contains fibers. Elastic fibers are composed of a protein called elastin. Collagenous fibers contain a protein called collagen. Loose fibrous connective tissue supports epithelium and also many internal organs, such as muscles, blood vessels and nerves. Its presence allows organs to expand. Dense fibrous connective tissue contains many collagenous fibers packed together, as in tendons, which connect muscles to bones, and in ligaments, which connect bones to other bones at joints.

Muscular tissue is composed of cells called muscle fibers. Muscle cells contain contractile filaments that move past each other and change the size of the cell. They are classified as skeletal, cardiac, or smooth muscles. Their function is to produce force and cause motion. Cardiac and smooth muscle contraction occurs without conscious thought and is necessary for survival. Examples are the contraction of the heart and peristalsis which pushes food through the digestive system. Voluntary contraction of the skeletal muscles is used to move the body and can be finely controlled. Examples are movements of the eye, or gross movements like the quadriceps muscle of the thigh.

Nervous tissue is found in the brain, spinal cord and nerves.



Nervous tissue is composed of two types of cells: neurons that transmit messages and neuroglia cells which assist the neurons. Motor neurons take messages from the spinal cord to muscles. They have several dendrites which take signals to a cell body where the nucleus is located and an axon that takes nerve impulses away from the cell body.

Examining Epithelial Tissue- examine prepared slides of each tissue type. Describe them using both words and drawings in the space provided.

- Simple squamous epithelium (lines blood vessels and various tracts)-

- Stratified squamous epithelium (the outer layer of the skin/epidermis, linings of the mouth, throat, anal canl, and vagina)-

- Simple cuboidal epithelium (lines kidney tubules and ducts of many glands)-

- Simple columnar epithelium (lines the digestive tracts from the stomach to the anus)-

Examining Connective Tissue- examine prepared slides of each tissue type. Describe them using both words and drawings in the space provided.

- Loose fibrous connective tissue (supports epithelium and many organs)-

- Dense fibrous connective tissue (tendons and ligaments)-

- Adipose tissue (fat)-
- Compact bone (makes up the skeleton)-

- Blood (red blood cells carry oxygen and are smaller, white blood cells fight infections and are larger)-

Examining Muscular Tissue- examine prepared slides of each tissue type. Describe them using both words and drawings in the space provided.

- Skeletal muscle (is 'striated,' has light and dark bands of actin and myosin filaments and voluntary)-

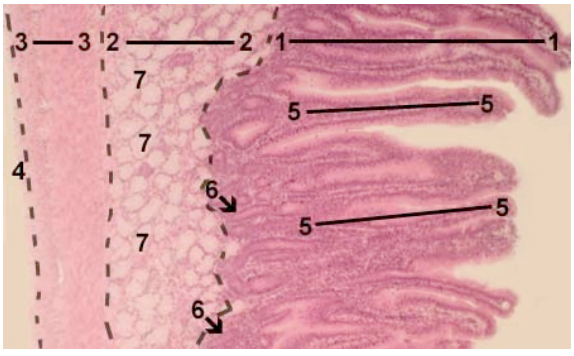
- Cardiac muscle (is only found in the heart and is involuntary)-

- Smooth muscle (makes up the walls of the internal organs, such as blood vessels and the intestines)-

Examining Nervous Tissue- examine prepared slides of each tissue type. Describe them using both words and drawings in the space provided.

Neurons (found in the brain, spinal cord and nerves)-

Tissues form Organs- study a slide of the intestinal wall and identify the following:



www.histol.chuvashia.com/../duodenum-01-l.jpg

1. Mucosa- made of columnar epilthelium. It secretes mucous and digestive enzymes. It's arranged in deep folds called villi.
2. Submucosa- made of connective tissue and contains nerve fibers, blood vessels and lymphatic vessels. The products of digestion are absorbed into these.
3. Muscularis- muscular tissue that contracts (peristalsis) to move food along the intestine.

4. Serosa- connective tissue which is part of the peritoneum that lines the entire abdominal cavity.
5. Villi- folds of the membrane which increase surface area for absorption of nutrients.

Post Lab Questions

1. List the four major types of human body tissues and the distinguishing characteristics of each.

2. Name a body location for smooth muscle.

3. Name a body location for nervous tissue.

4. What type of tissue works to move food along the digestive tract?

5. What is the scientific name for a nerve cell?

6. What type of muscular tissues is involuntary and striated?

7. Which type of epithelium has flattened cells?

8. In the potato/iodine portion of this lab the potatoes represent different cell sizes and the iodine represents nutrients. Explain why cells tend to be small in size.