Section 1: Course Success

Course Topics:
-Anatomy - structure
-Physiology - function
-Disease - Altered function (i.e. blocked blood flow)
-Health - Maintaining function (biological underpinnings of health recommendations)
Biology You Can Use:
-Consumer - health & prevention, personal medicine
-Culture - Global Impacts (like with COVID-19), local community
-Citizen - government (Medicaid), health care (political, economical, ethical considerations), and medical research (like with a vaccine)

Memory Formation:
-Memory is a physical connection between neurons (synapse)
-Neurotransmitters pass between neurons
-To help form synapses we need food and sleep
-To help make memories more effectively:

- Goal Insight - identify goals, barriers, and motivation; write down goals, then create a scaffold to outline steps of progression and potential barriers
    - Can use a journal, planner, etc.
- Trial and Error - Even if it doesn't work, you will learn and be able to improve in the future, reinforce behaviors with rewards and punishments
- Repetition - make sure to practice what you actually want to accomplish
- Reduce interferences - interferences prevent the chance of making a synapse connection

(Will talk about more when we discuss the nervous system)

Section 2: Science Discovery

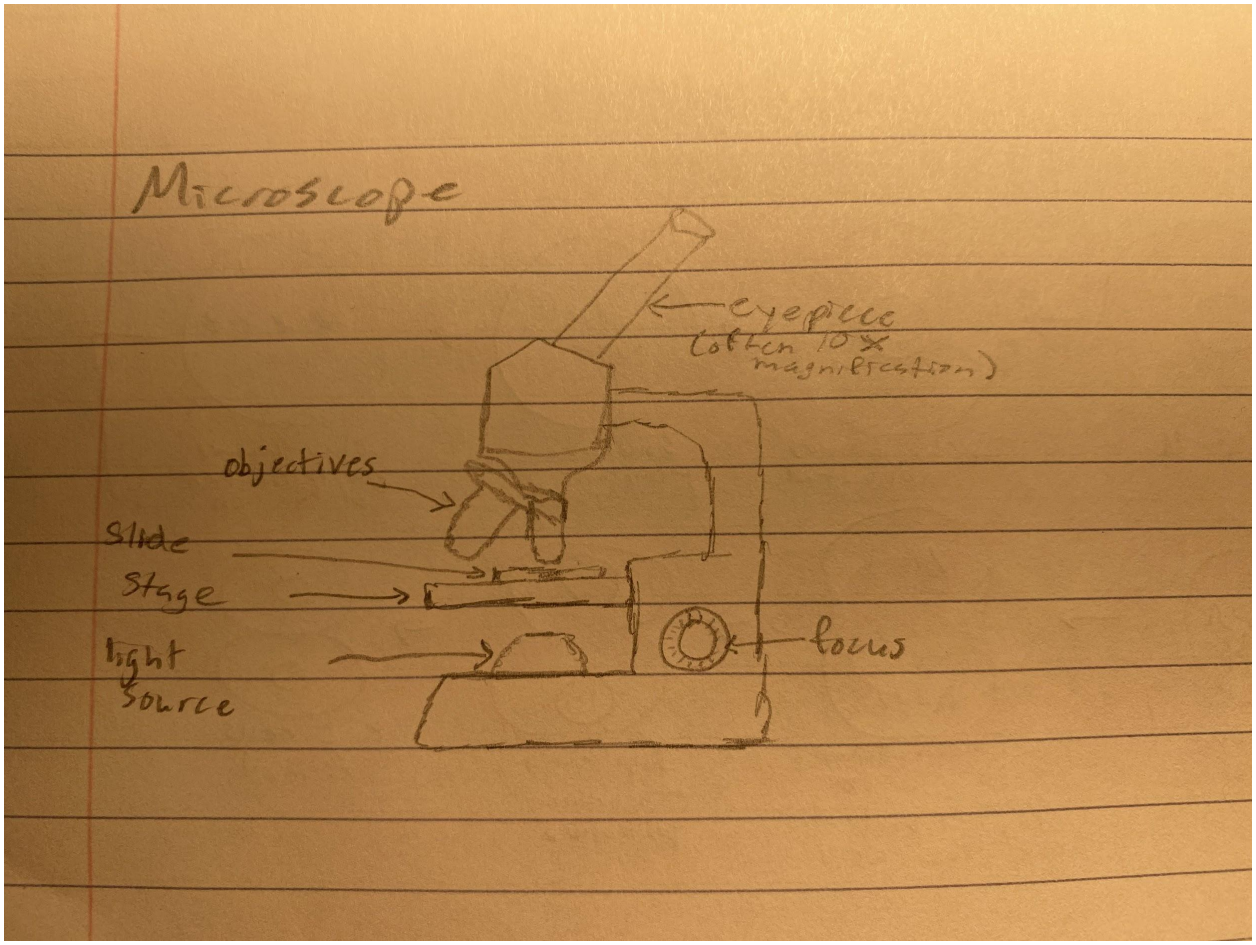
Science Discovery Includes:
-Exploration - Investigating natural phenomena you did not know about before (i.e. new location, perspective, etc.)
-Description - Details about natural phenomena (i.e. portrait, steps of process, etc.)
-Explanation - Information about how or why something happens (i.e. cause and effect, process of steps with variables)

Microscopes very typical in a biology lab setting:
-Earliest optical ("light") microscope from 1600's, 10x the naked/unaided eye

-Today microscopes have over 1500x magnification, and electron microscopes have 200,000x magnification
-Microscopic magnification is called "microscopy"

- Really just a small slice of a much larger 3D object/structure
- Magnification:
    - Eyepiece (often 10x)
    - Objective (varies, often choices ranging from 4x to 100x)
    - Final Magnification = eyepiece magnification times the objective magnification
- Magnification done by shining a bright light through thin ‾‾tissue, the image is then magnified by finely ground glasses
- Historically, often used dyes, pigments, chemicals to help bring out features (particularly clear ⊙cells) in microscope slides
    - Not used today because toxic, now known as carcinogens (cancer-causing agents)

Microscope Diagram:



⊙cells and ‾‾tissues:
-Science Matters because:

- Different fields acquire knowledge in different ways

    - Scientists acquire knowledge by conducting research of observable phenomena
        - Based on observation through sensory information (sight, taste, touch, smell, hear)
            - Such as through the use of a microscope
        - Make an inference - conclusion based on evidence and reasoning
            - Must be careful because can make a misconception - incorrect opinion or view based on faulty information or reasoning (i.e. fat free is a bad idea because many parts of body need fat to function)

-⊙cells:

- Each have a plasma ⚪membrane, organelles
- Rarely look like the model

-‾‾tissues:

- Group of ⊙cells
- Four types:
    - Epithelial ‾‾tissues - lining ‾‾tissues on the outside of organs, protect what is underneath is
    - Connective ‾‾tissues - make up many organs, have a matrix for structure
    - Muscle ‾‾tissues - allows movement of muscles, ⊙cells often have very usual shape
    - Nervous ‾‾tissues - communicate between ⊙cells to send messages throughout the body

Section 3: ⊙cell Structures

-All organisms made of ⊙cells which are similar between different species

- Unlike animal ⊙cells, plant ⊙cells have chloroplasts (for photosynthesis), vacuole (water storage), ⊙cell wall (rigged outer layer, for support)
- ⊙cells and organelles within maintain homeostasis or balance in the body
- Some organelles:
    - Nucleus (brain or control-center of the ⊙cell) - contains ⊙cell's genetic material (chromosomes), large ⊙cells (like skeletal muscle ⊙cells) can have several nuclei
    - Endoplasmic Reticulum
        - Rough endoplasmic reticulum (RER) produces protein (has ribosomes on it)
        - Smooth endoplasmic reticulum (SER) produces lipids and more (other materials the ⊙cell needs)
    - Lysosome - have ⚪membrane, has enzymes that break down bacteria, old organelles, and other unneeded substances
    - Plasma ⚪membrane - on outside of ⊙cell to protect from environment
    - Mitochondrion (powerhouse of the ⊙cell) - produces energy-rich ATP molecules, can be many in a ⊙cell

    - Cytoskeleton (cytoplasm) - area between organelles, has scaffolding of fibers to provide structure
    - Golgi Complex (factory in the ⚆cell) - amino acid chains from endoplasmic reticulum processed to make functioning proteins
    - Centriole - move ⚆cell parts when the ⚆cell divides
    - Vesicle - contains substances produced by the ⚆cell (i.e. hormones) and secretes them at the plasma ⚪membrane
- Proteins made in RER, sent to Golgi Apparatus to be processed

Call Structure Quiz:

A. Nucleus - contains ⚆cell's genetic material, including the chromosomes
B. Rough endoplasmic reticulum - produces proteins
C. Smooth endoplasmic reticulum - produces lipids and more
D. Golgi Complex - processes amino acid chains to make functioning proteins
E. Functioning proteins - made in RER then sent to the Golgi Complex to be processed
F. Mitochondrion - produce energy-rich ATP molecules

Process of Diffusion:

-Plasma ⚪membrane is the barrier the ⚆cell and the environment
- It must let some things move into (beneficial materials), move out of (harmful materials), and block from moving into the ⚆cell

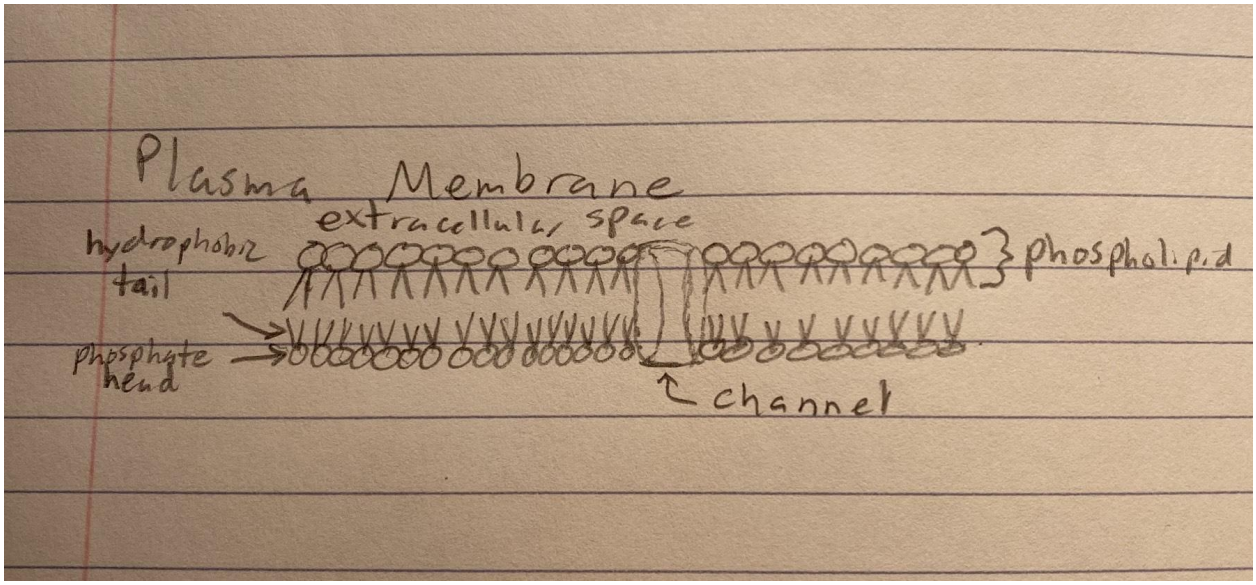
-Diffusion - moving from high concentration to low concentration

-Simple Diffusion - substances move down concentration gradient, if concentration lower inside ⚆cell then they move inside

-Protein Assistance - proteins assist substance movement
- Facilitated diffusion - move through channel or bounce through a protein to move through ⚪membrane, NO energy required
- Active Transport - move through channel from LOW concentration to HIGH concentration, requires energy

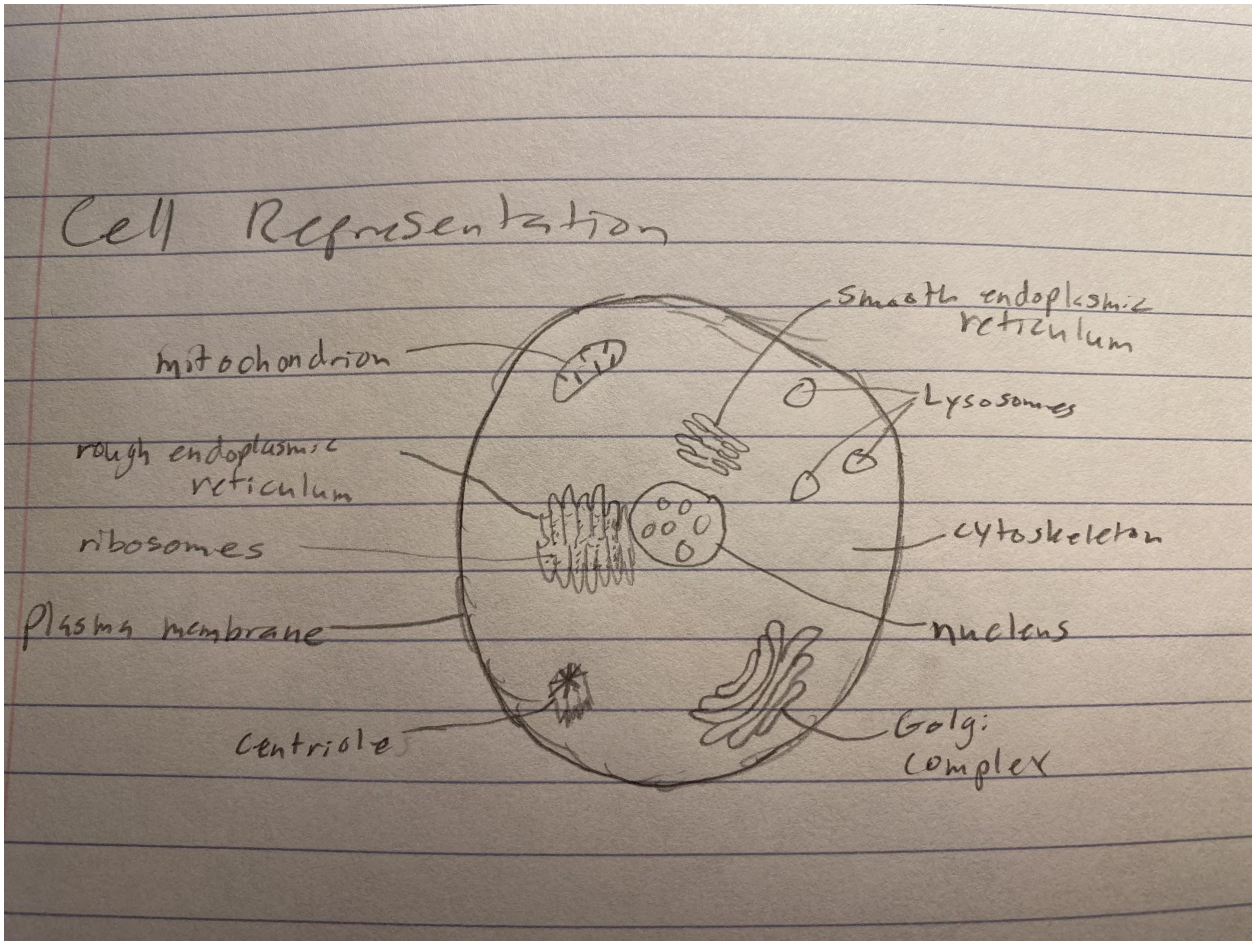
-⚪membrane has two layers of molecules (phospholipids)
- Each phospholipid has a head and a tail that points towards the other layer

- Diagram:



- Heads water soluble while tails water insoluble
- Can be a protein (channel) that passes through both layers of phospholipids, allowing for molecules to move into and out of the ⊙cell
    - Aquaporin channel allows water to move into the ⊙cell
    - Larger protein channels can allow larger molecules (like glucose) to move into the ⊙cell
    - Sometimes channels need help from energy (ATP) allowing for sodium potassium to move into the ⊙cell
        - Need higher concentration of sodium potassium inside the ⊙cell than outside of it

⊙cell Diagram:



Section 4: ⊙Cell Lives

⊙cell structures:

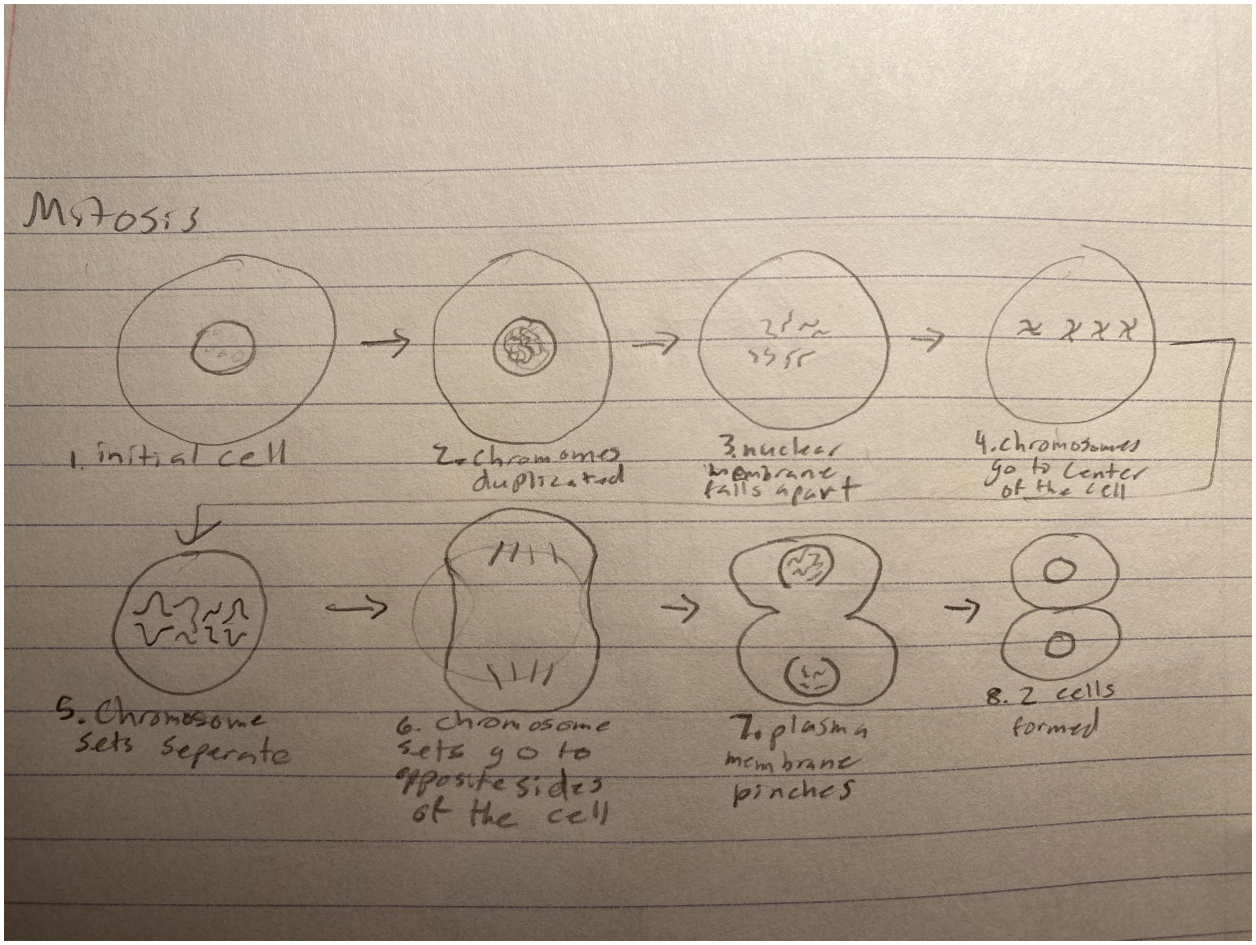
- Cheek ⊙cells are squamous (flattened) epithelial ⊙cells, which are similar to the rounded "generic" ⊙cells in the model
- Fertilized Egg - larger, contains nutrients for the ⊙cells that it will divide into after fertilization
- Sperm ⊙cell - made for finding and transporting genetic information to the egg ⊙cell, only in males
- Fat (adipose) ⊙cell - organelles pushed to side, fat stored within these ⊙cells
- Red blood ⊙cell - concave, no nucleus so it can travel through small blood vessels (capillaries), lots of surface area to hold oxygen
- Neuron - part of nervous system, branched (synapses) to make connections with other neurons
- Skeletal Muscle ⊙cell - long, striations are points of contraction

- Intestinal Lining ⚆cell - absorbs nutrients at the top (so can get into blood stream for other ⚆cells), thin, organelles protected by being further away from surface area, in a hostile environment (because acids involved in digestion)

⚆cellular Life Stages:

- Mitosis - one ⚆cell divides into two daughter ⚆cells
    - Chromatin duplicated (two sets of chromosomes), nuclear ⚪membrane falls apart, chromosomes line in middle of ⚆cell, two sets separate and go to different ends of ⚆cell, plasma ⚪membrane "pinches" in middle while new nuclear ⚪membranes form around each set of chromosomes, two ⚆cells formed each with own chromosomes and organelles
- Hypertrophy - ⚆cell grows in size over time
- Differentiation - ⚆cell changes its structure and function over time
- Apoptosis - ⚆cell is programmed to die at a certain time

Mitosis Diagram:



Course Objectives:

1. Define the four course topics; explain how biology has a consumer, cultural, and citizenry context; and describe strategies you can use to improve learning within this course.

- The four course topics are anatomy or structure, physiology or function, disease or altered function, and health or maintaining function.
- Biology has a consumer context because it affects the way we make decisions about our health and medicine choices to prevent disease and maintain normal function. Biology also has a cultural context because it can have global impacts, like in a pandemic, but also more local impacts, like in an epidemic. Finally, biology also has a citizen function because it has an impact in government decisions and programs, healthcare considerations, and medical research.
- To improve my learning both in and out of this course, I should consider doing four things. First, I should identify my goals, as well as barriers and motivation that could help or hurt my efforts towards my goals. I can record this in a journal or by using a scheduler or similar tool. Second, I should use trial and error so that I can learn from mistakes as well as reward and punish myself for making successes and failures on the way towards accomplishing my goals. Third, I should use repetition to practice to reinforce skills, but I need to be careful that I am actually practicing skills that will be helpful in accomplishing my goals. Finally, I should reduce interference so that I can increase my ability to create synapses or connections within my brain.

2. List and describe the three aspects of science discovery; explain the basics of microscope use (microscopy), including history, magnification, and the use of stains; and distinguish between the four major types of ‾‾tissues.

- The first aspect of scientific discovery is to investigate natural phenomena that you did not know about beforehand. This can be done by exploring a new location or considering something from a new perspective. The second aspect of scientific discovery is to describe this natural phenomena using details. This can be done by making a portrait or listing the steps of a process. The last aspect of scientific discovery is to explain the information about how or why this natural phenomena happens. This can be done with cause and effect or a list of steps with many variables.
- Microscope magnification is done by shining a light through the item of interest (such as ⚆cells on a microscope slide), and then magnifying the image with both an eyepiece and an objective. The final magnification value can be found my multiplying the eyepiece's magnification value by the objective's magnification value. However, some ⚆cells can be hard to view because they appear clear when a light is shined at them, so they are often stained so that they are easier to see and make observations about. The first microscope was made in the seventeenth century and had a magnification of ten times the naked or unaided eye. Today, we have microscopes that can have over 1,500 times magnification as well as atomic microscopes with 200,000 times magnification.
- There are four major types of ‾‾tissues. The first is epithelial ‾‾tissue, which serves as a lining on the outside of organs and thereby protects them. The second is connective ‾‾ tissue, which makes up organs and provides their structure. The third is muscle ‾‾tissue, which allows for movement of the muscles. And finally is nervous ‾‾tissue which allows for communication between ⚆cells and throughout the body.

3. Identify various organelles within a ⚆cell; match different ⚆cellular activities to specific organelles; and describe the structure of the plasma ⚪membrane including how it relates to diffusion.

- There are many organelles within a ⚆cell including the nucleus, endoplasmic reticulum, lysosome, plasma ⚪membrane, mitochondrion, cytoskeleton, Golgi complex, centriole, and vesicle.
- The nucleus is the brain of the ⚆cell and contains its genetic material, including the chromosomes. The rough endoplasmic reticulum has ribosomes on it and makes proteins. The smooth endoplasmic reticulum produces lipids as well as other materials the ⚆cell needs. The lysosome has its own ⚪membrane and has enzymes that break down bacteria, old organelles, and other unneeded materials. The plasma ⚪membrane surrounds the ⚆cell and protects it from the outside environment. The cytoskeleton makes up the area between organelles and has a scaffolding of fibers that provides structure. The Golgi complex creates functioning proteins using amino acid chains produced by the rough endoplasmic reticulum. The centrioles move ⚆cell parts as needed when the ⚆cell divides. The vesicle stores substances produced by the ⚆cell and keeps them secretes them from the plasma ⚪membrane.
- The plasma ⚪membrane is made up of two layers of molecules called phospholipids, which each has a head pointing outwards and a tail pointing inwards. The heads are each water soluble while the tails are water insoluble. This ⚪membrane helps move beneficial materials into the ⚆cell and harmful materials out of the ⚆cell. Substances can be diffused via simple diffusion, which is where they move from an area of high concentration to an area of low concentration without the assistance of protein. On the other hand, when protein assistance is used, two different methods of diffusion can occur. Either the materials can be diffused by using a channel, which does not require any energy; this is called facilitated diffusion. On the other hand, materials can be diffused with the use of energy to move them from areas of low concentration to that of high concentrations; this is called active transport.

4. List the steps involved in taking a ⚆cell from the body and preparing it for examination under the microscope; provide examples of ⚆cells that have different structures related to their functions; and explain different ⚆cellular life stages, including mitosis, hypertrophy, differentiation, and apoptosis.

- ⚆cells can be taken from the body, such as through the use of a cotton swab, and then placed onto a microscope slide, the ⚆cells are often stained to make them easier to see, then the cover slip is placed over the ⚆cells, as well as the other side of the microscope slide. The ⚆cells are now ready to be viewed under a microscope.
- ⚆cells often vary in structure due to their required function. A few examples include an egg ⚆cell, which is larger to contain nutrients needed for when the ⚆cell divides after fertilization, a sperm ⚆cell for finding the egg and transporting its genetic information, a fat or adipose ⚆cell which rounder to store fat, a red blood ⚆cell which is more concave in shape so that it can travel through small blood vessels or capillaries with oxygen, a neuron which is branched with synapses to make connections with other neurons for transporting information, a skeletal muscle which is very long and has striations for points of contraction, and finally the intestinal lining ⚆cell which is thinner with an area at

the top for absorbing nutrients, it also stores its organelles further away from its surface area to protect it from the hostile environment of the digestive system.

- ⊙cells can go through many life stages. In mitosis, a ⊙cell can divide into two daughter ⊙cells by first duplicating its chromosomes, then collapsing its nuclear membrane, moving the chromosomes to the middle of the ⊙cell which can then be split into two different sets that go to each end of the ⊙cell, the plasma membrane then "pinches" in the middle while new nuclear membranes form around each set of chromosomes, and finally the ⊙cell is split into two ⊙cells, each with its own pair of chromosomes and organelles. In hypertrophy, a ⊙cell grows over time. In differentiation a ⊙cell changes its structure and function over time. And in apoptosis the ⊙cell is programmed to eventually die.