3.1 Cell Theory

I. Improvements in the microscope lead to cell theory.
   A. Many scientists contributed to the cell theory.

1. **Hooke** – (late 1600’s) – viewed dead cork and called the tiny boxes he saw “cells”
2. **Leeuwenhoek** – (late 1600’s) – first to view living cells swimming in pond water
3. **Schleiden** – (1800’s) – concluded all plants are made of cells
4. **Schwann** – (1800’s) – concluded all animals are made of cells
5. **Virchow** – (1800’s) – stated all cells must come from existing cells
3.1 Cell Theory

B. The Cell theory has three principles.
   1. All organisms are made of cells.
   2. All existing cells are produced by other living cells.
   3. The cell is the most basic unit of life.
3.1 Cell Theory

C. All cells share four characteristics.
   1. Cell membrane (an outside edge)
   2. Cytoplasm (inside “filler” material)
   3. Genetic material in the form of DNA
   4. Ribosomes – makes proteins

D. Prokaryotic vs Eukaryotic Cells
   1. **Prokaryotic cells** – simple cells
      a. DO NOT have organelles
      b. DNA floats in cytoplasm
         Ex) single-celled bacteria
   2. **Eukaryotic cells** – complex cells
      a. Contain many organelles
      b. DNA located inside the nucleus
         Ex) single celled protists and yeasts; plants and animals
3.2 Cell Organelles

II. Organelles found in Eukaryotic Cells
   A. **Cytoskeleton** – made of microtubules, intermediate filaments, and microfilaments
      1. supports and shapes cell
      2. helps position and transport organelles
      3. provides strength
      4. assists in cell division
      5. aids in cell movement
   B. **Cytoplasm** – jelly-like material
      1. contains the organelles
      2. helps give the cell shape
   C. **Nucleus** – stores genetic information in the form of DNA
   D. **Nuclear Envelope** – double membrane surrounding the nucleus
      1. tiny pores allow molecules to enter/exit the nucleus
   E. **Nucleolus** – region inside the nucleus where ribosomes are assembled before they move to the cytoplasm
3.2 Cell Organelles

F. **Rough Endoplasmic Reticulum** – bumpy surface where proteins are made and then bind to ribosomes

G. **Smooth Endoplasmic Reticulum** – smooth surface where lipids are made
   1. Also acts as a transport system for the cells

H. **Golgi Apparatus** – stack of membrane sacks floating in the cytoplasm
   1. Proteins are sent here from the Rough ER for modification (usually addition of sugar chains)

I. **Mitochondria** – “Powerhouse of Cell” - bean shaped organelle
   1. Breaks down sugars to release ATP energy for the cell
3.2 Cell Organelles

J. **Vesicles** – membrane-bound sacs that hold and transport materials through the cytoplasm

K. **Vacuole** – fluid-filled sacs that hold materials
   1. Usually small in animals
   2. Extremely large in plants – holds water so the plant won’t wilt

L. **Lysosome** – contains enzymes used to digest food, kill invading bacteria/viruses, and break down worn out cell parts

M. **Cell Wall** – only found in plants, algae, fungi, and most bacteria
   1. Rigid outer layer made of cellulose that protects the cell and helps to give it shape

N. **Chloroplast** – found only in plants
   1. Contains chlorophyll which allows plants to make sugar during the process of photosynthesis
III. **Cell membrane** – barrier that separates a cell from the external environment

A. Made of a phospholipid bilayer (sandwiched together)
   1. Charged (polar) phosphate head
      a. Attracted to water
   2. Uncharged (nonpolar) fatty acid tail
      b. Wants to get away from water (hides on inside of membrane)
3.3 Cell Membrane

B. The cell membrane has two major functions.
   1. Forms a boundary between inside and outside of the cell
   2. Controls passage of materials in and out of the cell

C. There are other molecules embedded in the membrane.
   1. Proteins
   2. Carbohydrates
   3. Cholesterol
3.3 Cell Membrane

D. **Fluid Mosaic Model** – used to describe how the cell membrane is composed

1. “Fluid” – the phospholipids float side-by-side
2. “Mosaic” – similar to artwork composed of many small tiles
E. The cell membrane is **selectively permeable** - only certain things are able to pass through

1. This helps to maintain homeostasis.

2. Things that are able to pass through the membrane:
   a. Water (moves in or out as needed)
   b. Oxygen (moves in)
   c. Glucose (moves in)
   d. Carbon dioxide (moves out)

Some molecules can cross the membrane while others cannot.
3.3 Cell Membrane

F. Chemical signals are transmitted across the cell membrane.

1. **Receptors** – detect signal molecules and carry out responses
   
   a. Receptors bind with ligands and change shape.
   
   b. There are two types of receptors:
      
      1. intracellular receptor – inside of the cell – cannot cross the cell membrane
      
      2. membrane receptor – embedded in the cell membrane

2. **Ligands** – molecule that acts as a signal when bonded to a receptor
IV. Materials move across membranes because of concentration differences.

A. **Passive transport** - does not require energy input from a cell

1. **Diffusion** – movement of molecules across the cell membrane from regions of high concentration to regions of low concentration
   a. **Facilitated diffusion** - molecules can only diffuse through transport proteins

2. **Osmosis** – movement of water molecules across the cell membrane from regions of high concentration to regions of low concentration
a. The direction water moves through osmosis depends on the type of solution.

1. **Isotonic** – solution that has the same concentration as what you are comparing it to

   a. Water moves in and out at the same rate (equilibrium)
2. **Hypertonic** – solution with a higher concentration than what you are comparing it to (less water in solution)
   
a. Water moves out of the cell into the solution causing it to shrink

A hypertonic solution has more solutes than a cell. Overall, more water exits a cell in hypertonic solution, causing the cell to shrivel or even die.
3. **Hypotonic** – solution with a lower concentration than what you are comparing it to (more water in solution)

a. Water moves into the cell from the solution causing it to swell.

A hypotonic solution has fewer solutes than a cell. Overall, more water enters a cell in hypotonic solution, causing the cell to expand or even burst.
B. Active transport – requires energy input from a cell and enables a cell to move a substance against its concentration gradient. Ex) stomach builds up concentration of HCl to help digest food.

1. powered by chemical energy (ATP)
2. occurs through transport protein pumps
3. cells use active transport to maintain homeostasis
4. **Endocytosis** – active transport that takes large materials into the cell

   Ex) **phagocytosis** – engulfs solids to take into the cell
   Ex) **pinocytosis** – engulfs liquid droplets to take into the cell
5. **Exocytosis** – active transport that takes wastes out of the cell