CHAPTER 6 BIOLOGY – *A Tour of the Cell*

- **Cell Theory:**
  - All living things are made of cells.
  - Cells are the basic unit of structure and function.
  - All cells come from other, pre-existing cells.

- **Hooke** = scientist who named the cell in the mid 1600s; he used a basic microscope and saw dead cells in old bark (cork)
- **Leeuwenhoek =** scientist who took pond water and saw living cells, used a light microscope.

- **Microscopes =**

  - Light microscope = allows you to see Living cells at about 1000x the actual size
  - Electron microscope = allows you to see cell structure in far more detail (up to million times magnification, approximately); cells must be killed, however, in preparation for EM.

- **CELLULAR FEATURES OF EUKARYOTIC CELLS** (recall: eukaryotes have membrane-bound organelles, while prokaryotes do not):
  - **Plasma membrane =** thin outer covering of cell (separates inside of cell from outer environment)
  - **Organelles** = cell parts, all with specific jobs; almost all organelles are covered with their own membranes
    - **Nucleus =** holds cell's genetic material (DNA)
      - **Nuclear envelope =** porous membrane of nucleus; pores allow RNA to leave nucleus and go to ribosomes in the cytoplasm for protein production
      - **Nucleolus =** where ribosomes are made
    - **Cytoplasm –** not technically an organelle; it is the liquid in which all organelles are suspended
    - **Ribosomes =** where proteins are made
      - Some ribosomes float free in the cytoplasm and make proteins that stay in the cell.
      - Some ribosomes are attached to the ER (see below) and make proteins that eventually leave the cell.
    - **Endoplasmic Reticulum (ER) =** involved in manufacturing of some substances and in the transport of proteins
      - **Rough ER =** contains ribosomes
      - **Smooth ER =** no ribosomes, helps produce lipids
    - **Golgi =** modifies, stores, and routes proteins to their next destinations

        - The Golgi is the "post office" of the cell; it makes sure that proteins from the ER go to the correct location.
    - **Vacuoles =** store undigested nutrients (plants = have large central vacuole that stores water)
    - **Lysosomes =** contain digestive enzymes that break down waste (the lysosome is like Lysol; it has a cleaning function).
    - **Mitochondria =** energy production site
        - Glucose broken down here and the energy from the breakdown is stored in usable packets called ATP.
        - Mitochondria are highly folded structures.
    - **Cytoskeleton =** proteins within the cytoplasm that provide shape and support to the cell. (examples: microtubules and microfilaments)
    - **Flagella/Cilia =** hair like projections from the cell (extensions of the plasma membrane)
        - Cells usually have one flagellum or they have many cilia.
        - *Realize that not all cells have flagella/cilia.*
        - Assist in cell movement (like sperm cells) or in moving materials past the cell (the cilia in the airway brush junk out of the lungs, for example).
    - **Additional organelles in plants:**
        - **Chloroplasts =** where photosynthesis occurs (the process of using light energy to make food)
        - **Cell wall =** an additional border outside the plasma membrane

- **More detail on the plasma membrane:**
    - The plasma membrane is a **phospholipid bilayer** (see p. 116)
    - The phosphate heads are hydrophilic and face out into the watery exterior and in to the watery cytoplasm; the lipids are hydrophobic and stay buried in the interior of the membrane.
    - The bilayer creates a partition/wall between two watery environments and allows only certain substances to pass through; this makes the plasma membrane **semi permeable**.
    - The plasma membrane is a dynamic structure – proteins within the plasma membrane can move around, and even the phospholipids themselves can glide along the plane of the membrane.
    - Proteins inserted into the plasma membrane serve what kinds of functions?
        - Act as enzymes
        - Help cells recognize and communicate with each other
        - Form channels/tunnels for substances that would not be able to pass through the hydrophobic core of the plasma membrane on their own (water, for example, needs a protein tunnel).

- **Membranes regulate the traffic of molecules.**

- **There are several ways molecules/substances can move across the plasma membrane:**
  - **DIFFUSION =** movement of particles from where they are more concentrated to where they are less concentrated. *See p. 119, fig. 6-11.*
    - Once the number of particles on both sides of the plasma membrane is the same, the system is in **equilibrium** (balance), and the number of molecules moving in one direction equals the number of molecules moving in the opposite direction.
  - **PASSIVE TRANSPORT –** *see p. 116, fig. 6-12*
    - Transport across a plasma membrane in which NO energy is required.
    - Molecules move down their concentration gradient (from an area of high concentration to an area of low concentration)
    - One example of passive transport is diffusion.
    - **Facilitated diffusion** = a type of passive transport where a tunnel/channel/transport protein is required. This is still passive because no energy is used in the process.
    - **Osmosis =** diffusion of water.
      - **Hypertonic solution =** aqueous solution in which the solute is in higher concentration compared to the solute concentration on the other side of the plasma membrane; therefore, there is relatively less water in the hypertonic solution compared to the hypotonic solution on the other side of the membrane.
      - **Hypotonic solution =** aqueous solution in which solute concentration is lower compared to the solute concentration on the other side of the plasma membrane; therefore, there is relatively more water in the hypotonic solution compared to the hypertonic solution on the other side of the membrane.
      - **Water from the hypotonic solution will diffuse to the hypertonic solution until the solute concentrations are equal on both sides of the membrane. (*See p. 120, fig. 6-13)***
      - **Isotonic solution =** a solution whose solute concentration is equal to the solute concentration on the other side of the membrane.
      - **Why is this important?**
        - Your cells need to live in conditions in which the extracellular fluid (outside the cell) is isotonic with the intracellular fluid (inside the cell).
          - If I place red blood cells in a hypertonic solution, water will move out of the red blood cells and the cells will shrink and die.

- If I place red blood cells in a hypotonic solution, water will move into the red blood cells and the cells will swell, burst, and die.

- **ACTIVE TRANSPORT**
  - Movement of substances across a membrane in which energy is required.
  - Substances are being moved against their concentration gradient (from an area of low concentration to an area of high concentration).
  - The energy required usually comes in the form of ATP.
  - Active transport helps maintain the cell's chemical environment, especially in nerve cells.
  - *See p. 121, fig. 6-3.*
- **TRANSPORT OF LARGE MOLECULES**
  - Large molecules are packaged in **vesicles** = small, membrane-bound sacs that specialize in moving products in or out of a cell.
    - **Exocytosis =** Transportation of large molecules OUT of the cell (Exiting the cell) – see p. 122, fig. 6-17
    - **Endocytosis =** transport of large molecules iNto the cell- see p. 122, fig. 6-17.