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

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- **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:
  o **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.
  o **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.