Ch. 3 – The Cellular Level of Organization:

A cell is the basic unit of all living things.

- **Prokaryotic** cells are simple cells, pro (before) karyon ("nucleus") – they have no nucleus; most are unicellular bacteria

- **Eukaryotic cells** – complex cells w/ nucleus and sub cellular structures (organelles) containing all fungi plants and such

- **A Generalized Cell:**

    - **Plasma Membrane** – outer cells boundary, selectively permeable (regulates the flow of materials into and out of cell); role in cellular communication among cells and between cells and their external environment; separates *internal environment* (everything inside the cell) from *external environment* (everything outside the cell)

    - **Cytoplasm** – all of the other cellular contents between plasma membrane and nucleus; has 2 components: *cytosol* and *organelles*

        - **Cytosol**- fluid portion of cytoplasm, contains mostly water, dissolved solutes, & suspended particles

        - **Organelles** –(within the cytosol) each type of organelle has a characteristic shape and specific functions (eg. Cytoskeleton, ribosome's, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, and mitochondria)

    - **Nucleus** –contains the genetic library, large organelle that contains DNA in molecules called **chromosomes**; each chromosome consists of a single molecule of DNA and associated packaging proteins; a chromosome contains thousands of hereditary units called **genes** that control most aspects of cellular structure and function

- **The Plasma Membrane:**

    - Much more than just a "fence" – flexible yet sturdy, "intelligent" semi-permeable regulator that covers & protects cell, controls what goes in & comes out, links to other cells, flies certain "flags" to tell other cells "who" it is; best described by using a structural model called the *fluid mosaic model*

    - ***Fluid Mosaic Model*** – describes arrangement of molecules within the membrane: resembles a continually moving sea of fluid lipids with protein "icebergs" floating in it.

    - Lipids act as a barrier to certain polar substances, proteins act as "gatekeepers" allowing passage of specific molecules & ions

- The basic structural framework of the plasma membrane is the **lipid bilayer**- two back-to-back layers made up of 3 types of lipid molecules – *phospholipids, cholesterol, & glycolipids*

- **Phospholipids** – about 75% of membrane lipids; are lipids that contain phosphorus; form lipid bilayer – cholesterol (about 20%, a steroid with an attached –OH group) and glycolipids (about 5%; sugar-lipids; attached carbohydrate groups) also contribute

- **Integral Proteins:** extend into or through the bilayer among the fatty acid tails and are firmly embedded in it; most integral proteins are *transmembrane proteins*

    - **Transmembrane proteins** - span entire lipid bilayer and protrude into both the cytosol and extracellular fluid

- **Peripheral proteins**: not as firmly embedded in the membrane; attached to the polar heads of membrane lipids or to integral proteins at the inner or outer surface of the membrane

- **Glycoproteins:** (many integral proteins) membrane proteins with a carbohydrate group attached that protrude into the extracellular fluid (the carbohydrates are *oligosaccharides*- chains of 2 to 60 monosaccharides that may be straight or branched)

- **Glycocalyx**: the entire "sugary coating" surrounding the membrane (made up of the carbohydrate portions of the glycolipids and glycoproteins)

<u>Functions of Membrane Proteins:</u>

- Some integral proteins form **ion channels** – *pores* or holes that specific ions, such as potassium ions (K^+), can flow through to get into or out of the cell; most ion channels are *selective*; they allow only a single type of ion to pass through

- Other integral proteins act as **carriers** – selectively moving a polar substance or ion from one side of the membrane to the other (also known as **transporters**)

- Integral proteins called **receptors** serve as cellular recognition sites; each type of receptor recognized and binds a specific type of molecule (ex- insulin receptors bind the hormone insulin); a specific molecule that binds to a receptor is called a **ligand** of that receptor

- Some integral proteins are **enzymes** – catalyze specific chemical reactions at the inside or outside surface of the cell

- Integral proteins may also serve as **linkers** that anchor proteins in the plasma membranes of neighboring cells to one another or to protein filaments inside and outside the cell (peripheral proteins may also serve as enzymes and linkers)

- Membrane *glycoprotein's and glycolipids* often serve as **cell-identity markers** – may enable a cell to (1) recognize other cells of the same kind during tissue formation or (2) recognize and respond to potentially dangerous foreign cells (ex- ABO blood type markers

- Peripheral proteins help support the plasma membrane, anchor integral proteins, and participate in mechanical activities such as moving materials and organelles within cells, changing cell shape in dividing and muscle cells, and attaching cells to one another.

***Figure 3.3, page 67**

Membrane Permeability:

- Because of the distribution of lipids and the proteins embedded in it, membrane allows some substances to cross but not others; this is called **selective permeability**

- *Rule of thumb*: small, neutrally charged, lipid-soluble substances can freely pass

- ***Water is a special case*** – it is highly polar, yet still freely permeable

- For those substances that are needed by the cell but for which the membrane is impenetrable (impermeable), *transmembrane proteins* act as channels & transporters. They assist the entrance of certain substances that either can't pass at all (Glucose) or for which the cell needs to hasten passage

Transport Processes:

- **Passive Processes** - involve substances moving across the cell membranes without the input of any energy- said to move "with" or "down" concentration gradient (ex = diffusion)

- **Active Processes** - involve the use of energy, primarily from the breakdown of ATP, to move a substance uphill against its concentration gradient (ex = active transport)