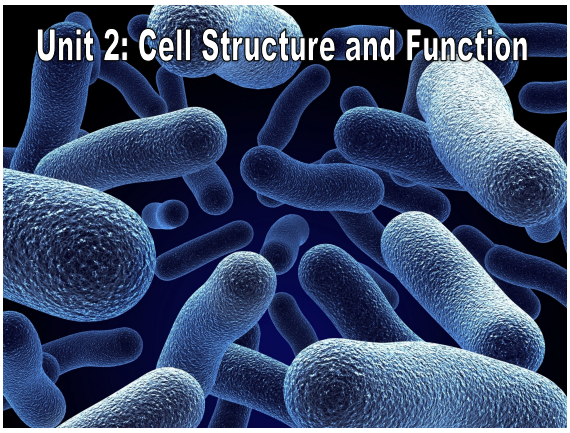


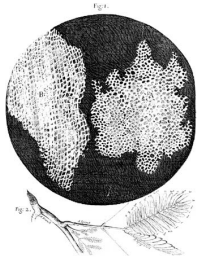
UNIT 2: Cells
Chapter 3: Cell Structure and Function

I. Cell Theory (3.1)

A. Early studies led to the development of the cell

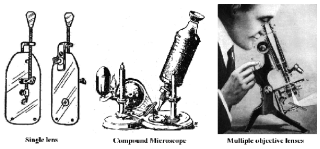
1. Discovery of Cells

a. **Robert Hooke** (1665)-Used compound microscope to look at cork cells. Gave the name "**cells**"



b. **Anton van Leeuwenhoek** (1674)- made powerful single lens microscope. One of first to look at and describe living cells

2. More was learned as **microscopes** were improved

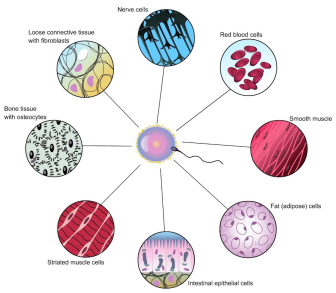


B. Development of Cell Theory

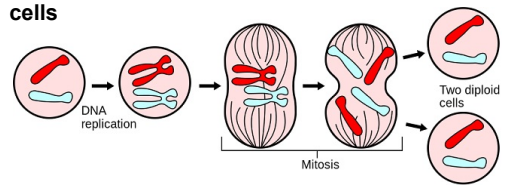
1. **Matthias Schleiden** (1838)- proposed all **plants** made of cells
2. **Theodor Schwann** (1839)- after talking with Schleiden, concluded that all **animals** were also composed of cells
3. **Rudolf Virchow** (1855)- Proposed that all cells come from pre-existing cells

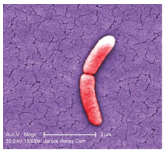
4. Accumulated research summarized as **Cell Theory** (one of first unifying concepts in biology)

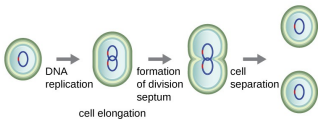
a. All organisms are made of **cells**



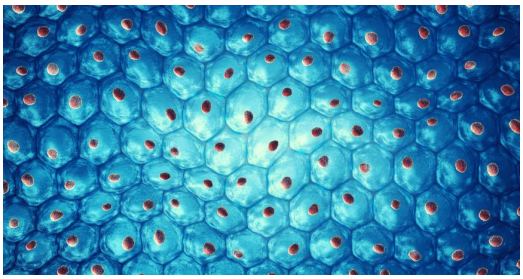
b. All existing **cells** are <u>produced</u> by other living **cells**





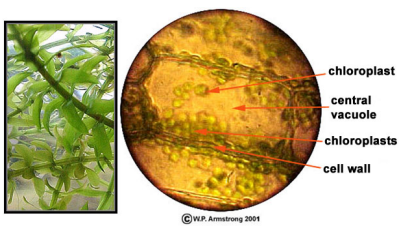


c. The **cell** is the most <u>basic unit of life</u>



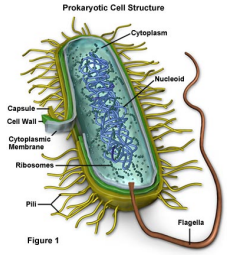
C. All cells share certain **characteristics**

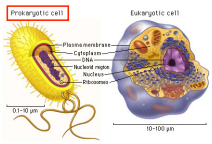
1. Cells tend to be **microscopic**
2. All cells are <u>enclosed</u> by a **membrane**
3. All cells are <u>filled</u> with **cytoplasm**



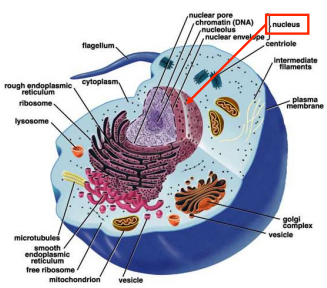
D. Cells can be separated into <u>two</u> broad categories

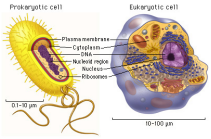
1. **Prokaryotic** cells- **<u>do not</u>** have a **nucleus** or other **membrane-bound organelles**





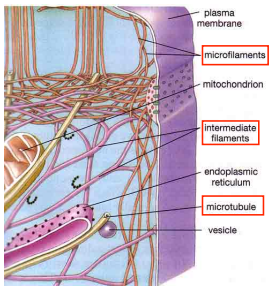
2. **Eukaryotic cells**- <u>have</u> a **nucleus** and other **membrane bound organelles**. May be single or multicellular organisms



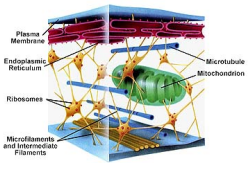


II. **Cell Organelles** (3.2)

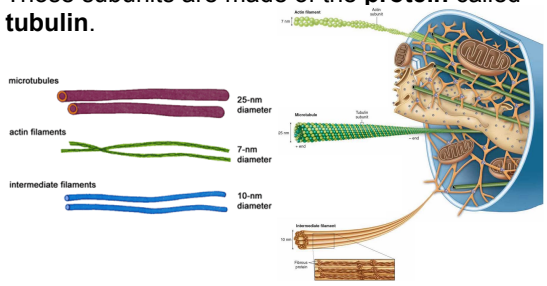
A. Cells have an **internal structure**



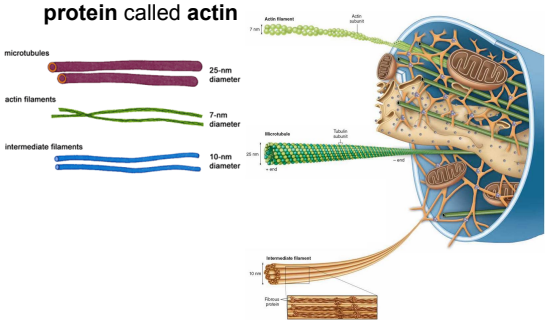
1. Each eukaryotic cell has a **cytoskeleton**



a. Supports and shapes the cell and helps position and transport organelles (**microtubules**) Made of thick, strong spirals of thousands of subunits. Those subunits are made of the **protein** called **tubulin**.

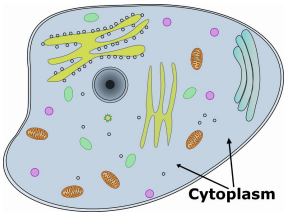


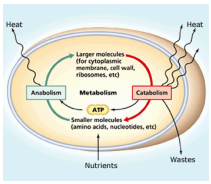
b. Provides strength (**intermediate filaments**)
c. Helps cells move and divide (**microfilaments**) Made of two intertwined strands of a globular **protein** called **actin**



2. **cytoplasm**- important contributor to cell structure

a. In eukaryotes, it fills space between nucleus and cell membrane
b. Made up mostly of **water**
c. Many chemical reactions occur in cytoplasm

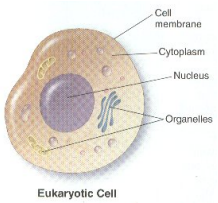




B. **Nucleus**- storehouse for **genetic material**

1. Two major demands on nucleus

a. Protects DNA
b. DNA must be available for use at proper time



Eukaryotic Cell

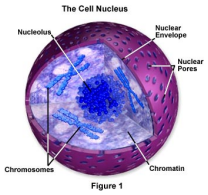
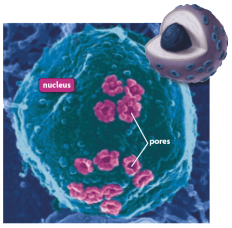
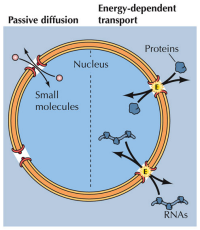


Figure 1

2. Nucleus surrounded by double membrane called **nuclear envelope**

a. Nuclear membrane pierced with holes called **pores**.
b. Allows large molecules to pass between nucleus and cytoplasm





3. Contains **nucleolus**- makes **ribosomes**

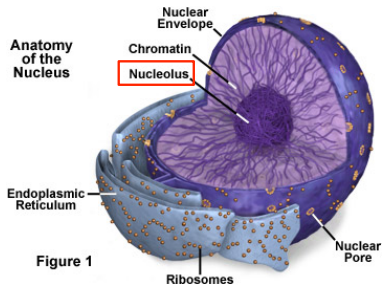
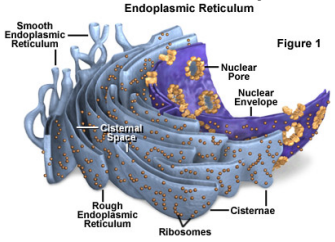


Figure 1

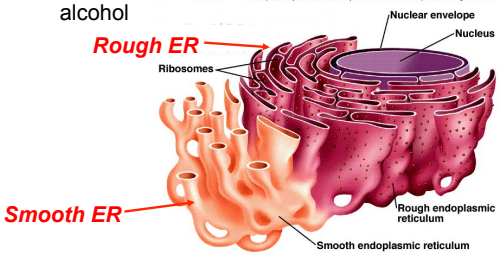
C. **Enodplasmic Reticulum** (**ER**)

1. Interconnected network of thin **folded membranes**

2. **Proteins** and **lipids** are <u>produced</u> in ER



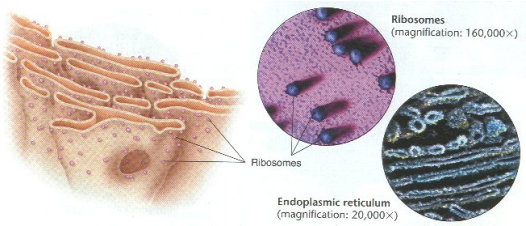
3. <u>Two types</u> of Endoplasmic Reticulum
   a. **Rough ER**- studded with ribosomes- makes proteins and lipids
   b. **Smooth ER**- no ribosomes on surface. Makes lipids and helps break down drugs and alcohol



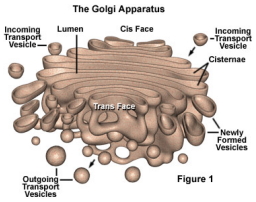
D. **Ribosomes** -composed of RNA and proteins

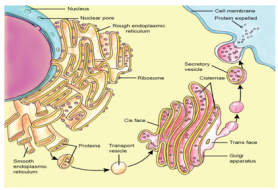
1. Site of **protein production**

2. Some bound to Rough ER and others suspended in cytoplasm

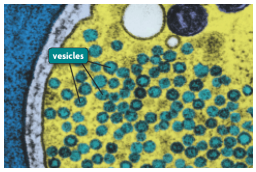


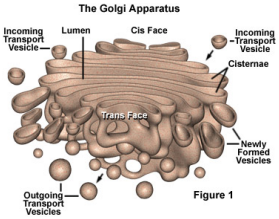
E. **Golgi Apparatus**- cells "post office"
1. Closely layered stacks of **membrane-enclosed spaces**
2. Packages **proteins** (some stored for later use)
3. Sorts and delivers **proteins**



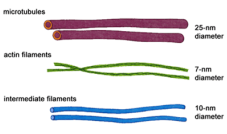


F. **Vessicles**- stores separate reactants for various chemical reactions
1. Membrane bound sacs
2. Transport materials from place to place (or for secretion)
3. Generally short lived and formed and recycled as needed



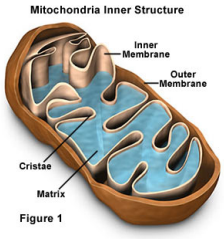


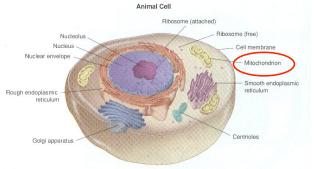
Microtubules are responsible for a variety of cell movements, including :
•Intracellular **transport** and positioning of membrane vesicles and organelles
•The separation of chromosomes at **mitosis**
•The beating of **cilia** and **flagella.** Movement along microtubules is based on the action of **motor proteins** that utilize energy derived from ATP hydrolysis to produce force and movement
- motor proteins: **kinesins** and the **dyneins**



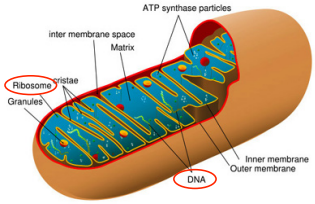
G. **Mitochondria**- cells "powerhouse"

1. Supply **energy** to cell
2. Bean-shaped with <u>two membranes</u>



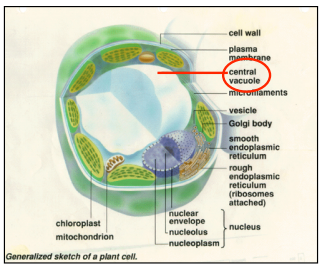


3. Series of chemical reactions inside folded inner folds <u>converts</u> **food** into usable **energy** for cell
4. Thought to have been originally free- living prokaryote because contain their own **ribosomes** and **DNA.**
5. Mitochondrion has its own independent **genome** that shows substantial similarity to bacterial genomes



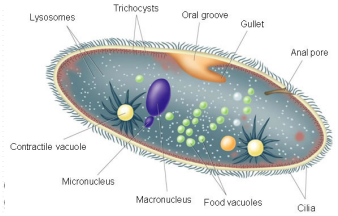
H. **Vacuole**- fluid-filled storage sac

1. Stores water, food molecules, inorganic ions, and enzymes.
2. **Plants** contain large, **central vacuole**

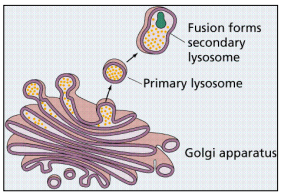


a. Takes up most of space in plant cell
b. Filled with **water** and <u>strengthens</u> the cell and helps to <u>support</u> plant
c. Plants rely on **turgor pressure** to maintain rigidity

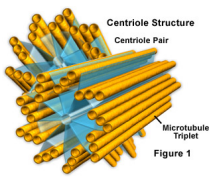
3. Animal cells contain many small vacuoles

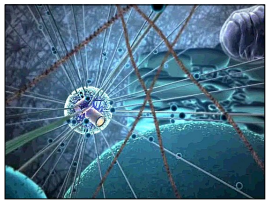


I. **Lysosome**- "suicide sacs"
a. membrane organelle containing **enzymes**
b. **Defend cell** from invading bacteria and viruses
c. Break down damaged and worn-out cell parts
d. <u>Not</u> found in **plant** cells



J. **Centrosome** and **Centrioles**
1. Small region of cytoplasm that produces **microtubules**.
2. In <u>animal cells</u>, contains two small structures called **centrioles**.
a. cylinder-shaped organelles made of short microtubules.





b. Help in **cell division** in <u>animal</u> <u>cells</u>

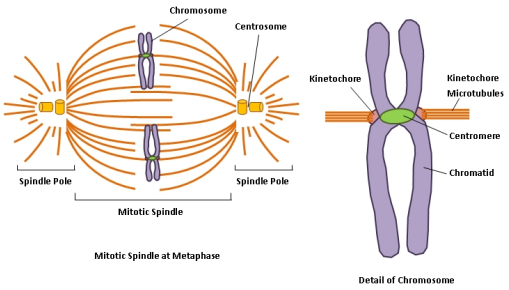
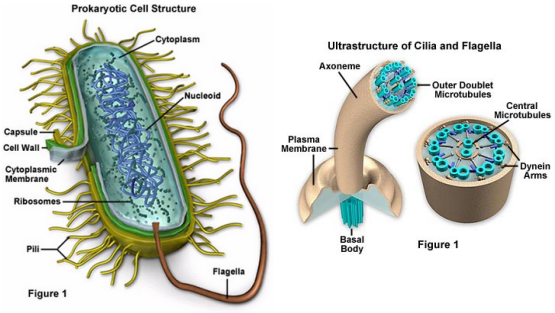


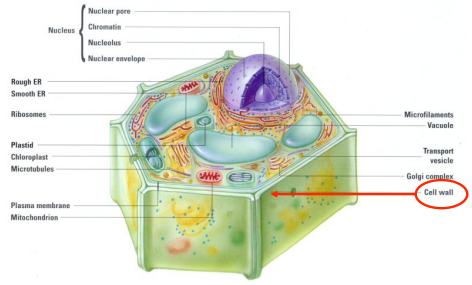
Figure 3 – Chromosomes and the Mitotic Spindle During Mitotis

c. Form **cilia** and **flagella**

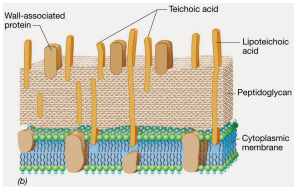


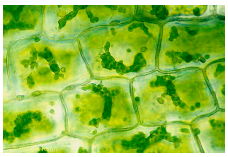
K. **Cell Walls**- found in plants, algae, fungi, and most bacteria

1. Strong rigid layer that <u>surrounds</u> **cell membrane**



2. Provides **protection**, **support**, and **shape** to cell
3. Cell wall composition varies
    a. plants- **cellulose**
    b. fungi-**chitin**
    c. bacteria- **peptidoglycan**





3. The **middle lamella** is a **pectin** layer which cements the cell walls of two adjoining cells together.
4. **Pectin** is a structural heteropolysaccharide contained in the primary cell walls of terrestrial plants.

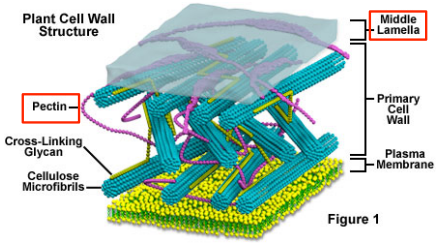
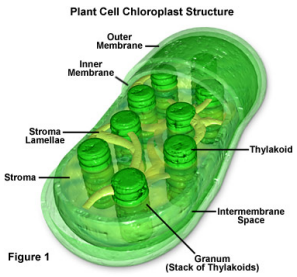
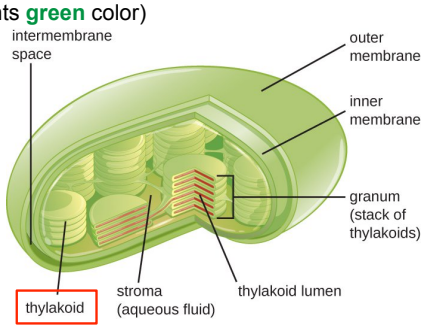


Figure 1

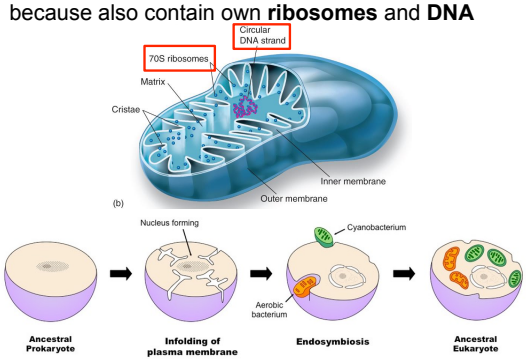
L. **Chloroplasts**- carries out photosynthesis
1. Highly compartmentalized organelle with outer and inner membranes.



2. Contain **thylakoids** (disc-shaped sacs) with light-absorbing **chlorophyll** for photosynthesis. (give plants **green** color)



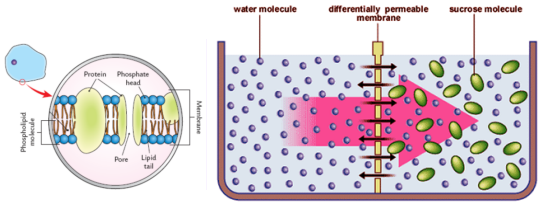
3. Also thought to be free-living prokaryote originally because also contain own **ribosomes** and **DNA**



III. **Cell Membrane** (3.3)

A. Forms <u>boundary</u> between cell and outside environment.

B. Controls passage of materials into and out of cell. Is **selectively permeable** (allows some things but not others) Helps to maintain the cells homeostasis

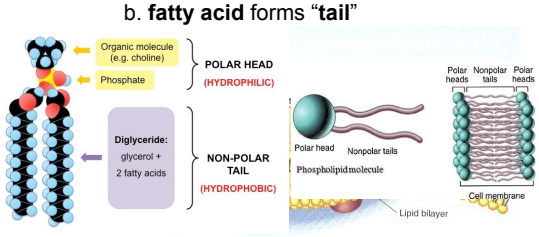


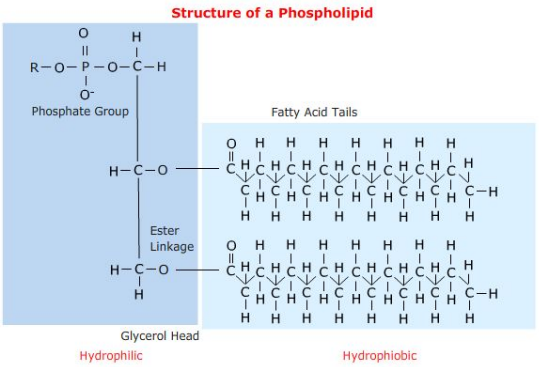
C. Consists of **double layer** of **phospholipids** interspersed with other molecules (proteins and carbohydrates)

1. **Phospholipid**- molecule composed of <u>3 basic parts</u>

a. **phosphate** and **glycerol** form "**head**"

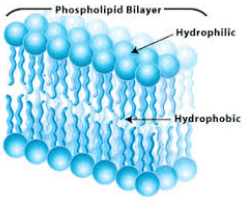
b. **fatty acid** forms "**tail**"

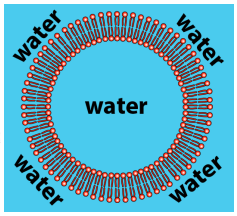




c. forms **polar** molecule (“head” hydrogen bonds to water molecules, and “tail” does not)
d. **Double layered** membrane had “heads” on outside and “tails” on inside.

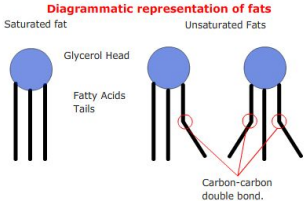
2. Forms **double layer** because of water on inside and outside of cell.

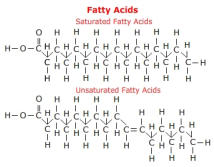




3. The length and the degree of unsaturation of fatty acid chains have a profound effect on membrane fluidity

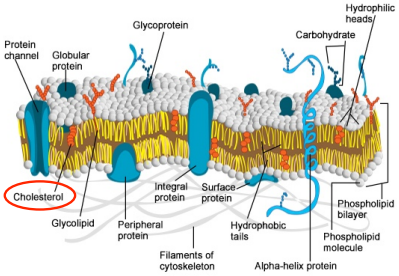
4. **Unsaturated fatty acids** create a kink, preventing the fatty acids from packing together as tightly



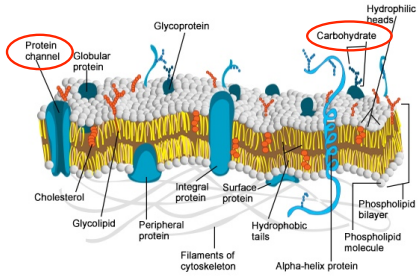


E. Other molecules are embedded with the phospholipid layers

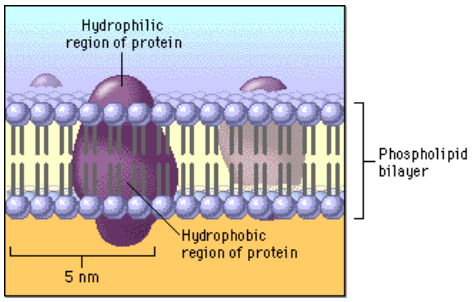
1. **Cholesterol** molecules strengthen cell membrane



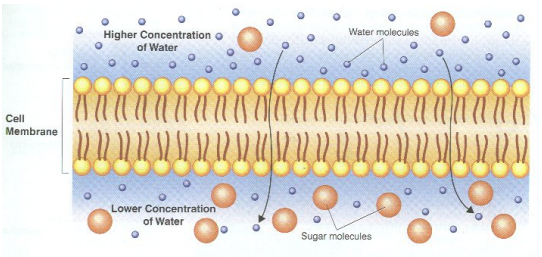
2. **Proteins** extend through membrane and form channels
3. **Carbohydrates** attached to proteins act like "identification tags"



4. **Fluid Mosaic Model**- describes arrangement of molecules in cell membrane. Flexible "<u>fluid like</u>" lipid embedded with "**mosaic**" of other molecules.

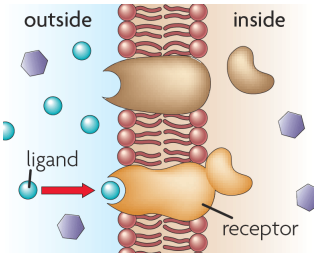


F. Molecules <u>cross</u> membrane in several ways
   1. Some methods of transport require **energy** and some do not.
   2. Depends molecules **size**, **polarity**, and **concentration** inside versus outside.



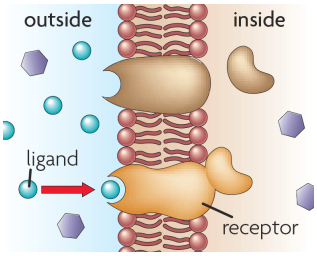
G. Cell membrane contains **receptors** that help transmit **signals** across membrane

1. Made of **proteins**
2. It <u>detects</u> a **signal** molecule and <u>performs</u> an **action** in response



3. **Receptors** bind to molecules called **ligands**.
   a. When bind, they <u>change shape</u>

   b. This **changed shape** affects how receptor interacts with other molecules



4. <u>Two types</u> of receptors
   a. **Intracellular receptors**- (means "within" cell)- can <u>interact</u> with **DNA** and start <u>production</u> of certain **proteins**

b
c
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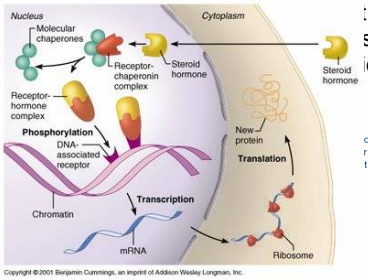
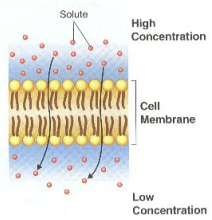


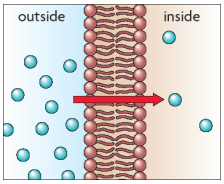
sage
ide cell

IV. **Diffusion and Osmosis** (3.4)

A. **Passive transport-** allows cell to move materials across cell membrane without using energy

1. **Diffusion**- Movement of materials (fluid or gas) from region of **high** concentration to region of **low** concentration

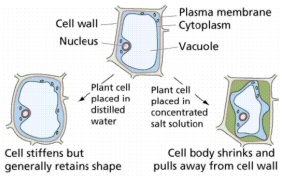


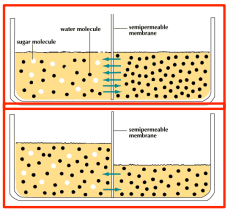


a. **Concentration gradient**- used to describe areas of high and low concentration.

b. When movement makes concentration **equal**- reaches **dynamic equilibrium** (Molecules still continue to move- **dynamic**)

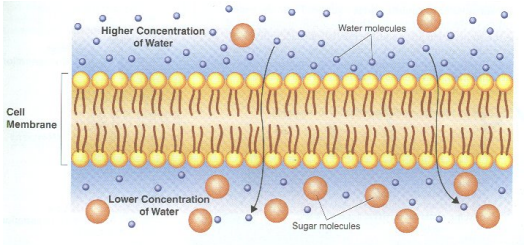
c. Diffusion plays important role in movement of **carbon dioxide** and **oxygen** molecules



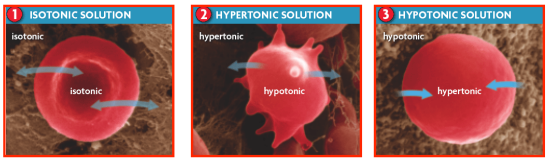


2. **Osmosis**- Diffusion of **water** molecules

a. Three terms used to describe the amount of **dissolved particles** in cell compared to **amount of water** (terms are comparisons)



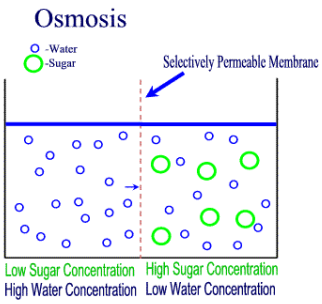
1). **Isotonic**- same concentration of dissolved materials (water moves in and out at **equal** rate)
2). **Hypertonic**- solution has higher concentration of dissolved materials (Water concentration higher in cell than outside- water moves **out** of cell
3). **Hypotonic**- Solution has lower concentration of dissolved materials (water moves **into** the cell)

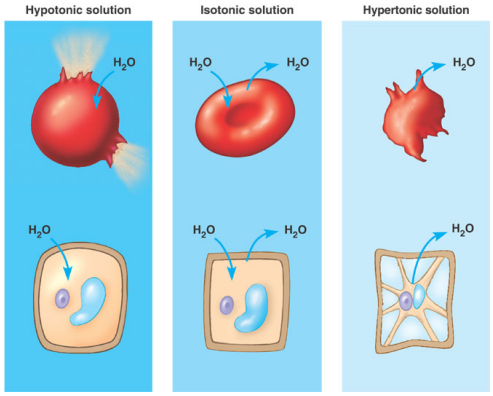


A solution is isotonic to a cell if it has the same concentration of solutes as the cell. Equal amounts of water enter and exit the cell, so its size stays constant.

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.

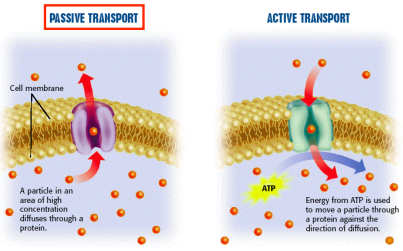
A hypotonic solution has fewer solutes than a cell. Overall, more water enters a cell in hypotonic solution, causing the cell to expand or even burst.





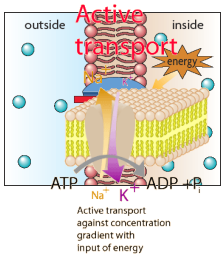
B. **Facilitated diffusion**- larger molecules can still diffuse through openings formed by **transport proteins**

1. Still form of **passive transport**
2. Many types of transport proteins- most allow only certain molecules to travel into cell



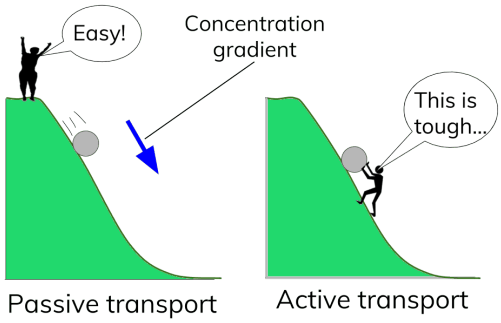
V. **Active Transport, Endocytosis, and Exocytosis** (3.5)

A. **Active Transport**- requires energy by cell to move materials in or out of cell.



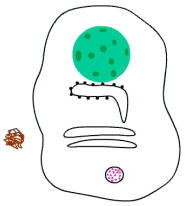
1.Can use transport proteins to move molecules against **concentration gradient** (from **low** to **high**)

2. Use energy from **ATP** molecule



B. **Endocytosis**- Movement of liquids or large molecules **into** a cell by <u>engulfing</u> them in a membrane

1. **Phagocytosis**- "cell eating"

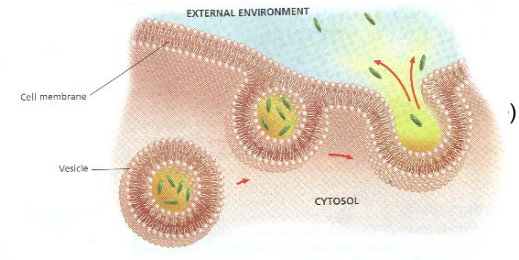


a. Key role in **immune** system (white blood cells)

b. Cell membrane make "<u>pocket</u>" around material

2. **Exocytosis**- opposite of endocytosis

a. <u>Release</u> of substances from cell



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