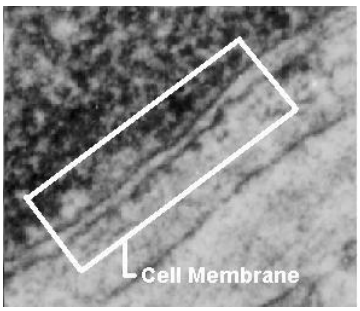
Cellular Transport Notes

About Cell Membranes

- All cells have a cell membrane
- **Functions**:
  - Controls what enters and exits the cell to maintain an internal balance called **homeostasis**
  - Provides protection and support for the cell

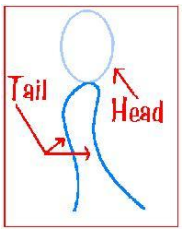


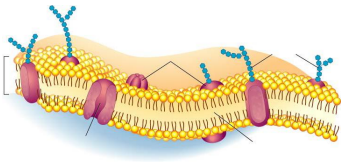
About Cell Membranes (continued)

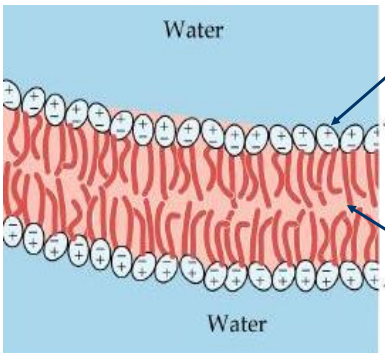
1. Structure of cell membrane

Lipid Bilayer -2 layers of phospholipids

- Phosphate head is *polar* (water loving)
- Fatty acid tails *non-polar* (water fearing)
- Proteins embedded in membrane



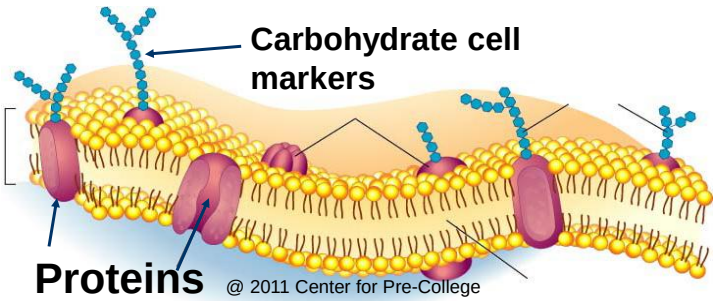




Polar heads **love water** & dissolve.

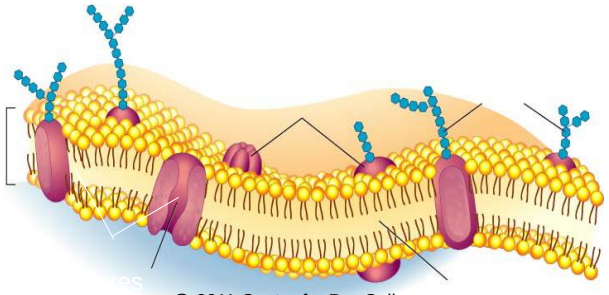
Non-polar tails **hide from water**.

Fluid Mosaic Model of the cell membrane

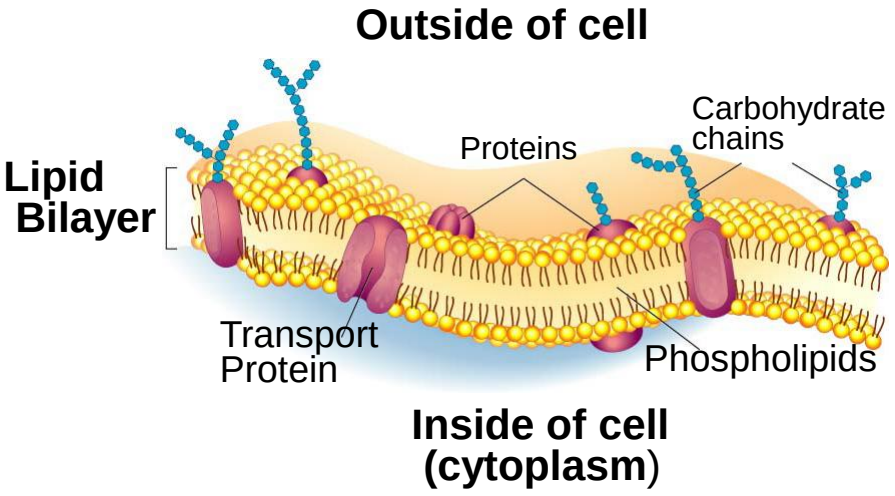


About Cell Membranes (continued)

- 4. Cell membranes have pores (holes) in it
  - **Selectively permeable**: Allows some molecules in and keeps other molecules out
  - The structure helps it be selective!



Structure of the Cell Membrane



Types of Cellular Transport

- **<u>Passive Transport</u>**

cell doesn't use energy

1. Diffusion
2. Facilitated Diffusion
3. Osmosis

- **<u>Active Transport</u>**

cell does use energy

1. Protein Pumps
2. Endocytosis
3. Exocytosis

Passive Transport

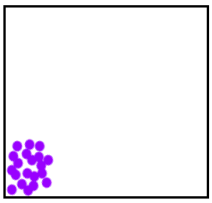
- cell **uses no energy**
- molecules move <u>randomly</u>
- Molecules spread out **from an area of <u>high</u> concentration to an area of l<u>ow</u> concentration**.
- (High→Low)
- **Three types:**

3 Types of Passive Transport

- **Diffusion**
- **Facilitative Diffusion** – diffusion with the help of transport proteins
- **Osmosis** – diffusion of water

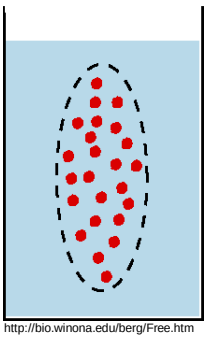
Passive Transport:
1. Diffusion

Simple Diffusion Animation



- **Diffusion**: random movement of particles **from an area of high concentration to an area of low concentration**.

(***High to Low***)



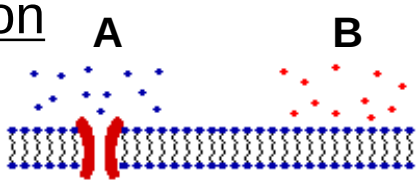
http://bio.winona.edu/berg/Free.htm

- Diffusion continues until all molecules are evenly spaced (**equilibrium** is reached)-***Note:*** molecules will still move around but stay spread out.

Passive Transport:
2. Facilitated Diffusion

2. Facilitated diffusion: diffusion of specific particles **through carrier proteins** found in the membrane

- Carrier Proteins are specific – they "select" only certain molecules to cross the membrane
- Transports larger or charged molecules



Facilitated diffusion (Channel Protein)

Diffusion (Lipid Bilayer)

Carrier Protein

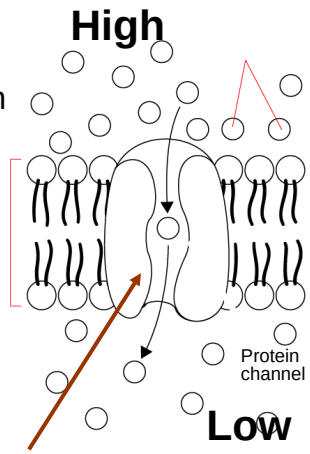
Passive Transport: 2. Facilitated Diffusion

Cellular Transport From a-

High Concentration

Cell Membrane

Low Concentration



- Channel Proteins

Transport Protein

Go to Section:

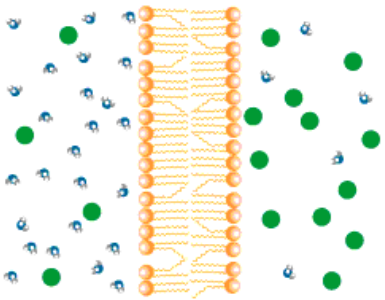
Facilitated Diffusion
Ion Channels

- Transport ions from high concentration to low concentration
- Transport ions such as Sodium (Na +) Potassium(K +), Calcium(Ca 2+), and Chloride(Cl -)
- Because ions are not soluble in Lipids, they cannot diffuse across the bilayer.
- Ion channels will open and close in order to allow specific molecules to cross the membrane.

Passive Transport:
3. **Osmosis**

- 3.**Osmosis**: diffusion of *water* through a selectively permeable membrane
- Water moves from high to low concentrations

Osmosis



Active Transport

cell **uses energy**

actively moves molecules to where they are needed

Movement **from an area of <u>low</u> concentration to an area of <u>high</u> concentration**

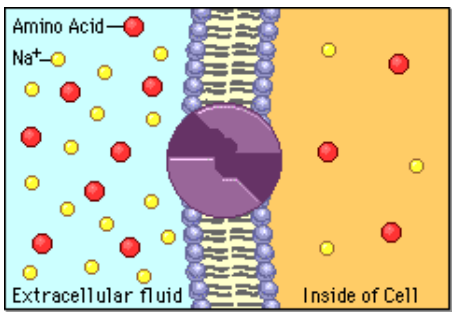
(Low → High)

- Three Types:

Types of Active Transport

Sodium Potassium Pumps

1. **Protein Pumps** - transport proteins that require energy to do work
    - Example: Sodium / Potassium Pumps are important in nerve responses.



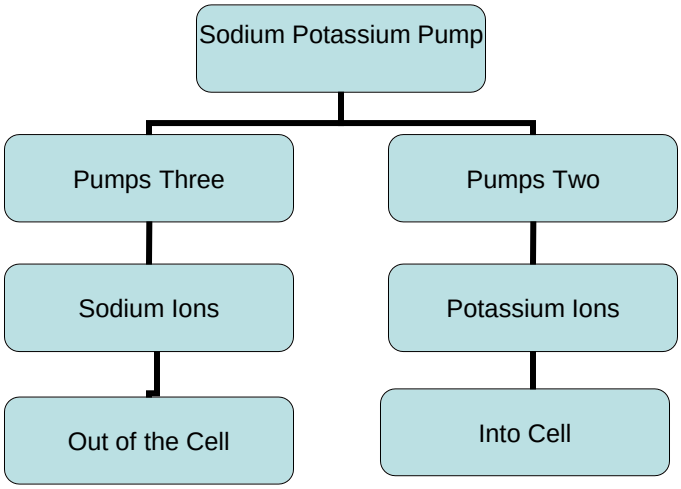
Sodium Potassium Pump

- 1. Sodium ions bind to the carrier protein on the cytoplasm side of the membrane while the carrier protein removes the phosphate group from the ATP
- 2. The phosphate group binds to the carrier protein changing its shape
- 3. The carrier protein carries the three sodium ions across membrane and forces them into the environment

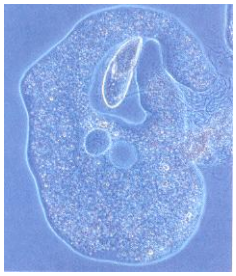
Sodium Potassium Pump Continued

- 4. The carrier protein now has the correct shape to carry two potassium ions across the membrane and into the cell; the potassium ions bind to the carrier proteins
- 5. The phosphate group (from the ATP earlier) is released, and the carrier original shape is restored
- 6. This causes the potassium ions to be released into the cytoplasm

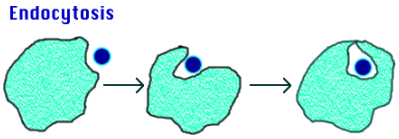
Sodium Potassium Pump

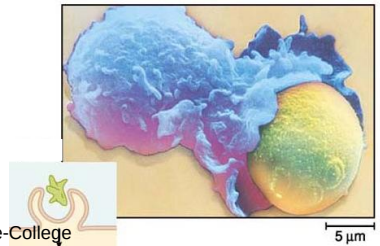


Types of Active Transport



- 2. **Endocytosis**: taking bulky material into a cell
  - Uses energy
  - Cell membrane in-folds around food particle
  - "*cell eating*"
  - forms food vacuole & digests food
  - This is how white blood cells eat bacteria!

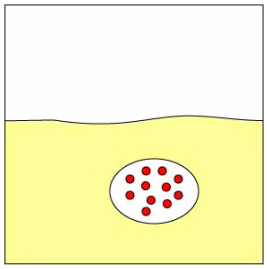




Types of Active Transport

3. **Exocytosis**: Forces material out of cell in bulk
   - membrane surrounding the material fuses with cell membrane
   - Cell changes shape – requires energy
   - EX: Hormones or wastes released from cell

Endocytosis & Exocytosis



Effects of Osmosis on Life

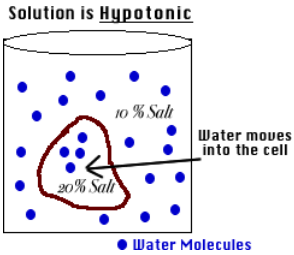
- Osmosis- diffusion of water through a selectively permeable membrane

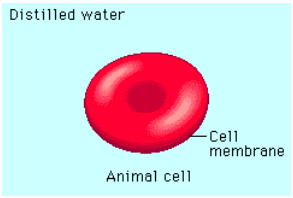
- **Water is so small and there is so much of it the cell can't control it's movement through the cell membrane.**

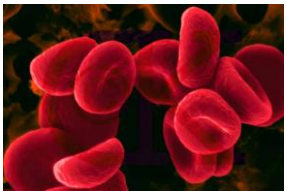
- Osmosis

Hypotonic Solution

Hypotonic: The solution has a lower concentration of solutes and a higher concentration of water than inside the cell. **(Low solute; High water)**





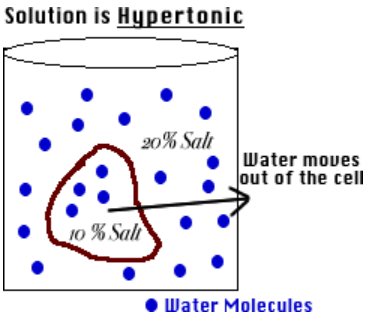


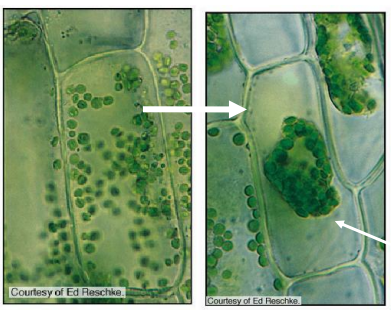
Result: Water moves from the solution to inside the cell): Cell Swells and bursts open (*cytolysis*)!

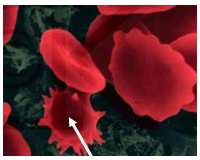
- Osmosis

Hypertonic Solution

Hypertonic: The solution has a higher concentration of solutes and a lower concentration of water than inside the cell. **(High solute; Low water)**







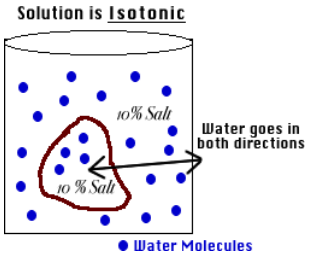
shrinks

Result: Water moves from inside the cell into the solution: Cell shrinks (*Plasmolysis*)!

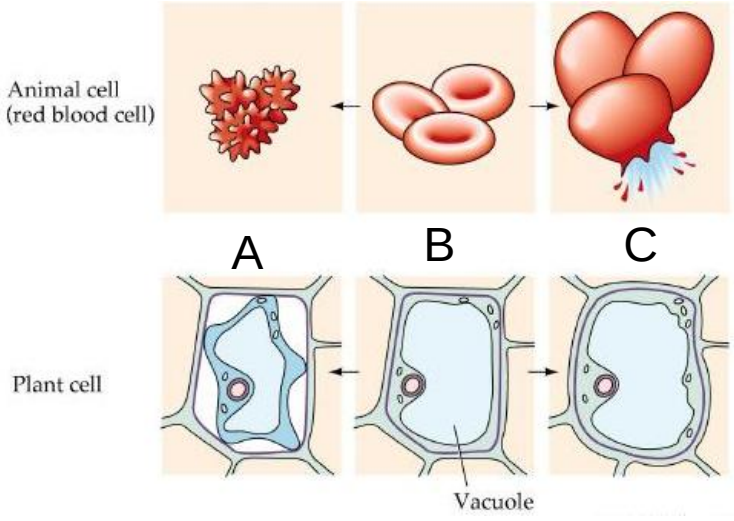
- Osmosis

Isotonic Solution

Isotonic: The concentration of solutes in the solution is equal to the concentration of solutes inside the cell.



Result: Water moves equally in both directions and the cell remains same size! (Dynamic Equilibrium)



How Organisms Deal with Osmotic Pressure

- Bacteria and plants have cell walls that prevent them from over-expanding. In plants the pressure exerted on the cell wall is called tugor pressure.

A protist like paramecium has contractile vacuoles that collect water flowing in and pump it out to prevent them from over-expanding.

- Salt water fish pump salt out of their specialized gills so they do not dehydrate.

- Animal cells are bathed in blood. Kidneys keep the blood isotonic by remove excess salt and water.