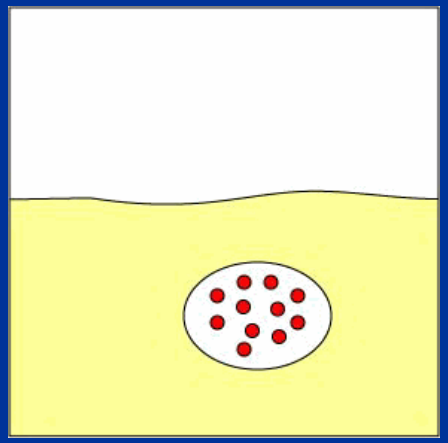
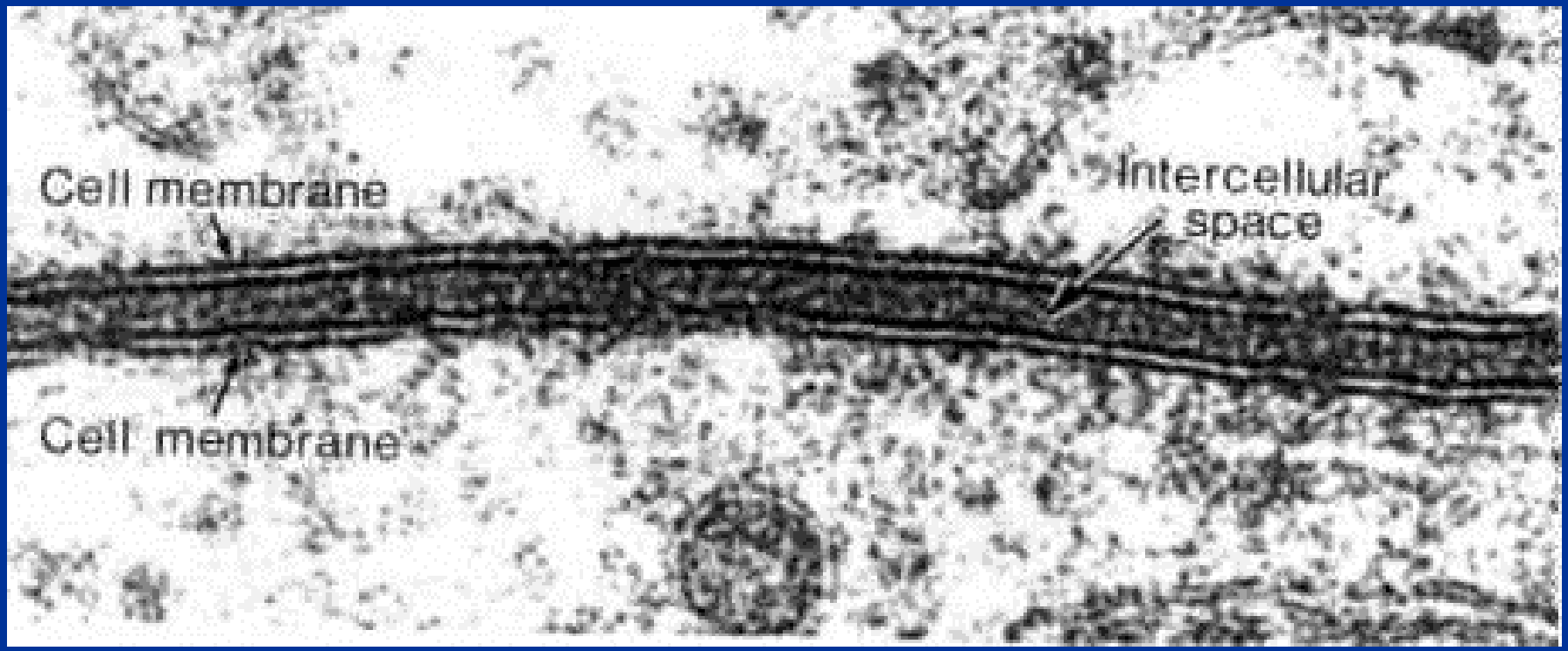
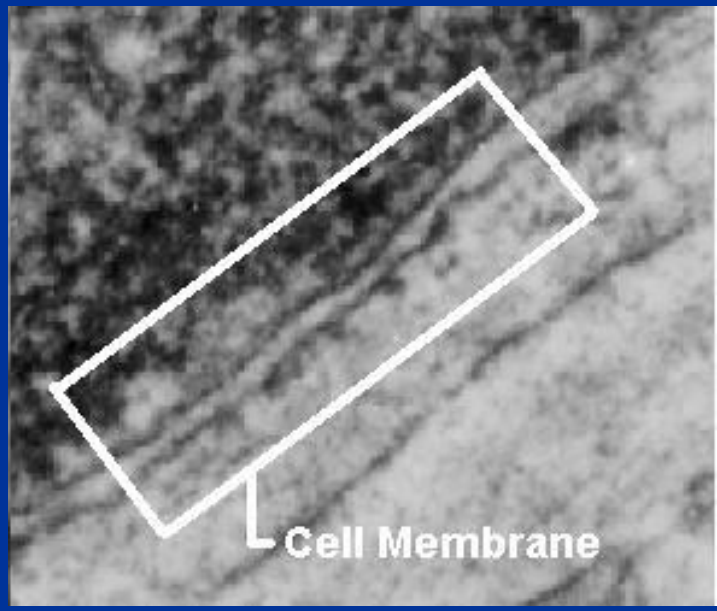
Cellular Transport Notes





About Cell Membranes

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



About Cell Membranes (continued)

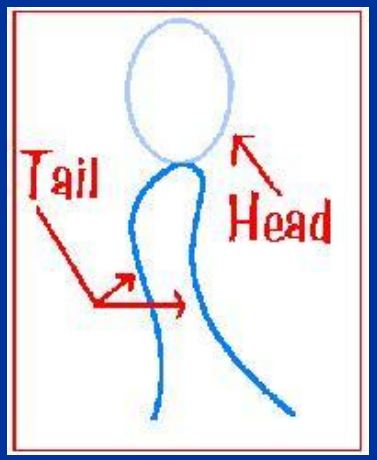
3. Structure of cell membrane

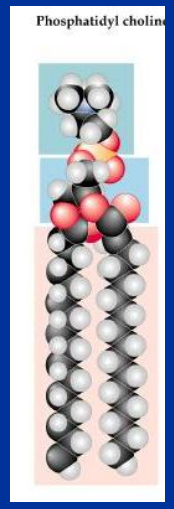
Lipid Bilayer -2 layers of phospholipids

a. Phosphate head is *polar* (water loving)

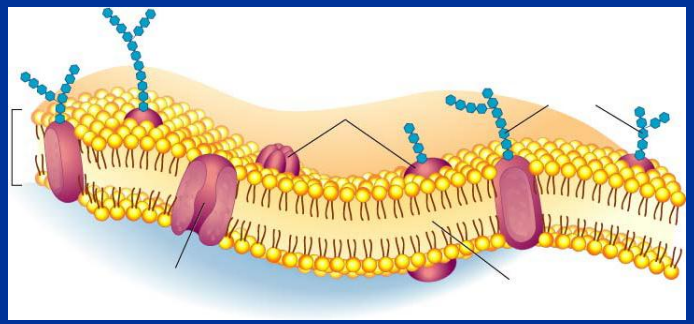
b. Fatty acid tails *non-polar* (water fearing)

c. Proteins embedded in membrane





Phospholipid

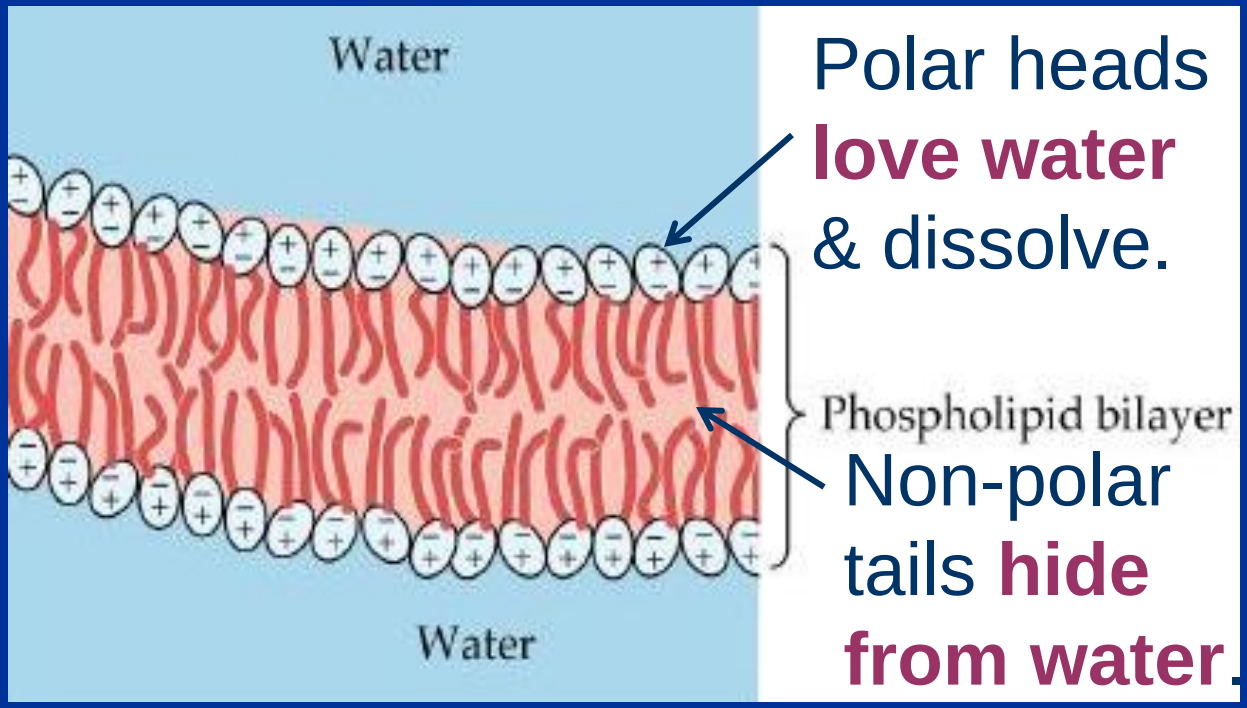


Lipid Bilayer

- **A. Channel proteins** - a protein that allows a particular molecule or ion to freely cross the membrane as it enters or leaves the cell.
  B. Carrier proteins - a protein that selectively interacts with a specific molecule or ion so that it can cross the cell membrane to enter or exit the cell.

- **C. Receptor proteins** - A protein that has a specific shape so that specific molecules can bind to them. The binding of a molecule, such as a hormone, can influence the metabolism of the cell.
  D. Enzyme proteins - An enzyme that catalyzes a specific reaction.
  E. Cell-recognition proteins - glycoproteins that identify the cell. They make up the cellular fingerprint by which cells can recognize each other

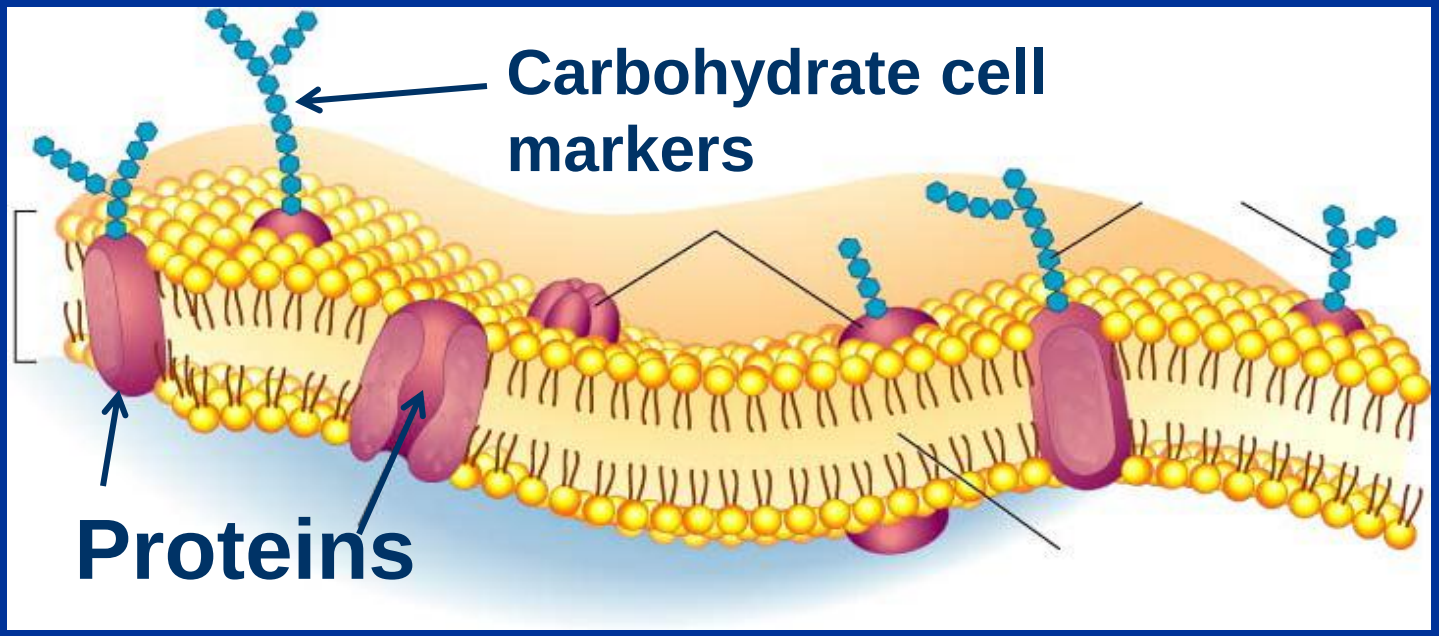
Fluid Mosaic Model of the cell membrane



Polar heads **love water** & dissolve.

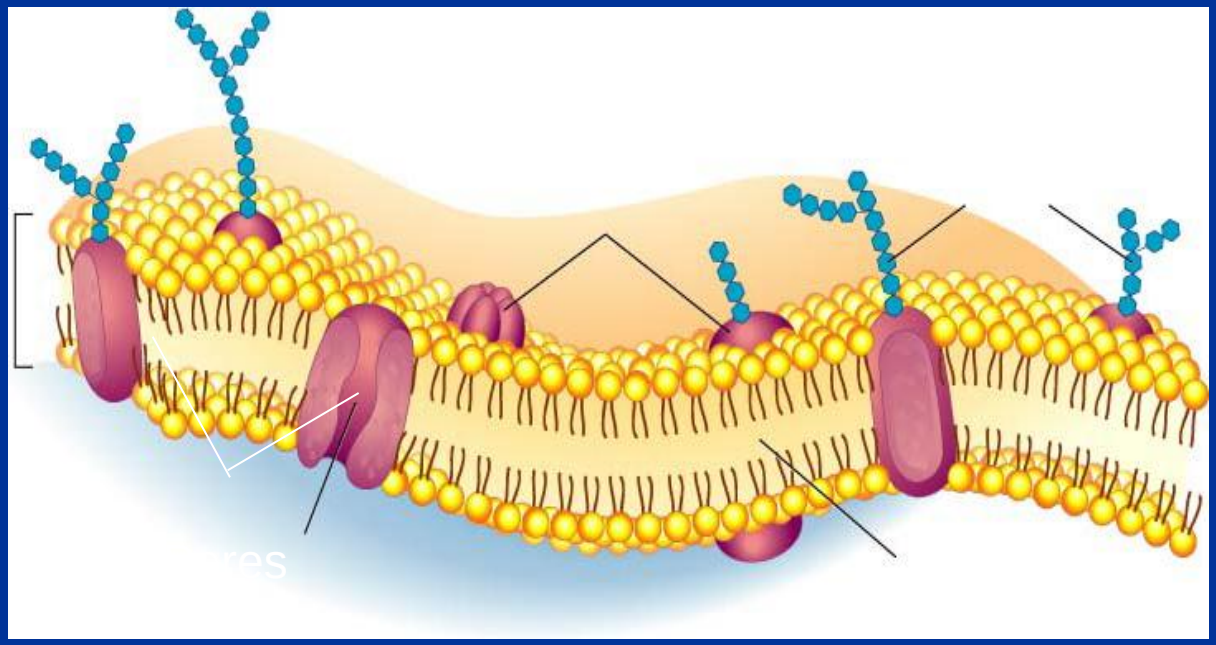
Non-polar tails **hide from water**.

Membrane movement animation



About Cell Membranes (continued)

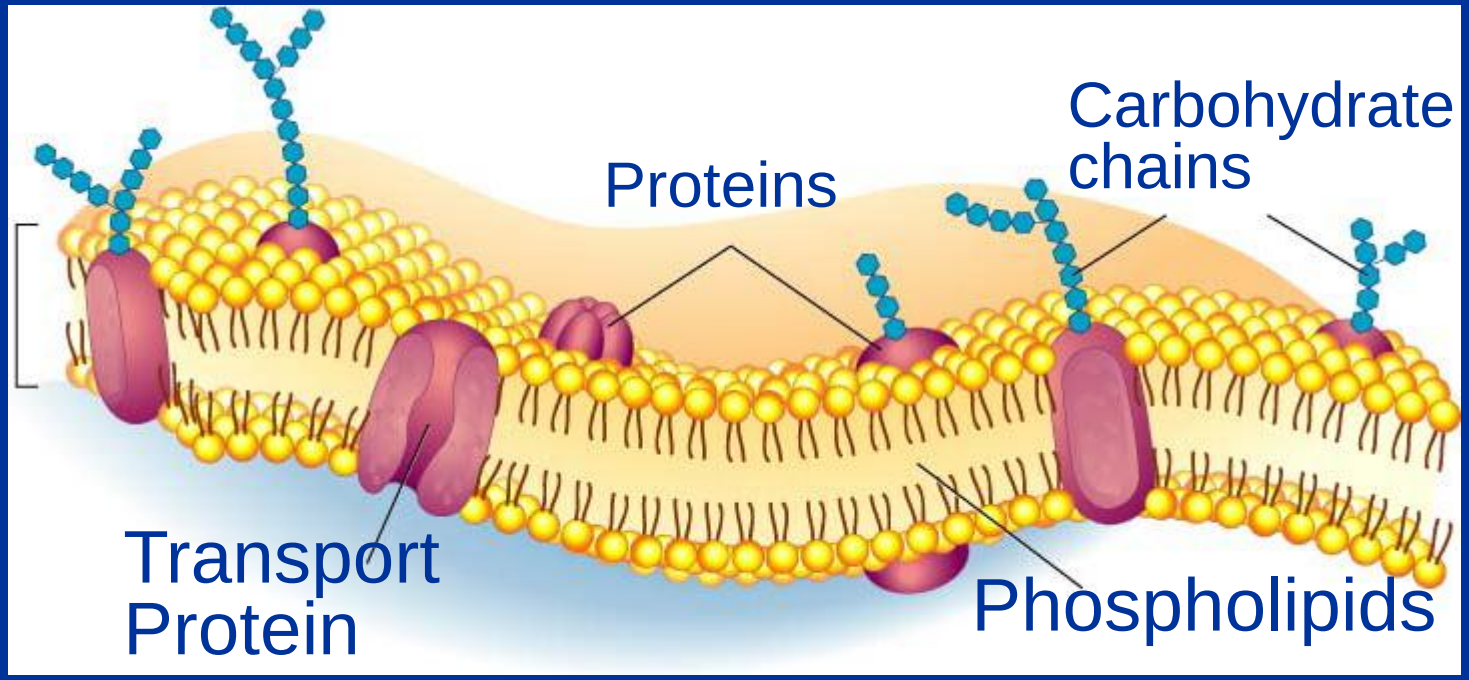
- 4. Cell membranes have pores (holes) in it
  a. **Selectively permeable**: Allows some molecules in and keeps other molecules out
  b. The structure helps it be selective!



Structure of the Cell Membrane

Outside of cell

Lipid Bilayer



Inside of cell (cytoplasm)

Go to Section:

Types of Cellular Transport

•Animations of Active Transport & Passive Transport

- **Passive Transport**

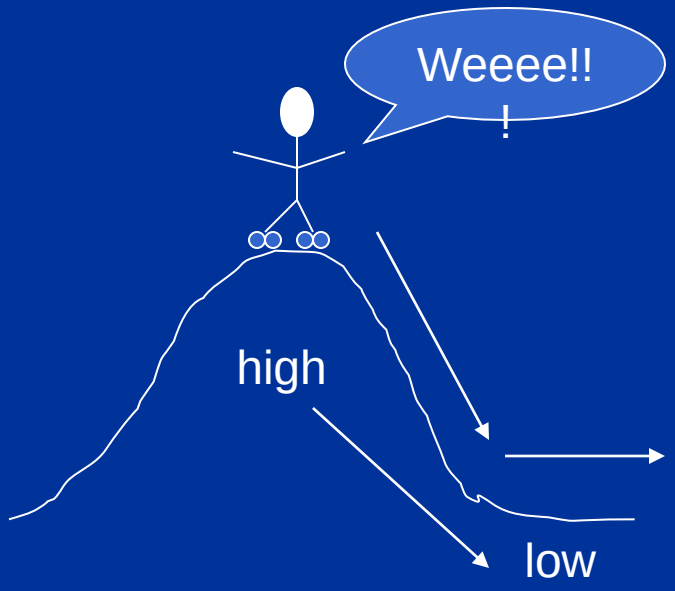
  cell doesn't use energy

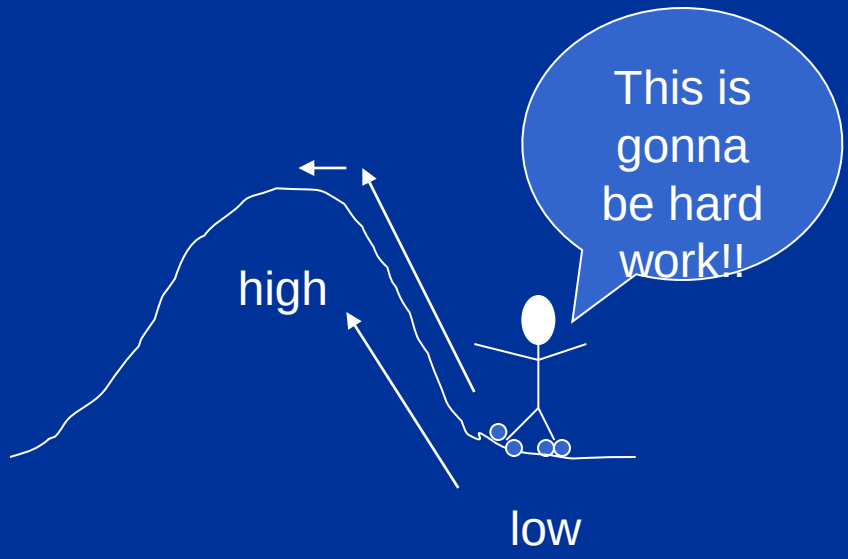
  1. Diffusion
  2. Facilitated Diffusion
  3. Osmosis

- **Active Transport**

  cell does use energy

  1. Protein Pumps
  2. Membrane-Assisted
     - A. Endocytosis
     - B. Exocytosis





Passive Transport

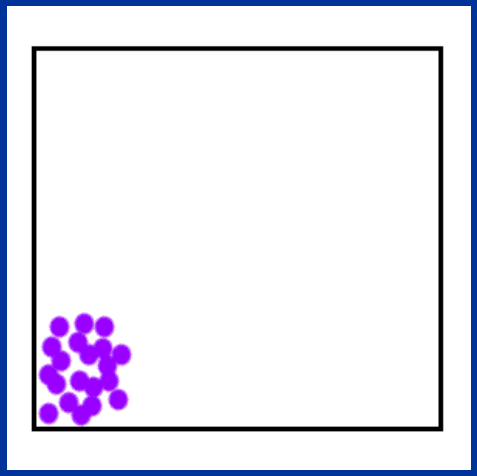
- cell **uses no energy**
- molecules move randomly
- Molecules spread out **from an area of high concentration to an area of low concentration**.
- (High→Low)
- **Three types:**

3 Types of Passive Transport

1. **Diffusion** (non-charged, lipid soluble (alcohol) water, and gases)
2. **Facilitative Diffusion** – diffusion with the help of transport proteins (glucose and amino acids)
3. **Osmosis** – diffusion of water

Passive Transport:
1. Diffusion

Simple Diffusion Animation



(***High to Low***)

- **Diffusion**: random movement of particles **from an area of high concentration to an area of low concentration**.
- Diffusion continues until all molecules are evenly spaced (**equilibrium** is reached)-***Note:*** molecules will still move around but stay spread out.

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

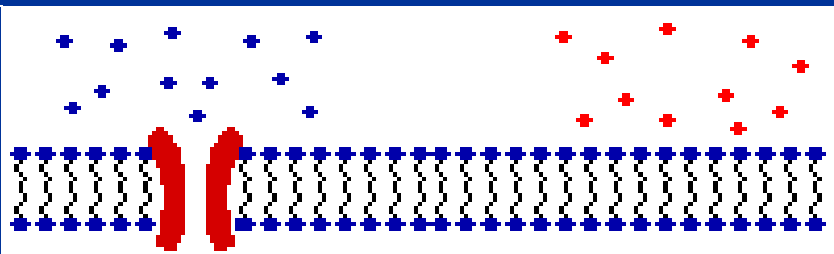
Passive Transport:

2. Facilitated Diffusion

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

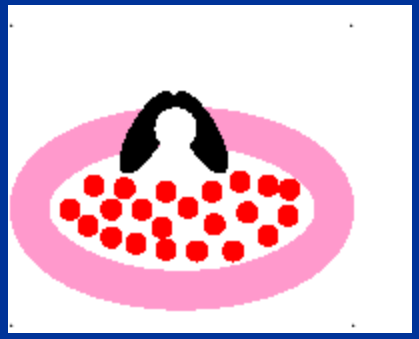
a. Transport Proteins are specific – they "select" only certain molecules to cross the membrane

b. Transports larger or charged molecules



Facilitated diffusion (Channel Protein)

Diffusion (Lipid Bilayer)



Carrier Protein

Passive Transport: 2. Facilitated Diffusion

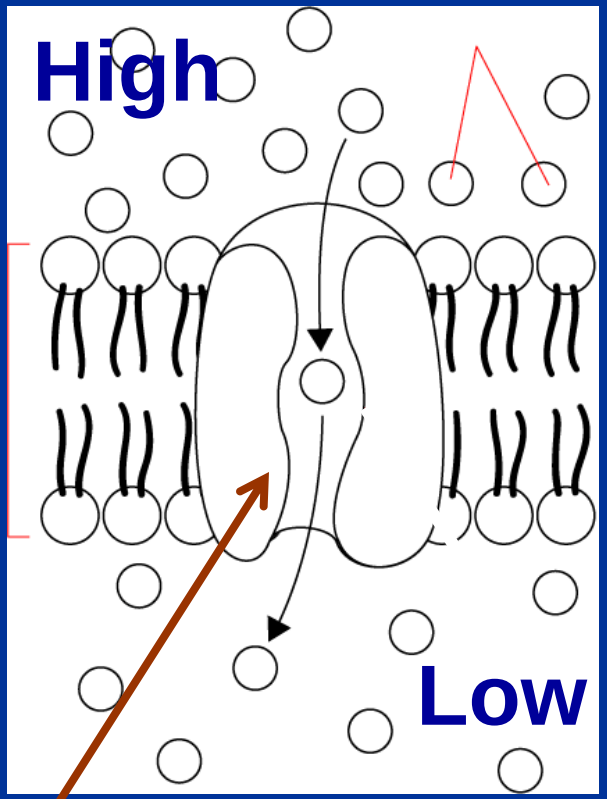
Glucose molecules

Cellular Transport From a-

High Concentration

Cell Membrane

Low Concentration



- Channel Proteins animations

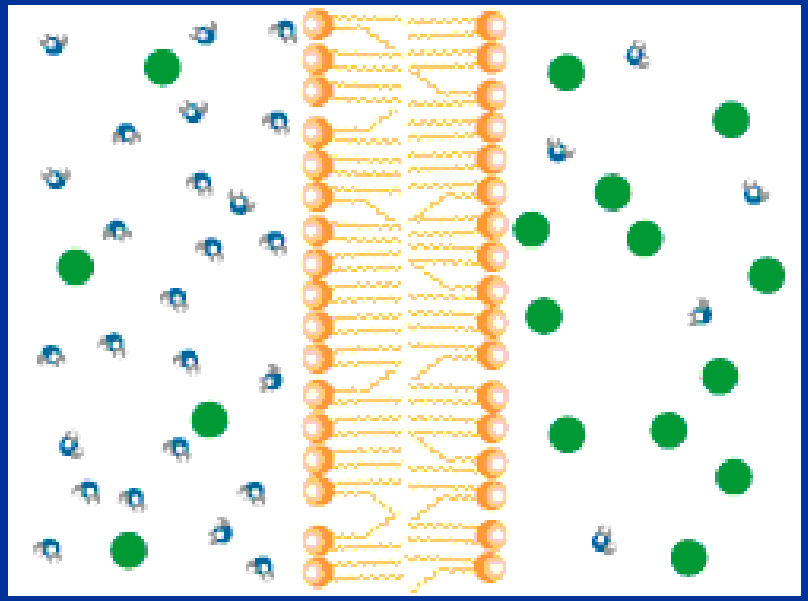
Through a → Transport Protein

Go to Section:

Passive Transport: 3. **Osmosis**

Osmosis animation

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



•Water moves freely through pores.

•Solute (green) to large to move across.

Effects of Osmosis on Life

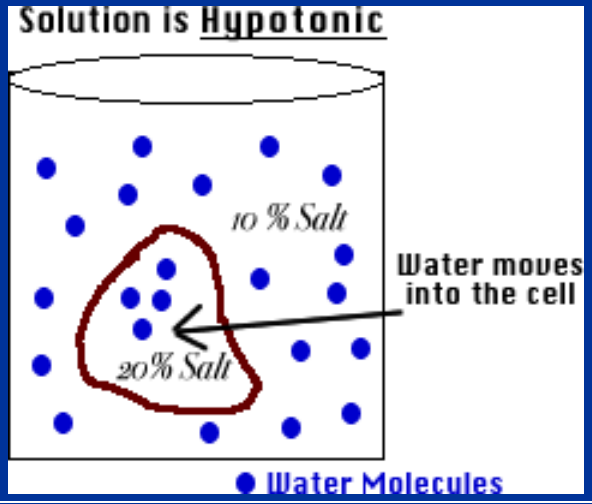
- Osmosis- diffusion of water through a selectively permeable membrane

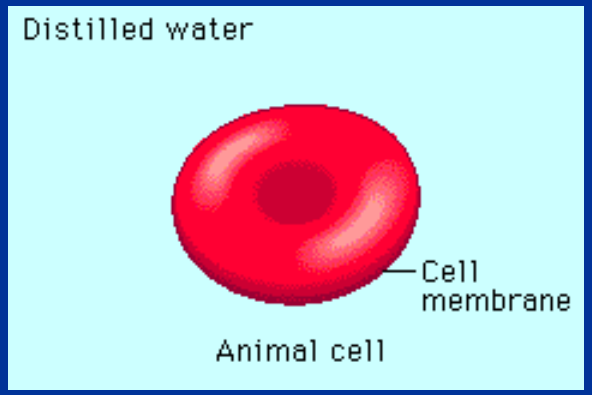
- **Water is so small and there is so much of it the cell can't control it's movement through the cell membrane.**

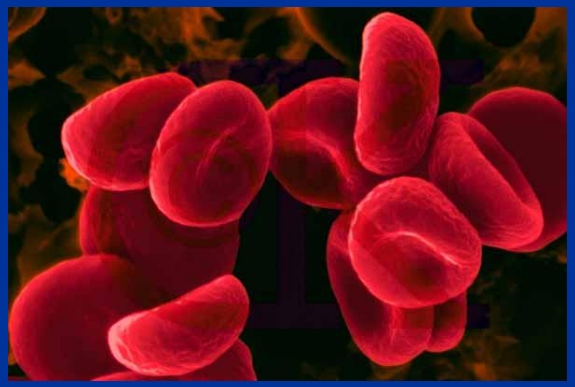
Hypotonic Solution

- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

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

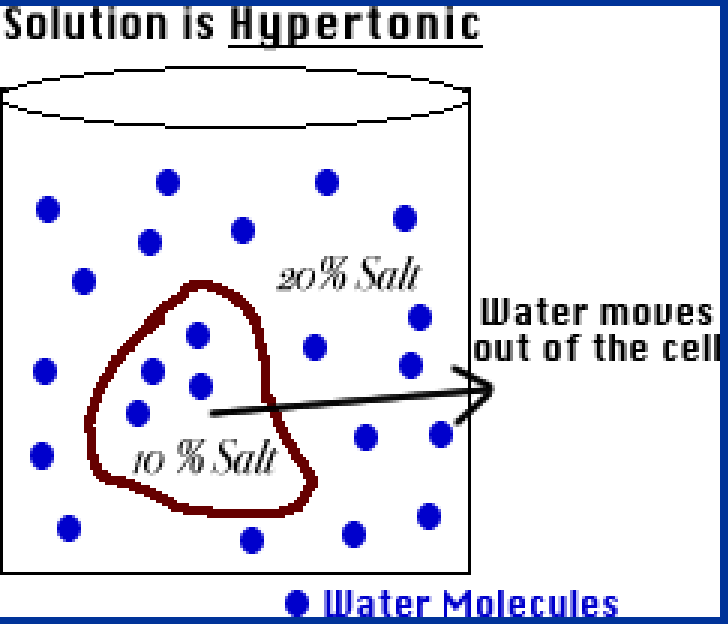
HEMOLYSIS" IN ANIMALS

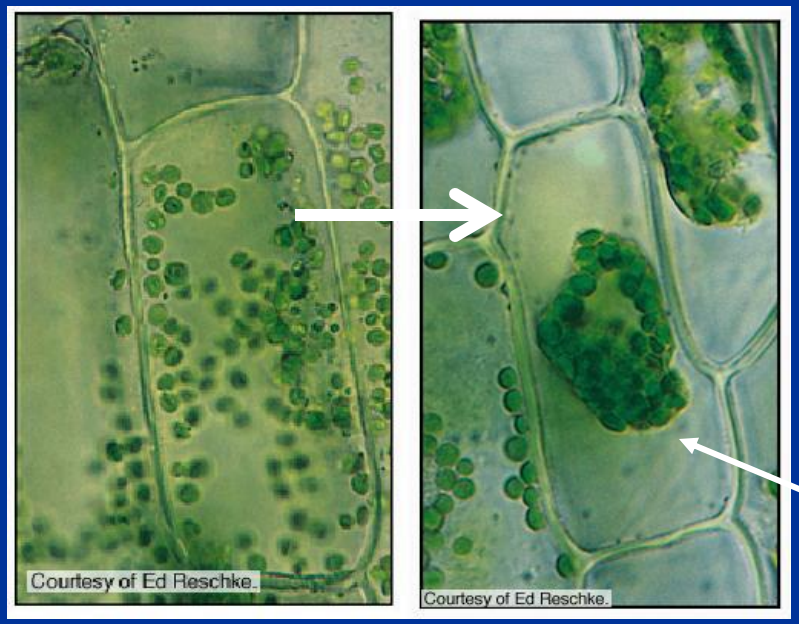
IN PLANTS - TURGOR PRESSURE

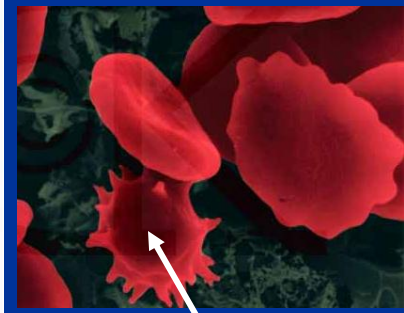
Hypertonic Solution

- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

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







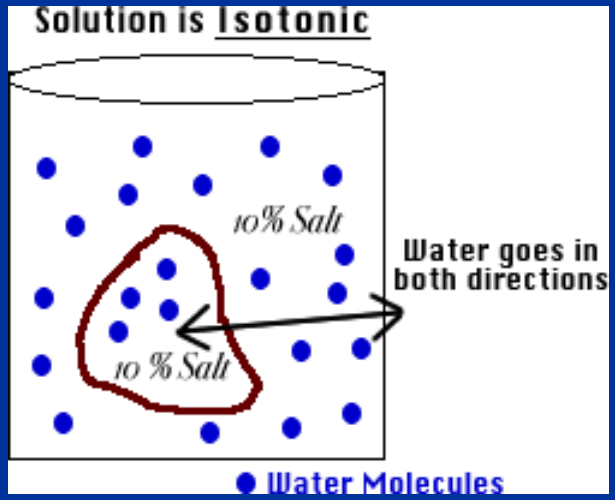
shrinks

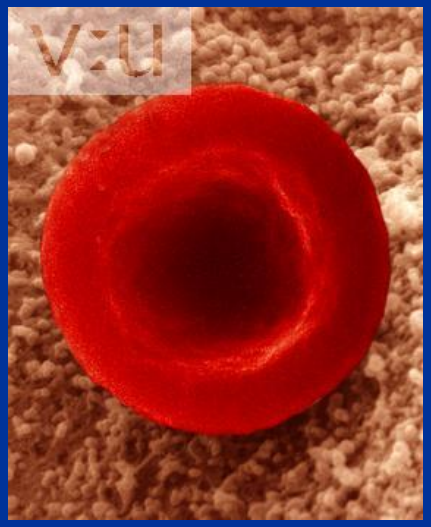
Result: Water moves from inside the cell into the solution: Cell shrinks - CRENATION" IN ANIMALS PLASMOLYSIS IN PLANTS

- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

Isotonic Solution

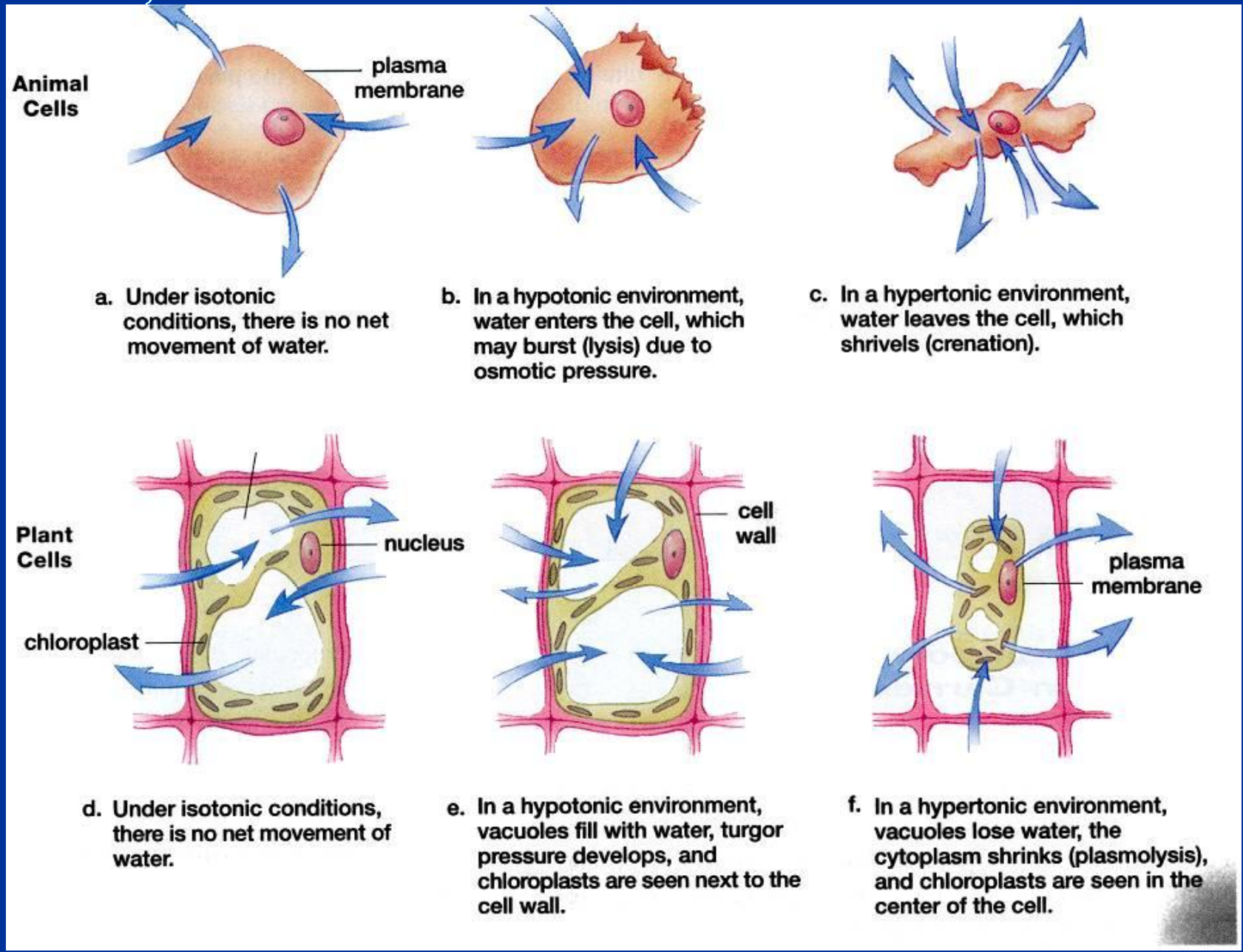
Isotonic: The concentration of solutes in the solution is equal to the concentration of solutes inside the cell.



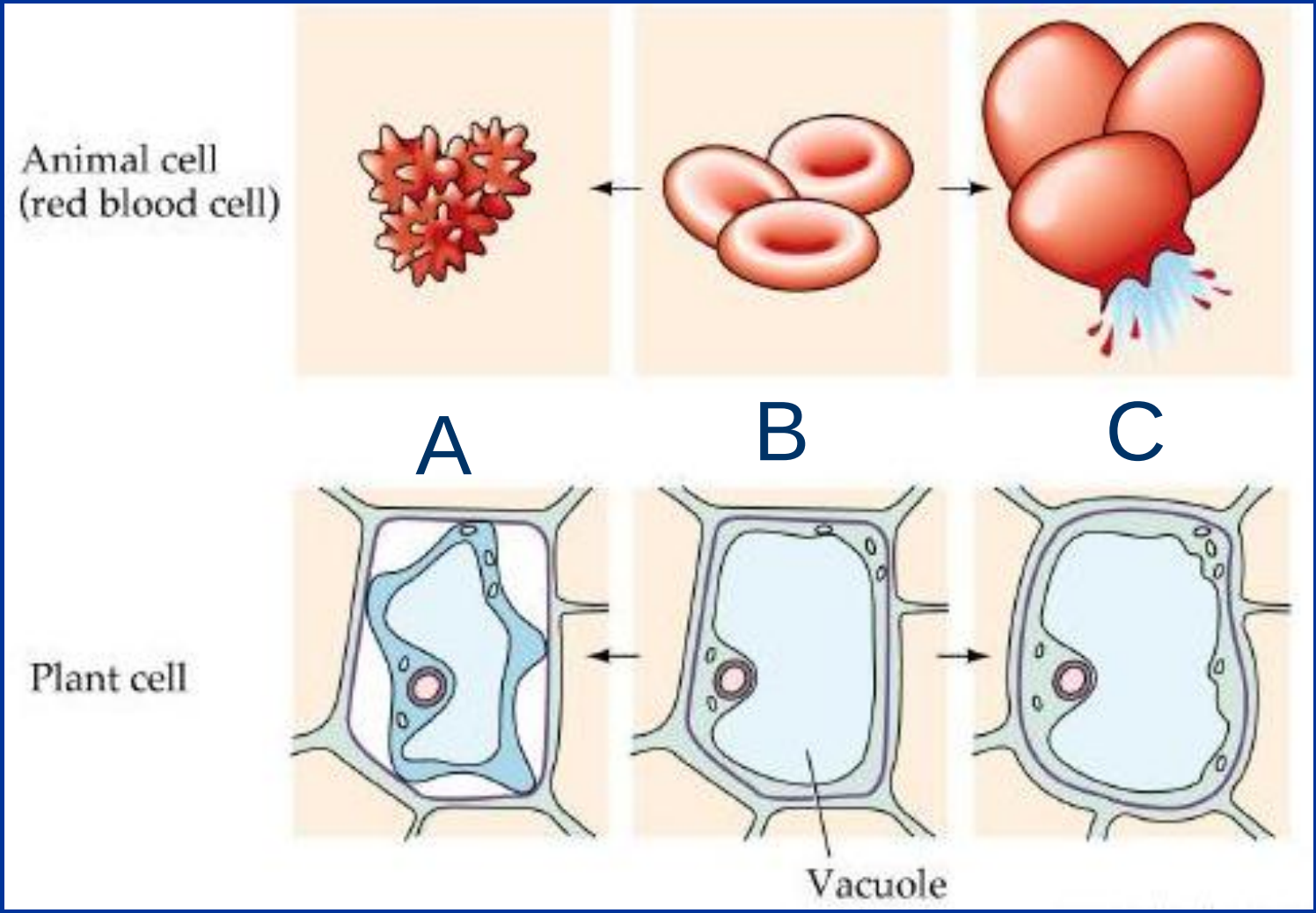


Result: Water moves equally in both directions and the cell remains same size! (Dynamic Equilibrium)

FIG. 6.9, Mader


Animal Cells
plasma membrane
a. Under isotonic conditions, there is no net movement of water.
b. In a hypotonic environment, water enters the cell, which may burst (lysis) due to osmotic pressure.
c. In a hypertonic environment, water leaves the cell, which shrivels (crenation).
Plant Cells
nucleus
chloroplast
cell wall
plasma membrane
d. Under isotonic conditions, there is no net movement of water.
e. In a hypotonic environment, vacuoles fill with water, turgor pressure develops, and chloroplasts are seen next to the cell wall.
f. In a hypertonic environment, vacuoles lose water, the cytoplasm shrinks (plasmolysis), and chloroplasts are seen in the center of the cell.

What type of solution are these cells in?



Hypertonic Isotonic Hypotonic

How Organisms Deal with Osmotic Pressure

- Paramecium (protist) removing excess water video

- 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.

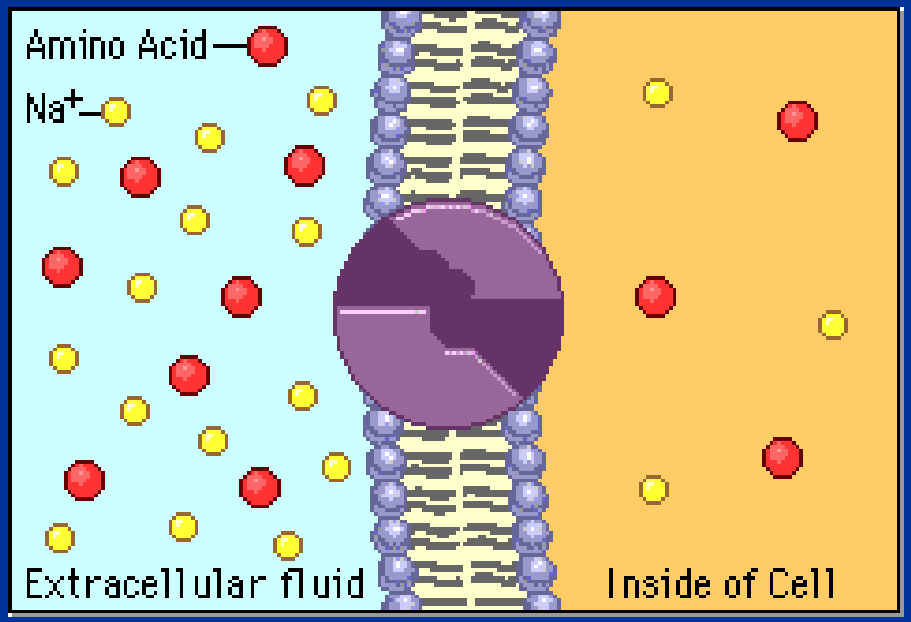
Active Transport

- cell **uses energy**
- actively moves molecules to where they are needed (macromolecules: carbohydrates, proteins and nucleic acids)
- Movement **from an area of low concentration to an area of high concentration**
- **(Low → High)**
- Three Types:

Types of Active Transport

Sodium Potassium Pumps (Active Transport using proteins)

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



Protein changes shape to move molecules: this requires energy!

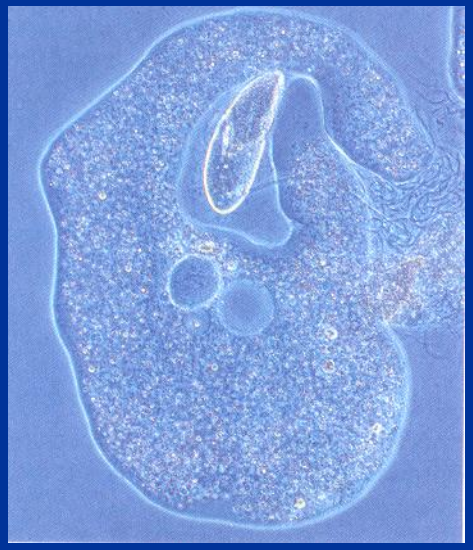
2.Membrane Assisted Transport or Bulk Transport

- Allows passage of very large molecules by vesicle formation that fuse into plasma membrane
- macromolecules: carbohydrates, proteins and nucleic acids

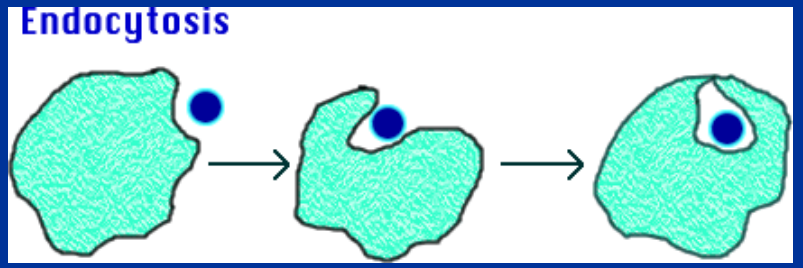
Macromolecules

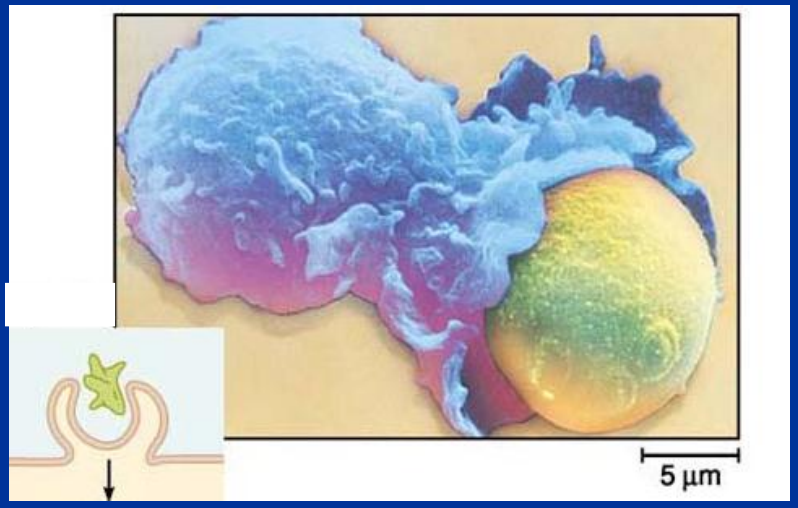
- **Protein** - Polypeptides - Chains of amino acids
- **Carbohydrates** - Polysaccharides - Chains of sugars
- **Nucleic Acids** - Polynucleotides - RNA, DNA

Types of Bulk Transport



- 1. **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!





Endocytosis

- **Solids: Phagocytosis**

- **Liquids: Pinocytosis**
  - Plants in roots
  - Blood cells in intestines

Types of Active Transport

2. **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

     INSULIN, Fig. 4.30, p. 94

Endocytosis & Exocytosis animations