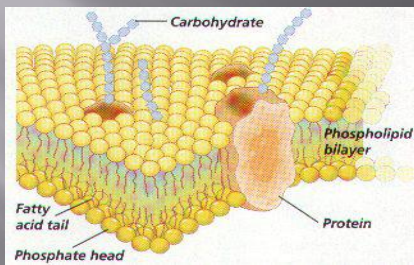
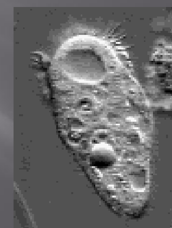
THE PLASMA MEMBRANE -



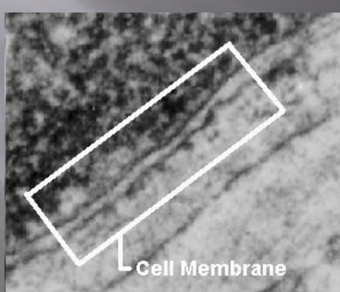
Gateway to the Cell

Cell Membrane

The cell membrane is flexible and allows a unicellular organism to move



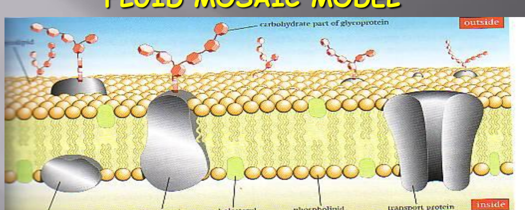
Photograph of a Cell Membrane



How is the structure related to its function?

- Isolates the cell, yet allows communication with its surroundings
- "fluid mosaics" = proteins (and everything else) move within layers of lipids
- Double layer
  - A barrier, binding site for enzymes, anchoring site, regulates transport in and out of cell
- Helps maintain homeostasis

FLUID MOSAIC MODEL

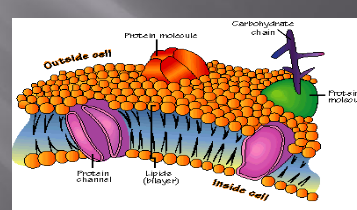


FLUID- because individual phospholipids and proteins can move around freely within the layer, like it's a liquid.

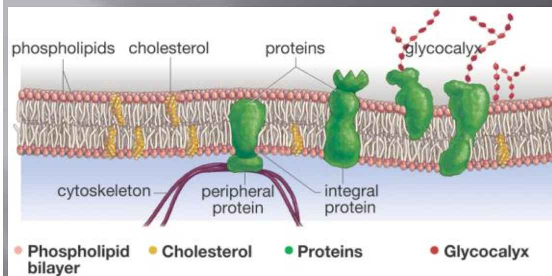
MOSAIC- because of the pattern produced by the scattered protein molecules when the membrane is viewed from above.

What is the bilayer made of?

- 2 layers of phospholipids
- Proteins (enzymes)
- Carbohydrates
- cholesterol



Membrane Components

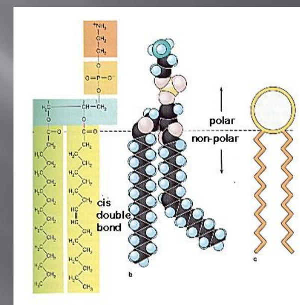


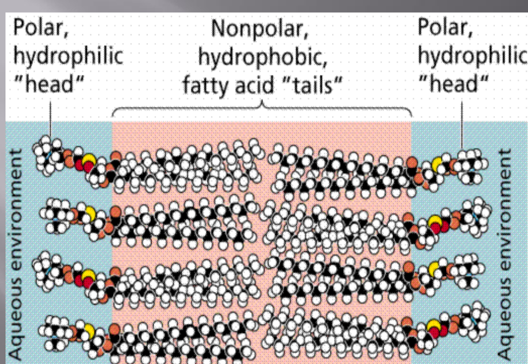
The cell membrane is made of 2 layers of phospholipids called the lipid **bilayer**

Phospholipids

Tails: 2 fatty acid chains that are **nonpolar**

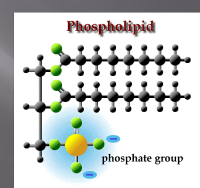
Head: contains a **$-PO_4$ group & glycerol**, is **polar**



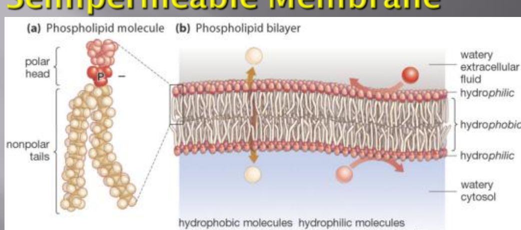


Solubility

- Materials that are soluble in **lipids** can pass through the cell membrane **easily**
- **Hydrophobic** can pass thru easily
- **Hydrophilic** can not

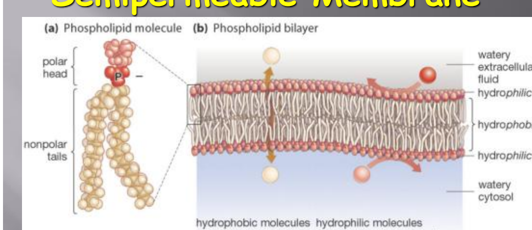


Semipermeable Membrane



Small molecules and **larger hydrophobic** molecules move through easily.
e.g. O_2, CO_2

Semipermeable Membrane



Ions, **hydrophilic** molecules larger than water, and large molecules such as **proteins do not move** through the membrane on their own.

Types of Transport Across Cell Membranes

Two types of transport

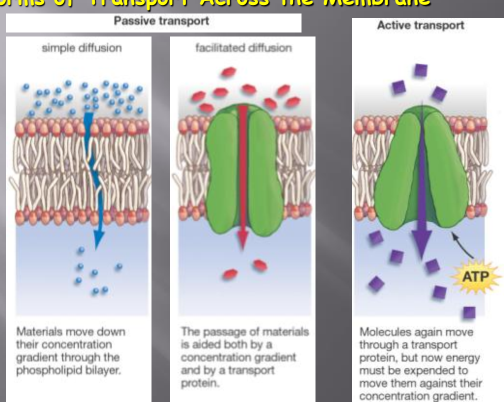
PASSIVE TRANSPORT

- Transport of molecules across the membrane from a high concentration to low concentration, requiring no energy
- Examples:
  - Simple Diffusion
  - Facilitated Diffusion
  - Osmosis

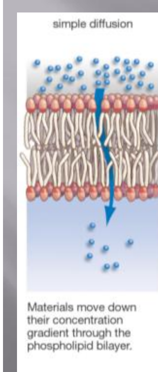
ACTIVE TRANSPORT

- Transport of molecules across the membrane from a low concentration to high concentration, requiring energy
- Examples:
  - Endocytosis
  - Exocytosis
  - "pumps"

Forms of Transport Across the Membrane



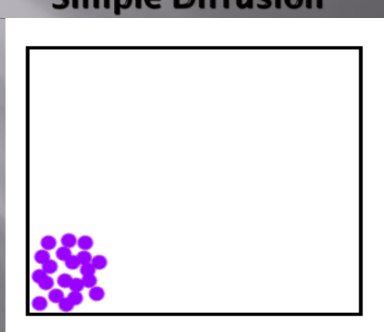
Passive Transport



Simple Diffusion

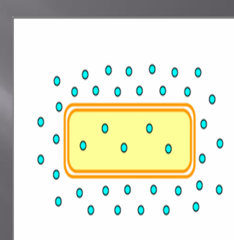
- Doesn't require energy
- Moves high to low concentration
- Example: Oxygen or water diffusing into a cell and carbon dioxide diffusing out.

Simple Diffusion

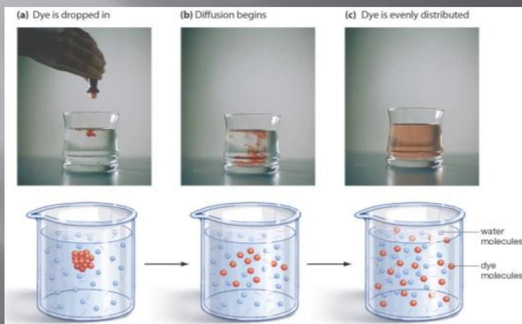


DIFFUSION

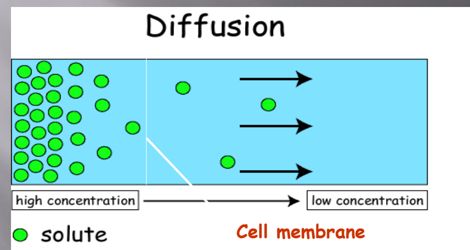
Diffusion is a PASSIVE process which means no energy is used to make the molecules move, they have a natural KINETIC ENERGY



Diffusion of Liquids



Diffusion through a Membrane



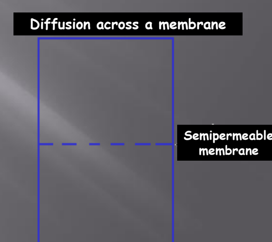
Solute moves DOWN concentration gradient (HIGH to LOW)

What molecules are involved?

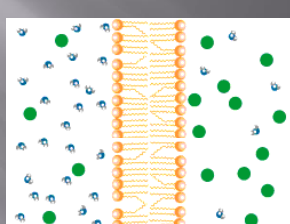
- Lipid soluble molecules and very small molecules – diffuse EASILY
- Rate of simple diffusion is determined by:
  - Size of molecule
  - solubility

Osmosis

- Diffusion of water across a membrane
- Moves from HIGH water potential (low solute) to LOW water potential (high solute)



Diffusion of H_2O Across A Membrane

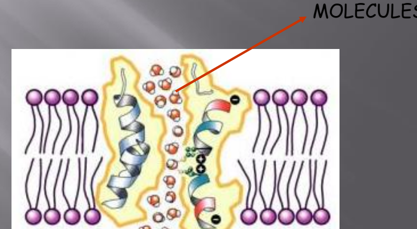


High H_2O potential
Low solute concentration

Low H_2O potential
High solute concentration

Aquaporins

- Water Channels
- Protein pores used during OSMOSIS



Types of Osmosis

- 3 types (subcategories)
  - Isotonic   Hypertonic   Hypotonic

TABLE 5-1 Direction of Osmosis

Condition	Net movement of water
External solution is hypotonic to cytosol	into the cell
External solution is hypertonic to cytosol	out of the cell
External solution is isotonic to cytosol	none

Cell in Isotonic Solution

ENVIRONMENT
10% NaCL
90% H_2O

CELL
10% NaCL
90% H_2O

NO NET MOVEMENT

What is the direction of water movement?

The cell is at ___equilibrium______.

Cell in Hypertonic Solution

ENVIRONMENT
15% NaCL
85% H_2O

CELL
5% NaCL
95% H_2O

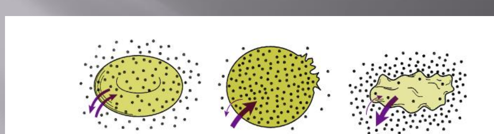
What is the direction of water movement?

Cell in Hypotonic Solution

10% NaCL
90% H_2O

CELL
20% NaCL
80% H_2O

What is the direction of water movement?

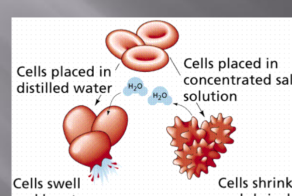


Isotonic Solution → NO NET MOVEMENT OF H_2O (equal amounts entering & leaving)

Hypotonic Solution → CYTOLYSIS

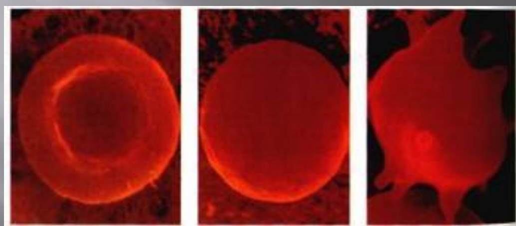
Hypertonic Solution → PLASMOLYSIS

Cytolysis & Plasmolysis



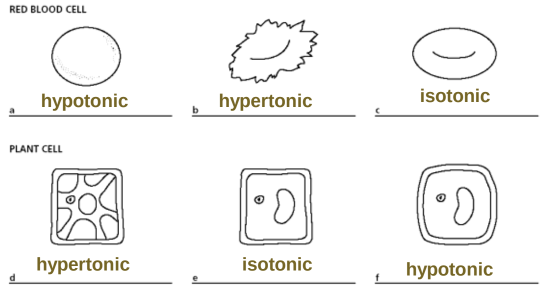
Cytolysis   Plasmolysis

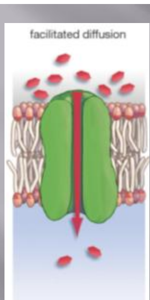
Osmosis in Red Blood Cells



Isotonic Hypotonic Hypertonic

STRUCTURES AND FUNCTIONS The drawings below show the appearance of a red blood cell and a plant cell in isotonic, hypotonic, and hypertonic environments. Label each environment in the spaces provided.





The passage of materials is aided both by a concentration gradient and by a transport protein.

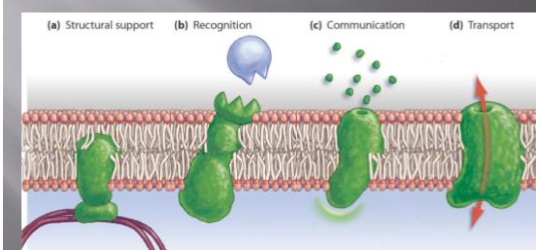
Passive Transport

Facilitated diffusion

- Doesn't require energy
- Uses transport proteins to move high to low concentration BUT needs some "guidance"

Examples: Glucose or amino acids moving from blood into a cell.

Proteins Are Critical to Membrane Function

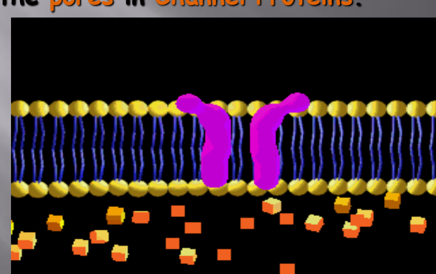


Types of Transport Proteins

- Channel proteins are embedded in the cell membrane & have a pore for materials to cross
- Carrier proteins can change shape to move material from one side of the membrane to the other

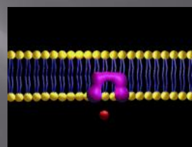
Facilitated Diffusion

Molecules will randomly move through the pores in Channel Proteins.



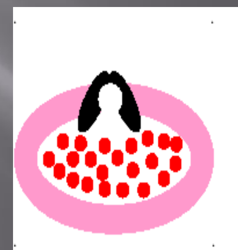
Facilitated Diffusion

- Some carrier proteins bond, then drag molecules to the other side



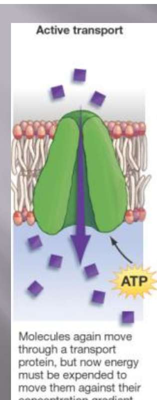
Carrier Proteins

- Other carrier proteins change shape to move materials across the cell membrane



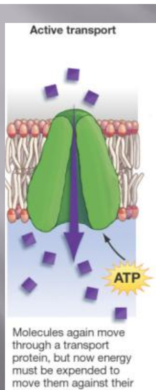
ACTIVE TRANSPORT

Needs energy!



Active Transport

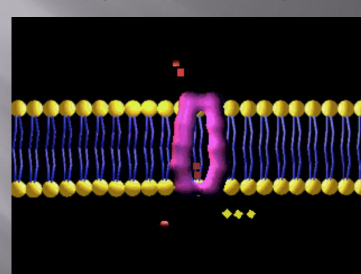
- Requires energy or ATP
- Moves materials from LOW to HIGH concentration
- AGAINST concentration gradient



Active transport

- Examples: Pumping Na^+ (sodium ions) out and K^+ (potassium ions) in against strong concentration gradients.
- Called Na+-K+ Pump

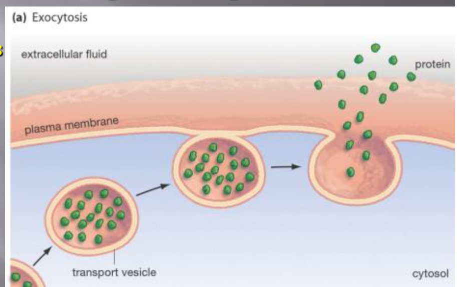
Sodium-Potassium Pump



3 Na+ pumped in for every 2 K+ pumped out; creates a membrane potential

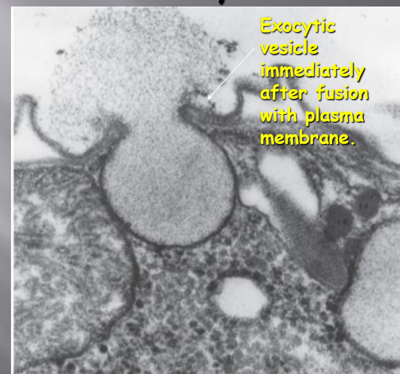
Moving the "Big Stuff"

Exocytosis - moving things out.



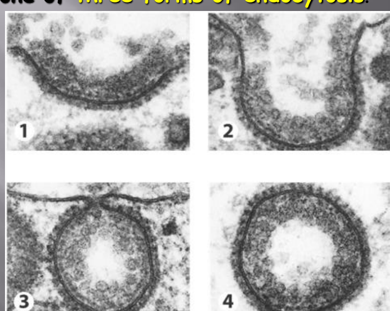
Molecules are moved out of the cell by vesicles that fuse with the plasma membrane.
This is how many hormones are secreted and how nerve cells communicate with one another.

Exocytosis

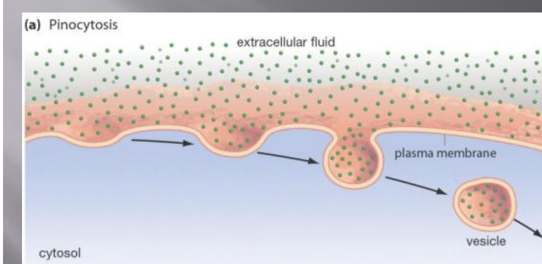


Moving the "Big Stuff"

Large molecules move materials into the cell by one of three forms of endocytosis.



Pinocytosis

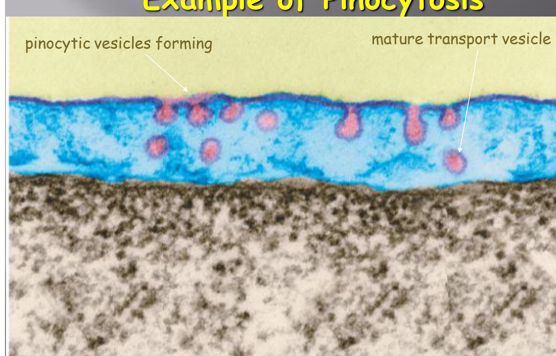


Most common form of endocytosis.
Takes in dissolved molecules as a vesicle.

Pinocytosis

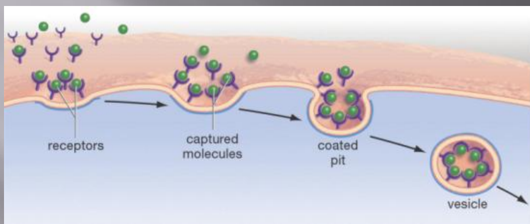
- Cell forms an indention
- Materials dissolve in water to be brought into cell
- Called "Cell Drinking"

Example of Pinocytosis



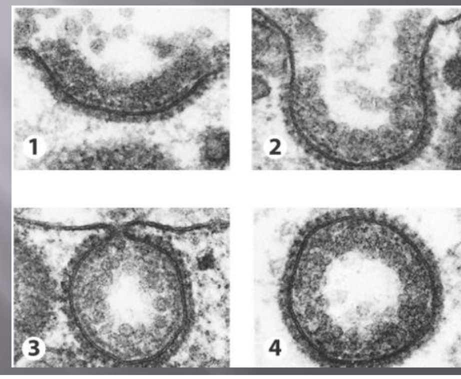
Transport across a capillary cell (blue).

Receptor-Mediated Endocytosis

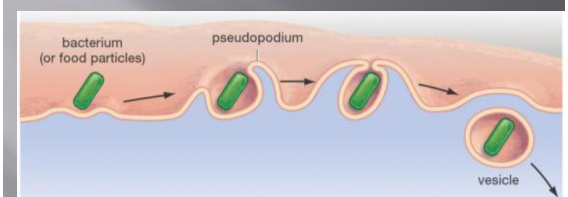


Some integral proteins have receptors on their surface to recognize & take in hormones, cholesterol, etc.

Receptor-Mediated Endocytosis



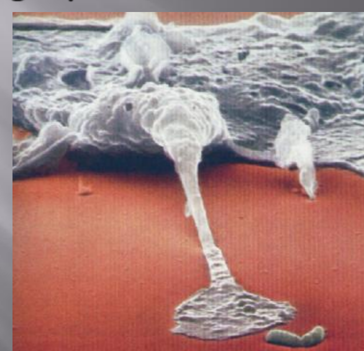
Endocytosis – Phagocytosis



Used to engulf large particles such as food, bacteria, etc. into vesicles

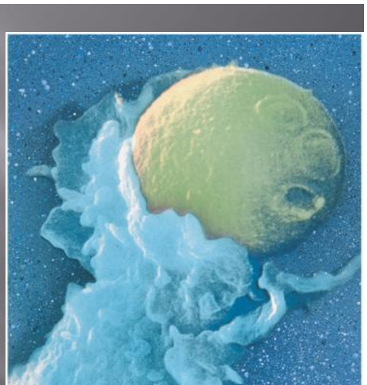
Called "Cell Eating"

Phagocytosis About to Occur



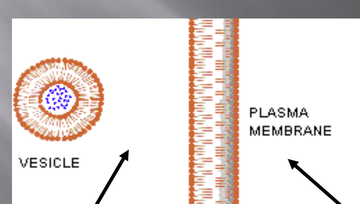
Phagocytosis

- Capture of a Yeast Cell (yellow) by Membrane Extensions of an Immune System Cell (blue)



Exocytosis

The opposite of endocytosis is exocytosis. Large molecules that are manufactured in the cell are released through the cell membrane.



Inside Cell

Cell environment