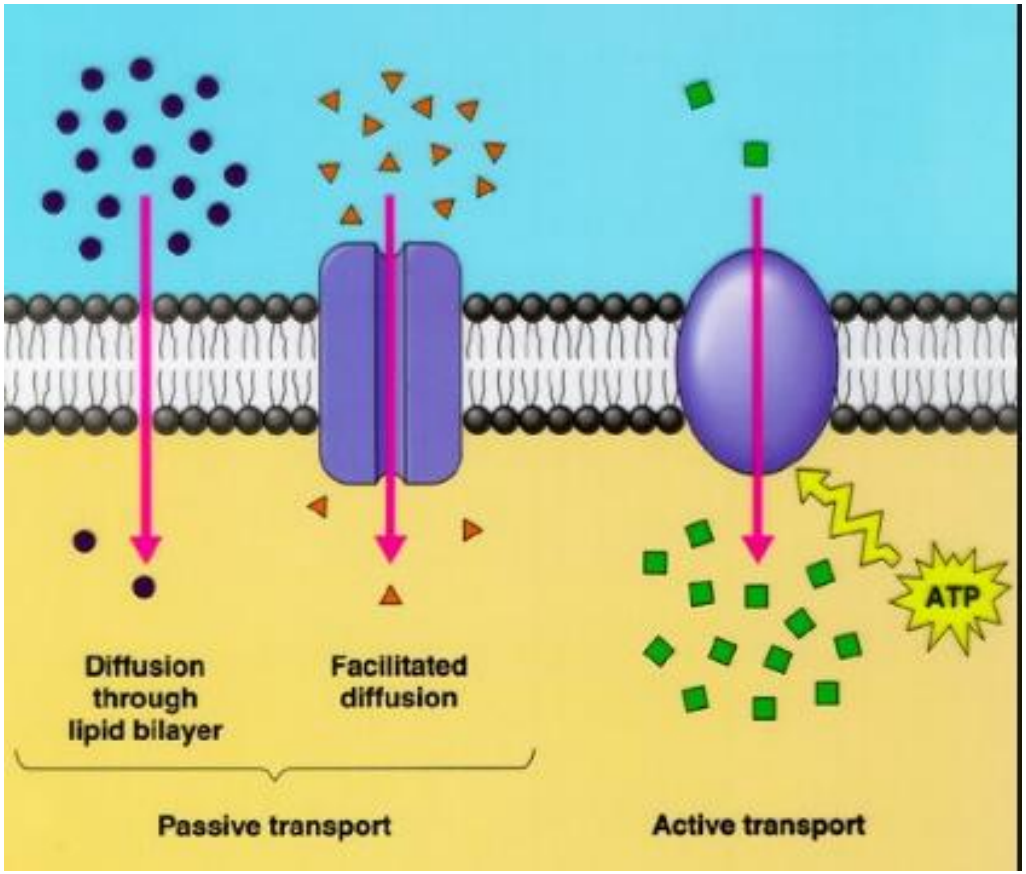
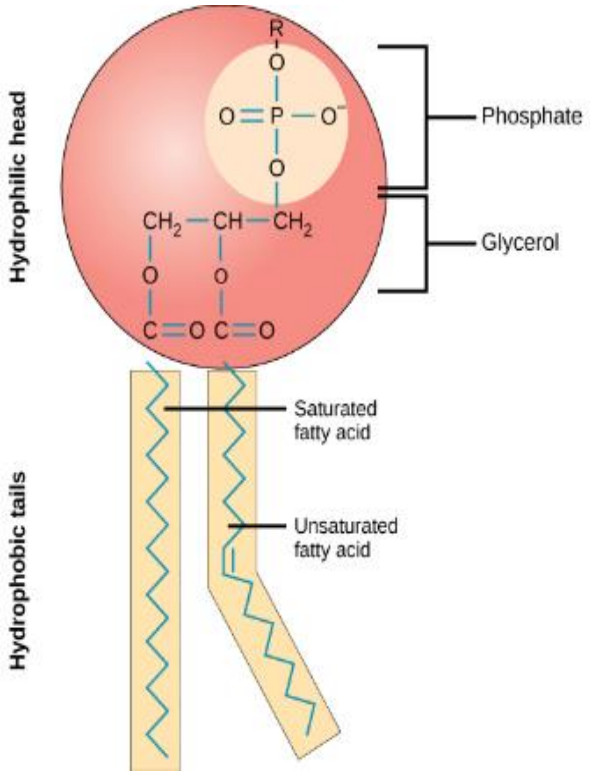
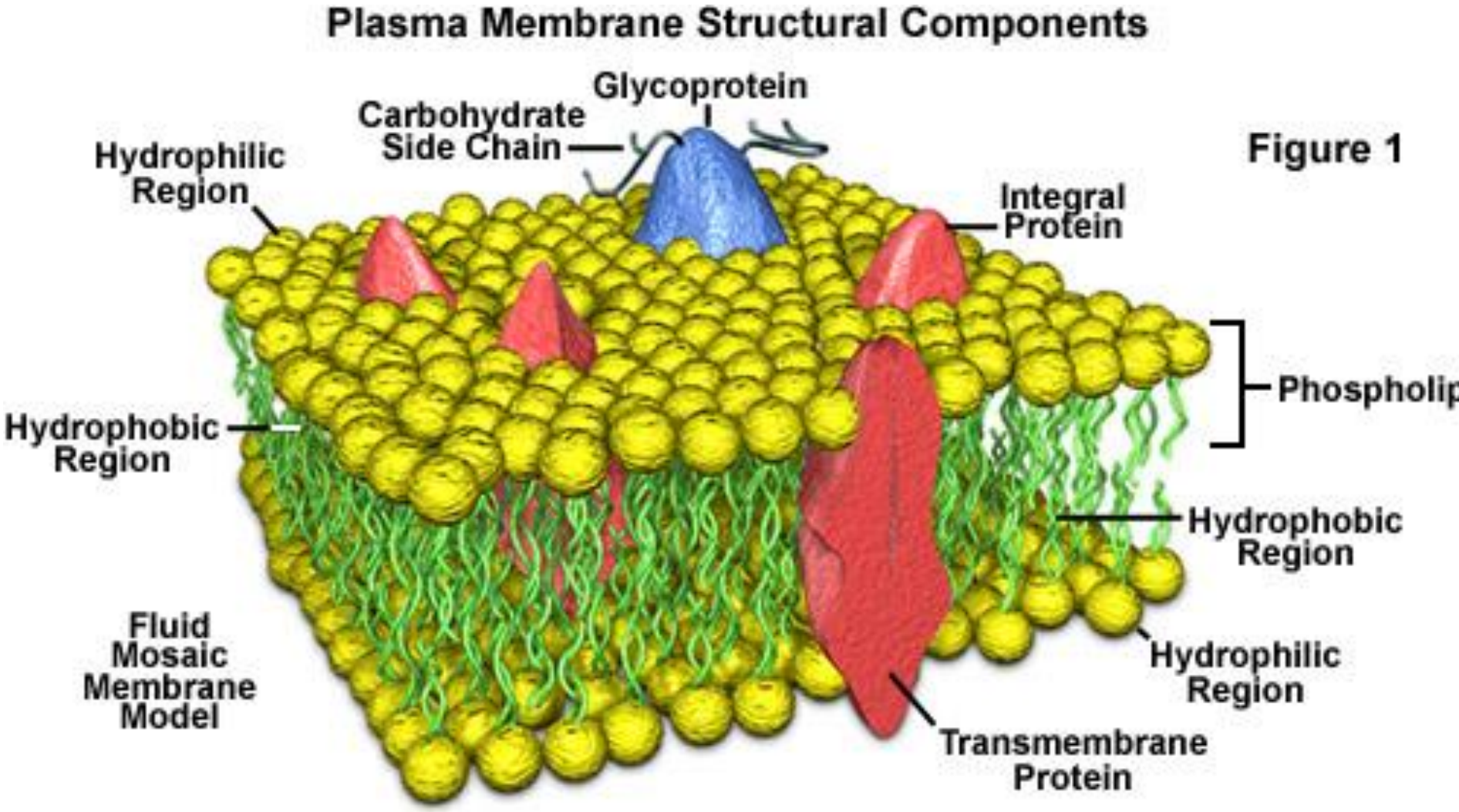
Unit 4 - Cell transport



Cell membrane

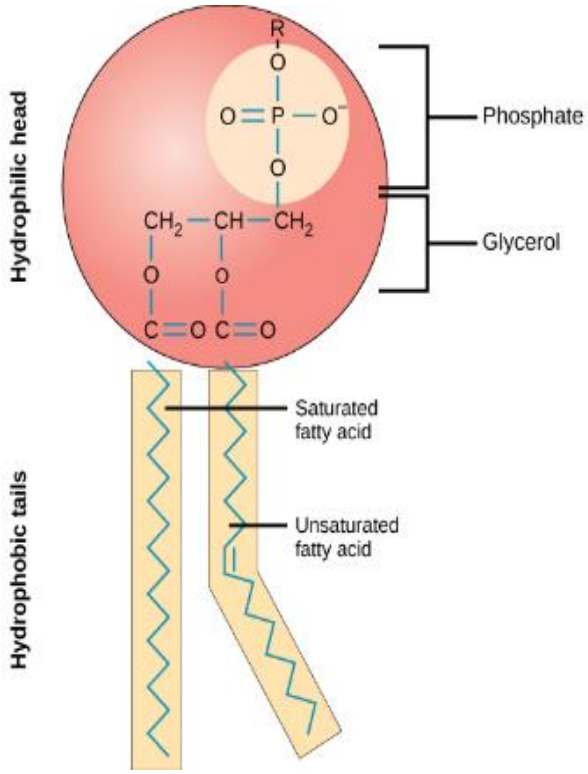
- This organelle is a phospholipid bilayer.
  - Two layers of lipids
  - Phospholipid
    - Hydrophilic/Polar head
    - Hydrophobic/Nonpolar tails
- Also made up of proteins and carbohydrates in less numbers




Plasma Membrane Structural Components
Glycoprotein
Carbohydrate Side Chain
Hydrophilic Region
Integral Protein
Figure 1
Phospholip
Hydrophobic Region
Hydrophobic Region
Fluid Mosaic Membrane Model
Hydrophilic Region
Transmembrane Protein

Cell membrane

- Functions:
  - Regulates what enters/exits
    - Semi/selectively permeable
  - Cell recognition
  - Protective barrier



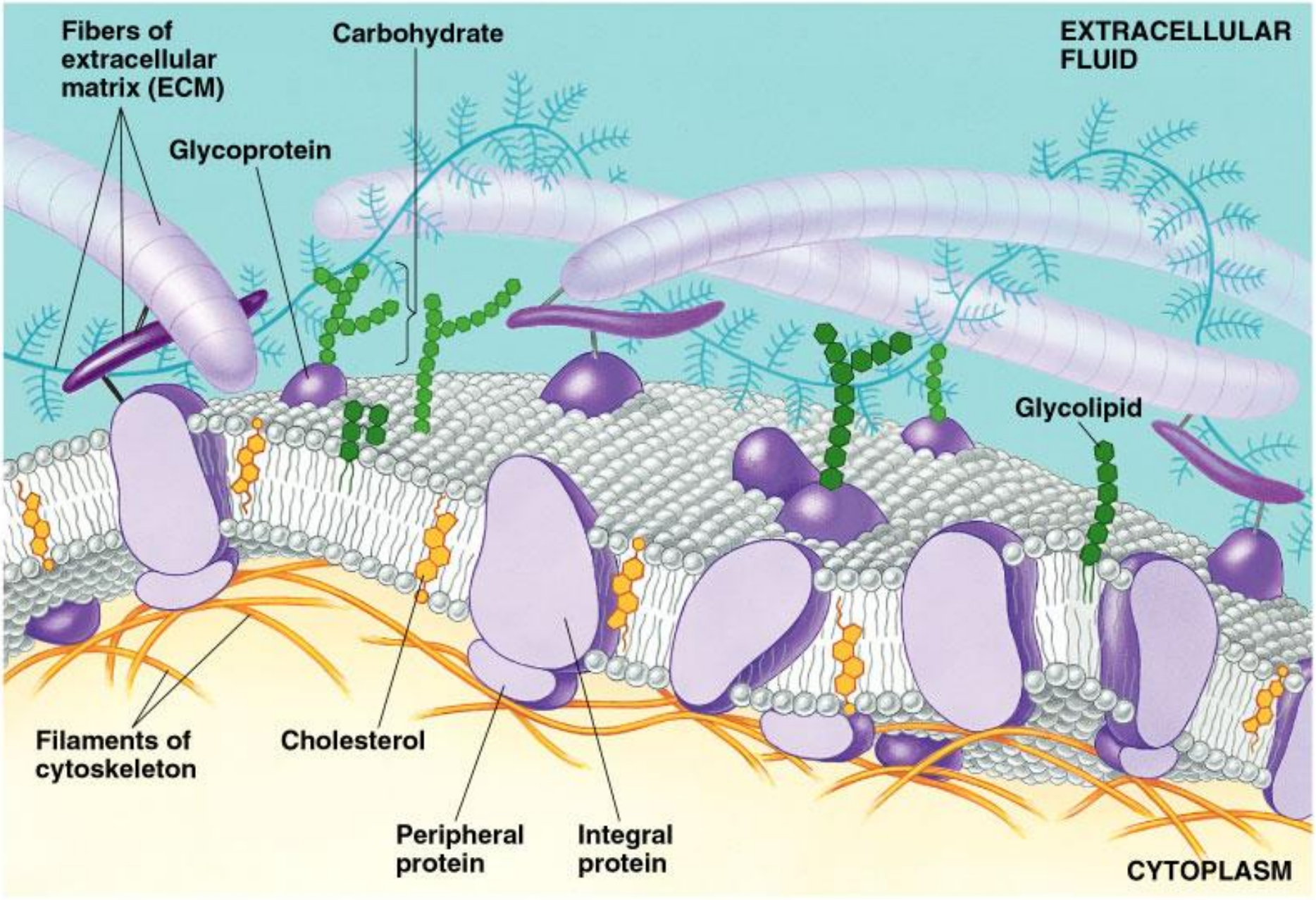
Fluid mosaic model

- Describes the cell membrane
  - The plasma membrane is fluid or in motion and the proteins drift among the phospholipids.
  - The membrane looks like a mosaic
    - Made of many different parts

Animation

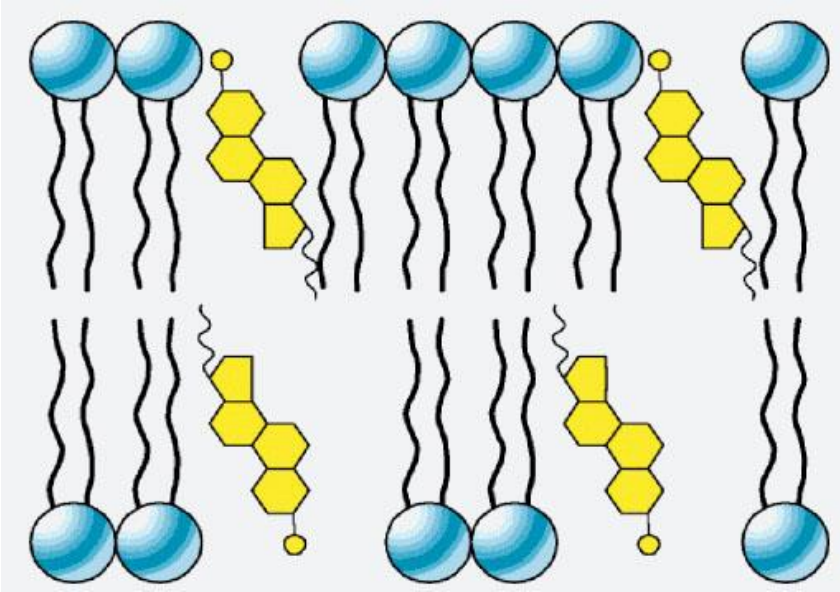
Proteins

- Proteins embedded in the cell membrane are used for transport and cell recognition.
- Integral proteins- proteins that span across the hydrophobic portion of the lipid bilayer.
- Peripheral proteins- proteins that are not embedded in the membrane but are loosely attached to the surface of the membrane.



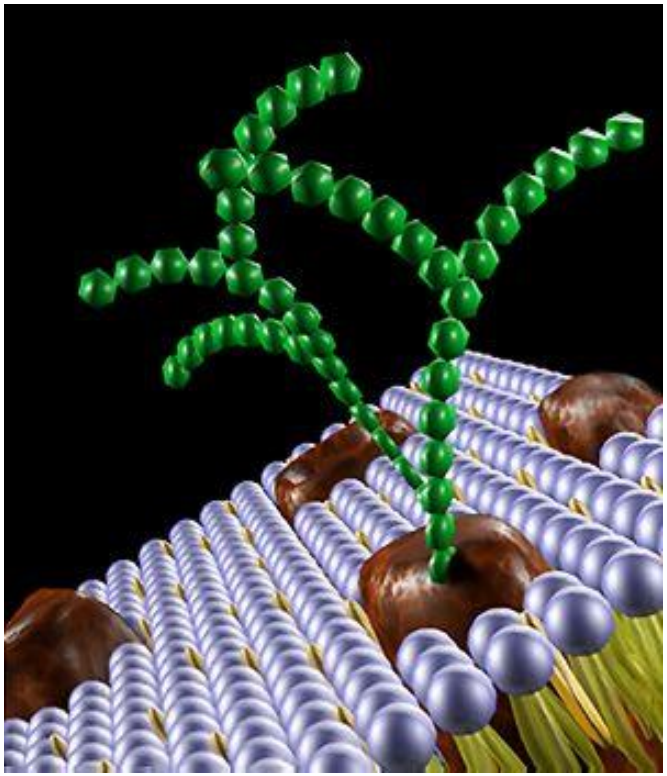
Cholesterol

- Between the phospholipids
  - Decreases fluidity of the membrane (stabilizes)
- Cholesterol has a second role to PREVENT solidification by spacing out the phospholipids so it takes longer to solidify at cooler temperatures.



Glycoproteins and Glycolipids

- Proteins or lipids found with carbohydrate chains attached. Used as recognition sites on the cell (crucial for immune system).



Homeostasis

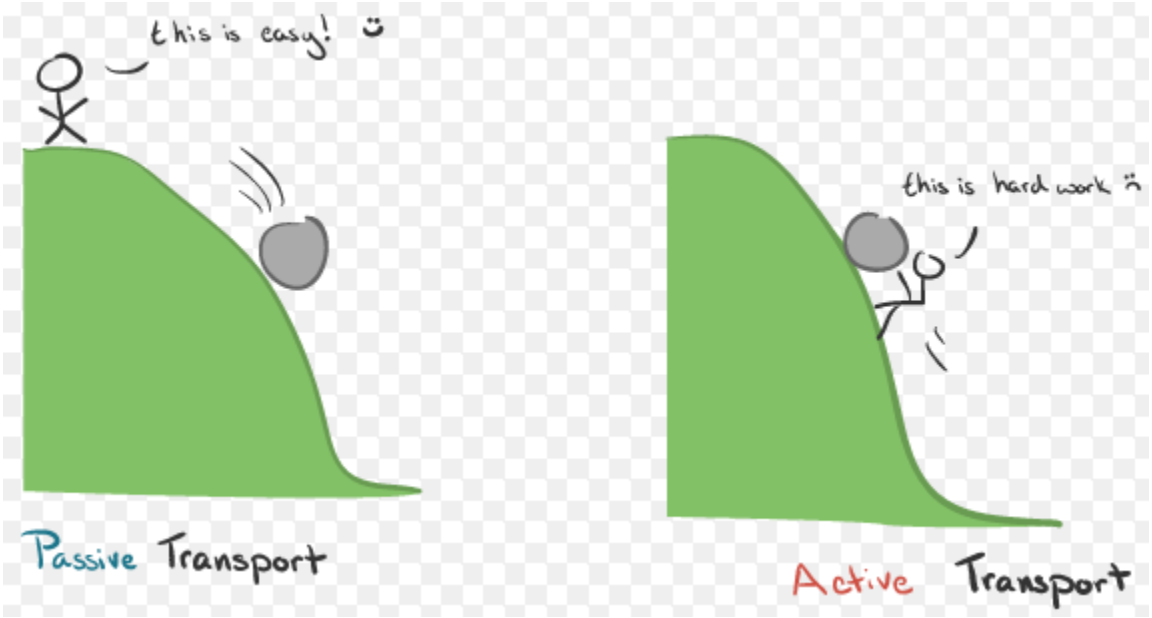
- Cell membrane acts as a regulator to maintain homeostasis
  - **Stable** internal environment
- To Maintain homeostasis materials must enter through the cell membrane, and certain materials should be removed.
  - Oxygen
  - Glucose
  - Carbon dioxide
  - Water

Transport

- Cell membranes are selectively permeable.
- SMALL and UNCHARGED things pass through the phospholipid bilayer easily like carbon dioxide and oxygen.
- LARGE or CHARGED molecules like glucose or Na+ have difficulty passing through.
  - Large and charged things have to go through a protein to get in or out of a cell.

Crossing the Membrane

- Materials pass through the membrane by PASSIVE or ACTIVE transport
  - Passive – No energy required
  - Active – Requires energy (ATP)

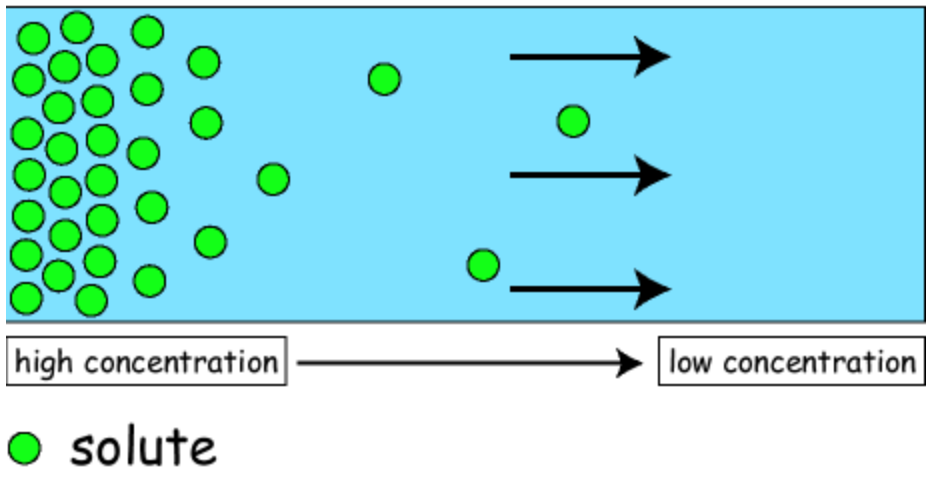


THE FLUID MOSAIC MODEL

Passive transport

Passive transport

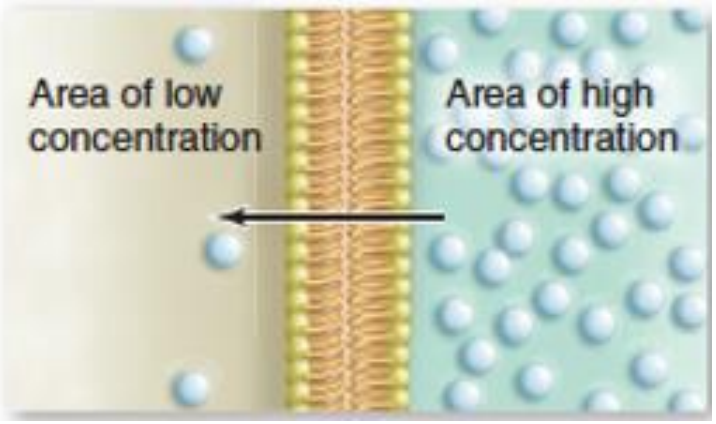
- No energy required
- 3 types
  - Diffusion
  - Facilitated diffusion
  - Osmosis

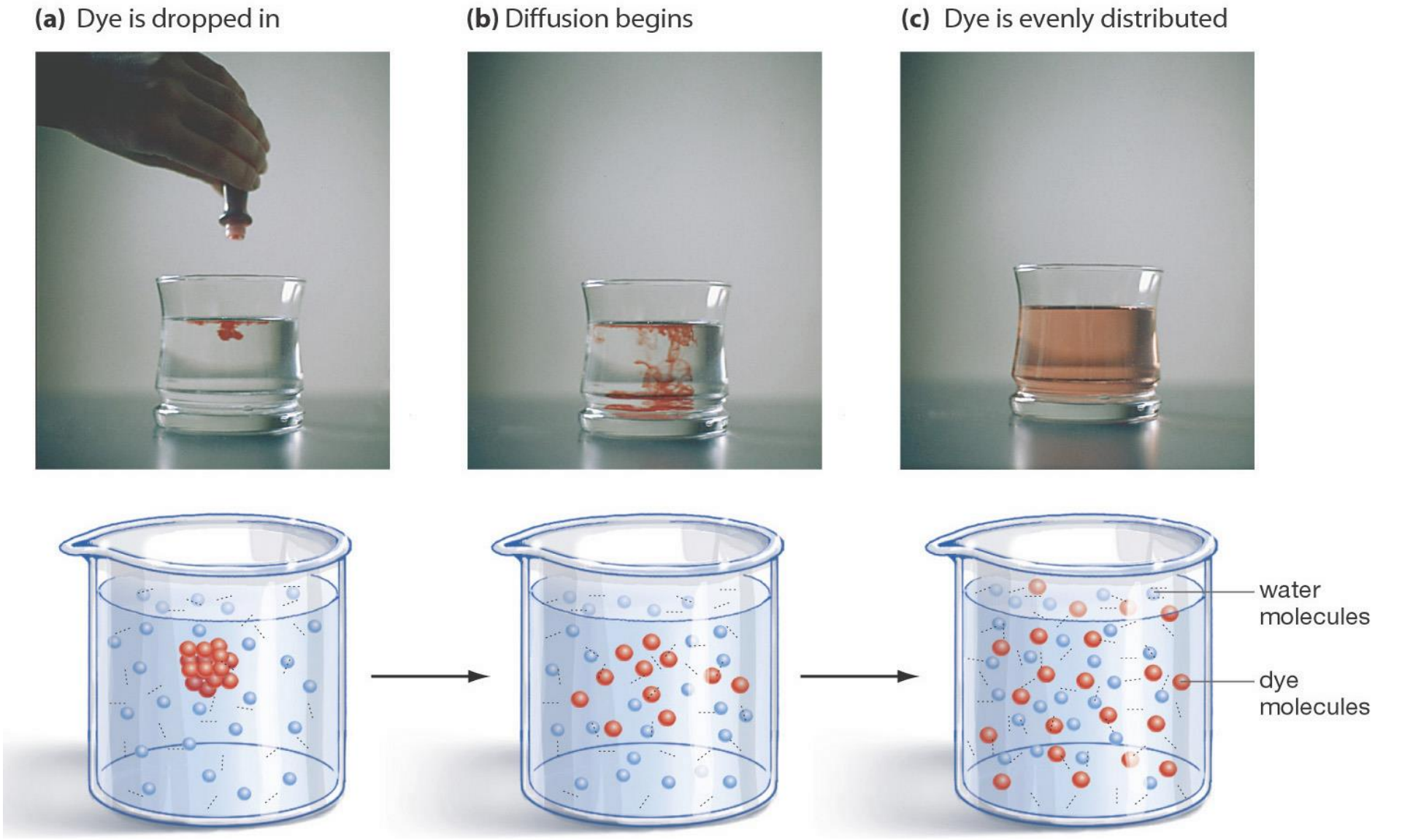


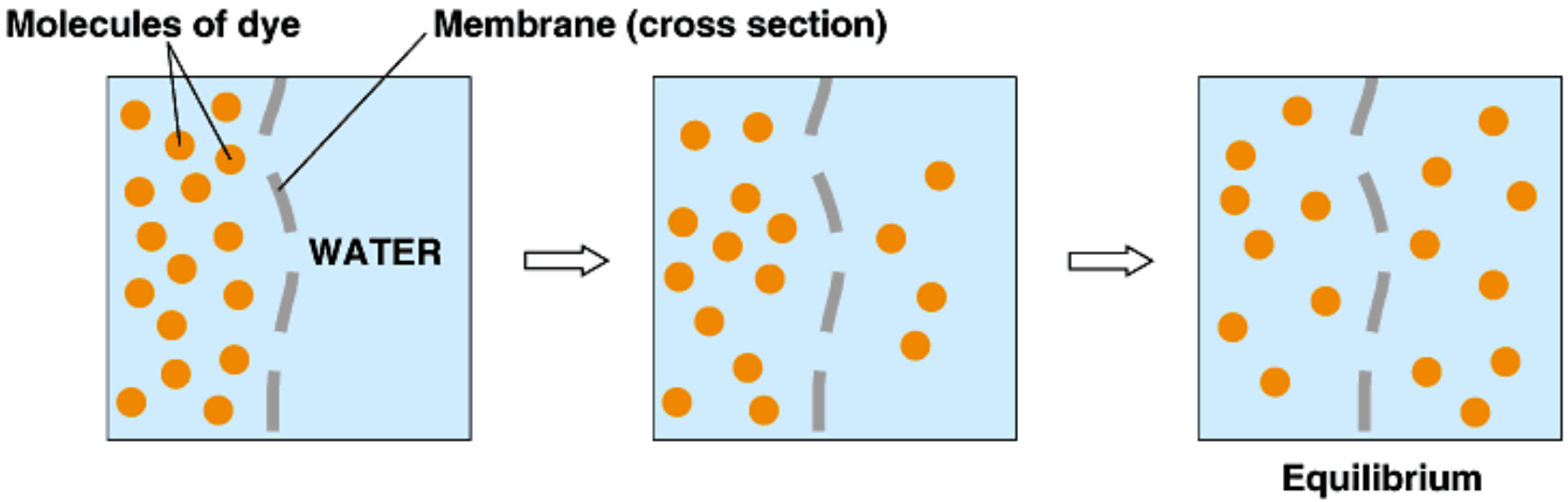
Diffusion

- Moves particles down concentration gradient
  - High concentration to low until equilibrium is reached
    - Equilibrium = equal concentration throughout
  - Examples: Air freshener, dye in water
  - Across a membrane: Small or Uncharged solutes can move

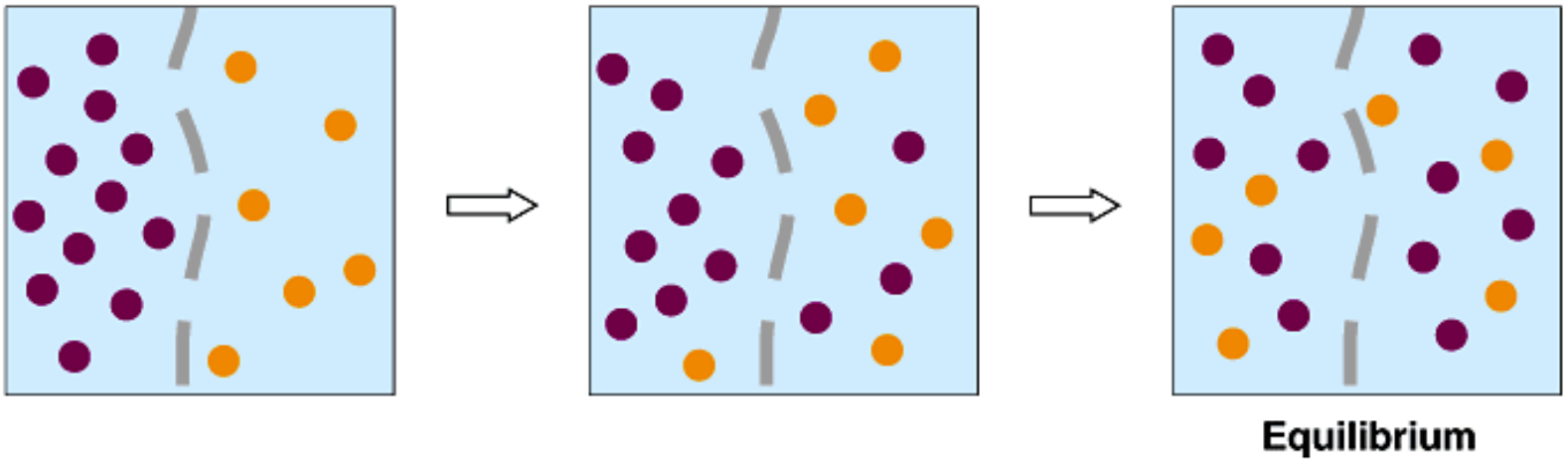
Animation




(a) Dye is dropped in
(b) Diffusion begins
(c) Dye is evenly distributed
water molecules
dye molecules



(a) Diffusion of one solute



(b) Diffusion of two solutes

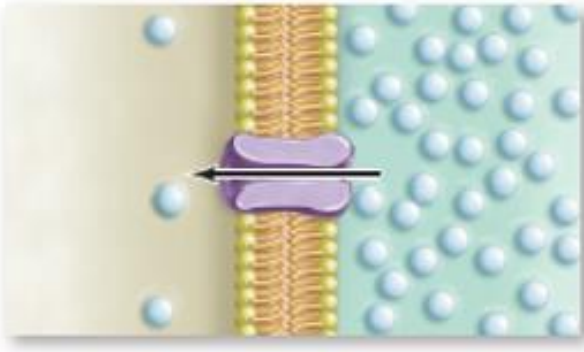
CFU

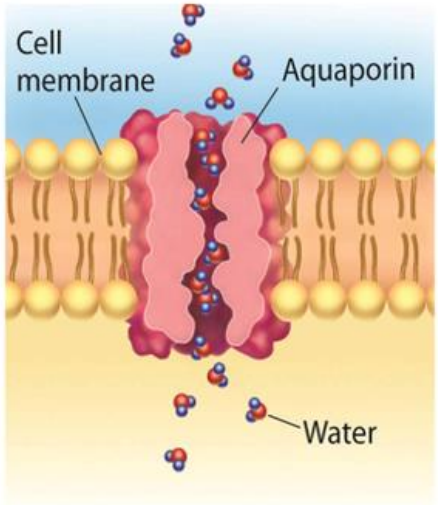
- What things can pass through a cell membrane without a protein?
- What is the energy requirement for passive transport?
- How does solute move in diffusion?

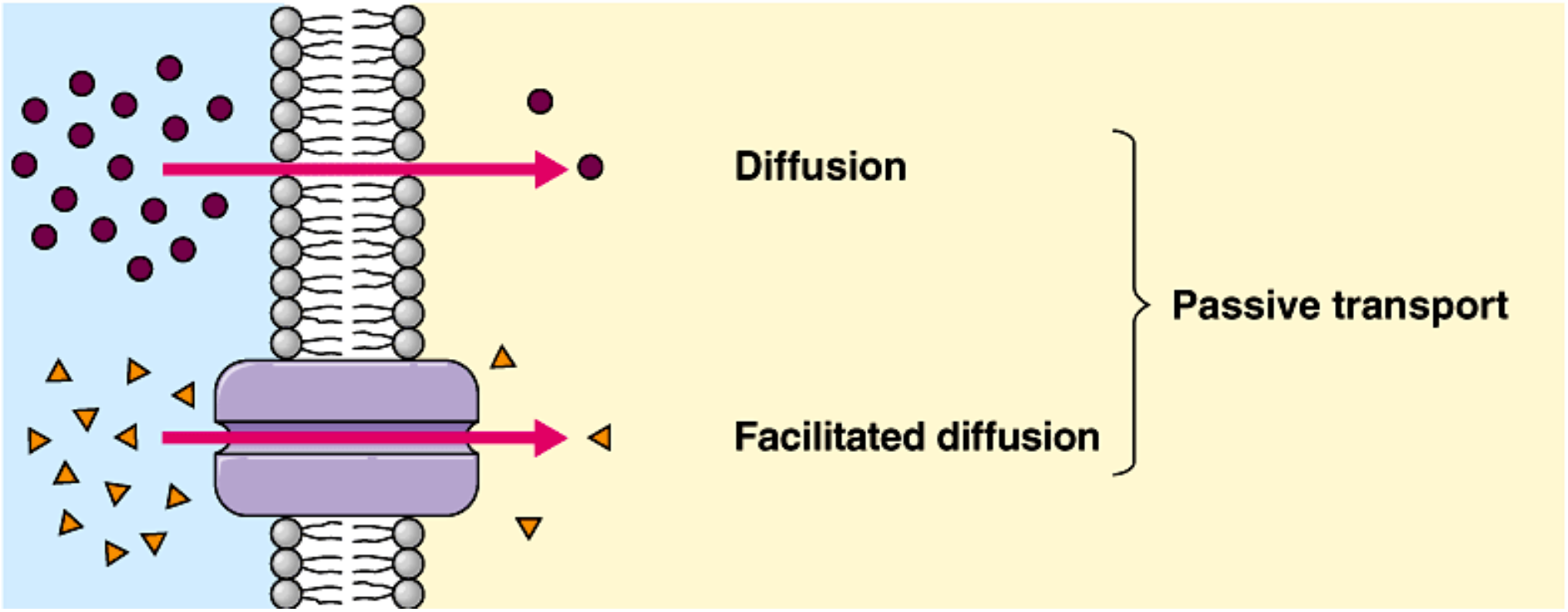
Facilitated diffusion

Animation

- Transport proteins found in the membrane move certain materials across the membrane
  - Cannot cross the membrane except through proteins (Large or charged)
  - Moves down concentration gradient
  - Glucose transported this way
  - Water moves this way through AQUAPORINS
    - *NOTE: Water can also diffuse directly through the membrane, however, the need for water movement is so great, this is supplemental



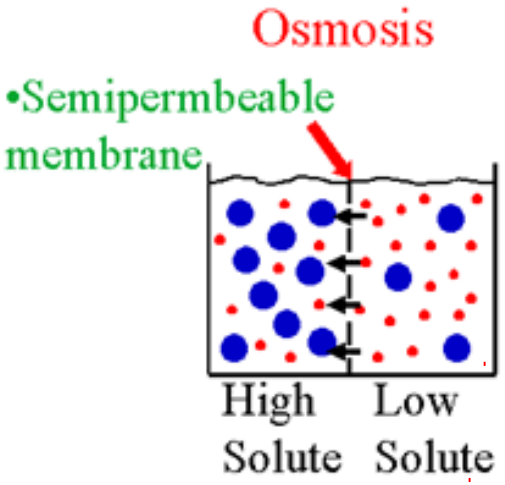



Diffusion
Facilitated diffusion
Passive transport

Osmosis

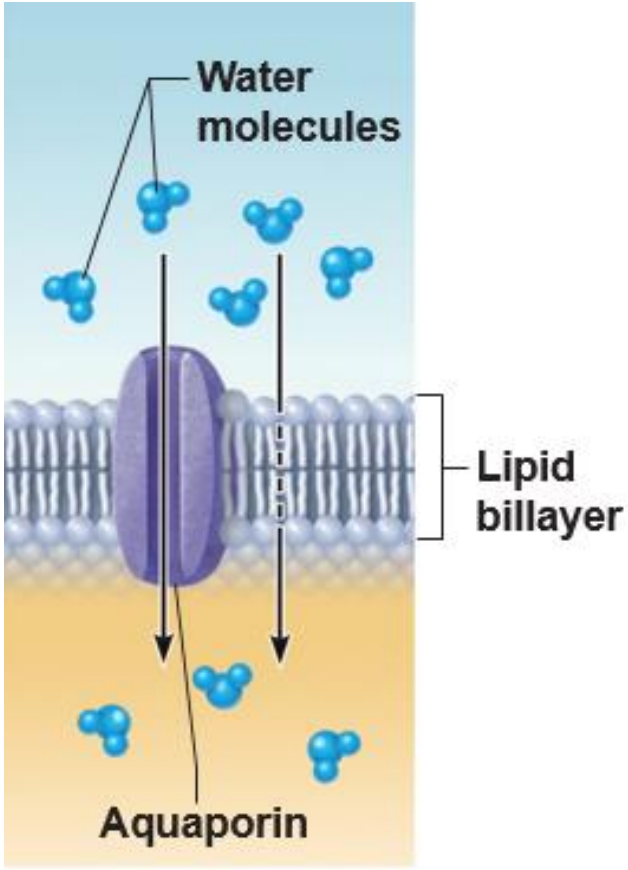
- The diffusion of **water** across a semi-permeable membrane from an area of high water concentration to low water concentration
- Used to BALANCE CONCENTRATION on either side of membrane
- (Water moves to the area more concentrated with solute)

Animation



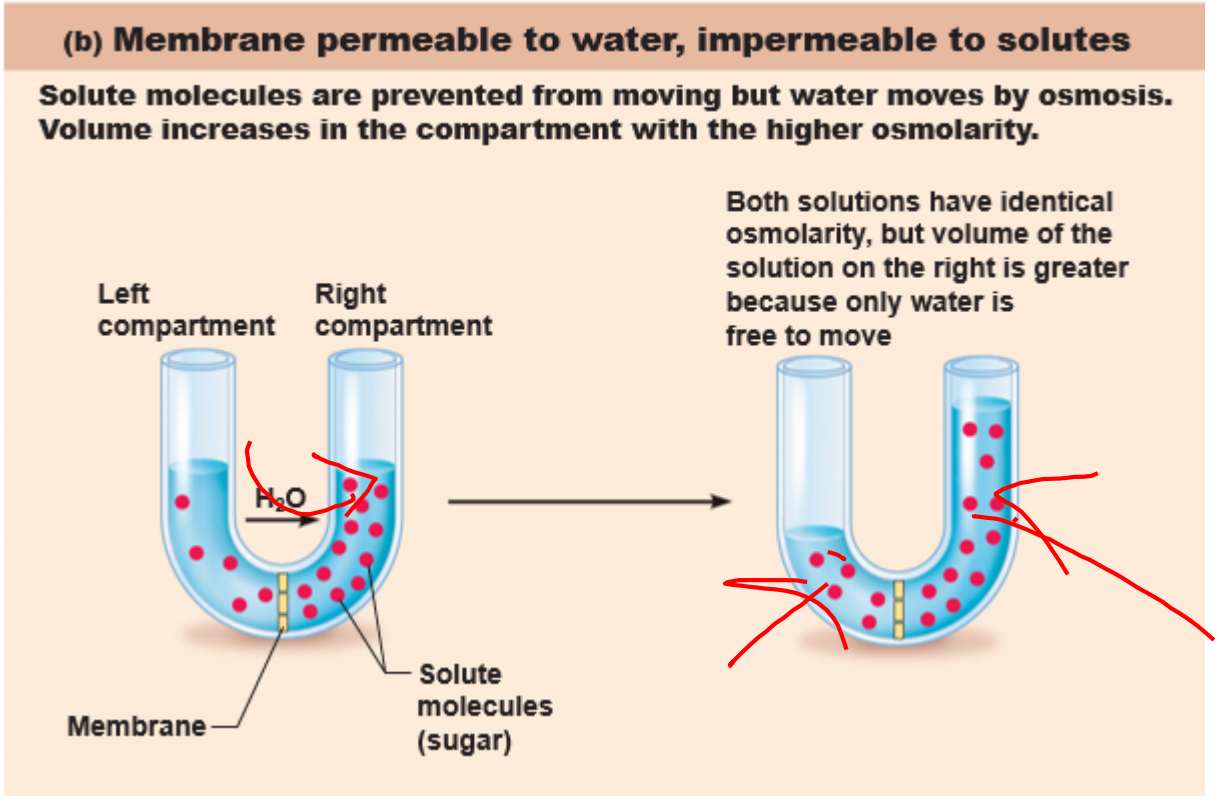
Osmosis

- Water can diffuse through membrane and use aquaporins



Osmosis

- For example: If a solute (ex. Sugar) is TOO Big to get across the cell membrane than water will move to balance out the concentration on either side (dilute the side with more solute- sugar)

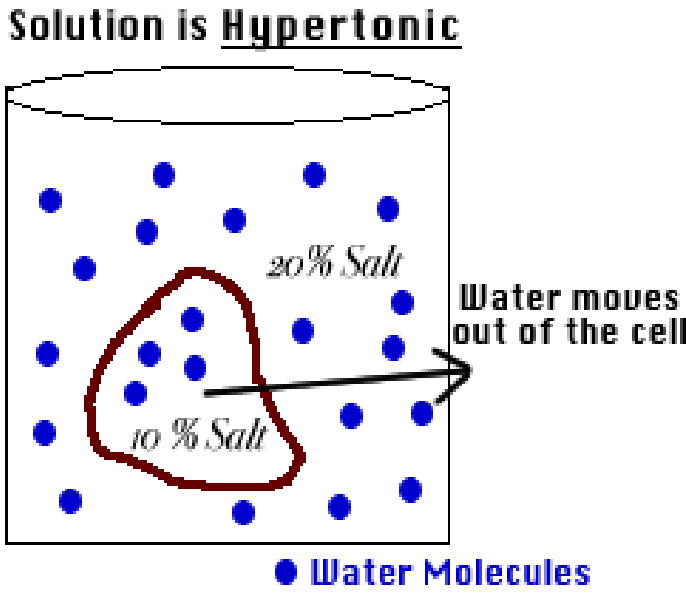


CFU

- What is the difference between diffusion and facilitated diffusion?
- How is osmosis different from diffusion?
- How does water move in osmosis?
- Why does water move in osmosis?

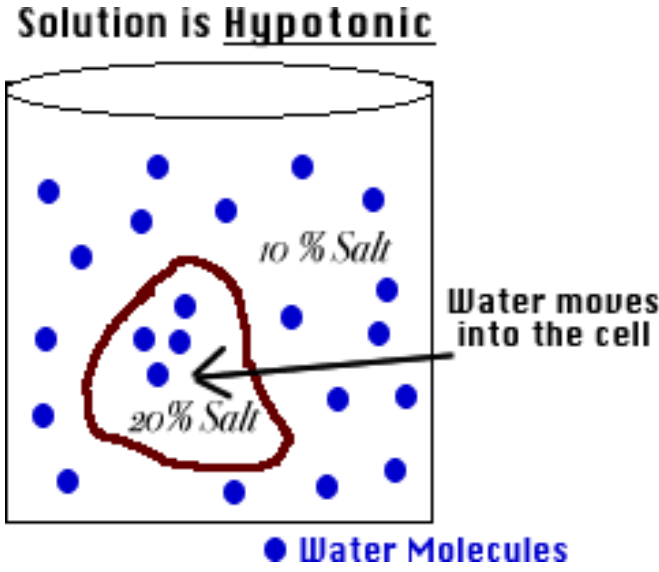
Types of Solutions

- Hypertonic
  - The solution has a high concentration of solutes in a solution
  - The cell will shrivel
  - Water is drawn from the cell to the surrounding environment, to reach equilibrium



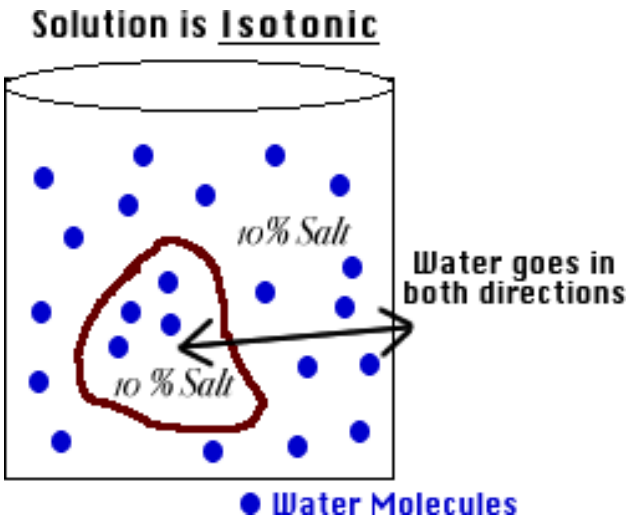
Types of Solutions

- Hypotonic
  - Low amounts of dissolved solutes in a solution
  - A cell will have water from the surroundings come into the cell
    - It may burst like a balloon (Lysed)
    - Attempting to reach equilibrium
    - Plants require this

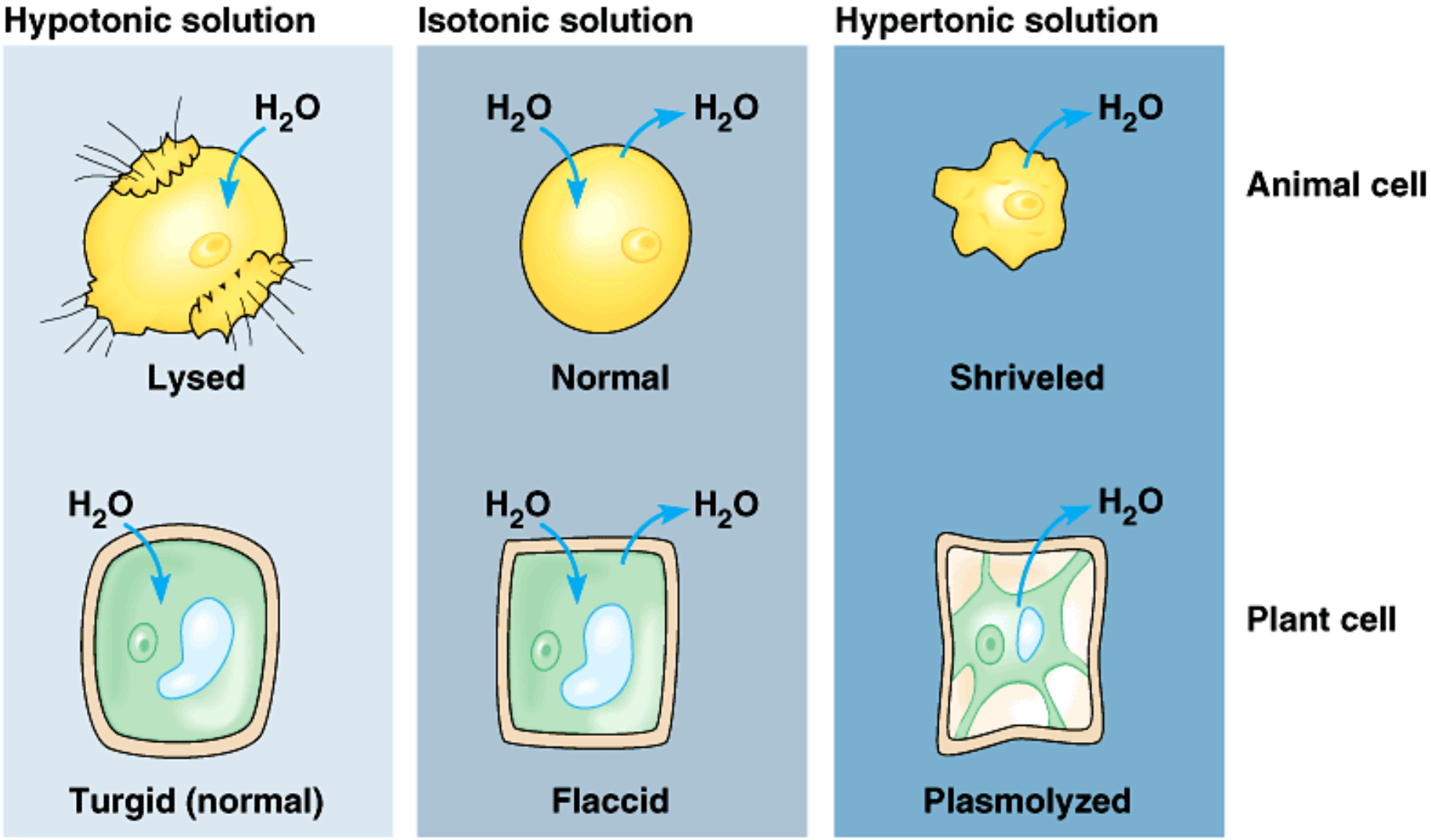


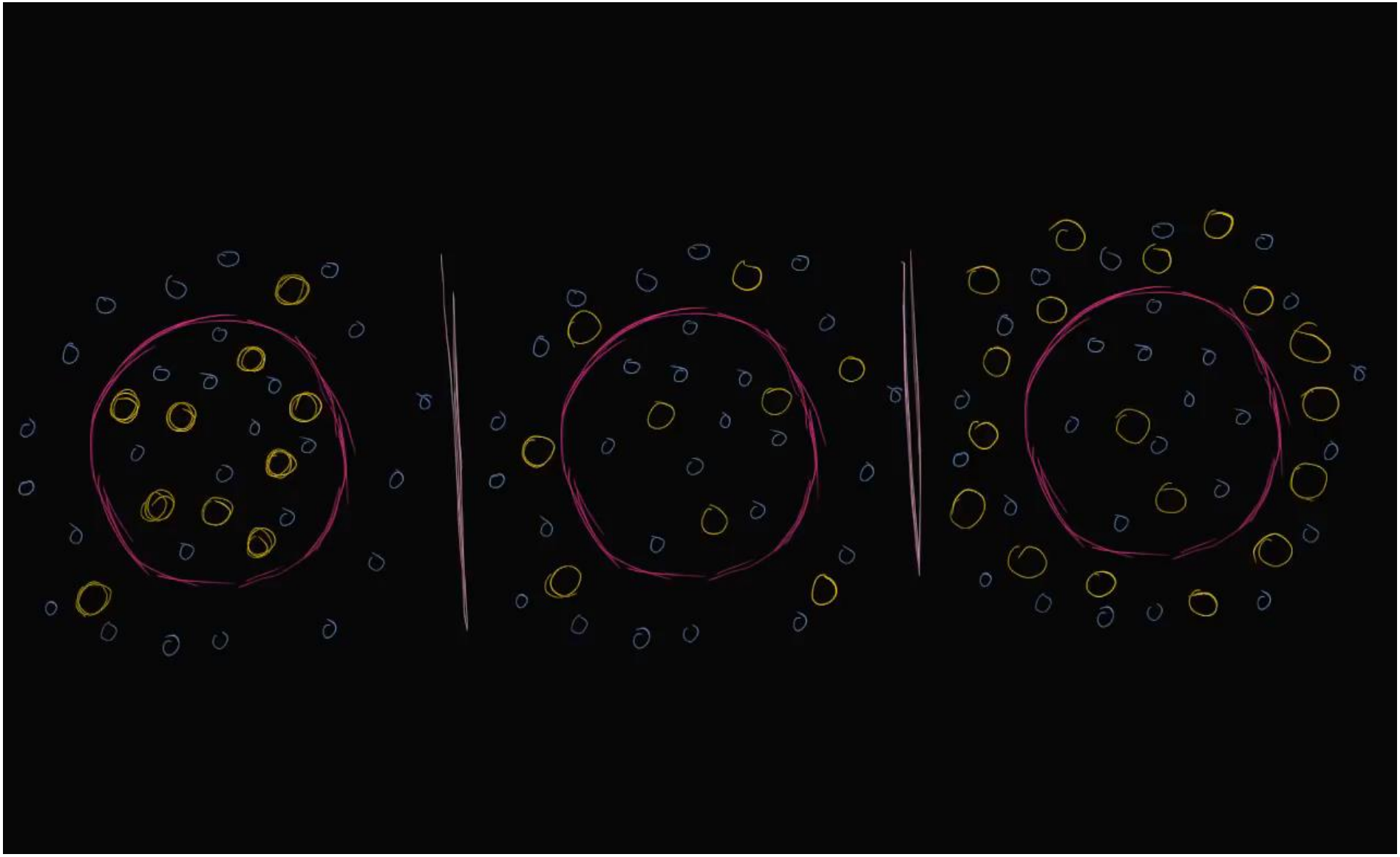
Types of Solutions

- Isotonic
  - Equal amounts of solutes in and out
  - Animal cells require this
  - Water moves BOTH in and out of cell



RESULTS OF OSMOSIS (and Osmotic Pressures)





CFU

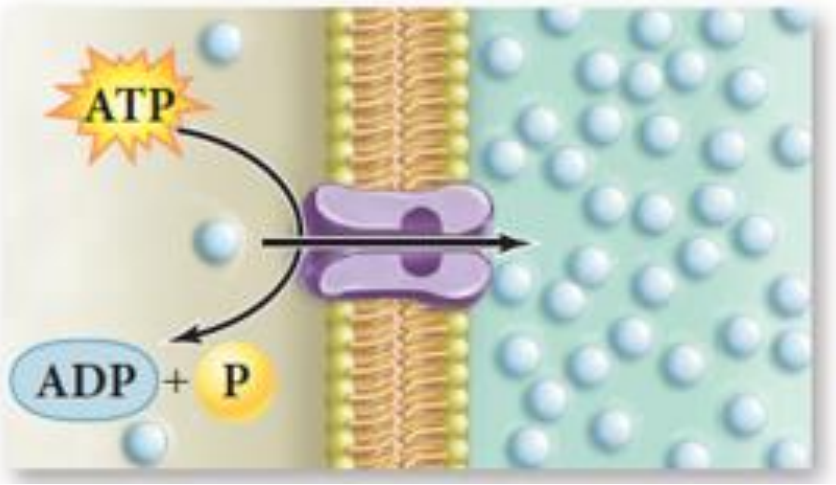
- If a solution has 10% solute and the cell has 50% solute, which way will water move? Is the solution hypertonic or hypotonic to the cell? Is the cell hypertonic or hypotonic to the solution?

- If a cell has 40% water and is placed in a solution with 80% water, which will water move? Is the cell hypertonic or hypotonic? Solution?
- If a animal cell is placed in a hypotonic solution- what happens to it? Plant cell?
- If an animal cell is placed in a hypertonic solution- what happens to it? Plant cell?

Active transport

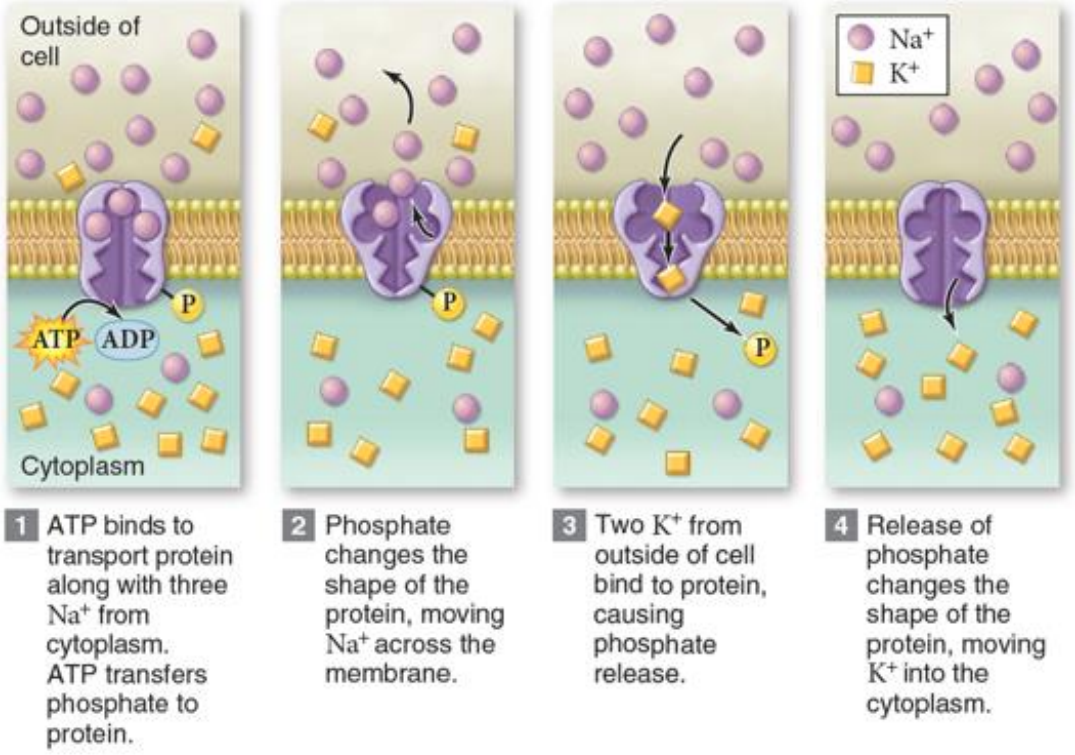
Active Transport

- **<u>Requires</u>** ATP
- Pumps materials against concentration gradient using a protein in membrane
- Examples
  - Calcium, potassium, and sodium ions
  - Proton pump

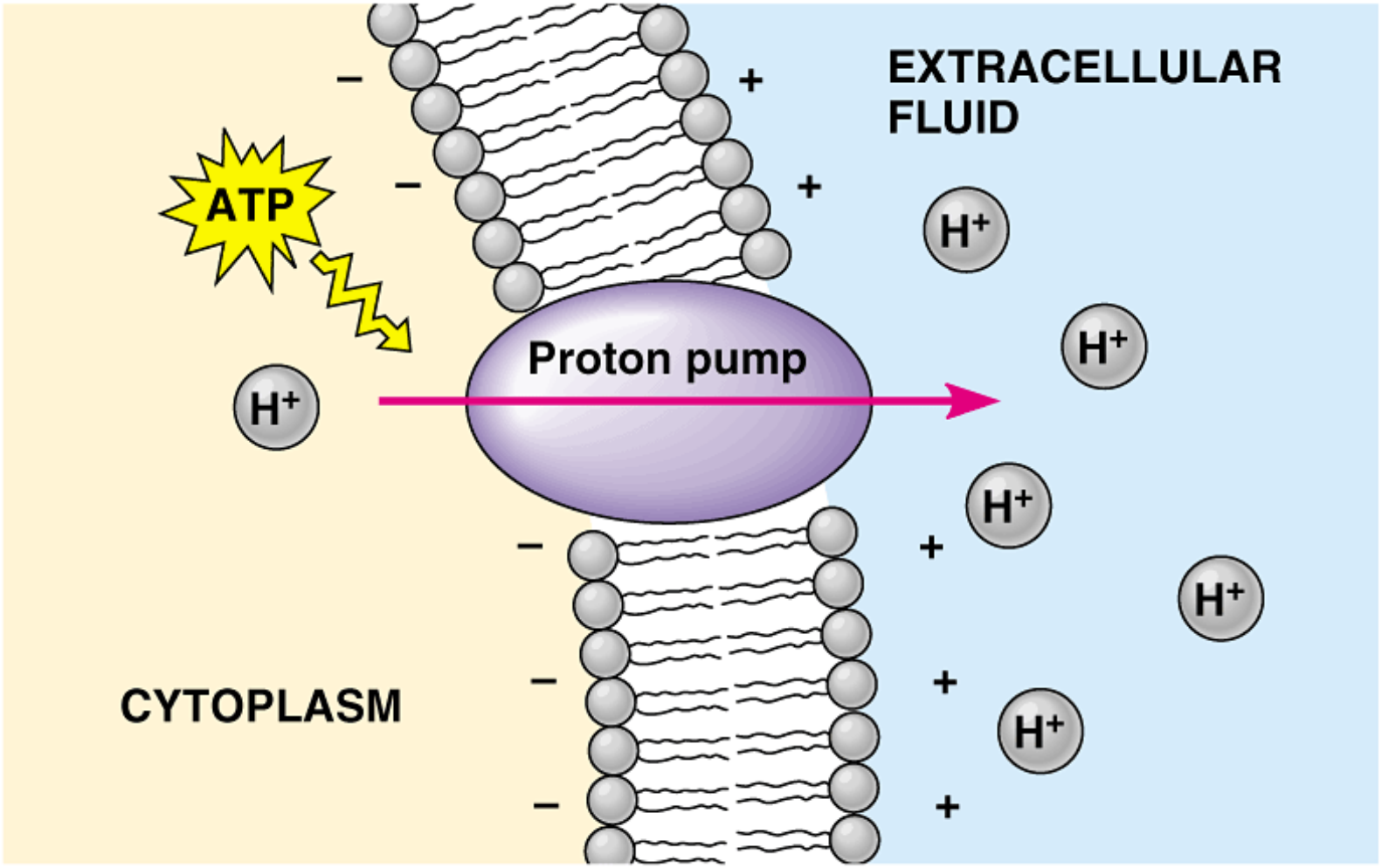


- Sodium/Potassium Pump
  - High Na^+ outside cell; High K^+ inside cell
  - Pump moves 3 Na^+ out for every 2 K^+ in
  - Both ions move against their gradients

[Animation]



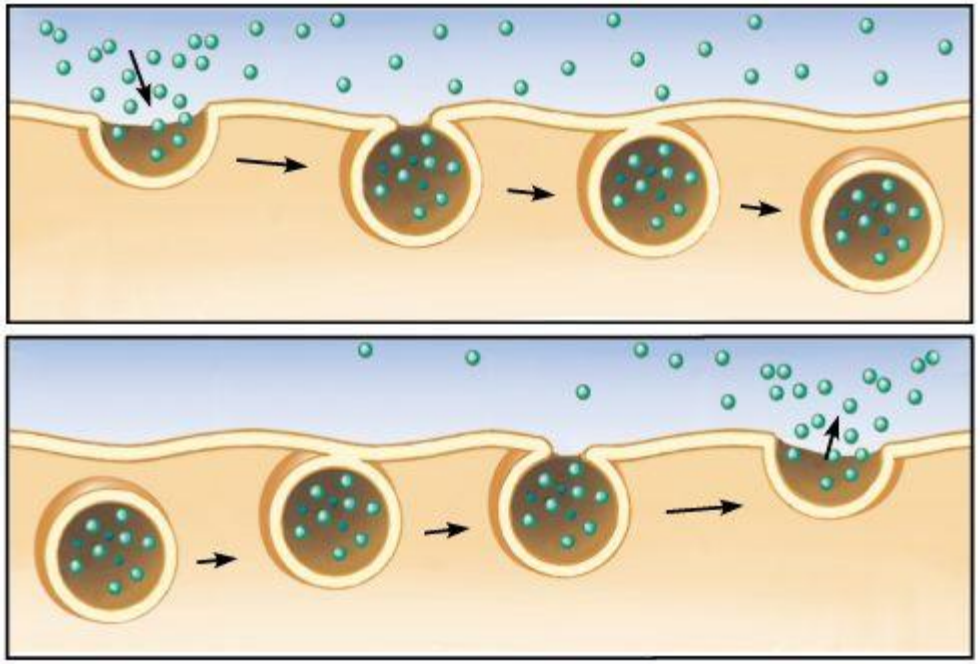
- Proton Pump



Bulk Transport

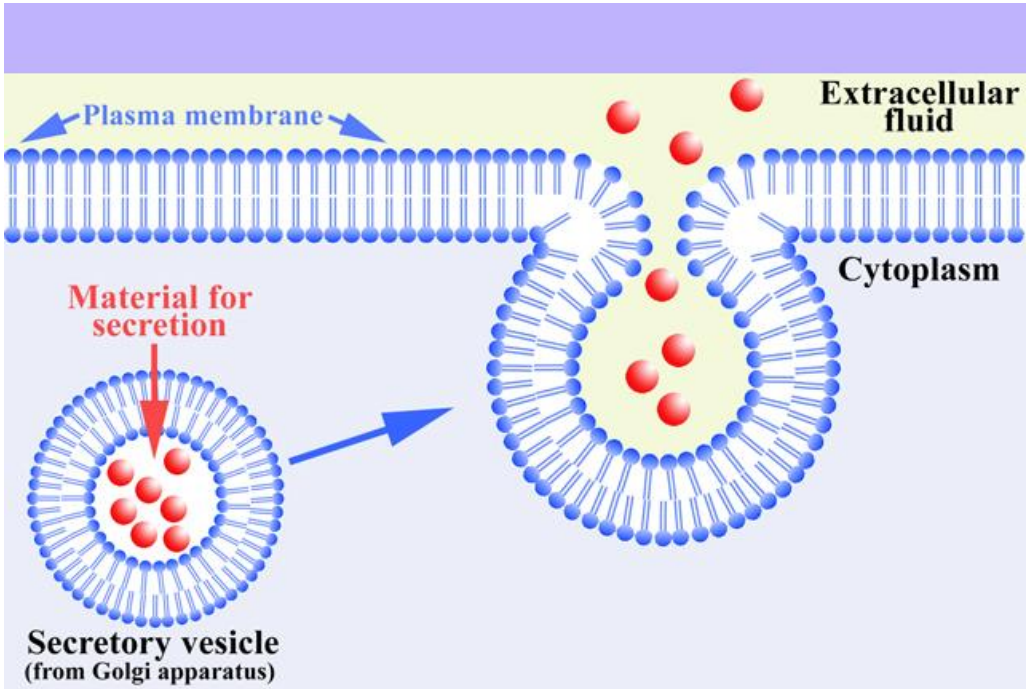
2 Methods:

1. Exocytosis
2. Endocytosis



Exocytosis

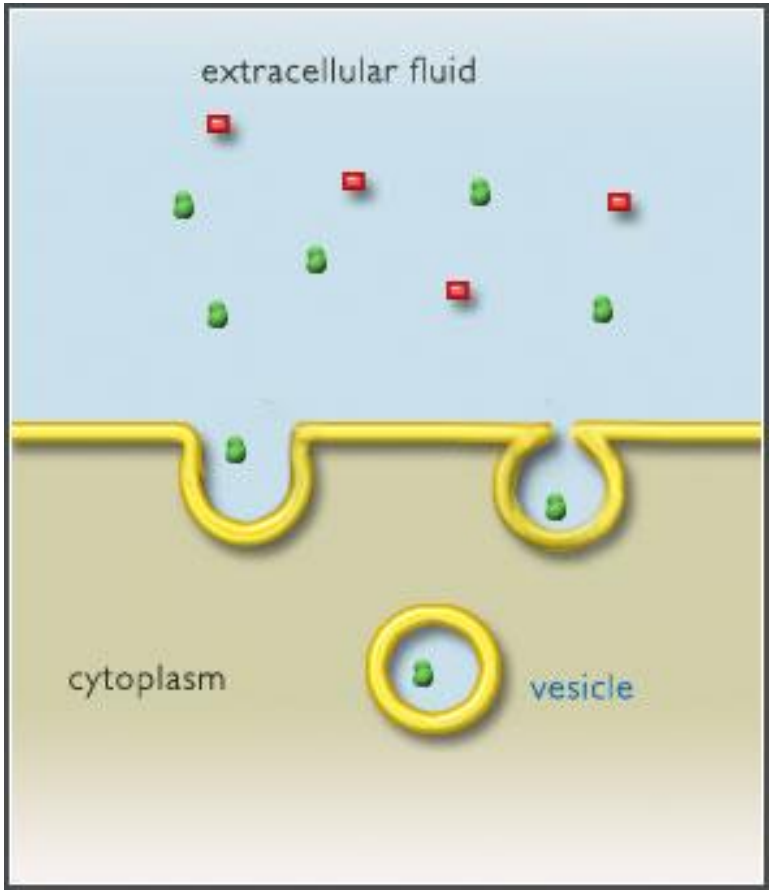
- Moving materials out of the cell
- Golgi creates a vesicle to fuse w/ the membrane
  - Example: Pancreatic cells releasing insulin into the blood stream to regulate blood sugar.



Endocytosis

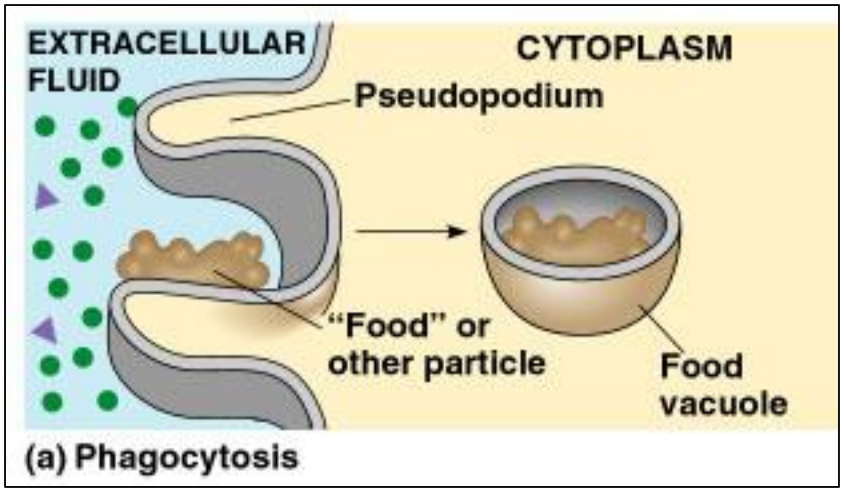
- Moving of large molecules into the cell
- Cell membrane pinches in to create a vesicle
- 2 Types:
  1. phagocytosis
  2. pinocytosis

animation

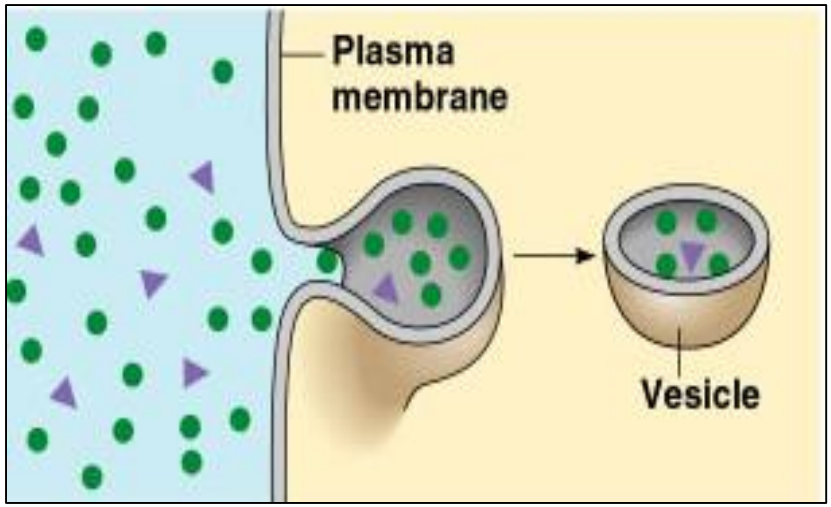


Phagocytosis v. Pinocytosis

- **pseudopodia** extend and engulf the particles
- **cell "eating"** animation



- cell creates a vesicle around the fluid
- **cell "drinking"**



CFU

- What is required for active transport?
- What is the difference between facilitated diffusion and active transport?
- When is active transport used?
- How are exocytosis and Golgi apparatus related?
- Give an example of endocytosis.
- Why doesn’t endocytosis or exocytosis destroy a cell membrane?