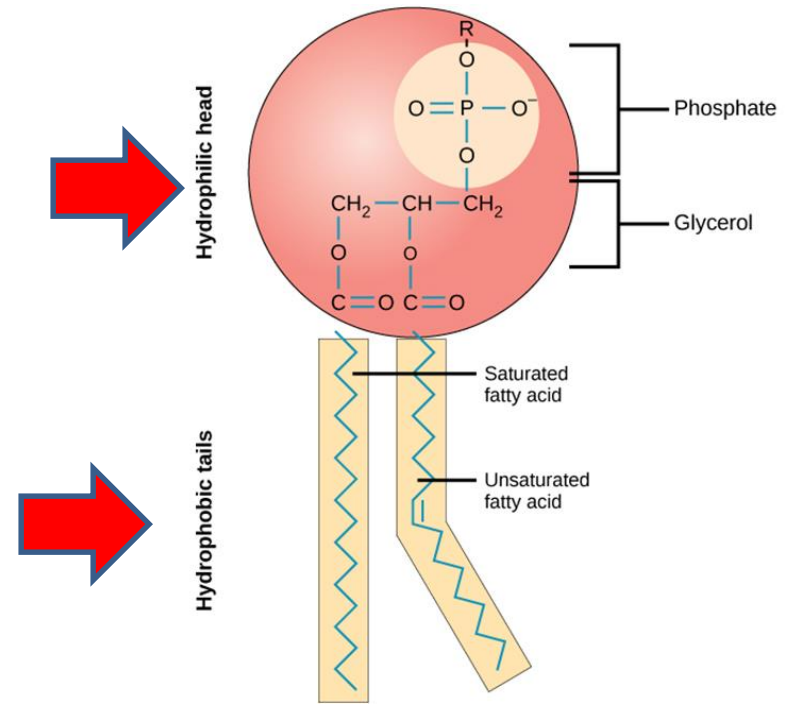
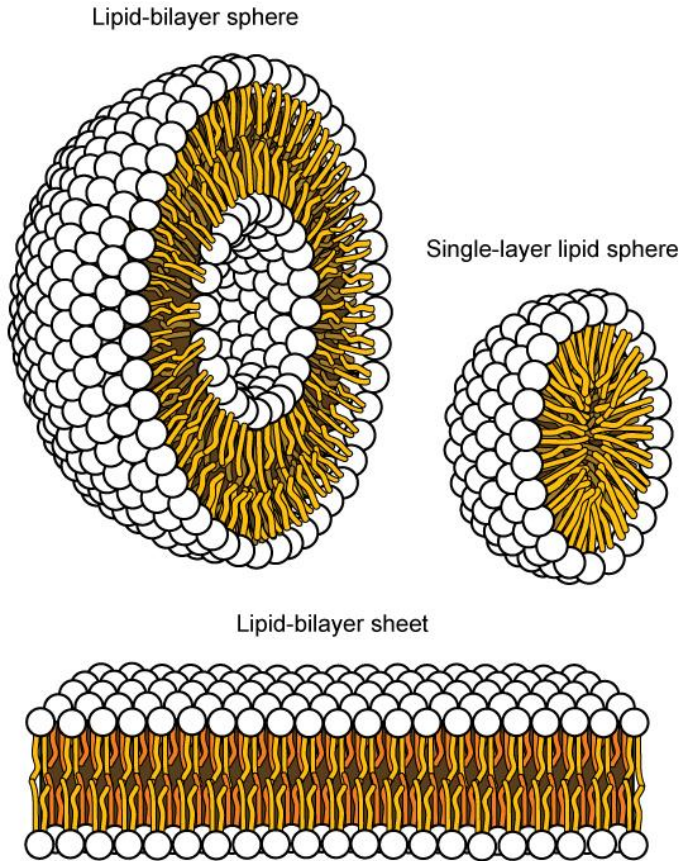


1.4 Membrane Structure and Function

Part 1: Structure and Cell Size

1. Biochemistry
AP Biology: The Cell

Phospholipids

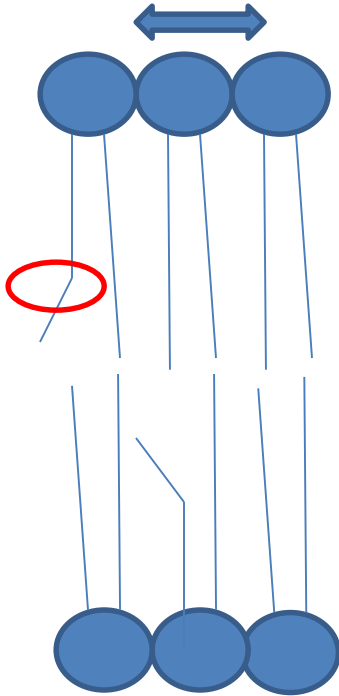


Amphipathic Molecules:
Hydrophobic AND Hydrophilic properties

Orients hydrophobic ends away from water and orients hydrophilic ends toward water.

Allows for Bilayer formation

Membrane Fluidity



Lateral movement of phospholipids

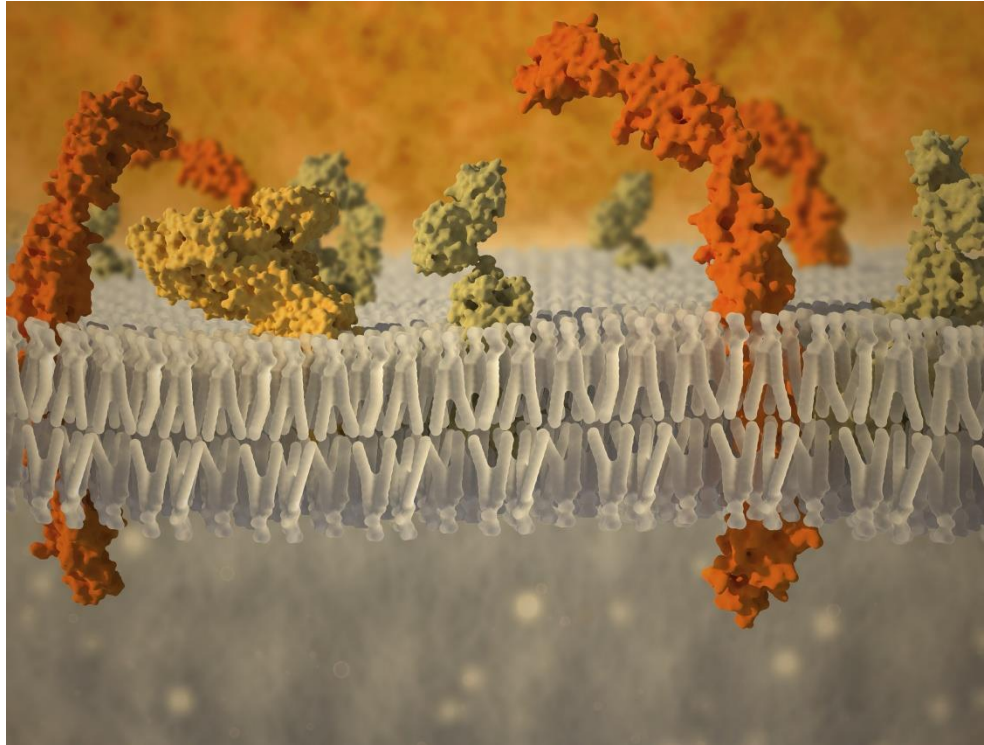
Unsaturated Fatty Acids: increase fluidity

Saturated Fatty Acids: decrease fluidity

Cholesterols: Animal Cells ONLY

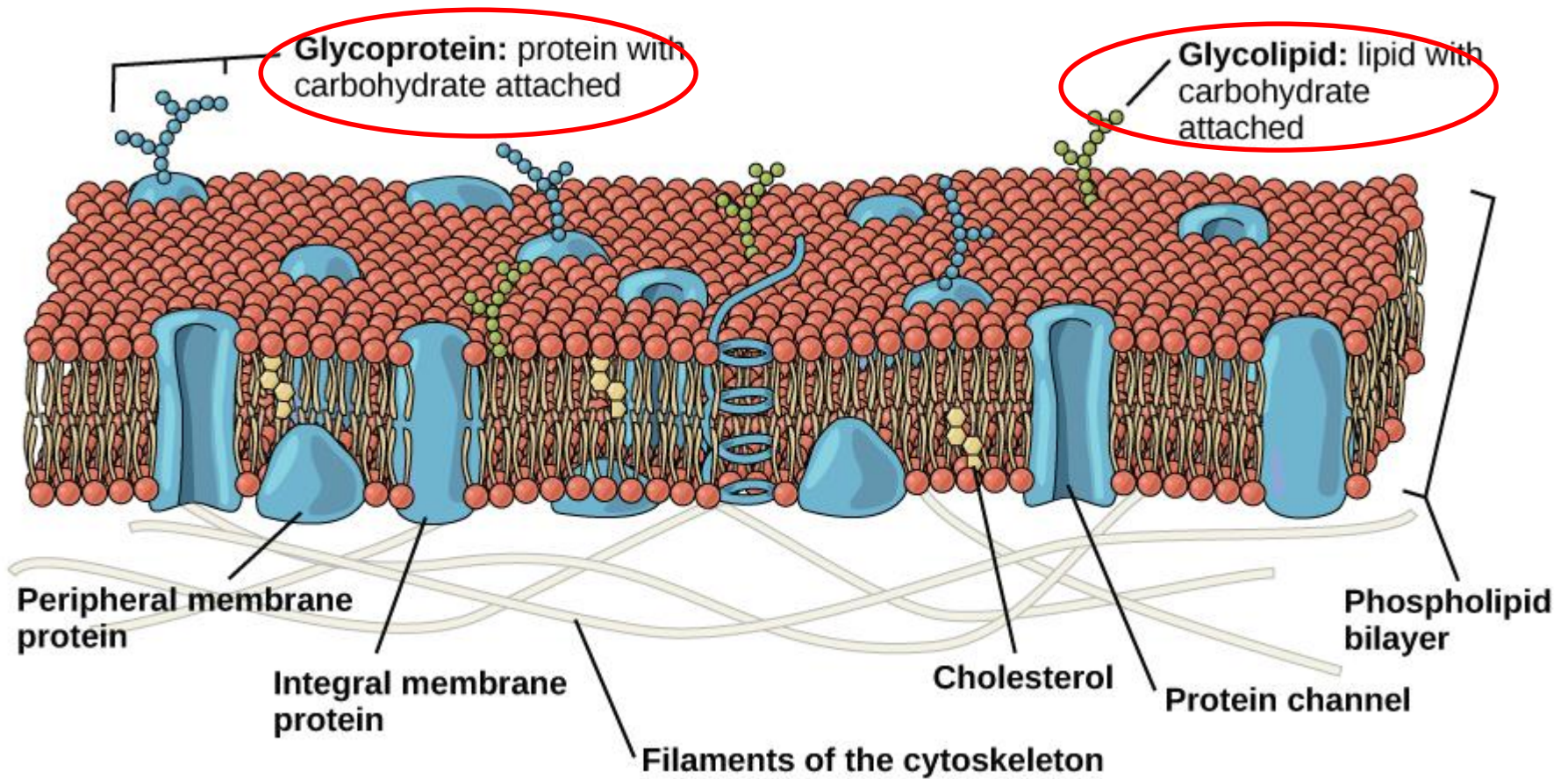
Fluidity Buffer

Fluid Mosaic Model



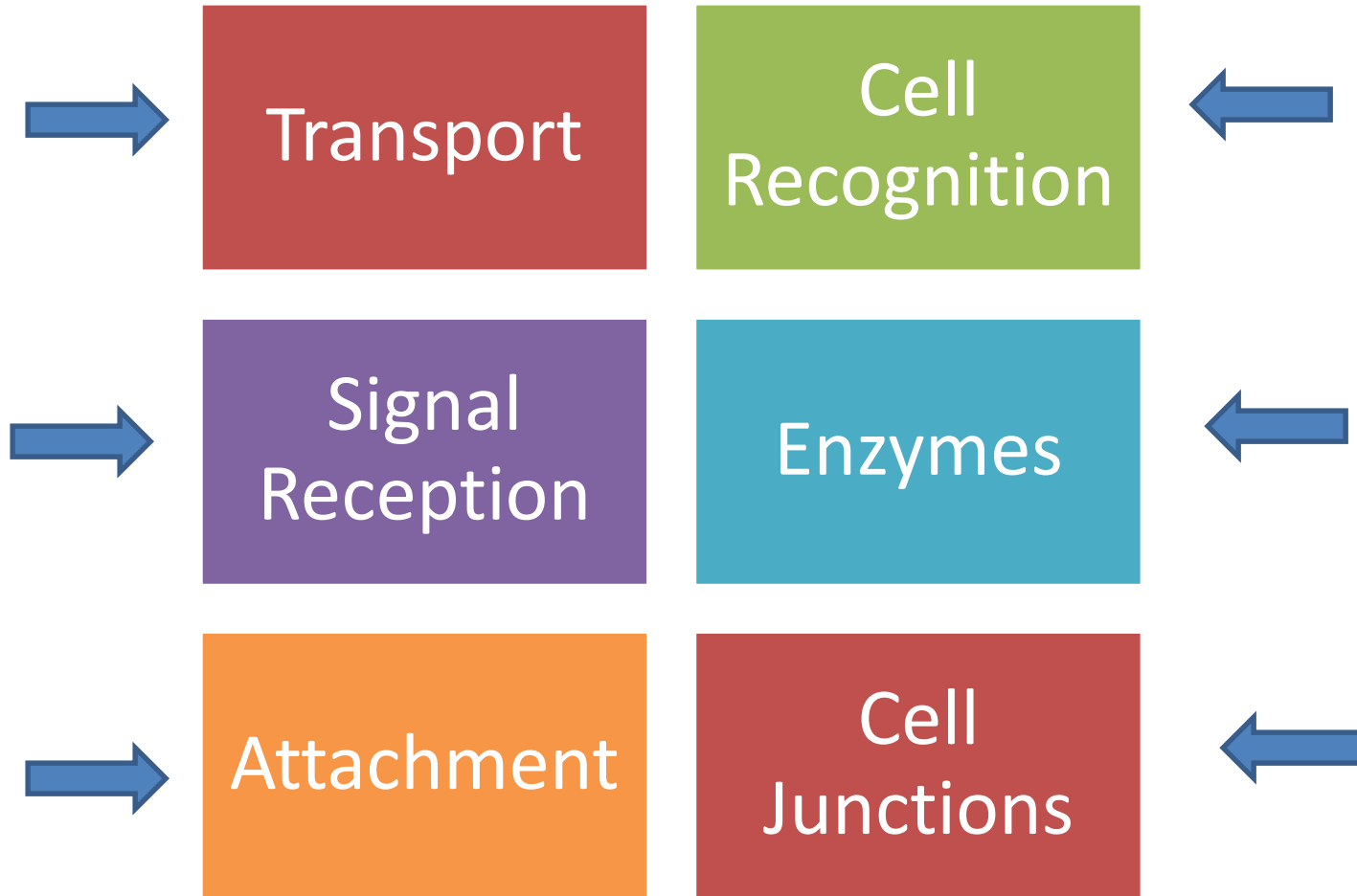
Membrane structure is fluid while various proteins and other molecules are embedded throughout the membrane allowing for various functions and permeability.

Components of the Membrane

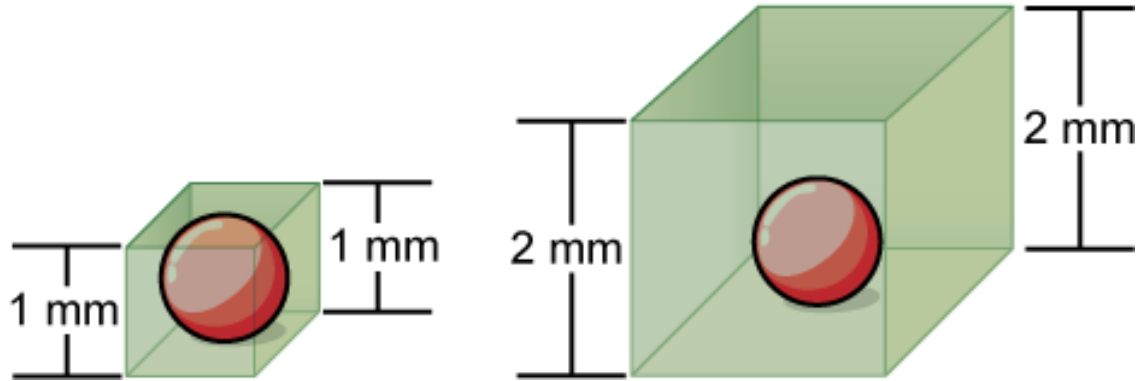


Glycolipids and Glycoproteins are recognition molecules – short polysaccharide chains are added as ID markers
Blood Types A and B refer to these types of markers.

Proteins of the Membrane



Restrictions to Cell Size



Larger the Cell, the smaller the surface area to volume ratio – inefficient for movement of substances across the membrane.

The GREATER surface area to volume ratio – more efficient the cell to exchange material with environment

1.4 Membrane Structure and Function

Part 2: Selective Permeability

1. Biochemistry
AP Biology: The Cell

Passive Transport

Diffusion

- Substances pass directly through the membrane

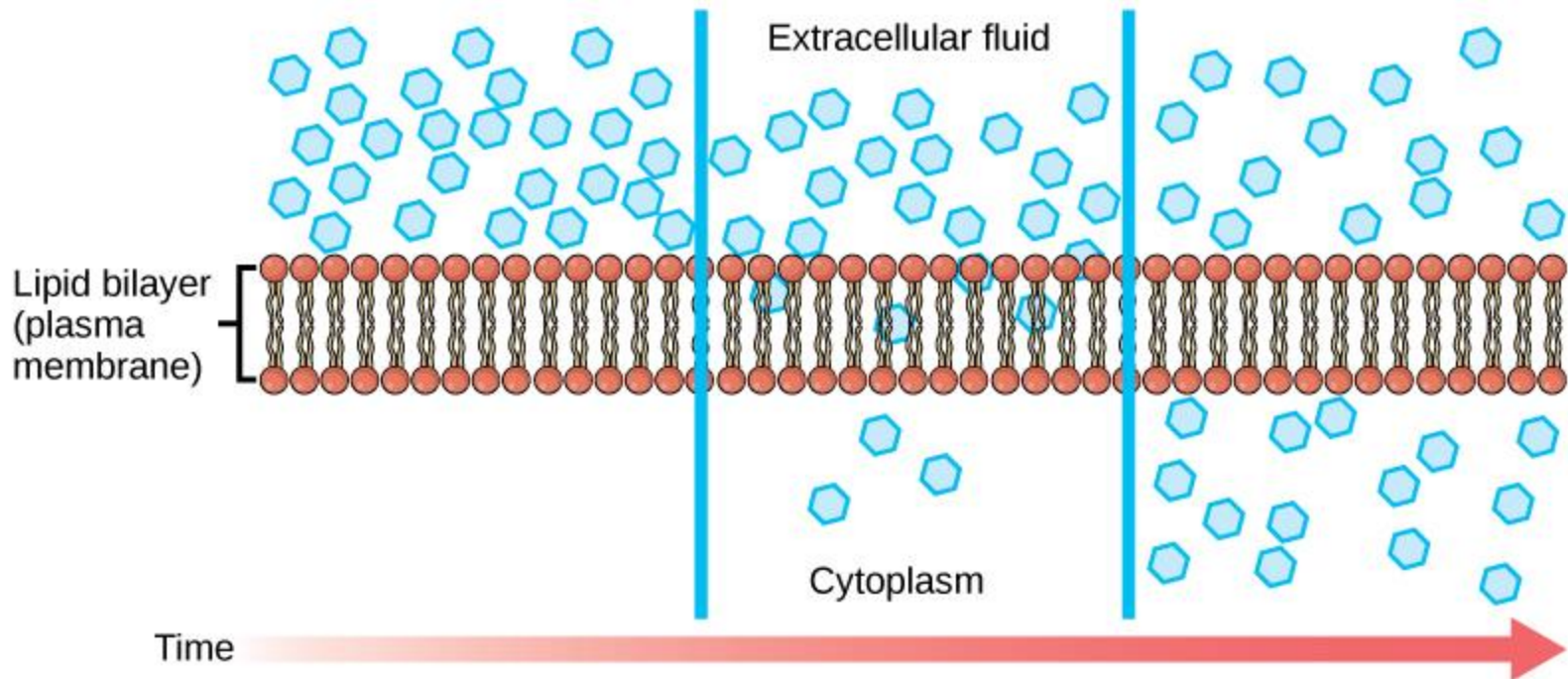
Facilitated Diffusion

- Polar and ionic substances
- Uses Protein; No Energy

Osmosis

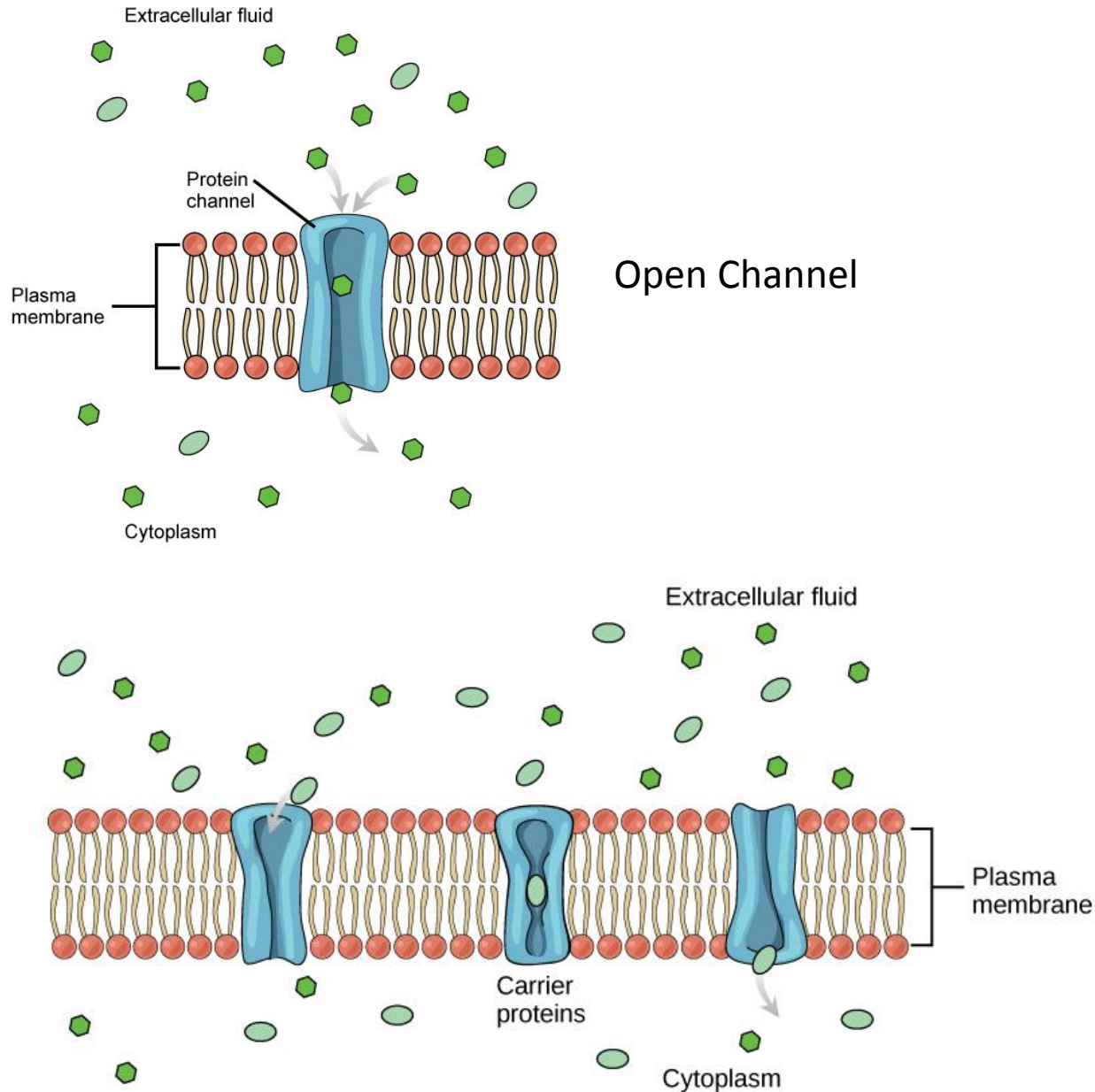
- Movement of Water
- Low solute to high solute

Simple Diffusion



Small, non-polar molecules can pass directly through the membrane –
Oxygen Gas; Carbon Dioxide

Facilitated Diffusion



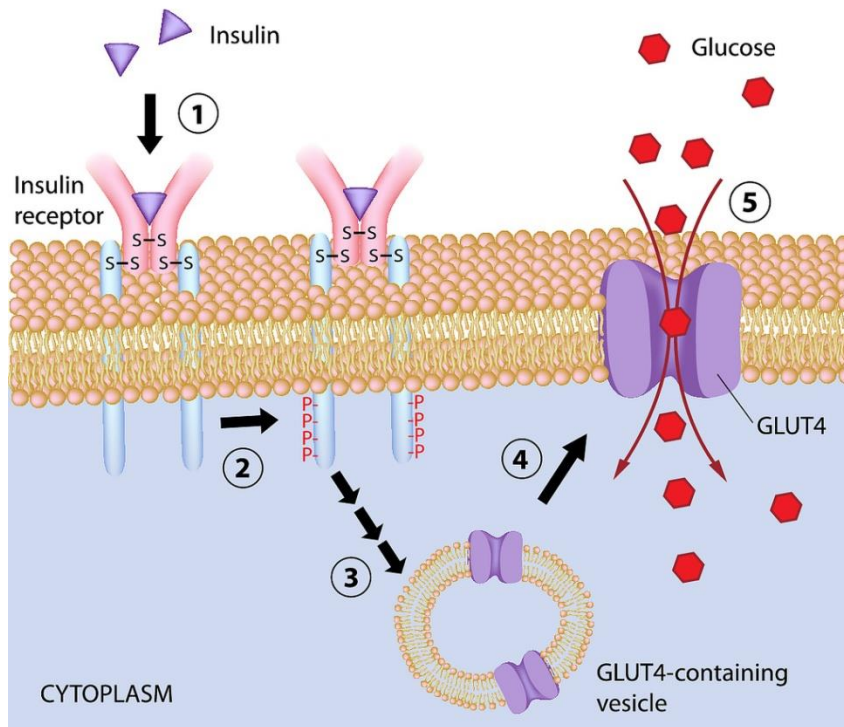
Ionic and Polar
Substances must
use a transport
protein to get
into the
membrane
Ex: Ions, Water

Substance
Specific:
Aquaporin

Gated Channels:
require a
stimulus or ligand
to trigger
opening of the
channel

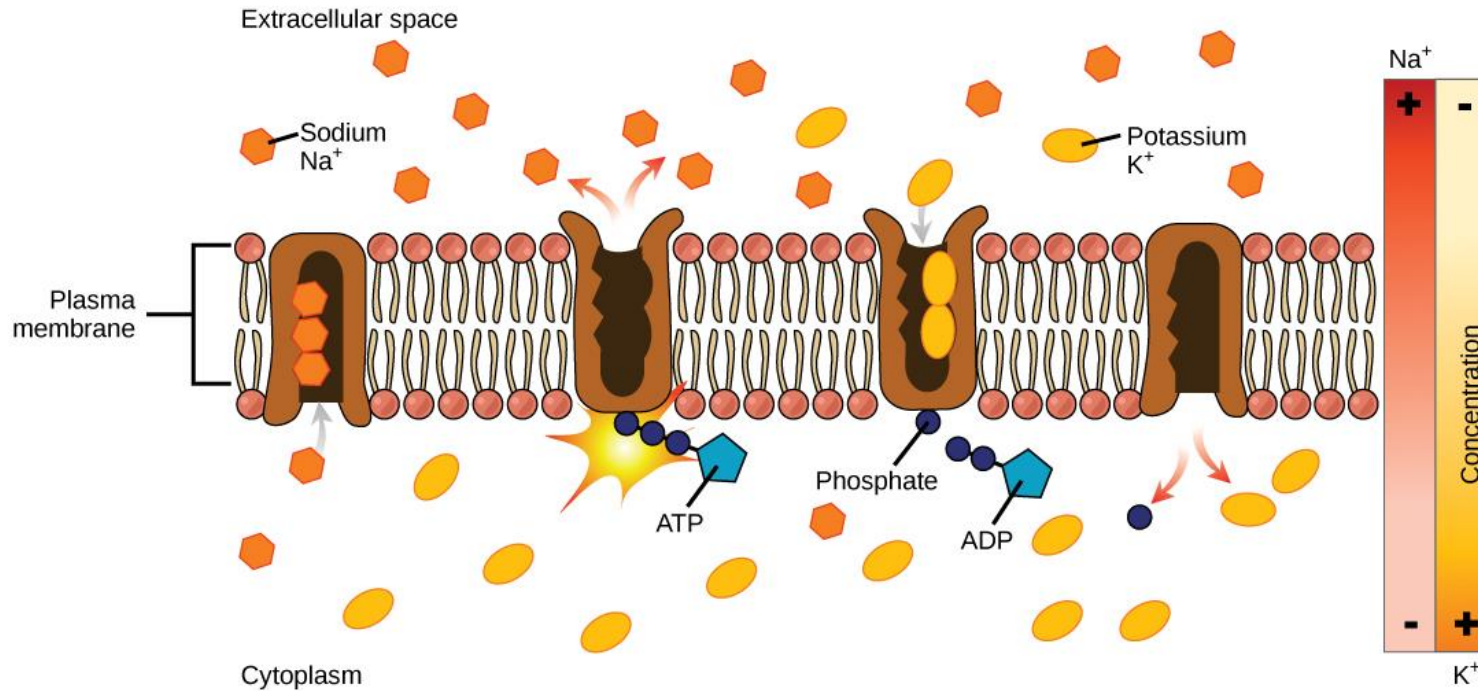
Facilitated Diffusion

Effect of Insulin on Glucose Uptake



Some Channels are produced only when specific signals are given such as the glucose transporter

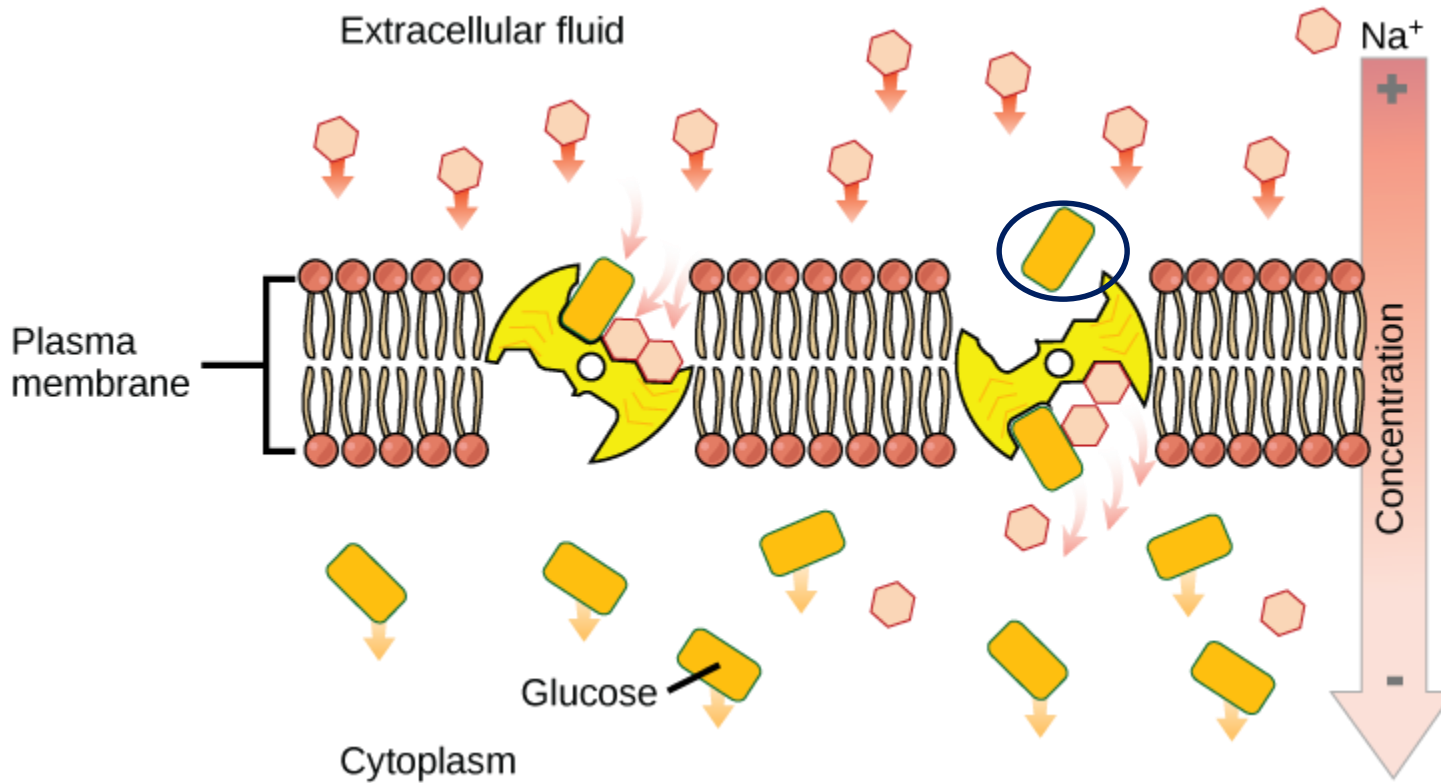
Active Transport



Uses Energy to move substances AGAINST their GRADIENT, forms an electrochemical gradient – changes the membrane potential

Some transporters use ATP as the source of energy.
EX: Proton Pumps and Sodium/Potassium Pumps

Active Transport



CoTransport Systems are ACTIVE TRANSPORT – They use ions diffusing down their gradient to pull in another substance. Proton pumps make a proton gradient which allows diffusion of the proton to move a substance against the gradient.

1.4 Membrane Structure and Function

Part 3: Osmosis and Bulk Transport

1. Biochemistry
AP Biology: The Cell

Osmosis

HYPO



HYPER

Water moves from LOW Solute Concentration to areas of HIGH solute concentration.

Tonicity compares the ENVIRONMENT to the CELL:

Hypotonic : Low Solute (More WATER, Less STUFF)

Isotonic: Same Concentration (Equilibrium) – water moving into and out of the cell at EQUAL RATES.

Hypertonic: High Solute (Less WATER, More STUFF)

TERMS ARE RELATIVE To Compared Solutions

Saltwater

VS

Fresh Water

Hypertonic

Hypotonic

Fresh Water

VS

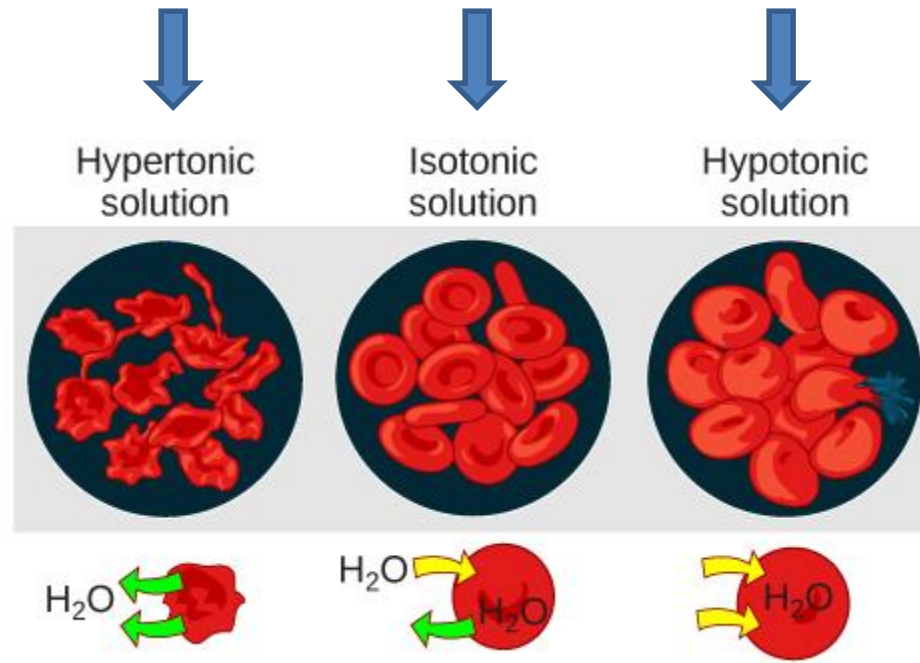
Distilled Water

Hypertonic

Hypotonic

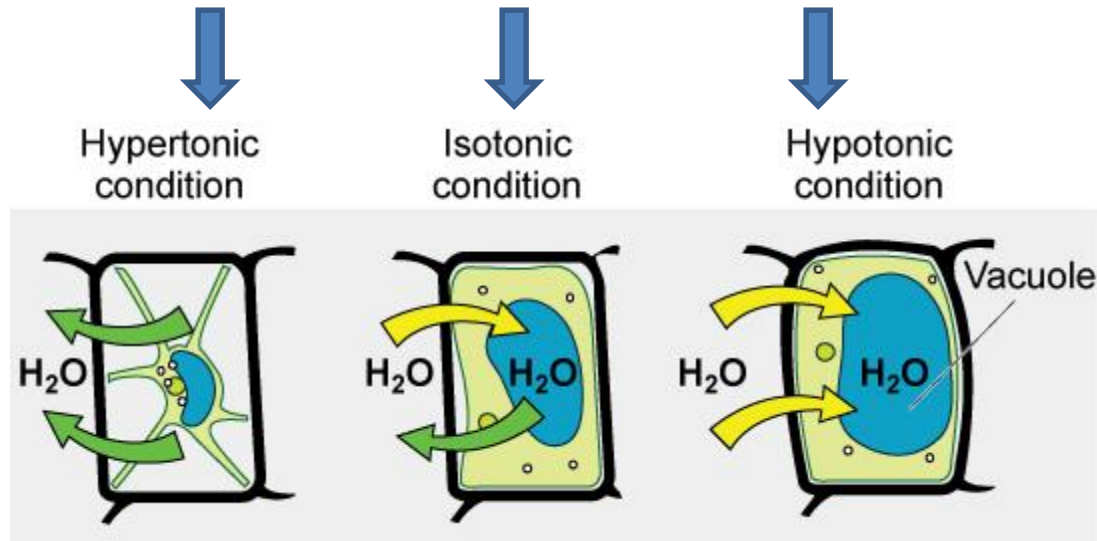


Osmosis



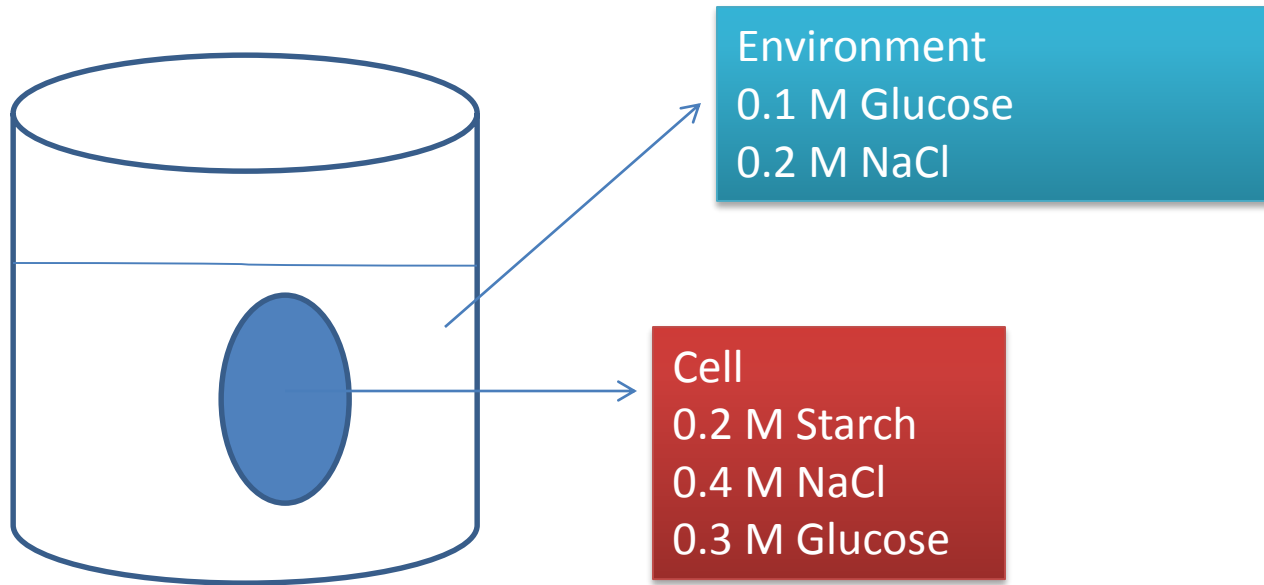
- 1) Animal Cells Shrink when placed in hypertonic environment
- 2) Animal Cells are NORMAL when placed in isotonic environment
- 3) Animal Cells Swell when placed in hypotonic environment (lyse)

Osmosis



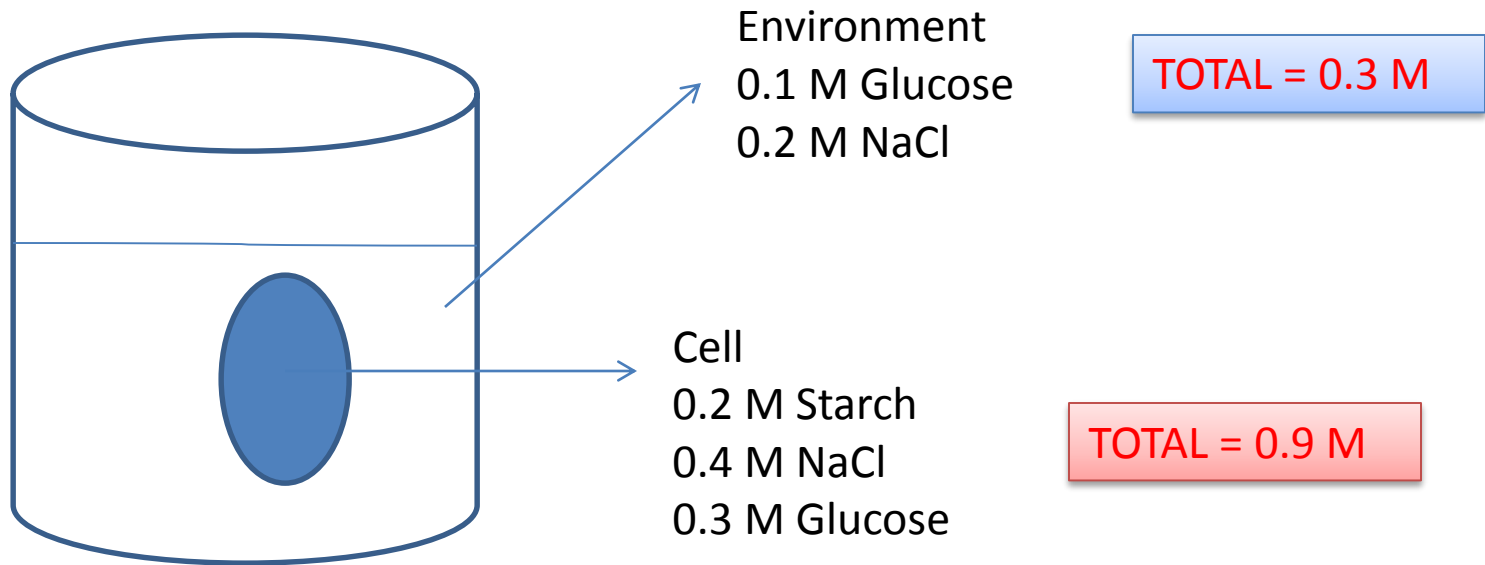
- 1) Plant Cells Shivel when placed in hypertonic environment (Plasmolysis)
- 2) Plant Cells are Flaccid when placed in isotonic environment. (wilted)
- 3) Plant Cells NORMAL when placed in hypotonic environment (TURGID)

Osmosis



- 1) Identify the tonicity of the Environment to the cell.
- 2) The cell is impermeable to starch, but permeable to sodium chloride, water, and glucose. Which direction will each of these substances move?
- 3) What will happen to the solution concentration over time?

Osmosis



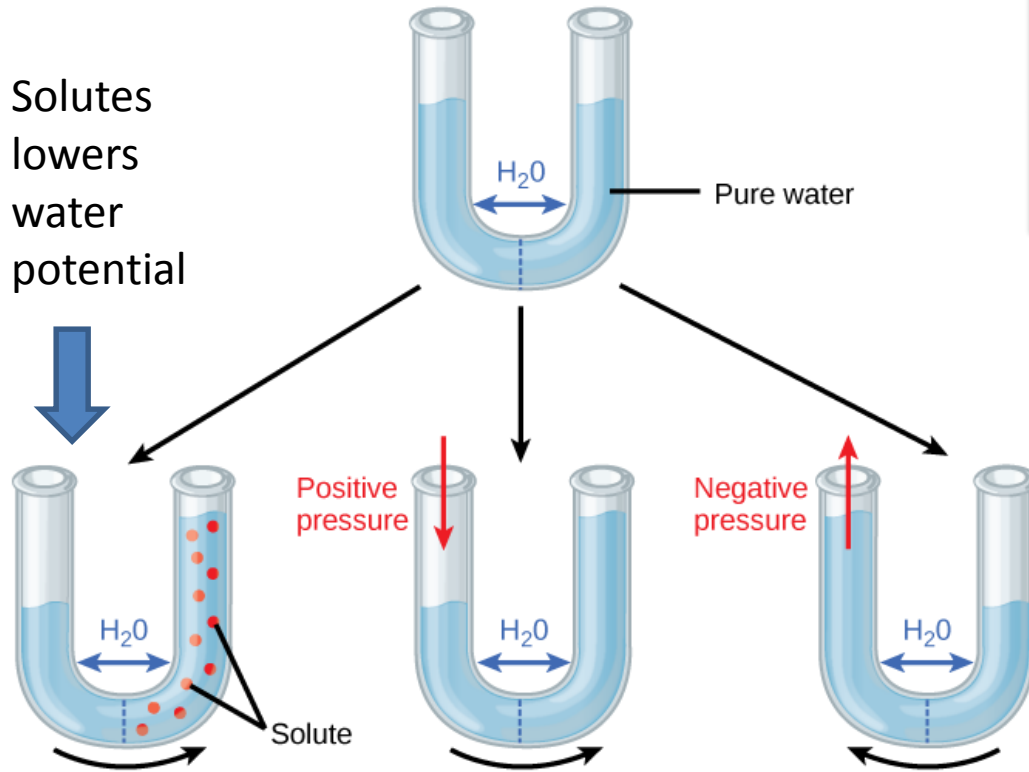
- 1) Identify the tonicity of the Environment to the cell.
Environment is HYPOTONIC; Cell is HYPERTONIC
- 2) The cell is impermeable to starch, but permeable to sodium chloride, water, and glucose. Which direction will each of these substances move?
Glucose = out of cell; sodium chloride = out of cell; water = into the cell
- 3) What will happen to the solution concentration over time?
Equilibrium will be reached; No Net Flow, rate into and out of cell will be constant

Water Potential

Pressure on plant cell walls affect movement of water. This is WATER POTENTIAL.

Pure Water in OPEN container = 0 Bars

Solutes lowers water potential



Adding solute to the right side lowers ψ_s , causing water to move to the right side of the tube.

Applying positive pressure to the left side increases ψ_p , causing water to move to the right side of the tube.

Applying negative pressure to the left side lowers ψ_p , causing water to move to the left side of the tube.

Positive or negative pressure also will affect water potential

Water Potential

$$\Psi = \Psi_p + \Psi_s$$

$$\Psi_s = -iCRT$$

i is Ionization Constant (number of components that dissociate)

NaCl = 2 (dissociates)

Glucose = 1 (does not dissociate)

C is Molarity

R is Pressure Constant 0.08341 liters bars / mole K

T is temperature (K)

Ψ_s = solute potential (osmotic potential)

0 for pure water

Ψ_p = pressure potential
(pressure on the system)

0 for open system (beaker)

These are GIVEN ON THE AP FORMULA CHART AND DEFINED

Water Potential

$$\Psi_s = -iCRT$$

$$\Psi = \Psi_p + \Psi_s$$

i is Ionization Constant (number of components that dissociate)

C is Molarity

R is Pressure Constant = 0.08341 L bar/mol K

T is temperature (K)

If plant tissue was placed in an open beaker of distilled water that had a solute potential of -0.65 bars and a water potential of -0.2 bars, what is the pressure potential of the cell?

If plant tissue was placed in an open beaker of 0.3M sucrose at 26°C, What is the water potential of the beaker?

If the plant tissue had a water potential of -0.4 bars, which way would the water move?

Water Potential

$$\Psi_s = -iCRT$$

$$\Psi = \Psi_p + \Psi_s$$

i is Ionization Constant (number of components that dissociate)

C is Molarity

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T is temperature (K)

If plant tissue was placed in an open beaker of distilled water that had a solute potential of -0.65 bars and a water potential of -0.2 bars, what is the pressure potential of the cell?

$$-0.2 \text{ Bars} = -0.65 \text{ Bars} + x$$

$$\text{Solute potential} = -0.45 \text{ Bars}$$

If plant tissue was placed in an open beaker of 0.3M sucrose at 26°C, What is the water potential of the beaker?

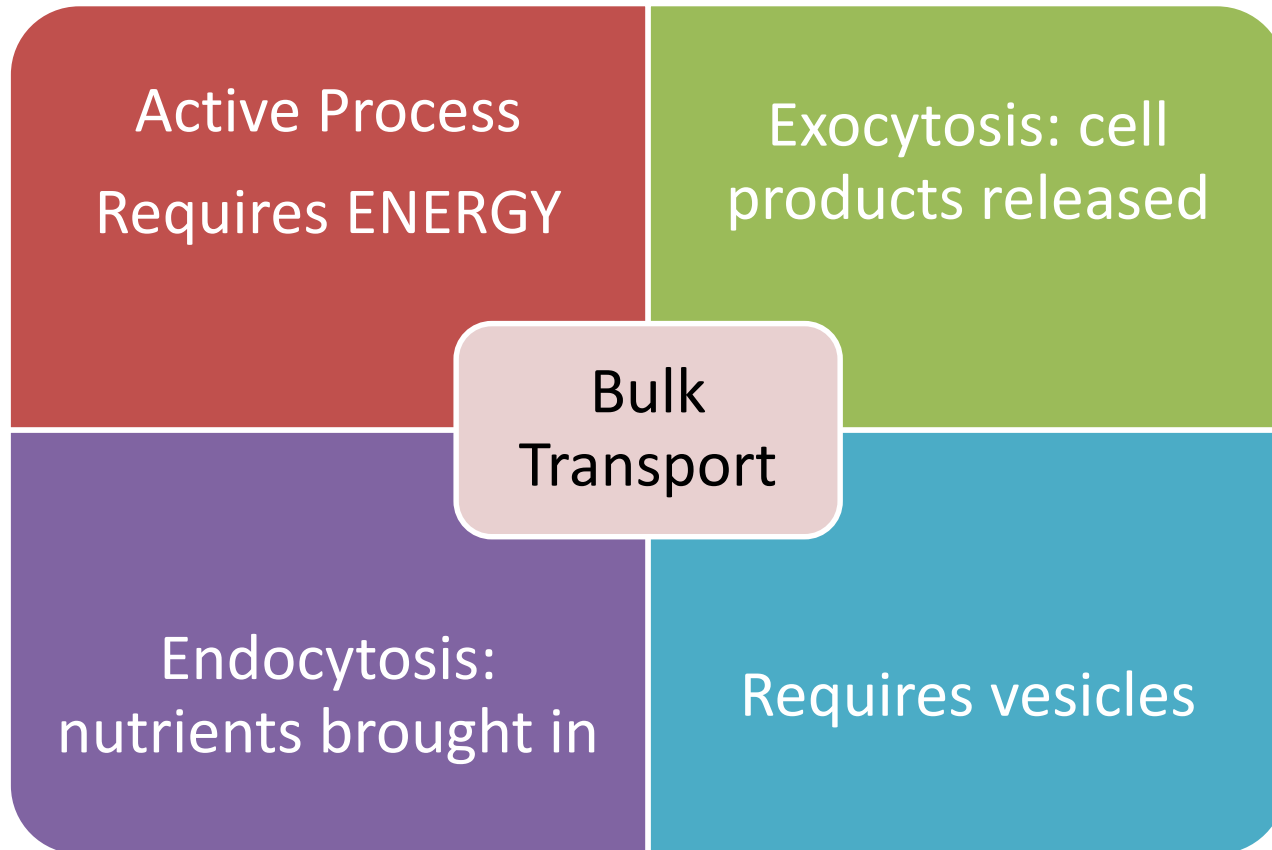
$$\text{Solute Potential} = -1(0.3)(0.0831)(299)$$

$$\text{Solute Potential} = -7.45$$

If the plant tissue had a water potential of -0.4 bars, which way would the water move? **Water potential (beaker) = -7.45**

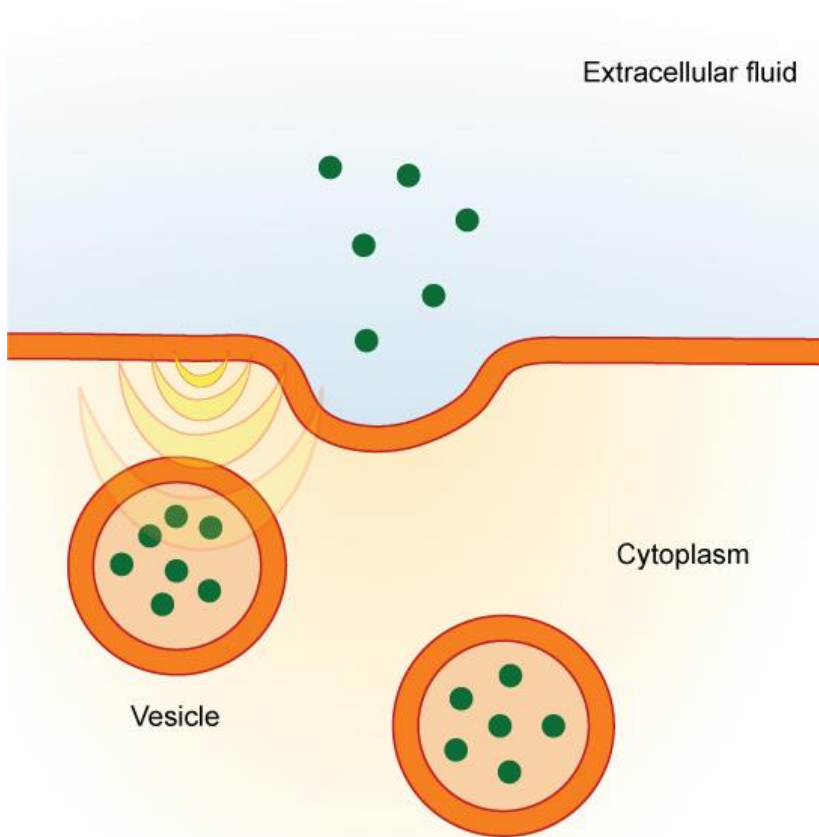
Water would move from the cell into the beaker

Bulk Transport



Exocytosis

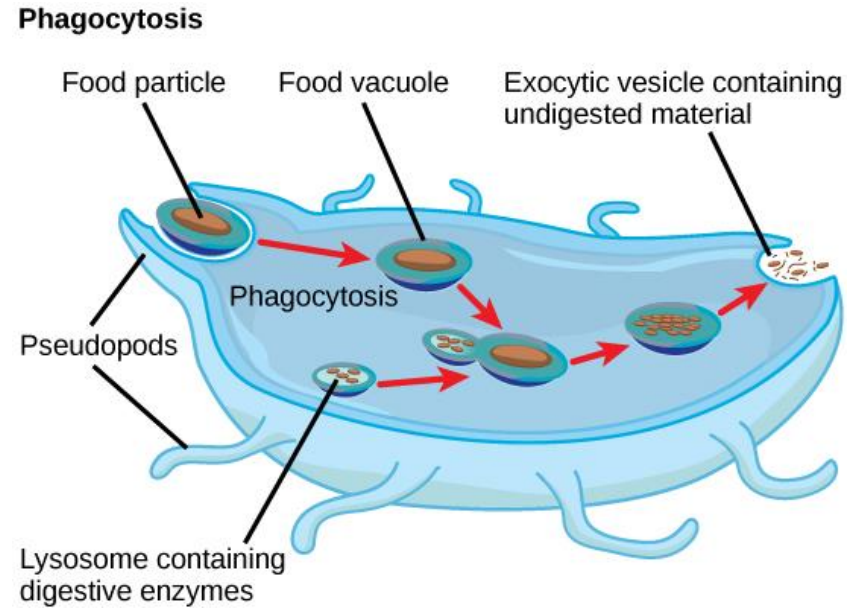
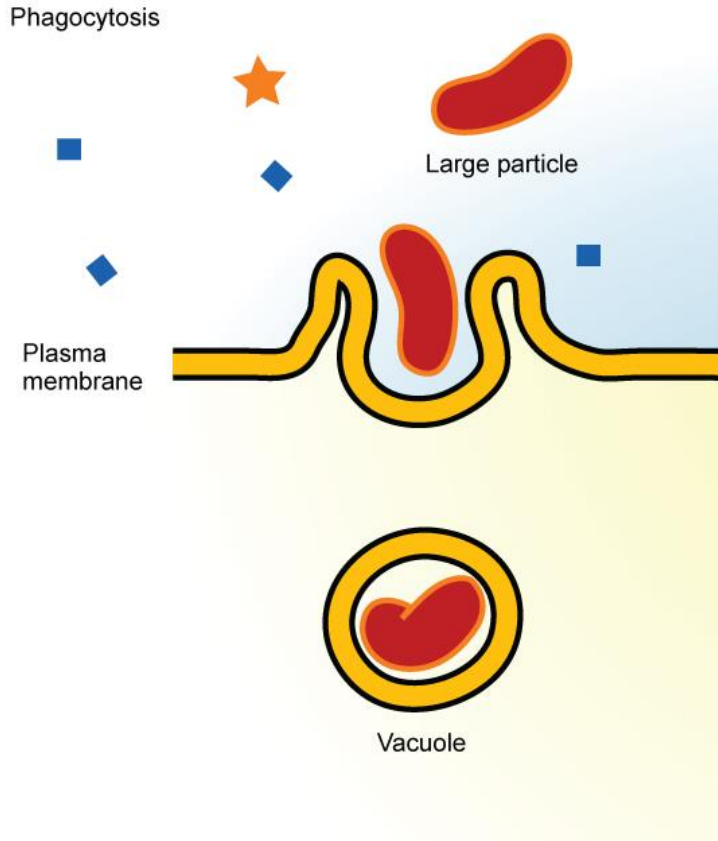
Exocytosis



Release cell products:
Glands
Nerve Cells
Plant Cells (cell wall material)

Change Membrane Proteins:
Channel proteins
Glycoproteins
Change Enzymes

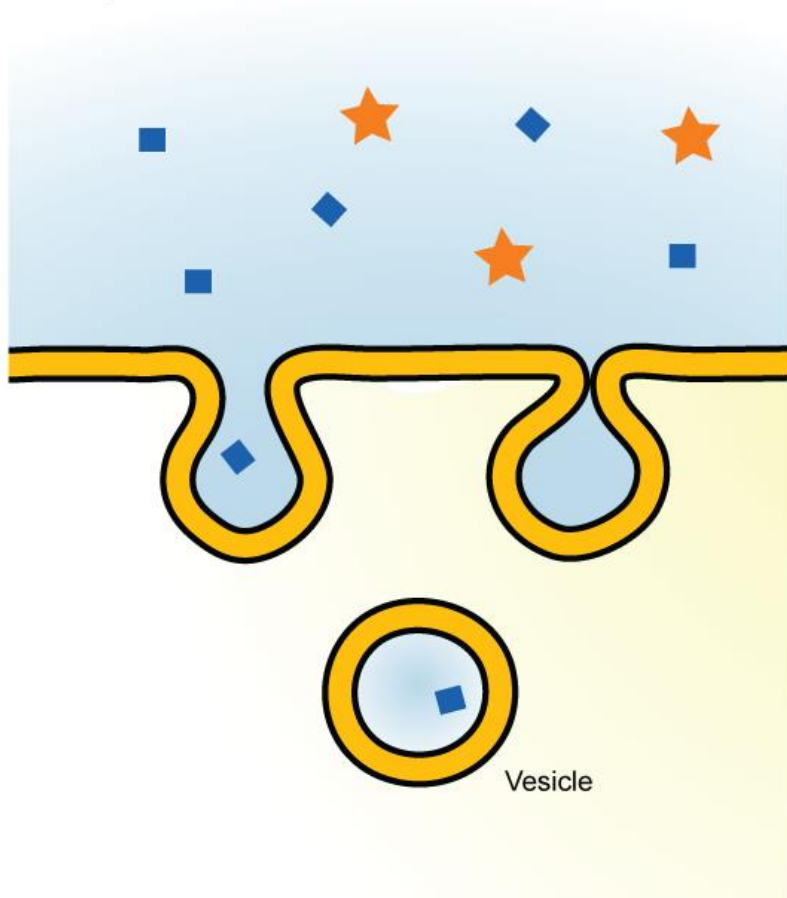
Endocytosis



Phagocytosis: Brings solid substances in..
EX: Macrophage, Ameobas

Endocytosis

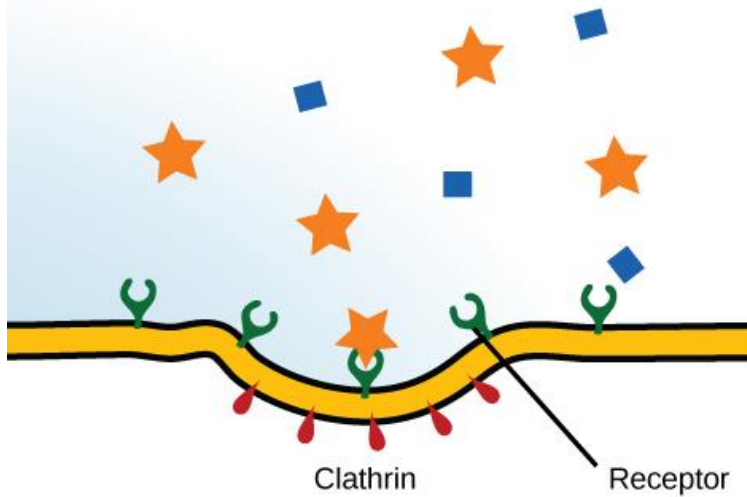
Pinocytosis



PINOCYTOSIS: Form of Endocytosis
Brings in extracellular fluid and dissolved solutes.

Endocytosis

Receptor-mediated endocytosis



Coated vesicle

Receptor Mediated Endocytosis

Used to bring in specific substances

Uses coated proteins to trigger vesicle formation.

EX: LDL receptors on cells brings in cholesterol.

Familial hypercholesterolemia – individuals lack the LDL receptors.