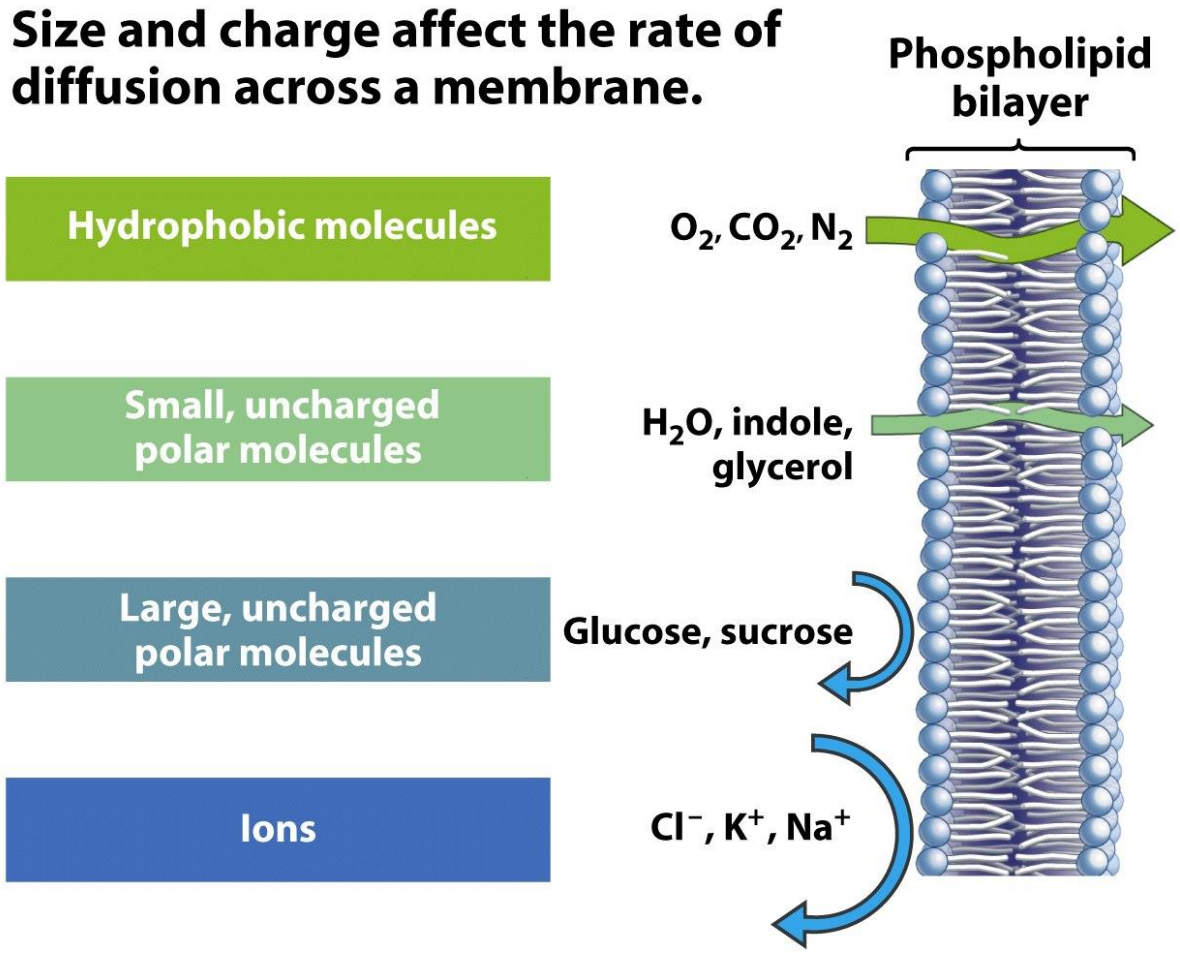
Passive Transport

SBI4U

MRS. FRANKLIN

Lipid Bilayer Recap

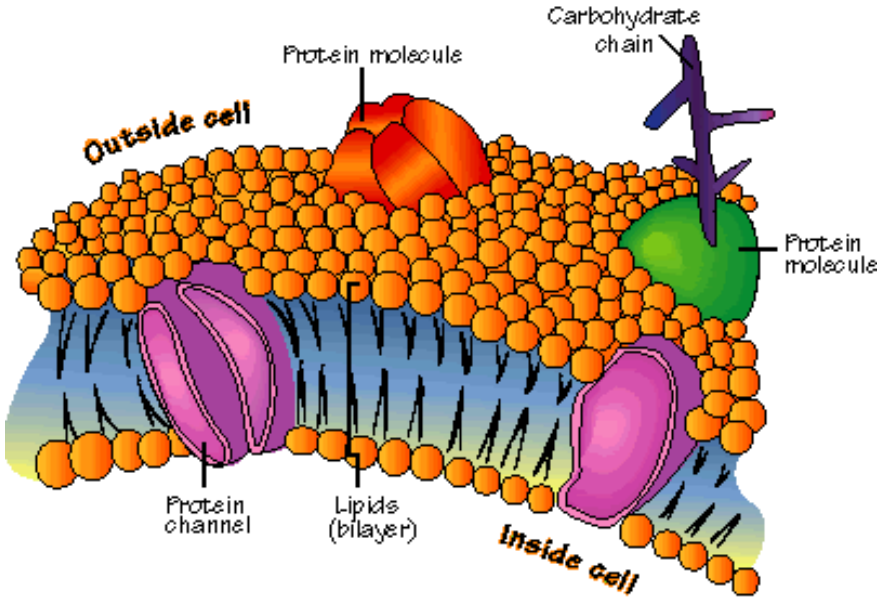


Crossing the Lipid Bilayer

Why are polar and charged molecules unable to cross the lipid bilayer?

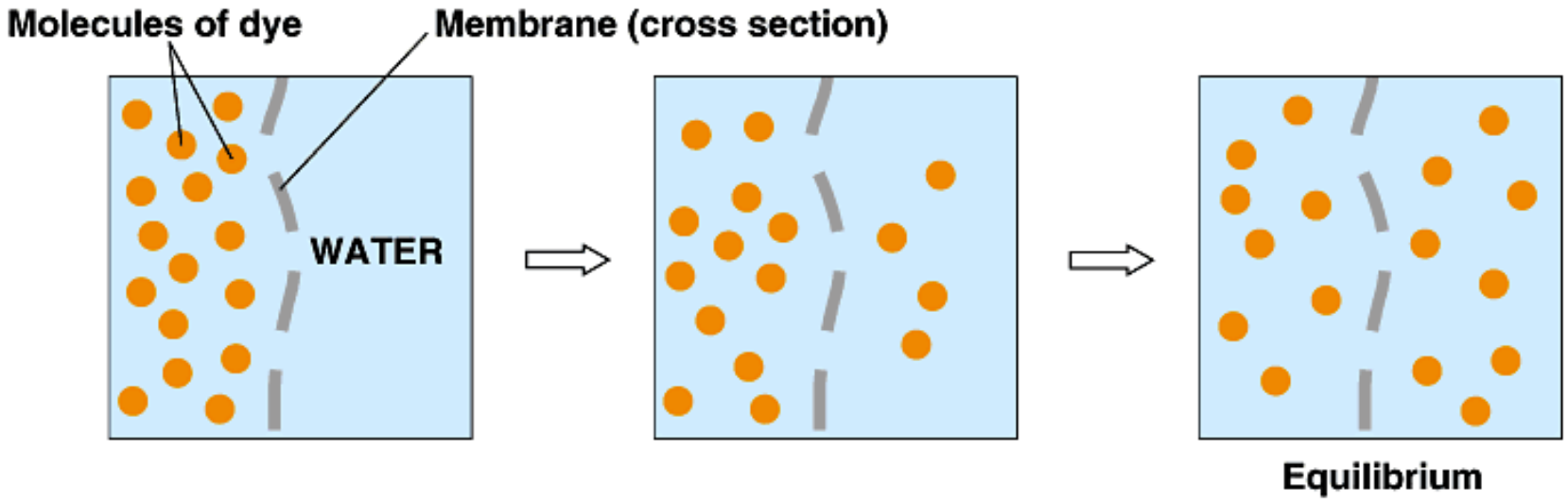
Polar or charged molecules are insoluble within the lipid bilayer due to its ***hydrophilic*** properties.

Remember . . . Phospholipids contain hydrophobic tails that line the interior of the lipid bilayer.



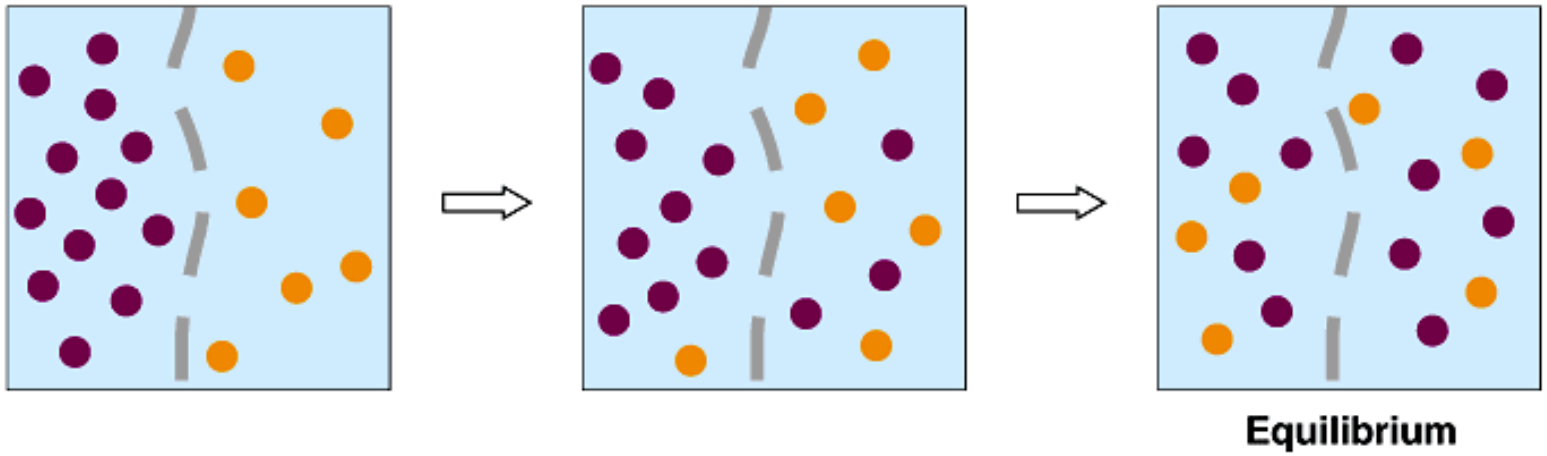
Diffusion of One Solute

Diffusion: substances will move from an area of high concentration to an area of low concentration.



All molecules move across the membrane with their concentration gradient until it has reached a point of Dynamic Equilibrium.

Diffusion of Many Solutes



All molecules travel with their own concentration gradient until they each reach a point of **DYNAMIC EQUILIBRIUM.**

Factors Affecting the Rate of Diffusion

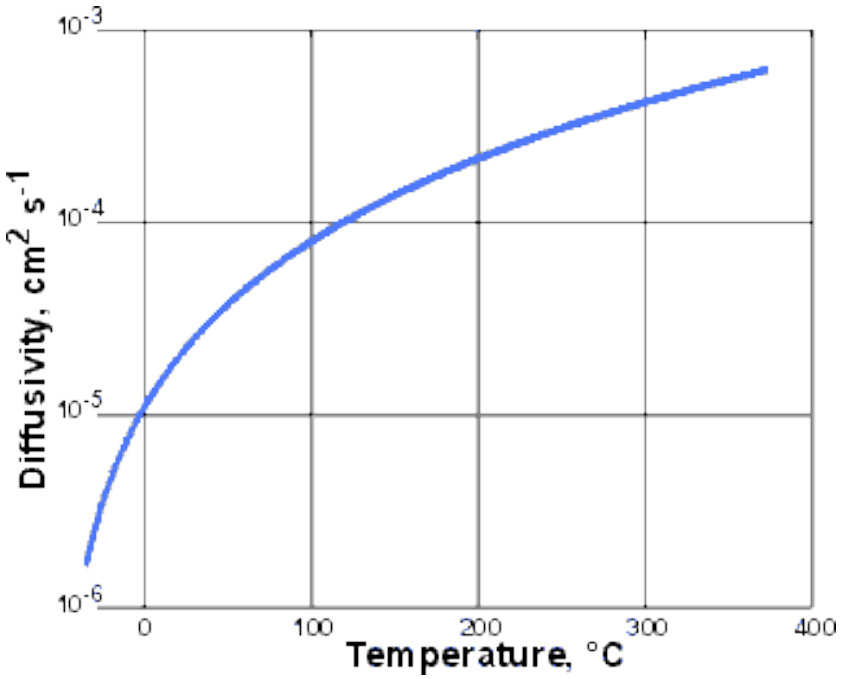
1) **Temperature:** increasing the temperature increases the rate of diffusion.

2) **Size of molecules**: the smaller the particle the quicker the diffusion rate.

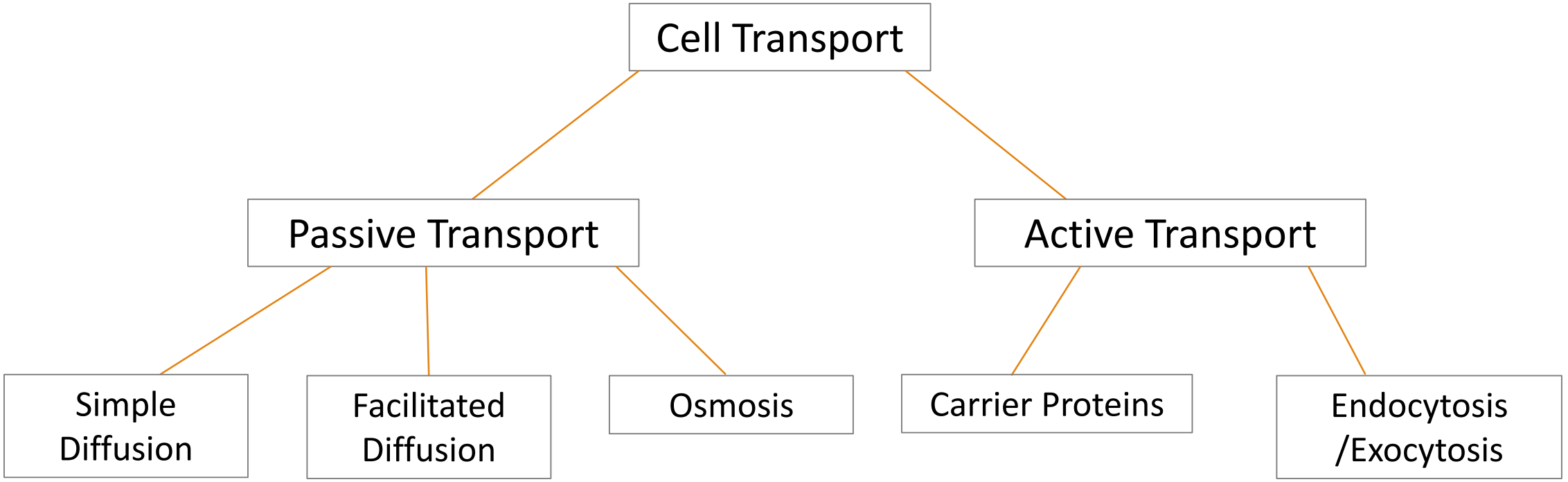
3) **Concentration difference:** the greater the concentration difference the quicker the rate of diffusion

4) **Molecule Ion or Charge:** charged or polar molecules cannot diffuse across the cell membrane.

5) **Surface Area:** the greater the surface area of a membrane the greater the diffusion rate.

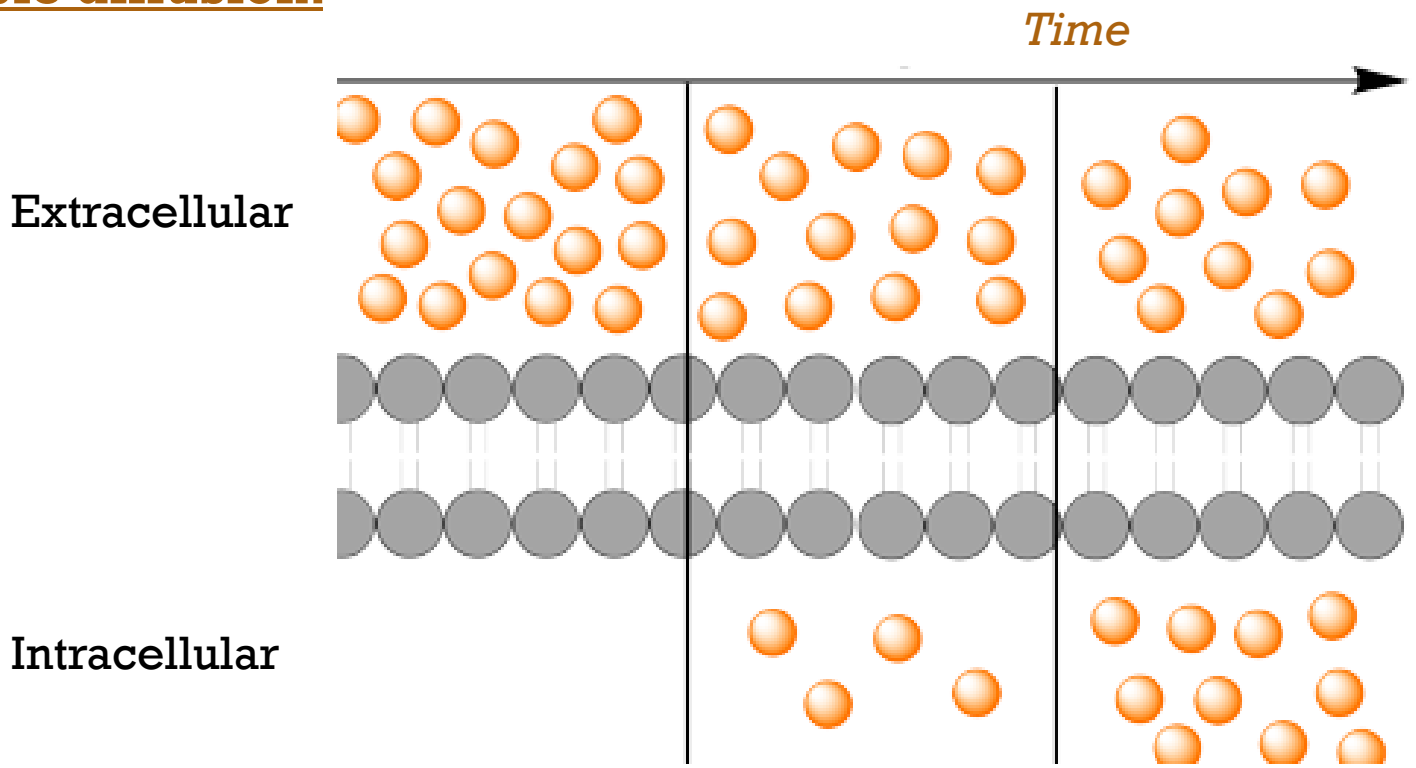


Cell Transport Overview



Passive Transport

Simple diffusion:



Molecules move from an area of high concentration to an area of low concentration.

Concentration gradient: *difference in concentration of solutes in two different areas.*

Passive Transport – Facilitated Transport

Facilitated Diffusion: large, polar and charged molecules require assistance from transmembrane proteins.

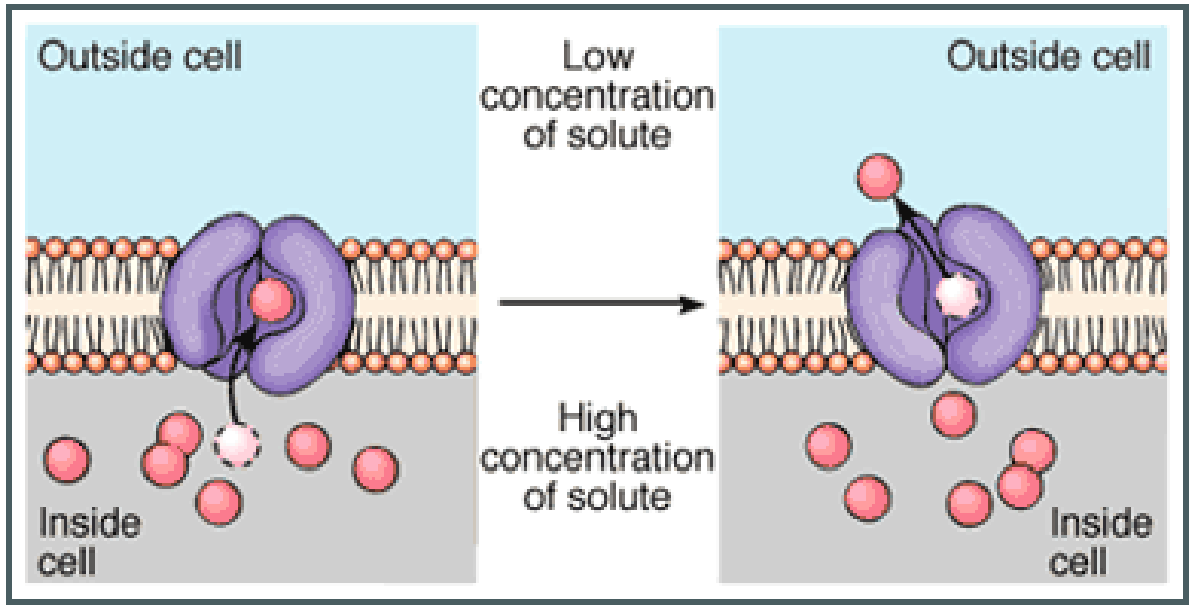
Characteristics:

1) Transmembrane proteins are specific to the solute.

2) The solute travels down its concentration gradient.

3) Spontaneous process (does NOT require energy)

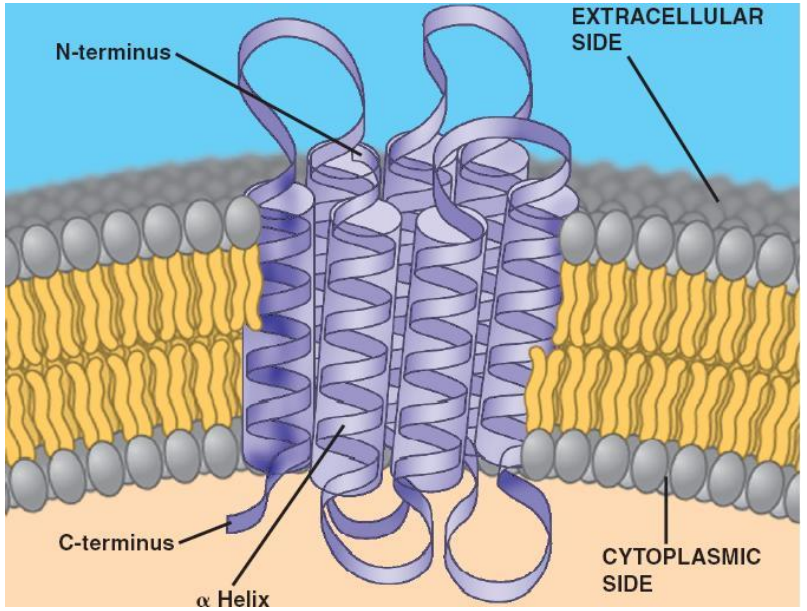
Facilitated diffusion



Passive Transport – Facilitated Transport

Transmembrane protein: protein in the membrane that spans the thickness of the phospholipid bilayer.

The diagram illustrates the transmembrane proteins in its quaternary structure.



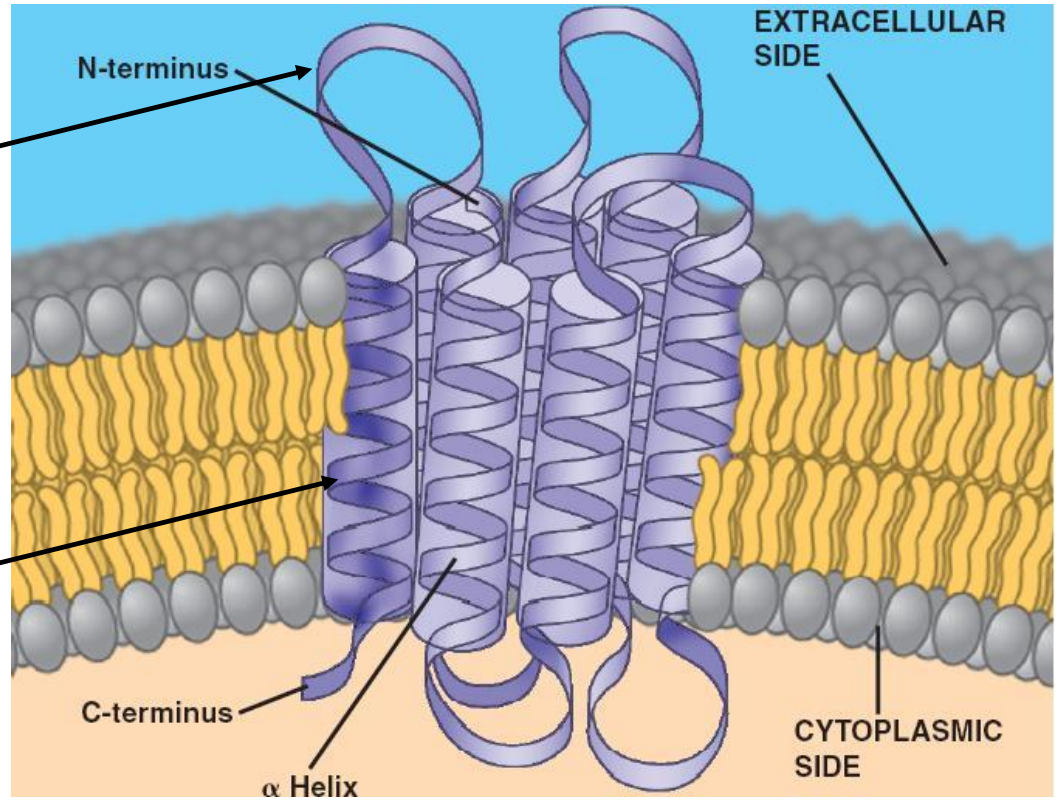
Ions, polar, small charged molecules and large molecules require transmembrane proteins to get across the cell membrane.

Passive Transport – Facilitated Transport

Structure of the transmembrane protein:

Beta-helix contains polar amino acids.

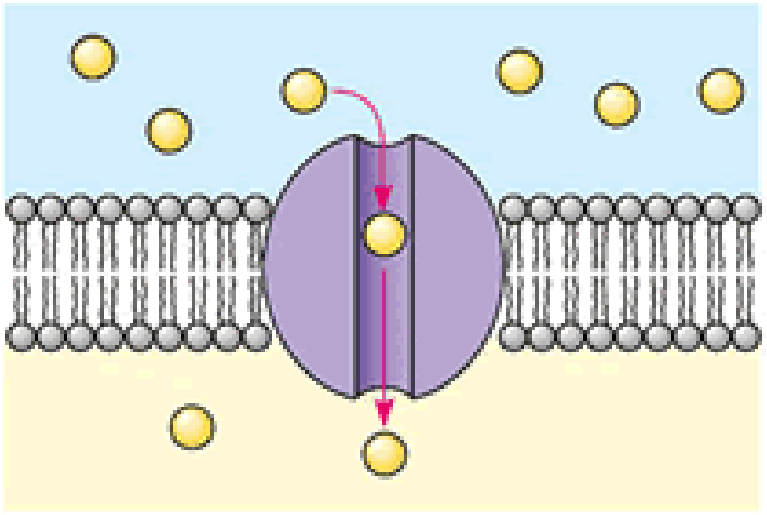
Alpha-helix contains non-polar amino acids.



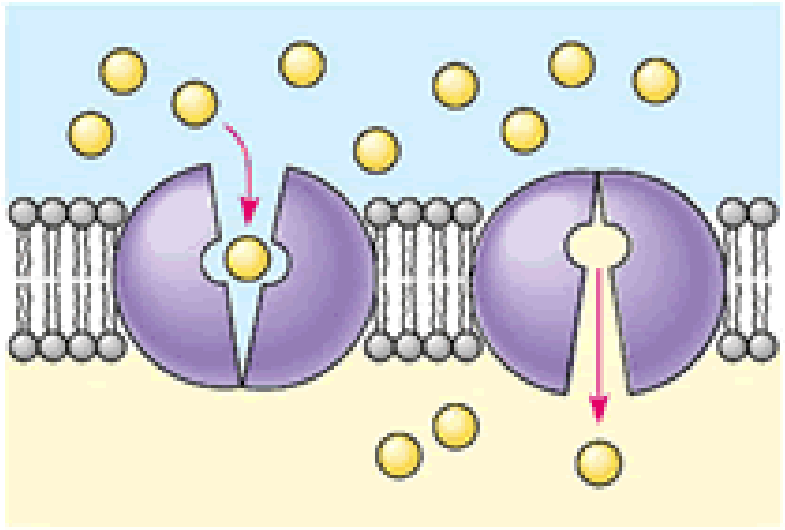
Nonpolar zone

Passive Transport – Facilitated Transport

There are two types of transmembrane proteins used in facilitated transport:

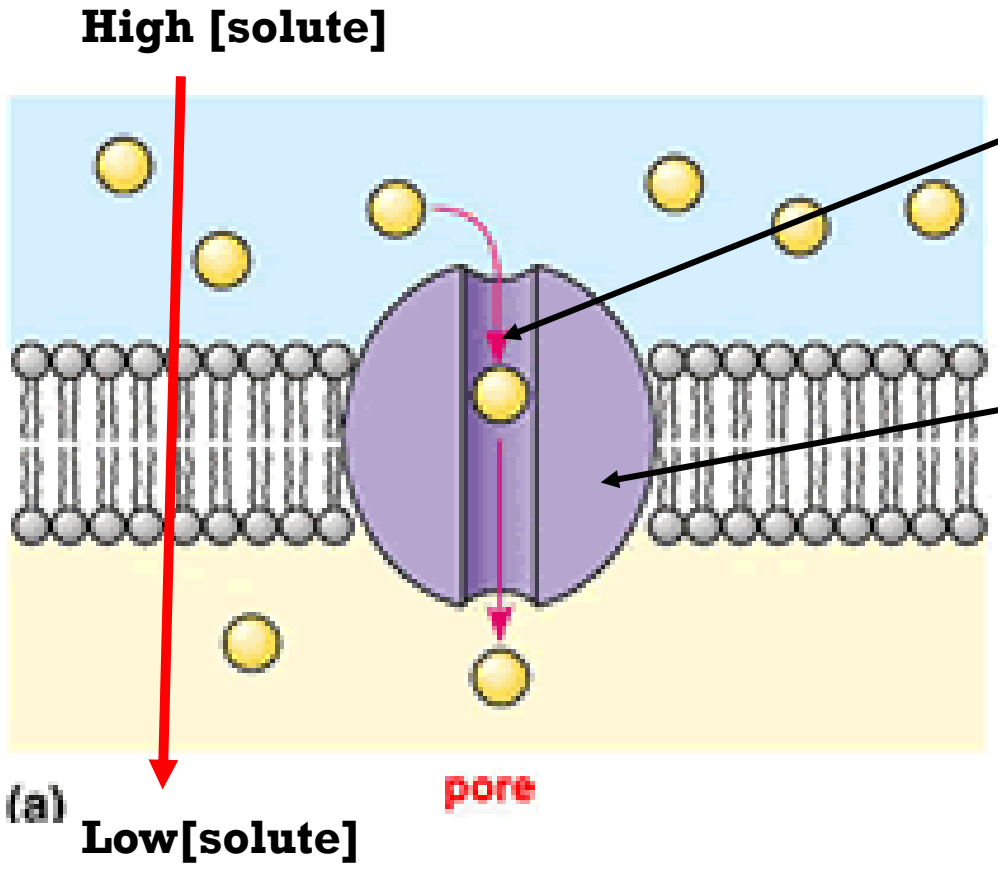


(a) pore



(b) carrier protein

Passive Transport – Facilitated Transport



The interior of the channel is hydrophilic (polar a.a)

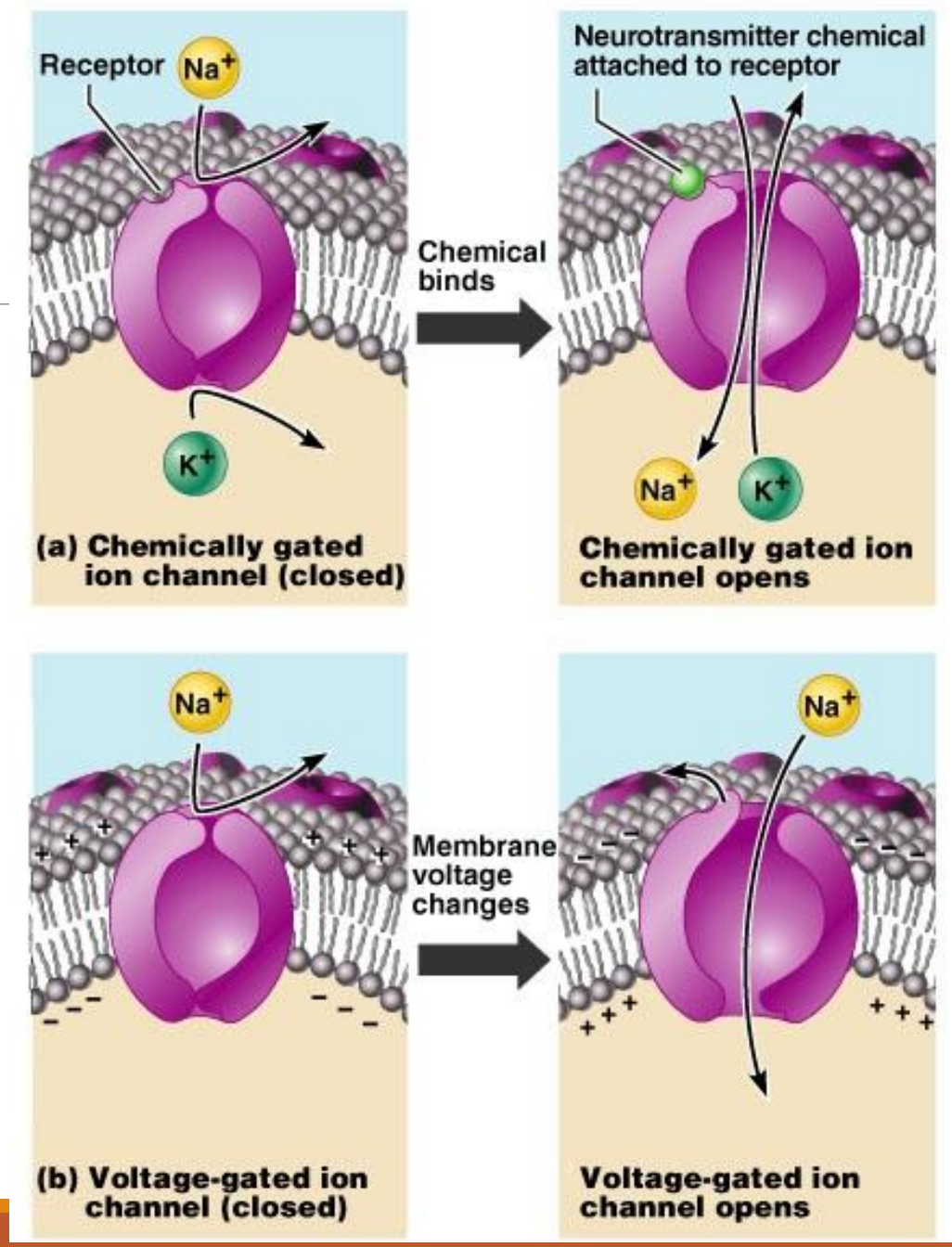
The channel is surrounded by non polar amino acids.

Why would the channel proteins require non polar amino acids on its exterior portion?

Passive Transport – Facilitated Transport

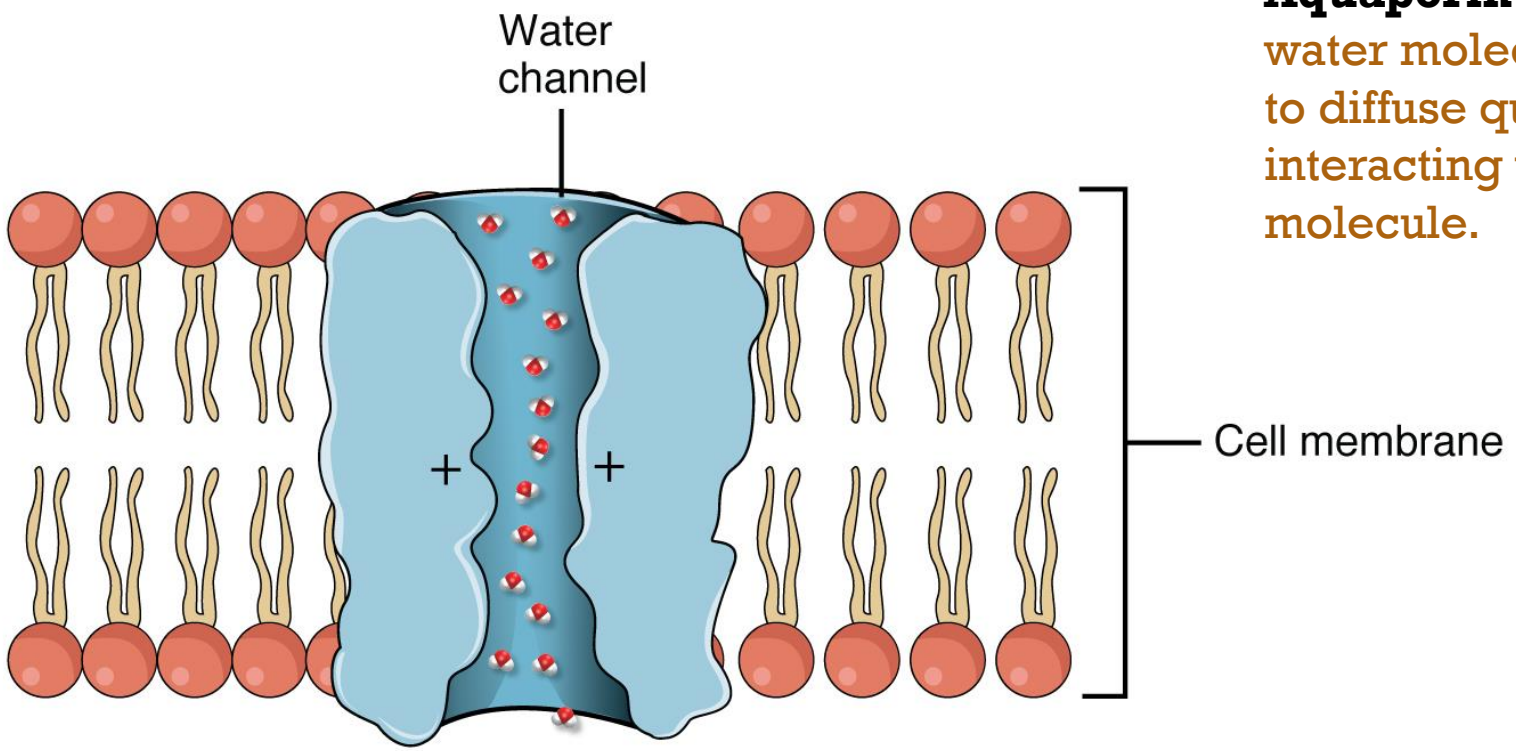
Some channel proteins are regulated by hormones, pressure, electric charge, etc.

The channel contains a gate that opens or closes the opening.



Passive Transport – Facilitated Transport

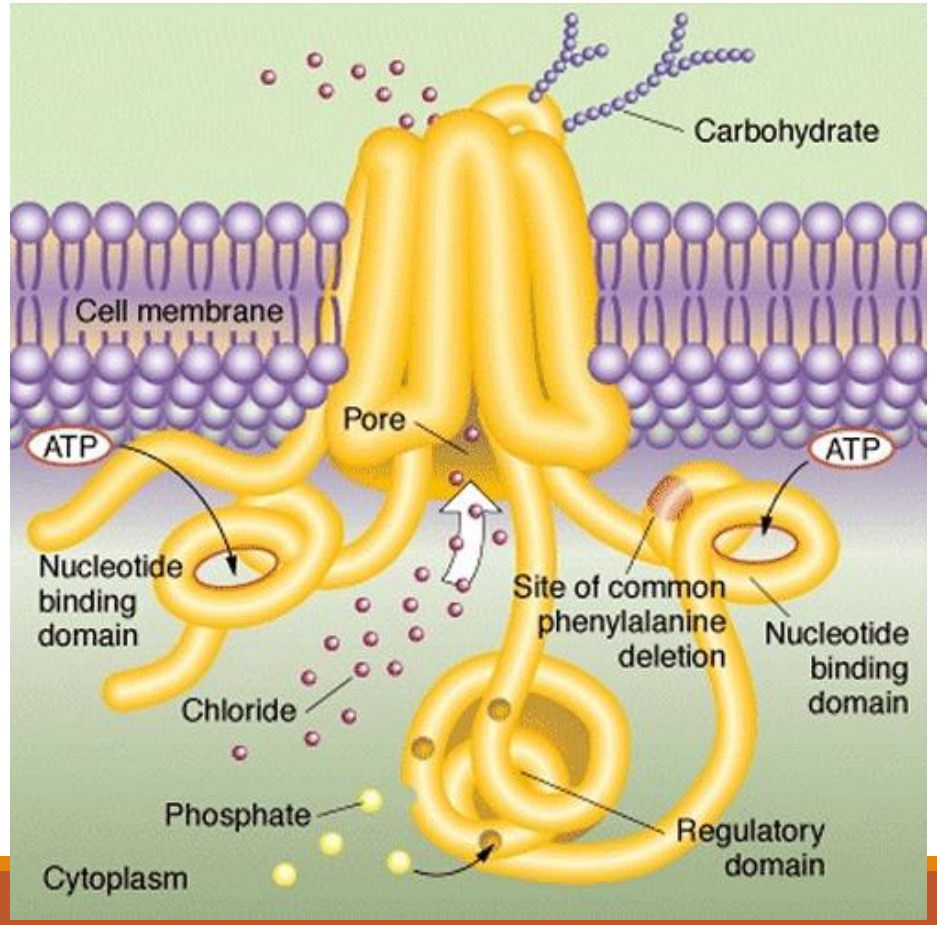
Example of Channel Protein:



Aquaporin channel is highly specific to water molecules. It allows water molecules to diffuse quicker across the membrane by interacting with partial charges of the molecule.

Passive Transport – Facilitated Transport

Example of Channel Protein:

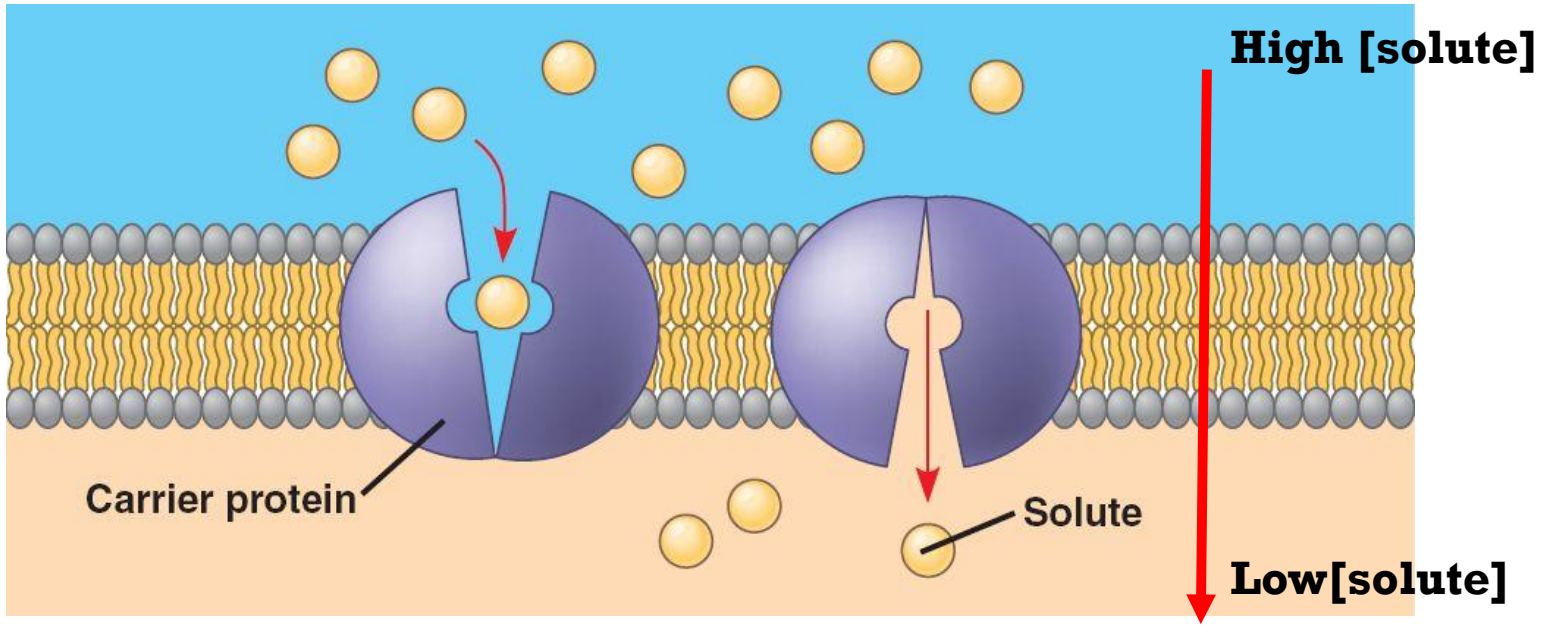


Chloride channel has approximately 10 – 12 transmembrane helices. The channel is highly specific for chloride ions and it used to establish a resting potential in the nerves.

These channels can also be found in the epithelial cells of the lung, liver and pancreas.

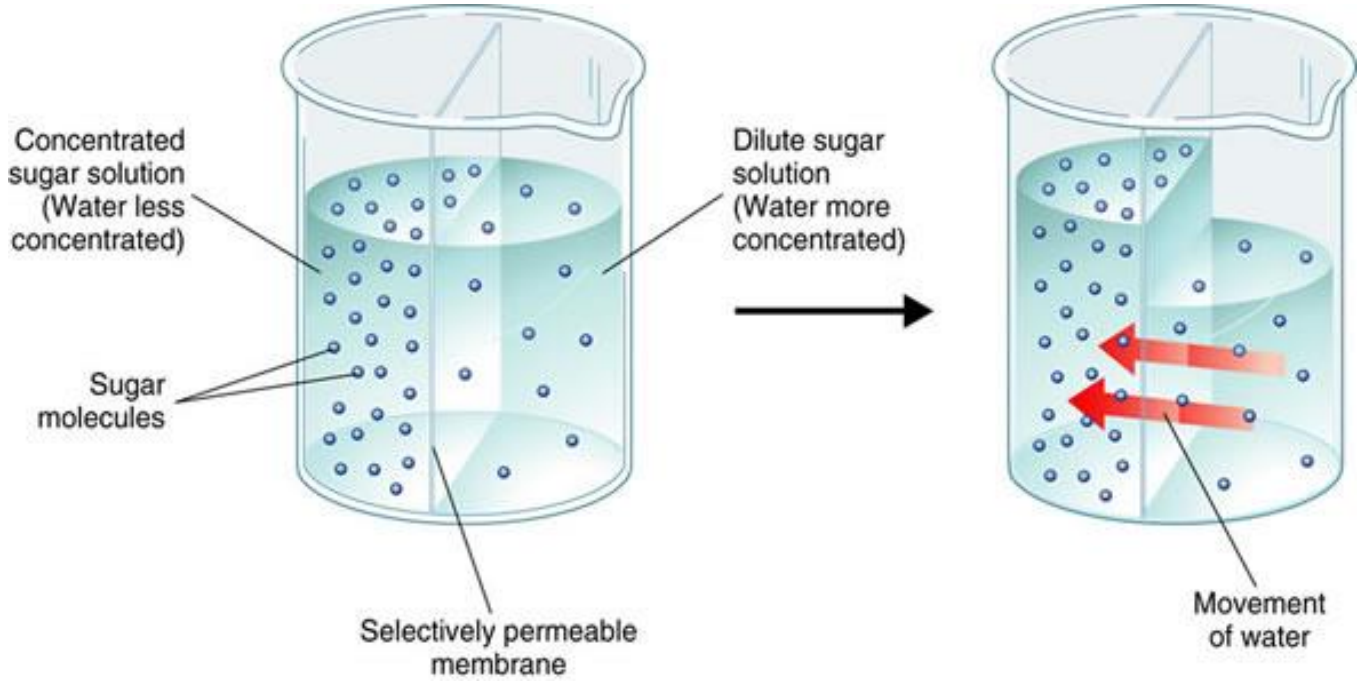
Passive Transport – Facilitated Transport

Carrier Protein: a membrane protein that binds to and transports one or more particles of a substance from one side of the membrane to another.



Passive Transport – Osmosis

Osmosis: net movement of water across a selectively permeable membrane. Water moves with its concentration gradient.

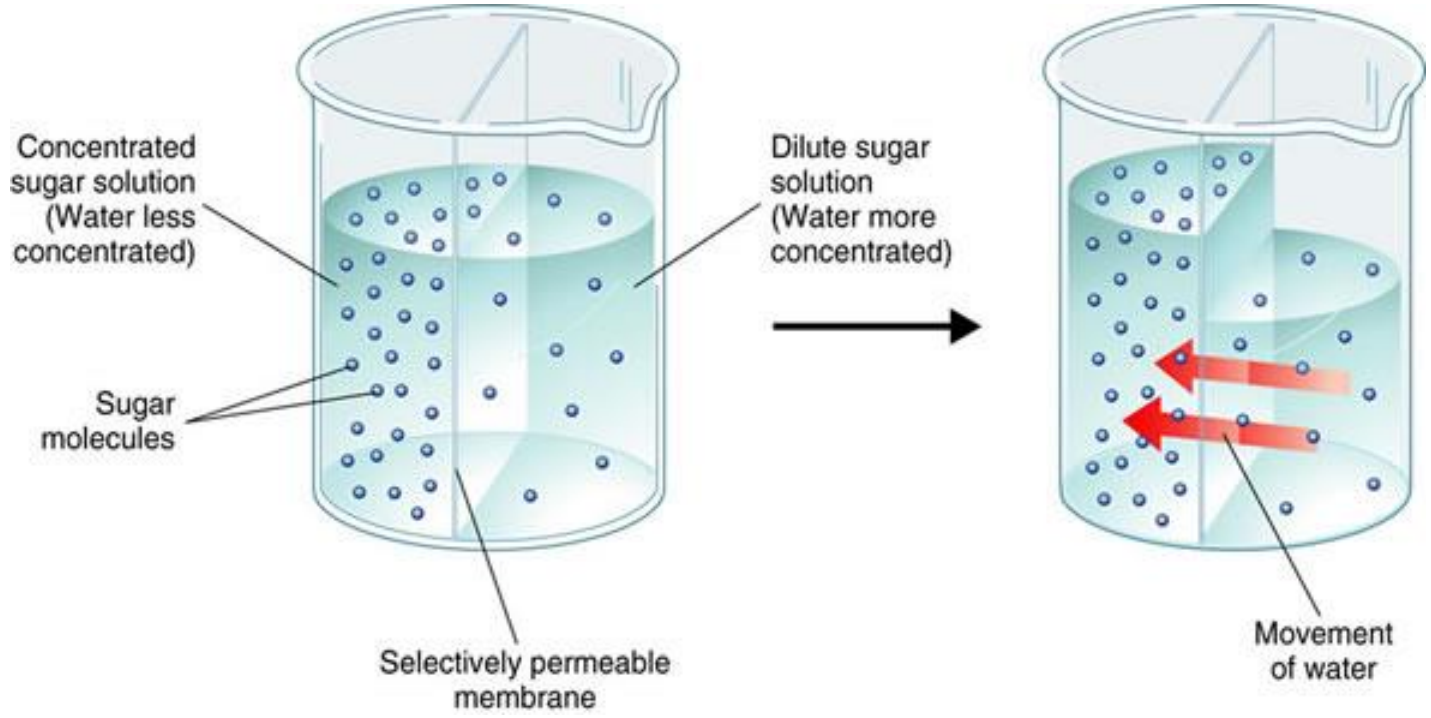


The cell remains the same size because H_2O molecules move in and out of the cell until a ***Dynamic Equilibrium*** *is reached.*

Passive Transport – Osmosis

Water will move from an area with ***low solute concentration*** (high water concentration) to an area of ***high solute concentration*** (low water concentration)

There is a low concentration of water when there is a high concentration of solute.



Passive Transport – Osmosis

Osmosis occurs when there is a difference in solute concentration across a membrane.

There are 3 key terms that are used to describe solute concentration:

1) Isotonic Solution

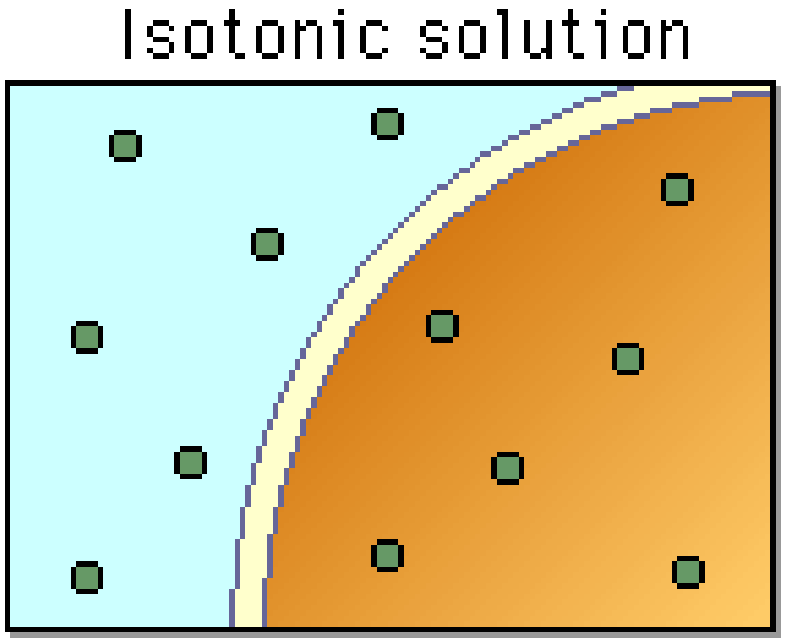
2) Hypertonic Solution

3) Hypotonic Solution

Passive Transport – Osmosis

1) **Isotonic Solution:** when the solution inside and outside of the cell have an equal concentration of solute.

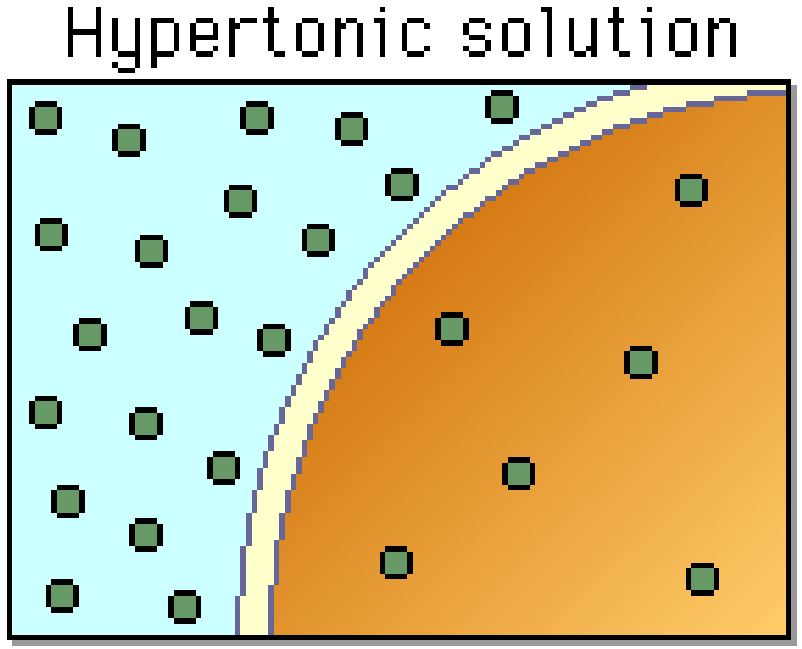
What direction will water move?



Passive Transport – Osmosis

2) **Hypertonic Solution:** when the solution on one side of the cell has a higher concentration of solute than the other area.

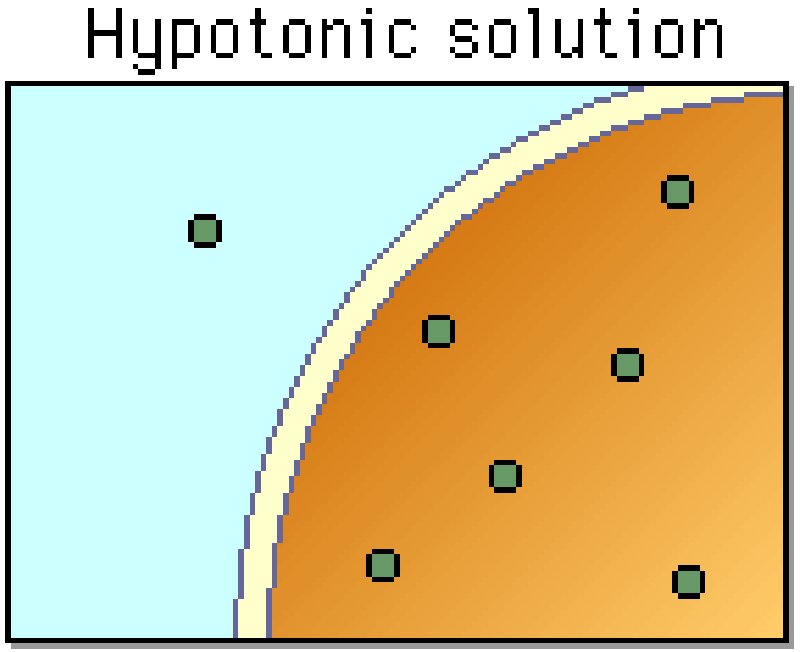
What direction will water move?



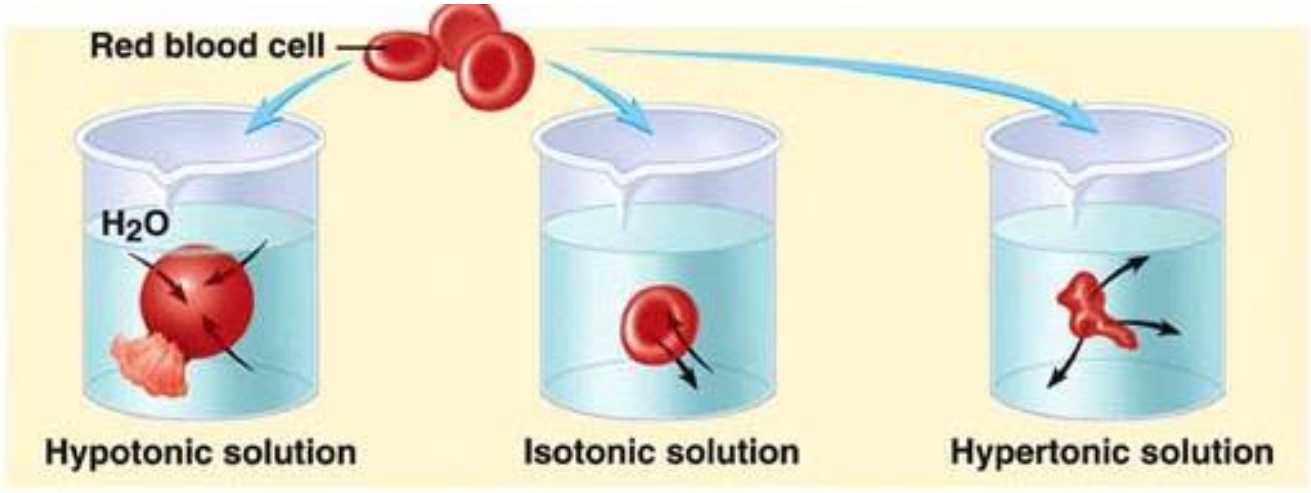
Passive Transport – Osmosis

3) **Hypotonic Solution:** When the solution in one side of the cell has a lower solute concentration compared to the other side.

What direction will water move?



Osmosis and Cells in our Body

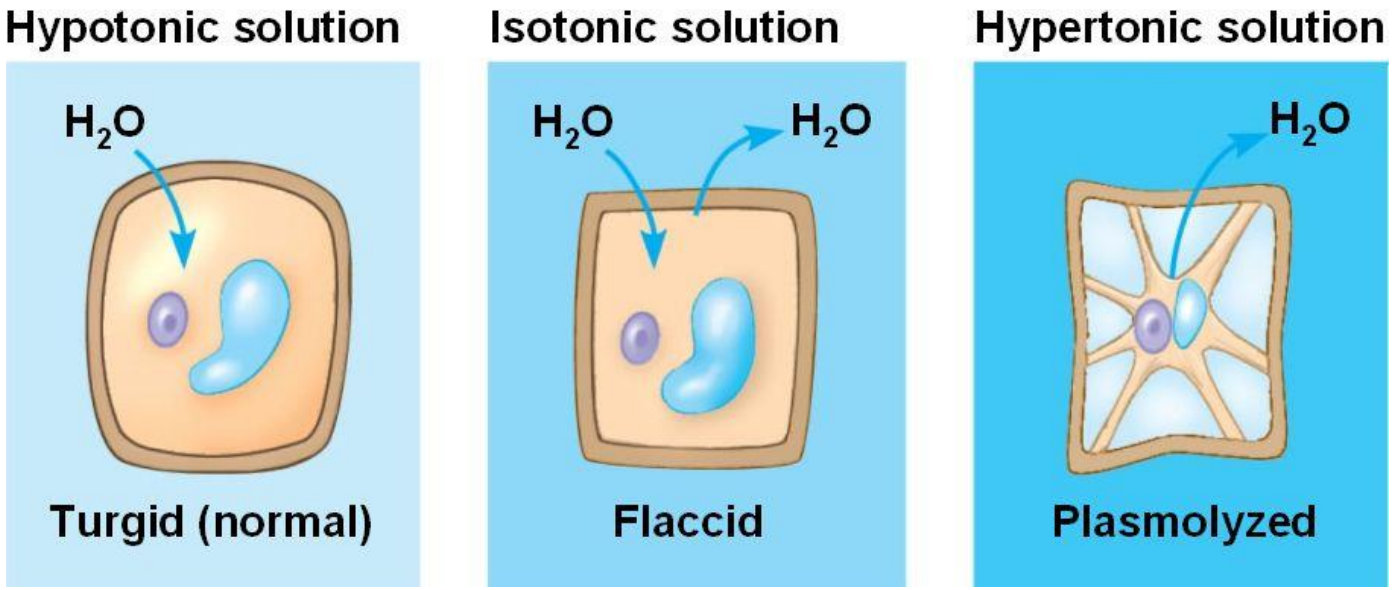


(a) A hypotonic solution with a low solute concentration results in swelling (*black arrows*) and lysis (*puff of red in the lower left part of the cell*) of a red blood cell placed into the solution.

(b) An isotonic solution with a concentration of solutes equal to that inside the cell results in a normally shaped red blood cell. Water moves into and out of the cell in equilibrium (*black arrows*), but there is no net water movement.

(c) A hypertonic solution, with a high solute concentration, causes shrinkage (crenation) of the red blood cell as water moves out of the cell and into the hypertonic solution (*black arrows*).

Osmosis and Plant Cells



Checking for Understanding

Why do phospholipids placed in water form bilayers?

A) the “heads” of the phospholipids engage in hydrophobic interactions with water molecules.

B) The fatty acid “tails” engage in hydrogen bonding with water molecules.

C) Each of the molecules has a polar and a non-polar region.

D) The water molecules cannot interact with phospholipids since each has a different polarity.

E) Lipid bilayers are required for the attachment of peripheral proteins.

Checking for Understanding

Which events require a net input of energy?

A) passage of an ion through a channel protein.

B) passage of an uncharged molecule through a channel protein.

C) The facilitated diffusion of a polar molecule our of a cell by a carrier protein.

D) The unassisted passage of a non-polar solute through the phospholipid bilayer of a membrane as it moves down its concentration gradient.

E) the movement of an ion out of a cell against its electrochemical gradient.

Checking for Understanding

Oxygen enters the cell by which process?

A) pinocytosis

B) diffusion

C) active transport

D) facilitated diffusion

E) osmosis

Homework

Textbook:

Pg. 74 # 22 & 23

Pg. 81 # 4, 6, 9, 10 & 11