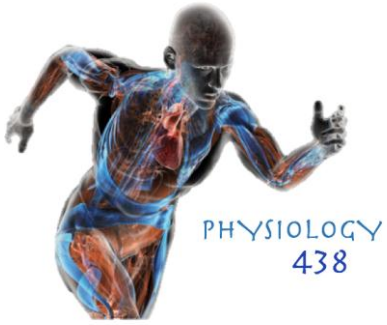
LECTURE 3

- Red : important
- Black : in male / female slides
- Pink or purple: in girls slides only
- Blue : in male slides only
- Green : notes, Extra

MED438
KING SAUD UNIVERSITY

Reviewed by Razan AlRabah & Khalid Alkhani

CELL MEMBRANE

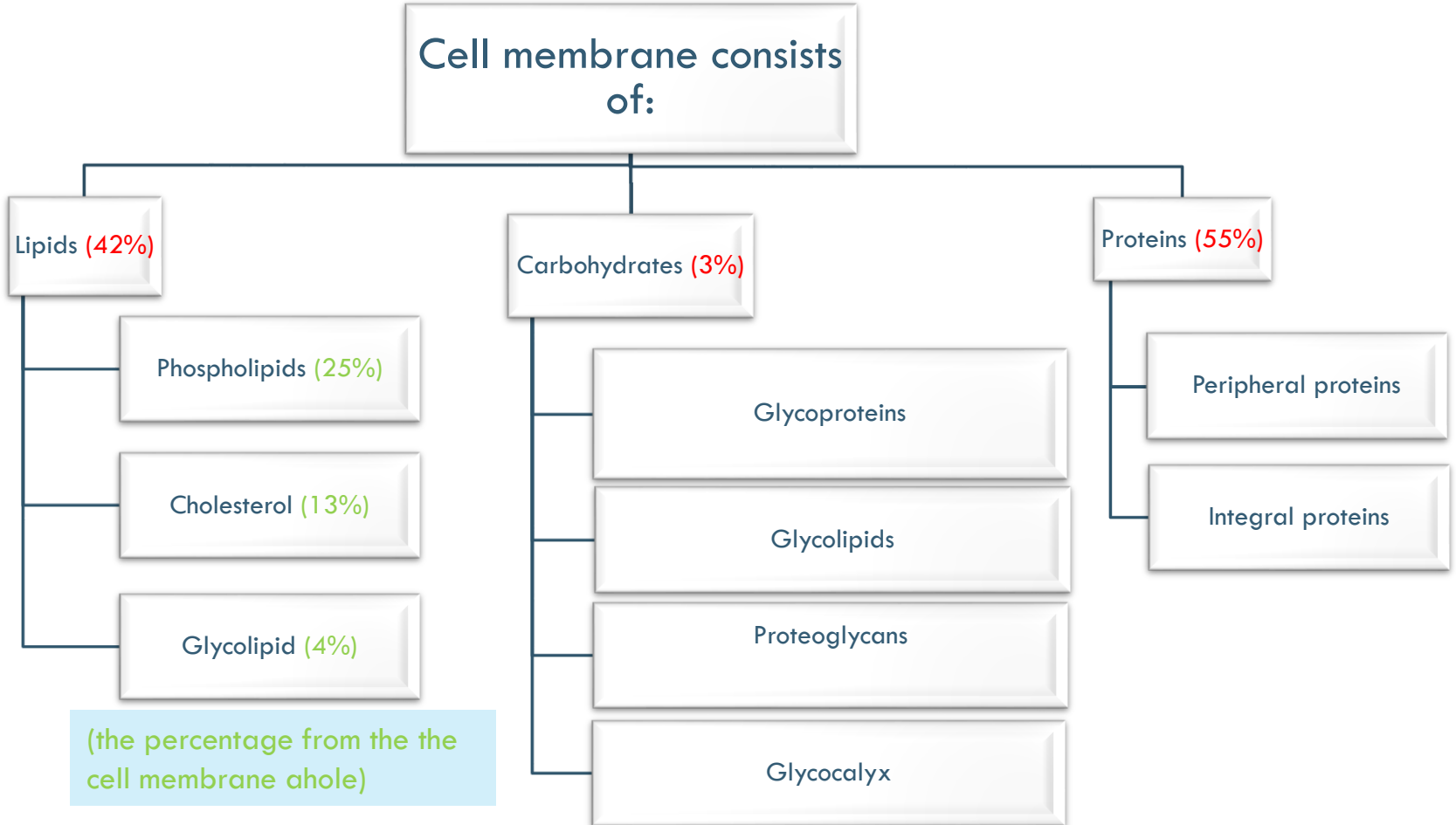


OBJECTIVES :

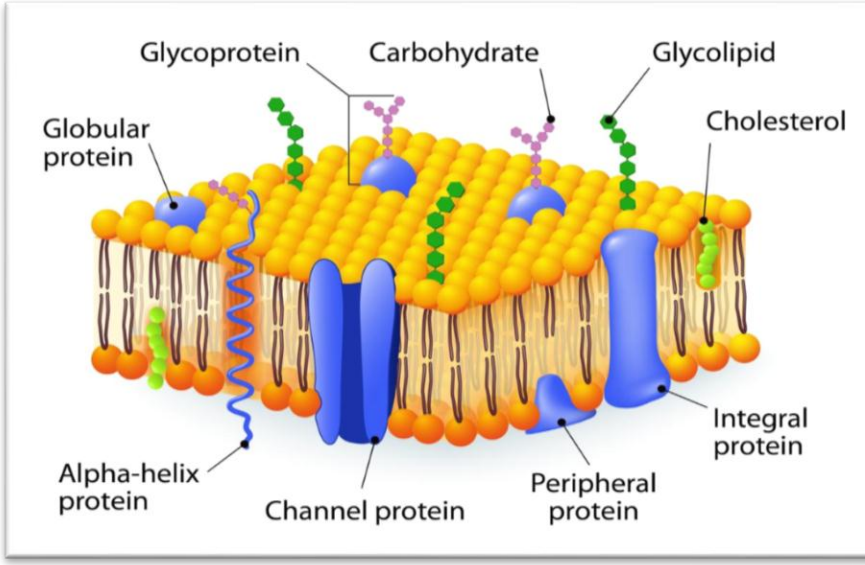
- Describe the fluid mosaic model of membrane structure and function.
- Define permeability and list the factors effecting permeability.
- Identify and describe transport processes in the cell membrane.
- Differentiate between passive and active transport mechanisms and give examples on each.

WHAT IS THE CELL MEMBRANE?

- It covers the cell.
- It's a fluid not solid. (thin, pliable and elastic)
- Cell membrane = plasma membrane = a *lipid bilayer*.
- Thickness = 7.5-10 nm.



(the percentage from the the cell membrane ahole)

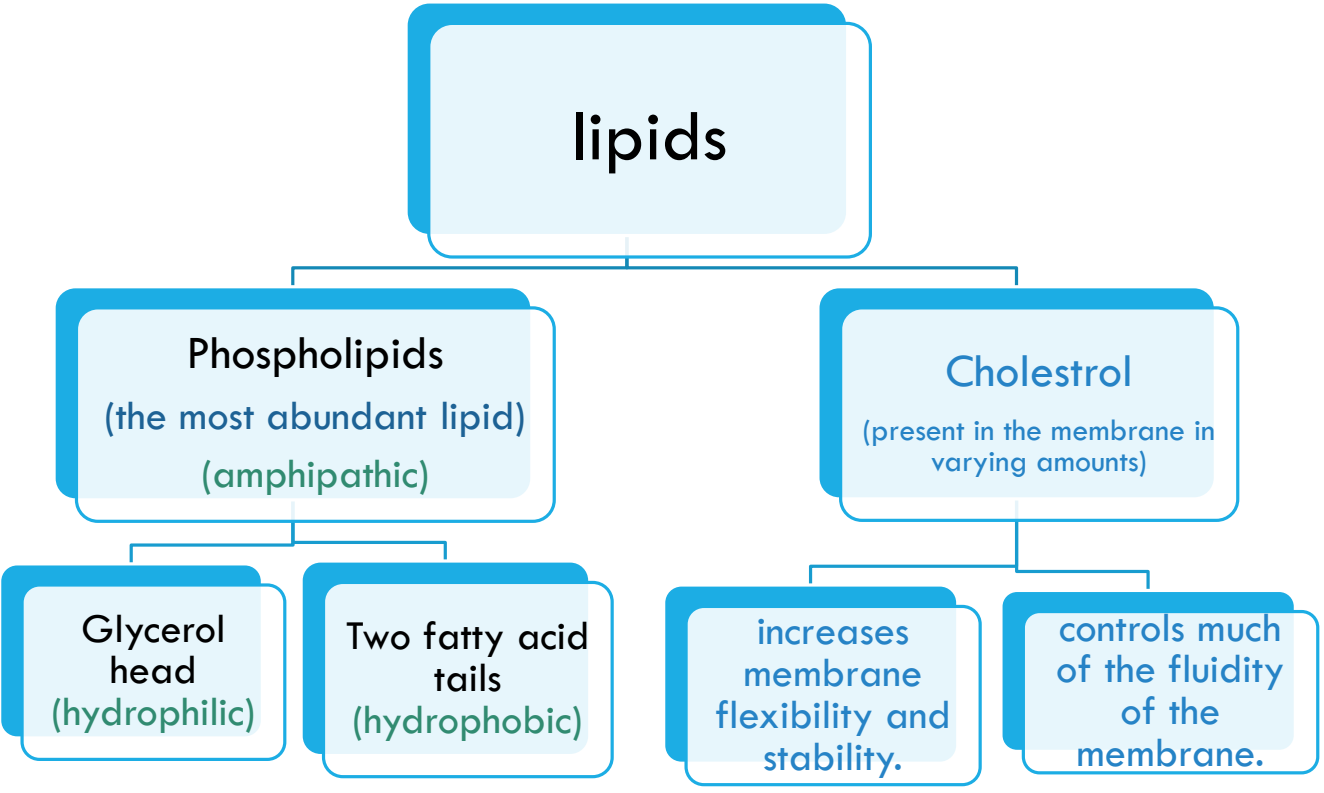


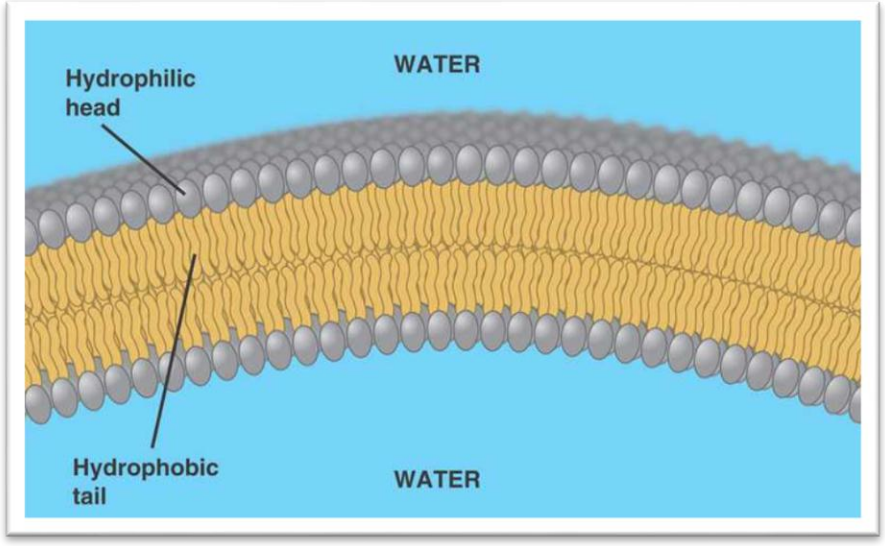
(the globular/alpha helix proteins are not included)

Carbohydrates				
	Glycoproteins	Glycolipids	Proteoglycans	Glycocalyx
Structure	Proteins + carbohydrates	Lipids + Carbohydrates	Mainly carbohydrate bounded by protien	Loose coat of carbohydrates on the cell membrane
Percentage	Most of the membrane carbohydrates	1/10		

Carbohydrates function:

- Attach cells together
- Act as receptors substances (help ligend to recognize its receptor.)
- Some are used in some immune reactions
- Give most of cells overall –ve surface





Lipids:

Phospholipids: consist of:-

1. Glycerol head (hydrophilic).
2. Two fatty acid tails (hydrophobic).

Note: the phospholipid a hole are considered amphipathic (both hydrophilic/phobic)

Cholesterol:

- present in membrane in varying amounts.
- controls much of the fluidity of the membrane.
- Function:• increases membrane flexibility and stability.

Proteins

Peripheral proteins (carrier protein):

-present in one side.

-hormone receptors.

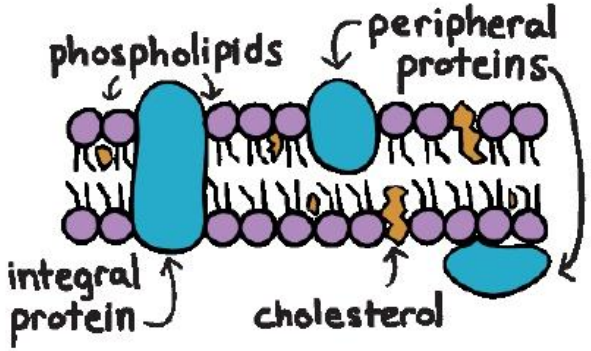
-cell surface antigens

Integral proteins:

-span the membrane.

-provide structural channels and pores.

-Carrier proteins

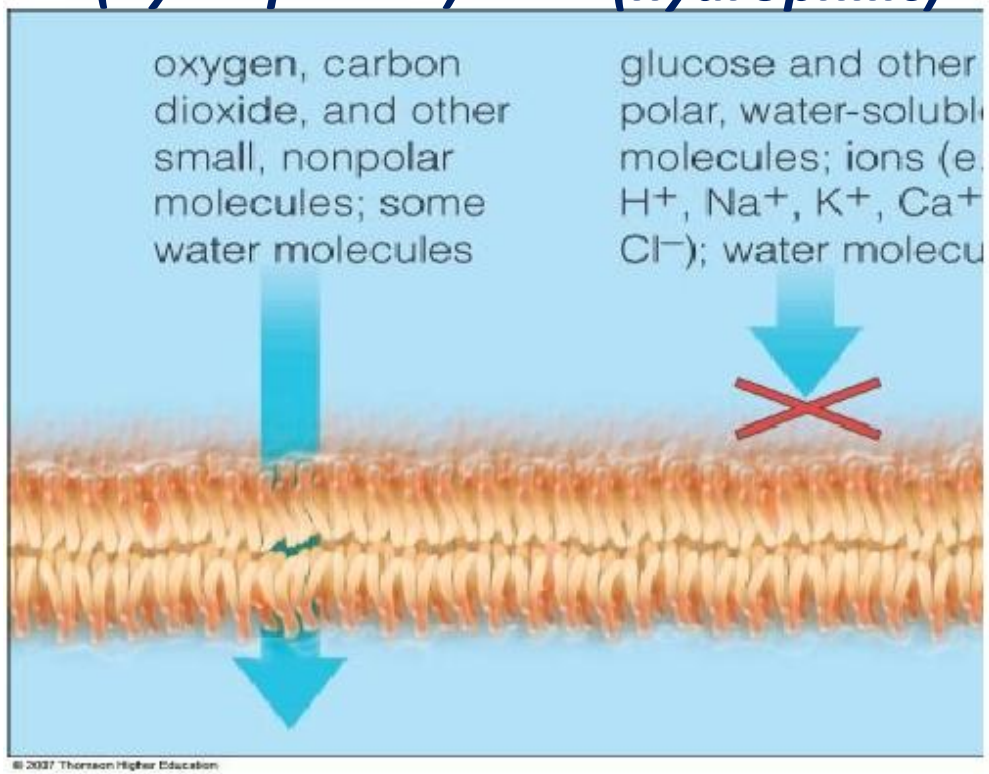


Transport through the cell membrane:

- Cell membrane is selectively permeable.

Lipid soluble substances (hydrophobic)

Water soluble substances (hydrophilic)



Alternative route

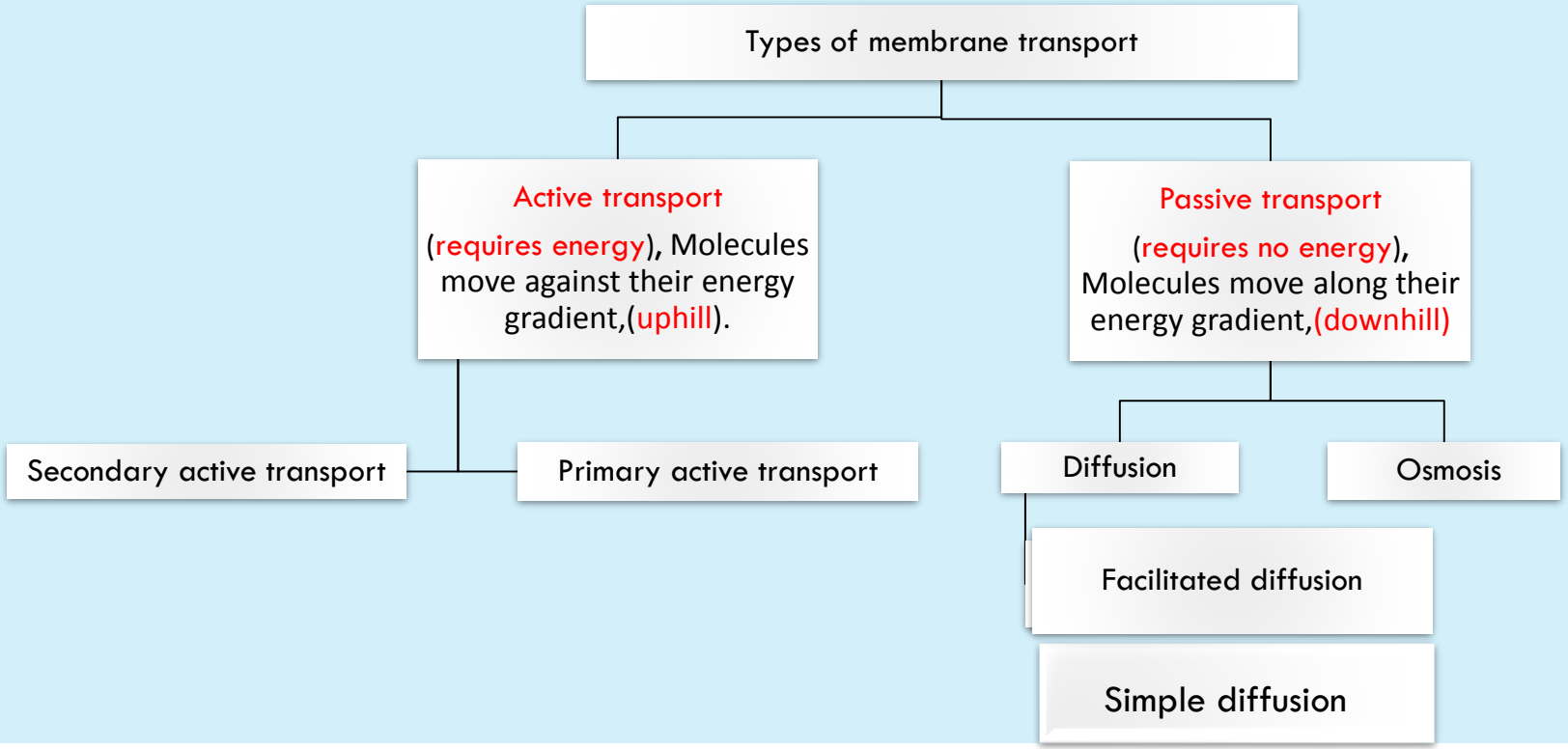
Directly through the lipid bilayer

(Cross freely by diffusion)

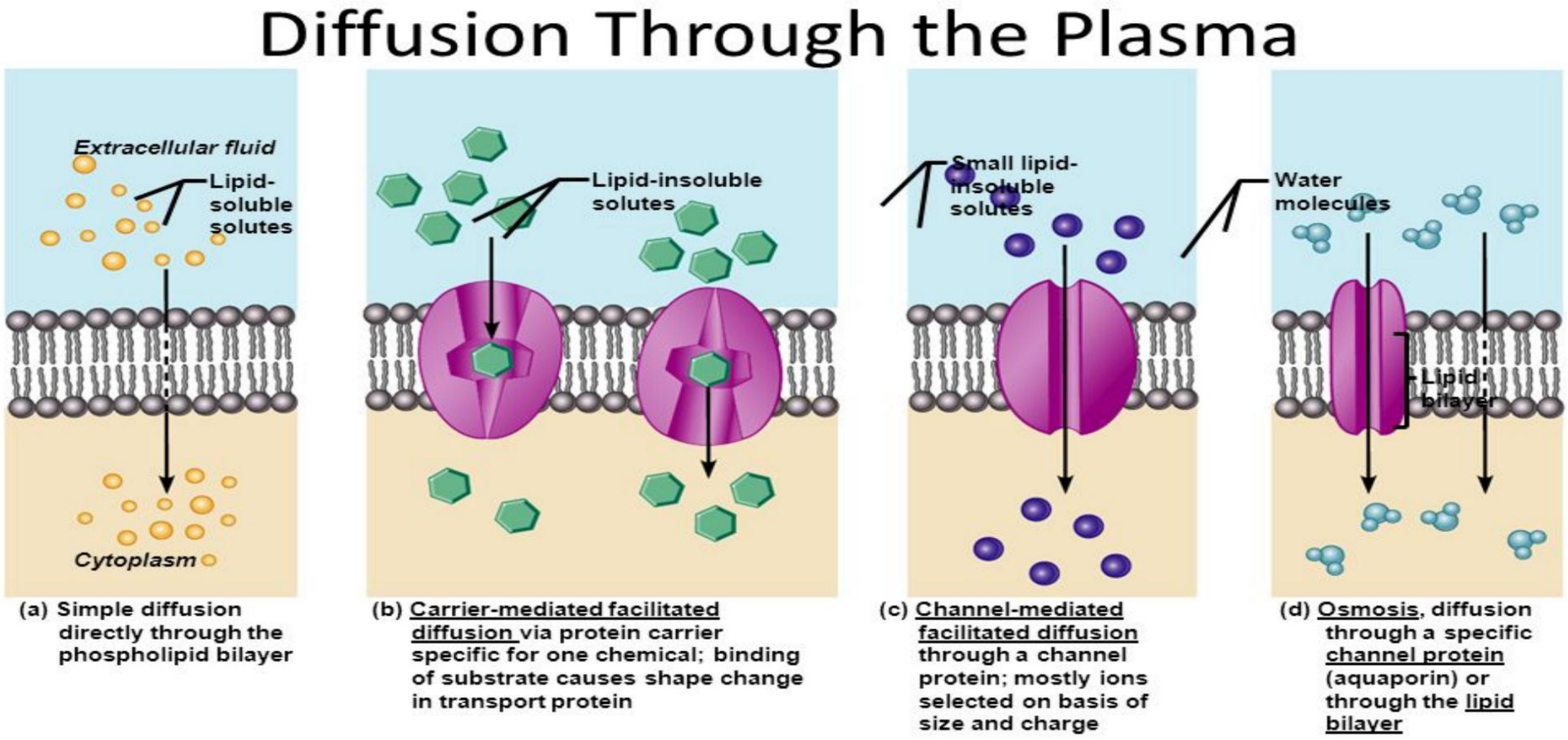
Through membrane proteins

Transport through the cell membrane:

- Cell membrane is selectively permeable.



Diffusion: random movement of substance either through the membrane directly or in combination with carrier protein down an electrochemical gradient.

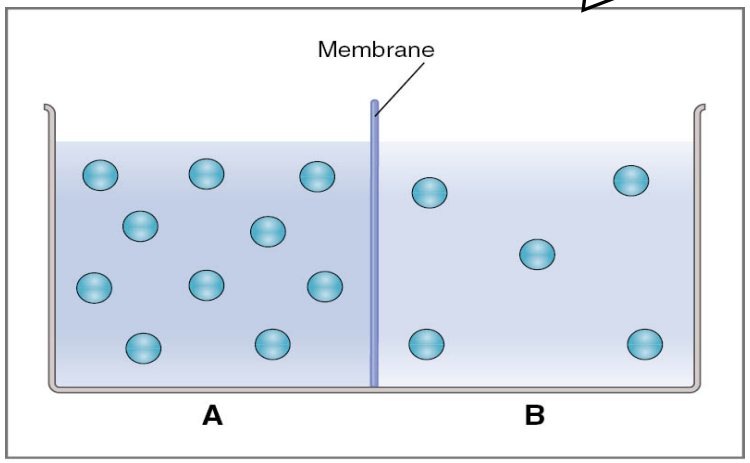


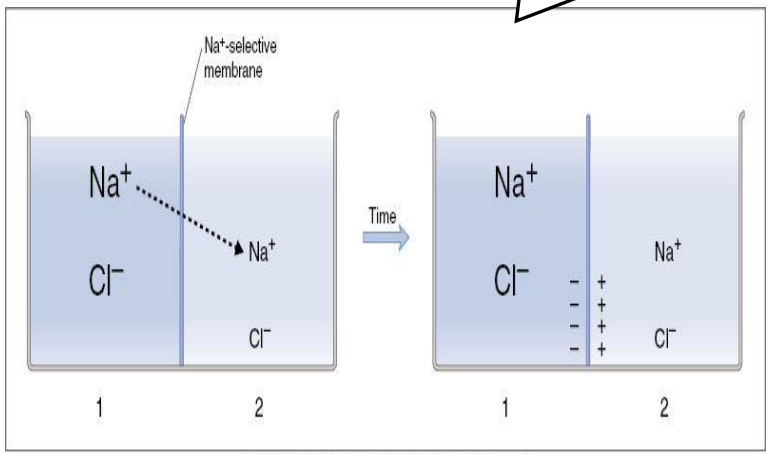
Simple diffusion:

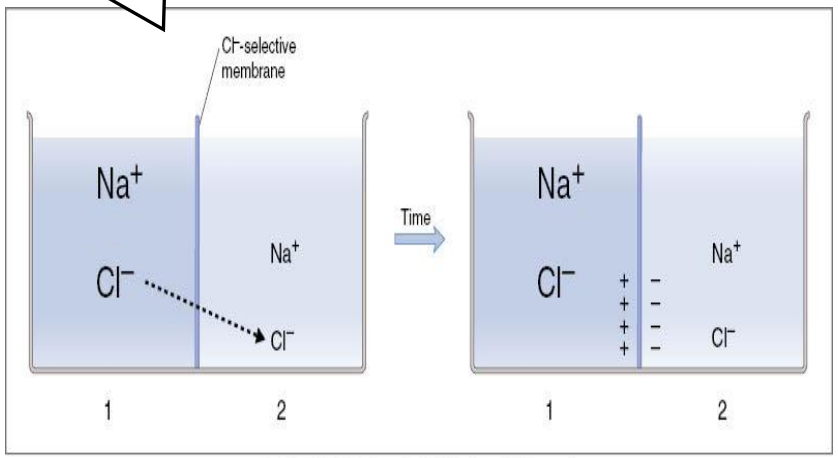
Non carrier mediated transport down an electrochemical gradient.

Diffusion of nonelectrolytes (uncharged) from high concentration to low concentration.

Diffusion of electrolytes (charged) depend on both chemical as will as electrical potential difference.







The rate of the simple diffusion depends on:

1-amount of substance available.

2-the number of openings in the cell membrane for the substance.

3-chemical concentration difference.(net diffusion= P x A (Co-Ci))

P= permeability coefficient
A= surface area

4-electrical potential difference.

5-molecular size of the substance.

6-lipid solubility.

7-temperature.

$$Rate\ of\ diffusion = P\ X\ A\ (C1–C2)$$

1. P = Permeability coefficient.

a.Temperature. b. Size of molecule. c. Solubility in lipids. d. Thickness of membrane.

2. A = surface area.

3. C1-C2 = gradient difference:

a. Concentration difference
b. b. Electrical difference.
c. Pressure difference.

Facilitated diffusion:

-Carrier mediated transport down an electrochemical gradient.

Transports glucose, most of amino acids.

Features Of Carrier Mediated Transport

1- Saturation:

↑ concentration → ↑ binding of protein.

-If all protein is occupied we achieve full saturation.

2- Stereopecificity:

The binding site recognize a specific substance

D-glucose but not L-glucose.

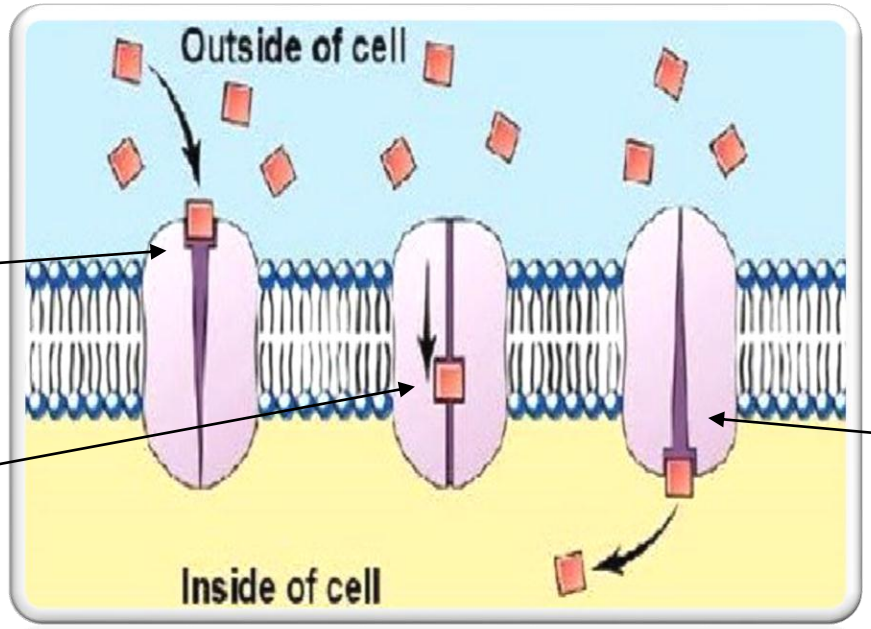
3- Competition:

Chemically similar substance can compete for the same binding site.

General Steps for Facilitated Diffusion (or any carrier mediated transport):

1. Solute binding.

2. Change in carrier conformation allowing solute to pass through.

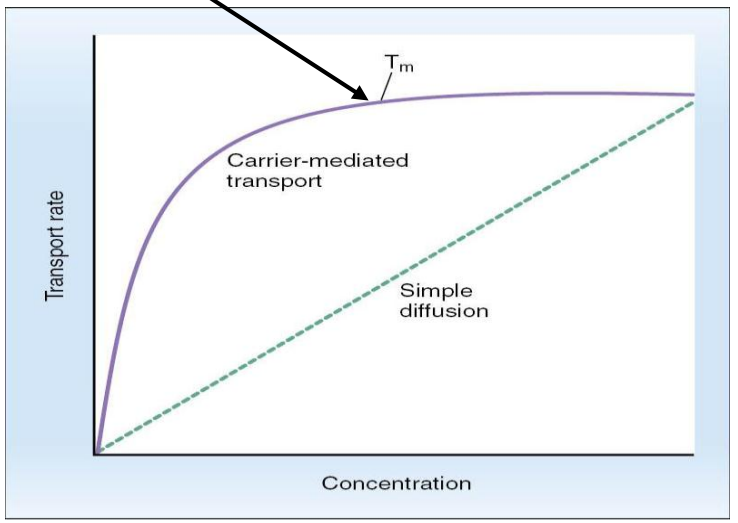


3. Release of solute on the opposite side of the membrane.

What the difference between facilitated and simple diffusion?

Simple diffusion	Facilitated diffusion
• Non carrier mediated transport. • The rate of diffusion increases proportionately with the concentration of the diffusing substance.	• The rate of diffusion increases proportionately with the concentration of the diffusing substance ***until it reaches a transport maximum (Tmax)***. • At Tmax, an increase in the concentration of the diffusing substance ***does not*** increase the rate of diffusion.

Tm = ***transport maximum*** = the transport rate at which saturation occurs.



(Active transport)

-against the electrochemical gradient , requires energy, (uphill).

-carrier mediated(requires carrier protein)

(primary)

-direct energy source.

(secondary)

-indirect energy source.

- Co-transport
- countertransport

1- primary active transport:

-Energy is supplied directly from ATP.

Examples:-

A - Sodium-Potassium pump (Na-K pump):

- **It's present in all cell membranes.**

3 Na+ in ⟶ out.

2 K+ out ⟶ in.

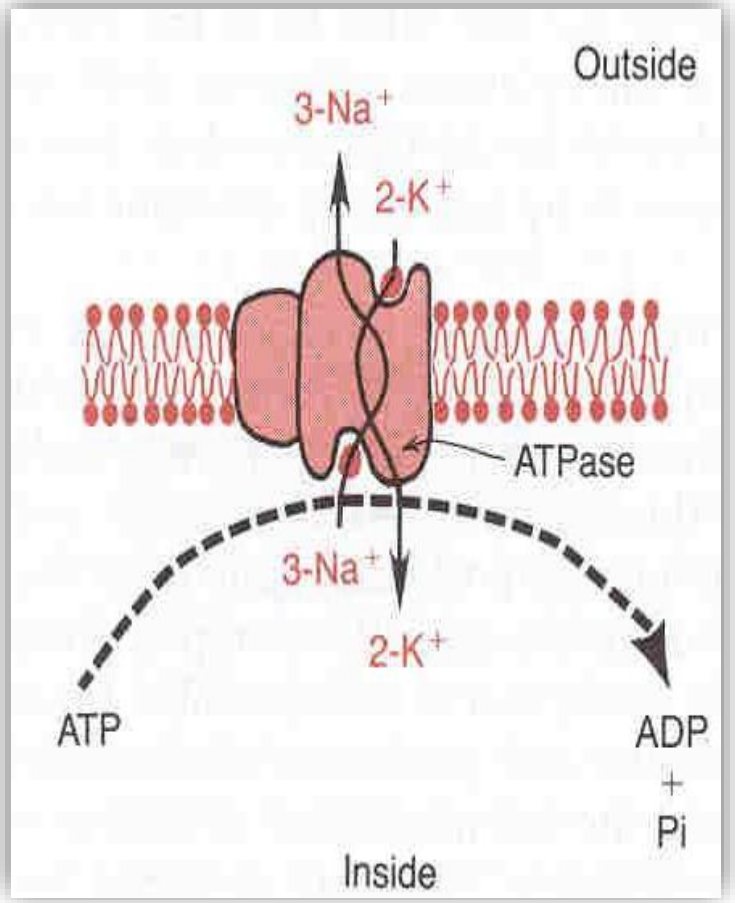
Characteristic Of The Na-K pump:

1. Carrier protein is formed from α and β subunits.
2. Binding site for Na inside the cell.
3. Binding site for K outside the cell.
4. It has ATPase activity.
5. 3 Na are pumped out.
6. 2 K are pumped in.

It's main functions:

1. Maintaining Na and K concentration difference .
2. It's the basis of nerve signal transmtion .
3. Maintaining negative potential inside the cell.
4- Maintain a normal cell volume.

$$ATP \longrightarrow ADP + P + Energy$$



B - Calcium ATPase (Ca^{2+} ATPase): found in:

- sarcoplasmic reticulum (SR).
- mitochondria.
- in some cell membranes.

Its main function is to maintain a low Ca^{2+} concentration level inside the cell.

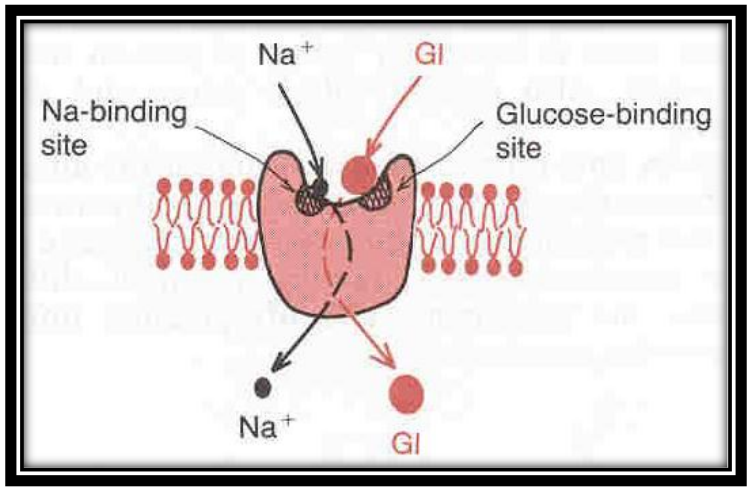
C. - Primary active transport of hydrogen ions H+-K ATPase: found in:

- stomach.
- kidneys.
- pump to the lumen.
- H+-K ATPase inhibitors (treat ulcer disease), (omeprazole).

2 – secondary active transport:

is the transport of one or more solutes against an electrochemical gradient ,coupled to the transport of another solute down an electrochemical gradient .

- "downhill" solute is Na.
- Energy is supplied indirectly form primary transport.



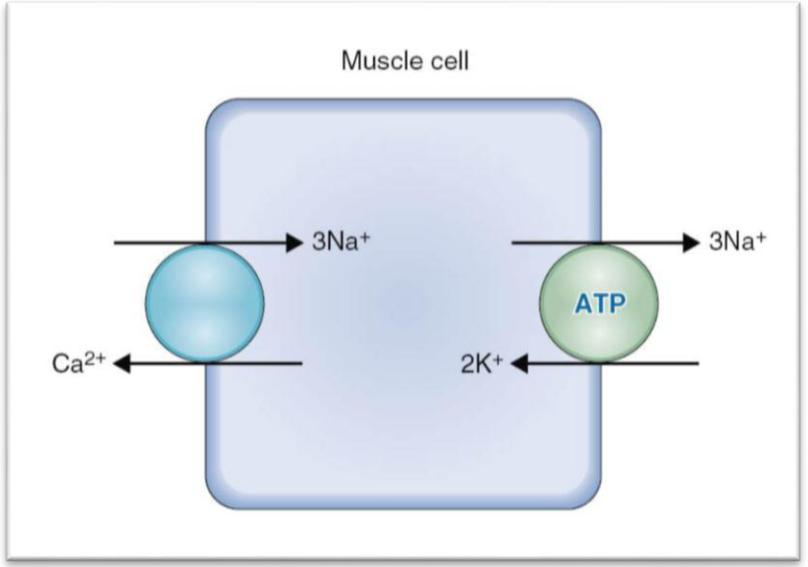
- **Co transport:**

- All solutes move in the same direction "inside cell".
- e.g. - Na - glucose Co transport.
- Na – amino acid Co transport.
- in the intestinal tract kidney.

- **Countertransport:**

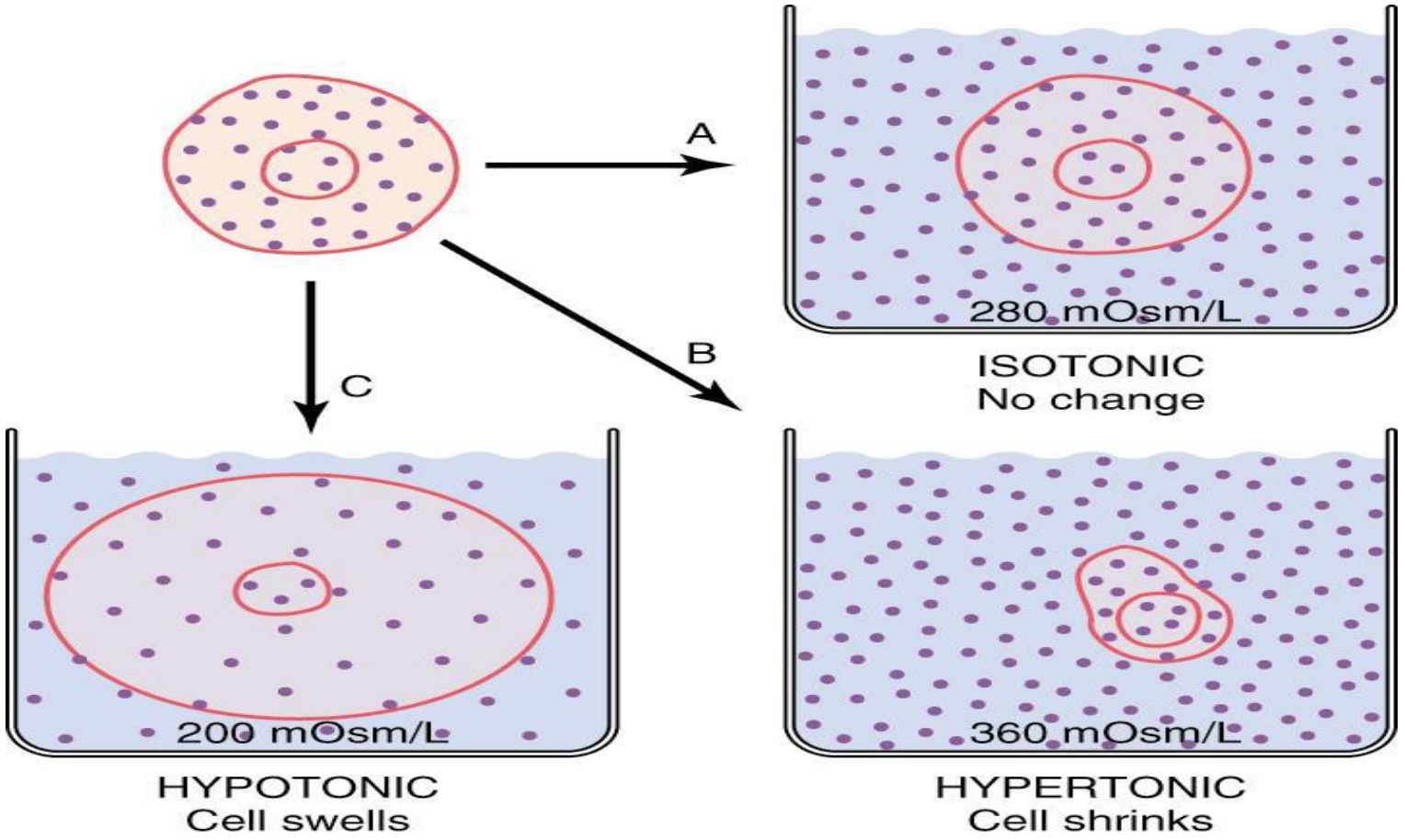
-Na is moving to the interior causing other substance to move out.

- Ca^{2+} - Na+ exchange. (present in many cell membranes).
- Na –H+ exchange in the kidney.



Osmosis:

net diffusion of water from a region of high water concentration to region of low water concentration.



QUIZ

1. In the Co transport of Glucose, which of the following travels downhill?			
A) Glucose	B) Sodium	C) Potassium	D) Water

2. Which of the following requires indirect supply of energy?			
A) simple diffusion	B) Primary Active transport	C) Facilitated diffusion	D) Secondary Active transport

3. Which of the following does not require a carrier protein?			
A) simple diffusion	B) Primary Active transport	C) Facilitated diffusion	D) Secondary Active transport

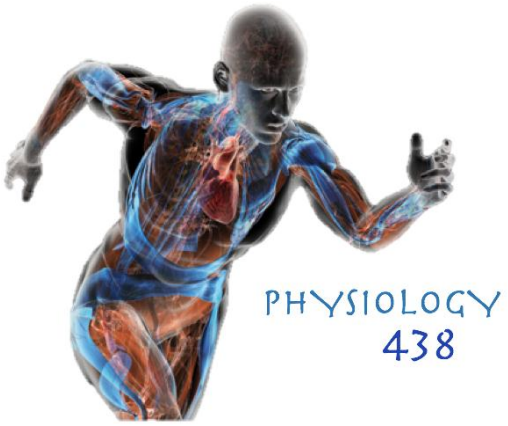
4. How many ATPs are needed to activate the Na/K pump?			
A) 1 ATP	B) 2 ATP	C) 1 NADH	D) None

5. Which if the following is not a factor affecting the rate of simple diffusion?			
A) Electrical difference	B) Surface Area	C) Temperature	D) Stereospecificity

Key answer:
1- B
2- D
3- A
4- A
5- D

THANK YOU

Boys team members	Girls team members
• عمر الدوسري	• اروى الامام
• زياد الدوسري	• ديما المزيد
• عبدالله الغامدي	• جود الخليفة
• محمد الحمد	• جود العتيبي
• عوض العنزي	• ريناد المطوع
• فيصل القفاري	• ريما المطوع
• عبدالله باسمح	• طرفة آل كلثم
	• مي بابعير
	• نجود العلي
	• نورة المزروع



Team leaders:

- عمر الشيناوي
- ايلاف المسيحل

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