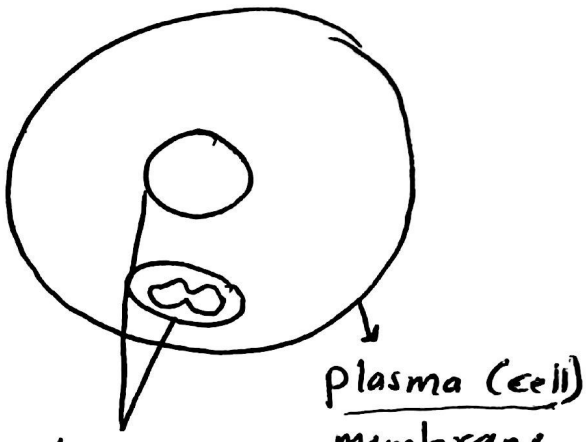
iological Membranes

Consist of

1. Proteins 20 - 80%
   Cell membrane is crowded with proteins

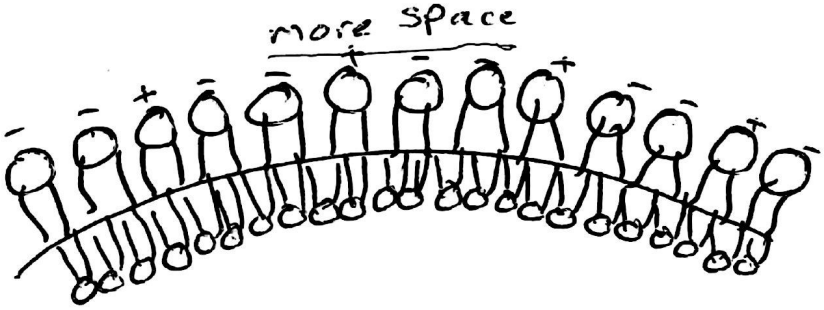


2. Lipid → mainly phospholipids
   * But Never TAG because its not amphipathic (No-polar-parts)

3. Carbohydrate (oligosaccharide) bind to:
   - protein → Glycoprotein
   - lipid → Glycolipid (only on the outer layer because more space)

   (Markers & For cell identification)

Lipid part



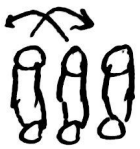
- Bilayer
- polar, charged heads from Outside in contact with water
  (charged molecules can bind to the heads)
- Non-polar Hydrophobic tails from inside away from water

* Lipid bilyer are Assymetric
  → bulkier lipids such as Ganglioside, Cerebroside, Sphengomylein more in the Outer layer

linked Mainly by Hydrophobic interaction and Van der Waals

Fluidity of the membrane $\xrightarrow{\text{means}}$ = Movement

* Lipids movement:

ⓐ lateral movement (حركة جانبية)  in the same layer — Frequent

ⓑ Flip-Flop movement  Between the 2 layers — ~~Rare~~ Rare

* Proteins in the membrane move only laterally (proteins float in the lipid bilayer)

☒ Fluidity of the membrane depends on:-

① Saturated : Unsaturated
Solid : Fluid

↑ % Unsaturated ↑ Fluidity

② cholesterol ↑ order (الترتيب) and Rigidity (الصلابة)

- Plant cell membrane → higher % of unsaturated tails, No cholesterol ⇒ more fluid

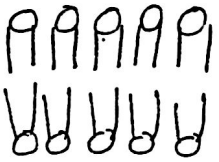
- prokaryotic Cell membrane → No steroid at all ⇒ Most fluid.

* Flouresence spectroscopy: strong method to monitor the motion of molecules in the membrane

* Transition Temperature (Tm) or melting Temp.:-

the Temperature at which the membrane becomes fluid

↑ % Saturated → ↑ Rigidity → ↑ Tm
↑ cholesterol → (↓ Fluidity) ↗

*  is Heated → 

When Gel becomes liquid then:
* surface area increase
* thickness decrease

* DSC : Differential Scanning calorimetry
strong method to determine phase transition Temperature

حرارة ذوبان الغشاء

Q: which of the following would NOT be enriched on the outer layer of the membrane compared to the inner layer?

a. phosphoacylglycerol

b. Ganglioside
c. Cerebroside
d. sphingomylein

} bulky → outer

Q: The distribution of lipids in membrane is:

a. uneven, with bulkier molecules on the exterior
b. characterized by even distribution of molecules
c. distinguished by the absence of cholesterol
d. non- of these

Q: when membrane reaches it's transition temperature, membrane proteins dissociate from the bilayer.

True

False

Proteins in membranes

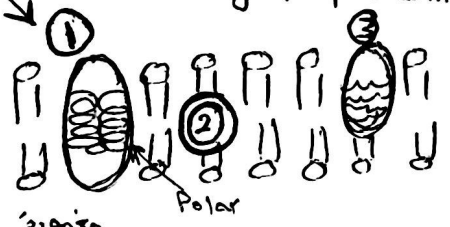
Peripheral Proteins

- Surface of the membrane
- bind by polar or electrostatic interaction
- easily removed
  - ↑ ionic strength of the medium (1 Mole NaCl)
  - Or change pH

Integral Proteins

They have 3 shapes:

1. transverse
2. lie entirely within tails
3. project from the bilayer



- Span the membrane
- α helix or β-sheet to minimize contact of polar backbone with the non-polar tails
- hard to remove
  - if removed → denaturated
  - by: Sonication (ultrasound vibration), detergent
- Study them in living tissue by NMR (in place, not removed)

* Some proteins bind to membranes covelently with Anchors:-

- Myristoyl → bind to glycin in the N-terminal by amide bond
- Palmitoyl → bind to cystein by thioester Bond
  - Ex:- G-protein coupled Receptor

Most protiens bind through non covalent bond

fluid mosaic model — most accepted description of cell membrane

→ membrane consist of Proteins & phospholipids

1) phospholipids are the major lipid in the membrane

2) proteins embedded in the lipid bilayer

→ Using Freez - Fracture technique → Expose the interrior of the membrane → granular appearance due to Integral proteins

* all membrane proteins go with the interior layer.

3) lipids / proteins are NOT fixed, they are in dynamic movement

lipids movements < lateral / Flip flop

Proteins → lateral (or Float in the lipid bilayer)

Functions of the membrane :-

1) Surround the cell and separating it from External Environment

2) Regulate transport of Substances (lipid + protein)

3) Receptors (proteins)

4) Catalysis = Enzymes (proteins)

* Transport, Receptor and enzymatic proteins in the membrane all are integral proteins.

Q: Which property has not been observed for membrane proteins?

a. energy storage
b. transport of substances into and out of the cell
c. catalysis
d. acting as a receptor

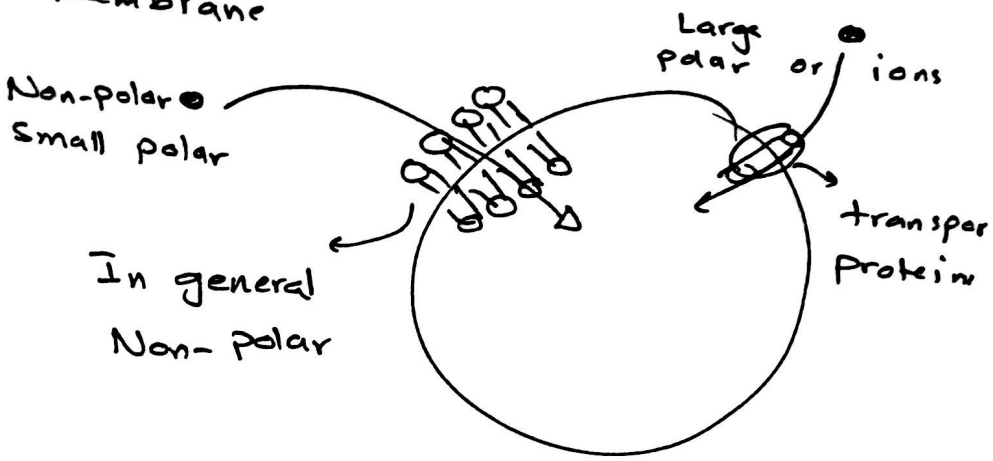
Q: which of the following treatments would be most useful in separating an integral protein from the lipid bilayer?

a. change the pH
b. add a salt
c. add a detergent
d. add a mixture of proteases
e. None of these, you cant separate integral proteins

Q: a useful method for studying membrane proteins in place in the membrane is :-

a. Nuclear Magnetic Resonance
b. X-ray crystalography
c. treatment with mercaptoethanol
d. treatment with detergent.

ansport across membrane

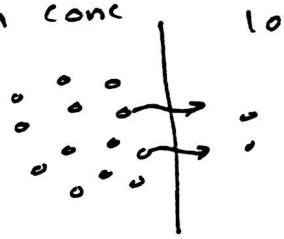


Transport

Passive

- Simple Diffusion
- Facilitated Diffusion

* High conc → low conc



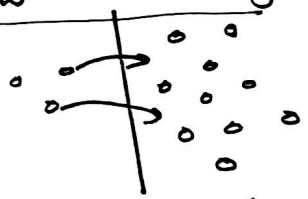
with down

* Need No energy (ATP)

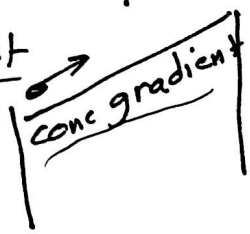
Active

- 1° active (ex. pump)
- 2° active

* low → High



* against conc gradient

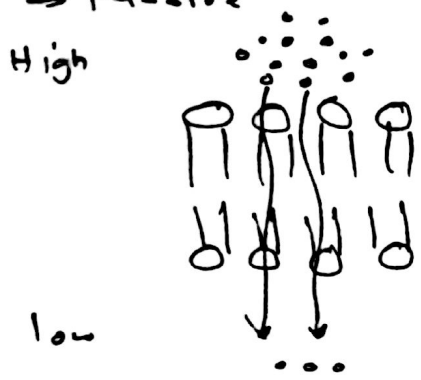


* Need energy (ATP)
* Need transport protein (Pump.)

Passive Transport

simple Diffusion
الانتشار البسيط

→ passive

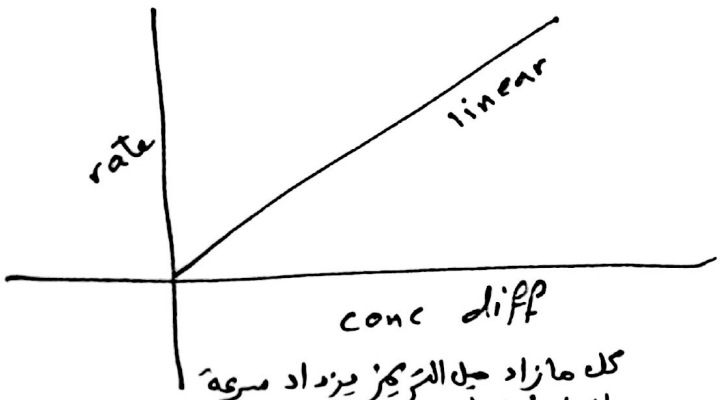


→ through Lipid bilayer
→ Need No transport proteins for Non-polar or small polar

CO_2 , O_2 , N_2 , H_2O

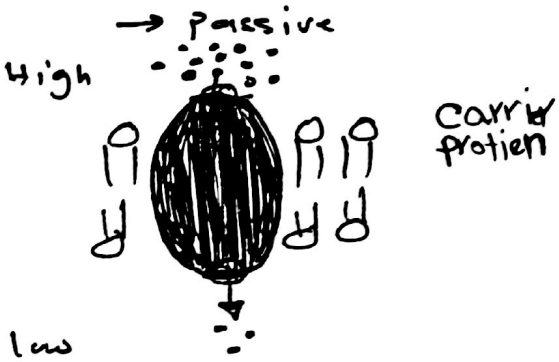
Rate of simple Diffusion

↑ Concentration difference ↑ rate



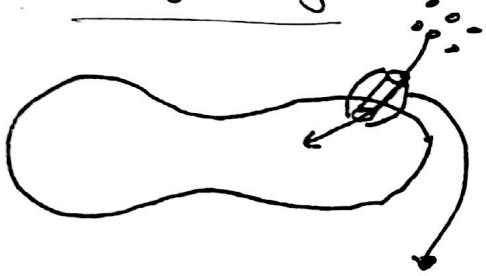
كل ما زاد حيل التركيز يزداد سرعة الانتشار العادة

Facilitated Diffusion
الانتشار المسهل

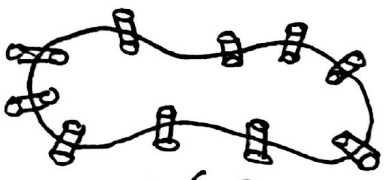


→ through transport Proteins
→ for larg polar or ions

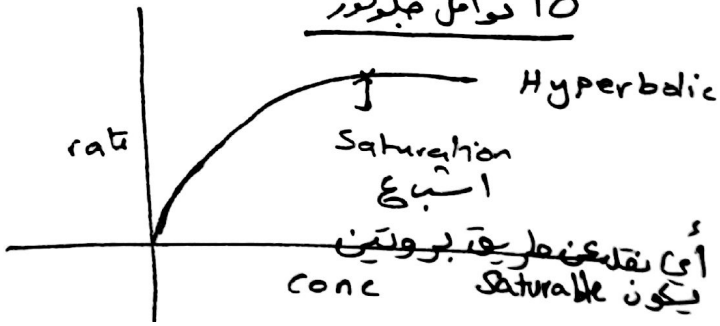
Ex:- Glucose transport to Erythrocytes 5mM



ناقل الجلوكوز Glucose permease



10 نواقل جلوكوز



أي بقلة عن عدد بروتين يكون Saturable

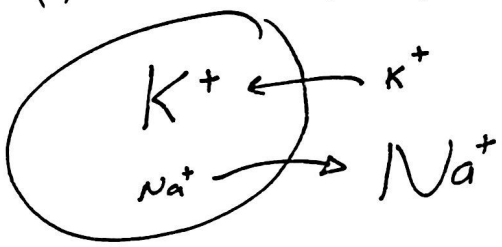
Active transport → Need Energy (ATP)
↳ transport protein (pump)

primary active 1°

* اذا البروتين الذي ينقل المادة هو الذي يستخدم ATP

Ex:- $Na^+ - K^+$ pump
($Na^+ - K$ ATPase)

Normal Cell



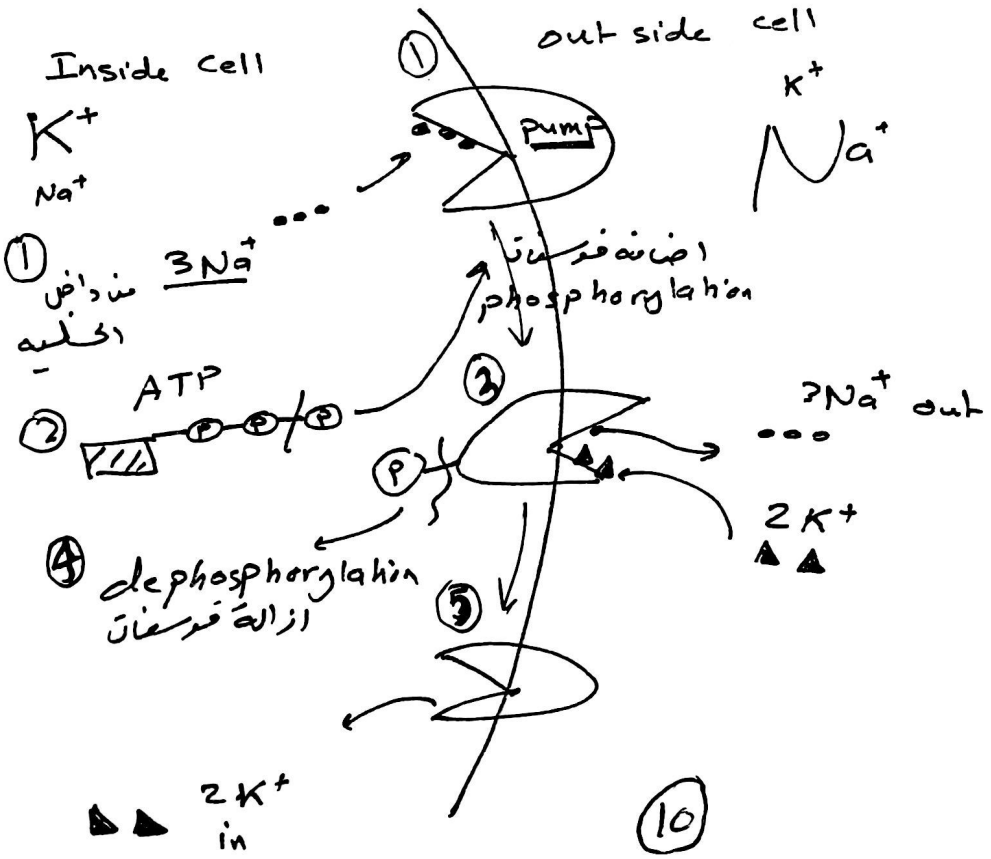
to Keep that

in ← active K^+

Na^+ active → out

secondary active 2°

غير ذلك



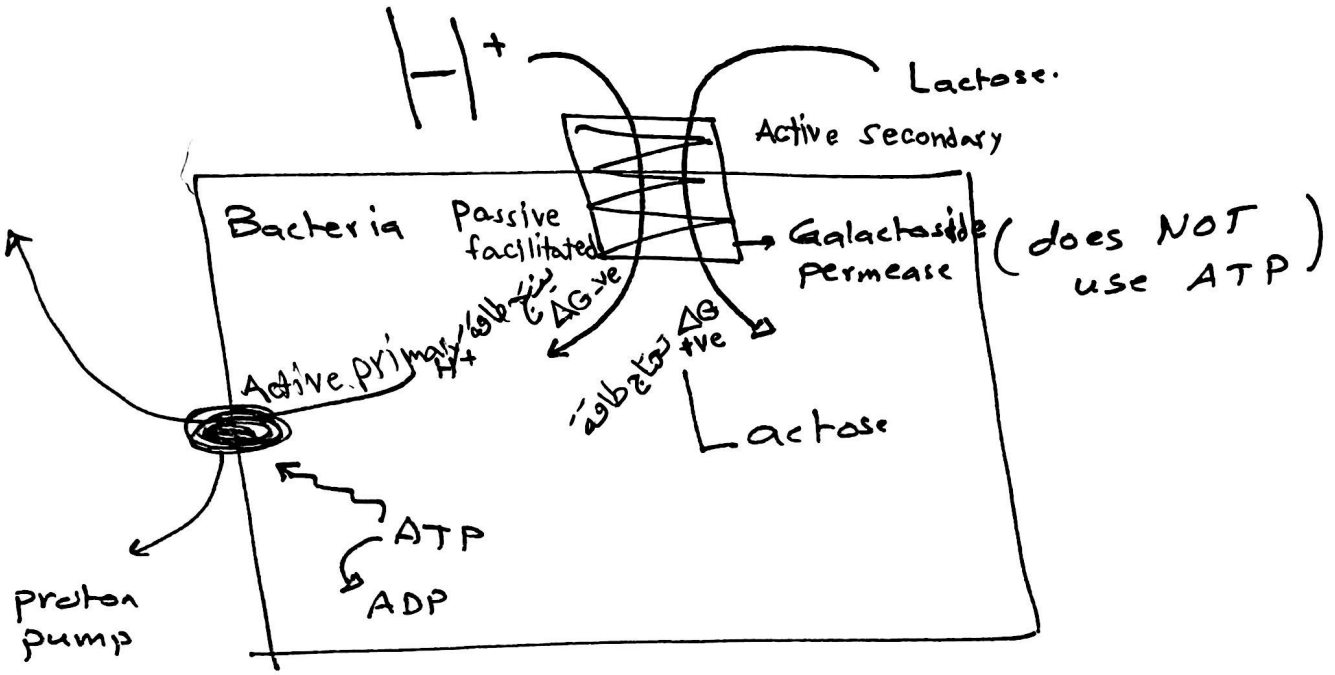
$3Na^+ \longrightarrow$ out

in $\longleftarrow 2K^+$

1 ATP

Secondary active transport

Ex:- Lactose transport in Bacteria



Lactose transport is Active 2°

H+ Entrance is Passive facilitated

H+ Exit is Active 1°

ΔG for H+ flow inside is -ve ينتج طاقة
ΔG for Lactose flow inside is +ve يتفاعل طاقة
] Coupled

الطاقة الناتجة من دخول الـ H+ تستغل في ادخال الـ Lactose

what distinguishes primary from secondary active transport ?

a. The requirment of protein
b. The type of linkage to ATP
c. The number of kind of molecules or ions transported
d. The relative direction of transport

Q: transport of a compound across a cell membrane (down a concentration gradient) (passive) was measured at several concentrations, The presence or absence of ATP had no effect on the transport, which best describe the mechanism of transport?

Concentration difference μM	Transport rate
2.5	30
5	60
10	100
25	175
50	200

في البداية كانت زيادة السرعة ثابتة ثم قلت بسبب حصول إشباع

a. facilitated diffusion
b. Simple diffusion
c. primary active transport
d. Secondary active transport
e. proton pumping

In the Operation of sodium - potassium pump :-

a. Conformational changes in membrane proteins are inhibited

b. the ion involved bind to the lipid portion of the membrane

c. a membrane protein is phosphorylated with ATP as a source of phosphate group

d. a membrane protein is phosphorylated with ADP as a source of phosphate group

Q: which of the following methods of transport across membrane does NOT require a protein ?

a. Simple Diffusion

b. Facilitated Diffusion

c. active transport

d. passive transport

Q: which of the following statements concerning active transport is true ?

a. It takes place in the same direction as a concentration gradient

b. it requires no expenditure of energy by the cell

c. it can be compared to water running downhill

d. A membrane associated protein must be involved.