



**Cell &
Molecular
Biology
Notes**

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8.6 | Membrane lipids and Membrane fluidity.

* Lipids are responsible on the membrane fluidity.

* The physical state of the membrane lipids is described by its fluidity which determined by the lipids.


(fluidity or viscosity)
اللزوجة

* How the cell adapts with the changing in temperature? Is the membrane able to change its composition if the temperature is changed? Does the lipid composition depend on the temperature?

yes !!

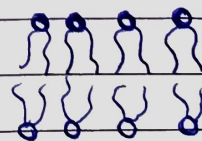
- If the temperature of the lipid bilayer is kept warm 37° , the lipids exist in relatively fluid state, and is described as

A TWO-DIMENSIONAL LIQUID CRYSTAL

* If the temperature is lower than the transition temperature (The temperature in which the membrane fluidity switches the situation between the solid and fluid), the lipid is converted into to the frozen crystalline  (The movement is restricted)



(32°) lower temperature
the movement is
restricted



37° (natural)

* If the temperature is 37° , the lipids move laterally and rotate around their axis.

* The influence of fatty acids on the fluidity:

The fatty acids differ from each other according to the length (No. of carbon atom) ¹⁶⁻²⁰ & Saturation level.

- * Saturated
- * mono-unsaturated
- * poly saturated

* The Saturation level influences the fluidity

* If the unsaturation increases, the melting point decreases. (because the unsaturation decreases the packing of the phospho lipids).

(we are talking about the cis double bonds not the trans).

Saturated fatty acids are straight so they pack together tightly.

The degree of unsaturation \uparrow Fluidity \uparrow
melting point \downarrow

The shorter of fatty acid chains, the lower its melting point.

The shorter fatty acid means that it has a weaker interactions between the chains is less.

If the chains become taller the hydrophobic interactions become stronger \rightarrow the melting temperature increases, and the fluidity decreases

The influence of cholesterol on the fluidity :-

it creates the condition of intermediate fluidity (buffering the fluidity) prevents it from being solid or extremely fluid. It decrease the membrane permeability (It has hydrophobic properties) because it is the less amphipathic molecule according to the lipids in the membrane.

* Fluidity allows for interaction.

* If the fluidity doesn't exist, all cellular processes that happen within the membrane will stop (e.g. of processes, cell movement, cell growth, endocytosis and phagocytosis, cell division) they all depends in the movement (fluidity of the membrane).
The movement will be restricted.

* How does the cell maintain the membrane fluidity?

The internal temperature of most organism can fluctuate (even the human).

The cell respond to the fluctuation that happen from temperature by altering the phospholipid composition.

* ليد تغير درجة الحرارة في الخلية بغير تغير في تركيب الـ phospholipids (Remodeling) في الغشاء الخلوي.

If the temperature becomes **low** the remodeling be like:-

① **Desaturating** **Single bonds** in the **fatty acid chains**.

The temperature ↓ Fluidity ↓
Unsaturated **prevents the tight packing**.
So the fluidity of the membrane will increase. ↑

② **reshuffling** (**جلب**) between different **phospholipid molecules** to make ones that have **two unsaturated fatty acids** (reshuffling of the chains of fatty acids)

فوسفوليبيدات (**جلب**) بين الجزيئات لإنتاج جزيئات بها 2 unsaturated chains fluid

This process **catalyzed** by **different enzymes**

- ① **desaturases** (**إنزيمات**)
- ② **phospholipases** (reshuffling) the splitting
- ③ **acyl-transferases** (transfer fatty acids between phospholipids)

* If the temperature **increases** :-

- ① we will increase the **saturation** (packing)
- ② we will increase the packing (**the length of fatty acids chains**) → restriction (**maintaining the fluidity**)
somewhat natural ↗

③ The cell changes the type of phospholipids from the (endoplasmic reticulum)

Lipid Rafts

We are gonna to talk about the outer leaflet of the plasma membrane

The outer leaflet of plasma membrane contain a specialized region is called microdomain which moves as one unit inside the membrane and forms the lipid rafts which float within the more fluid and disordered environment.

The properties of lipid rafts:-

- Rich with the cholesterol and the sphingolipids
- Provide favorable environment for cell-surface receptors and GPI-anchored proteins

lipids rafts is is a go to the internal

GPI-anchored proteins are involved in the infections

8.11 The Dynamic Nature of the plasma membrane

- * The plasma membrane can move laterally within the same leaflet
- * Phospho lipids can diffuse from one leaflet to another (flip-flop). In bacteria, this movement takes from an hour to days because the hydrophilic head should cross the hydrophobic region (it's difficult) it is catalyzed by an enzyme called flippase (that move certain phospho lipid from one leaflet to the another)
- * The rotation around their axis.

leaflet \rightarrow mono layer.

The diffusion of membrane proteins after cell fusion

(المركبات التي تتحرك في الغشاء)

- * The experiment of human cell and mouse cell (the proteins are tagged and then the two cells fused (hybrid cell), we observe that the proteins move from a place to another.

FRAP (Using the fluorescence dye to label the proteins \Rightarrow laser beam \rightarrow photobleach spot

و يمكن ترميز الجزيء في الإبر و يتم تفتيح
البروتينات في مكان ما في الغشاء

The Polarity

* The membrane composition varies between the cells, organisms and species due to the different structures, such as the epithelial cell (the membrane differs according to the type of membrane or the location of the membrane). → The epithelial cell always secrete the materials toward the lumen.

epithelial membrane

- a. apical plasma membrane.
- b. lateral plasma membrane.
- c. Basal plasma membrane.

Each membrane has different function and different protein composition

apical → regulate the nutrients and water intake (we find many transporter) / regulate the secretion.

lateral side contains the junctions (contact)

Basal membrane → (cell substratum contact)
generation of ion gradient.

Differentiation function of the plasma membrane
Due to the the variation of protein composition

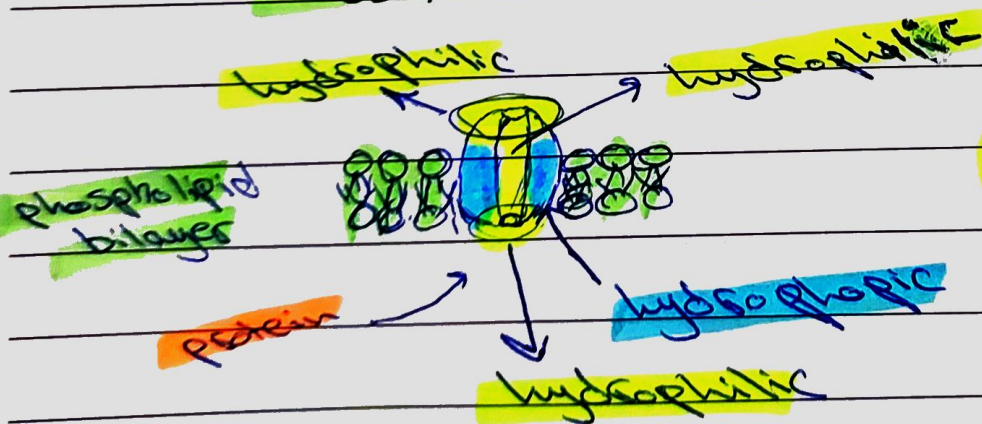
another example → Sperm (each part has special function)

8.81 Red Blood Cells is example of the plasma membrane (the most membrane has been studied) it doesn't has nuclei and the preparation of the hemolysis (SEM) photo is easy

Glycoproteins of plasma membrane

أغلب البروتينات في الغشاء

Sickle Cell disease → clumping of RBC's
So that the capacity of carrying the O_2 will decrease



البروتينات في الغشاء