

# y**to**ology

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Sheet

Slides

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**CONTRIBUTED IN THE SCIENTIFIC CORRECTION**

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# Sheet(6)/part(1)

Chapter8/ 8.6

## 8.6:Membrane lipids and membrane fluidity.

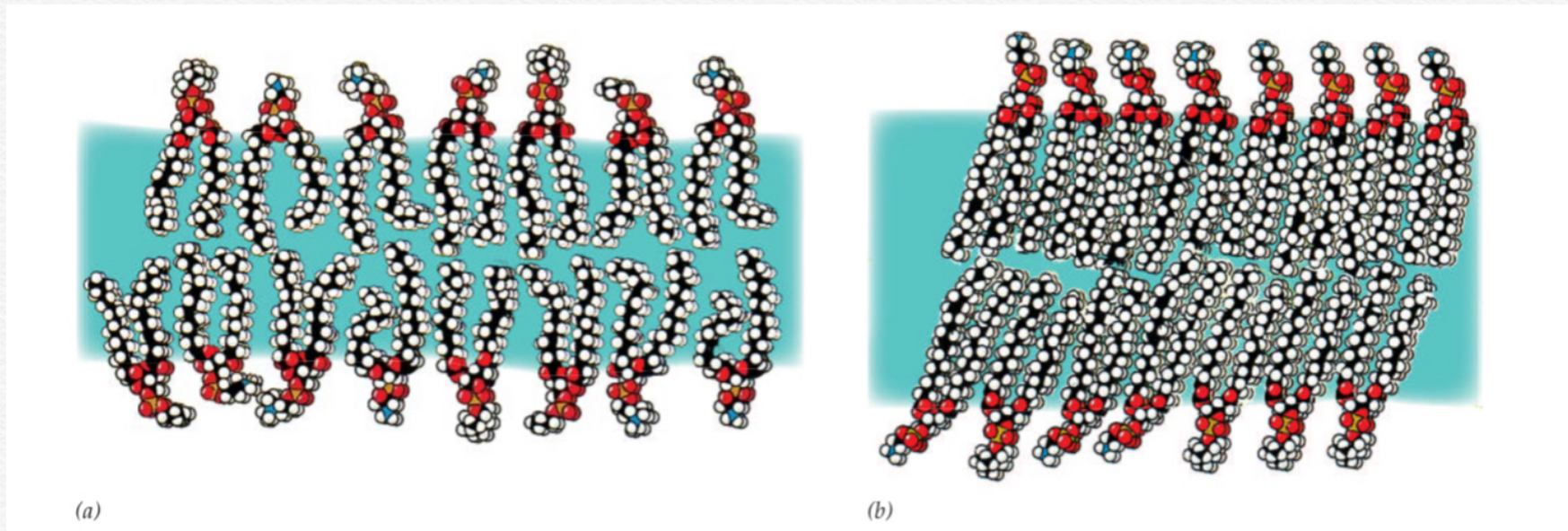
[1] The physical state of the lipid of a membrane is described by its fluidity (or viscosity)

\*\* Fluidity and viscosity are inversely related

Fluidity : a measure of the ease of flow

Viscosity: a measure of the resistance to flow

\*\* phosphatidylcholine & phosphatidylethanolamine are made of largely unsaturated fatty acids





[2] The effect of temperature on the membranes' fluidity

A. If the temperature of the bilayer is kept relatively warm (e.g., 37°C)

1-the lipid exists in a relatively fluid state

2-the lipid bilayer is best described as a two-dimensional liquid crystal

3-the molecules still retain a specified orientation

4-the long axes of the molecules tend toward a parallel arrangement>> individual phospholipids can rotate around their axis or move laterally within the plane of the bilayer.

B. If the temperature is slowly lowered

1- a point is reached where the bilayer distinctly changes

2- The lipid is converted from a liquid crystalline phase to a frozen crystalline gel in which the movement of the phospholipid fatty acid chains is greatly restricted

C. Transition temperature

1-Definition: The temperature at which this change occurs

2- Depends on

A...the ability of the lipid molecules to be packed together, which depends in turn on the particular lipids of which it is constructed

\*\* Fatty acids are the parts of the lipid which affect the fluidity

Saturated fatty acids : have the shape of a straight, flexible rod

Cis- unsaturated fatty acids: have crooks in the chain at the sites of a double bond

According to this :

\*\* phospholipids with saturated chains pack together more tightly than those containing unsaturated chains.

\*\* The greater the degree of unsaturation of the fatty acids of the bilayer, the lower the temperature before the bilayer gels. ( e.g ; Vegetable oils remain a liquid in the refrigerator, whereas margarine is a solid( margarine: سمنة))

B.... fatty acid chain length;the shorter the fatty acyl chains of a phospholipid, the lower its melting temperature

C.... the amount of cholesterol molecules **only** in animal cells' membranes ( fluidity buffer)

\*\* cholesterol molecules disrupt the close packing of fatty acyl

\*\* The presence of cholesterol tends to abolish sharp transition temperatures and creates a condition of intermediate fluidity.

يعمل وجود الكوليسترول على إلغاء درجات الحرارة الانتقالية الحادة ويخلق حالة من السيولة المؤقتة.

\*\* **Important** : cholesterol tends to increase the durability while decreasing the permeability of a membrane.

**TABLE 8.2** Melting Points of the Common 18-Carbon Fatty Acids

Fatty acid	<i>cis</i> Double bonds	M.p. (°C)
Stearic acid	0	70
Oleic acid	1	13
Linoleic acid	2	-9
Linolenic acid	3	-17
Eicosapentanoic acid (EPA)*	5	-54

\*EPA has 20 carbons.



### [3] The Importance of Membrane Fluidity

A...Membrane fluidity provides a perfect compromise between :

- a. rigid, ordered structure ( disadvantage: mobility would be absent )
- b. completely fluid, nonviscous liquid ( disadvantage: the components of the membrane could not be oriented and structural organization and mechanical support would be lacking.)

B... Because of membrane fluidity, molecules that interact can come together, carry out the necessary reaction, and move apart.(e.g on the activities that can be done ; intercellular junctions, light-capturing photo- synthetic complexes, and synapses)

C... Membranes arise only from preexisting membranes, and their growth is accomplished by the insertion of lipids and proteins into the fluid matrix of the membranous sheet.

D... Many of the most basic cellular processes, including cell move- ment, cell growth, cell division, formation of intercellular junctions, secretion, and endocytosis, depend on the movement of membrane components

#### [4] Maintaining Membrane Fluidity

**\*\*important :** The internal temperature of most organisms (other than birds and mammals) fluctuates with the temperature of the external environment.

**\*\*** membranes fluidity is essential for many activities that's why cells respond to changing conditions by altering the types of phospholipids of which they are made and this maintenance is an example of homeostasis

**\*\*** As the cell responds to the different conditions affecting the cell , the initial "emergency" response is mediated by enzymes that remodel membranes, making the cell more cold resistant.

**\*\*** Stages of remodeling:

(1) desaturating single bonds in fatty acyl chains to form double bonds( Desaturation is catalyzed by enzymes called desaturases)

(2) reshuffling the chains between different phospholipid molecules to produce ones that contain two unsaturated fatty acids, which greatly lowers the melting temperature of the bilayer.( Reshuffling is accomplished by : phospholipases;which split the fatty acid from the glycerol backbone, and acyltransferases; which transfer fatty acids between phospholipids)

**\*\*** Maintenance of fluid membranes has been demonstrated in a variety of organisms, including :

1/hibernating mammals

2/pond-dwelling fish whose body temperature changes markedly from day to night

3/cold-resistant plants

4/bacteria living in hot springs

5/Prokaryotic cells that live at very high temperatures have plasma membranes that contain highly unusual lipids(such as archae)



## [5] Lipid rafts

\*\* When membrane lipids are extracted from cells and used to prepare artificial lipid bilayers, cholesterol and sphingolipids tend to self-assemble into microdomains that are more gelated and highly ordered than surrounding regions consisting primarily of phosphoglycerides

\*\* microdomains tend to float within the more fluid and disordered environment of the artificial bilayer and as a result of this , these patches of cholesterol and sphingolipid are referred to as lipid rafts

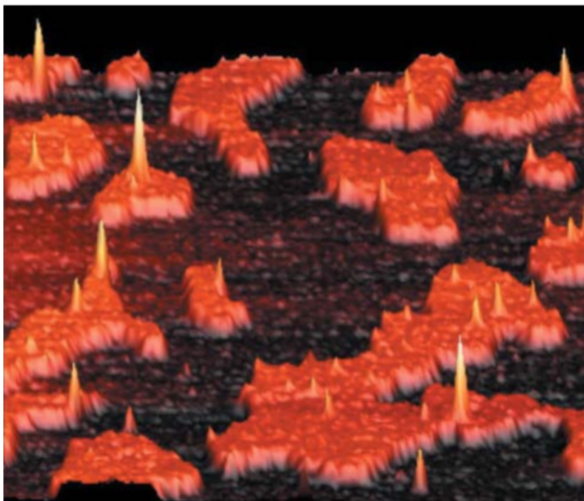
\*\* certain proteins (e.g; GPI-anchored ) tend to become concentrated in the lipid rafts, whereas others tend to remain outside their boundaries.

\*\* Attempts to demonstrate the presence of lipid rafts in living cells have generally been unsuccessful, which can either mean that :

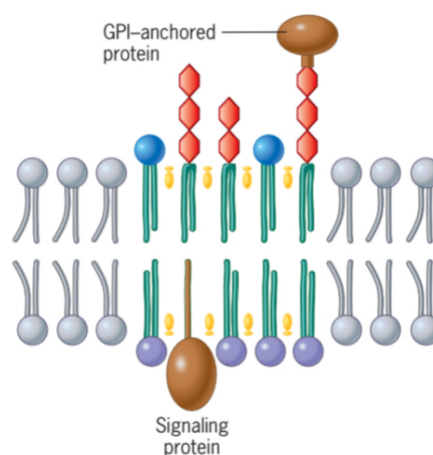
1/ rafts do not exist

2/ rafts are so small (5 to 25 nm diameter) and short-lived as to be difficult to detect with current techniques.

\*\* Lipid rafts serve as floating platforms that concentrate particular proteins, thereby organizing the membrane into functional compartments(e.g ; lipid rafts are thought to provide a favorable local environment for cell-surface receptors to interact with other membrane proteins that transmit signals from the extracellular space to the cell interior)



(a)



(b)

*The end*

Don't let the fear of losing be greater than the excitement of winning

*Wish you all the best*