

Membranes and Lipids

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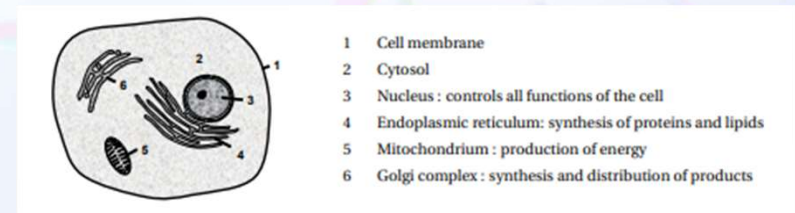
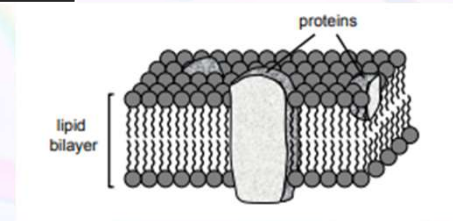
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Introduction and Topic Content.

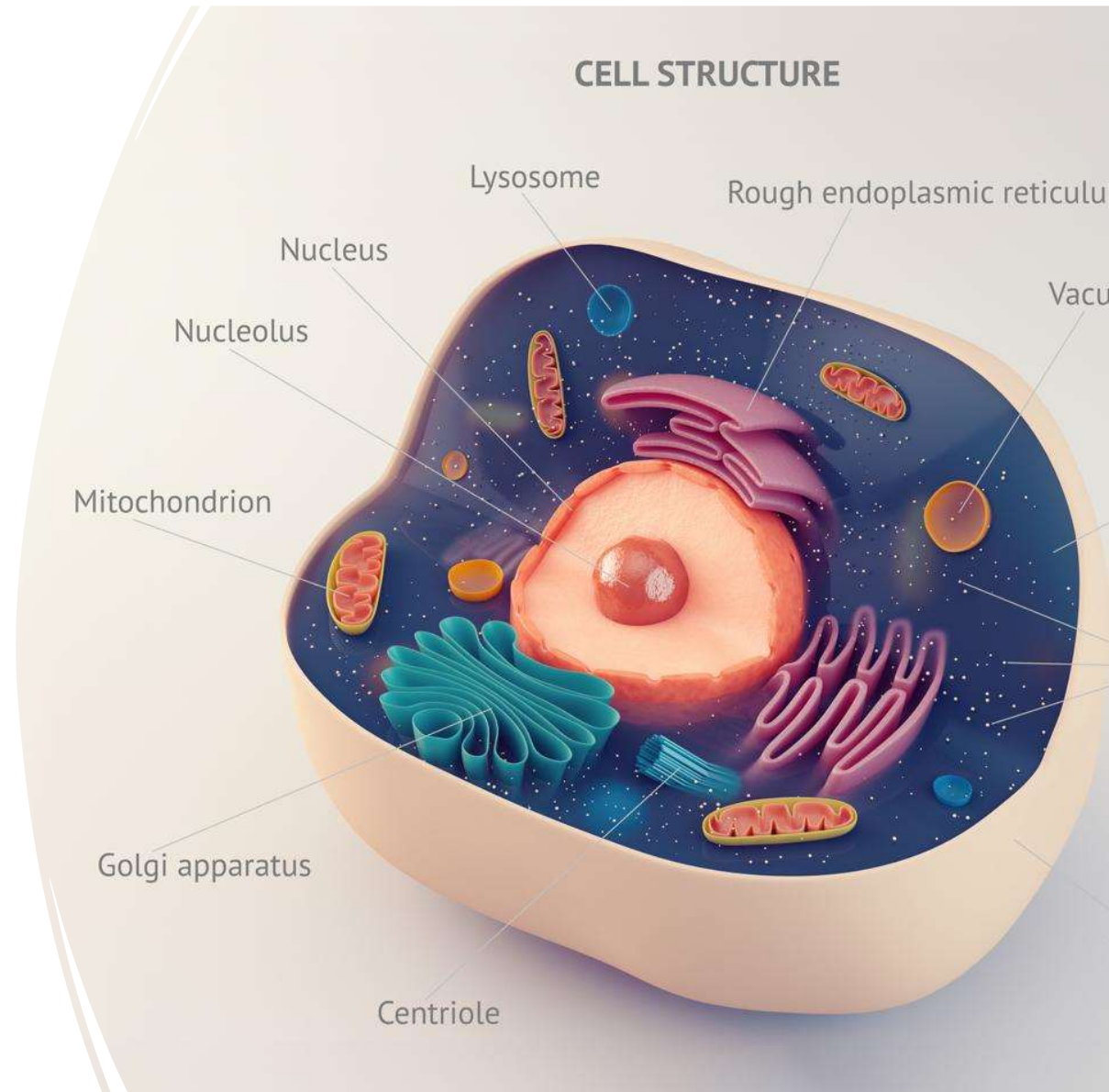
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Introduction Of Membrane and Lipids

- **The cell:-** The cell is the most important unit in life. In **1665 Hooke** observed that the tissue of
- a **cork plant** was divided into tiny compartments, which he called cells.
- In **1840** improved observations on many tissues led to the hypothesis that all organisms exist either as
- **single cells** or **aggregates of cells**.



Introduction OF Membrane and Lipids

The cell membrane was discovered by Swiss botanist **Carl Naegeli and C. Cramer** in 1955. A **membrane** is a selective **barrier**; it allows some things to pass through but stops others. Such things may be **molecules, ions, or other small particles**. Membranes can be generally classified into **synthetic** membranes and **biological** membranes.

Biological membranes include cell membranes (outer coverings of cells or organelles that allow passage of certain constituents);

Nuclear membranes which cover a cell nucleus; and tissue membranes, such as **mucosae** and **serosae**.

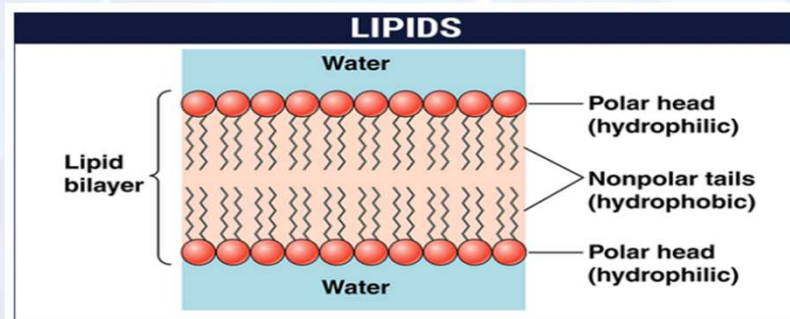
Synthetic membranes are made by humans for use in laboratories and industry (such as chemical plants).

In Simple words a thin sheet of tissue or layer of cells acting as a boundary, lining, or partition in an organism.

Around 1959, **John William Gofman** researched on identification, quantification and clinical implications of lipoproteins.

He identified three major classes of lipoproteins in serum; they are VLDL, LDL, and HDL. **Kare Berg** discovered

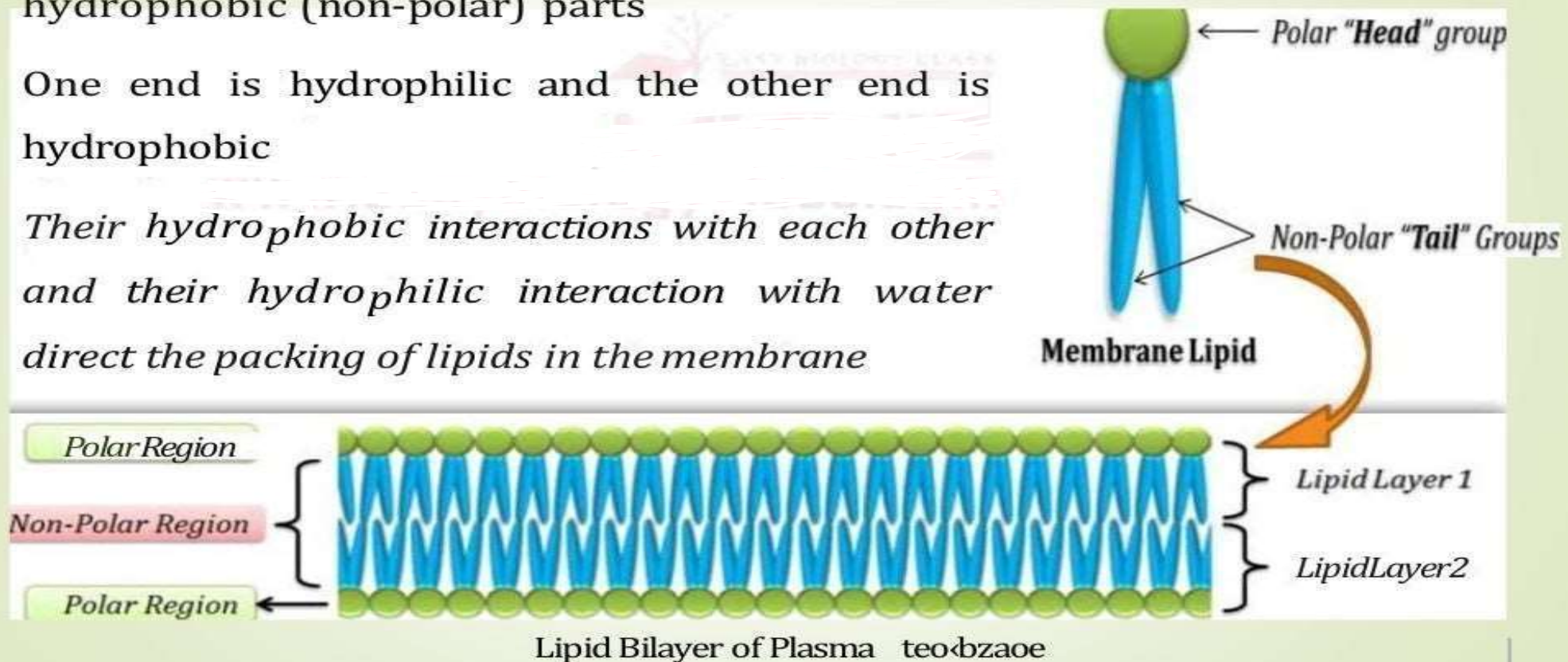
lipoprotein (a) or Lp (a) in 1963. In May 2007, the Journal of Clinical-Lipidology named him the Father of Clinical Lipidology.



Lipids are so-called amphipathic molecules, meaning that one molecule contains both a polar, **hydrophilic** ("water-loving") head group, which tends to associate with water, and one or more **hydrophobic** ("water-fearing"), water repelling, tails. Due to this amphipathic character, lipids associate together in water, a process called self assembly. The hydrophobic parts stick together, while the hydrophilic head groups are in contact with water.

Membrane lipids

- Membrane lipids have hydrophilic (polar) & hydrophobic (non-polar) parts
- One end is hydrophilic and the other end is hydrophobic
- *Their hydrophobic interactions with each other and their hydrophilic interaction with water direct the packing of lipids in the membrane*



Membrane lipids classification

- ↙ Membrane lipids are classified based on the properties of 'head' group
- ↙ Membrane lipids of Prokaryotes, Eukaryotes and Archaeobacteria are grouped into Four major categories:
 1. *Phospholipids (Glycero-phospholipids, Sphingo-phospholipids)*
 2. *Glycolipids (Galactolipids, sphingo-glycolipids)*
 3. *Sterols*
 4. *Archoebacteriol ether lipids*

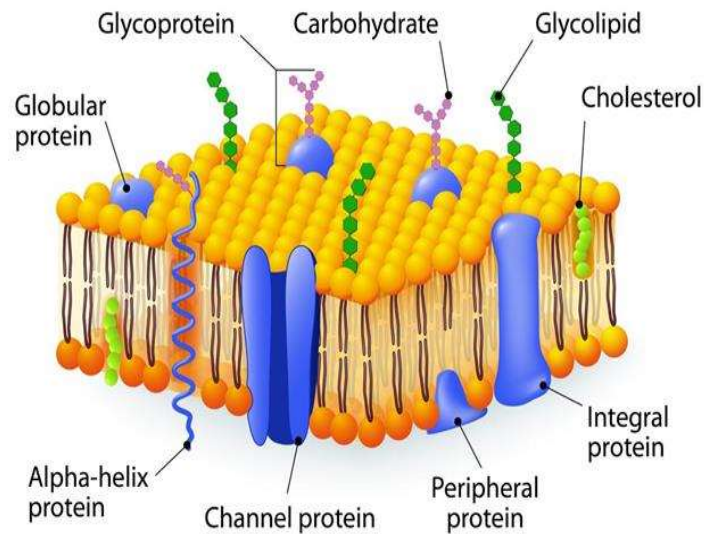
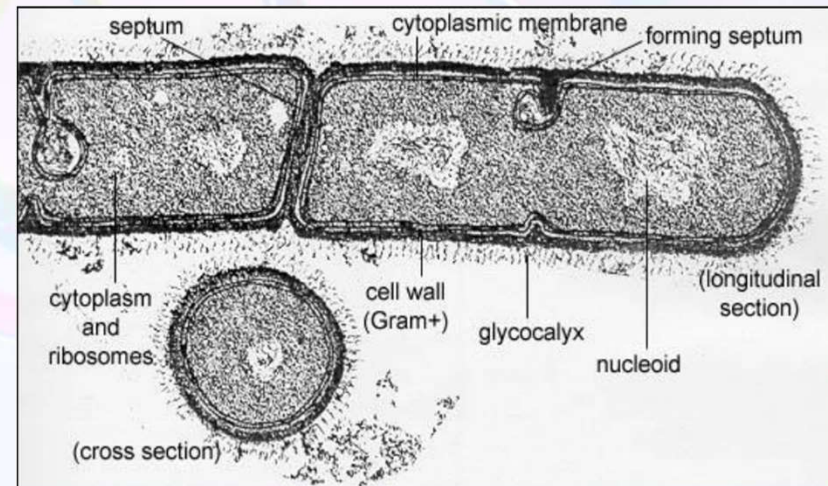
CELL MEMBRANE ARCHITECTURE

Fluid phospholipid bilayer-composed of **phospholipids** (40%) and peripheral and integral proteins (60%).

Prokaryotic phospholipids do not contain **sterols** unlike eukaryotes.

Some do contain sterol like molecules called **hopanoids**, which stabilize the cytoplasmic membrane.

Phospholipids are amphoteric- polar hydrophilic **glycerol head** attached to two hydrophobic **fatty acid tails** via ester bonds.



The bilayer is arranged such that the polar heads form the outermost surface of the membrane while the non-polar tails form the center.

The plasma membrane also contains proteins, sugars, and other lipids. The model that describes the arrangement of these substances in lipid bilayer is called the **Fluid Mosaic model**.

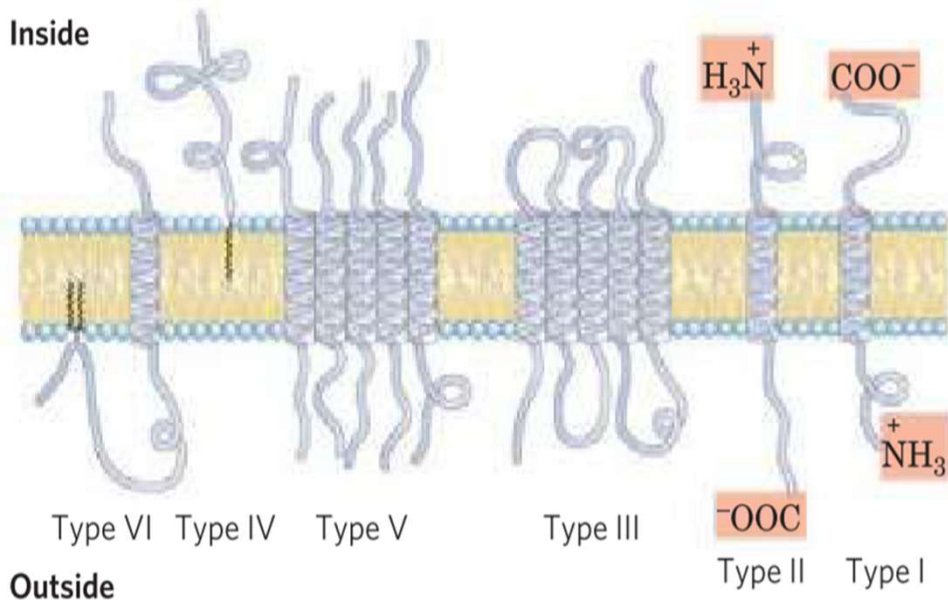
Some membrane proteins are located and function on one or the other side of the membrane (**peripheral proteins**). Other proteins are partly inserted into the membrane, or possibly even traverse the membrane as channels from the outside to the inside (**integral proteins**).

Lipids are capable of rapid diffusion within their layer, but “**flip-flopping**” from one layer to the other is rare.

Integral proteins are very firmly associated (strong hydrophobic interactions) with the lipid bilayer and are removable only by agents that interfere with hydrophobic interactions, such as detergents, etc.

TABLE 11-1 Major Components of Plasma Membranes in Various Organisms

	Components (% by weight)			Sterol type	Other lipids
	Protein	Phospholipid	Sterol		
Human myelin sheath	30	30	19	Cholesterol	Galactolipids, plasmalogens
Mouse liver	45	27	25	Cholesterol	—
Maize leaf	47	26	7	Sitosterol	Galactolipids
Yeast	52	7	4	Ergosterol	Triacylglycerols, steryl esters
Paramecium (ciliated protist)	56	40	4	Stigmasterol	—
<i>E. coli</i>	75	25	0	—	—



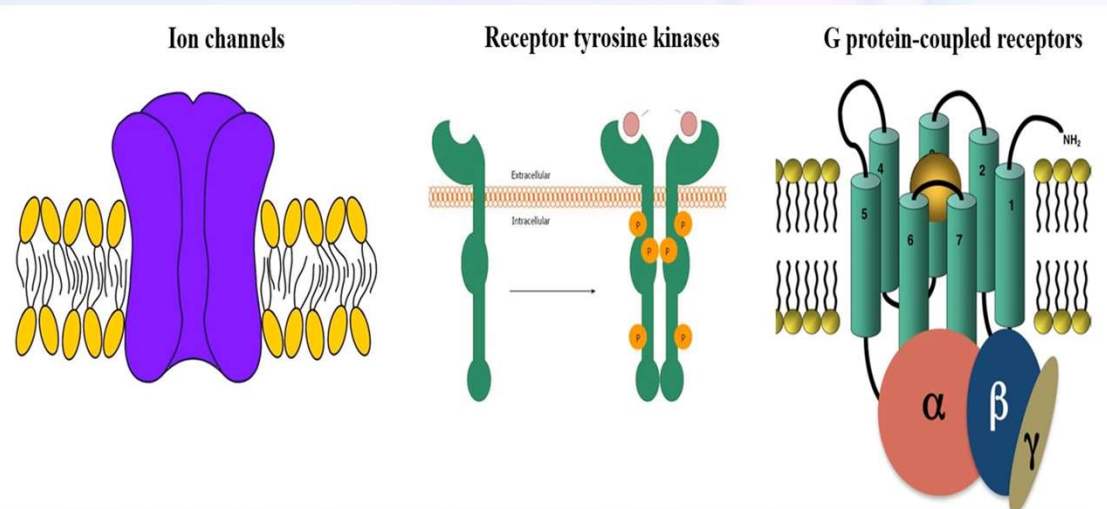
Peripheral proteins associate with the membrane through electrostatic interactions and hydrogen bonding with the hydrophilic domains of integral proteins and with the polar head groups of membrane lipids.

Amphitropic proteins are found both in the cytosol and in association with membranes.

Many of these phospholipid molecules lie on the protein surface, their head groups interacting with polar amino acid residues at the inner and outer membrane.

These **annular lipids** form a bilayer shell (annulus) around the protein, oriented roughly as expected for phospholipids in a bilayer.

Membrane Protein

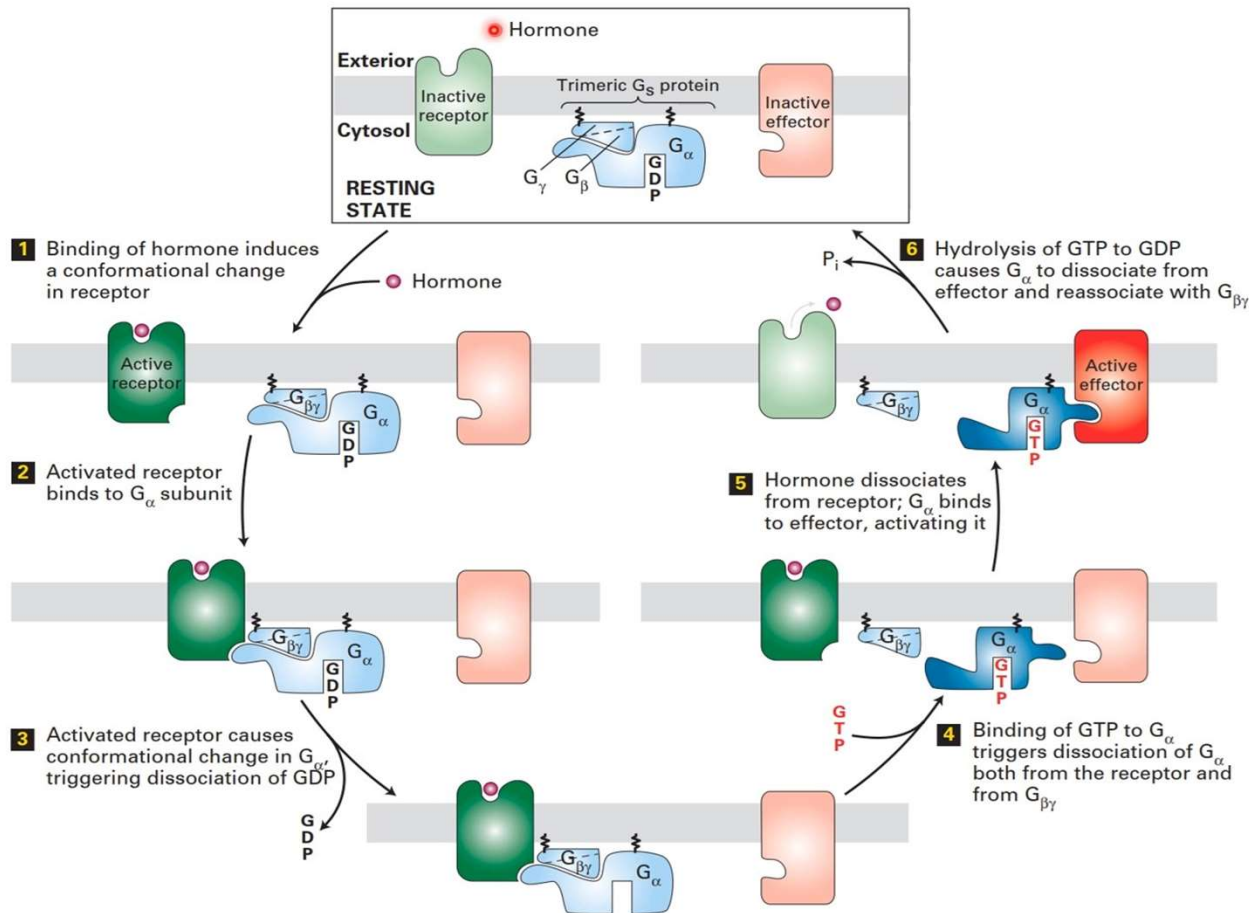


Membrane Protein are common protein that are part of interact with biological membrane. Membrane protein perform several function that is vital to survival of organisms. Some membrane proteins are Ion channel, Membrane receptor etc.

The part of protein which are inside the membrane are hydrophobic and the part which inside the cell and outside the cell are hydrophilic.

Ion Channel- A protein that act as a pore in a cell and permit selective passage of ion through plasma membrane. Ion channel can be voltage gated, ligand gated. Voltage gated channel open or close depending on the voltage gradient across plasma membrane while ligand gated ion channel open or close depending on the binding of ligands on the channel. Ion channels are specific to the ions, like sodium ion channel does not allow chloride to pass through plasma membrane.

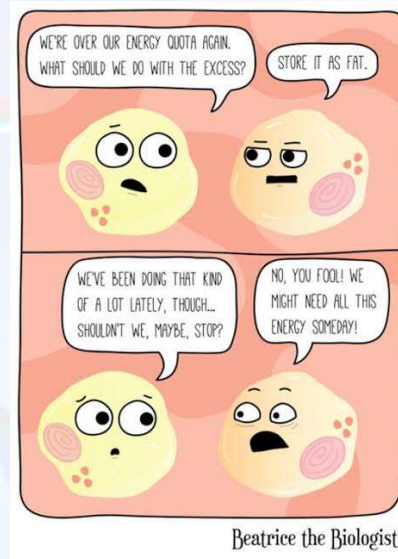
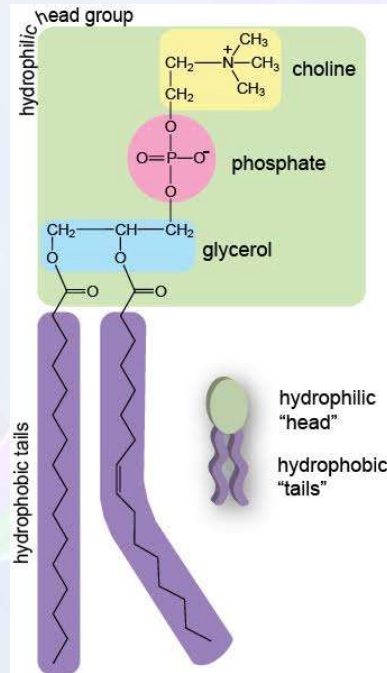
Membrane Protein



GPCR - G- protein coupled receptor are protein that activate when hormone binds to it. Activated GPCR bind to g- protein which bind to effector molecule which release secondary messenger depending on the G-protein binds to it. GPCR are express in almost all cell type. GPCR are also clinically important almost one-third drugs in market target GPCR and we still don't know the function of two-third GPCR.

Lipids-an introduction

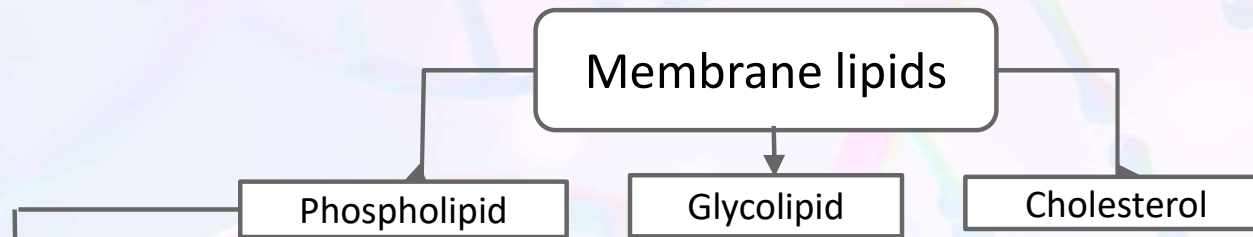
- The word lipids is derived from the Greek word 'lipoS' meaning fat.
- Lipids are chemically heterogeneous group of compounds that are insoluble in water
- Soluble in non-polar solvents such as hexane, chloroform
- In the human body, lipids are synthesized in the liver
- Composed of fats and oils, lipids are molecules that yield high energy and have a chemical composition mainly of carbon, hydrogen, and oxygen



Functions of lipids

- Lipids perform three primary biological functions within the body
- 1) They serve as structural components of cell membranes,
 - 2) function as energy storehouses
 - 3) function as important signaling molecules

Classifications



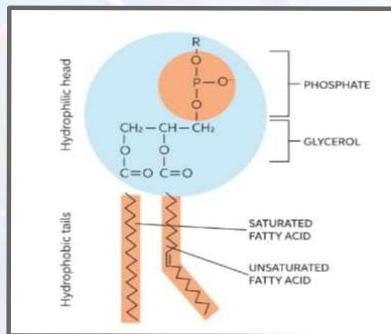
Major component of the cell membrane

Provide a fluid character to the membranes and exert structural function

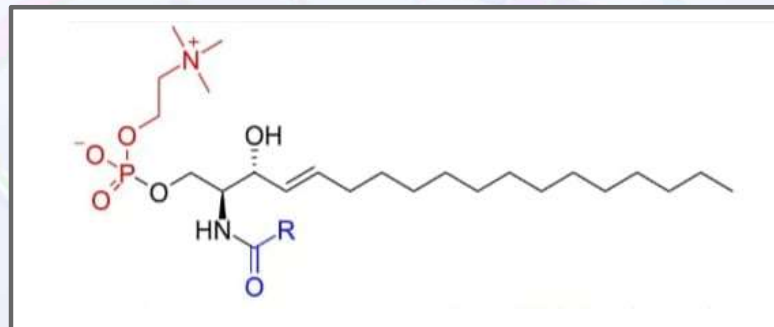
These are **amphipic molecules** having polar headgroups and nonpolar hydrocarbon chains

Subtypes -

(i) Phosphoglycerides

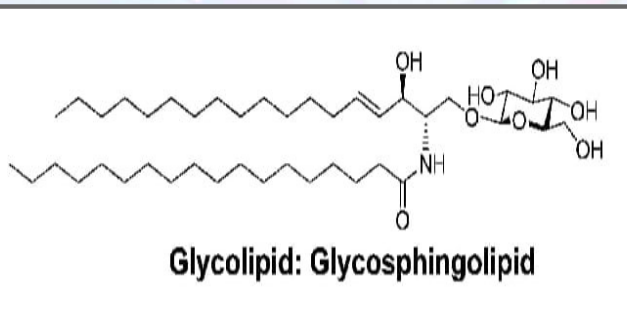


(ii) Sphingomyelin



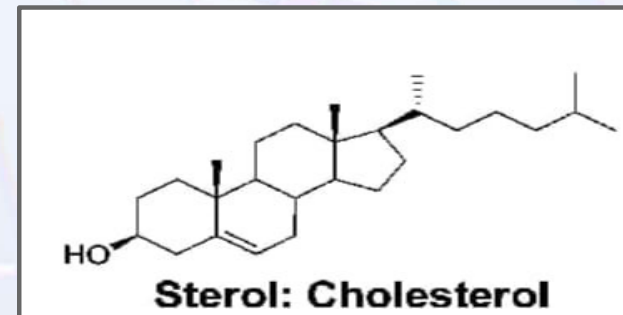
Glycolipids

- ✓ 'Glyco' stands for sugar; **lipids with a carbohydrate attached by a glycosidic bond**
- ✓ Found on the surface of all eukaryotic cell membranes
- ✓ Maintain the stability of the cell membrane and facilitate **cellular recognition** which is crucial to the immune response



Cholesterol

- ✓ Best known sterol
- ✓ -OH group interacts with water molecules surrounding the membrane; bulky steroid and the hydrocarbon chain are embedded in the membrane
- ✓ **Increases membrane packing** which alters membrane fluidity and maintains membrane integrity





THANK YOU!!!