Various Models of Plasma Membrane

The four historical models of Plasma Membrane are:

1. ***Lipid and Lipid Bilayer Model*** by Gorter and Grendel (1925)
2. ***Dannelli Model (Sandwich Models)*** by James Danielli and Hugh Davson (1935)
3. ***Unit Membrane Model*** (Protein-Lipid Bilayer-Protein) by Robertson (1953)
4. ***Fluid Mosaic Model*** by S.J. Singer and Garth L. Nicolson (1972)

1. Lipid and Lipid Bilayer Model:

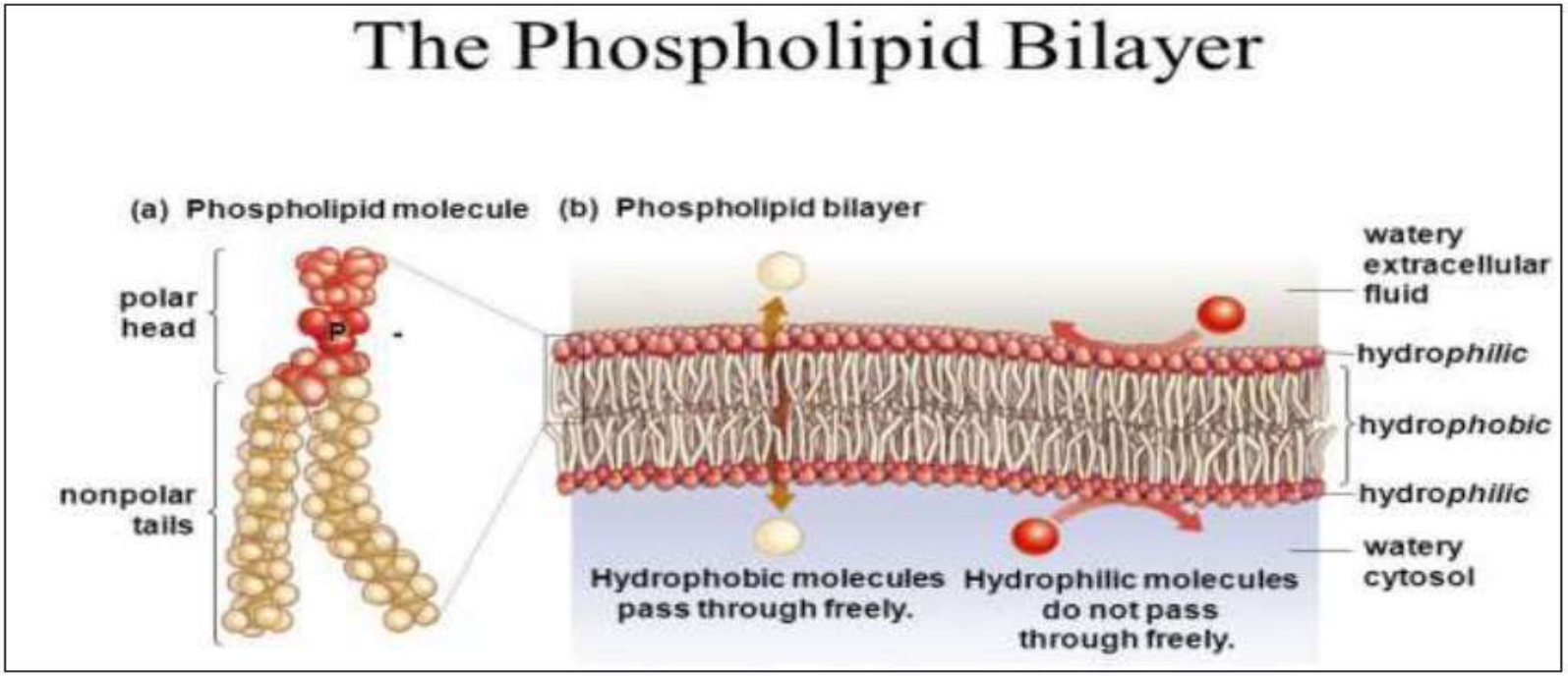


Fig: Lipid and Lipid Bilayer Model

According to this model, it was thought that the membrane consisted of double layers of lipid molecules, the polar hydrophilic groups of the molecules being situated on the outside and hydrophobic ends standing at right angles to the surface are oriented inwardly. These models of Gorter and Grendel could not explain the proper structure of plasma membrane but they put the foundation of future models of membrane structure.

2. Dannelli Model (Sandwich Model):

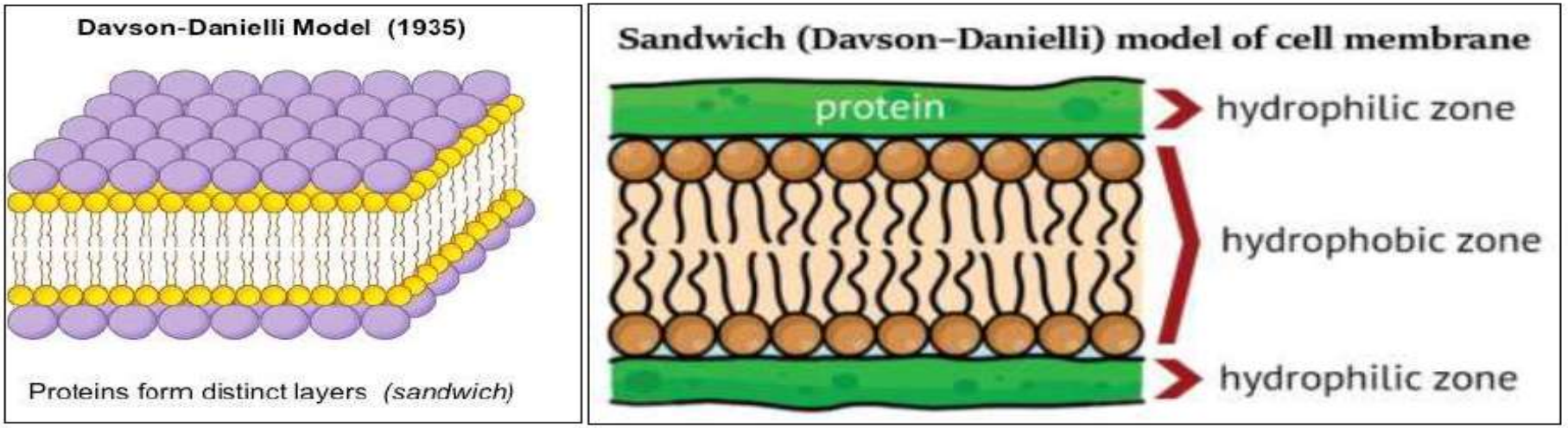


Fig: Sandwich (Davson–Danielli) model of plasma membrane

- *A protein-lipid sandwich*
- Lipid bilayer composed of phospholipids (hydrophobic tails inside, hydrophilic heads outside)
- Proteins coat outer surface
- Proteins do not permeate the lipid bilayer

The plasma membrane consist of a double layer of phospholipid molecules sandwiched between two essentially continuous layers of protein.

3. Unit Membrane Model:

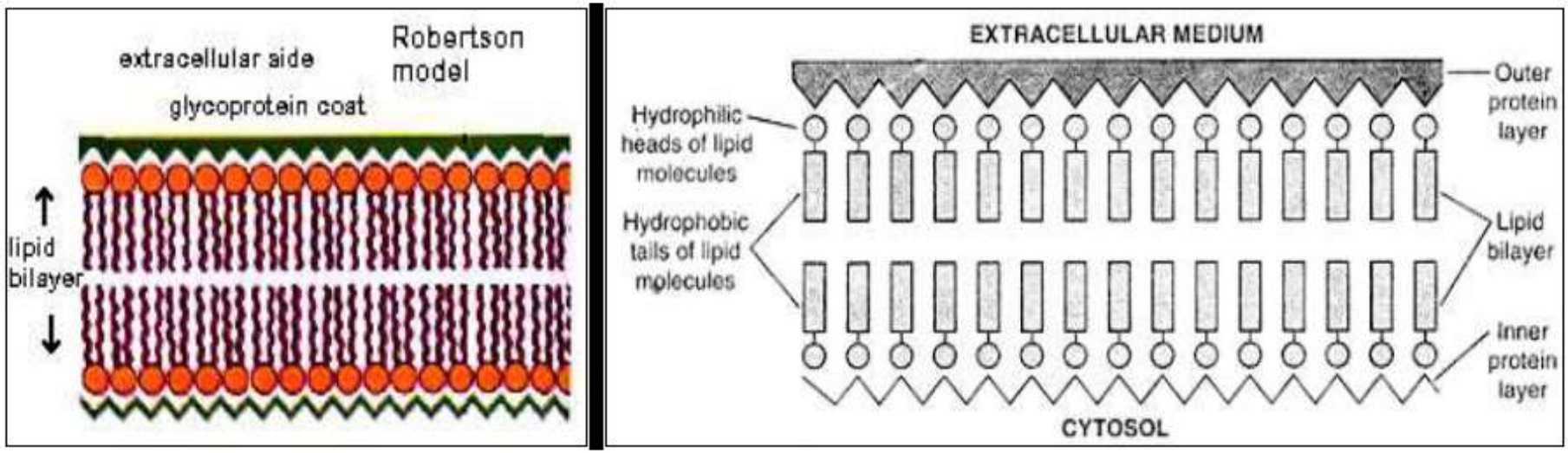


Fig: Unit Membrane Model

According to this model, all biological membranes show generalized unit membrane construction. The unit membrane model visualizes cell membrane as a trilaminar and indicates structure consisting of two dark osmiophilic layers separated by a light osmiophilic layer. The physical appearance of this trilaminar model has led to the term unit membrane.

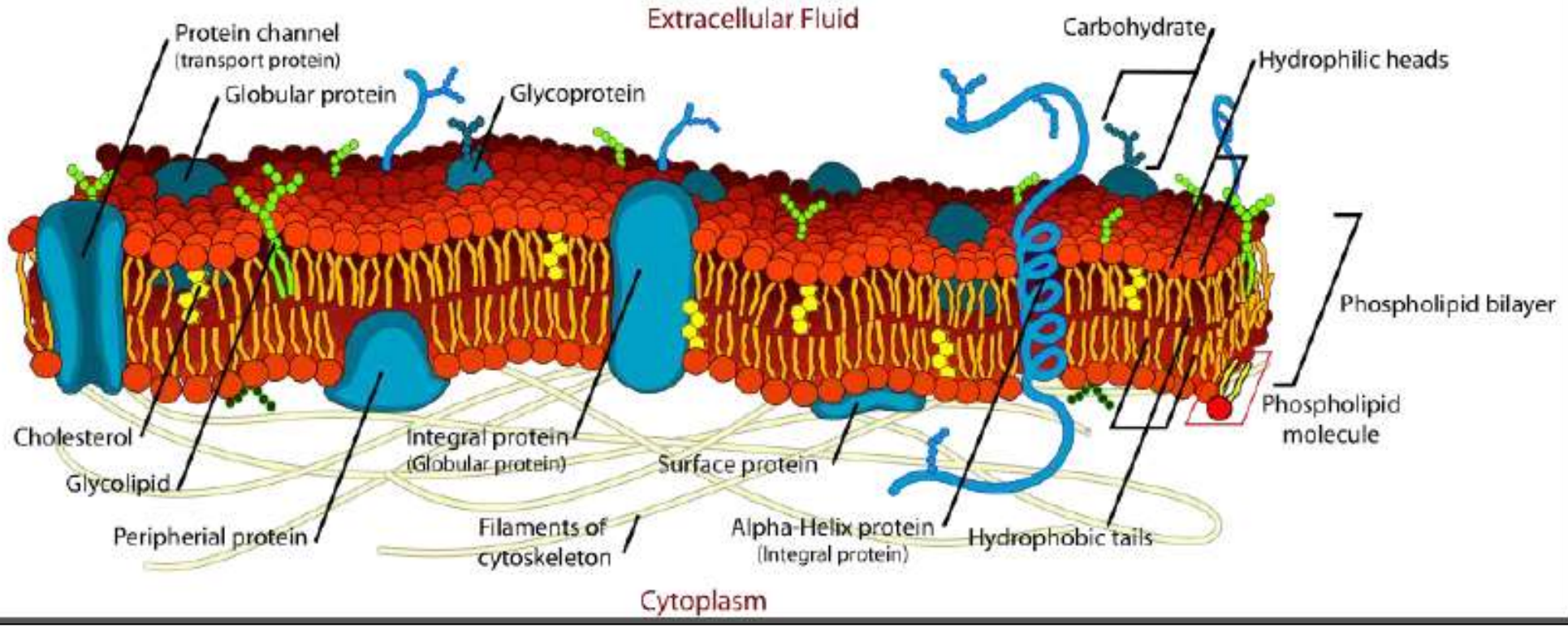
The unit membrane is 75 Å thick with a 35 Å thick phospholipid layer between two 20 Å thick protein layers.

4. Fluid Mosaic Model

Our current model of the cell membrane is called the **Singer-Nicholson fluid mosaic model**

Key features:

- Phospholipid molecules form a bilayer - phospholipids are fluid and move laterally
- Peripheral proteins are bound to either the inner or outer surface of the membrane
- Integral proteins - permeate the surface of the membrane
- The membrane is a fluid mosaic of phospholipids and proteins
- Proteins can move laterally along membrane

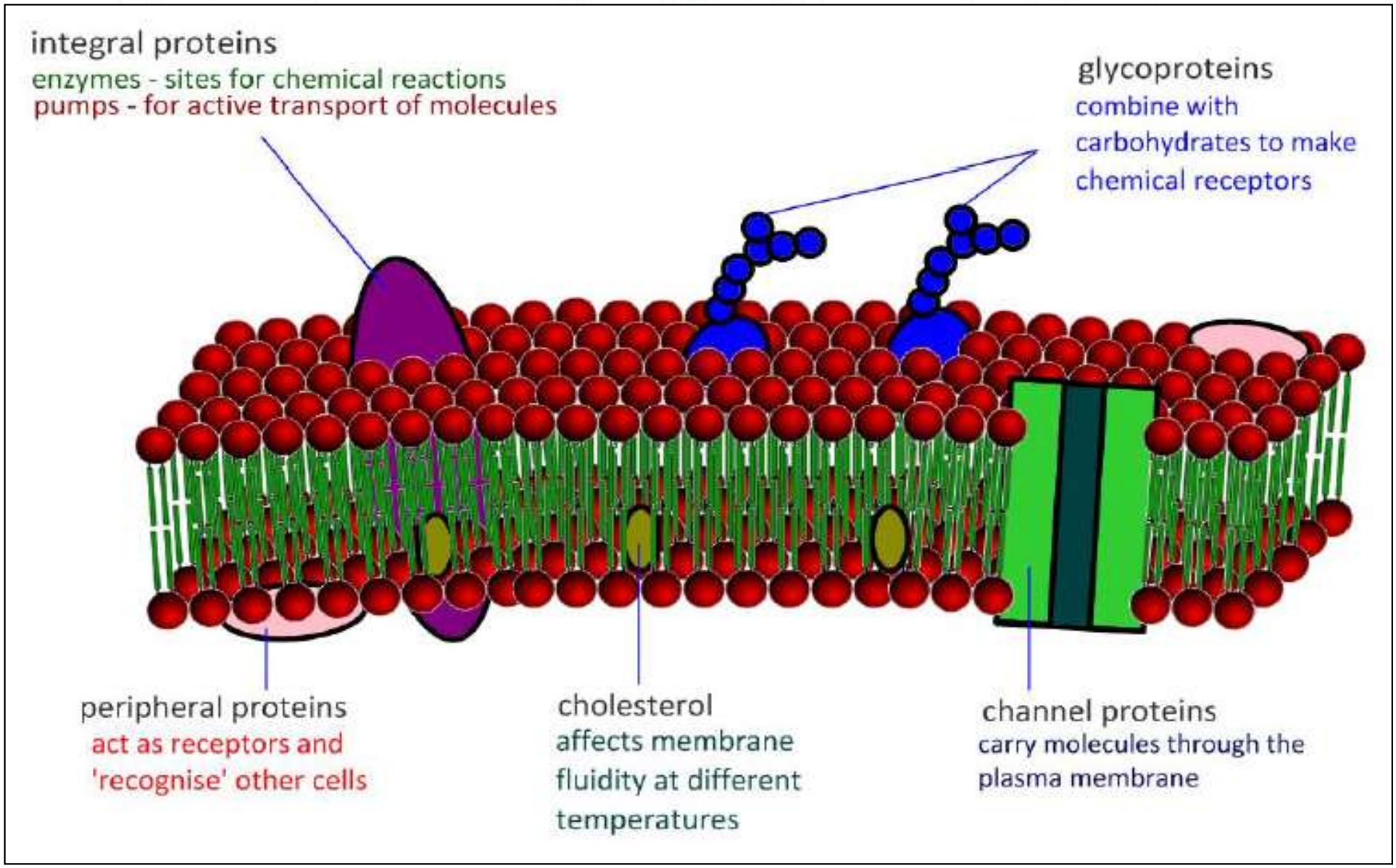


The Fluid Mosaic Model

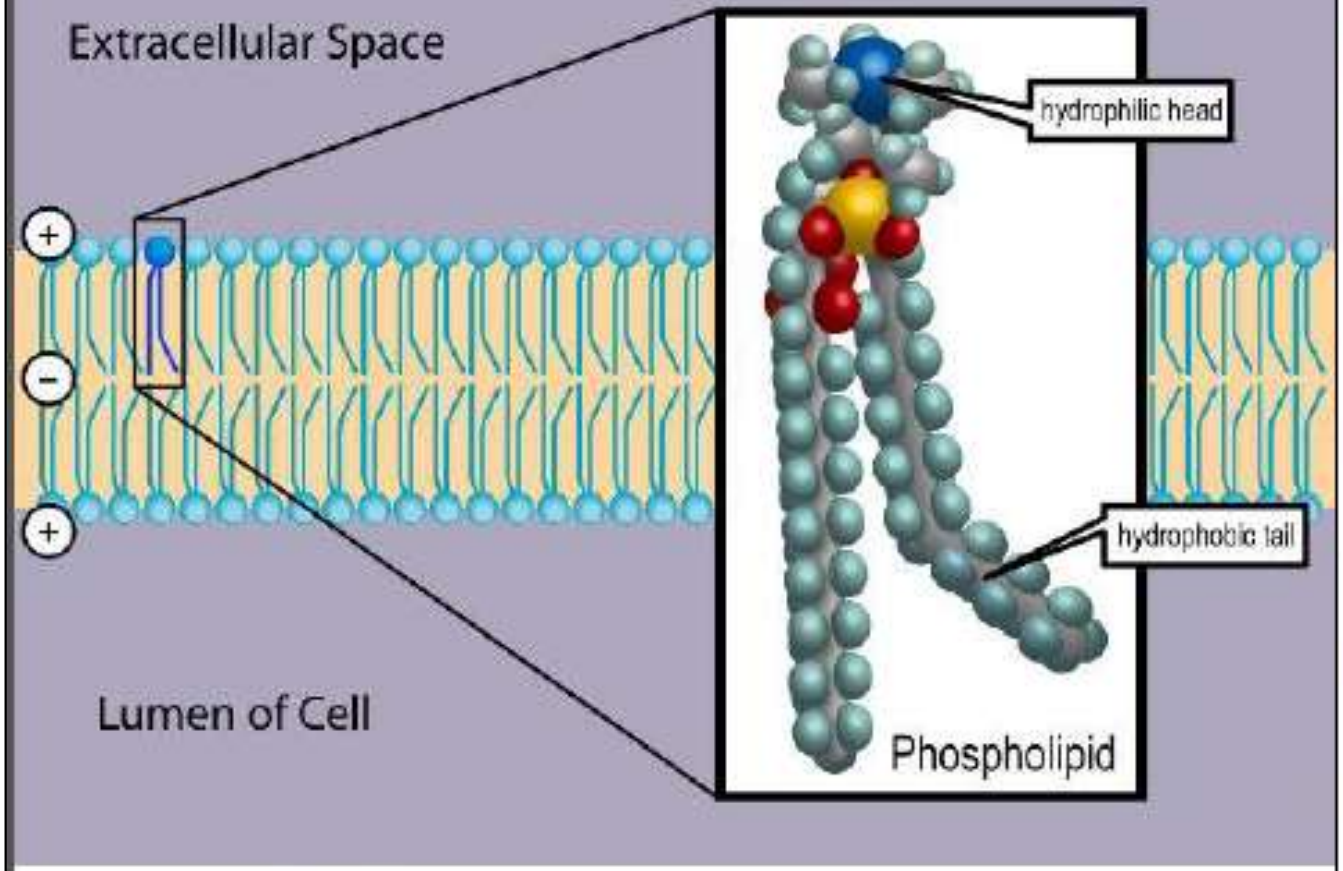
Fluid — always moving, not solid

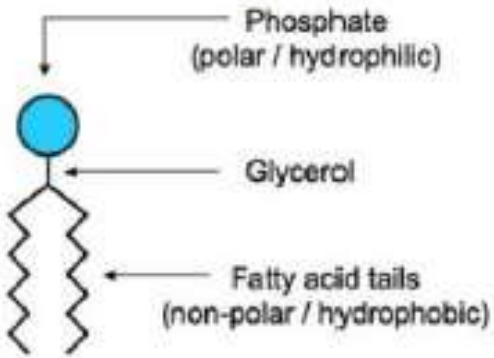
Mosaic — collection of things stuck together

Model — representation of real life



Phospholipids form bilayers in water due to the amphipathic properties of phospholipid molecules.





When drawing a diagram of a phospholipid this is a good example which shows all the key features

Phospholipid molecules have a polar (charged) phosphate head and long non-polar lipid tails

The head is **hydrophilic** (attracted to water)

The tails are **hydrophobic** (repelled by water)

An example of an **amphipathic** molecule (w/ both polar and nonpolar regions)

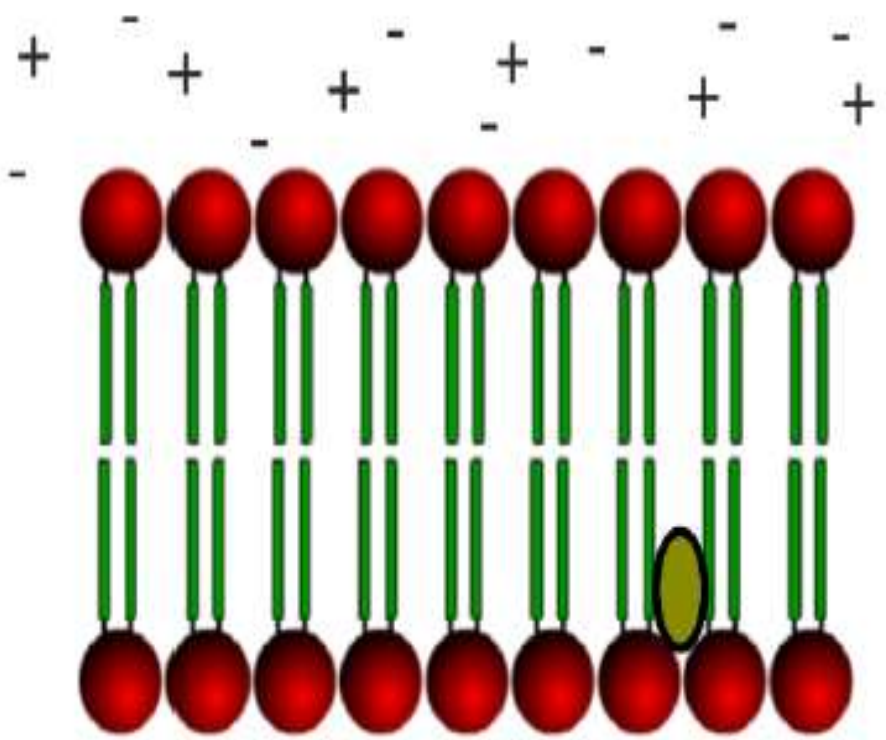
The phospholipid bilayer is selectively permeable

controlled entry/ exit of molecules

Some molecules pass through easily (diffusion), or go through a 'tunnel' (facilitated diffusion)
Others need energy to get them through (active transport)
Large molecules use their own membrane to get them through (endo-/exo-cytosis)

polar heads:
attracted to other polar
(charged) molecules

non-polar tails:
will repel any charged molecule,
therefore preventing passage of ions
through the membrane.



Functions of a plasma membrane

1. Hold the cell together

2. Control what goes in and out
   (diffusion, osmosis, active transport)

3. Protect the cell

4. Allow the cell to recognise and be recognised
   (cell signalling and immunity)

5. Bind to other cells and molecules

6. A site for biochemical reactions
   (enzymes, areas for reactions)