DEPARTMENT OF ZOOLOGY ONLINE LECTURES PART-II

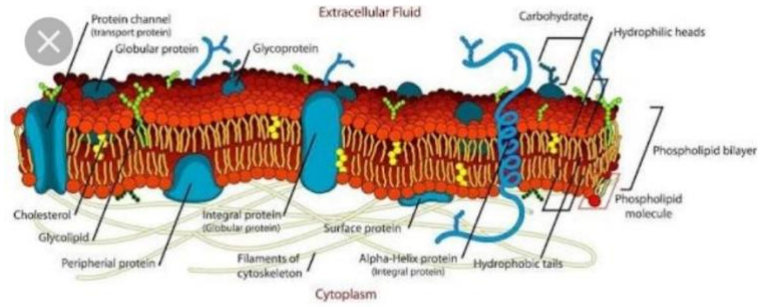
Raiganj Surendranath Mahavidyalaya

Presented by- Banashree Barman

Topic- Cell membrane ultra structure

Cell membrane-

The **cell membrane** (also known as the **plasma membrane** (**PM**) or **cytoplasmic membrane,** and historically referred to as the **plasmalemma**) is a biological membrane that separates the interior of all cells from the outside environment (the extracellular space) which protects the cell from its environment.



Different model of cell membrane-

Gorter and Grendel(1925), experimentally concluded that cell membranes are made of two opposing thin molecular layers and they proposed that this double layers is constructed such two lipid layers form a bilayer with the polar head groups pointing towards the aqueous environment.

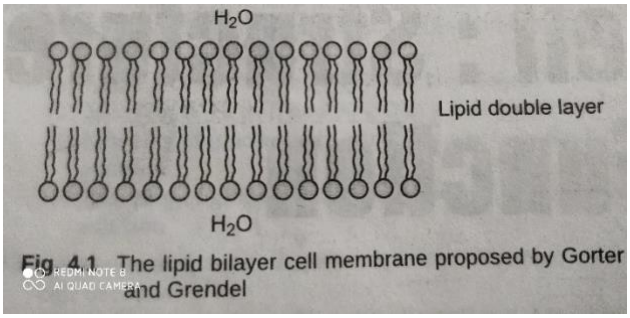


Fig. 4.1. The lipid bilayer cell membrane proposed by Gorter and Grendel

JR Danielli and H Davson(1935), proposed the molecular model for the biomembrane structure including known as the **sandwich model.** In particular, they assumed that the membrane has both a lipophilic and a hydrophilic character. Water containing region in the membrane give rise to ion transport depending on water content of the membrane and it's charge; lipophilic parts are responsible for the transport of water- insoluble molecules.

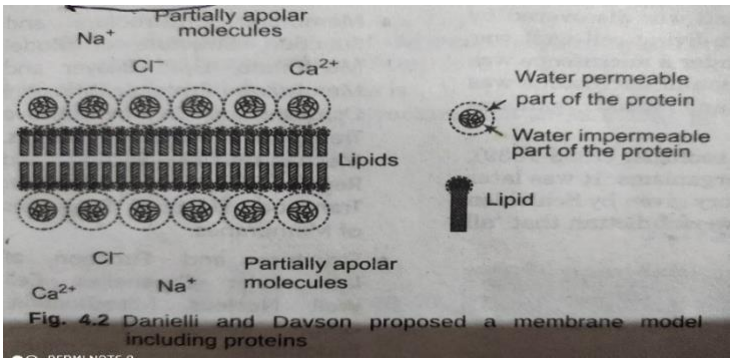


Fig. 4.2 Danielli and Davson proposed a membrane model including proteins

JD Robertson(1959), proposed the unit model (trilamellar concept). The electron microscopic studies of plasma membrane reveals that it is three layered. The two outer layers are dense and approximately 20amstrong thick and the middle layer is about 35amstrong thick. This three layered structure is called the **unit membrane.** This trilamellar concept was proposed by **Robertson,** even all bio membranes present inside the cell and around the cell organelles have a trilamellar (**protein-lipid-protein)** arrangement.

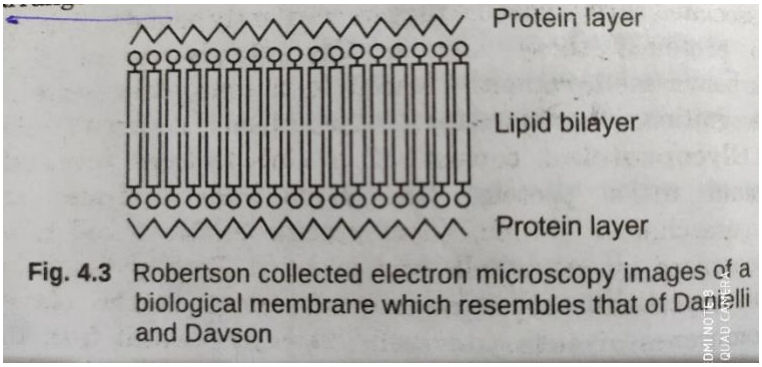
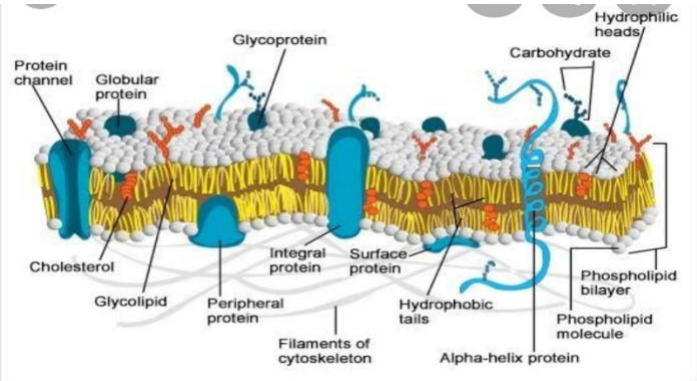


Fig. 4.3 Robertson collected electron microscopy images of a biological membrane which resembles that of Danielli and Davson

SJ Singer and GL Nicolson(1972), proposed **fluid mosaic model-** a widely accepted and best suited model to explain the structure and physiological nature of the cell membrane. **Singer and Nicolson** concluded that proteins may also span through membranes.

The model can be summarized as follows:

- Membranes are constructed from lipids and proteins.
- The proteins from mainly two classes they are as follows:
- **Peripheral proteins** are those proteins that are only loosely attached to the membrane surface and can easily be separated from the membrane by mild treatment. (e.g, cytochrome-c in mitochondria or spectrin in erythrocytes)
- **Integral proteins** cannot easily be separated from the major fraction of membrane proteins. The structure forming unit is the lipid double layer(bilayer). Proteins may be either adsorbed to the membrane surface or span through the membrane.



Ultrastructure of cell membrane-

The physical organization and functioning of all biological membranes depend on their constituents: **lipids, proteins and carbohydrates.**

- **Proteins:** proteins embedded in the phospholipid bilayer have a number of functions, including moving materials through the membrane and recevining chemical signal from the cell's external environment.
- **Carbohydrate:** carbohydrates associated with membranes are attached either to the lipids or to protein molecules. They are located on the outside

of the plasma membrane. Membrane associated carbohydrate may be **covalently** bound to lipids or to proteins; These are:

1. **Glycolipids:** Glycolipids consist of a carbohydrate covalently bound to a lipid, they serve as recognition signals for interactions between cells.
2. **Glycoproteins:** Glycoproteins consist of a carbohydrate covalently bound to a protein. The bound carbohydrate are oligosaccharide chains. Glycoproteins enable a cell to be recognized by other cells and proteins.

- **Lipids:** Lipids constitute the bulk of a membrane. Most of the lipids in biological membrane are phospholipids. Some compounds are **hydrophilic (water-loving)** and others are **hydrophobic (water-hating).** Phospholipids have both hydrophilic and hydrophobic regions and thus, are amphiphatic.
    1. **Hydrophilic regions:** The phosphorous containing 'heard of the phospholipid is electrically charged and hence, associates with polar water molecules.
    2. **Hydrophobic regions:** The long, non polar fatty acid **tail** of the phospholipid associate with other non polar materials, but they do not dissove in water or associate with hydrophilic substances.

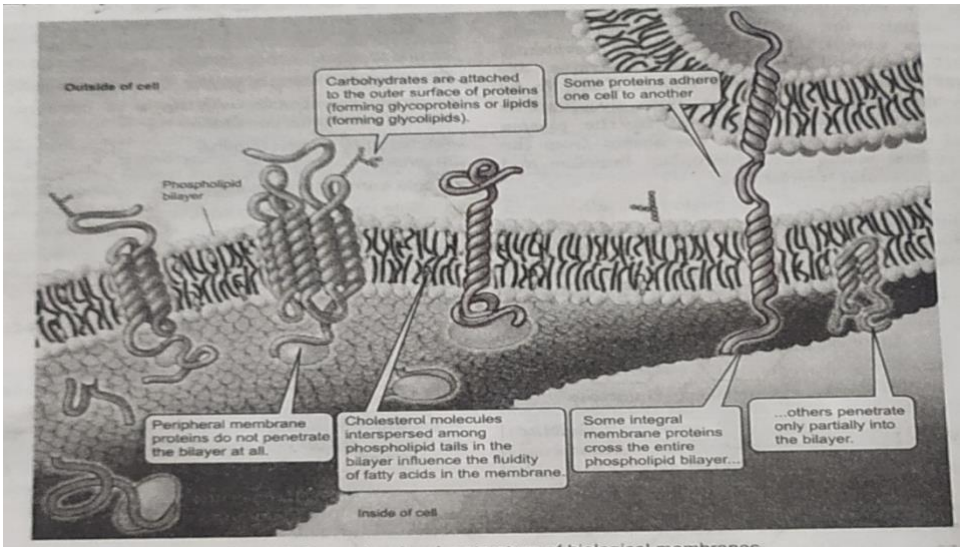


Fig. 4.6 General molecular structure of biological membranes