MAJOR ASSIGNMENT.

PLASMA MEMBRANE.

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PLASMA MEMBRANE.

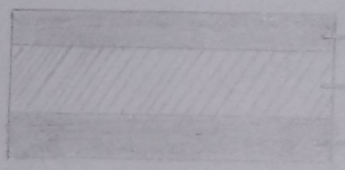
* The plasma membrane may be defined as the thin, elastic semipermeable living membrane that serves as a boundary for the cytoplasm. The term plasma membrane was coined by Nageli in 1855. Plasma membrane is otherwise called cell membrane or plasmalemma.
* It is the outer limiting membrane in all animal cells. But in plant cells and bacterial cells, it is present inner to the cell wall. It determines the composition of cytoplasm in the cell. It serves as a barrier for the flow of some components into and out of the cells.
* It is about 75 Å in thick. Its thickness is almost constant in all plant cells, animal cells and bacterial cells.
* Plasma membrane is formed of glycoproteins and phospolipids. The following models are proposed to explain the structure of plasma membrane:
    * Trilaminar model.
    * Bimolecular leaflet model.
    * Lattice model.
    * Micellar model.
    * Fluid mosaic model.

Models of Plasma Membrane :-

1. Trilaminar model.

* This model was proposed by Robertson in 1950. According to this model, the plasma membrane is formed of three layers. The three layers are an outer protein layer, a middle lipid layer and an inner protein layer. The middle layer is 35 Å thick and the inner and outer layers are 25 Å each. Such a trilaminar membrane is called a unit membrane.

* In the electron micrograph of plasma membrane, the outer and inner dark lines correspond to globular proteins and polar group of lipids and the middle region corresponds non-polar lipids.



(Fig). Unit Membrane.

* According to Robertson, all biological membranes are unit membranes and this concept is called unit membrane hypothesis.

Unit Membrane Concept :

* All biological membranes have a trilaminar structure. Because of the unity in structure of all membranes of bacteria, plants and animals, it is called an unit membrane. This concept is called unit membrane concept.

2. Bimolecular Leaflet Model.

* This model was proposed by Danielli and Davson in 1934. According to this model, the Plasma membrane is formed of two layers of two layers of lipid molecules Coated with Protein. Each molecule has a hydrophobic tail and a hydrophilic head. The hydrophilic heads face out-wards and the hydrophobic tails of the layers face each other. This model explains the biological and chemical properties of Plasma membrane, but not the Surface tension.

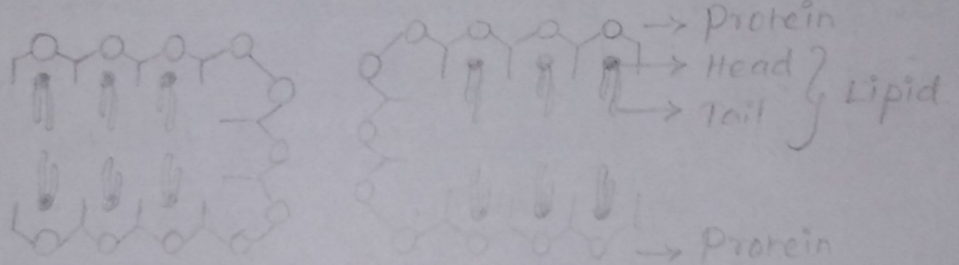


Fig: Bimolecular model

3. Lattice Model.

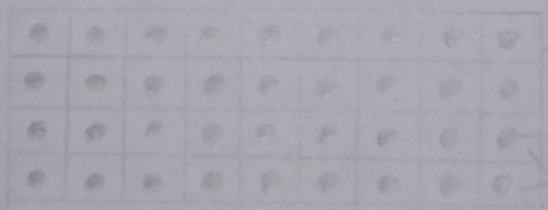


Fig: Lattice model

* This model was proposed by Wolpers in 1941. According to this model, in the plasma membrane lipids and proteins are arranged as a Lattice or network. Proteins form a kind of mechanical frame work. The lipid Component is distributed in the meshes of frame protein.

4. Micellar Model.

* This model was proposed by Hilleir and Hoffman in 1953. According to this model, the molecules in the plasma membrane are arranged in the form of globular Sub-units Called micelles.
* The lipid micelles are the building blocks of the membrane and the protein globules are arranged on either side
* In a lipid micelle, the lipid molecules are arranged in the form of a circle
* Each lipid molecule has a head and a tail. The head is hydrophilic and the tail is hydrophobic. The tail is directed inwards.

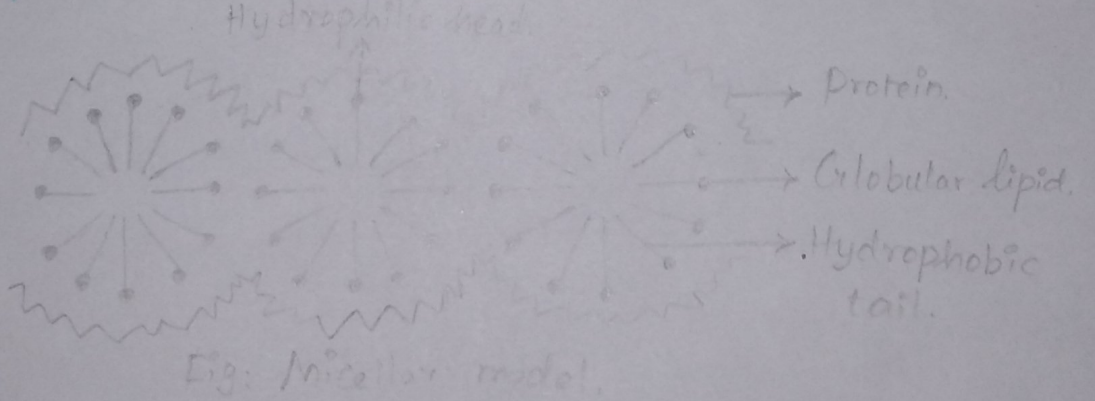


Fig: Micellar model.

5. Fluid Mosaic Model.

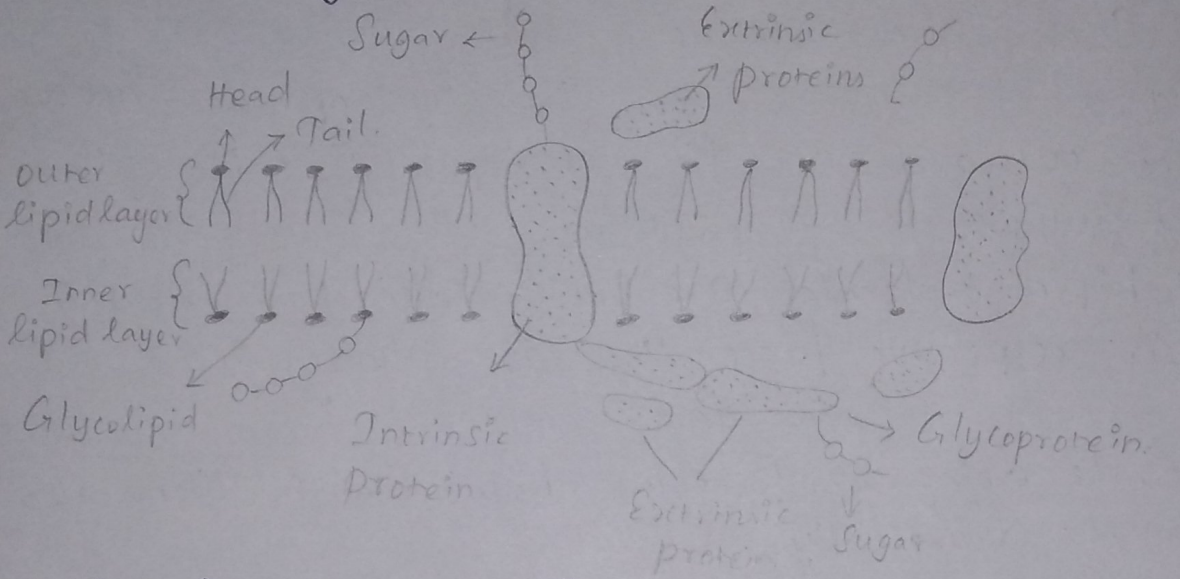
* Fluid mosaic model explains the Structure of plasma membrane. This model was proposed by Singer and Nicolson in 1972. According to this model, the plasma membrane Consists of lipids.

and Proteins. The lipid is in the form of fluid and the proteins are embedded here and there in the lipid in a mosaic pattern. Hence the name fluid mosaic model.

* The lipids are arranged in the form of two layers, an outer layer and an inner layer
* The proteins do not form a layer.
* Each lipid molecule has a hydrophobic tail and a hydrophilic head. The hydrophilic heads face outwards and the hydrophobic tails of the two layers face each other.
* Lipid molecules are not rigidly positioned in their respective places. They are always in a Constant motions and undergo lateral diffusions. While doing so, proteins bound with them also moves drastically.
* The Protein molecules are globular and are of two types, namely Peripheral or extrinsic proteins and integral or intrinsic proteins. The Peripheral proteins are arranged on the Surface and are loosely bound to the lipid. The integral proteins are deeply embedded and are tightly bound to the lipid molecules. The Peripheral proteins as well as the outer part of integral proteins are Studded with Sugars. Such proteins attached Sugars are Called glycoproteins.

* If the extrinsic proteins are removed from the membrane, there is no distruption in the membrane structure, but if intrinsic proteins are removed, the membrane structure is disrupted.

* Similarly, sugars are also attached to the outer surface of some lipids. These lipids with attached sugars are called glycolipids.



* The Carbohydrates found in intrinsic proteins and glycolipids form a surgery covering called glycocalyx. It recognizes certain foreign proteins as in immune cells and protects the cell from the extracellular digestive fluids.

* This model stresses that the plasma membrane is semi fluid in nature; the lipid as well as the intrinsic proteins move freely within lipid bilayer.

* Fluid mosaic model is the "most accepted model" because it convincingly explains the transport through the membrane.

Functions of Plasma Membrane:

The plasma membrane has the following functions.

1. Mechanical Support:

* Plasma membrane gives a definite shape to the cell. It protects then cell contents and keeps the cell components in place.

2. Exchange of Materials:

* Plasma membrane regulates the exchange of materials into and out of the cell. It allows the needed materials to enter the cell and sends out the unwanted materials from the cell. This property of the cell membrane said to be Selective permeability.

3. Biogenesis of Cell organelles:-

* Certain cell organelles like endoplasmic reticulum, nuclear membrane, etc. develop from the plasmamembrane.

4. Absorption:-

* The Microvilli of intestinal cells increase the surface area. Hence the rate of absorption increases.

5. Cell Recognition:

* Mammalian leucocytes recognize foreign cells like bacteria and engulf them by phagocytosis. Similarly, the macrophages of spleen can identify worn out RBC's from healthy RBCs and destroy them.

* The sites of cell recognition are located on the surface of the plasma membrane.

The amino Sugar Sialic acid is involved in Cell recognition.

6. Antigenic Specificity:

* The antigen Specificities of the Cells are located on the Surface of the plasma membrane. The antigenic determinants are the glycoproteins of Plasma membrane

* The rejection of transplend tissues is determined by antigens located on the Cell membrane of implanted Cells.

7. Transmission of impulses:

* The plasma membrane of nerve fibres transmits nerve impulses.

8. Osmosis:

* The plasma membrane allows the free movement of water. The process of movement of water molecules from the region of higher water Concentration to the region of lower water Concentration is known as Osmosis.

* The Osmotic process in which the water molecule enter the Cell is known as exo-osmosis. Due to endomosis, the pressure inside the Cell increases. This pressure is termed as hydrostatic pressure. Since this pressure is Caused by osmosis, it is also termed as Osmotic Pressure. The plasma membrane maintains a balance between the osmotic pressures of the inter and intracellular fluids.

9. Passive Transport or Diffusion:

* The movement of molecules across the plasma membrane from the region of higher Concentration to a region of lower Concentration is Called Passive transport or diffusion.

* Diffusion occurs through pores present in the Cell membrane. This process doesn't utilize energy. Hence this process is also Called downhill movement

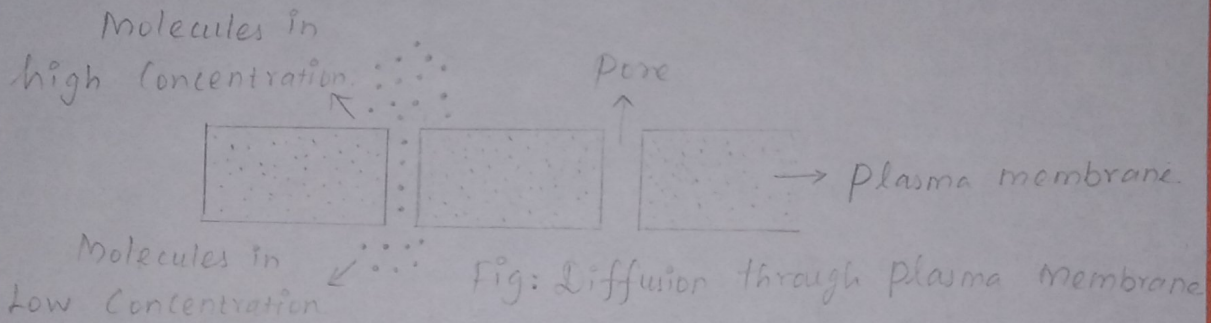


Fig: Diffusion through plasma membrane

10. Active Transport:

* The movement of molecules and ions from the region of lower Concentration to the region of higher Concentration against the Concentration gradient is Called active transport. So it is Campared to uphill movement. It needs energy. The energy is provided by the mitochondria. In this Case, Substances do not move by themselves, but they are Carried by Some Carriers Present in the membrane These Carriers are mainly membrane Proteins.

* In kidney and nerve Cells, Na^+ ions are expelled outside and K^+ ions are accumulated inside. This phenomenon is Called ionic pump. These Cells actively pump these ions again the

Concentration gradient

11. Endocytosis:

* It is the engulfing of food or foreign particles through the plasma membrane. The endocytosis can be differentiated into Phagocytosis and Pinocytosis.

1. Phagocytosis or Cell Eating:

* Phagocytosis is the engulfing of Solid Particles through the plasma membrane. It is also called Cell eating. It is observed in a number of Protozoans and leucocytes. The cells exhibiting Phagocytosis are called Phagocytes. The term "Phagocytosis" was coined by Metchnikoff in 1855.

* The food particles are adsorbed at the surface of the membrane. Later on, they are taken into the cytoplasm by the infolding of the plasma membrane. At the infoldings gets pinched off in the form of a small vesicle called Phagosomes. Then the phagosomes fuse with Lysosomes to form the digestive vacuoles.

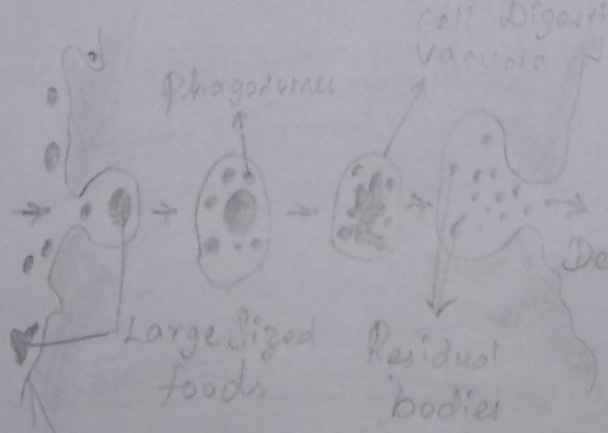


Fig: Phagocytosis

The food is digested inside the Vacuole and the digested food diffues into the Cytoplasm.

Eg: 1. Capturing and ingestion of diatoms of Ameoba 2. Devouring of disease causing germs by WBC, Macrophages, etc.

2. Pinocytosis or Cell Drinking:

* It is the process of engulfing of fluid particles through the plasma membrane. It was first observed by Lewis.

* During pinocytosis, it is invaginated to form Sac-like Structures. The fluid food is drawn into the Sac. Then the Sac is pinched off from the Plasma membrane, forming a vesicle called pinosome. The pinosome later fuses with lysosome. The food is digested by the enzymes of the lysosome. The digested food diffuses into the cytoplasm.

Eg: Absorption of fat, droplets by intestinal epithelial cell.

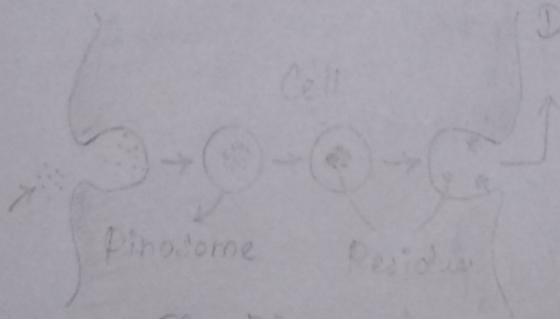


Fig: Pinocytosis

12. Exocytosis or Cell Vomiting:

* The process of exudating the Secretory products from the Secretory Cells to the outside of the cell cytoplasm is known as exocytosis or Cell Vomiting. This process is also called emeiocytosis or reverse endocytosis.

Eg: In pancreatic cells, the enzymatic Secretions are passed out through the plasma membrane by exocytosis.

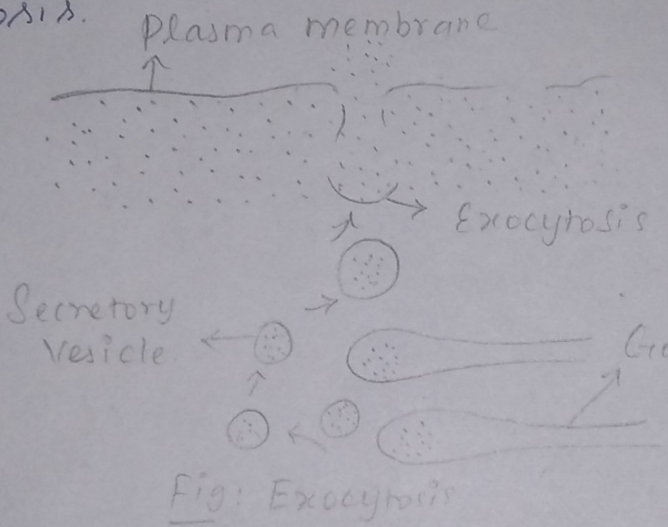


Fig: Exocytosis

13. Cytopemphis:

* It is the transport of materials through a cell. The material passess into the cell by endocytosis and then it comes out of the cell by exocytosis without any change.

* Glucose molecules from this intestine move into the blood capillary through the epithelial cells by Cytopemphis.

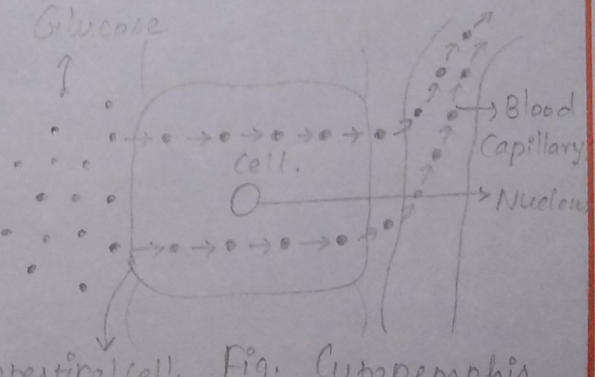


Fig: Cytopemphis.