

CELL BIOLOGY

Plasma Membrane

Molecular models of cell membrane

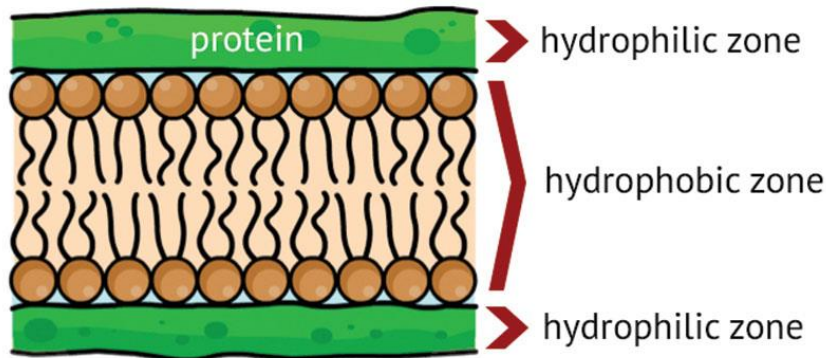
- Several models are proposed to explain the ultrastructure, physical and biological features of plasma membrane.

Lipid Bilayer Models

- Here the protein and lipid molecules of plasma membrane are placed in layers.
- Three models come under this category.

A. Sandwich model (Daniell – Davson model)

Sandwich (Davson–Danielli) model of cell membrane

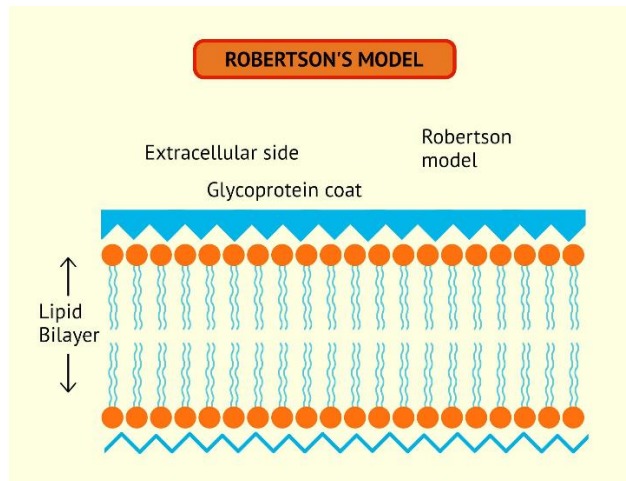


- Proposed by Daniell and Davson in 1935.
- “Plasma membrane is formed of a double layer of lipid molecules sandwiched between two layers of proteins molecules”
- The inner ends of lipid molecule are nonpolar and are provided with hydrophobic tails (water hating)
- The outer ends of the lipid molecule are polar and are provided with hydrophilic heads (water loving)
- The hydrophilic heads face outwards towards the protein molecule.
- So the lipid molecules are linked to the protein molecules by their hydrophilic ends.

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- The arrangements of the proteins and lipids are such that there exist pores in the membrane.
- The membrane pores permit the passage of small ions and water molecules.

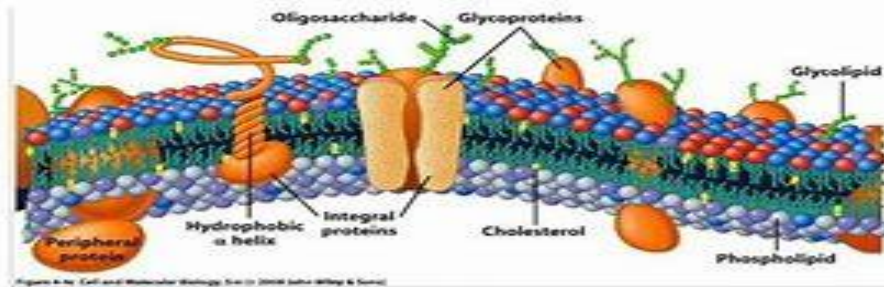
B. Unit membrane model



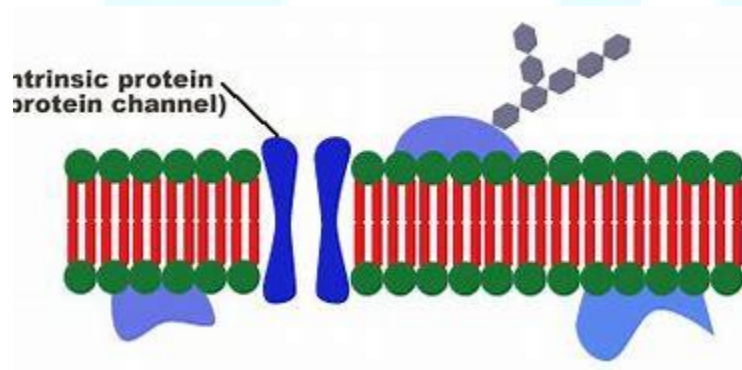
- Proposed by **Robertson** in **1953**.
- Also known as **Robertson model**.
- Also known as **Trilaminar model**.
- "Plasma membrane consists of two layers of molecules. the two layers are protein layer (outer and inner) and biomolecular layer of lipid which forms the central region".
- Protein layer have **20 A⁰** thickness.
- Lipid layer have **35 A⁰** thickness.

C. Fluid mosaic model

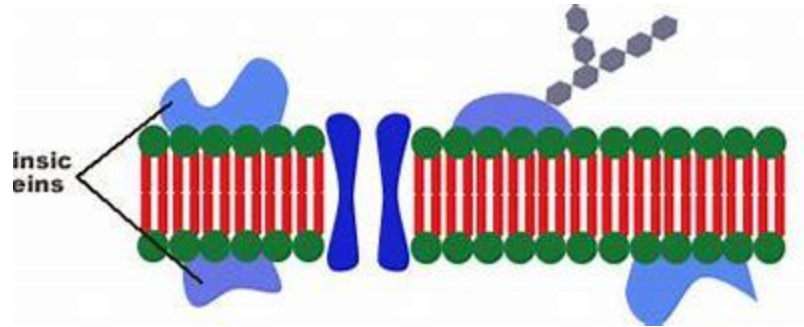
The Fluid Mosaic Model



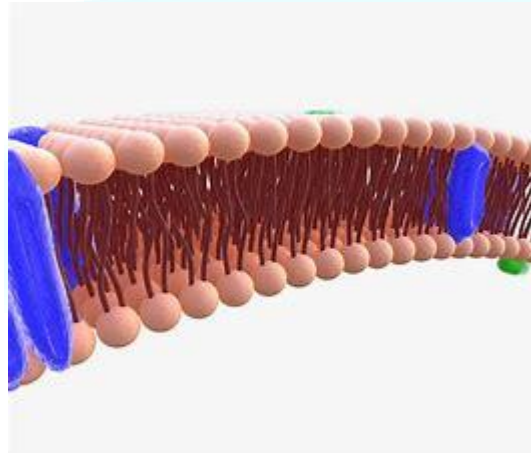
- **Singer and Nicolson** proposed this model in **1972**.
- "*plasma membrane are quasi fluid structure in which proteins and lipids are organized in a mosaic manner*".
- There is a layer of phospholipids in centre.
- The protein molecules surrounding the phospholipids are arranged in different ways in different region of the plasma membrane.
- Some protein molecules penetrate the lipid bilayer partially or wholly, these are called **Intrinsic proteins**.



- Other protein molecules lie outside the lipid layer on either side, these protein molecules are called **extrinsic proteins**.

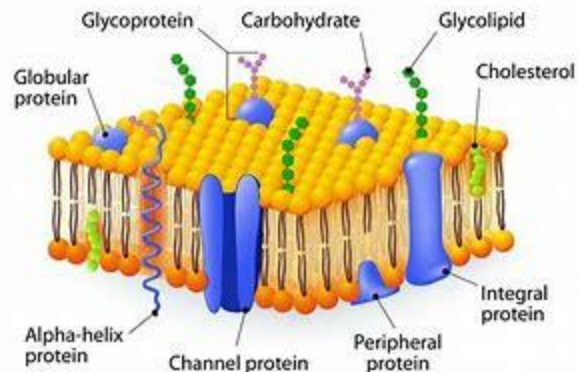


- The extrinsic protein molecules are globular.
- Extrinsic proteins are loosely bound to the lipid layer.
- Intrinsic proteins are tightly bound to the lipid bilayer.
- Hydrophobic tails of phospholipids face each other internally.
- Hydrophilic heads of lipids face towards the protein layers.



- Molecules of cholesterol and glycolipids are seen between the phospholipids in animal cells.

CELL MEMBRANE



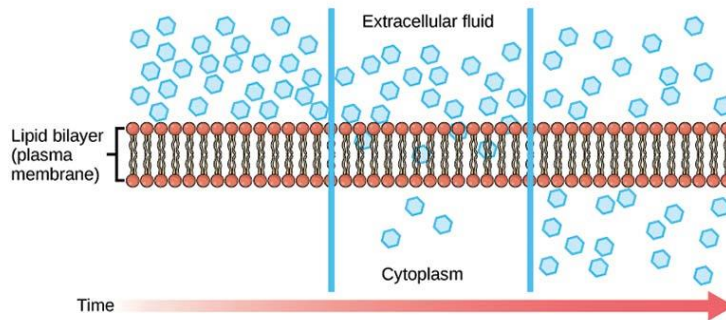
Functions Of Cell Membrane

- **Protection and support**
 - Maintains shape and size of cell.
 - Provide protection and support to cell.
- **Selective permeability**
 - It is selectively permeable.
 - It permit the movements of solvents and solution into and out of the cell according to the need of the cell.
 - Molecule with low molecular weight could easily pass through the plasma membrane.
 - High molecular weight substances are not permitted.
- **Diffusion**
 - It is also called as **passive transport**.
 - It is the process by which molecules pass from a region of higher concentration to a region of lower concentration.
 - It takes place through the pores present in the plasma membrane .
 - Substances like gases, liquids or solids show passive transport.
 - It is called **passive transport or downhill movements**.
 - Since it is a passive process, it does not require energy from ATP molecules for the movement of molecules across.
 - Two types of passive transport are there; they are
 1. **Simple diffusion**
 2. **Facilitated diffusion**

Simple diffusion(Passive Diffusion)

- Molecule dissolve in the phospholipid bilayer and moves across the membrane.
- Molecules then dissolve in the aqueous solution at the other side of the membrane.
- Eg: **movement of oxygen,nitrogen,carbon dioxide and water**.
- But the movements of molecules like glucose and ions are slow.
- Significance: molecules of nutrients enter the cell, waste materials leave the cell.

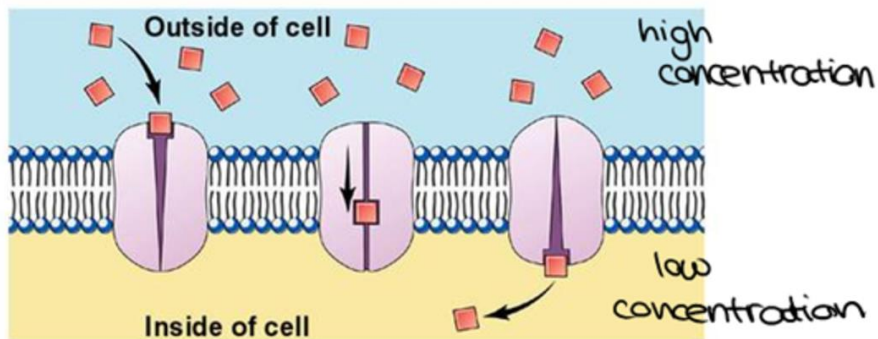
Simple Diffusion



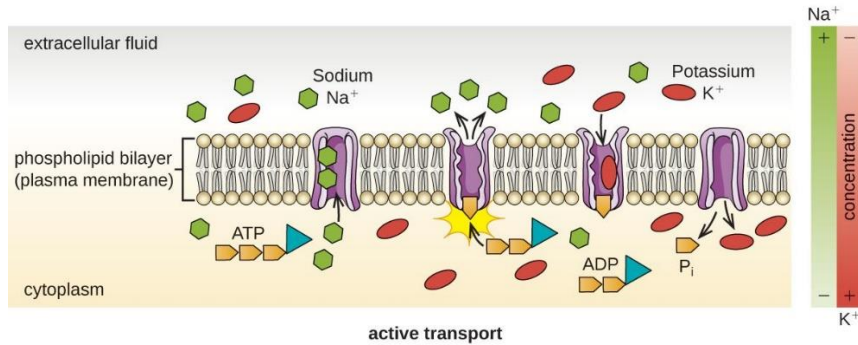
Facilitated Diffusion

- Molecules do not dissolve in the phospholipid bilayer.
- But their passage is facilitated by **carrier proteins**.
- Eg; diffusion of sugars, amino acids, nucleosides, ect.
- Certain proteins called **channel proteins** are present.
- Channel proteins form pores through the membrane.
- Pores allows small molecules such as **Na⁺, K⁺, Ca²⁺, Cl⁻** etc.

Facilitated Diffusion

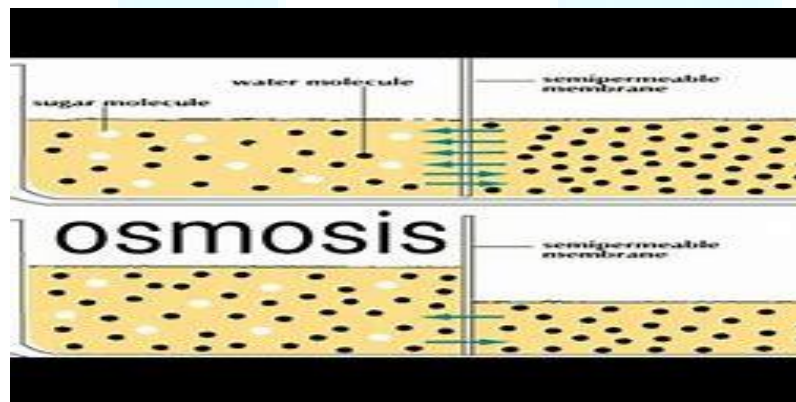


➤ Active transport



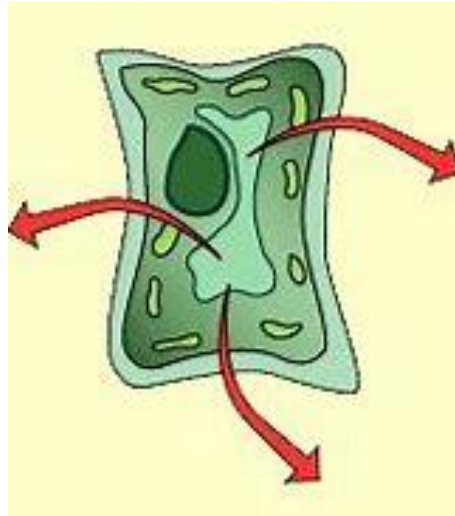
- Movements of molecules or ions against their concentration gradient.
- Molecules move from a region of lower concentration to higher concentration.
- Energy required is provided by **ATP hydrolysis**.
- This is also called **carrier mediated process**.
- Active transport is **very rapid and selective**.
- Eg; membrane of lysosome, mitochondria and other cellular systems.

➤ **Osmosis**



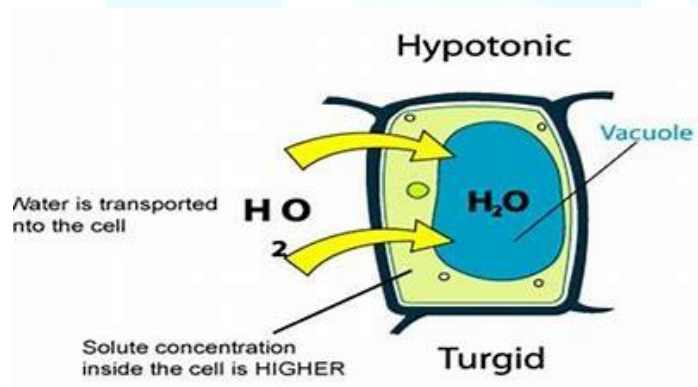
- Process by which water molecules pass from a region of **higher concentration to a region of lower concentration**.
- Plasma membrane allows the free movements of water molecules.
- Two types of osmosis are present:
 1. **Exosmosis**
 2. **Endosmosis**

Exosmosis



- Movement of water molecules **out of the cell** through the plasma membrane is called exosmosis.

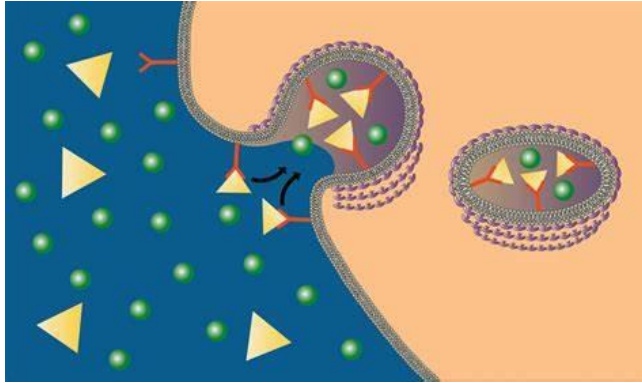
Endosmosis



- Movement of water **molecules in to the cell** through the plasma membrane is known as endosmosis.
- Due to this the *pressure inside the cell increases*.
- Plasma membrane maintains a balance between the osmotic pressure of the inter and intra cellular fluids.

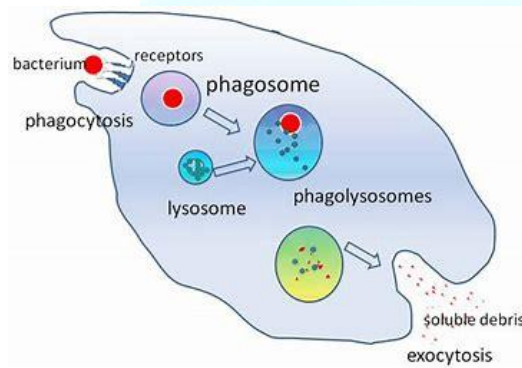
➤ **Endocytosis**

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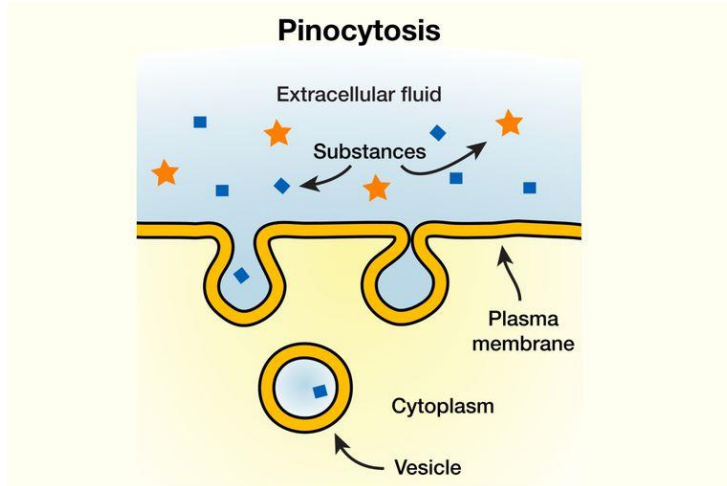
- Process by which solid particles or liquid substances are taken into the cytoplasm through the plasma membrane.
- It is of two types:
 1. Phagocytosis
 2. Pinocytosis

Phagocytosis (cell eating)



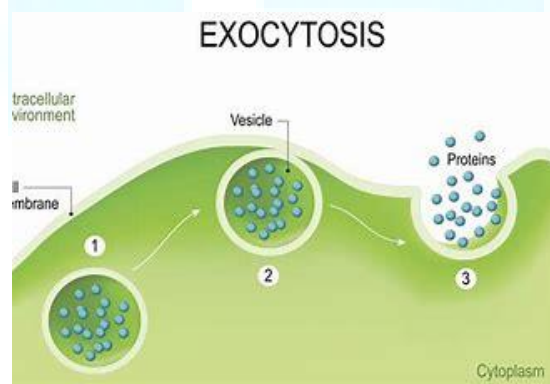
- Ingestion of solid particles into the cytoplasm through plasma membrane.
- Evagination of plasma membrane surrounded solid particles and engulf these particles.
- It is subsequently taken into vesicles in the cytoplasm.
- Vesicles containing solid particles are called **Phagosomes**.

Pinocytosis (cell Drinking)



- Taking in of liquid substance into the cytoplasm by invaginations of the plasma membrane.
- Plasma membrane is invaginated into tiny vacuoles containing liquid substances.
- These vacuoles are pinched off to form **pinocytic vesicles or pinosomes**.
- Many proteins are taken into the cell by pinocytosis.

➤ **Exocytosis**

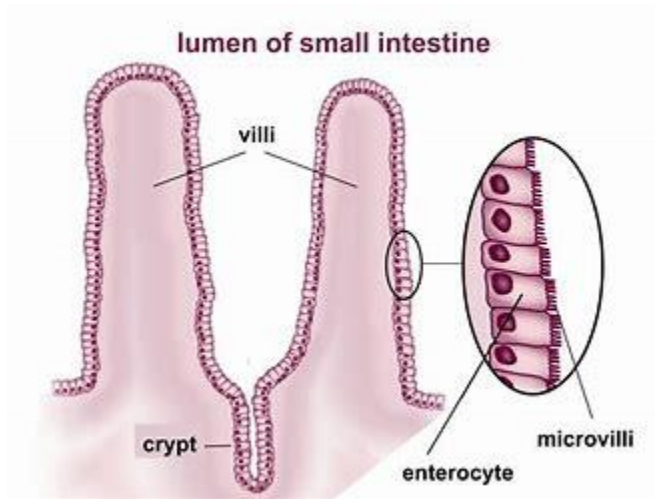


- It is the transport of materials out of the cell.
- It is the exact reversal of endocytosis.
- Materials to be exported must be enclosed in a membrane vesicle usually from the rough ER and Golgi body.
- **Hormones and digestive enzymes are secreted by exocytosis** from the secretory cells of the intestine and endocrine glands.
- Some times materials can pass straight through cells.
- *Materials are taken in by endocytosis at one end of the cell and pass out by exocytosis at the other end.*

➤ **Formation of cell organelles**

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- Plasma membrane helps in the formation of certain organelles like nuclear membrane and ER.
- **Transmission of nerve impulses**
 - Plasma membrane of nerve fibres transmits the nerve impulses.
- **Increase in absorptive surface**



- Plasma membrane increases the absorptive surface of intestine by forming microvilli.
- **Recognition of foreign cells**
 - Recognition of **bacteria by mammalian leucocytes.**
- **Recognition and binding of some hormone**
 - Recognition and binding of some hormones like insulin.
- **Chemorespiration**
 - Chemorespiration in bacteria and several other cells.