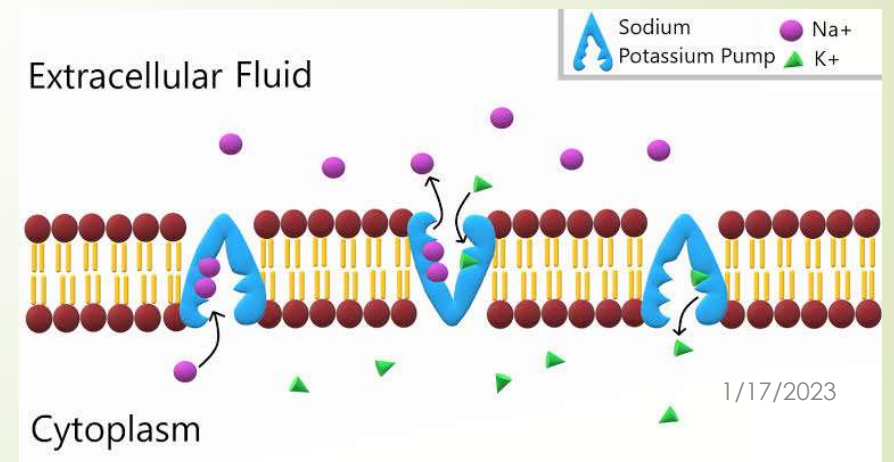


# Plasma Membrane

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1

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## Introduction :

- Outer most layer, gives particular shape to cell and protect the cell from outer environment
- There are several concepts of membrane structure of membrane composed by various scientists
- Unit membrane concept : proposed by Robertson
- Sandwich model or protein lipid protein model : proposed by Danielli and Davison
- Fluid mosaic model : proposed by Singer and Nicolson

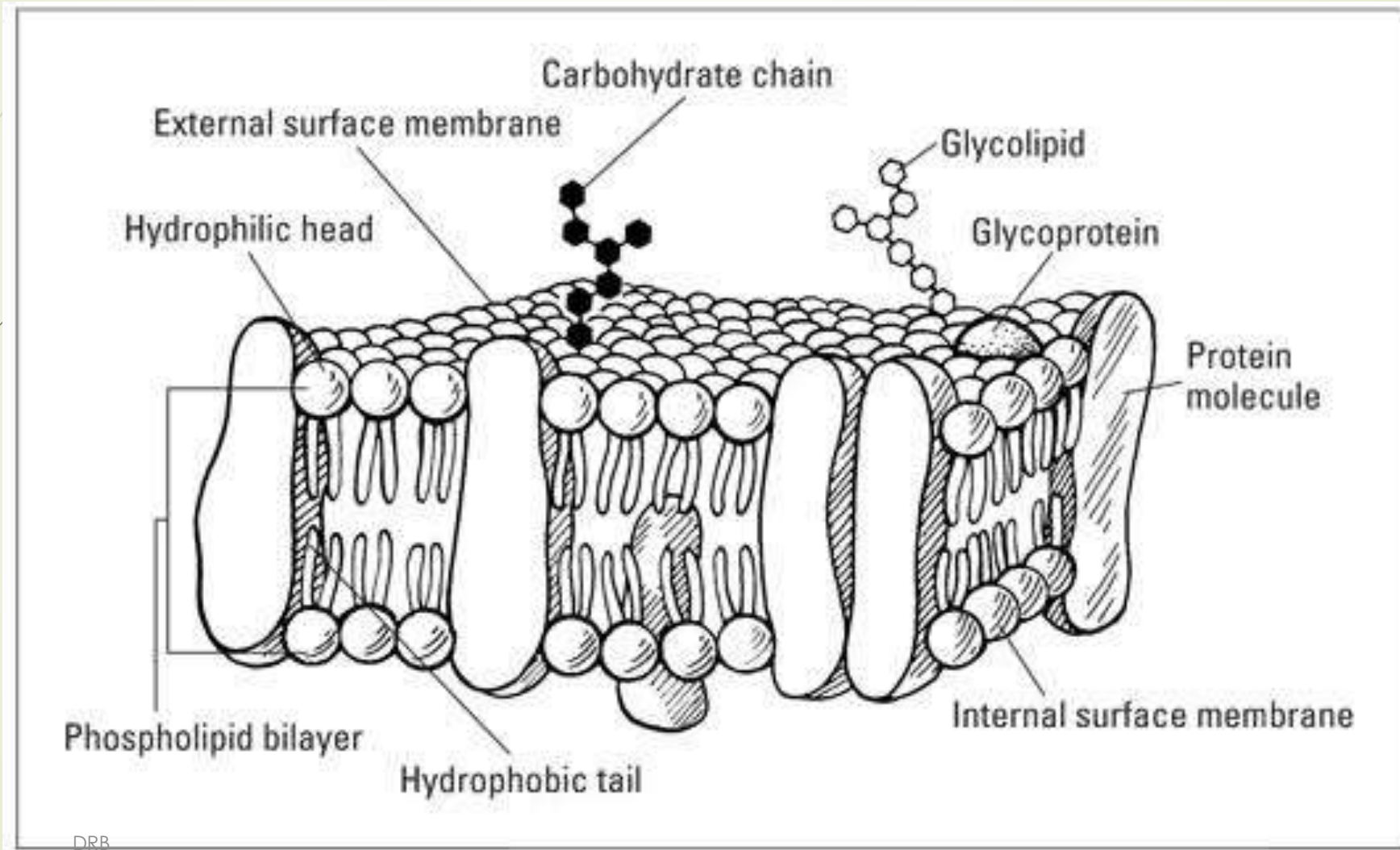
# Structure of Plasma Membrane :-

## Fluid mosaic model :

- This model gives the well defined structure of Plasma Membrane
- According to this model membrane is fluid structure
- Proposed by Singer and Nicolson in 1972
- It explained that the membranes are mosaic of lipids and proteins
- Membrane looks like as quasi fluid structure

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4



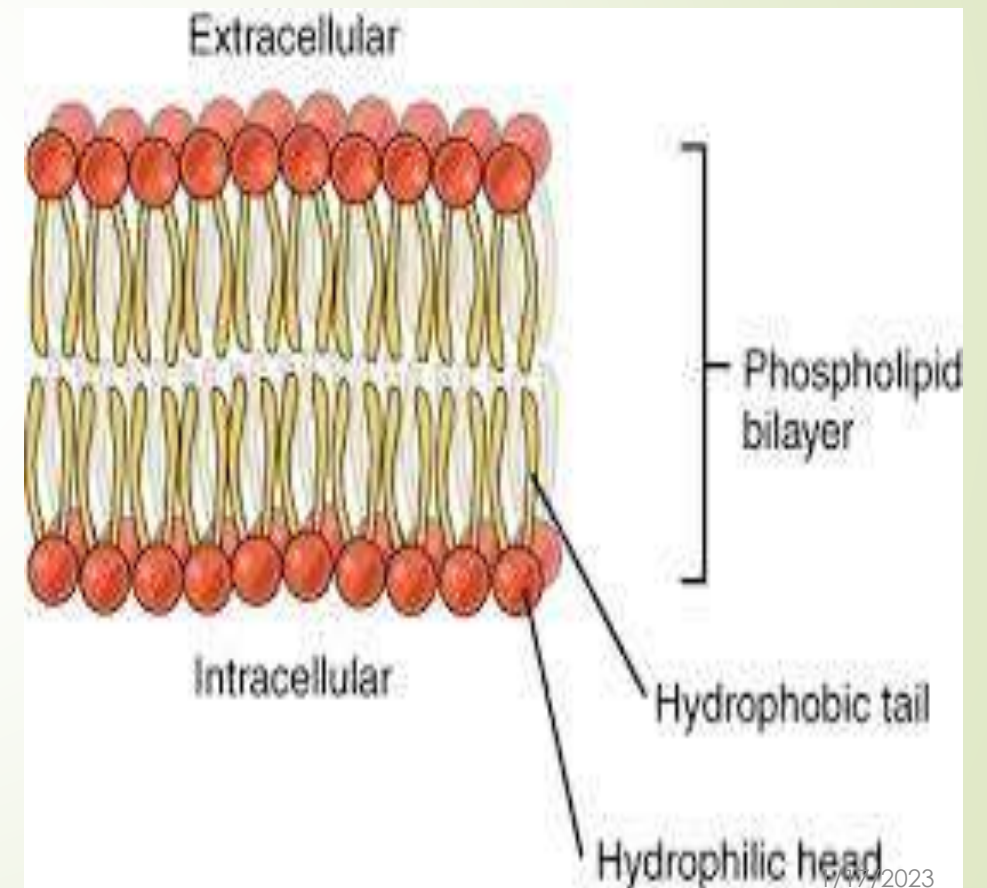
## Chemical Constituents:

- Contains lipids as well as proteins
- Ratio of protein to lipid varies and depend on cell type
- Carbohydrates also present (5-10%)
- Carbohydrates present in the form of glycolipids and glycoproteins
- Carbohydrates especially abundant in plasma membrane of eukaryotic cells



## Lipid Bilayer :

- Basic structure of Plasma Membrane form by lipid Bilayer
- 2- chain of amphipathic lipid molecules are form lipid Bilayer
- Hydrophobic interaction is the primary physical force present in lipid Bilayer
- There are 3 – types of lipid molecules are present in lipid Bilayer- phospholipid, glycolipids and sterol



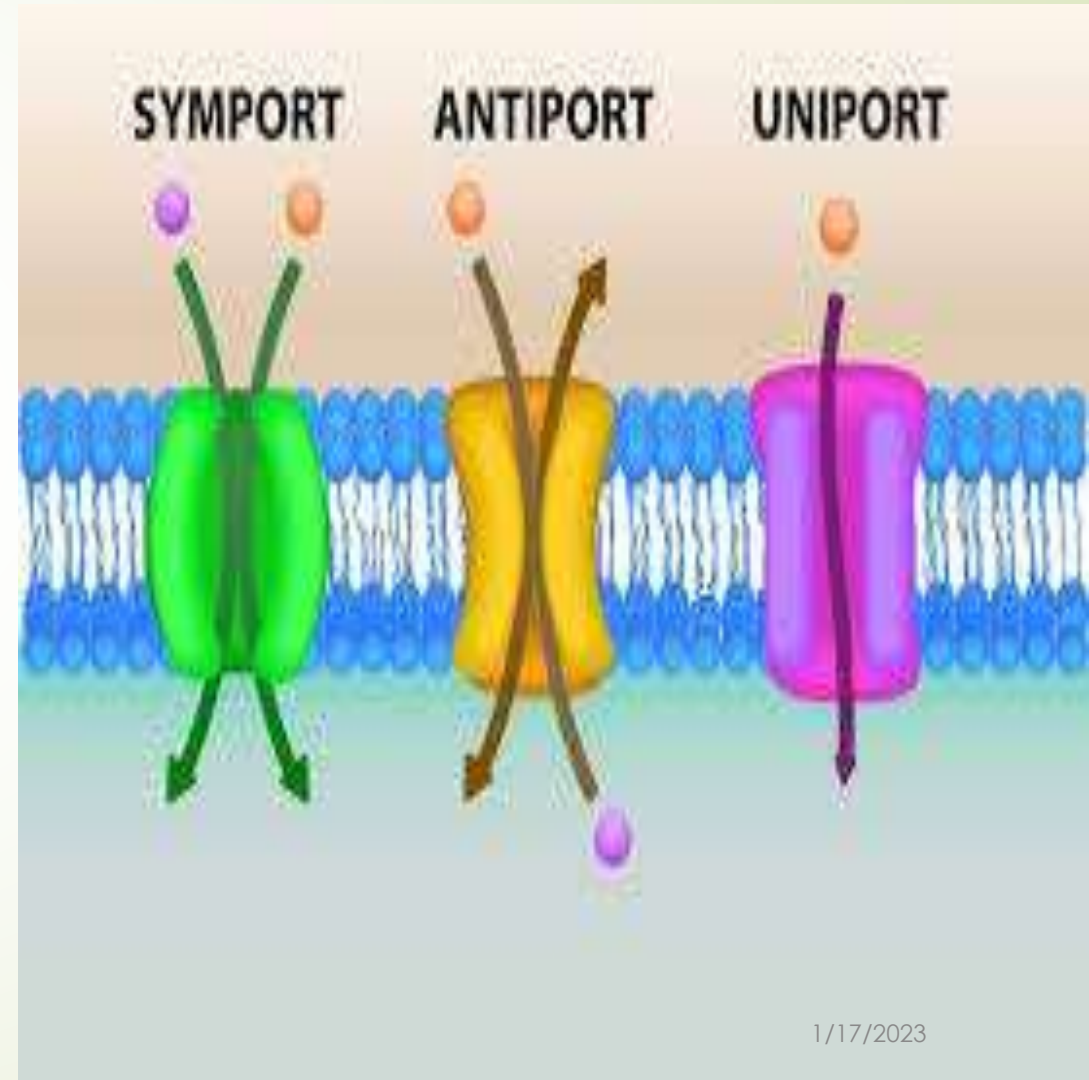
# Membrane Proteins :

- 2 – types:- integral & Peripheral
- **1) Peripheral proteins :-**
- Bound to membrane by electrostatic force and hydrogen bonds
- **2) Integral Proteins :-**
- Held in lipid Bilayer tightly
- Mostly transmembrane proteins
- **3) Transport Proteins :-**
- 3 types – catalytic, structural & transport proteins
- They are carrier or channel proteins

## Continued....

8

- Carrier Proteins :-
- I) Uniporters : transport single solute from one side to other
- II) Symport or Couple transporter : transport two solute at a time from one side to other
- III) Antiporter : transport one solute inside and other solute outside of the cell
- Channel Proteins :-
- Transport solutes down their conc. Gradients
- Gated or non gated channels



1/17/2023



## ➤ Asymmetry of lipid Bilayer :-

- Phospholipids in membrane are asymmetrically distributed
- Amine containing phospholipid at cytoplasmic surface and choline containing and sphingolipid enriched phospholipid at outer surface
- This helps in slow diffusion, protein lipid interaction and protein mediated transport

## ➤ Motion of lipid molecules and fluidity of lipid Bilayer :-

- It depends on temperature and lipid composition
- If temperature increases fluidity also increases and when temperature decreases fluidity decreases is called as phase transition

# Transport across membrane:-

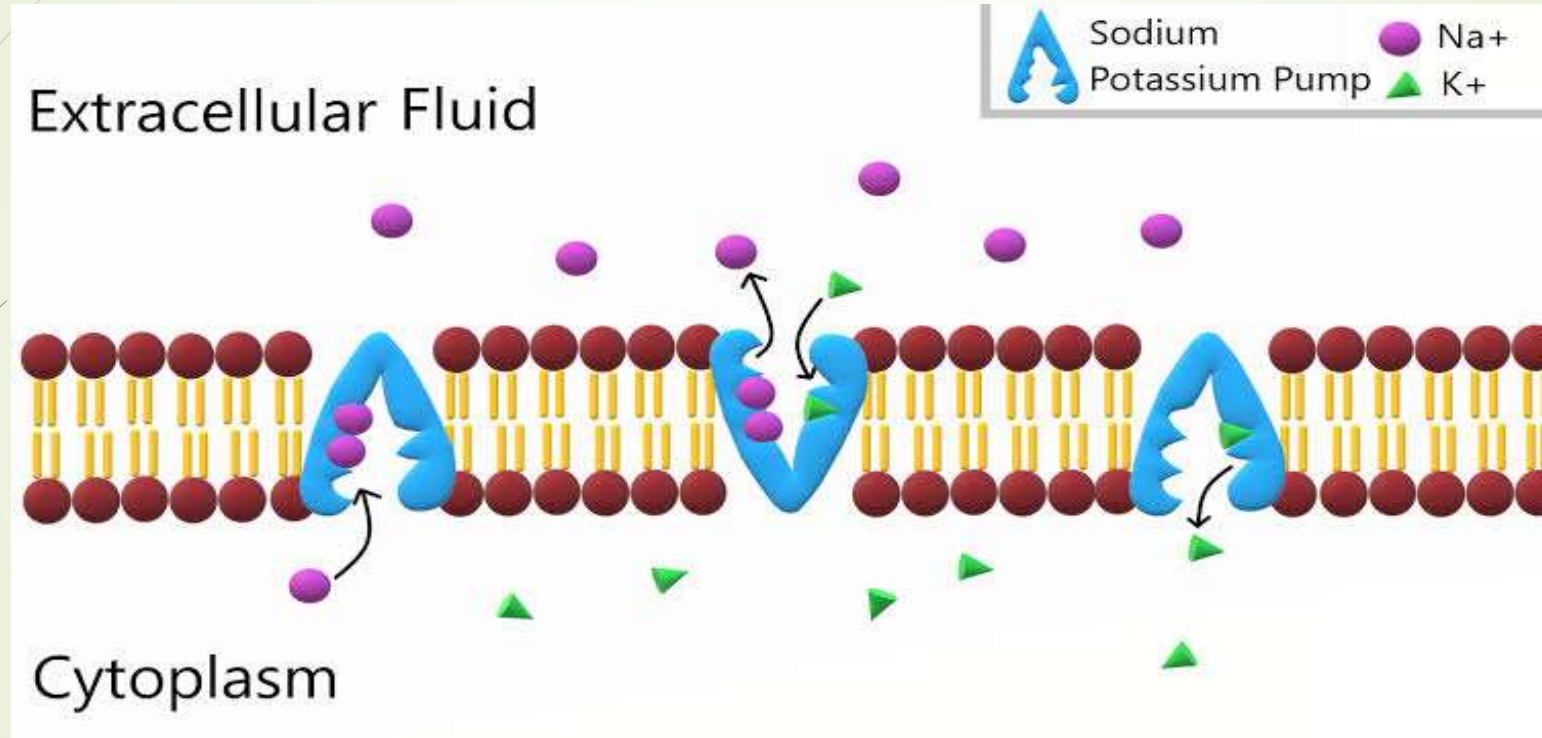
10

- Plasma Membrane is selectively permeable or semipermeable membrane
- Transport proteins present on plasma membrane help for the transport of molecules
- Transport based on lipid phase diffusion and protein mediated transport
- **1) Active Transport :-**
- Occurs against the concentration gradient and mediated by carrier Proteins
- Metabolic energy is used to move ions or molecules against concentration gradient
- It again consists two types:-
- **I) Primary Active Transport :-**
- Use metabolic energy, such as hydrolysis of ATP

## Continued.....

11

- Transport of  $\text{Na}^+$  &  $\text{K}^+$  by carrier Proteins
- Eg.-  $\text{Na}^+$ - $\text{K}^+$  ATPase help in  $\text{Na}^+$  -  $\text{K}^+$  pump



- II) Secondary Active Transport :-
- It occurs when inside (uphill) transport of one solute with the outside ( downhill) flow of a different solute that originally pumped uphill by primary transport

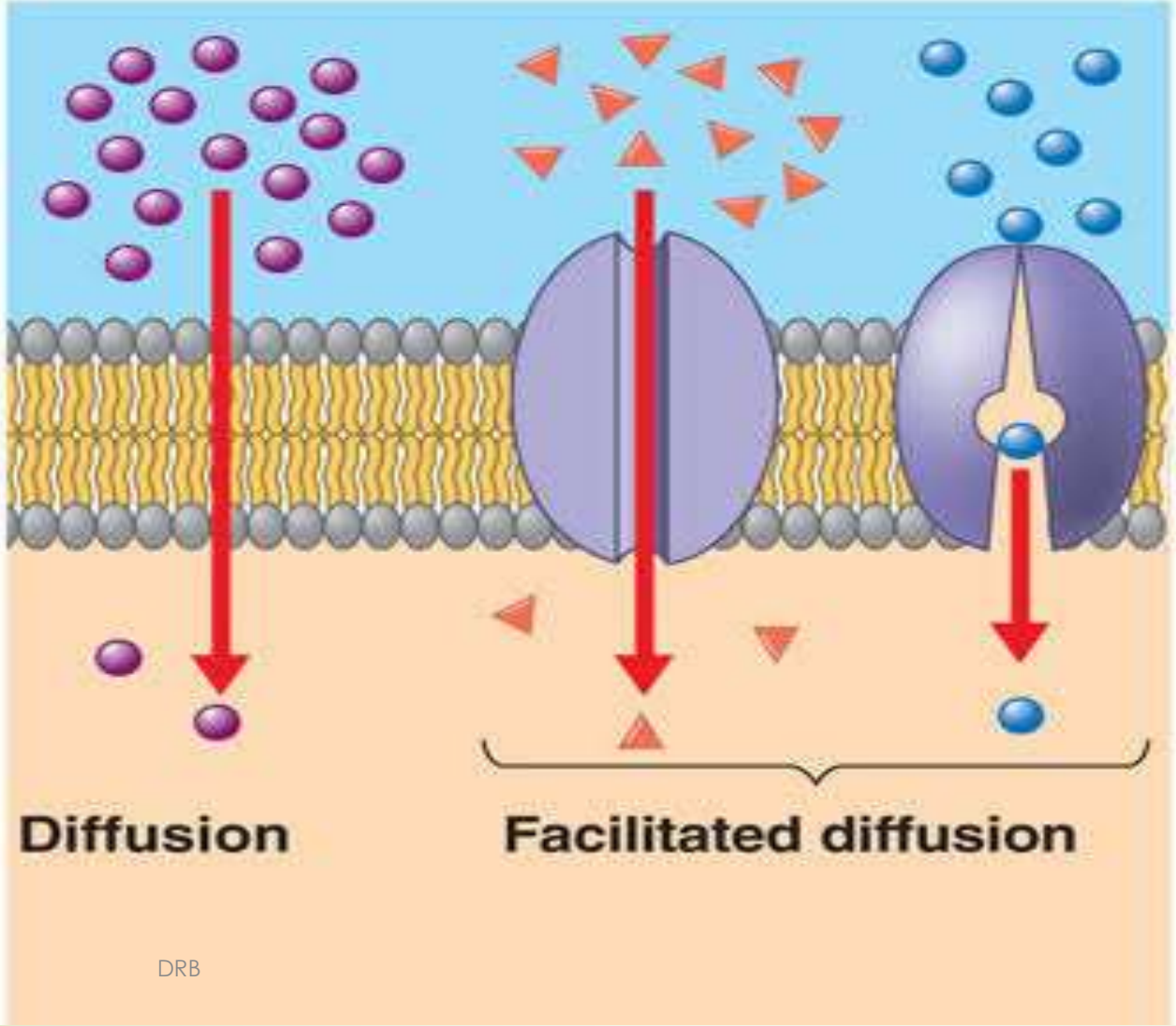
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12

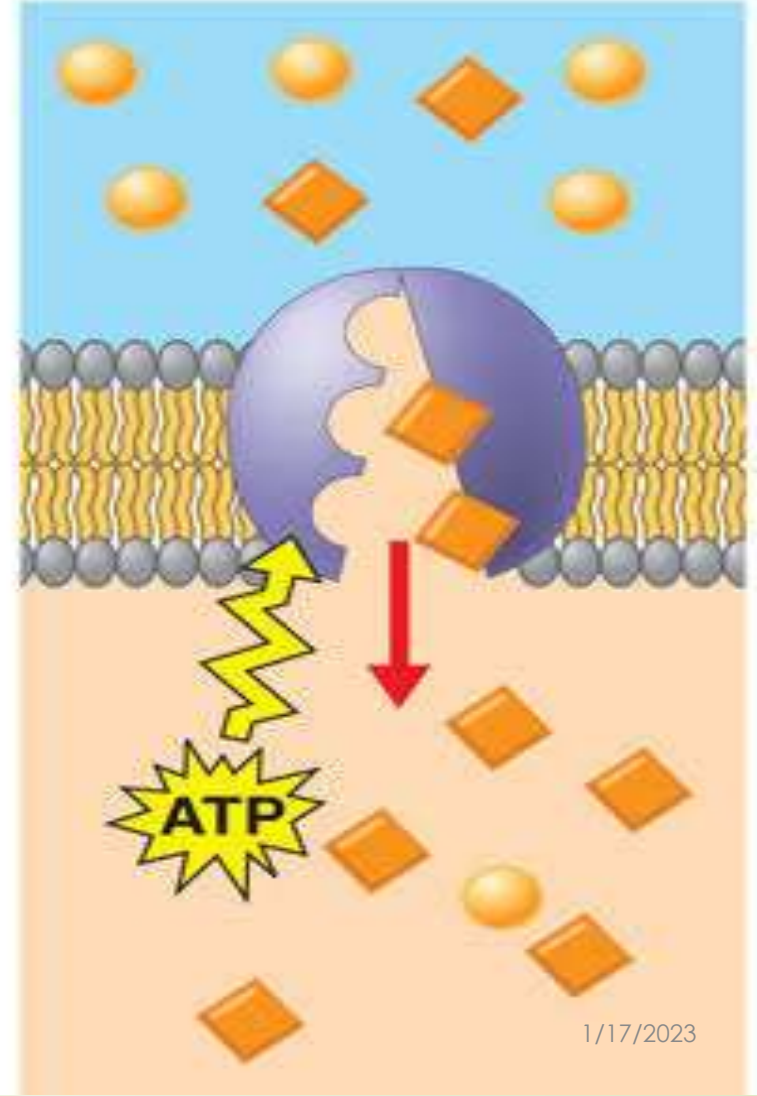
- Eg.- transport of Na<sup>+</sup> and glucose
- Transmembrane protein Na<sup>+</sup> glucose transporter allows Na<sup>+</sup> and glucose to enter together
  
- **2) Passive Transport :-**
- Along concentration gradient and without use of metabolic energy
- Two types :-
- **1) Simple diffusion:-**
- Molecules to be transport simply dissolve in phospholipid bilayer and diffuse across it
- No membrane proteins are involved and direction of transport determined by the relative concentration gradient of molecule inside and outside of the cell



### Passive transport



### Active transport





## ➤ II) Facillated diffusion :-

➤ It is like simple diffusion involved movement of solute along concentration gradient but the passage is mediated by transport proteins.

➤ It is selective in nature

➤ It allows polar and charged molecules

### ➤ A) Carrier Protein Mediated :-

➤ Also called as transporters or permeases

➤ Non covalently bind specific molecules to be transport

➤ Proteins undergo conformational changes

➤ Eg.- movement of glucose

### ➤ B) Channel proteins mediated :-

➤ these proteins form open pores throughout membrane

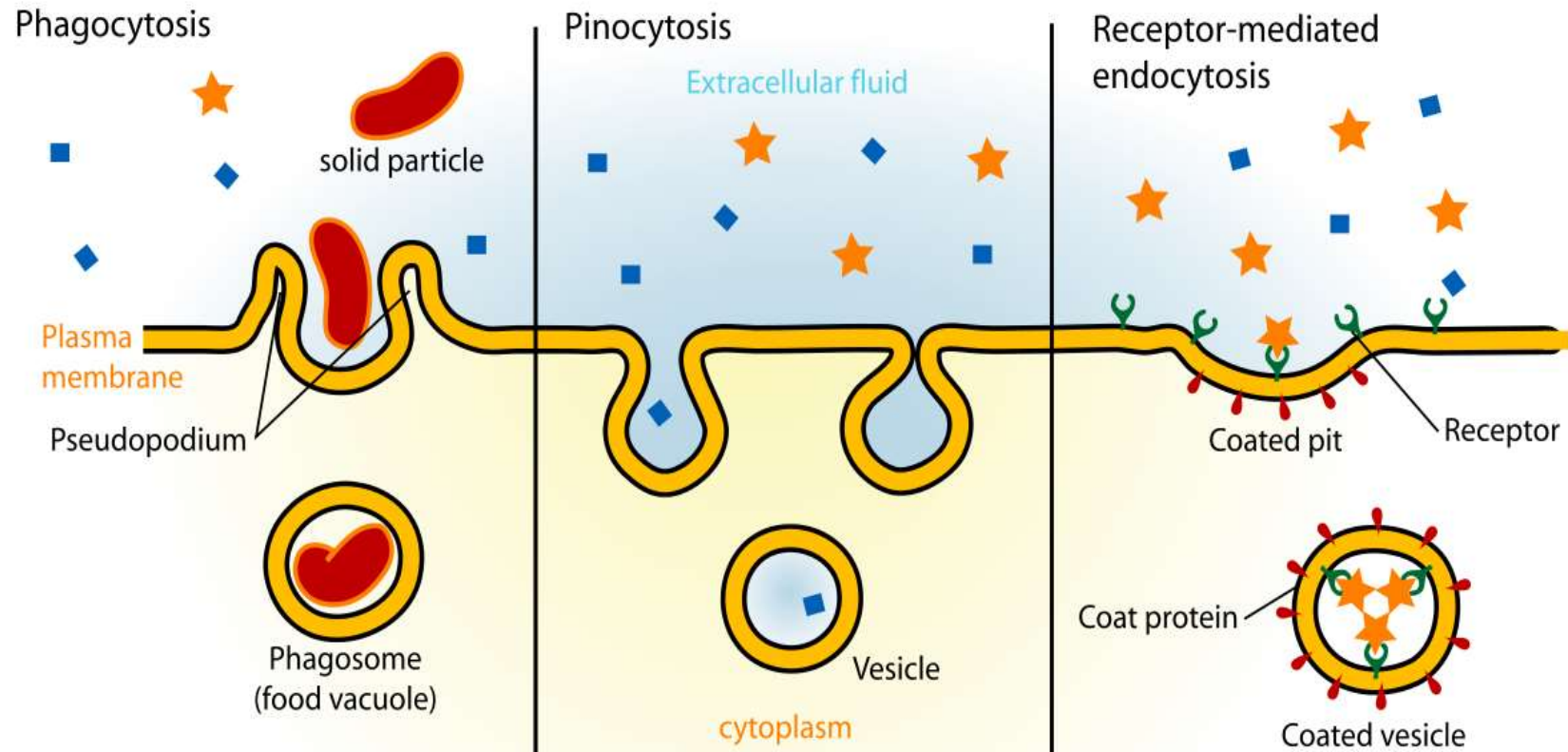
➤ Eg.- Voltage gated channels

# Endocytosis:-

15

- The intake of material from the surrounding environment of the cell is called as endocytosis.
- Internalization or intake achieve by formation of membrane bound vesicles at the cell surface
- The progressive invagination of Plasma Membrane, followed by pinching off and release of vesicle in cytoplasm
- It divided into phagocytosis and pinocytosis
- **1) Phagocytosis:-** (eating of cell)
- Intake of large solid particles by the cell is called as Phagocytosis
- Particles bind to specific plasma membrane receptors and form a large endocytic vesicle known as phagosome
- Phagosome fuse with lysosome to form phagolysosome & digestion of takes place.
- **2) Pinocytosis :-** ( cell drinking)
- The injection of fluid by formation of small endocytic vesicle is known as pinocytosis
- It involves uptake of soluble material dissolved in extracellular fluid
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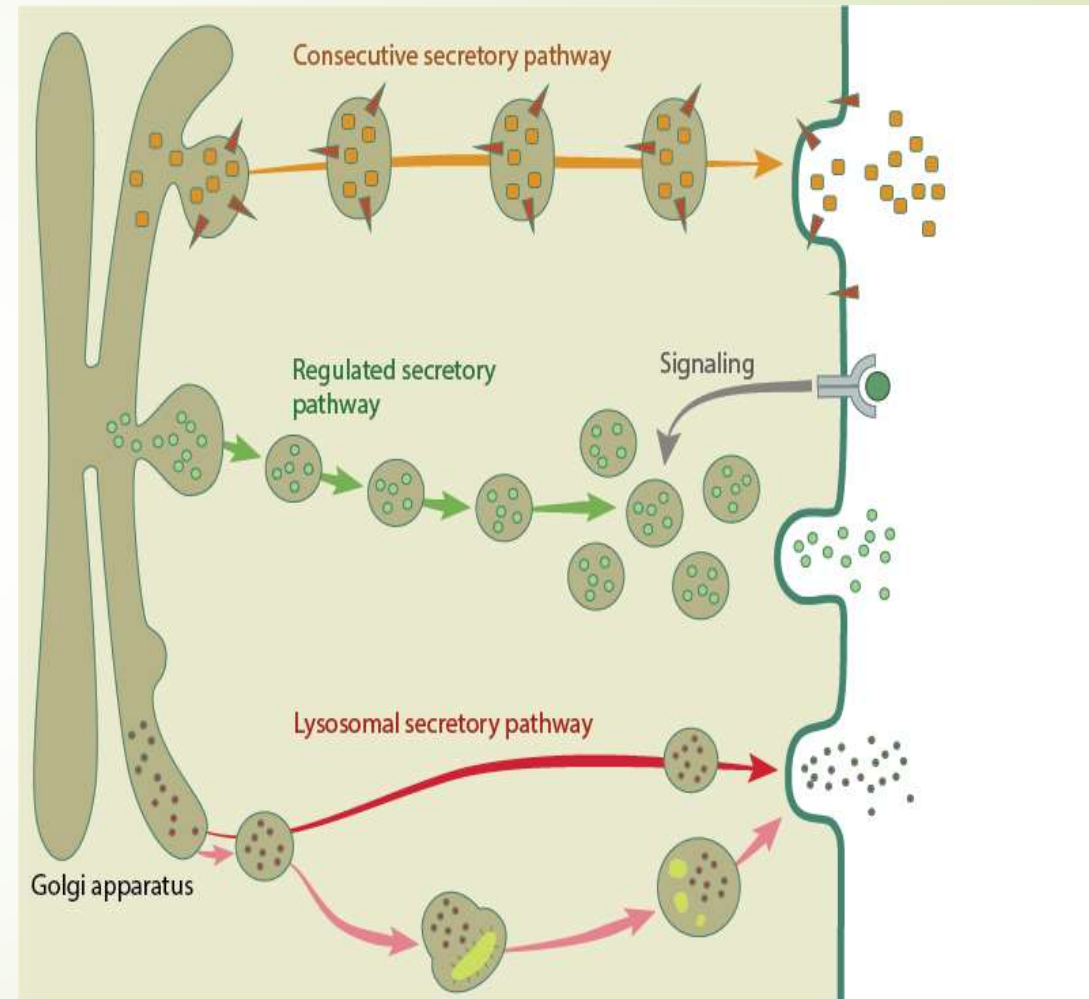
## Endocytosis



# Exocytosis:-

17

- Transport of the vesicle fuse with plasma membrane and release content outside of the cell is known as exocytosis
- It consists of 2 pathways:-
  - **A) Constitutive secretory pathway:-**
  - Carried out by all cells
  - Proteins release by such constitutive pathway
  - **B) Regulated secretory pathway:-**
  - Carried out by specialized cells
  - Such as hormone, neurotransmitters or digestive enzyme secreting cells





## FUNCTIONS OF PLASMA MEMBRANE

- The most important function of plasma membrane is to provide passage for various substances, into and out of the cell and regulates flow of water and inorganic molecules through it, as lipid molecules are only closely placed to each other but are not joined to each other.
- Plasma membrane is selectively permeable, allows some solute particles ( $1-15\text{\AA}$ ) to pass through it readily along with solvents.
- It acts as a protective layer, from the uptake of some harmful molecules.
- Cell membranes often include receptor sites for interaction with specific biochemicals such as certain hormones, neurotransmitters and immune proteins.
- It helps in conversion of signals conveyed by some extra cellular agents
- In this way the cell can recognize and process some signals received from the extracellular environment.



Plasma membrane is responsible for the transportation of materials, molecules or ions through it, by various ways

Exocytosis- Molecules are taken out of the cell

Endocytosis- Ingestion of molecules either in solid form (phagocytosis) cell eating or in liquid form (pinocytosis) cell drinking.

For Active transport chemical energy is required because molecules move against the normal diffusion gradient.

Passive transport- Movement of molecules from the region of higher concentration to lower concentration.

Diffusion of different gases takes place through plasma membrane

Oligosaccharide molecules (in the form of Glycolipid/Glycoprotein) of the cell membrane help in cell to cell recognition/recognizing self from non self.

- Plasma membrane separates the components of the cell from its outside environment
- It allows only selected substances into the cell and keeps others out.
- Plasma membrane has a major role in protecting the integrity of the interior of the cell.
- Plasma membrane serves as a base of attachment for the cytoskeleton in some organisms and cell walls in other organisms
- Plasma membrane provides cell shape (in animal cells) e.g. the characteristic shape of red blood cells, nerve cells, bone cells, etc
- Plasma membrane allows transport of certain substances into and out of the cell but not all substance, so it is termed selectively permeable.



- Endocytosis is the process in which cells absorb molecules by engulfing them. The plasma membrane creates a small deformation inward, called an invagination, in which the substance to be transported is captured.
- Endocytosis is a pathway for internalizing solid particles ("cell eating" or phagocytosis), small molecules and ions ("cell drinking" or pinocytosis), and macromolecules.
- Endocytosis requires energy and is thus a form of active transport.
- Proteins and lipids make up the composition of a cell membrane. There are three different types of proteins found within a cell membrane: structural protein, transport protein and glycoprotein. These support cell structure and shape, move molecules through the membrane and transmit signals between cells.

•The cell membrane maintains the physical integrity of the cell.

It's most obvious in the cases of animal cells (because they don't have cell walls) that the cell membrane holds the cell together by enclosing the cytoplasm and organelles within it.

▪The cell membrane forms a barrier between the inside of the cell and the environment outside the cell – enclosing cytoplasm and any organelles within the cell, and enabling different chemical environments to exist on each side of the cell membrane.

▪The cell membrane physically separates the intracellular components (e.g. organelles in eukaryotic cells) from the extracellular environment.

▪The cell membrane protects the cell from some harmful chemicals in its external environment.

▪The cell membrane also protects the cell from loss of useful biological macromolecules held within the cell