Plasma Membrane

The plasma membrane ((also known as the cell membrane or cytoplasmic membrane) of a cell is a network of lipids and proteins that forms the boundary between a cell's contents and the outside of the cell. The main function of the plasma membrane is to protect the cell from its surrounding environment. It is semi-permeable and regulates the materials that enter and exit the cell. The cells of all living things have plasma membranes.

Every cell is surrounded by a membrane and also the cell has a complex internal membranous structure. Again, membranes make some compartments inside the cytoplasm to perform some specific functions as in mitochondria, chloroplasts, lysosomes etc.
Membrane-bound enzymes also perform certain specific reactions which are needed for certain cellular activities. Proteins present in the membrane help in the transport of certain molecules from inside and outside of the cell.
Proteins also help in anchoring some cytoskeletal fibers to give the cell its shape. So, the membrane is a highly differentiated dynamic structure that controls the behavior of the cell. It is the most multifunctional cellular structure.

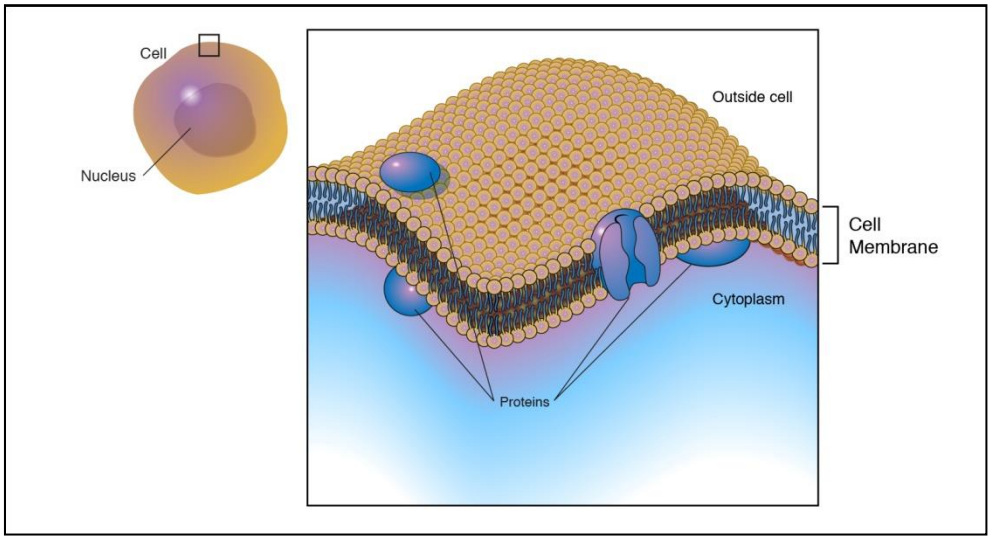

Fig 1: Plasma membrane

Important Functions of the Plasma Membrane:

1. A Physical Barrier

The plasma membrane surrounds all cells and physically separates the cytoplasm, which is the material that makes up the cell, from the extracellular fluid outside the cell. This protects all the components of the cell from the outside environment both mechanically and chemically. and allows separate activities to occur inside and outside the cell.
The plasma membrane provides structural support to the cell. It tethers the cytoskeleton, which is a network of protein filaments inside the cell that hold all the parts of the cell in place. This gives the cell its shape. Certain organisms such as plants and fungi have a cell wall in addition to the membrane. The cell wall is composed of molecules such as cellulose. It provides additional support to the cell, and it is why plant cells do not burst like animal cells do if too much water diffuses into them.

2. Selective Permeability

Plasma membranes are selectively permeable (or semi-permeable), meaning that only certain molecules can pass through them. Water, oxygen, and carbon dioxide can easily travel through the membrane. Regulated and selective transport of substances through pores, channels, and transporters is necessary because the cells and organelles are enclosed by membrane systems. Generally, ions (e.g. sodium, potassium) and polar molecules cannot pass through the membrane; they must go through specific channels or pores in the membrane instead of freely diffusing through. This way, the membrane can control the rate at which certain molecules can enter and exit the cell. The plasma membrane is essential for maintaining differences in the concentration of many substances between the intracellular and extracellular compartments. This determines the internal milieu and is a precondition for homeostasis—i. e., the maintenance of constant concentrations of substances and physiological parameters.

3. Enzymatic catalysis of reactions.

Important enzymes are located in membranes at the interface between the lipid and aqueous phases. This is where reactions with apolar substrates occur.
Examples include lipid biosynthesis and the metabolism of apolar xenobiotics. The most important reactions in energy conversion—i. e., oxidative phosphorylation and photosynthesis also occur in membranes.

4. Endocytosis and Exocytosis

Endocytosis is when a cell ingests relatively larger contents than the single ions or molecules that pass through channels. Through endocytosis, a cell can take in large quantities of molecules or even whole bacteria from the extracellular fluid. **Exocytosis** is when the cell releases these materials. The cell membrane plays an important role in

both of these processes. The shape of the membrane itself changes to allow molecules to enter or exit the cell. It also forms vacuoles, small bubbles of membrane that can transport many molecules at once, in order to transport materials to different places in the cell.

5. Cell Signaling

Another important function of the membrane is to facilitate communication and signaling between cells from the reception of extracellular signals and transfer of these signals to the inside of the cell as well as the production of signals. It does so through the use of various proteins and carbohydrates in the membrane. Proteins on the cell "mark" that cell so that other cells can identify it. The membrane also has receptors that allow it to carry out certain tasks when molecules such as hormones bind to those receptors.

6. Anchoring of the cytoskeleton

Plasma membrane helps to maintain the shape of cells and organelles and to provide the basis for movement processes.

Summary: Important Functions of Plasma Membrane:

a. Interactions of series of enzymatic processes for performing several cellular events and in the production of chemical energy (ATP) by confining macromolecules in a small space.

b. It acts as a receptor site for some agents like hormones, neurotransmitters, immune proteins.

c. It helps in the conversion of signal conveyed by some extracellular agents as stated above.

d. It prevents the loss of different macromolecules.

e. It protects the cell from the uptake, of some harmful materials.

f. The cell membrane interacts with other adjacent cells in forming tissues and organs during organogenesis and embryonic development

Composition of Plasma Membrane:

The membrane is mainly composed of lipids, proteins and carbohydrates. Water makes about 29% of total weight. Robertson (1959) proposed that plasma membrane is three-layered structure where proteins form the outer and inner layers of membrane that encloses lipids to form a unit membrane. The membrane is made of a lipid bilayer

(Fig:2). It's made predominantly of phospholipid molecules, which are amphipathic – part hydrophobic and part hydrophilic:

They contain, from top to bottom:

1. A polar head group. This can be charged: serine (-), inositol (-), or it can be neutral, with both positively and negatively charged groups: choline, ethanolamine.
2. A glycerol linker.
3. A phosphate group.
4. Two fatty acid chains.

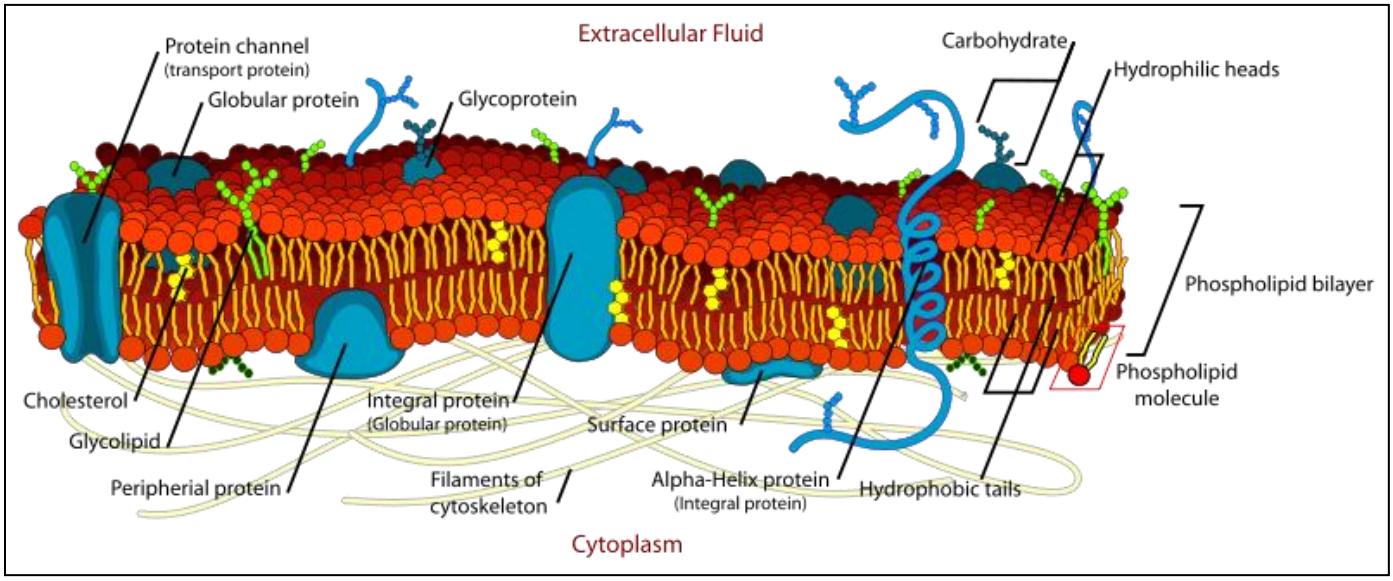

Fig 2: Structure and composition of Plasma membrane

Phospholipids: The membrane is partially made up of molecules called phospholipids, which spontaneously arrange themselves into a double layer with hydrophilic ("water loving") heads on the outside and hydrophobic ("water hating") tails on the inside. These interactions with water are what allow plasma membranes to form.

Proteins: Proteins are wedged between the lipids that make up the membrane, and these transmembrane proteins allow molecules that couldn't enter the cell otherwise to pass through by forming channels, pores or gates. In this way, the cell controls the flow of these molecules as they enter and exit. Proteins in the cell membrane play a role in many other functions, such as cell signaling, cell recognition, and enzyme activity.

Carbohydrates: Carbohydrates are also found in the plasma membrane; specifically, most carbohydrates in the membrane are part of glycoproteins, which are formed when a carbohydrate attaches to a protein. Glycoproteins play a role in the interactions between cells, including cell adhesion, the process by which cells attach to each other.

The components of the plasma membrane

Component	Location
Phospholipids	Main fabric of the membrane
Cholesterol	Tucked between the hydrophobic tails of the membrane phospholipids
Integral proteins	Embedded in the phospholipid bilayer; may or may not extend through both layers
Peripheral proteins	On the inner or outer surface of the phospholipid bilayer, but not embedded in its hydrophobic core
Carbohydrates	Attached to proteins or lipids on the extracellular side of the membrane (forming glycoproteins and glycolipids)

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