CELL BIOLOGY

Dr. Treefa F. Ismail **4th stage**

Lecture 3: Cell Membrane 18/10/2021

All cells, whether prokaryotic or eukaryotic, have a membrane that envelops the cell, regulates what moves in and out (selectively permeable), and maintains the electric potential of the cell. Inside the membrane, the cytoplasm takes up most of the cell's volume. All cells (except red blood cells which lack a cell nucleus and most organelles to accommodate maximum space for hemoglobin) possess DNA, the hereditary material of genes, and RNA, containing the information necessary to build various proteins such as enzymes, the cell's primary machinery. There are also other kinds of biomolecules in cells.

Plasma Membrane:-

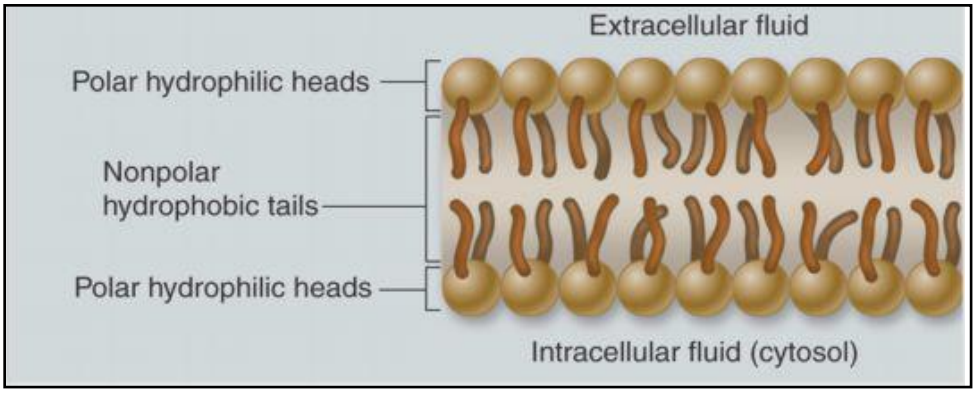
The cell membrane, or plasma membrane, is a biological membrane that surrounds the cytoplasm of a cell. The cell membrane is very important, because it works as a selective filter that allows only certain things to come inside or go outside the cell, it act as a body guard for our body. It can maintain a stable and healthy environment for the cell.
In animals, the plasma membrane is the outer boundary of the cell, while in plants and prokaryotes it is usually covered by a cell wall.

Its mainly consist of **Lipids**, **Proteins** and **Carbohydrates**

Membrane Lipid

Cell membrane made mostly from a double layer of phospholipids, both the interior of the cell and the area surrounding the cell is made up of water or similar aqueous solution. Consequently, phospholipids orient themselves with respect to the water and with each other so that the hydrophilic ("water loving") head groups are grouped together and face the water, and the hydrophobic ("water fearing") tails turn away from the water and toward each other.
The membrane is semi-permeable, and selectively permeable, in that it can either let a substance (molecule or ion) pass through freely, pass through to a limited extent or not

pass through at all. Cell surface membranes also contain receptor proteins that allow cells to detect external signaling molecules such as hormones



At least 10 different types of lipids are commonly found in cell membranes. Each type of cell or organelle will have a different percentage of each lipid, protein and carbohydrate.
Major classes:-
1-Phospholipids
2-Glycolipids
3-Fatty acids
4-Phosphoglycerides
5-Sphingolipids
6-Sterols

Hence, the layer is called a phospholipid bilayer, or sometimes a **fluid mosaic membrane** (fluid mosaic model state that the phospholipid bilayer behaves like a fluid more than solid.
Cholesterol gives membrane firmness and prevent freezing in low temperature**.**

Membrane proteins
Embedded within this membrane is a macromolecular structure called the porosome, protein molecules act as channels and pumps that move different molecules into and out of the cell. The membrane is semi-permeable, and selectively permeable, in that it can either let a substance (molecule or ion) pass through freely, pass through to a limited extent or not pass through at all. Cell surface membranes also contain receptor proteins that allow cells to detect external signaling molecules such as hormones.

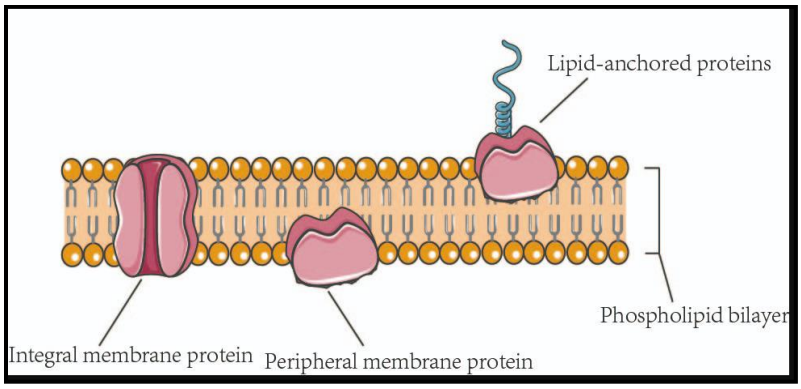
Types of membrane proteins:

1) Integral membrane proteins

Proteins which penetrate the hydrophobic core. These may include integrins, cadherins, desmosomes, clathrin-coated pits, caveolaes, and different structures involved in cell adhesion. Integral proteins are the most abundant type of protein to span the lipid bilayer.

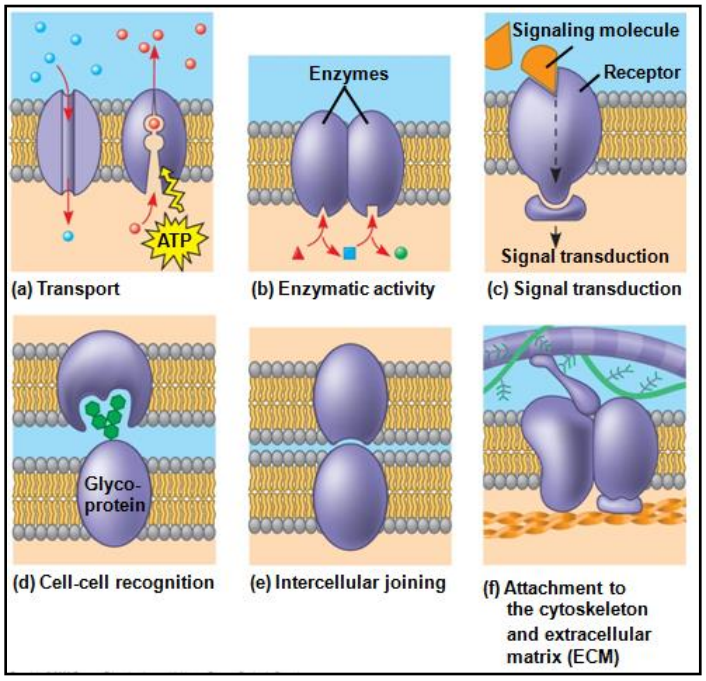
2) Peripheral membrane proteins

Peripheral proteins are proteins that are bounded to the surface of the membrane by electrostatic interactions and hydrogen bonding with the hydrophilic phospholipid heads. Many of these proteins can be found bounded to the surfaces of integral proteins on either the cytoplasmic side of the cell or the extracellular side of the membrane.



Six major functions of membrane proteins:

1. **Transport:-** Transport proteins are used in various ways to move substances back and forth across the cell membrane
2. **Enzymatic activity:-** When a protein built into the membrane may be an enzyme with its active site exposed to substances in the adjacent solution
3. **Signal transduction:-** Transmission of molecular signals from a cell's exterior to its interior
4. **Cell-cell recognition:-** Cell's ability to distinguish one type of cell from another When some glycoproteins (proteins bonded to short chains of sugars) serve as identification tags that are specifically recognized by other cells
5. **Intercellular joining:-** Proteins on adjacent cells hook together, briefly, for cell interaction/sharing
6. **Attachment to cytoskeleton and extracellular matrix:-** Maintains cell shape and stabilizes cytoskeleton



Membrane Carbohydrate

The Fluid Mosaic Model describes membranes as a fluid lipid bilayer with floating proteins and carbohydrates.

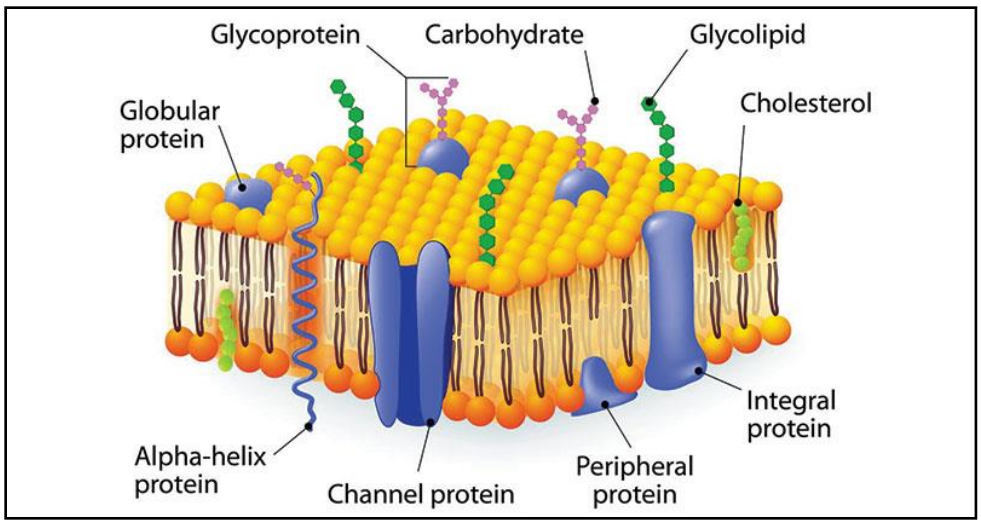
Membrane carbohydrates are chemically bound to lipids and protein as glycolipids and glycoproteins.

However, some membrane carbohydrates are part of proteoglycans that insert their amino acid chain among the lipid fatty acids.

Types of Membrane Carbohydrates

Cells recognize each other by binding to surface molecules, often **carbohydrates**, on the plasma membrane

Membrane carbohydrates may be covalently bonded to lipids (forming **glycolipids**) or more commonly to proteins (forming **glycoproteins**)



Functions of Membrane Carbohydrates

Membrane carbohydrates perform two main functions:

1- Participate in cell recognition and adhesion, either cell-cell signalling or cell-pathogen interactions.

-For instance, blood groups are determined by cell surface carbohydrates of erythrocytes, and they also have the ability to trigger immunological responses.

-After an infection, endothelial cells near the injured tissue expose a type of proteins, known as selectins, in their plasma membranes. They recognize and bind carbohydrates of the plasma membrane of lymphocytes that go through the bloodstream. In this way, lymphocytes get attached to the blood vessel walls, can cross the endothelium and move to the infection focus.

2- They have a structural role as physical barrier.

3-Carbohydrates as recognition molecules are also important during embryonic development.