STRUCTURE OF THE CELL

Each cell is formed by a cell body and a cell membrane or plasma membrane that covers the cell body. The important parts of the cell are (Fig. 1-1)

a. Cell membrane
b. Nucleus
c. Cytoplasm with organelles

CELL MEMBRANE

The cell membrane is a protective sheath that envelops the cell body. It separates the fluid outside the cell called extracellular fluid (ECF) and the fluid inside the cell called intracellular fluid (ICF). It is a semipermeable membrane and allows free exchange of certain substances between ECF and ICF (Fig. 1-2).

COMPOSITION OF CELL MEMBRANE

The cell membrane is composed of three types of substances:

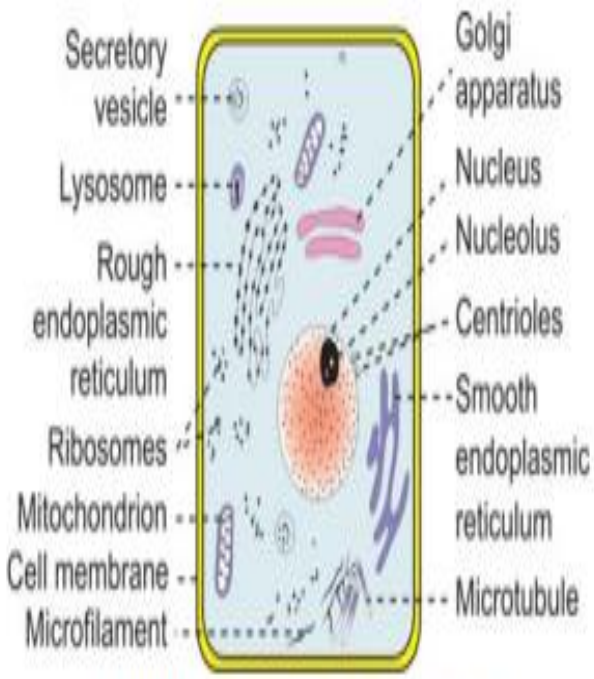

FIGURE 1-1: Structure of the cell

1. Proteins (55%)
2. Lipids (40%)
3. Carbohydrates (5%).

STRUCTURE OF CELL MEMBRANE

The cell membrane is a unit membrane having the 'fluid mosaic model' i.e., the membrane is a fluid with mosaic of proteins (mosaic means pattern formed by arrangement of different colored pieces of stone, tile, glass or other such materials) lipids and carbohydrates. The electron microscopic study reveals three layers in the cell membrane namely, one electron lucent lipid layer in the center and two electron dense layers on either side of the central layer. Carbohydrate molecules are found on the surface of the cell membrane.

Lipid Layer of Cell Membrane

It is a bilayered structure formed by a thin film of lipids. It is fluid in nature and the portions of the membrane along with the dissolved substances move to all areas of the cell membrane. The major lipids are:

a. Phospholipids
b. Cholesterol

1. *Phospholipids*

The phospholipid molecules are formed by phosphorus and fatty acids. Each phospholipid molecule resembles the headed pin in shape (Fig. 1-3). The outer part of the phospholipid molecule is the head portion which is water soluble (hydrophilic) and the inner part is the tail

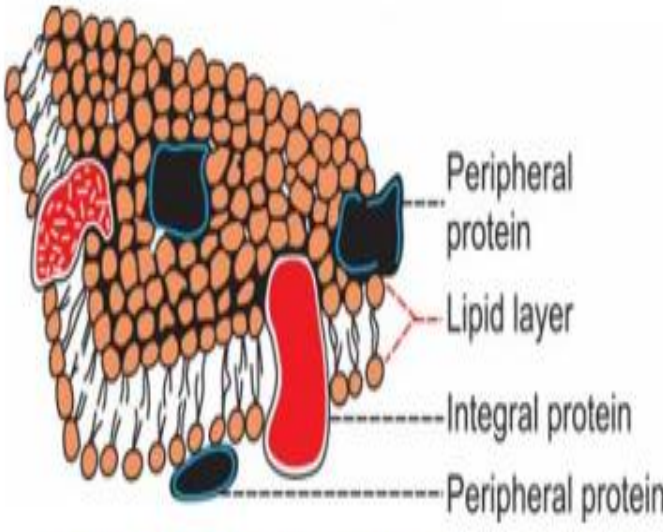

FIGURE 1-2: Diagram of the cell membrane

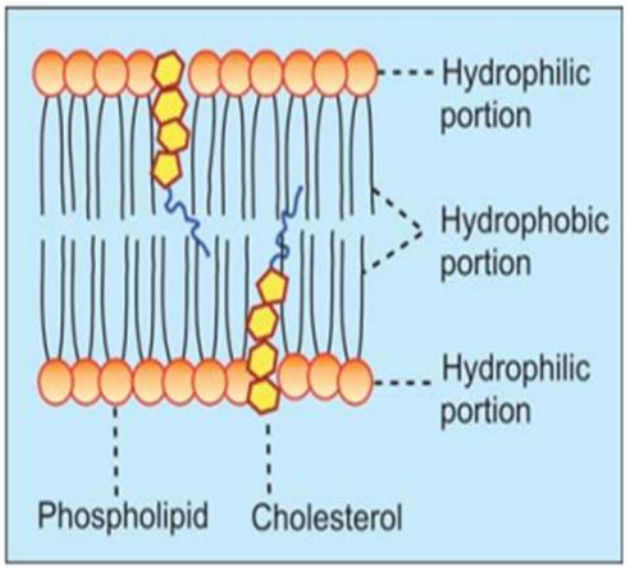

FIGURE 1-3: Lipids of the cell membrane

portion that is not soluble in water (hydrophobic). The hydrophobic tail portions meet in the center of the membrane. The hydrophilic head portions of outer layer face the ECF and those of the inner layer face the cytoplasm.

2. *Cholesterol*

The cholesterol molecules are arranged in between the phospholipid molecules. As phospholipids are soft and oily in nature, cholesterol helps to "pack" the phospholipids in the membrane and maintain the structural integrity of cell membrane.

Functions of lipid layer

The lipid layer is semi permeable in nature and allows only the fat soluble substances like oxygen, carbon dioxide and alcohol to pass through it. It does not allow the water soluble materials like glucose, urea and electrolytes to pass through it.

Protein Layers of the Cell Membrane

The protein layers of the cell membrane are the electron dense layers situated on either side of the central lipid layer. The protein substances present in these layers are mostly glycoproteins. These protein molecules are classified into two categories:

a. Integral proteins

b. Peripheral proteins

1. *Integral proteins*

The integral proteins, also known as transmembrane proteins, are tightly bound with the cell membrane. These protein molecules pass through the entire thickness of the cell membrane from one side to the other side.

2. *Peripheral proteins*

The peripheral proteins, also known as peripheral membrane proteins do not penetrate the cell membrane but are embedded partially in the outer and inner surfaces of the cell membrane. These protein molecules are loosely bound with the cell membrane and so dissociate readily from the cell membrane.

Functions of protein layers

Functionally, the proteins in the cell membrane exist in different forms such as integral proteins, channel proteins, carrier proteins etc.

1. *Integral proteins* provide structural integrity of the cell membrane
2. *Channel proteins* provide route for diffusion of water soluble substances like glucose and electrolytes
3. *Carrier proteins* help in transport of substances across the cell membrane
4. *Receptor proteins* serve as receptor sites for hormones and neurotransmitters
5. *Enzymes:* some of the protein molecules form the enzymes which control chemical reactions within the cell membrane
6. *Antigens:* Some proteins act as antigens and induce the process of antibody formation

Carbohydrates of the Cell Membrane

Carbohydrate molecules form a thin loose covering over the entire surface of the cell membrane called glycocalyx. Some carbohydrate molecules are attached with proteins and form glycoproteins and some are attached with lipids and form glycolipids.

Functions of carbohydrates

1. The carbohydrate molecules are negatively charged and do not permit the negatively charged substances to move in and out of the cell.
2. The glycocalyx from the neighboring cells helps in the tight fixation of cells with one another.
3. Some of the carbohydrate molecules form the receptors for some hormones.

FUNCTIONS OF CELL MEMBRANE

1. *Protective function:* Cell membrane protects the cytoplasm and the organelles present in the cytoplasm.
2. *Selective permeability:* Cell membrane acts as a semipermeable membrane which allows only some substances to pass through it and acts as a barrier for other substances.
3. *Absorptive function:* Nutrients are absorbed into the cell through the cell membrane.
4. *Excretory function:* Metabolites and other waste products from the cell are excreted out through the cell membrane.
5. *Exchange of gases:* Oxygen enters the cell from the blood and carbon dioxide leaves the cell and enters the blood through the cell membrane.
6. *Maintenance of shape and size of the cell:* Cell membrane is responsible for the maintenance of shape and size of the cell.