PUC 1ST YEAR –SEMESTER-2

UNIT I: Cell Biology

Module No 3: Cell wall and cell membrane structure and function

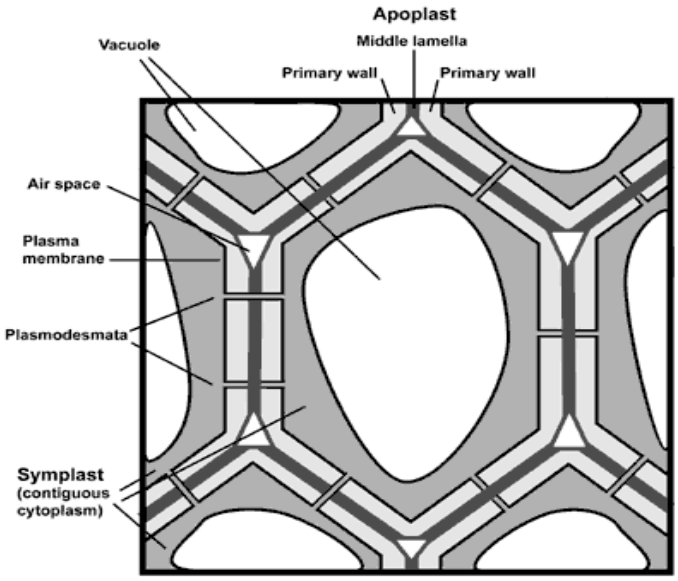
Every cell is enclosed by a layer known as cell membrane. The cell membrane consists of either living or both living and non-living matters. In both the animal and plant-cells cell membranes are present. However, the membrane enclosing the cytoplasm is called plasma membrane. In many plants, in addition to plasma membrane, there is an outer most layer of non-living matter, the cell wall.

I. Cell wall:

The cell wall is thick, non-living, rigid outer covering that surrounds all plant cells. It is absent in animal cells. It consists of three distinct regions 1.Middle lamella 2. Primary cell wall and 3. Secondary cell wall

1. **Middle lamella**: It is the outermost and the first formed layer of the cell wall. This layer joins the adjoining cells. It is made of calcium and magnesium pectates.
2. **Primary cell wall**: It lies next to middle lamella. It is thin and permeable layer made up of cellulose, hemi cellulose and other poly saccharides.
3. **Secondary cell wall**: It lies inner to primary cell wall. It is thick and permeable made up of cellulose, lignin, suberin or cutin etc. This wall is responsible for providing mechanical support.

Details of cell walls of plant in front view



II. Plasma membrane:

Plasma membrane is the term used for the cell membrane which is present in all the cells of the plants and animals. This membrane surrounds the cytoplasm. In animal cell, it is single and is the outer most limiting membrane. However in plant cells, it is followed by another layer of the cell wall.

Plasma membrane is living, thin, elastic and porous, semipermeable membrane. It is also found around the cell organelles. It is composed of a double layer of phospholipids and proteins.

Structure of plasma membrane:

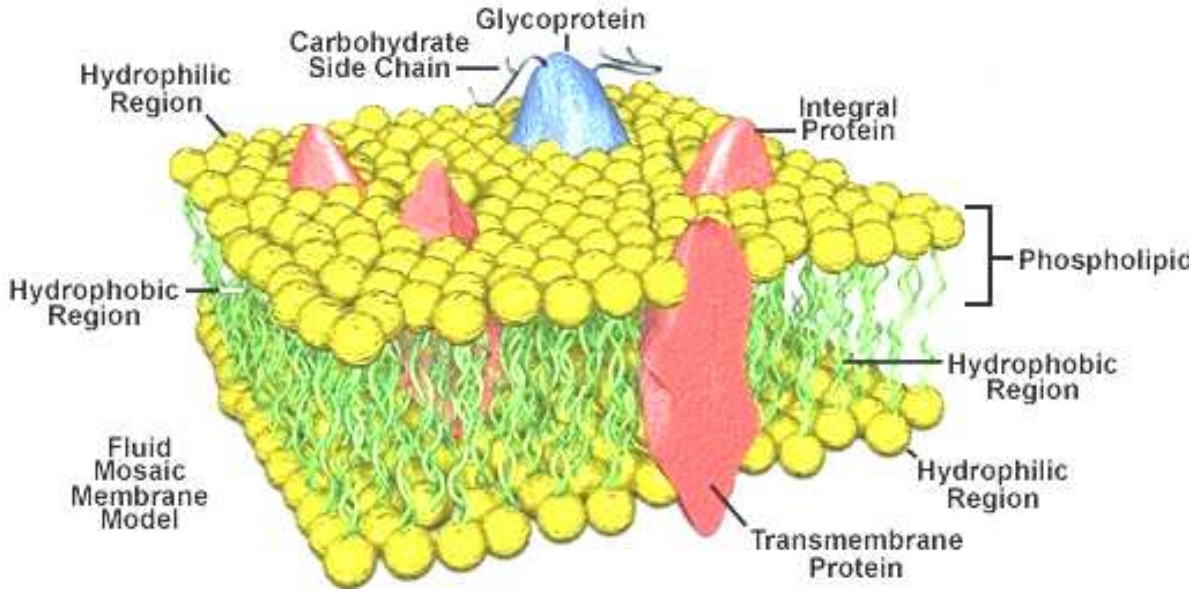
Many theories and models are proposed to explain the molecular structure of plasma membrane. Out of which Fluid Mosaic model proposed by Singer and Nicolson (1972) is the most widely accepted theory at present.

Fluid Mosaic Model:

According to this theory the biological membranes are semi fluid in nature. The plasma membrane is made of a phospholipid bilayer, with their hydrophobic

fatty acid tails are attracted to each other and oriented away from the water or aqueous environment while the hydrophilic phosphate groups are on the outside and are attracted to the watery environment of the cytoplasm or the outside of the cell. Protein molecules occur as separate particles asymmetrically arranged in a mosaic pattern. The proteins molecules are arranged in two ways. Some are floating like icebergs between the phospholipids molecules. These are called integral proteins or intrinsic proteins. These molecules and phospholipids molecules cannot move freely within the membrane. Some protein molecules are arranged on the outside. These are called as extrinsic or peripheral proteins. Thus lipids are not capped with a solid protein coating so leaving many portions of the lipid bare and exposed to the extra and intra cellular environments. It is through these bare areas that lipid soluble molecules pass. This arrangement of protein and lipid molecules help the membrane to regulate the entry and exit of substances through it. A part from proteins, a small quantity of glycolipids, cholesterol and carbohydrates are also found in the fluid matrix.

FLUID MOSAIC MODEL SHOWING HYDROPHILIC AND HYDROPBOBIC LAYERS



Functions of plasma membrane:

1. It provides mechanical support, provides stability and maintain its shape.
2. The main function of plasma membrane is to regulate flow of ions and molecules of various substances into and out of the cell. Different methods
   of transport are a) osmosis b) diffusion c) facilitated diffusion d) active transport e) exocytosis etc.

Check Points:

- Cell membrane is present both in plants and animals .Cell membrane is covered by cell wall in plants.
- Cell wall is absent in animals.
- The main structural component of cell wall is cellulose. It also contains hemi cellulose, pectin and glyco protein.
- Middle lamella joins the adjacent cells.
- Plasma membrane is living, porous and semi permeable membrane.
- Fluid mosaic model proposed by singer and Nicolson is the accepted theory at present, which explain the structure of plasma membrane.

Multiple choice Questions:

1. This cell structure separates the interior of the cell from its surroundings, and regulates the movement of particles in and out of the cell.
   a. Cytoplasm **B. Cell membrane** C. Lysosome D. Cell wall
2. The cell wall is best described as a tough, rigid structure found in
   a. Plant cells that surrounds the cell membrane.
   b. Animal cells that surrounds the cell membrane.
   c. Animal cells located just inside the cell membrane.
   d. Plant cells located just inside the cell membrane.

3. Fluid mosaic model proposed by Singer and Nicholson explains about:
   A. Plasma membrane with proteins floating in bilipid layer
   B. Plasma membrane with bilipid layer sandwiched between proteins
   C. LPS layer of bacteria
   D. Structure of cell wall
4. The main function of plasma membrane is to
   A. Regulate the flow of materials into and outside the cell
   B. Provide support
   C. Maintain shape and size
   D. All the above
5. Plasma membrane is mainly made of
   A. Lipids and carbohydrates
   B. Proteins and starch
   C. Fats and starch
   D. Proteins and phospholipids
6. Which one of the following layers is responsible for holding the adjoining cells together?

A. **Middle lamella** B. Primary cell wall C. Secondary cell wall D. All

7. One of the following functions of primary cell wall
   A. Mechanical support
   B. Maintain cell shape
   C. Protect against pathogens
   D. All

8. Fluid mosaic model to explain the structure of plasma membrane is proposed by
   A. Davson and Danielli
   B. Singer and Nicholson
   C. Robert Brown
   D. Schwann and Schledien

9. The rigidity (support) of a plant cell is primarily due to the presence of the
   A. Cytoskeleton B. Cell sap C. Cell membrane **D. Cell wall**

10. Which structure permits the entry and exit of dissolved materials of an animal cell?
    A. Tonoplast B. Nuclear membrane C. Cell wall **D. Cell membrane**

11. This is not the function of plasma membrane
    A. Is a boundary layer of cell to hold the cytoplasm
    B. Regulate the flow of ions.
    C. Selective permeability
    D. Intercellular transport

Short Answer Questions:

1. Give an account of fluid mosaic model for the structure of membranes?
2. Explain briefly the functions of cell wall?
3. Explain the functions of plasma membrane?

Long Answer Questions:

1. Describe the structure and functions of cell wall?
2. Explain the Fluid Mosaic model to describe the structure of plasma membrane?