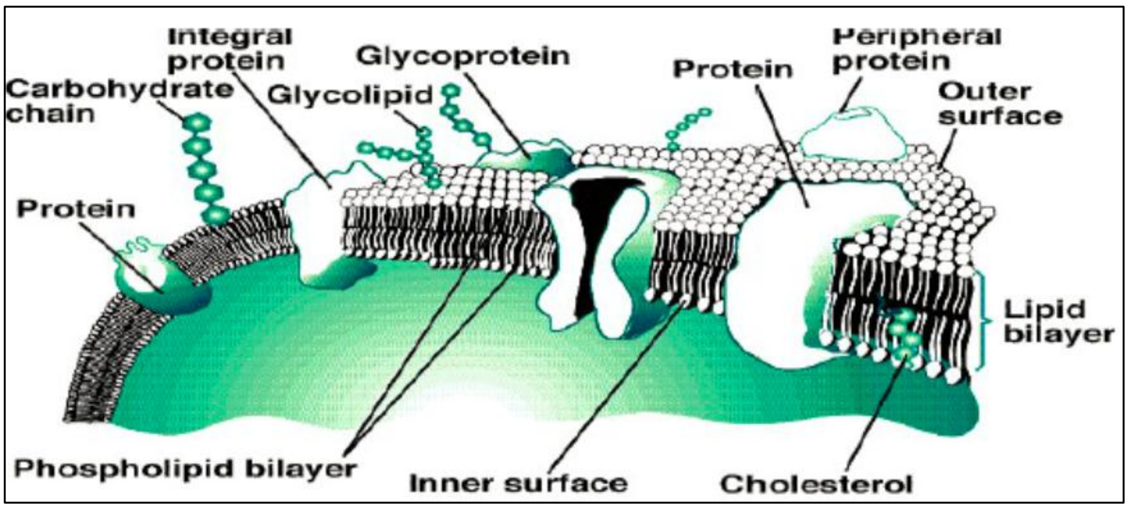
The Cell Membrane

A thin membrane surrounds every living cell, delimiting the cell from the environment around it. Enclosed by this cell membrane (also known as the plasma membrane) are the cell's constituents, often large, water-soluble, highly charged molecules such as proteins, nucleic acids, carbohydrates, and substances involved in cellular metabolism. Outside the cell, in the surrounding water-based environment, are ions, acids, and alkalis that are toxic to the cell, as well as nutrients that the cell must absorb in order to live and grow. The cell membrane, therefore, has two functions: first, to be a barrier keeping the constituents of the cell in and unwanted substances out and, second, to be a gate allowing transport into the cell of essential nutrients and movement from the cell of waste products.

Chemical Composition and Membrane Structure

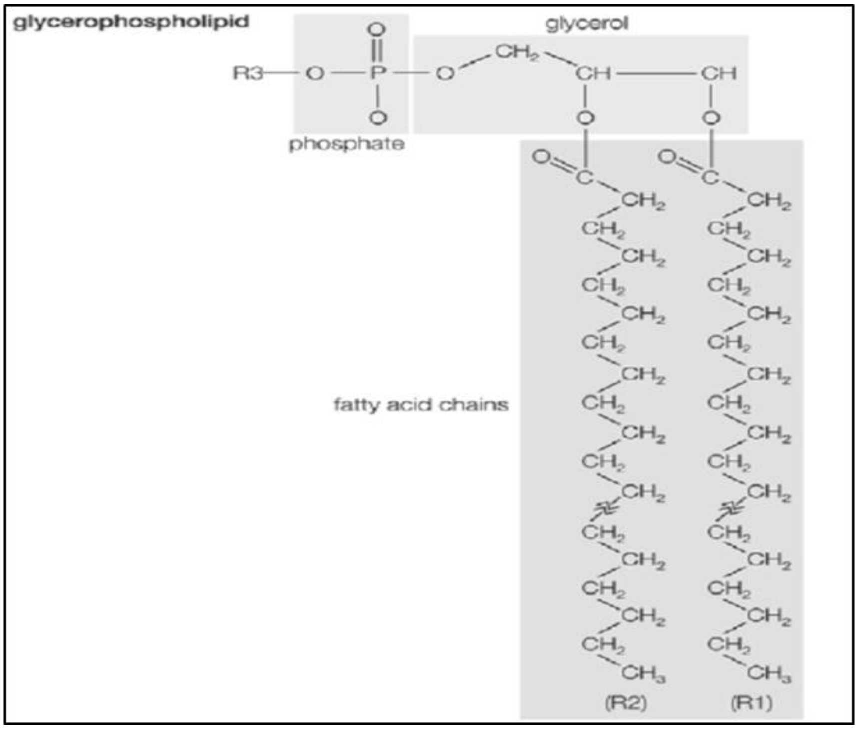
Membranes are composed of proteins and fatty-acid-based lipids. Membranes actively involved in metabolism contain a higher proportion of protein. Thus, the membrane of the mitochondrion, the most rapidly metabolizing organelle of the cell, contains as much as 75 percent protein, while the membrane of the Schwann cell, which forms an insulating sheath around many nerve cells, has as little as 20 percent protein.



Cell membrane structure

Membrane Lipids

Membrane lipids are principally of two types, phospholipids and sterols (generally cholesterol). Both types share the defining characteristic of lipids—they dissolve readily in organic solvents—but in addition they both have a region that is attracted to and soluble in water. This "amphiphilic" property (having a dual attraction; i.e., containing both a lipid-soluble and a water-soluble region) is basic to the role of lipids as building blocks of cellular membranes. Phospholipid molecules have a head (often of glycerol) to which are attached two long fatty acid chains that look much like tails. These tails are repelled by water and dissolve readily in organic solvents, giving the molecule its lipid character. To another part of the head is attached a phosphoryl group with a negative electrical charge, and to this group in turn is attached another group with a positive or neutral charge. This portion of the phospholipid dissolves in water, thereby completing the molecule's amphiphilic character. In contrast, sterols have a complex hydrocarbon ring structure as the lipid-soluble region and a hydroxyl grouping as the water-soluble region.



General structure formula of a glycerol phospholipid

Membrane Proteins

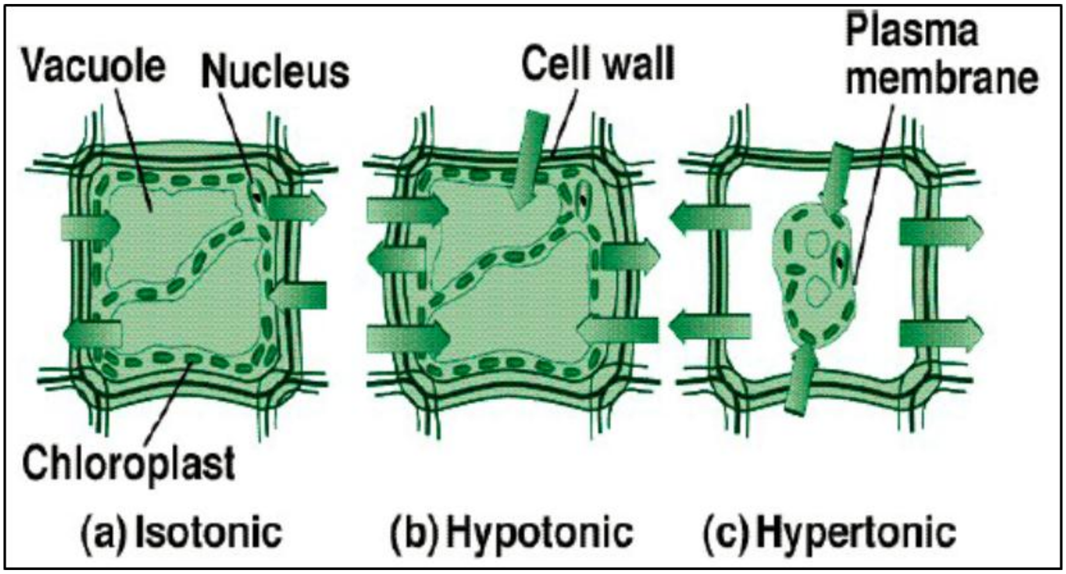
Membrane proteins are also of two general types. One type, called the extrinsic proteins, is loosely attached by ionic bonds or calcium bridges to the electrically charged phosphoryl surface of the bilayer. They can also attach to the second type of protein, called the intrinsic proteins. The intrinsic proteins, as their name implies, are firmly embedded within the phospholipid bilayer. Almost all intrinsic proteins contain special amino acid sequences, generally about 20- to 24-amino acids long, that extend through the internal regions of the cell membrane. Most intrinsic and extrinsic proteins bear on their outer surfaces side chains of complex sugars, which extend into the aqueous environment around the cell. For this reason, these proteins are often referred to as glycoproteins. Some glycoproteins are involved in cell-to-cell recognition.

Plasma Membrane Transport

The membrane allows selective permeability of molecules in and out of the cell. For example, a plant cell, placed in an isotonic solution has equal movement of molecules in and out of the cell. When the plant cell is placed in pure water (distilled water or hypotonic solution), water molecules diffuse into the cell much more than out of the cell, the cell becomes turgid. When the plant cell is placed in a 1.5% or higher salt solution (hypertonic solution), water molecules diffuse out of the cell much more than into the cell, the cell shrinks, this is known as plasmolysis. Plant cells remain in the same physiological state when placed in a solution isotonic (0.9% salt solution) to their cells. The transport of molecules across the membrane could be passive, where no energy is required or active where energy in the form of ATP is required for molecules to be transported across the membrane.

Passive transport system utilizes various processes, among them include: simple diffusion, and osmosis, and filtration, where molecules move along the concentration gradient.

Osmosis: Movement of water molecules from higher to lower concentrations through a selectively permeable membrane.



Osmosis / Plasmolysis in cell

Simple Diffusion: Movement of molecules from higher to lower concentrations.

Filtration: Movement of molecules can occur through a selectively permeable membrane with the help of a pressure gradient.

Active transport processes include phagocytosis (cell eating processes), pinocytosis (cell drinking processes). **Phagocytosis** can be divided into endocytosis (cell engulfing solid materials or other cells), and exocytosis (cell secreting molecules, or pinching off of cellular fragments). Molecules can move against the concentration gradient in this process.

The Cell walls of plants

The plant cell wall is a specialized form of extracellular matrix that surrounds every cell of a plant and is responsible for many of the characteristics distinguishing plant cells from animal cells. Although often perceived as an inactive product serving mainly mechanical and structural purposes, the cell wall actually has a multitude of functions upon which plant life depends. Such functions include (1) providing the protoplast, or living cell, with mechanical protection and a chemically buffered environment, (2) providing a porous medium for the circulation and distribution of water, minerals, and other small nutrient molecules, (3) providing rigid building blocks from which stable structures of higher order, such as leaves and stems, can be produced, and (4) providing a storage site of regulatory molecules that sense the presence of pathogenic microbes and control the development of tissues.

The cell wall is made up of 2 layers: primary wall and the secondary wall. In many plant cells can be found cellulose, lignin and other polysaccharides. Lignin a tough plant tissue, it provides strength to plant and also acts as a protective tissue to plants. Plant cell wall contains pits, which are pores that allow passage of molecules from cell to cell. Between cells are cytoplasmic connections known as **Plasmodesmata** (plasmodesma, singular). A middle lamella (made up of sticky substances secreted by the cell in the form of pectin) is usually present between adjacent cell walls.

-Lignin *is the general name for a diverse group of polymers of aromatic alcohols.*
-Pectin *class of plant cell wall polysaccharide.*
-Cutin *is the major component of the cuticle, the waxy, water-repelling surface layer of cell walls exposed to the environment aboveground. By reducing the wettability of leaves and stems—and thereby affecting the ability of fungal spores to germinate—it plays an important part in the defense strategy of plants.*
-Suberin *serves with waxes as a surface barrier of underground parts. Its synthesis is also stimulated in cells close to wounds, thereby sealing off the wound surfaces and protecting underlying cells from dehydration.*

Cell Wall Proteins

Although plant cell walls contain only small amounts of protein, they serve a number of important functions.

1. Extensin is a prominent example of glycoprotein uncertain function may be structural.
2. Enzyme: in addition to the structural proteins, cell wall contains a variety of enzymes help protect plants against fungal pathogens by breaking fragments off of the cell walls of the fungi. The fragments in turn induce defense responses in underlying cells. The softening of ripe fruit and dropping of leaves in the autumn are brought about by cell wall-degrading enzymes.