# 1.3. Plasma membrane

- Plasma membrane forms the outermost boundary of the living cell and functions as an active interface between the cell and its environment. In this capacity **plasma membrane controls the transport of molecules into and out of the cell, transmits signals from the environment to the cell interior, participates in the synthesis and assembly of cell molecules and provides physical links between elements of the cytoskeleton and extracellular matrix.**

- In conjunction with specialized domains of the ER, the plasma membrane produces **plasmodesmata**, **membrane tubes** that cross cell walls and **provide direct channels of communication between adjacent cells.**
- As a result of these plasmodesmal connections, **all the living plant cells of the individual plant share a physically continuous plasma membrane. This contrasts sharply with situation in animals,** where virtually every cell has a separate plasma membrane.

- Plant and algae cells communicate with each other though they are surrounded by cell walls via plasmodesmata. They are cytoplasmic channels that pass through the cell wall and bind the cytoplasm of neighboring cells together. Nearly all of the plant cells are bound to neighboring cells with plasmodesmata.

- Plasmodesmata are not just open channels. The inner parts of these channels are covered with cell membrane along the cell wall and a central band is found at the middle that derive from endoplasmic reticulum. Some proteins are found in the space between the cells. Ions and big molecules like nucleic acids are determined to pass to the neighboring cell via plasmodesmata.

- Therefore, these channels are important for the development of the plant and the root tissue. When the plants are wounded, plasmodesmata in that region are occluded with a polysaccharide type filling material called callose, cytoplasm leakage from neighboring cells and the entrance of pathogenic microorganisms are prevented. Callose also provides a scaffold for repairing the damaged cell membrane and wall, or reinforcing the wall itself.

- Another important difference between plants and animals is the fact that plant cells are normally under **turgor pressure, which forces the plasma membrane tightly against the cell wall.**

## 1.4. Endoplasmic reticulum

- Endoplasmic reticulum (ER) is the most extensive, versatile and adaptable organelle in eukaryotic cells. It consist of a three-dimensional network of continuous tubules and flattened sacs that underlie the plasma membrane, course through the cytoplasm and connect to the nuclear envelope but remain distinct from the plasma membrane.

- Endoplasmic means «within the cytoplasm» and reticulum means «net». In plants, the principal functions of ER include synthesizing, processing and sorting protein targeted to membranes, vacuoles or the secretory pathway as well as adding N-linked glycans to many of these proteins and synthesizing a diverse array of lipid molecules. ER also provides anchoring sites for the action filament bundles that drive cytoplasmic streaming and plays a critical role in regulating the cytosolic concentrations of calcium, which influence many other cellular activities.

- Eukaryotic cells have 2 types of ER: rough ER and smooth ER. These 2 types of ER are physically bound to each other at some special points, however they both have different functions.

- In smooth ER, fatty acids and phospholipids are used in the making of membranes. In addition, SER is the place for biodegradation of toxins and conversion of them into less harmful molecules. These molecules can be expelled from the cell.

- The surface of rough endoplasmic reticulum (RER) is covered with **ribosomes**. Ribosomes are small spherical structures consisting of proteins and RNA molecules.

- Ribosomes are found on RER or as free in eukaryotic cells. Their function is to bind free amino acids to each other and form proteins. The proteins that will be sent outside the cell are produced by the ribosomes found on the surface of RER. These proteins have a special amino acid sequence at the end. This small sequence is the signal demonstrating that the synthesis starts at the free ribosomes. If this special sequence appears when protein synthesis starts, then the ribosome is attached to the RER and protein synthesis continues into the ER tubes through the protein channels found in the RER.

- When proteins enter into RER, sugars (oligosaccharides) may also be attached to them; thus proteins become glycoproteins. Then glycoproteins are directed to the vicinity of Golgi apparatus by RER for other chemical processes to take place. Glycoproteins leave the RER in small, spherical vesicles.

# 1.5. Golgi apparatus

- The term Golgi apparatus refers to the complement of Golgi stacks and associated trans-Golgi networks (TGNs) within a given cell. Each membranous sack is called **cistern**. Golgi apparatus occupies **a central position in the secretory pathway, receiving newly synthesized proteins and lipids from the ER and directing them to either the cell surface or vacuoles.** Golgi apparatus is involved in many other cell functions. The function of Golgi is to produce new cell materials, make modifications in the products and send the products out of the cell or distribute them within the cell.

- Typically , the middle part of the cisterns are thin, and the ends are swollen. The inner side of the cisterna sac at the edge towards the inner side is called the «**cis face (binding side**)». Proteins that recognize the vesicles coming from the ER and bind to them are present at the cis side. Spherical small vesicles fuse with the cis side with the help of these proteins. By this way, glycoproteins that have been synthesized in ER reach the Golgi.

- The outer side of the cistern that is found at the side facing the cell membrane is known as the «**trans face (secretory face)**». The distribution of materials produced in Golgi apparatus is performed with the help of vesicles detaching from the trans face.

- Different enzyme groups are found in each cistern. Materials transported in the Golgi move towards one direction through the cistern sacs during this process and go through different chemical changed in each vesicle in an orderly way. Golgi enzymes shorten the oligosaccharides that are attached to protein in ER or reorganize them. These changes modify the related proteins to perform their specialized functions within the cell.
- In addition to these functions, Golgi also produces non-cellulosic cell wall polysaccharides like **pectin** and **hemicellulose**.

# 1.6. Vacuoles

- Vacuoles, fluid-filled compartments (the liquid part of the vacuole is called **tonoplasm**) encompassed by a membrane called **tonoplast (=vacuolar membrane)**, are conspicuous organelles of most plant cells. They usually occupy more than 30% of the cell volume. In large, mature cells, the space occupied by the vacuole compartments can approach 90% of the cell volume.

It is an organelle full of fluid and is the place where substances found within the cell fluid are gathered (crystals, tannins, tartaric acid, malic acid, minerals, pigments, proteins, lipidic substances).

Vacuole also regulates the water equilibrium of the cell. Vacuole takes water from the outside or release water to the outside according to osmotic pressure.

- Some of the important functions of vacuoles:

- Isolating materials that might be harmful or a threat to the cell
- Containing waste products
- Containing water in plant cells
- Maintaining internal hydrostatic pressure or turgor within the cell
- Maintaining an acidic internal pH
- Exporting unwanted substances from the cell
- Allows plants to support structures such as leaves and flowers due to the pressure of the central vacuole