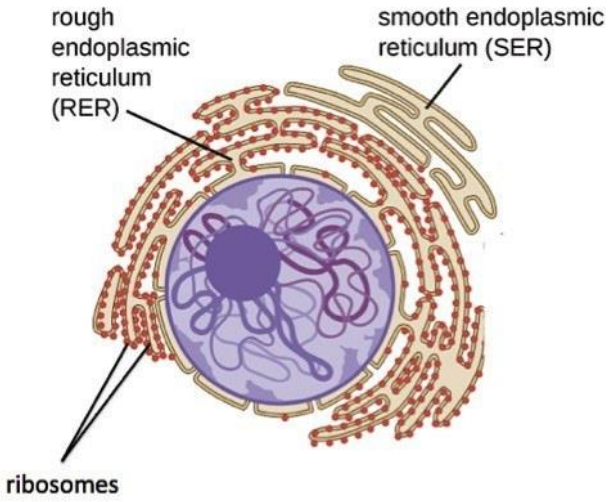
**Endomembrane system-** consist of Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles.

## Endoplasmic Reticulum are the tubular structure scattered in the cytoplasm.

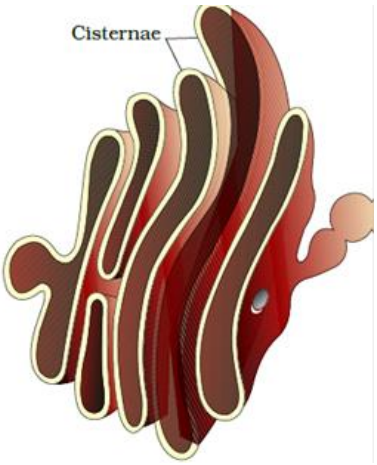
Made up of membranous channels and flattened vesicles scattered in form of network.
Absent in prokaryotes but is present in all eukaryotic cells except germinal cells and mature human RBCs.
Divides the intracellular space into two main compartments
(i) Luminal (inside ER) compartment
(ii) Extra-luminal (cytoplasm) compartment




1. **Rough endoplasmic reticulum**- continuous with outer membrane of nucleus.
   Bears ribosomes on its surface.
   Involved in protein synthesis and secretion.
2. **Smooth endoplasmic reticulum** does not bear ribosomes.
   Involved in lipid synthesis and steroidal hormones.

**Endoplasmic reticulum possess the following functions**
(i) It provides support to the cytoplasmic matrix.
(ii) Helps in the rapid intracellular transport of the material.
(iii) ER membranes contains a variety of enzymes for various metabolic processes, e.g., ATPase, phosphatases, etc.

## Golgi apparatus -observed by Camillo Golgi in 1898.




- Consist of many flat, disc-shaped sacs or **cisternae** stacked parallel to each other.
- Found in all cells except prokaryotes (i.e., PPLO, bacteria, cyanobacteria) and some eukaryotes such as human RBCs, sieve tubes of plants, etc.
- Golgi apparatus performs the function of packaging of materials and its transportation.
- A number of protein synthesized by ribosomes are modified in cisternae of Golgi apparatus.
- Golgi apparatus is the site for synthesis of Glycoproteins and glycolipids.

They are concentrically arranged near the nucleus with two distinct faces
(i**) Cis face {forming face)** This is **convex** in shape that lies towards the cell membrane and receiving secretory materials through vesicles, released from the SER.
(ii) **Trans face (maturing face)** This is **concave** in shape that lies towards the nucleus and is responsible for releasing the material, which is being secreted by cis face and modified in the cisternae.

**Golgi apparatus possess the following functions**
(i) Formation of lysosomes & vesicles that contain proteins or enzymes
(ii) Packaging material.
(iii) Site for the formation of glycoproteins and glycolipids.
(iv) It helps in the production of complex carbohydrates other than glycogen and starch.
(v) It helps in the formation of cell wall.

## Lysosomes- Suicidal bags of the Cell

Membrane bounded vesicles that are produced by the Golgi apparatus. Rich in several hydrolytic enzymes helps in digestion of: Lipases - Lipids
Proteases - Protein
Carbohydrase - Carbohydrates
Optimally active at the acidic pH (less than 7).
These are called **suicidal bags** due to the presence of hydrolytic enzymes can digest whole cell during starvation.
**Autophagy:** A process by which a cell breaks down and destroys old, damaged, or abnormal proteins and other substances in its cytoplasm

**Lysosomes possess the following functions:**
(i) They digest the food contents (intra cellular digestion).

(ii) They also perform extracellular digestion that enter cell.
(iii) They also digest the old and useless organelles of the cells.
(iv) They also have functioning in cell division.

## Vacuoles

Vacuole are a large membranous sac found in the cytoplasm.
Fluid present inside vacuole- **Sap**
Store substances that are not essentially useful for the cell (like water, sap, excretory product and other materials).
Plant vacuoles contain not only water, sugars and salts but also contain pigments and toxic molecules and also occupy up to 90% of the volume of the cell.
The vacuole is bounded by a single membrane structure known as **tonoplast** which in plant cells, facilitates the transport of materials and some ions against the concentration gradient inside the vacuole.
Thus, the concentration of material is tend to be the higher in vacuole, than to be in the cytoplasm

**Following types of vacuoles are being found in different organisms**
(i) **Contractile Vacuole:** Help in osmoregulation and excretion in Amoeba, etc.
(ii) **Food Vacuole** Help in digesting & engulfing the food particles, i.e., by the fusion of lysosome and phagosome.
(iii) **Air vacuoles** store metabolic gases found in prokaryotic cell.
(iv) **Sap vacuoles** store mineral salts