Historical Account		
Scientist	**Year**	**Work**
Robert Hooke	1665	observing a slice of cork in which he saw honey comb like structure which he called cell
Leeuwenhoek	1674	Discovered free living cells in pond water by his improved microscope
Robert Brown	1831	Discovered nucleus in cell
Schleiden and Schwann	1838-1839	▪ Presented **cell theory** ▪ Schleiden discovered that all plants were composed of cells. ▪ Schwann discovered that all animals were composed of cells
Purkinje	1839	A cell is made of living substance called protoplasm. Coined the term '**Protoplasm**' for fluid substance of cell.
Rudolf Virchow	1855	Cell theory was expanded and concludes that all cells come from previously existing cells

Postulates of Cell Theory:

Cell theory was presented by Schleiden and Schwann. Accordingly, all plant and animal are composed of cell and the cell is the basic unit of life.

Modern cell Theory postulates that:

1 All living organisms are composed of one or more cells
- German botanist Matthais Schleiden in 1838
- German zoologist Theodor Schwann in 1839

2. A cell is mass of protoplasm containing nucleus and bounded by a cell membrane, in many cases by cell wall also
3. Cells are the basically alike in structure and metabolic activity
4. The function of an organism as a whole is result of the activities and interaction of the constituent cells
5. All cells come from previously existing cells (***'Omnis Cellula e Cellula'***)

▪ German physician **Rudolph Virchow** in 1855's

Characteristics of cell

* They have the ability to replicate independently
* They contain hereditary information
* Performs all the life sustaining activities on their own
* They show similar chemical composition and metabolic activities
* Every living cell has got division of labour, its cell organelles perform special function and constitute the basic building block thus cell is structural and functional unit of living organisms.
* On basis of number of cells present in the organism, they are classified into two type: (a) Unicellular Organism (b) Multicellular Organism

Unicellular Organism: A single cell comprises the whole organism. eg: Amoeba, Paramecium, Bacteria.
Multicellular Organism: Many cells group together to form tissues and organs which assumes different specific functions in the body in multicellular organism.

A cell is capable of carrying out all life processes, such as nutrition, excretion, respiration, etc. Hence it is called as the functional unit of life. The cell is the smallest unit of life and all the living beings are made up of cells. Hence a cell is called the structural unit of life.

Website: greyquanta.com email:greyquanta@gmail.com

Cell shape:

- Shape of cell depends upon the function they perform.
- The shape of cell may be variable or fixed.
- Variable shape occur in *Amoeba*, WBC etc.
- Fixed shape occur in most plant and animals.
- Cells may be diverse shapes such as polyhedral (8, 12 or 14 sides) spherical (e.g. eggs of mainly animals), spindle shaped (Smooth muscle fibres), elongated (e.g.

Cell Size:

- The size of different cells ranges between broad limits.
- Some plants and animals cells are visible to the naked eye.
- Most cells are visible only with microscope.
- The prokaryotic cells usually range between 1 to 10 μm.
- The eukaryotic cells usually range between 10 to 100 μm.
- *Amoeba proteus* may reach a diameter of 0.5 mm.
- **The smallest cells are those of *Mycoplasma laidlawiil (0.1μ in diameter)* or PPLO (pleura pneumonia like organism).**

Division of labour:

Unicellular organism: Every single cell posses certain specific component called cell organelles which perform specific function. Eg: Mitochondria generates energy, chloroplast prepares food.

Multicellular organism: Division of labour in multicellular organisms can be seen as these organism have different tissues and organs for performing some specific functions. Eg: Stomach for digestion, heart for pumping blood etc.

Cell organelles cannot be regarded as the basic unit of life because a single cell organelle can perform only one function like mitochondria generates energy but a single cell can perform all the function through the help of all its cell organelles.

Structural organisation of a cell

Component of cell:

Major components are –

A living part of cell

- **Cell membrane or Plasma membrane**
- **Nucleus**
- **Cytoplasm**

a) Mitochondrion
b) Endoplasmic reticulum
c) Ribosome (little dots)
d) Golgi apparatus (or "Golgi body")
e) Lysosome
f) Centrosome
g) Plastids

Non living part of cell

- **Cell wall**
- **Vacuoles**

Properties of Plasma membrane:

- The *'cell membrane'* (also known as the plasma membrane or cytoplasmic membrane) is a biological membrane that separates the interior of all cells from the outside environment
- It is present in both plant and animal cells.
- Plasma membrane is a living, thin, delicate elastic, selectively permeable membrane.
- The cell membrane is **selectively permeable** as it allows the entry and exit of only certain substance in and out of cell. In general, these membranes are impermeable to large molecules, such as ions, proteins and polysaccharides, while allows entry of some selected molecules like lipids as well as other small molecules like oxygen, carbon dioxide.
- It is made up of layer of protein and lipids (phospholipid bilayer) due to which the cell membrane are flexible.

Function of Plasma Membrane

- The cell membrane (or plasma membrane or plasmalemma) surrounds the cytoplasm of living cells, physically separating the intracellular components from the extracellular environment thus acts as **mechanical barrier.**
- The main function of plasma membrane is to regulate the movement of molecules inside and outside the cell
- Protect the cell from microorganism and foreign substance and injury.
- Helps to maintain the shape of the cell
- It maintains the individuality of cell

Transportation Across the membrane

Transport of substance across the membrane may take place with or without the expenditure of energy.

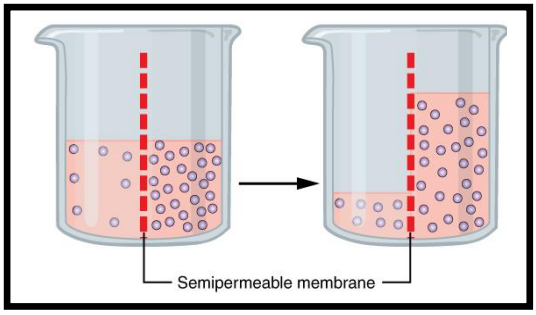
- Molecules in fluid move in response to **gradients**
- Movement across membranes occurs by both **passive transport** (without energy) and **active transport** (with energy).

Passive transport

Movement of substances down a concentration gradient and does not require energy. It is slow process and does not use carrier protein.

- **Bulk flow** is collective movement of substance in the same direction in response to force, such as pressure. Blood moving through a vessel is an example of bulk flow.
- **Diffusion:** Diffusion is the spontaneous movement of substance (solids, liquids and gases) from a region of higher concentration to lower concentration due to their random-motion, until they are evenly distributed throughout the available space. Eg: Exchange of oxygen and carbondioxide. Carbondioxide accumulates in higher concentration inside the cell. In the cells external environment, concentration of carbondioxide is lowered compared to inside the cell. Due to the difference in the concentration, CO_2 moves out of the cell by process of diffusion.
  Similarly oxygen enters the cell by the pocess of diffusion when the concentration of oxygen decreases inside the cell.

Osmosis



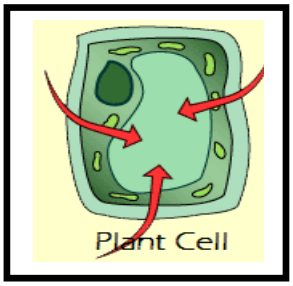
Osmosis is the spontaneous movement of water molecules **from the region of higher concentration of water (i.e. dilute solution) to the region of lower concentration of water (i.e. concentrated solution)** through a semi permeable membrane till the concentration on both the sides are equalised

Process of osmosis can be seen in cell placed in the solution of different concentration such as hypotonic solution, hypertonic solution and isotonic solution,

When the cell is immersed in water, the diffusion of water molecules from the outside into the cell takes place resulting in **endosmosis** (i.e. inward flow) and the reverse process is known as **exosmosis** (i.e. outward flow).

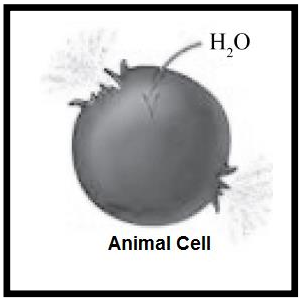
Hypotonic solution: The solution surrounding the cell has high water concentration as compared to inside of the cell. A hypotonic solution has a lower concentration of solutes and higher concentration of water surrounding it as compared to cytoplasm of cell.

In an attempt to balance the concentrations of solutes inside and outside the cell, water flows into the cell, and can cause it to burst.

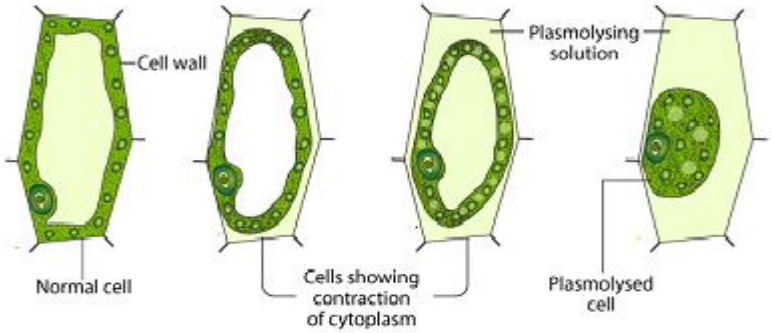


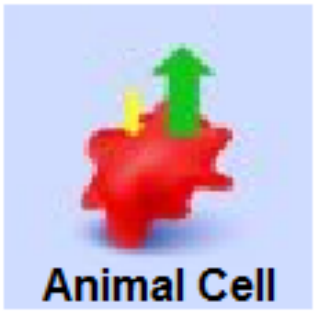
Plant Cell: When a plant cell is kept in hypotonic solution it will gain water (endosmosis) and will swell up and becomes turgid. The cell will not burst due to presence of cell wall. The cell wall will exert equal pressure against the swollen cell.

Animal Cell: When an animal cell is kept in a hypotonic solution it well swell and burst because cell membrane is very thin and delicate



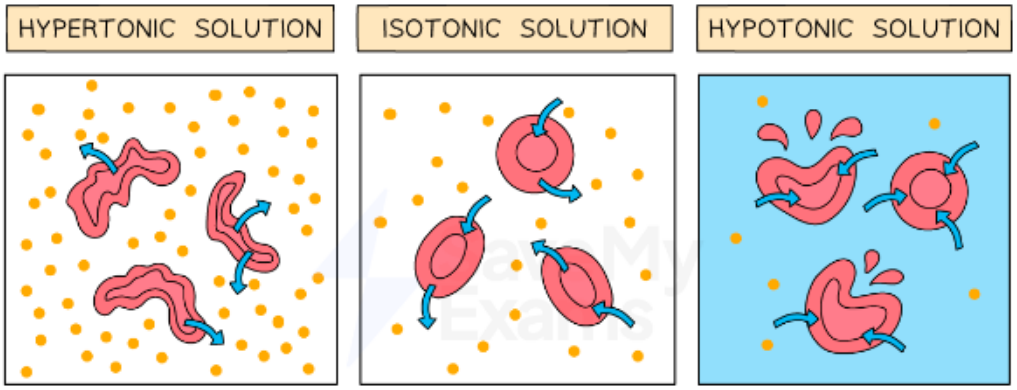
Hypertonic solution: The solution surrounding the cell has low water concentration as compared to the inside of the cell. A hypertonic solution is one in which concentration of solutes is more and concentration of water is less as compared to in the cytoplasm of the cell.
Water flows out of the cell (exosmosis) in order to balance the concentration of the solution when cell is placed in hypertonic solution..
Plant cell: When plant cells are placed in a hypertonic solution, the cell will lose water by exosmosis and the flexible **cell membrane** pulls away from the rigid **cell wall,** but remains joined to the cell wall at points called plasmodesmata. This phenomenon is known as **plasmolysis**.
Because of presence of cell wall, the plant cells can withstand much greater changes in external medium as compared to animal cell.



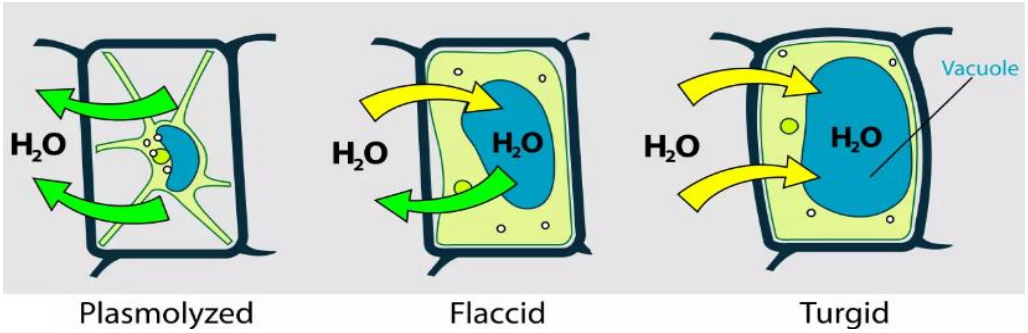


Animal Cell: When an animal cell is kept in hypertonic solution it will lose water by exosmosis and shrink
Isotonic solution: The solution surrounding the cell has same concentration of water as inside the cell.
Isotonic solution is one in which concentration of solutes and water is the same as in the cytoplasm of the cell.
When a plant cell or animal cell is placed in isotonic solution, the amount of water moving in and out of the cell will remain same. Hence there will be no overall movement of water molecules.
The size of the cell will remain same.

Osmosis in Animal Cell



Osmosis in Plant cell

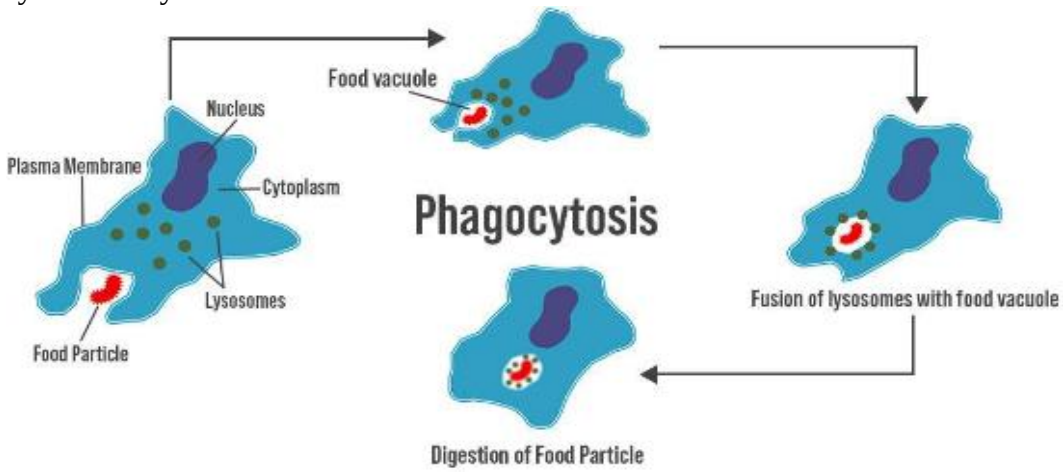


Endocytosis: Endocytosis is the process of capturing a substance or particle from outside the cell by engulfing it with the cell membrane, and bringing it into the cell. The plasma membrane creates a small deformation inward, called an **invagination,** in which the substance to be transported is captured. At this point a membrane-bound sac, or vesicle, is formed and moves the substance into the cell. Endocytosis requires energy and is thus a form of **active transport**.

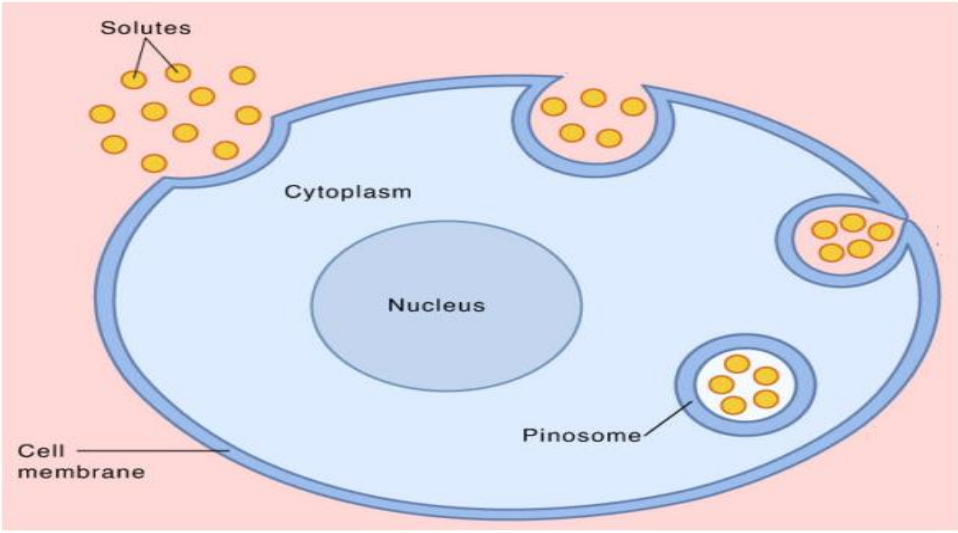
Endocytosis can only be seen in animalcells as animal cells have no cell wall and cell membrane is thin and flexible.

There are two main kinds of **endocytosis:**

- **Phagocytosis(cell eating):** Phagocytosis refers to the engulfing of larger, solid particles. Phagocytosis occurs in specialized cells called phagocytes, which include macrophages and other white blood cells. Invagination produces a vesicle called a **phagosome**, which usually fuses with one or more lysosomes containing hydrolytic enzymes. Materials in the phagosome are broken down by these enzymes.



- **Pinocytosis, or "cell drinking,"** refers to the process of ingestion of fluid into cells , The cell engulfs extracellular fluid into cells using the budding of small vesicles from the cell membrane. A small region of plasma membrane invaginates and the fluid droplet passes into the pocket (**caveola**).The pocket deepens and finally nips off as a fluid-filled vacuole called **pinosome** or **pinocytotic vesicle**. These materials enter the cell inside a vesicle, although they do not mix with cytoplasm. Epithelial cells in capillaries use pinocytosis to engulf the liquid portion of blood at the capillary surface.



Exocytosis describes the process of vesicles fusing with the plasma membrane and releasing their contents to the outside of the cell. Exocytosis occurs when a cell produces substances for export, such as a protein, or when the cell is getting rid of a waste product or a toxin.

Cell Wall:

- ✓ The cell wall is a tough, non living layer outside the plasma membrane in the plant cells and fungal cells.
- ✓ In plant cell, it is made up of **cellulose** and in fungal cells it is composed of **chitin.**
- ✓ Cell wall is permeable.
- ✓ It provides these cells with structural support and protection.
- ✓ Plant cells need protection against variation in temperature, high wind speed, atmospheric moisture etc. They are exposed to these variations because they cannot move.

Function of cell wall

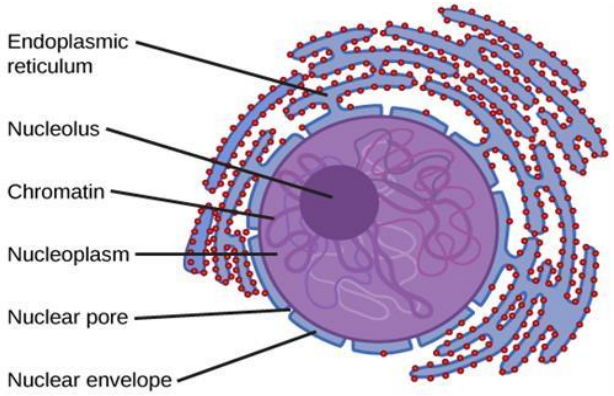
- ✓ A major function of the cell wall is to act as a **pressure vessel,** permitting the cells of plant to withstand hypotonic condition without brusting.
- ✓ The wall gives cells **rigidity and strength,** offering protection against mechanical stress.
- ✓ In multicellular organisms, it permits the organism **to build and hold its shape**
- ✓ The cell wall also **limits the entry of large molecules that may be toxic to the cell.**
- ✓ The plasmodesmata form intercellular connection that allow exchange of materials between adjacent living cell content

Nucleus:

- ❖ The nucleus is the most conspicuous and the **largest organelle** of a eukaryotic cell.
- ❖ **Robert Brown** (1831) discovered a dense, spherical body in the cells of an 'orchid' and named it as 'Nucleus'.
- ❖ It is a prominent, spherical or oval structure, usually located near the centre of cell.
- ❖ It is called as the **brain of cell** as it controls all cell activities.
- ❖ It contains most of the cell's genetic material, organized as multiple long linear **DNA** molecules in complex with a large variety of proteins, such as histones, to form chromosomes. The **genes** within these chromosomes are the cell's nuclear genome.
- ❖ The function of the nucleus is to maintain the integrity of these genes and to control the activities of the cell by regulating gene expression — the nucleus is, therefore, the **control centre or brain** of the cell.
- ❖ It is composed of double layered covering called **nuclear membrane.**
- ❖ Nuclear membrane has numerous pores called **nuclear pore** for transport of material from nucleus to cytoplasm.
- ❖ Inside the nuclear membrane, there is liquid ground substance called **nucleoplasm.**
- ❖ Dense round structure present inside the nucleus which does not have any covering of membrane is known as **nuclelolus** (factory of ribosomes).
- ❖ **Chromatin** is entangled network of long thread like structure which contains information of inheritance. During cell division it condenses to form **chromosomes**.

The chief **components** of the nucleus are

- Nuclear membrane
- Nucleoplasm
- Nuclear pore
- Nucleolus
- Chromatin



Nuclear Membrane

- The nuclear membrane is a double layered membrane that encloses the nucleus and isolates its contents from the cellular cytoplasm
- The nuclear membrane completely encloses the nucleus and separates the cell's genetic material from the surrounding cytoplasm
- Barrier to prevent macromolecules from moving freely between the nucleoplasm and the cytoplasm
- It is perforated by numerous minute, circular **nuclear pore**
- Outer membrane bears ribosomes on the cytoplasmic side and is continuous with ER

Nuclear pore: Transfer of material from nucleus to cytoplasm

Nucleolus: Dense round granular structure (sub organelle) without limiting membrane. It is rich in RNAs and Protein. The main roles of the nucleolus are to synthesize and assemble ribosome.

Nucleoplasm: The nuclear membrane encloses a liquid ground substance called nucleoplasm. It is a fibrous, transparent, semi-solid granular substance that fills the nucleus. It includes chromatin fibers and nucleolus.
Chromatin material: It occurs in non-dividing nucleus as fine filaments termed as **chromatids**. Chromatid material condenses during cell division to appear as ribbon like **chromosomal** structure.
Chromosomes: Nucleus contains chromosomes, which contains information for inheritance of features from parents to offsprings in the form of **DNA (Deoxyribo Nucleic Acid).** Chromosomes are composed of two components, i.e. DNA and protein.
The DNA molecules store information **for constructing and organising** cell. The functional segment of DNA are called **genes.** Genes are known as **basic unit of inheritance.**

Functions of Nucleus:

- ❖ The nucleus controls all metabolic activities of the cell.
- ❖ Nucleus plays an important role in cellular reproduction in which cell divide to form new cell
- ❖ It determine the cell development and maturity by directing the chemical activity of cell
- ❖ It is concerned with the transmission of hereditary traits from the parents to offspring.

Endoplasmic Reticulum

It is a system of membranes attached to the nucleus and present in the cytoplasm. It is large network of membrane bound tubes and sheets (vesicles) and looks like tubules, round (long bags like vesicles). Endoplasmic Reticulum (ER) membrane is made up of lipids and proteins. It is similar to plasma membrane in their structure.
The Endoplasmic Reticulum (ER) is divided into two parts
(a) Rough Endoplasmic Reticulum (RER): possesses rough wall because ribosomes remain attached on the surface. **RER** is present in cells which are involved in protein synthesis. RER is more abundant in the deeper part of cytoplasm near the nucleus where it is connected to nuclear envelope.
(b) Smooth Endoplasmic Reticulum (SER): smooth endoplasmic reticulum lacks ribosomes and is more abundant near the peripheral part of the cytoplasm where it may be attached to plasma membrane. SER helps in synthesis of fat or lipid molecule.

Functions of Endoplasmic Reticulum:

- **Support:** The ER act as supporting skeletal framework of the cell and also maintain form
- **Transport of material:** The ER forms a network system, providing a channel for transport of materials between various region of cytoplasm or between cytoplasm and nucleus.
- Smooth endoplasmic reticulum is used in **synthesis of fats molecules or lipids.**
- Rough E.R. is concerned with protein synthesis and its transport throughout the cell.
- The rough endoplasmic reticulum works in concert with the Golgi complex to target new proteins to their proper destinations
- Smooth E.R. is involved in the process of **detoxification** of poisons and drugs**.**
- **Membrane biogenesis:** Formation of new cell membrane during cell division. Some of the lipids and protein synthesized by ER helps in building cell membrane.

Golgi Complex:

Golgi apparatus is a disc-shaped organelle consisting of a system of membrane-bound vesicles arranged approximately parallel to each other in stacks called cisternae.

- Golgi bodies are absent in prokaryotic cells. Golgi complex is found in all eukaryotic cells except RBCs.
- **Camillo Golgi** (1898), a zoologist, observed Golgi bodies in nerve cells of barn owl.
- It is also called **Golgi complex** or **Golgi apparatus**
- In plant cells, Golgi complex exist as freely distributed sub unit of Golgi apparatus and are called **Dictyosome**.
- In animal cells, Golgi apparatus is usually located at a specific site close to the nuclear envelope.
- Golgi apparatus originates from RER that has lost its ribosomes.
- Golgi bodies are interconnected with the tubules.
- Found within the cytoplasm of both plant and animal cells, the Golgi is composed of stacks of membrane-bound structures known as cisternae (singular: cisterna)
- A mammalian cell typically contains **40 to 100 stacks**
- Each cisternae comprises a flat, membrane enclosed disc that includes special Golgi enzymes which modify or help to modify proteins that travel through it
- Material synthesized near Endoplasmic reticulum is packaged and dispatched to various parts (inside and outside) of cell through Golgi.

Functions of Golgi Apparatus (molecule transport and modification):

- Golgi apparatus store, modify and pack products in vesicles.
- It primarily modifies proteins delivered from the rough endoplasmic reticulum but is also involved **in the transport of lipids around the cell.**
- It helps in the formation of **lysosomes** and acrosomes
- It produces vacuoles or secretory vesicles which contain cellular secretions like enzymes, proteins, cellulose etc.
- Golgi apparatus is also involved in the synthesis of **cell wall and plasma membrane.**
- It is involved in the formation of **cell plate** during cell division.
- Formation of yolk: It produces yolk in the eggs

Vesicle

- **Vesicle** is a small organelle within a cell, consisting of fluid enclosed by a lipid bilayer membrane
- Vesicles can form naturally, for example, during the processes of secretion (exocytosis), uptake (phagocytosis and endocytosis) and transport of materials within the cytoplasm
- The membrane enclosing the vesicle is similar to that of the plasma membrane, and vesicles can fuse with the plasma membrane to release their contents outside of the cell. Vesicles can also fuse with other organelles within the cell.

Lysosomes (*Lysis = dissolution: soma = body*)

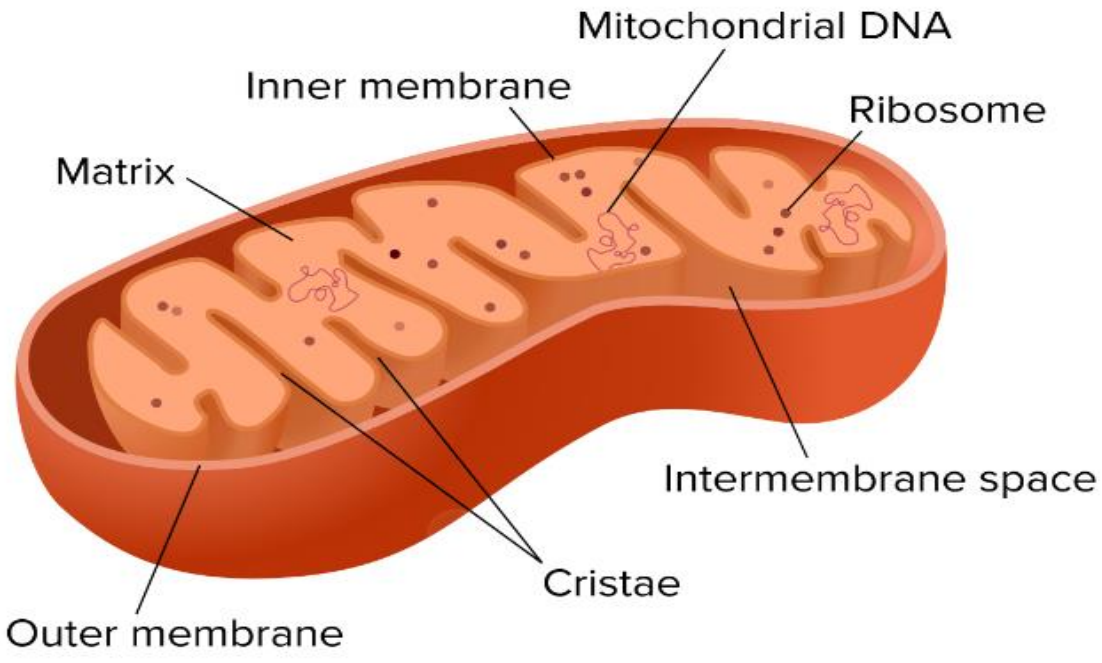
Lysosomes are generally found in the cytoplasm of animal cells. The term **lysosome** was introduced by **de Duve** in 1955.

It is also called **demolition squads, scavengers, cellular house keepers and suicide bags.**

- Lysosome are membrane-bound sacs filled with digestive enzymes (hydrolytic enzyme).
- The digestive enzymes are made by rough endoplasmic reticulum.
- **Lysosomes arise from golgi complex.**
- Lysosomes are structurally and chemically spherical vesicles containing **acid hydrolase**, which are capable of breaking down virtually all kinds of biomolecules, including proteins, nucleic acids, carbohydrates lipids, and cellular debris
- Lysosomes are known as '**suicide-bags**' because when cell gets damaged during the disturbance in cellular metabolism, lysosomes may burst and the digestive enzymes thus released digest their own cell.
- Lysosomes are interlinked with three intracellular processes namely phagocytosis, endocytosis, and autophagy. Extracellular materials such as microorganisms taken up by phagocytosis, macromolecules by endocytosis, and unwanted cell organelles are fused with lysosomes in which they are broken down to their basic molecules

Functions of Lysosomes :

- **Digestion of useful material**: The food particle taken up by the cells in vacuole (pinosomes anad phagosomes) from the environment are digested in the lysosomes. Lysosomes serve as intracellular digestive system hence called **digestive bags**.
- **Digestion of harmful material**: The lysosomes dispose off the foreign particles (eg. virus, bacteria) by breaking (hydrolysing) them into small pieces as it contains powerful digestive enzymes which can break down all organic material. This is called **natural defence** of body which a character of higher animals.
- **Digestion of unwanted materials:** Lysosomes removes the worn out and poorly working cellular organelles by digesting them to make way for their new replacement. Thus they are also called **natural scavenger** or **cellular housekeeper.**



Mitochondria

- The **mitochondrion** (plural **mitochondria**) is a membrane-bound organelle found in most eukaryotic cells
- Mitochondria are rod shaped organelles, bounded by a double membrane envelope.
- The outer membrane is smooth, porous and freely permeable.
- Inner membrane is selectively permeable. It is deeply folded inward into finger like projection called **cristae**. Folding increases the surface area for ATP generating chemical reaction catalysed by enzyme ATP synthesase
- Space between outer and inner membrane is called **intermembrane** space. It contains a clear, homogeneous fluid.
- The compartment enclosed by the inner membrane is called the **mitochondrial matrix**. The matrix contains mitochondrial DNA and ribosomes.

Functions of Mitochondria :

- It generates energy for various activities of the cell hence it is known as **power house** of the cell. The energy is released in form of ATP (adenosine triphosphate).
- Whenever, the cell requires energy, ATP molecules breaks down to release energy. ATP is known as **energy currency of the cell**.
- Mitochondria as place of cellular respiration. Kreb's cycle occurs in mitochondria.
- Mitochondria are capable of self duplication (replication). They have their own DNA, ribosome and enzymes. They are able to synthesize some of their own proteins. Hence they are regarded as **semi-autonomous organelle.**
- Synthesis of many amino acid occurs in mitochondria

Ribosomes:

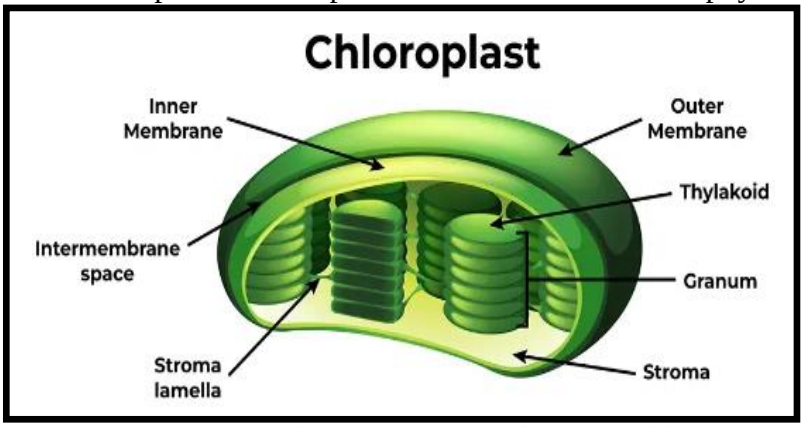
- In plant cells ribosomes were first of all observed by **Robinson** and **Brown** (1953). In animal cells these are called **Palade particles,** observed by **Palade** (1955).
- Ribosomes are found in both prokaryotic and eukaryotic cells. In prokaryotes, they are found in the cytoplasm in free form, called **monosomes.**
- Ribosomes are the smallest membrane less organelles in the cell.
- Ribosomes are dense, spherical and granular bodies which occur freely in cytoplasm or may remain attached to surface of endoplasmic reticulum. These are also known as **RNP particles** (Ribonucleoprotein particles.)
- Ribosomes are cell organelles that consist of RNA and proteins.
- Ribosomes are sites of protein synthesis. They are responsible for assembling the proteins of the cell. Ribosomes are the **'protein factories'** of the cell.
- Depending on the protein production level of a particular cell, ribosomes may number in the millions.

Plastids:

- Plastids are spherical or discoidal in shape and are enclosed by a double membrane.
- They are present in plant cells.
- Plastids are self replicating organelles like mitochondria (have the power to divide). They contain their own DNA, RNA and ribosomes. They have their own protein synthesising machinery hence are called **semi autonomous bodies.**
- Plastids are the site of manufacture and storage of important chemical compounds used by the cell
- They often contain pigments used in photosynthesis, and the types of pigments present can change or determine the cell's colour

Types of Plastids:

- Chloroplasts: Green plastids which contain chlorophyll.



- Chloroplast are spherical, ovoid or discoidal in shape and are enclosed by a double membrane.
- A plastid shows two distinct regions: **grana** and **stroma**
- **Grana** are stacks of membrane-bound, flattened, discoid sacs containing chlorophyll molecules embedded in the matrix called **stroma**.
- The outer membrane is smooth and freely permeable.
- Inner membrane is selectively permeable. It is greatly infolded but infolds become free in the mature chloroplast to lie as **lamellae** in the matrix.
- Lamellae are closed, flattened, membrane bound ovoid sac called **thylkoids** which lie in closely packed in piles, the **grana**.
- Matrix is colourless, granular, colloidal ground substance called **stroma**.

- Chromoplasts: Variously coloured plastids present in flower and fruits.
- Leucoplasts: Clourless plastids. They store food in the form of starch, protein and lipids.

Function:

1. By trapping solar energy, green plastids manufacture food through photosynthesis.
2. Chromoplasts provide colour to various flowering parts
3. Leucoplasts help in the storage of protein, starch and lipids.

Vacuoles:

- Vacuoles are fluid filled and membrane bound organelle in the cytoplasm.
- In animal cells, these are absent and if present they are small in size and more in number.
- In plant cells, they are larger in size and occupies more space. Some may occupy 50 – 90% of the total cell volume.
- Vacuoles are storage sacs for liquid or solid contents. They are bound by a membrane known as **tonoplast.**
- Fluid present inside vacuole is called **cell sap** which is watery and contains substance like sugar, protein, minerals and metabolic wastes.

Functions of Vacuoles:

- It is full of cell sap, so it provides turgidity and rigidity to the cell
- Substance like amino acids, sugar, organic acids etc are stored in vacuoles.
- Maintaining internal hydrostatic pressure or turgor within the cell (osmoregulation).
- In amoeba, food is consumed in food vacuole.
- They help in elimination of excess of water from the cell (osmoregulation) and maintains internal pressure of the cell.

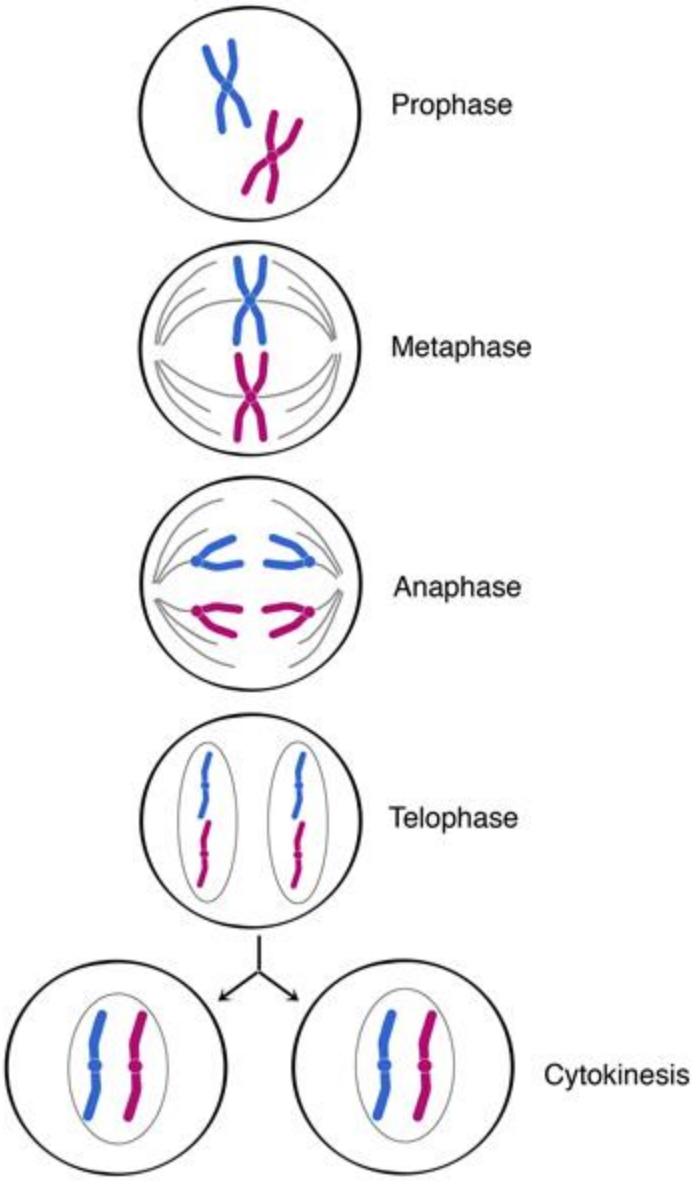
Types of Vesicle	Function
Lysosomes	1. Lysosomes are involved in cellular digestion.
Vacuoles	2. Vacuoles are vesicles which contain mostly water
Transport vesicles	3. Transport vesicles can move molecules between locations inside the cell, e.g., proteins from the rough endoplasmic reticulum to the Golgi apparatus.
Secretory vesicles	4. Secretory vesicles contain materials that are to be excreted from the cell

Difference in prokaryotic and eukaryotic cell

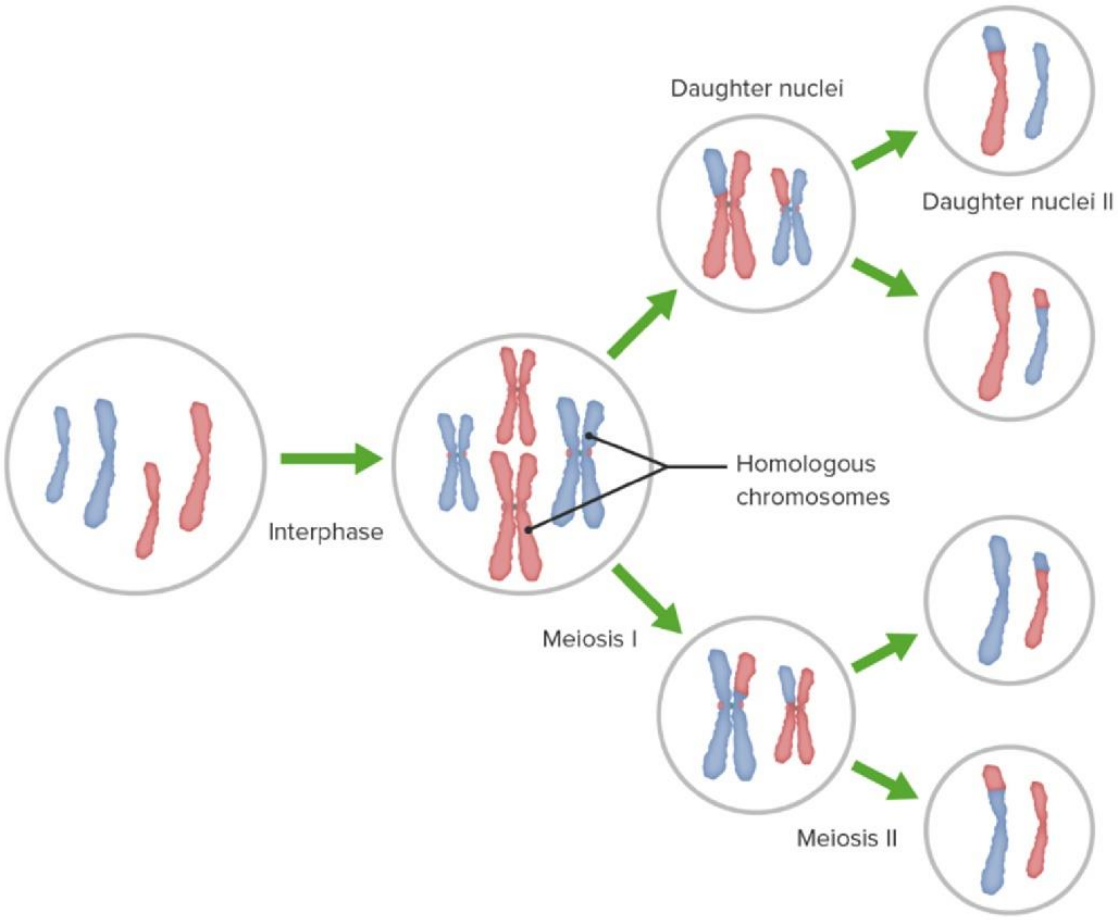
Prokaryotes (Pre-primitive; Karyote-Karyon)	Eukaryotes ((Eu-good ; Karyote-Karyon)
Size of cell **is generally small (1-10 μm)**	Large (5-100 μm)
Nucleus **Absent ; or poorly developed nucleus due to absence of nuclear membrane. This nuclear region is called** nucleoid.	Nucleus Present
Contain single chromosome	Contain **many chromosome**
Nucleolus **is absent**	Present
Membrane bound cell organelles **are absent (Ribosomes are present). Most functions are performed by poorly organised parts of cytoplasm due to absence of such organelles.**	Present
Cell division **take place fission or budding (No mitosis)**	Cell division occurs by mitosis or meiosis
Ex. Blue-green algae, PPLO etc.	Ex. *Amoeba*, *Paramecium* etc.

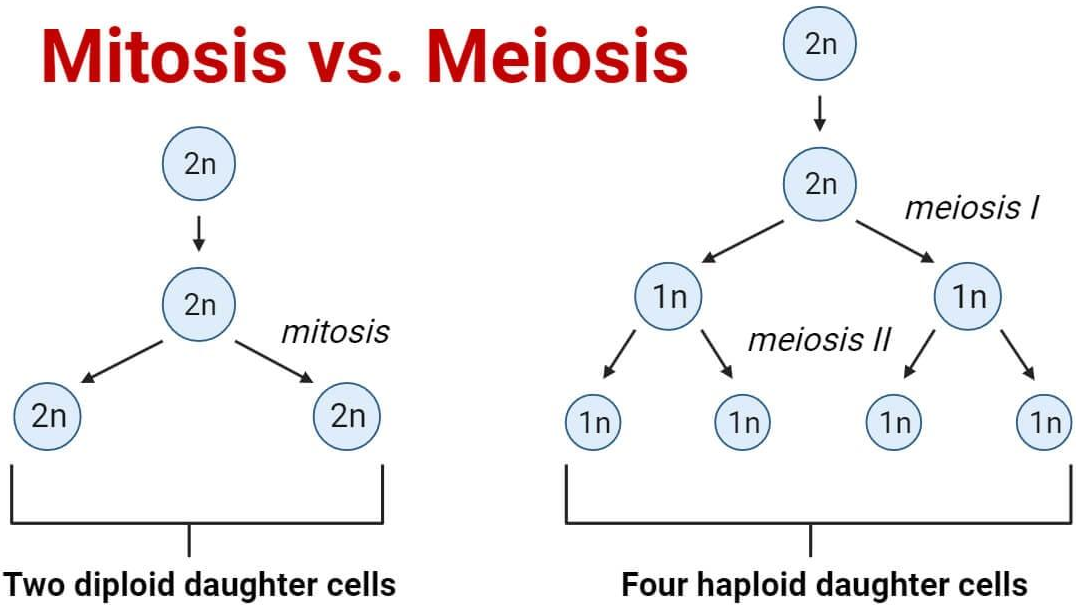
Cell Division

Mitosis



Meiosis


Daughter nuclei
Daughter nuclei II
Homologous chromosomes
Interphase
Meiosis I
Meiosis II


Mitosis vs. Meiosis
2n
2n
mitosis
2n
2n
Two diploid daughter cells
2n
2n
meiosis I
1n
1n
meiosis II
1n
1n
1n
1n
Four haploid daughter cells

Mitosis	Meiosis
Takes place in somatic cell	Take place in reproductive cell (sperm or ovum)
2 new cells are formed	4 new cells are formed
Chromosome number remains same	Chromosome number are halved
Diploid cells are formed	Haploid cells are formed
It is a single step process	It take place in 2 steps