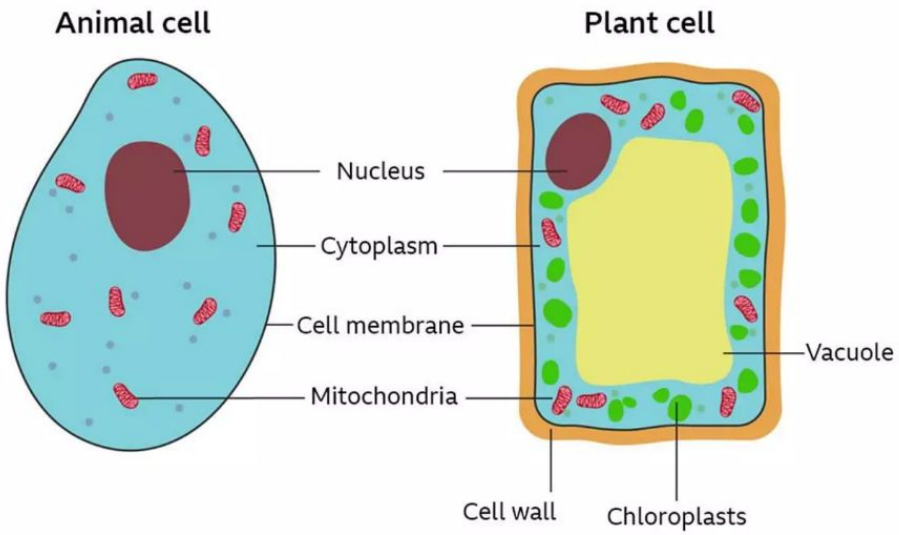
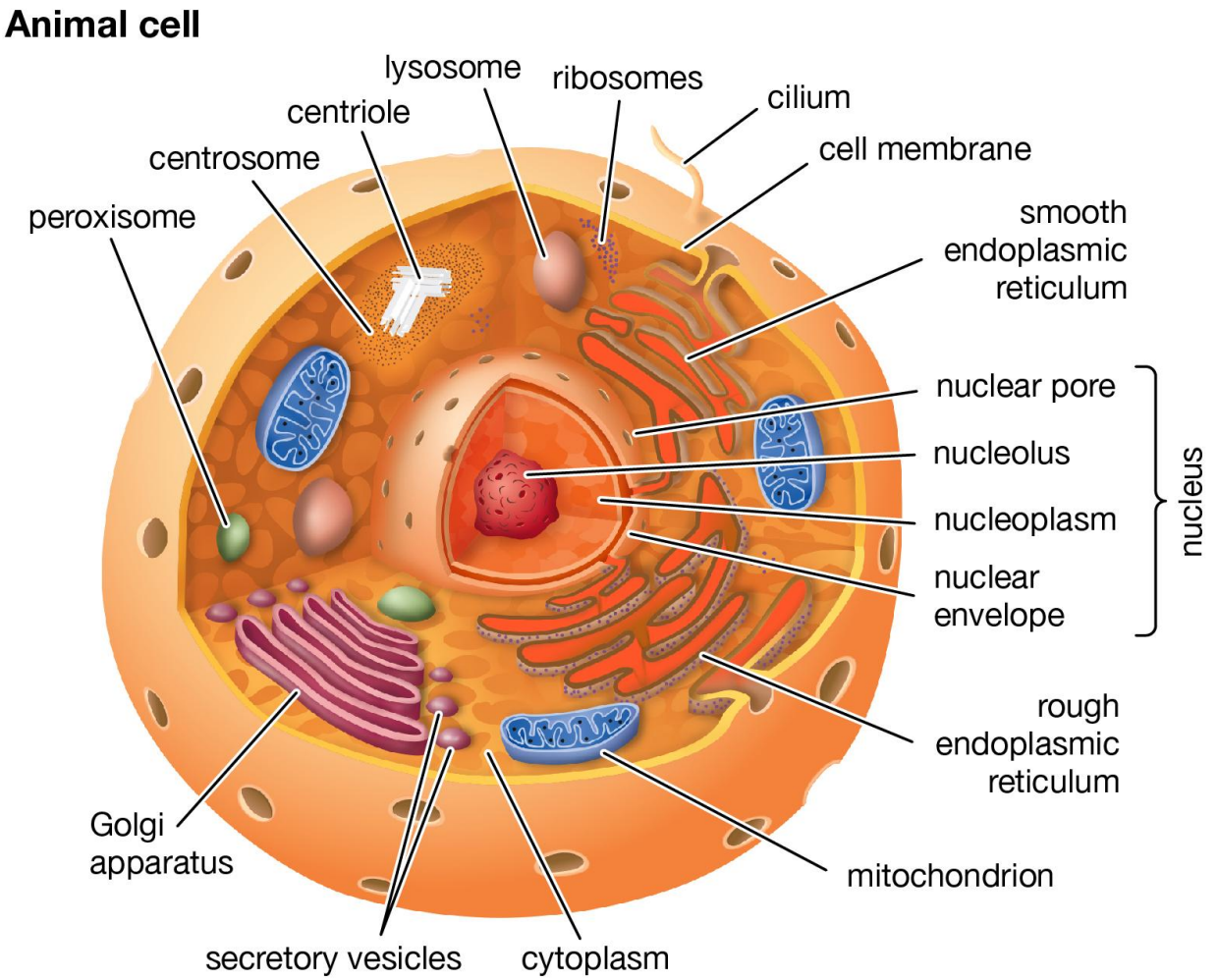
CELL: STRUCTURE AND FUNCTION



Cell structure & Functions

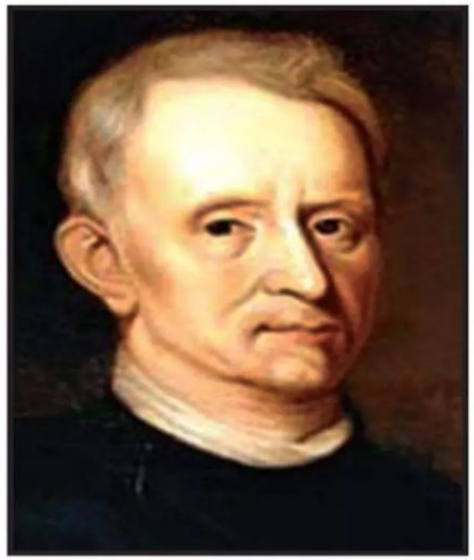
- As students, we have heard the term cell numerous times.
- So, what is a cell? All the living matter in the universe is composed of microscopic structures that are known as cells.
- A cell is the fundamental unit of life that is essential for an organism to develop and exis in its surroundings.

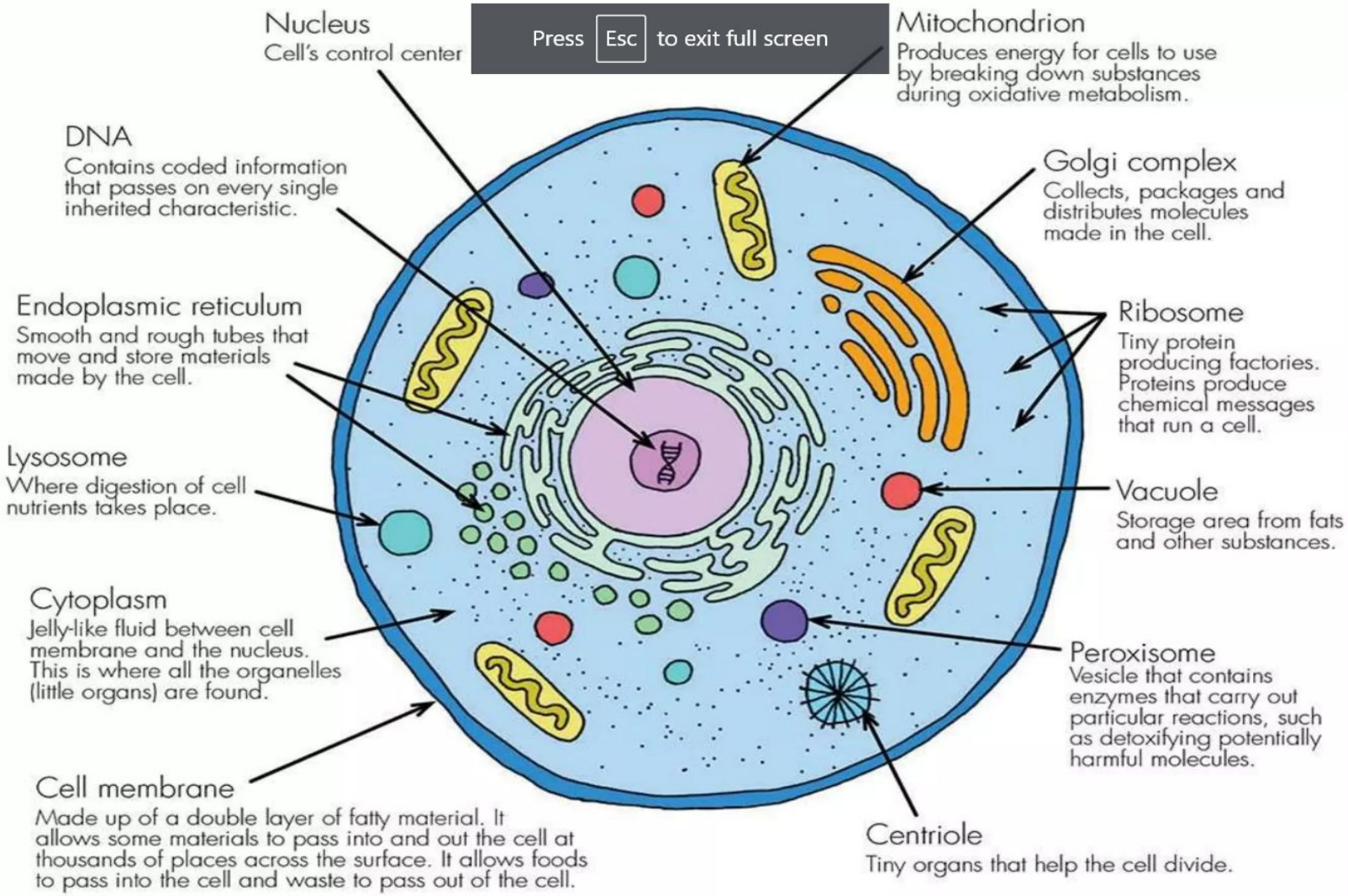


- Every living organism is made up of cells.
- The cells provide structure and functions to their bodies

INTRODUCTION

- **Fundamental unit of life.**
- Self replicating structure
- The first cells were observed and named by **Robert Hooke** in **1665** from **slice of cork**.
- Some organisms consist of a unicellular organism, others are multicellular.
- **Diameter- 2-120µm.**




Nucleus
Cell's control center
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Mitochondrion
Produces energy for cells to use by breaking down substances during oxidative metabolism.
DNA
Contains coded information that passes on every single inherited characteristic.
Golgi complex
Collects, packages and distributes molecules made in the cell.
Endoplasmic reticulum
Smooth and rough tubes that move and store materials made by the cell.
Ribosome
Tiny protein producing factories. Proteins produce chemical messages that run a cell.
Lysosome
Where digestion of cell nutrients takes place.
Vacuole
Storage area from fats and other substances.
Cytoplasm
Jelly-like fluid between cell membrane and the nucleus. This is where all the organelles (little organs) are found.
Peroxisome
Vesicle that contains enzymes that carry out particular reactions, such as detoxifying potentially harmful molecules.
Cell membrane
Made up of a double layer of fatty material. It allows some materials to pass into and out the cell at thousands of places across the surface. It allows foods to pass into the cell and waste to pass out of the cell.
Centriole
Tiny organs that help the cell divide.

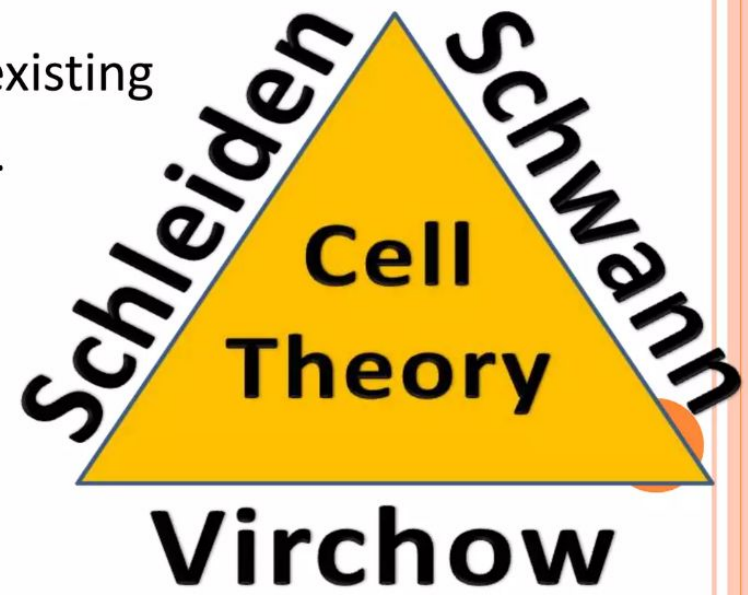
CELL THEORY

- Proposed by **Matthais Schleiden** and **Theodor Schwann** in **1839**:-

  -All living things are made up of cells.

  -Cells are the smallest working unit of all living things.

  -All cells come from pre-existing cells through cell division.



- The study of cells and their relative functions is called **cytology.**
- A cell is an independent living component.
- Cells arise from pre-existing cells.
- Robert Hooke first discovered cells

- Even though cells are the fundamental unit of life, they have other components that perform various other biological functions.
- A group of cells working together form an **organ.** Thus, our body has multiple types of cells with different shapes and sizes.
- Cells also contain hereditary material

Types of cells

- A group of similar cells works together to perform the same function. However, there are **two main types** of cells based on their cellular structure. They are-

- Prokaryotic cells (As bacterial cells)
- Eukaryotic cells (As animal and plant cells)

The components that comprise a specific structure to the cell (3 types).

1. Cell membrane

- The cell membrane is a structure that gives rigidity and protection to the cell.
- It controls the movement of biomolecules in and out of the cell.
- It protects the cell and its organelles from the external environment.
- By nature, the cell membrane is semi-permeable. Meaning it only allows specific substances to pass through it.

2. Cell wall

- The cell wall is a cell structure that is prominently associated with plant cells only.
- Biomolecules like cellulose, hemicellulose, and pectin form the cell wall.
- It is the outermost layer of plant cells that exclusively protects the plasma membrane and other cell components.
- It provides stiffness to the cell membrane.
- It protects the plant cell from mechanical shocks and injuries.

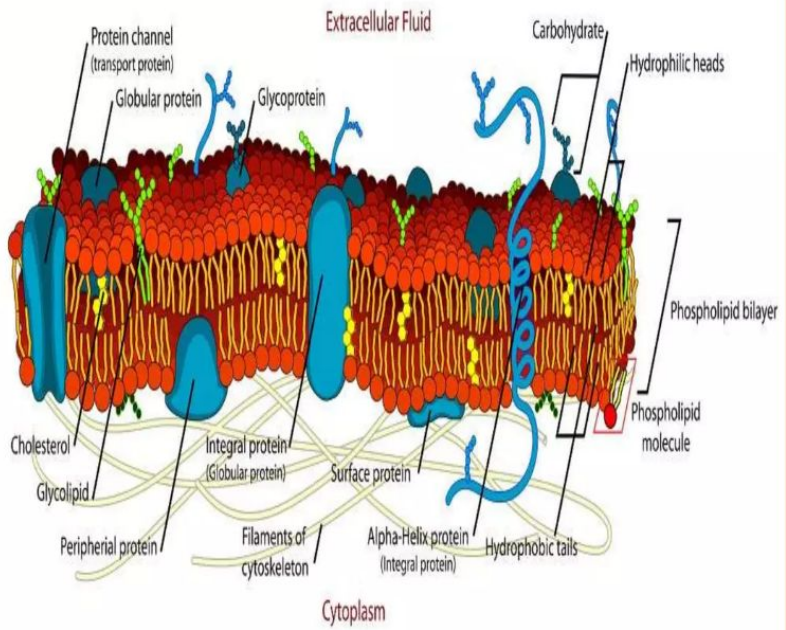
CELL MEMBRANE

- Thin pliable elastic **outermost structure** which envelops the cell.

- It consists of **bilipid layer** with embedded **proteins** that are-

  i)Integral Proteins

  ii)Peripheral proteins



3. Cytoplasm

- The cytoplasm is a jellylike pool inside the cell membrane.
- All other cell organelles are suspended into the cytoplasm of the cell.
- Biochemical reactions like glycolysis take place within the cytoplasm.

Cell organelles: their structure and function

The Constituents present inside it:

1. Nucleus

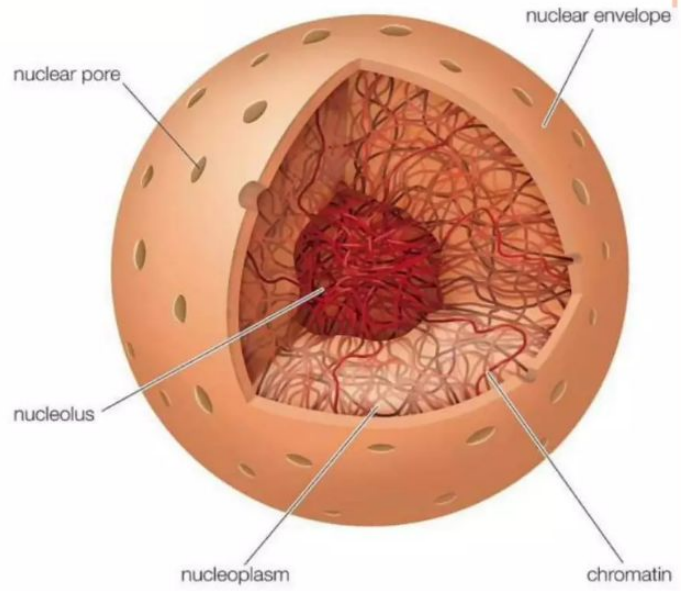
- The nucleus is the main component of a cell.
- It contains DNA, which is a hereditary material.
- It transports signals to other components to further grow, mature, and carry on other life processes.
- The nucleus is a structure that provides protection to the genetic material.

2. Nucleolus

- The nucleolus is present inside the nucleus
- It is the site for ribosome synthesis
- It also controls cellular reproduction

THE NUCLEUS

- The nucleus contains chromatin, RNAs, and nuclear proteins move freely in aqueous solution.
- Nucleus has an internal structure that organizes the genetic material and localizes nuclear functions.
- A loosely organized matrix of nuclear lamins extends from the nuclear lamina into the interior of the nucleus.



CONTD.

- These lamins serve as sites of chromatin attachment and organize other proteins into functional nuclear bodies.

- Chromatin within the nucleus is organized into large loops of DNA, and specific regions of these loops are bound to the lamin matrix by lamin-binding proteins in the chromatin.

ORGANELLES

- Following organelles are present in the Cytoplasm:-

  i)Mitochondria ii)Endoplasmic Reticulum

  iii)Lysosomes iv)Golgi Appartus

  v)Peroxisomes vi)Vacuole

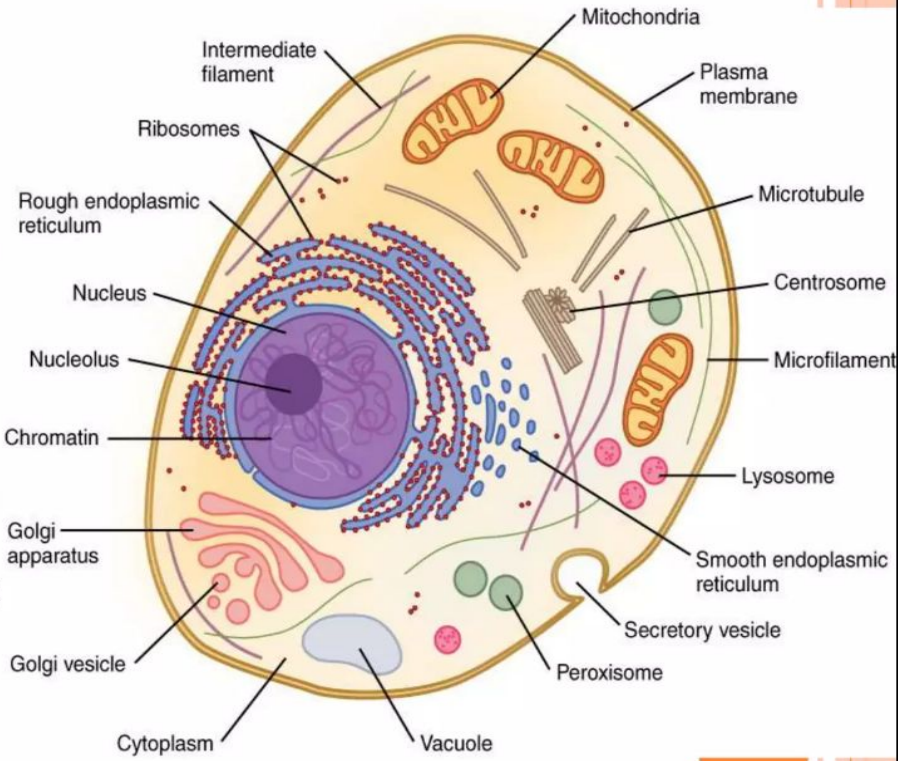
- Each organelle is bounded by a lipid membrane, and has specific functions.

CYTOPLASM

- **Thick, gel-like semitransparent fluid** that is found in both plant and animal cell.

- The constituent parts of cytoplasm are **cytosol, cell organelles and cytoplasmic inclusions.**

- Bounded by the plasma membrane, and contains many organelles in a eukaryotic cell (cell containing membrane bounded nucleus).



3. Nuclear membrane

- The nucleus is enclosed by a nuclear membrane.
- The membrane forms a barrier between the genetic material and other cell components.

4. Chromosomes

- Condensed chromatin fibre forms chromosomes.
- These are the structures that form during cell division that contain genetic material.
- Chromosomes contain DNA and histones.
- They determine the sex of an individual.
- Humans have 23 pairs of chromosomes.
- Two sister chromatids are attached by a structure called a centromere.

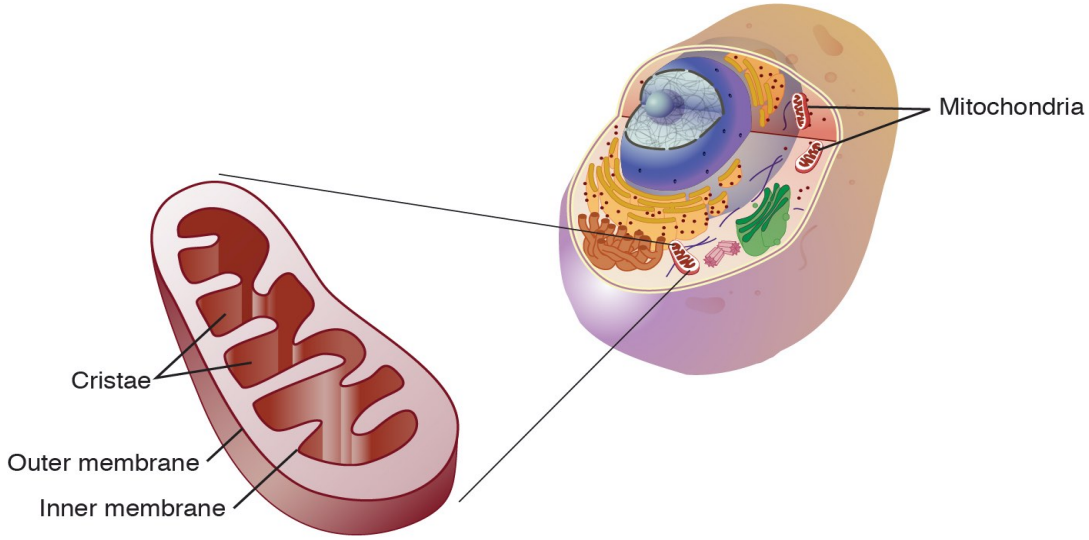
5. Mitochondria

- Universally known as the- Powerhouse of the Cell, mitochondria synthesises ATP during cellular respiration.
- It is a double membrane structure, inner membrane forms inward foldings called cristae.
- Mitochondria produce cellular energy through aerobic respiration.
- The mitochondrial matrix also contains DNA, along with RNA, ribosomes, and proteins.

- **Mitochondria** are membrane-bound cell organelles (mitochondrion, singular) that generate most of the chemical energy needed to power the cell's biochemical reactions.
- Chemical energy produced by the mitochondria is stored in a small molecule called adenosine triphosphate (ATP).
- Mitochondria contain their own small chromosomes.
- Generally, mitochondria, and therefore mitochondrial DNA, are inherited only from the mother.

What do mitochondria do?

- Producing energy.
- Cell death. Cell death, also called apoptosis, is an essential part of life.
  Storing calcium
- Heat production



MITOCHONDRIA

- The mitochondria were first observed by **Kolliker** in **1850** as granular structures in the striated muscles.

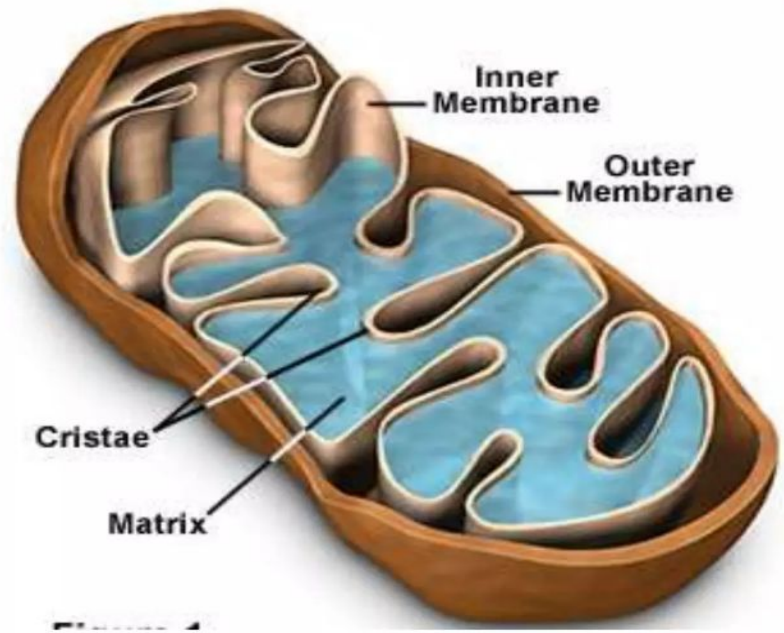
- Mitochondria are called **the 'powerhouse of the cell'.**

STRUCTURE-

- **Length-** 5-12µm

  Diameter- 0.5-1µm

- Filamentous or globular in shape.



FUNCTIONS

- Power generating units of the cells.
- Important to maintain proper concentration of calcium ions within the various compartments of the cell.
- Energy transduction through respiration.
- Responsible for thermogenesis.

6. Endoplasmic reticulum

- These are tubular structures found in the proximity of the nucleus.
- It organises and synthesises selective molecules and sorts them to appropriate locations.
- There are two types of ER found in the cell- Rough endoplasmic reticulum and smooth endoplasmic reticulum.
- RER structures are associated with protein synthesis.

7. Ribosomes

- Appear on the surface of the endoplasmic reticulum; ribosomes are called the protein factory of the cell.
- Polyribosomes are formed when ribosomes get attached with mRNA.

8. Golgi bodies

- Also sometimes known as the Golgi apparatus, these structures are responsible for the transportation of materials within the cytoplasm.
- Their other function includes assorting the proteins (glycoproteins) and lipids (glycolipids) for secretion.

9. Lysosomes

- Lysosomes are regarded as cell's suicide bags.
- They engulf foreign particles and prevent them from entering the cell. Thus, providing protection.
- Lysosomes also get rid of metabolic wastes.
- These structures help in renewing the cell.

10. Chloroplasts

- Chloroplasts are only present inside the plant cells.
- Like mitochondria, they are also double-membrane structures.
- The structure bound by the inner membrane is called the stroma.
- Stacks of thylakoids grouped together are known as grana.
- Chloroplasts contain chlorophyll and are the site for photosynthesis.
- Genetic material is also observed stranded inside the stroma.

What is cell biology?

- Cell biology is the branch of science that deals with the structure, function, and nature of cells.

- It includes all the aspects of a cell, including its anatomy, cellular functions, signaling, reproduction, respiration, genetics, and cell death.

What is the main function of a living cell?

Even though cells are the fundamental unit of life, there goes a lot inside a living cell. It is responsible for the following:

- Synthesis of genetic material
- Producing energy in the form of ATP
- To grow and divide to replace old cells
- For the development of a living organism
- Helps in the reproduction of a new living organism

What happens when a cell dies?

- Apoptosis is the phenomenon of programmed cell death. When a cell dies on the external surface of the body, it is usually sloughed off.
- Whereas when a cell dies inside the body, it is ingested by phagocytic cells.

SUMMARY

COMPARTMENTS	MAJOR FUNCTIONS
Plasma Membrane	Transport of ions and molecules
Cytosol	Metab. of carbohydrate, lipids and amino acids
Mitochondria	Energy production
Endoplasmic Reticulum	Synthesis of proteins and lipids
Golgi apparutus	Modification and sorting of proteins
Lysosomes	Cellular digestion
Peroxisomes	Utilisation of H_2O_2
Cyotoskeleton	Cell Morphology and cell motility
Nucleus	DNA synthesis and Repair

THANK YOU