Prepp

Practice, Learn and Achieve
Your Goal with Prepp

SSC MTS Exam

Study Material for Genral Awareness

Simplifying
Government Exams

SSC CHSL | IAS EXAM | RRB NTPC | NTSE | CDS
SSC CGL | CBSE UGC NET | IBPS PO | NDA
SBI PO | IBPS CLERK | AFCAT | SSC JE | CTET
CSIR UGC NET | CAPF | IBPS RRB

www.prepp.in

FUNDAMENTAL UNIT OF LIFE

Introduction

- The fundamental unit of life is cell.
- Cell was first discovered by Robert Hooke in 1665 in a simple microscope.
- In 1674, Leeuwenhoek, with the help of developed microscope, discovered the free living cells in pond water.
- In 1831, Robert Brown had discovered the **nucleus** in the cell.
- In 1839, Purkinje used the term 'protoplasm' for the fluid substance found in the cell.
- The cell theory was proposed by Schleiden (1838) and Schwann (1839).
- According to the cell theory, all the plants and animals are composed of cells and that the cell is the basic unit of life.
- In 1855, Virchow further expanded the cell theory and suggested that all cells arise from pre-existing cells.
- In 1940, the discovery of electron microscope made possible to observe and understand the complex structure of the cell.

Unicellular Organisms

- The single cellular organisms, such as *Amoeba, Chlamydomonas, Paramoecium*, and bacteria, are known as unicellular organisms.

Multicellular Organisms

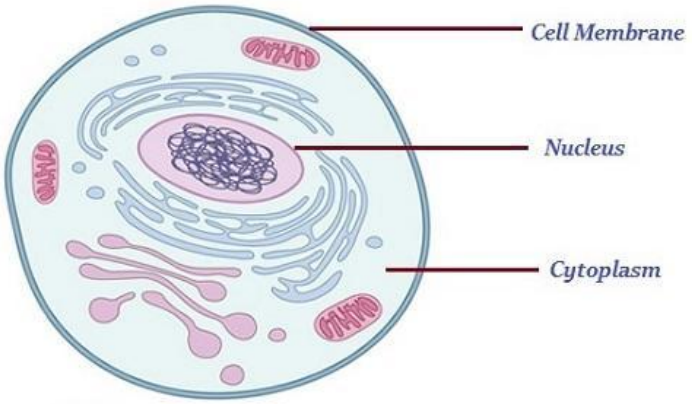
- The organisms consisting of many cells are known as multicellular organisms. E.g. human being, animals, birds, etc.

Significant Characteristics of Cells

- Each living cell has the aptitude to perform certain basic functions that are characteristic of all living forms.
- Each such cell has certain specific components within it known as cell organelles.
- Different types of cells have different function and each cell organelle performs a special function.
- These organelles collectively constitute the basic unit of life known as cell.
- All cells are found to have the same organelles, irrespective of their different functions and the organism they found in.

Structural Organization of Cell

- Following are the three basic features that every cell possesses:
    - Plasma Membrane/Cell Membrane
    - Nucleus
    - Cytoplasm



Basic Features of Cell

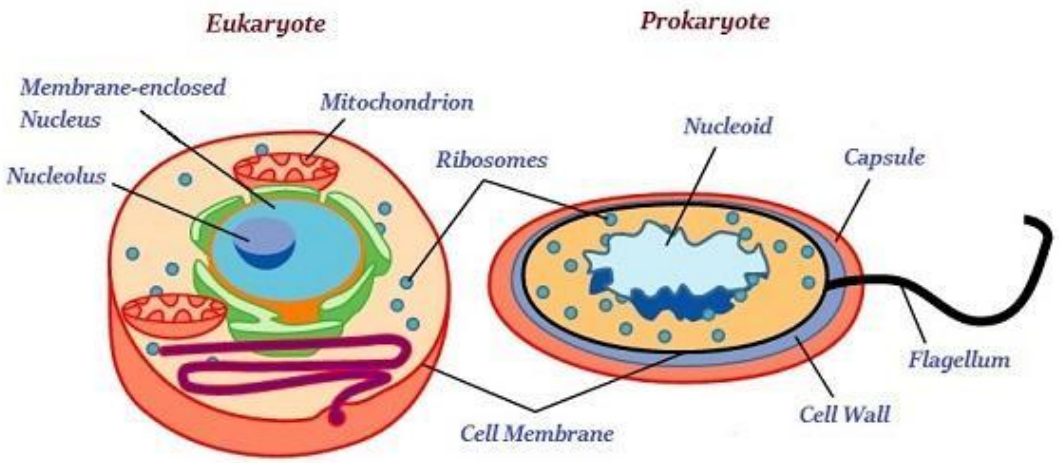
Plasma Membrane/Cell Membrane

- Plasma membrane is the outermost covering layer of the cell (as shown in the image given above).
- Plasma membrane allows certain materials to enter inside the cell and come out from the cell; therefore, it is known as **selectively permeable membrane**.
- The movement of water molecules through the selectively permeable membrane is known as **osmosis**.
- Plant cells have an addition protecting cover known as **cell wall** (absent in animal cell).
- The cell wall lies outside the plasma membrane; likewise, it also covers plasma membrane.
- The cell wall is essentially composed of cellulose.

Nucleus

- Nucleus or nuculeus is a Latin term and its meaning is **kernel** or seed.
- The nucleus has a double layered covering, which is known as nuclear membrane (see the image given above).
- The nuclear membrane has some pores, which allow certain materials come inside (in nucleus) and go outside (in the cytoplasm).
- The most significant feature of nucleus is – it contains **chromosomes**.
- Chromosomes are rod-shaped structures and it is visible only when the cell is about to divide.
- Chromosomes are composed of **DNA** and **protein**.
- DNA (**Deoxyribo Nucleic Acid**) molecules contain inheritance features from parents to next generation.
- DNA molecules also contain the information essential for constructing and organizing cells.
- Functional segments of DNA are known as **genes**.
- DNA is present as the part of chromatin material.
- Chromatin material is visible as entangled mass of thread like structures.
- Whenever the cell is about to divide, the chromatin material gets organized into chromosomes.
- The nucleus plays a central and significant role in cellular reproduction.

- The cell, which has no nuclear membrane, is known as **prokaryotes** (i.e. Pro = primitive or primary; karyote ≈ karyon = nucleus). See the image given below:



- The cell, which has a nuclear membrane, is known as **eukaryotes**.
- Prokaryotic cell does not have many other cytoplasmic organelles those are present in eukaryotic cells.

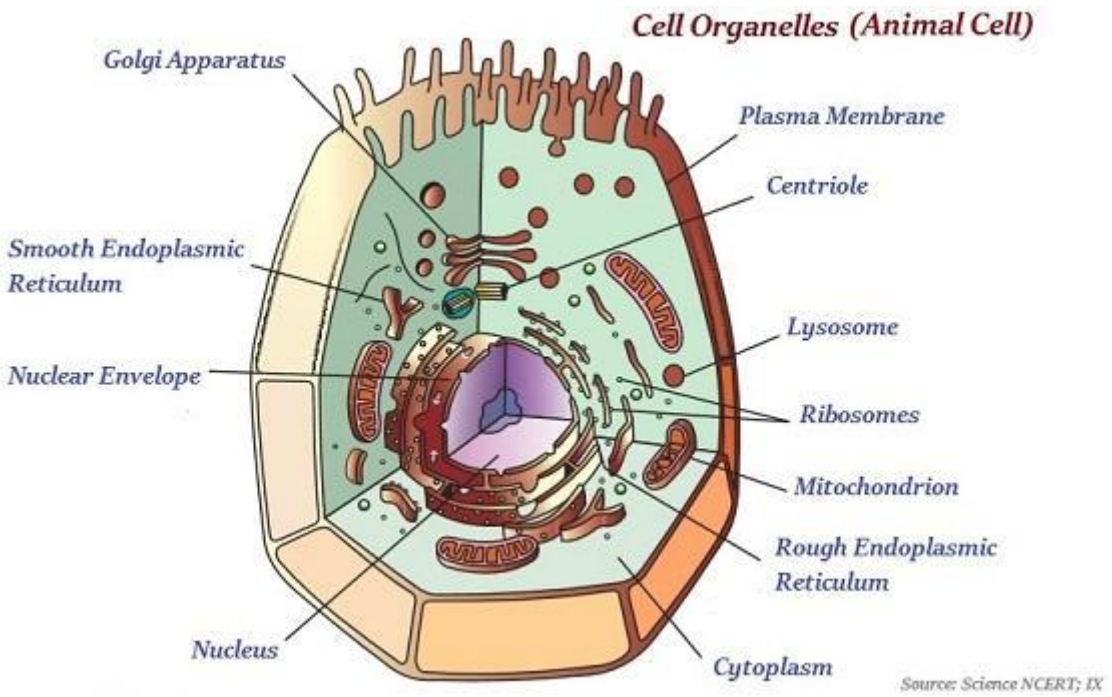
Cytoplasm

- Cells consist of cytoplasm inside the cell membrane, which contains many biomolecules including proteins and nucleic acids.
- There are many structures found in the cytoplasm known as cell organelles.

Cell Organelles

Following are the major cell organelles that play a major role in the functioning of cell:

- Nucleus
- Endoplasmic Reticulum
- Ribosome
- Golgi apparatus
- Lysosomes
- Mitochondria
- Plastids
- Vacuoles



Endoplasmic Reticulum

- The endoplasmic reticulum (or simply ER) is a large network of membrane-bound tubes and sheets (see the image given above).
- Based on visual structure, ER is categorized as **rough endoplasmic reticulum** (RER) and **smooth endoplasmic reticulum** (SER).
- When the ribosome attached on the surface of ER, it is known as Rough Endoplasmic Reticulum and without ribosome, it is known as Smooth Endoplasmic Reticulum.
- The SER helps in the manufacturing of fat molecules, or lipids, which is important for cell functioning.
- One of the significant functions of ER is to serve as channels for the transportation of materials (especially proteins) in various regions of the cytoplasm and also between the cytoplasm and the nucleus.

Ribosome

- The ribosomes, normally, present in all active cells.
- Ribosome are the sites of protein manufacturing.

Golgi Apparatus

- The Golgi Apparatus is named after the name of its discover Camillo Golgi.
- Golgi Apparatus consists of a system of membrane-bound vesicles arranged roughly parallel to each other in stacks known as **cisterns** (see the image given above).
- The significant functions of Golgi Apparatus are the storage, modification, and packaging of products in vesicles.
- The Golgi apparatus also helps in the formation of lysosomes.

Lysosomes

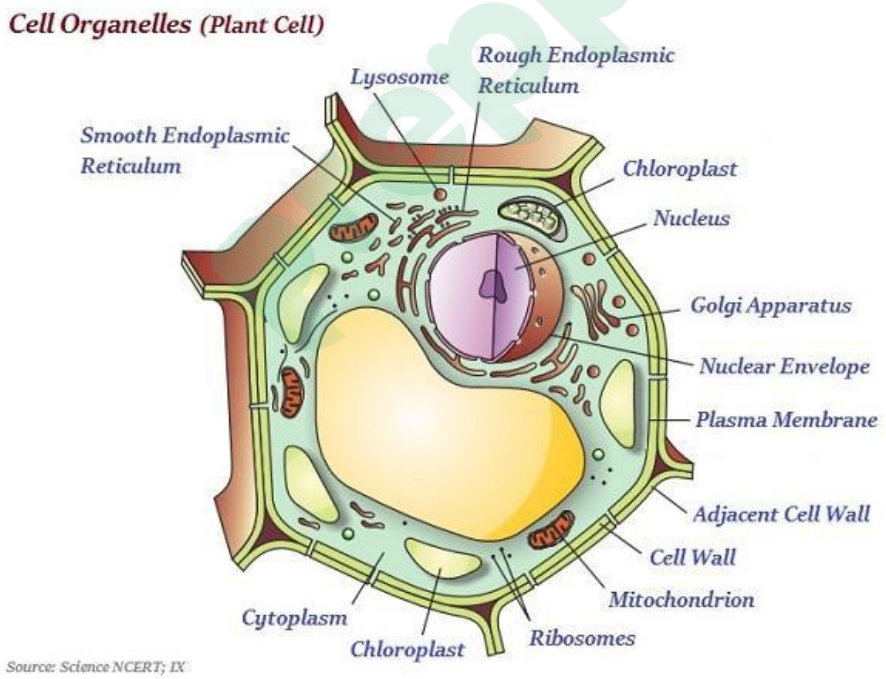
- Lysosomes are a sort of waste disposal system of the cell.
- Lysosomes help in keeping the cell clean by digesting the foreign material as well as worn-out cell organelles.
- Lysosomes contain powerful digestive enzymes capable of breaking down all sorts of organic materials.
- Lysosome has a typical feature i.e., when the cell gets damaged lysosome most likely bursts and the released enzymes digest their own cell. Because of this reason, lysosome is also known as the 'suicide bags' of a cell.

Mitochondria

- Mitochondria, commonly, are known as the powerhouses of the cell.
- Mitochondria release the energy required for various chemical activities (essential for the life).
- Mitochondria release energy in the form of ATP (Adenosine Triphopshate) molecules.
- ATP is popular as the energy currency of the cell.
- Mitochondria have their own DNA and ribosomes; hence, they are capable to make some of their own proteins.

Plastids

- Plastids are present only in the plant cells (see image given below).



- Plastid is categorized as – **Chromoplasts** (it is colored plastids) and **Leucoplasts** (It is either white or colorless plastids).
- Plastids contain chlorophyll pigment, which are known as **Chloroplasts**.
- Chloroplasts play important role in the photosynthesis in plants.
- Chloroplasts also contain various types of yellow or orange pigments.
- Leucoplasts are the organelles in which some important materials such as starch, oils, and protein granules get stored.
- Plastids look like mitochondria (in terms of external structure).

- Like the mitochondria, plastids also possess their own DNA and ribosomes.

Vacuoles

- Vacuoles are commonly the storage sacs that contain solid or liquid materials.
- In animal cell, vacuoles are small; whereas in plant cell, vacuoles are of large size.
- Plant cells vacuoles are filled with cell sap and provide turgidity and rigidity to the cell.

Cell Division

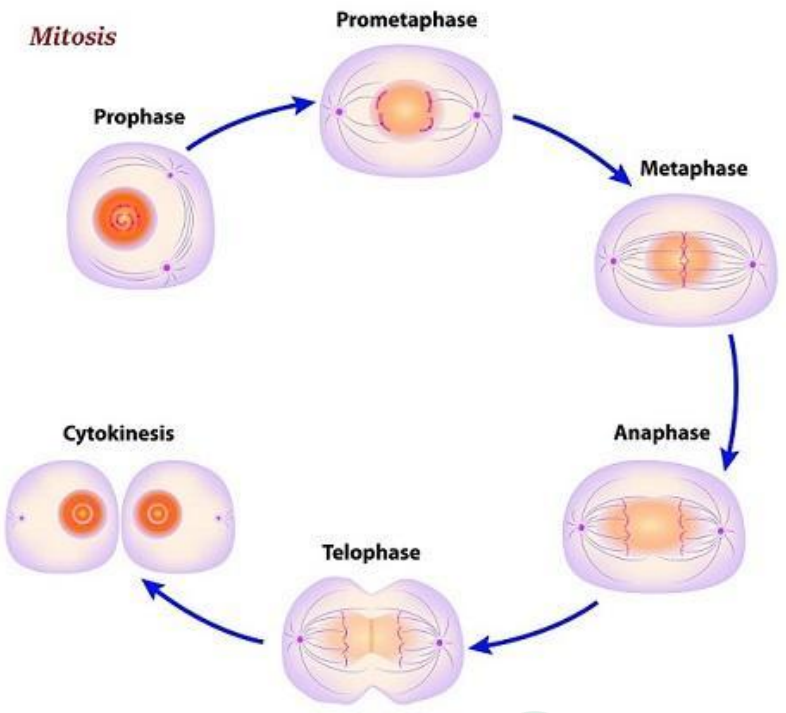
- The process of division of parent cell into two or more daughter cells is known as cell division.
- In early 1880s, Flemming first observed the process of cell division.
- Following are the three types of cell division –
    - **Amitosis**
    - **Mitosis**
    - **Meiosis**

Amitosis

- Parent cell gets divided into two parts, and each of them grows as a new complete organism.
- Amitosis can be seen in less developed organisms. E.g. bacteria.
- Amitosis is also known as binary fission.
- There is no stage of division, cell directly gets divided into two new organisms.

Mitosis

- The process of division of parent cell into two new identical cells is known as mitosis.
- In both the new cells, the number of chromosomes remain same.
- Mitosis (cell division) occurs only in eukaryotic cells.
- In mitosis, the division of the nucleus is preceded by the S stage (i.e., interphase - during this phase, the DNA is replicated).
- After the interphase, the cytokinesis process begins, which divides the cytoplasm, cell organelles, and cell membrane into two new cells.
- The process of mitosis is divided into the following stages:
    - **Prophase**
    - **Prometaphase**
    - **Metaphase**
    - **Anaphase**
    - **Telophase**
- The stages of mitosis are described in the following image –



Prophase

- During the prophase, cell prepares to get divided.
- The prophase process is also known as chromosome condensation, as chromatin fibers condense into discrete chromosomes.
- Each chromosome has two chromatids and these two chromatids are joined at a place known as centromere.

Prometaphase

- In this phase, the nuclear envelope gets disintegrated into small membrane vesicles.

Metaphase

- In this phase, the two centrosomes start pulling the chromosomes towards opposite ends of the cell and ensure the equitable distribution of chromosomes.

Anaphase

- In this phase two identical daughter chromosomes are formed.

Telophase

- Telo is a Greek word meaning **'end'**.
- In this phase, the nuclear envelop gets broken and a new nuclear envelop forms.
- The new envelope gets formed around each set of separated daughter chromosomes; parallel, the nucleolus reappears.
- Likewise, the mitosis is complete.

Cytokinesis

- Cytokinesis, technically, is not a phase of mitosis, but rather a distinct process, essential for completing the cell division.

- In this phase, cytoplasm begins to divide and completed with the development of two new identical cells.

Meiosis

- Meiosis is a typical type of cell division in which the chromosome number gets reduced by half, creating four haploid cells. Each cell is genetically distinct from the parent cell.
- Meiosis cell division process occurs in all sexually reproducing single-celled and multicellular eukaryotes, including plants, animals, and fungi.
- Meiosis cell division is primarily categorized as Meiosis I and Meiosis II.