Cell:

Definition:

The smallest structural and functional unit of an organism, typically microscopic and consisting of cytoplasm and a nucleus enclosed in a membrane.

OR

The cell is the functional basic unit of life. It was discovered by Robert Hooke and is the functional unit of all known living organisms. It is the smallest unit of life that is classified as a living thing, and is often called the building block of life.

Cell Structure And Functions (Plant & Animal Cell)

1. Cell wall

- Most commonly found in plant cells
- Controls turgidity
- Extracellular structure surrounding plasma membrane
- Primary cell wall: extremely elastic
- Secondary cell wall: forms around primary cell wall after growth is complete

2. Plasma membrane

- Outer membrane of cell that controls cellular traffic
- Contains proteins (left, gray) that span through the membrane and allow passage of materials
- Proteins are surrounded by a phospholipid bi-layer.

3. Protoplasm

-colourless, semitransparent, viscous granular fluid present inside the cell is called as protoplasm.
-colloidal in nature and considered as physical basis of life.
-exhibits the active streaming movement called cyclosis
-it consists of water, protein, lipid or fats, carbohydrates, enzymes, salts, nucleic acid in a fixed proportion.
-it is divided into Nucleus and Cytoplasm

4. Cytoplasm

-Protoplasm outside the nucleus is called cytoplasm
-all the organelles are present in the cytoplasm like;

i) Endoplasmic reticulum

- Tubular network fused to nuclear membrane
- Goes through cytoplasm onto cell membrane
- Stores, separates, and serves as cell's transport system
- Smooth type: lacks ribosomes
- Rough type (pictured): ribosomes embedded in surface

ii) Golgi apparatus

- - Composed of numerous layers forming a sac
- Works as the distribution and shipping department of the cell's chemical product.

iii) Lysosome

- - Digestive 'plant' for proteins, lipids, and carbohydrates
- Transports undigested material to cell membrane for removal
- Vary in shape depending on process being carried out
- Cell breaks down if lysosome explodes

iv) Mitochondria

- Second largest organelle with unique genetic structure
- Double-layered outer membrane with inner folds called cristae
- Energy-producing chemical reactions take place on cristae
- Controls level of water and other materials in cell
- Recycles and decomposes proteins, fats, and carbohydrates, and forms urea

v) Ribosomes

- Each cell contains thousands
- Miniature 'protein factories'
- Composes 25% of cell's mass
- Stationary type: embedded in rough endoplasmic reticulum
- Mobile type: injects proteins directly into cytoplasm

vi) Vacuoles

- Membrane-bound sacs for storage, digestion, and waste removal
- Contains water solution
- Contractile vacuoles for water removal (in unicellular organisms)

vii) Chloroplasts

- A plastid usually found in plant cells
- Contain green chlorophyll where photosynthesis takes place

viii) Cytoskeleton

- Composed of microtubules
- Supports cell and provides shape
- Aids movement of materials in and out of cells

ix) Centrioles

- Paired cylindrical organelles near nucleus
- Composed of nine tubes, each with three tubules
- Involved in cellular division
- Lie at right angles to each other

5. Nucleus:

-Control centre of the cell
-Serves as information processing and administrative centre of the cell
-Performs the following major functions:
a) stores the cell's hereditary material, or DNA
b) coordinates the activities of the cell, which includes growth, metabolism, protein synthesis, and reproduction or cell division.

i) Nuclear membrane

- Surrounds nucleus
- Composed of two layers
- Numerous openings for nuclear traffic

ii) Nucleolus

- Spherical shape
- Visible when cell is not dividing
- Contains RNA for protein manufacture

iii) Chromosomes

- Usually in the form of chromatin
- Contains genetic information
- Composed of DNA
- Thicken for cellular division
- Set number per species (i.e. 23 pairs for human)

Difference Between Animal And Plant Cell:

1) Cell Wall OR Cell Membrane

- The outer boundary of plant cells is known as the cell wall, which is mainly composed of cellulose.
- It helps the plant cell to maintain its shape.
- The cell wall is absent in animal cell.
- In animal cell the outer covering is known as cell membrane which is composed of lipid bilayer, proteins and carbohydrates.

2) Plastids

- Plants cells also contain organelles which are known as plastids.
- The most common type of plastid is the chloroplast which contains chlorophyll.

- These organelles or plastids are totally absent in animal cell.

3) Vacuole

- The main difference between the vacuole of animal and plants is their size.
- The vacuole of plant cell is much bigger than that of animal cells.

4) Centrosomes

- In animal cells centrosomes are present, which are responsible for making some protein fibres which help in movement of chromosomes during division of cells.
- Centrioles are absent in the plant cells.

5) Lysosome

- Lysosomes are not evident in plants while they are prominent in animal cells.

Cell Division:

The process in which the cells divide and replicate. This process is the basis for growth and replication. There are two main types of cell division, which are as under:

1) Mitosis
2) Meiosis

Mitosis:

A type of cell division in which a cell divides into two identical daughter cells each having same number of chromosomes as that of parent cell.

Stages Of Mitosis:

There are four stages of mitosis, which are as under:

i) Prophase
ii) Metaphase
iii) Anaphase
iv) Telophase

i) Prophase:

- Prophase is the first phase of mitosis.
- Chromatin material condenses and becomes visible
- The nucleolus of the cell disappears
- The nuclear membrane also disappears
- Centrioles begin to move opposite ends of the cell

ii) Metaphase:

- Metaphase is the second stage of mitosis.
- Chromosomes line up in the centre of the cell, separate and become a pair of identical chromosomes.
- The chromatids become uncoiled and apart from each other.

iii) Anaphase:

- It is the third phase of mitosis.
- During this phase each set of chromosomes move towards the opposite end of the cell.

iv) Telophase:

- The fourth phase of mitosis is known as Telophase.
- During this phase spindle fibres disappear.
- Nuclear membrane appears
- Cell divides into two daughter cells
- Nucleolus re-appear
- The chromosomes disperse and are no longer visible.

Significance Of Mitosis:

1. Growth: The number of cells within an organism increases by mitosis and this is the basis of growth in multicellular organisms.
2. Cell Replacement: Cells are constantly sloughed off, dying and being replaced by new ones in the skin and digestive tract. When damaged tissues are repaired, the new cells must be exact copies of the cells being replaced so as to retain normal function of cells.

3. Regeneration: Some animals can regenerate parts of the body, and productions of new cells are achieved by mitosis.\
4. Vegetative Reproduction: Some plants produce offspring which are genetically similar to themselves. These offspring are called clones.

Meiosis:

A type of cell division in a cell divides into four daughter cells with having half number of chromosomes as compared to parent cell.

Characteristics Of Meiosis:

- Takes place in sexual reproduction at the time of formation of male and female gametes
- In animals it takes place during the formation of sperms and ova while in plants during spore formation
- Diploid cells reduce to haploid cells
- Consists of two consecutive divisions
- First division is reductional or meiotic and the second is simple mitotic division.

Stages Of Meiotic Division:

i)	Prophase	I
ii)	Metaphase	I
iii)	Anaphase	I
iv)	Telophase	I
v)	Prophase	II
vi)	Metaphase	II
vii)	Anaphase	II
viii)	Telophase	II

Prophase I:

Prophase I consists of 5 sub stages, these are:

a. Leptotene

- Nucleus increases in size
- Chromosomes become long and uncoiled threads
- They become more visible

b. Zygotene

- Homologue (similar) chromosomes attract each other and form pairs.
- This process is called synapses

c. Pachytene

- Chromosomes become condensed due to widening of coils
- They form chiasmata i.e. cross each other in double nature or bivalents.

d. Diplotene

- Homologous chromosomes go apart from each other except at chiasmata
- Chromosomes become more short and thicker

e. Diakinesis

- The bivalents become more apart.
- Chromosomes become deeply stained
- Nucleolus and nuclear membrane disappear and spindles become distinct

Metaphase I:

- Chromosomes now rearrange themselves in an equatorial line
- Spindles attach to the centrosome of the chromosomes

Anaphase I:

- Spindles start to contract
- Split the tetrahedral chromosomes into two chromatids and drag them to opposite poles
- Here the reduction takes place.

Telophase I:

- Spitted chromosomes reach to opposite poles
- Nucleolus and nuclear membrane reappear

- At the end of Telophase I, prophase II starts.

Prophase II:

- Chromatin network breaks into bivalent chromosomes
- Nuclear membrane and nucleolus disappear and spindles start to reappear

Metaphase II:

- Bivalent chromosomes rearrange themselves at equator
- Spindles attach to the centrosomes of each chromosome

Anaphase II:

- Spindles contract and split the chromosomes longitudinally into two chromatids
- Each chromatid travel to opposite pole

Telophase II:

- Each chromatid reach to the opposite pole
- Spindles disappear and nuclear membrane and nucleoli reappear
- As a result 4 nuclei are formed

Significance Of Meiosis:

- To allow trait inheritance in offspring
- To maintain diploid number in each generation
- To ensure the production of haploid gametes in sexual reproduction
- To produce genetic variations among offspring

Classification Of Plants:

Plants are those organisms which contain chlorophyll and synthesize their own food through photosynthesis. Plants are divided into:

1) Flowering Plants OR Phanerogams
2) Non-Flowering Plants OR Cryptogams

Flowering Plants:

Flowering plants are those plants which contain seed. These are known as Phanerogams. They are further subdivided into:

i) Gymnosperms
ii) Angiosperms

Gymnosperms:

Gymnosperms are those flowering plants which contain naked and unprotected seeds. **Examples:** Pine, Fir, Cedar, Spruce and Cypress etc.

Angiosperms:

Angiosperms are those flowering plants whose seeds are protected by a fruit or seed pod. **Examples:** Grass, Crops, Vegetables, Fruits and weeds.

Non-Flowering Plants:

Non-Flowering plants are also known as cryptogams. These are the plants which do not have seed or in other words they are seedless. Following are the main characteristics of these plants:

- They reproduce by spores
- They have long life
- They have no long fibres
- They cannot grow to greater size
- They generally have simple structure, except ferns.

Examples: Moses, Ferns, Algae.

Flower & Its Parts:

The flower is the reproductive part of the plant. It is mainly concerned with formation of seeds. It is regarded as the modified shoot for the purpose of reproduction.

Parts Of Flower:

A typical flower consists of a short axis known as the thalamus, on which floral leaves are inserted in four distinct whorls, which are as under:

i) Calyx
ii) Corolla
iii) Androecium
iv) Gynaecium

Calyx:

Calyx is the outermost whorl of floral leaves called sepals. The sepals can be defined as the green and leaf like structures which are mainly concerned with the protective function.

Corolla:

Corolla is the second whorl of floral leaves called petals. The petals are beautifully coloured which are responsible for the attraction to the insects towards them.

Androecium:

The third whorl of the leaves consists of stamens. It is considered as the male part of the flower.

Gynaecium:

Gynaecium is the inner most whorl of the floral leaves called carpels. It is considered as the female part of the flower.

Parts Of Plants:

i) Ginger: Modified Stem (rhizome) and it is also a root.
ii) Cinnamon: Bark of stem
iii) Radish: Root
iv) Potato: Stem (tuber)
v) Peanut: Seed
vi) Saffron: Stigma/flower
vii) Almond: Fruit
viii) Chillies: Fruit
ix) Spinach: Leaves
x) Tomato: Fruit
xi) Turnip: Root
xii) Carrot: Root
xiii) Cucumber: Fruit

Photosynthesis:

Definition:

Photosynthesis is a process in which plants manufacture their food (simple carbohydrates) in the presence of chlorophyll and sunlight by the combination of carbon dioxide and water.

Raw Material For Photosynthesis:

i) Carbon dioxide: Taken from air
ii) Water: Absorbed by roots from soil
iii) Sunlight: From Sun
iv) Chlorophyll: green pigment present in leaves

By-Products Of Photosynthesis:

i) Carbohydrates (simple sugar): used by plants as a food material and excess of it is converted into starch
ii) Oxygen: Released into air

Importance Of Photosynthesis:

i) Major process of food production in plants
ii) Utilization of CO_2 of the atmosphere and liberation of oxygen

iii) Important in reducing CO2 of the atmosphere which is dangerous for the human beings as well as animal health.

Pollination:

Definition:

Pollination is the phenomenon of transfer of pollen from male reproductive organ (anther) to female reproductive organ (stigma) in flowering plants through biological or physical agency.

Types Of pollination:

There are two types of Pollination

i) Self-Pollination:

In this type of pollination pollens are transferred to the stigma in the same flower. Some plants are by nature self-pollinated as wheat and grasses.

ii) Cross Pollination:

In this type the pollen grains are transferred from the anther of one flower to the stigma of another flower. The cross pollination is considered and advantageous to the plant as the seeds produced by cross-pollination are usually greater in number and the plant germinated from them are superior in vigour, height and weight.

Vehicles For Pollination:

Vehicles for pollination are animals, water, wind and insects. Therefore cross pollination may be:

a) Entomophily-by insects
b) Anemophily-by wind
c) Hydrophily-by water
d) Zoophily-by animals

Importance Of Pollination:

- Vital process for reproduction in plants
- Reproduction is carried out by reproductory organs of plants due to pollination
- It is the process by which seeds are produced.

Fertilization:

The fusion of male and female gametes is called fertilization.

Types Of Fertilization:

Following are the major types of fertilization:

i) External Fertilization
ii) Internal Fertilization
iii) Self-Fertilization
iv) Cross-Fertilization

External Fertilization:

- This type of fertilization is generally observed I simple aquatic animals.
- In such animals both ova and sperms are released into the water where fertilization occurs.
- In terms of evolution external fertilization is of primitive type and is not better biologically as compared to internal fertilization.

Internal Fertilization:

- In the internal fertilization the females keep ova inside their bodies and males deposit sperms within the tube of reproductive tacts of females.
- For all land animals internal fertilization is almost must because sperms are quickly killed by dehydration.

• In terms of evolution internal fertilization is highly evolved and much better biologically as compared to external fertilization.

Self-Fertilization:

• Self-fertilization occurs within the same animal.
• It is that fertilization in which sperms are used by the ovaries of same animal e.g. Tapeworm

Cross-fertilization:

• Cross-fertilization is the process in which sperms of one animal are transferred into the body of another animal e.g. Earthworm.