

Study of Cell (Cytology)

1. Cell : Cell is the basic structural and functional unit of life.
2. The word 'cell' was first coined by British scientist Robert Hook in the year 1665.
3. The smallest cell is Mycoplasma gallisepticum.
4. The longest cell is Neuron.
5. The biggest cell is egg of Ostrich.
6. Schlden and Schwan established cell theory in the year 1838-39

Main features of the cell theory :

1. All organism are composed of cell.
2. Body of every organism is made of cell.
3. Each cell arises from pre-existing cell
4. Every organism starts its life from single cell.

Cell is of two kinds

1. Prokaryotic cell : These are primitive cell having three basic structure of typical cell but lack nuclear membrane. Nuclear material is present in a region of cytoplasm called nucleoid. Other membrane bound organelles are absent such as mitochondria, ribosome, golgi bodies etc. Ex.- Virus, bacteria and cyanobacteria are Prokaryotes.

2. Eukaryotic cell : These are complete cell which contain membrane bound organelles and nucleus. Unicellular and multicellular plant and animal have Eukaryotic cell.

Structure of typical cell : A cell have following structure.

1. **Cell wall :** In plant cell there is a rigid cell wall which is non living and freely permeable. It is made up of cellulose and chitin. It provide shape and rigidity to the cell.
2. **Cell membrane :** It is also known as plasma membrane which form the outer covering of animal cell. In plant cell it is found within cell wall. It is thin, elastic, living, double layer, permeable membrane. It is made up of phospholipid molecules.

Function : It regulates movement of molecules inside and outside of the cell.

3. Protoplasm : The whole fluid present inside plasma-membrane is protoplasm. The name protoplasm is given by Purkenje in 1839. Protoplasm is made up of various chemical substances like water, ions, salt and organic molecule. It is the living part of cell. Protoplasm is divided into two parts.

A. Cytoplasm : The fluid found outside the nuclear membrane.

B. Nucleoplasm : The fluid found inside the nuclear membrane.

4. Mitochondria : Discovered by Altman in the year 1886. These are cylindrical, rod shaped or spherical structure found in cytoplasm. It is surrounded by double layered membrane. Inner membrane has many fold called cristae. The fluid present inside mitochondria is called matrix, which contain many enzyme & co-enzyme

Function : Mitochondria is the respiratory site of cellular respiration. Mitochondria synthesize energy rich compound. ATP. It is also known as "Power House" of the cell.

5. Golgi bodies : Discovered by scientist Camillo Golgi. Golgi bodies are made up of group of tubes, vesicles and vacuoles. In plant it is more in number and here it is known as dictyosomes.

Function : It work as storage, providing and packaging of material. It also involved in the synthesis of cell wall, plasma membrane and lysosomes.

6. Endoplasmic reticulum : Membranous network of tubules like structure found in cytoplasm is called endoplasmic reticulum. It is attached with the nucleus on one side and on other side it is joined with plasma membrane.

Function : Endoplasmic reticulum helps in the distribution of material. It forms supporting framework of cell.

7. Ribosome : Discovered by Palade. Small granules like structure found attached to the endoplasmic reticulum or in free state. It is made up of ribonucleic acid. (RNA)

Function : Take part in protein synthesis.

8. Lysosome : Discovered by De Duve. These are sac like structure bounded by single membrane and contain hydrolytic enzyme.

Function : It helps in intracellular digestion. The enzyme found in lysosome may digest the entire cell. So it is also known as suicidal bag.

9. Centrosome : Discovered by Boveri. It is only found in animal cell taking part in cell division. It is not bounded by membrane consist of two centriole.

Function : Help in the formation of spindle fibre during cell division.

10. Plastid : Only found in plant cell. It is of three type : (a) Chloroplast (b) Chromoplast (c) Leucoplast.

(a)Chloroplasts : These are green pigment found in green plant involve in photosynthesis. So, it is known as 'Kitchen of the cell'. Chloroplast is bounded by two unit membrane having grana and stroma. Grana are membrane bounded like structure found in stacks containing chlorophyll molecule. Stroma is the medium present inside the chloroplast which contain photosynthetic enzymes and starch grain. Grana is the site of light reaction during photosynthesis while stroma is the site of dark reaction.

Function : Chloroplast provides green colour to plant & take part in photosynthesis.

(b) Chromoplast provides various colours to the plant.

(c) Leucoplast is colourless. It stores the food in the form of starch, fat & protein.

11. Vacuole : These are fluid filled single membrane bounded, dead organelles of cell. In plant cell it is larger in size but in animal cell is smaller in size.

Function : It helps in osmotic regulation. It stores toxic metabolic waste.

12. Nucleus : The nucleus is a spherical, centrally located is a major structure found in the cell. In plant cell it is shifted towards periphery. It is bounded by double layered nuclear membrane having pore. Within nucleoplasm nucleolus and chromatin material is present. Nucleolus is rich in protein and RNA. Chromatin material is thin thread like structure forming network. This is made up of genetic substance DNA (deoxyribonucleic acid) and histone protein. During cell division chromatin breaks into pieces and forms chromosome.

Function : It controls all the activity of cells. So it is also known as "control room" of cell. Chromatin transmits hereditary characters from parents to their offspring.

Chromosome

1. Chromosome is thread like structure found in the nucleus. It becomes visible during cell division. Each chromosome is made up of two chromatids joined together at a point centromere. Bead like structure found on chromosome is called gene. Genes are made up of DNA (deoxyribonucleic acid) which is the carrier of genetic information from

generation to generation. In some viruses RNA is the genetic material called rietrovirus. In prokaryotes there is only one chromosome, like bacteria and viruses.

2. Eukaryotic cell posses many chromosome. A particular kind of species have definite number of chromosome in their cell, which are in pair known as diploid. The set of impaired chromosome is called haploid. Gametes have haploid set of chromosome.

Nucleic Acid : Nucleic acid is complex organic compound found in cell. It contains special genetic instruction in coded form. Nucleic acids are of two kinds.

A. Deoxyribo nucleic Acid (DNA) : Frederic Meischer was the first wh isolat ed DNA from the nucleus of pus cells. DNA is a macromolecule in which large n mber of nucleotides are present. Chemically a nucleotide has three comp s. (1) Nitrog n base (2) Sugar (3) Phosphate group.

---> Nitrogen base are of two type—Purines & Pyrimidine ines cont n two nitrogen base—Adinine and Guanine. Pyrimidine nitrogen base ar Thym e and Cytosine. Thus there are four kinds of nucleotides present in DNA.

Watson and Crick give the structural model of DNA —

1. DNA molecule is consists of two polynucle ide strand forming a double helix. Each strand has a backbone of sugar and phosph te. Nitrogen b se is attached to the sugar.

2. Nitrogenous base of the two strands of double helix form a pair with the help of hydrogen bonds. Adenine pairs wi h ymin where as guanine pairs with cytosine. Adenine and thymine are c mplementa y to ea h other and cytosine is complementary to guanine. Hydrogen bonding b ween nitro nous base holds the two strands together. This structure can be com red w th the steps of spiral staircase.

Function : 1. It cont n genetic formation in coded form.

2. DNA synthesise RN

Not : DN is ainly found in nucleus. In small amount it is also found in mitochondria and chloropla

Gene : Gen is her ditary unit which is made by a segment of DNA found on the chromosome.

B. Ribonucleic A id (RNA) : RNA is single stranded nucleic acid made up of phosphate, ribose sugar and nitrogen base uracil, adinine, guanine and cytosine. It is found in nucleus as well as cytoplasm.

RNA is of three kind.

- 1. Messenger RNA (mRNA) :** It brings the message from DNA found in the nucleus to cytoplasm in the coded form.
- 2. Ribosomal RNA (rRNA) :** Present in ribosome which is the site of protein synthesis.
- 3. Transfer RNA (tRNA) :** It is the carrier of amino acid and transfer it to the ribosome.

Function : Synthesis of protein.

Difference between RNA and DNA

---> **Cell cycle :** It is the sequence of events in which cell duplicates its genetic material, synthesise the other constituents of cell and ultimately divide into daughter cells.

---> **Cell Division :** The process in which cell increase in the number is cell division. It is needed for growth, development and repair of body. There are mainly two kind of cell division.

A. Mitosis : Mitosis cell division occur in somatic cell which take part in growth, repair and development. In unicellular organism asexual reproduction takes place by this type of cell division.

---> **Significance of Mitosis :** 1. After Mitosis cell division one cell divided into two daughter cell in which number of chromosomes is equal to the parent cell.

2. Uncontrolled Mitosis may cause tumor or cancerous growth.

B. Meiosis : 1. Meiosis cell division occur in reproductive cell. This type of division takes place during the formation of haploid gamete. i.e. ova & sperm.

2. It is also known as reduction division during which each daughter cell have haploid number of chromosome.

3. Four daughter cells are produced from one meiotic cell division.

Terms related to Cytology :

- 1. Karyokinesis :** Division of nucleus during cell division called Karyokinesis.
- 2. Cytokinesis :** Division of cytoplasm called cytokinesis.
- 3. Diploid :** Two complete set of chromosome is called diploid, found in somatic cell.

4. **Haploid** : Single set of chromosome in cell is called haploid found in gametes.
5. **Crossing over** : Exchange of genetic material between two non sister chromatids takes place during meiosis cell division is called crossing over.
6. **Homologous chromosome** : A pair of chromosome having same size and shape bearing corresponding gene.
7. **Phenotype** : The character of organism which can be seen directly.
8. **Genotype** : Genetic constitution of organism is called genotype.
9. **Tonoplast** : The membrane surrounding the vacuole.
10. **Unit membrane** : The basic trilamilar structure of cell membrane.

