E-Study material
For 1st Semester Botany Honours (CBCS)
Course Code: BC102 T
Core Course II: BIO-MOLECULES AND CELL BIOLOGY
Unit 1: The cell, cell wall and plasma membrane
Topic: Introduction to cell structure and Function

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Q. Who discovered cell?
Ans: **Robert Hooke** discovered Cell in **1665**. He published his observations in his book **Micrographia.**

Q. Who discovered living cell?
Ans:
Anton Von Leeuwenhoek *in* 1674 discovered the living cell like bacteria, protozoan and blood cells etc.

Q. Who confirmed that plants are made up of cells?
Ans: **Dutrochet** confirmed that plants were made up of cells.

Q. What do you mean by Cell theory? Who proposed it? What are the postulations of cell theory?
Ans:
Cell theory:
M.J. Schleiden, a German botanist in **1838** stated that "*All plants are formed of one or more cells*'. **Theodre Schwann**, a German Zoologist in **1839** stated that "*All animals are formed of cells, have nuclei and were enclosed by thin cell membrane instead of thick cell wall as found in plant cells*'. Schwann also described the cell as membrane bound, nucleus containing structure. On the basis of their discoveries, **M. J. Schleidlen (1838)** and **Theodor Schwann. (1839)** postulated cell theory.

Postulations of Cell Theory
The various points of cell theory are:
1. Cells are the structural unit of life:
Organisms whether unicellular or multicelluar are composed of cells and their products Each cell is made of a small mass of protoplasm having a nucleus and bounded by a cell membrane with or without cell wall.

2. Cells are the functional unit of life:
Every cell carries out all essential functions such as respiration, nutrition, growth etc. They perform independently but function as integral part of the complete organism Therefore; the functions of organisms are due to activities and interactions of its cells.
3. Life begins with a single cell:
Single celled zygote is the first cell from which full flagged organism is formed.
4. Cells originated from pre-existing cell:
Rudolf Virchow in 1858 observed that new cells arise from pre-existing cell by division i.e., ***Omnis cellula e cellua*** Cell theory was first modified in the light of Virchow's findings that cells develop from pre-existing cells and not from a single cell

Q*. What are the various limitations or drawbacks of cell theory?*
Ans:
Important drawbacks to cell theory are given below:
1. Viruses are regarded as exception to the cell theory. In fact, they are not organisms and are not expected to be covered by the cell theory. They consist of a nucleic acid (DNA or RNA) core surrounded by a protein sheath.
2. Bacteria and blue-green algae do not have an organized nucleus. Their genetic material (DNA) is not enclosed by a nuclear envelope and lies directly in the cytoplasm.
3. Certain fungi, such as ***Rhizopus*** and algae like ***Vaucheria*** is composed of a multi-nucleated mass of cytoplasm without division into cells.
4. Some tissues, e.g., connective tissues, have a good deal of nonliving material, the matrix, between the cells. There is no mention of intercellular material in the cell theory.
5. RBC of mamals and sieve tubes of phloem do not contain nuclei. Cell theory unable to explain these facts.
6. The mature human red blood cell loses its capacity for aerobic respiration, DNA replication and RNA synthesis.
7. Mature nerve cells are incapable of division.
8. Liver cells and muscle cells retain mitotic ability but seldom divide normally.

Q. *Who modified cell theory? What is cell principle or modern cell theory?*
Ans:
Modern cell theory or cell principle or cell doctrine was proposed by **Rudolf Virchow (1858)** in his Book " **CELLULAR PATHOLOGY**" states that all organism are made up of cells and cells arise from pre-existing cells (***Omnis cellula e cellula*** i.e. all cell originated from pre- existing cell.) It is known as law of cell lineage Thus **Rudolf Virchow** modify the cell theory. Numbers of other modifications were carried out in cell theory. The modern cell theory is known as cell principle because it is universally applicable to life.
The various points Modern Cell Theory are:
1. A cell is a small mass of protoplasm usually contain a nucleus or nuclear material and some other organelles, and is bounded by a cell membrane. A cell organelle does not survive alone.
2. Cells always arise from the pre-existing living cells by division. They never arise *de novo*. The new cells are like the parent cell in all respects.
3. Cell is also a unit of function. All metabolic activities takes place within cell,
4. Life exists only in cells.
5. Cells maintain homeostasis to remain alive.

6. Genetic information is stored and expressed within the cells. A cell, though an integral part of an organism, can act (grow, divide and die) independently of the other cells around it.
7. Life passes from one generation to another of the organisms in the form of cells.
8. Protoplasm is the physical basis of life.
9. All metabolic activities takes place within cell
10. Cells undergoes reproduction

Q. "Cell as an Autonomous Unit" Explain
OR
"Cell is a self contained unit" explain
Ans:

Cell is regarded as an Autonomous Unit due to following reasons

1. All cells are basically capable of independent existence and work as autonomous units.
2. The cells perform fundamental biological functions independently such as nutrition, respiration, excretion, multiplication, homeostasis, synthesis of proteins and other complex molecules.
3. The cells produce daughter cells by cellular division with similar hereditary characters.
4. Each cell maintains the essential internal physiochemical conditions for its survival and to regulate its activities.
5. The cells pass out their metabolic wastes in the form of CO_2 and H_20. Each cell during nutrition takes food and synthesizes the living protoplasm.
6. Energy liberated is utilized for various metabolic activities. Some energy is also stored in the form of ATP molecules.
7. Each cell has its fixed life span. Each cell is thus an autonomous unit of an organism.

Q. ***Why in multicelluar organisms cells cannot be considered as autonomous unit?***

Ans: The autonomous unit characters may not hold true in multicelluar organisms because

1. The cells are specialized for additional functions such as nutrition, respiration, reproduction, secretion, support, protection etc, along with their fundamental life processes. There is a division of labour in multicelluar organism. Some cells secrete extracellular material to hold the cells together, some carry out reproduction, some transmit nerve impulses and some bring about contraction.
2. Their cells show interaction and co-operation with one another to give a cumulative effect to exhibit life processes. Cells regulate energy and flow of information. In these some cells receive information from other cells for their functioning e.g., nerve cells.
3. Due to specialization, certain cells of multicelluar organisms lose certain activities essential for autonomy either temporarily or permanently e.g., erythrocytes do not respire lose the ability to multiply permanently. Muscle cells normally do not divide. But all specialized cells retain the capacity for their independent existence since these carryon fundamental biological processes. This has been demonstrated through cell culture or tissue culture techniques. In this technique, the cells are isolated from the multicellular organism and are grown in a sterile nutrient medium under suitable controlled conditions.

Q. ***What do you mean by Tissue Culture (in vitro culture) ? Who discovered it?***

Ans: Tissue culture is a technique of culturing living somatic cells in artificial medium under aseptic conditions. The idea of tissue culture was developed by **Haberlandt (1902).**

Q. ***What do you mean by callus?***

Ans: Cells in tissue culture divide to form undifferentiated mass of cells called callus.

Q. What do you mean by cellular totipotency? Disscus the experiment of Steward regarding totipotency

Ans:

Cellular Totipotency

Cellular totipotency refers that vegetative cells of a plant body have got all the potentialities to grow into a new plant. **Gottlieb Haberlandt (1902),** a German botanist, was first to grow on culture, cells isolated from plant. Although he was unsuccessful in his attempts to culture cells of leaves, he gave the concept of tolipotency. The term totipotency was given by **Morgan**. The first evidence of cellular totipotency was given by **F. Steward et al. in 1950**

Steward's experiment:

Steward et al. showed the phenomenon of cellular totipotency in carrot cultures. Small fragments (phloem) of mature carrot roots were placed in liquid medium, in special containers and growth factors like 'coconut milk' was added. The cultures were gently shaken by automatic shakers. Some of these developed into embryoids. When the callus shows differentiation of shoots and roots, the structures are called embryoids (non zygotic embryo). Few cells and few cell clusters became free and started floating on the media. When these were shifted to serni-solid media, full plants were formed.

Q. What are the Commonness to all cell?

Ans:

1. Genetic material in all cells consists of nucleic acid i.e. DNA or RNA.
2. DNA replication and Protein synthesis are similar.
3. Aerobic respirations in all cells are similar.
4. All cells contain plasma membrane, ribosome and nucleus or nucleiod.

Q. Why multicellular organisms are more efficient than unicellular organism?

Ans:

Multicellular organisms are more efficient than unicellular one because

1. In unicellular organisms all function of the organisms like respiration, division, digestion , locomotion etc are performed by the single cell but in Multicellular organisms division of labour exists, thus no duplication of work takes place
2. If the cell dies the unicellular organism will die but death of few cells in Multicellular organisms doesnot harm too much and it donot die
3. In Multicellular organisms strong immunity system is present which is absent in Unicellular organisms

4. Multicellular organisms adapt in diverse environment but unicellular organisms can not. Therefore Multicellular organisms are more efficient than unicellular organisms

Q. What are the types of cell?

Ans: Prokaryotic, Mesokaryotic and Eukaryotic cell. The term Prokaryote and Eukaryote were coined by **Dougherty** (1957)

Q. What do you mean by Mesokaryote?

Ans: The mesokaryotes are intermediate of prokaryotes and eukaryotes. They do not have deoxyribonucleic histones and undergo dinomitosis. Eg ***Dinoflagellates***

Q. What are the characters of Prokaryotic cell?

Ans:

***Prokaryotic* cell** has the following characteristic features:

1. The cell wall is made of **murein** derived from substance like N-acetyl glucosamine and N-acetyl muromic acid
2. Plasma Membrane forms infoldings called **mesosomes or chondrioids** which control DNA replication, cell division and respiration as they store respiratory enzymes
3, Membrane bound organelles such as mitochondria, plastids, ER and Golgi bodies are absent
4. Vacuoles are absent
5. Flagella (if present) lack 9 + 2 fibrillar structure but have a single fibril made up of flagellin proteins. .
6. Cytoplasmic streaming or **cyclosis** is absent.
7. These cells divide by simple binary fission.
8. Organized or true or definite nucleus is absent but a simple structure called **nucleoid** or chromatin body or **Gonophore** is present. The nucleioid lacks nuclear envelope and nucleolus but contains a single circular molecule of double-stranded DNA which is also called a ring-chromosome. The DNA do not have **histone proteins** associated with it, but contain acidic proteins.
9. 70 S ribosomes (30 S and 50 S subunits) are seen.

Q. What are the characters of Eukaryotic cell?

Eukaryotic cell has the following characteristic features:

1. These cells contain a membrane-bound nucleus having nucleolus and chromosomes, and membrane bound organelles.
2. Nucleus, mitochondria, chloroplast and other organelles like Endoplasmic reticulum are present
3. Fibrils of histones are tightly bound to DNA
4. Actin and myosin proteins are present in Microtubules.
5. Generally more than one linear DNA molecule chromosome is found in the genome
6. Have 80 S ribosomes (40 Sand 60 S subunits)
7. Monocystornic mRNAs are found. Three major forms of RNA polymerase are seen

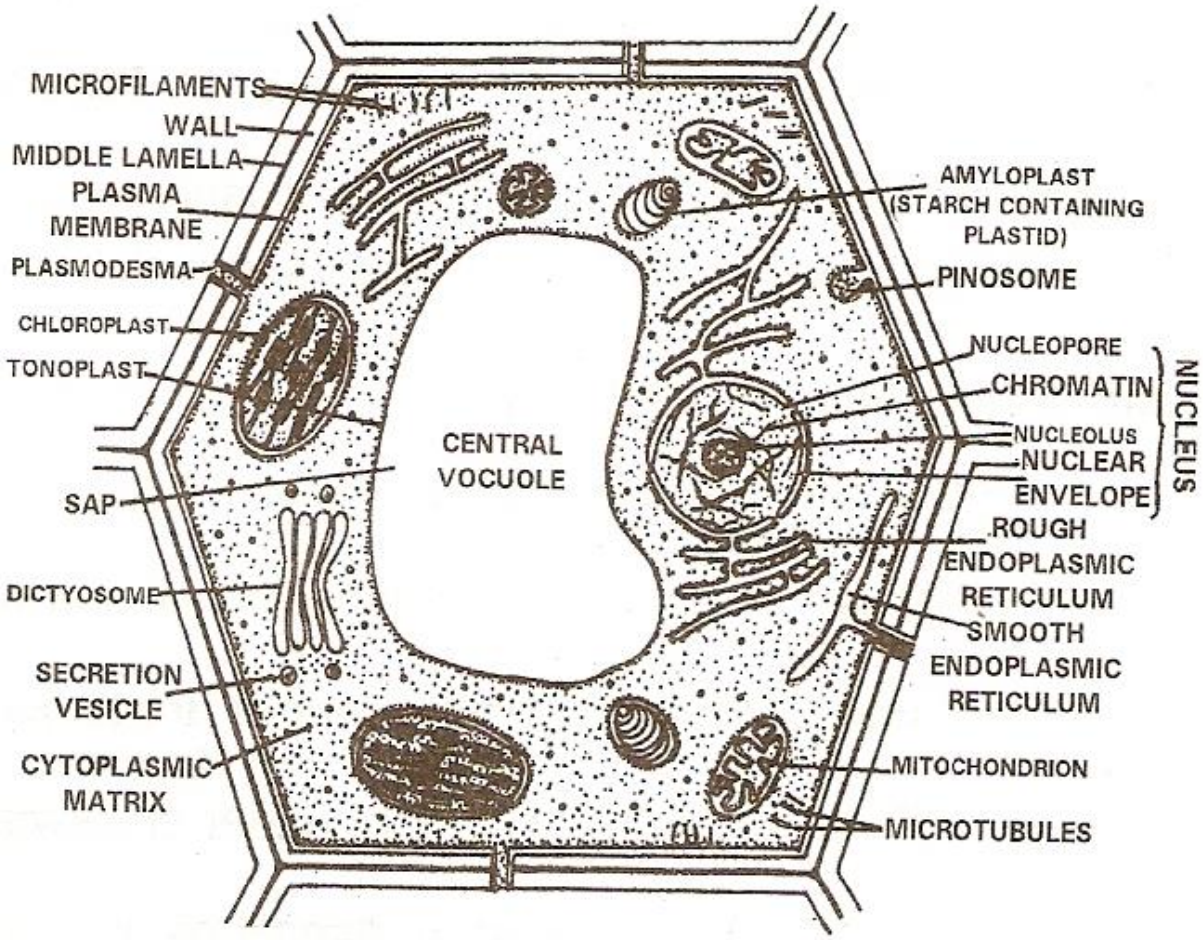
. Differentiate between Prokaryotic and Eukaryotic cell?

Ans:

Prokaryotic cells	Eukaryotic cells
1. Cytoplasm lacks membrane bound organelles like endoplasmic reticulum, mitochondria, golgi apparatus, centrosome, microfilaments, microtubules, intermediate fibres, microbodies etc, It contain only ribosomes.	1. Cytoplasm contains all membrane bound cell organelles.
2. A prokaryotic cell is a single membrane system.	2. A eukaryotic cell is a double membrane system.
3. Cell membrane bears respiratory enzymes.	3. Cell membrane lacks respiratory enzymes.
4. Photosynthetic lamellae i.e., (if present) thylakoids occur free in the cytoplasm.	4. Photosynthetic lamellae if present, occur within the chloroplasts.
5. Ribosomes are 70S, lie free in cytoplasm or joined to cell membrane.	5. Ribosomes are 80S, may lie free or bound to E.R. and nuclear envelope.
6. There are no streaming movements of cytoplasm.	6.Cytoplasm shows streaming movements (cyclosis).
7. Vacuoles absent	7. Present
8. Mitotic spindle is not formed in cell division. division.	8. Mitotic spindle is formed in cell
9. Mesosomes are formed by infolding of cell membrane.	9. Mesosomes are absent.
10. Nuclear material is not enclosed by nuclear envelope and lies directly in cytoplasm. It is called nucleoid.	10. Nuclear material is enclosed by nuclear envelope to form a nucleus distinct from cytoplasm.
11. There is no nucleolus.	11. One or more nucleoli occur within the nucleus.
12. DNA is circular and without a protein coat.	12. Nuclear DNA is linear with a protein coat,
13. DNA occurs in the cytoplasm only.	13. DNA occurs in the nucleus as well as in mitochondria and chloroplasts.
14. Plasmids and pili occur in many prokaryotic cells	14. There are no plasmids and pili in eukaryotic cells.
15. Flagella, if present, are single stranded and are formed of a protein flagellin.	15. Flagella, if present, are complex, have 9 + 2 patterns of microtubules formed of a protein tubulin.
16. Occur in bacteria, blue-green algae, mycoplasmas, rickettssiae and spirochaetes etc.	16. Occur in algae protists, fungi plants and animals.

Q. Draw a plant cell?

Ans:



PLANT CELL

Q. Differentiates between Animal Cell and Plant Cell

Ans:

	Animal Cell	**Plant Cell**
1.	Cell wall is absent in all animal cells. Cells are covered flexible living cell membrane.	Cells are covered by thick by a thin rigid, cellulosic cell wall in addition to cell membrane.
2.	Animal cells have centrioles and centrosome in their cytoplasm.	Centrioles and centrosome are absent in plant cells.
3.	During cell division it forms amphiastral spindle.	It forms anastral spindle.
4.	Small sized few food vacuoles and contractile vacuoles may be present in cytoplasm.	Vacuoles are large in size and more in number. Food vacuoles and contractile vacuoles are absent.
5.	Cytokinesis occurs by constriction or furrowing.	Cytokinesis occurs by cell plate method.
6.	Chloroplasts are absent and other plastids are generally absent.	Choloroplasts and other plastids are present.
7.	Goigi complex is distinct, well developed, lies near the	Golgi complex is indistinct in

nucleus.	the form of unconnected units called dictyosomes.
8. Glyoxisomes are absent in animal cells.	Glyoxisomes may be present
9. Many animal cells can change their shape and move about.	Plant cells due to rigid cellwall cannot change their shape and cannot move about.
10. In animal cells, nucleus is located at the centre	Due to the large vacuole, nucleus is peripheral in position in cytoplasm.
11. The Iysosomes are present in animal cells.	Absent. Their activity is performed by specialized vacuoles.