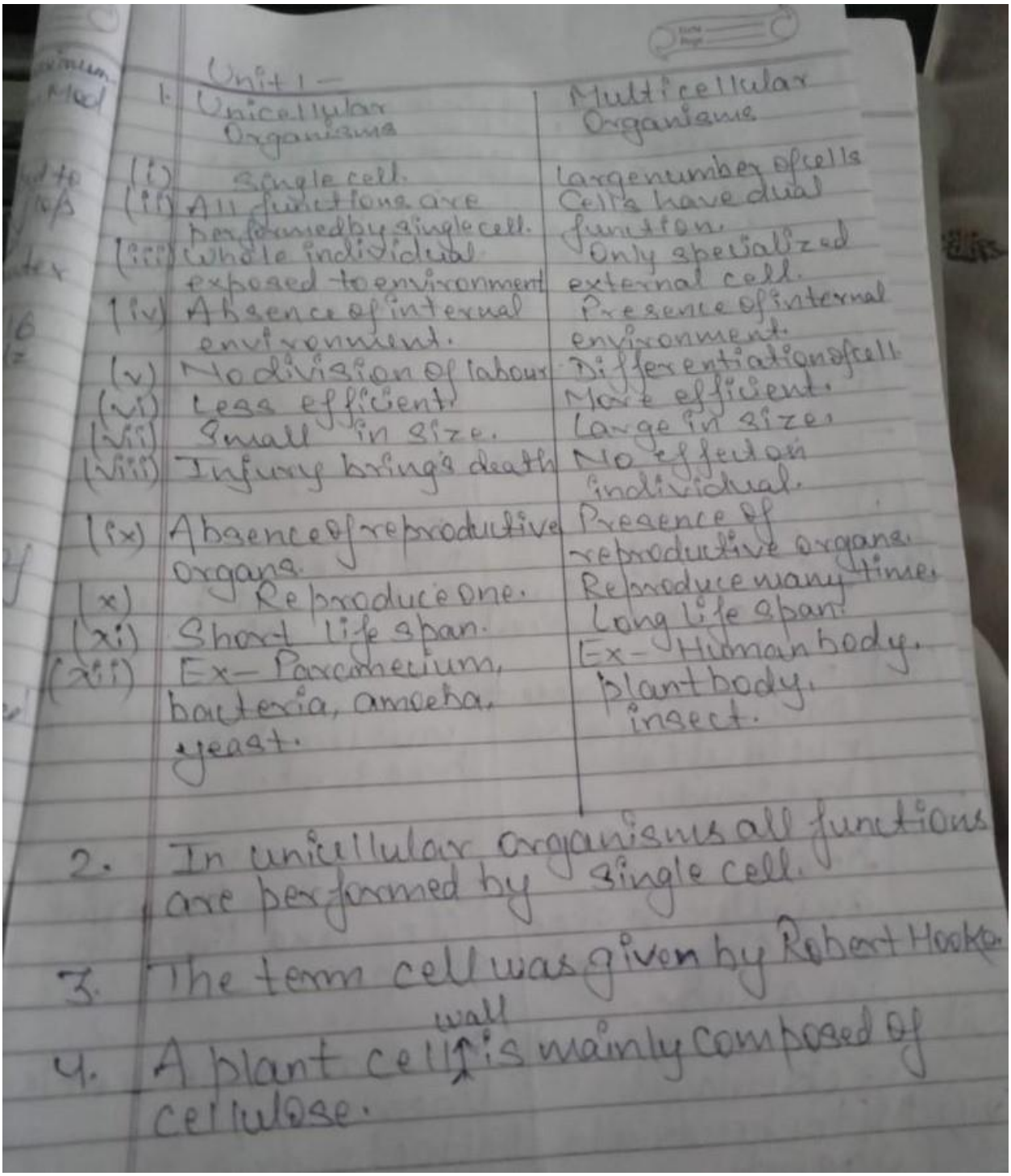
Answer

Unit 1 :



Unit 1 –

1. Unicellular Organisms | Multicellular Organisms

(i) Single cell. | Large number of cells
(ii) All functions are performed by single cell. | Cells have dual function.
(iii) Whole individual exposed to environment | Only specialized external cell.
(iv) Absence of internal environment. | Presence of internal environment.
(v) No division of labour | Differentiation of cell
(vi) Less efficient. | More efficient.
(vii) Small in size. | Large in size.
(viii) Injury bring's death | No effect on individual.
(ix) Absence of reproductive organs. | Presence of reproductive organs.
(x) Reproduce one. | Reproduce many time.
(xi) Short life span. | Long life span.
(xii) Ex- Paramecium, bacteria, amoeba, yeast. | Ex- Human body, plant body, insect.

2. In unicellular organisms all functions are performed by single cell.

3. The term cell was given by Robert Hooke.

4. A plant cell wall is mainly composed of cellulose.

5. Cell is the structural and functional unit of life. It is also called building blocks of life. It contains a cytoplasm which is enclosed by a membrane and contains several biomolecules like proteins, nucleic acids, etc.

6. Cell is of two types :-

(i) Prokaryotes.
(ii) Eukaryotes.

7.	Prokaryotic Cell	Eukaryotic Cell
(i)	Size - 0.1 - 5.0 µm	5 - 100 µm
(ii)	Single cell.	Multicellular.
(iii)	Cell wall is usually present, complex in nature.	Cell wall is present and simple in nature.
(iv)	Nucleus is absent Nucleoid (false nucleus) is present.	Nucleus (true nucleus) is present.
(v)	Ribosomes are present in smaller in size and spherical in shape.	Ribosomes are present in larger in size and linear in shape.
(vi)	DNA arrangement is circular.	DNA arrangement is linear.
(vii)	Mitochondria is absent.	Mitochondria is present.

9. Schleiden and Schwann gave cell theory.

10. The functions of cells are following :-

(i) Provide support and structure.
(ii) Facilitate growth & mitosis.
(iii) Allow transport of substances.
(iv) Energy production.
(v) Aids in Reproduction.

11.

Plant Cell	Animal Cell
(i) Cell shape is square or rectangular.	Cell shape is irregular or round.
(ii) Cell wall is present	Cell wall is absent.
(iii) Cell membrane is present.	Cell membrane is present.
(iv) ER is present.	ER is absent.
(v) Nucleus is present and lies on one side of the cell.	Nucleus present in the centre of the cell.
(vi) Lysosomes are rarely present.	Lysosomes are present.
(vii) Centrosomes are absent.	Centrosomes are present.
(viii) Golgi apparatus is present.	Golgi apparatus is present.
(ix) Cytoplasm is present.	Cytoplasm is present.
(x) Ribosomes are present.	Ribosomes are present.

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(xi)	Plastids are present.	Plastids are absent.
(xii)	Vacuoles are large, single and present in centre.	Vacuoles are small and numerous.
(xiv)	Cilia is absent	Cilia is present.
(xv)	Mitochondria is present in less number.	Mitochondria is present in large number.
(xvi)	Autotrophic mode of nutrition.	Heterotrophic mode of nutrition.

12. Cell wall is absent in animal cell.

13. Structure of Cell -

(i) Cell wall.
(ii) Cell membrane.
(iii) Cytoplasm.
(iv) Nucleus.

14. Cell organelles -

(i) Nucleolus
(ii) Nuclear membrane
(iii) Chromosomes.
(iv) Endoplasmic Reticulum.
(v) Golgi bodies.
(vi) Ribosomes
(vii) Lysosomes
(viii) Vacuoles.
(ix) Chloroplast
(x) Mitochondria

15. Power house of the cell is mitochondria.

16. Plasma/cell membrane regulates the entry and exit of molecules to and from the cell

17. The central dogma was discovered by Francis' Crick in the year 1958. It is the conversion of DNA instructions into proteins. According to central dogma, the genetic information flows from DNA to RNA to form a functional product, protein.

18. Transcription is the process of making an RNA copy of a gene sequence. This copy is called messanger RNA (mRNA).It is done by replication of DNA into two strands.

19. Translation is the process by which RNA codes for specific proteins. It is an active process requires energy. This energy is provided by tRNA molecules.

20. Gene is the basic unit of heredity and a sequence of nucleotides in DNA and RNA that encodes the synthesis of gene product either RNA or protein.

21. Central dogma is called the flow of genetic in formation in the cells.

22. The **primary structure** of protein is the hierarchy's basic level, and is the particular linear sequence of amino acids comprising one polypeptide chain.

- **Secondary structure** is the next level up from the primary structure, and is the regular folding of regions into specific structural patterns within one polypeptide chain. Hydrogen bonds between the carbonyl oxygen and the peptide bond amide hydrogen are normally held together by secondary structures.
- **Tertiary structure** is the next level up from the secondary structure, and is the particular three-dimensional arrangement of all the amino acids in a single polypeptide chain. This structure is usually conformational, native, and active, and is held together by multiple noncovalent interactions.
- **Quaternary structure** is the next 'step up' between two or more polypeptide chains from the tertiary structure and is the specific spatial arrangement and interactions.

23. Amino acid is the smallest unit of protein.

24. The process by which the mRNA codes for a particular protein is known as Translation. In the process, the ribosome translates the mRNA produced from DNA into a chain of specific amino acids. This chain of amino acids leads to protein synthesis. It is a process where the expense of ATP is required and this energy is given by the charged tRNA. The whole machinery of translation is present in the ribosomes.

25. Messenger RNA (**mRNA**) molecules carry the coding sequences for **protein synthesis** and are called transcripts; **ribosomal RNA** (**rRNA**) molecules form the core of a cell's ribosomes (the structures in which **protein synthesis** takes place); and **transfer RNA** (**tRNA**) molecules carry amino acids to the ribosomes during **protein synthesis.**

26. In ribosomes amino acids are assembled into a chain of proteins.

27. Mitosis is nuclear type of division.

28. 3 bases nitrogenous bases are present in one codon.

29. Chloroplasts is called kitchen of the cell.

30. Nucleus is called the director of the cell.

31. Ribosome is called the protein factory of the cell.

32. False In prokaryotes 70 S types of ribosomes in its cytoplasm.

33. Cells arise from pre existing cells by cell division was suggested by Rudolf Virchow.

34. Cell division cycle or the cell cycle is a 4-stage process in a somatic cell during which two significant molecular processes occur – parent chromosome duplication (occurring in S phase) and equal detachment of the chromosome to the daughter cells (occurring during M phase)

In eukaryotic cells, the cell cycle phases are split into two significant phases – interphase and the mitotic phase. While in

interphase, the cell significantly grows and replicates a DNA copy, in the mitotic phase or the M phase, the cell splits its DNA into two sets and hence the division of the cytoplasm to form two daughter cells.

The four significant phases are as follows:

G1 (Gap 1) Phase

- This is the primary stage of the interphase, known as the G1 or first gap phase as diminutive changes are observed due to the hyperactivity of the cell at the biochemical degree
- This phase is characterized by changes in the chromosomes from the condensed to the extended state in addition to a range of metabolic activities leading to the initiation of replication of DNA.
- Characteristics of the chromatin fibres in this phase are – less coiled and slender, extended fully and ready for transcription. The process of transcription results in the production of RNAs and also a sequence of protein molecules vital for DNA replication to be initiated
- G1 phase is lengthier than the other three phases and varies from cell to cell
- This is a significant phase as cell grows and assembles building blocks of chromosomal DNA and the linked proteins. In addition, it also reserves adequate energy to accomplish chromosome replication
- DNA synthesis in this phase is initiated at a distinct checkpoint. The cell progresses towards division once all

the biochemical events at this particular point have concluded.

Synthesis (S) phase

- It is an active DNA synthesis and histone synthesis phase of the interphase
- Here the chromosomes replicate, enabled by linked proteins and DNA replication. Most of the histone protein synthesis occurs in this phase, though some of it occurs in G1 phase
- Identical pair of DNA molecules are formed as the process of DNA replication is discontinuous and semi-conservative
- Even after the chromosomes have doubled, the sister chromatids are securely attached to the centromeric region. The chromosome count of the cell remains the same
- Centrosomes of animal cells at the centre of each animal cell is linked with centrioles positioned perpendicular to each other. The centrioles are functional in organizing the cell division process
- During this phase, the centrosome is duplicated, producing the mitotic spindle, the apparatus which liaises chromosomal movement while mitosis is taking place

G2 (Gap 2) Phase

- This phase is succeeded by the S phase. Here the chromosomes comprise two chromatids thus cell has double the quantity of DNA
- Here, the cell restores its energy, producing proteins essential for chromosomes to manipulate

- Few of the cell organelles are replicated. Cytoskeleton dismantles to render resources for mitosis
- Additional growth of cell may be observed. Before the cell enters the first phase of mitosis, the concluding preparations of the mitotic phase must be done.

M (Mitotic) Phase

- This phase is succeeded by the G2 phase. Here the cell divides into two daughter cells along with equal distribution of chromosomes between the daughter cells. Once the M phase steps into the G1 phase, the next cell cycle is initiated to be repeated. Some cells, however, do not enter into the G1 phase. These are referred to as G0 cells
- It comprisesq the following sub-phases –
- Prophase – in this stage, the nucleus disappears, spindle fibres are formed, DNA condenses into sister chromatids
- Metaphase – the sister chromatids orient alongside the cell-equator by linking their centromeres to the spindle fibres
- Anaphase – separation of sister chromatids at the centromere, being pulled towards the opposite poles of the cell by mitotic spindle
- Telophase – At the opposite poles, the chromosomes arrive to unwind into fine DNA strands. Spindle fibres vanish. Nuclear membrane resurfaces
- Cytokinesis – cell membrane splits, animal cells drift away. Plant cells form a cell plate which turns into a new cell wall
- Cells arriving at the G0 phase, which is the inactive phase once they exit the cell cycle when they are not preparing

actively to divide. Few of these cells tend to remain in this stage permanently.

35. Nuclear DNA replicates in S phase.

36. Formation of cell plate starts at Telophase.

37. There are two distinct types of cell division out of which the first one is vegetative division, wherein each daughter cell duplicates the parent cell called mitosis. The second one is meiosis, which divides into four haploid daughter cells.

Mitosis: The process cells use to make exact replicas of themselves. Mitosis is observed in almost all the body's cells, including eyes, skin, hair, and muscle cells.

Meiosis: In this type of cell division, sperm or egg cells are produced instead of identical daughter cells as in mitosis.

Binary Fission: Single-celled organisms like bacteria replicate themselves for reproduction.

Phases of the Cell Cycle

There are two primary phases in the cell cycle:

1. **Interphase**: This phase was thought to represent the resting stage between subsequent cell divisions, but new research has shown that it is a very active phase.
2. **M Phase (Mitosis phase)**: This is where the actual cell division occurs. There are two key steps in this phase, namely cytokinesis and karyokinesis.

The interphase further comprises three phases:

1. **G0 Phase (Resting Phase):** The cell neither divides nor prepares itself for the division.

2. **G1 Phase (Gap 1)**: The cell is metabolically active and grows continuously during this phase.
3. **S phase (Synthesis)**: The DNA replication or synthesis occurs during this stage.
4. **G2 phase (Gap 2):** Protein synthesis happens in this phase.
5. **Quiescent Stage (G0)**: The cells that do not undergo further division exits the G1 phase and enters an inactive stage. This stage is known as the quiescent stage (G0) of the cell cycle.

There are four stages in the **M Phase,** namely:

1. Prophase
2. Metaphase
3. Anaphase
4. Telophase

38. Synapsis is defined as the pairing of homologous chromosomes.

39. Chromosomes structure can be observed best during metaphase.

40. The spindle apparatus is formed during metaphase of mitosis.

41. The longest stage in the cell cycle is Interphase.

42. The condensation of chromosomes is observed in

prophase 1.

43. Meiosis is a form of cell division which results in the creation of gametes or sex cells.

44. 2 is the number of DNA in the chromosome at the G2 stage of the cell cycle

45. The stage which serves as a connecting link between meiosis 1 and meiosis 2 is Interkineses.

46. The G0 state implies the exit of cells from the cell cycle.

47. Apoptosis is a form of programmed cell death that occurs in multicellular organisms. Biochemical events lead to characteristic cell changes and death. These changes include blebbing, cell shrinkage, nuclear fragmentation, chromatin condensation, chromosomal DNA fragmentation, and global mRNA decay.

48. Cell organelle that participates actively in animal apoptosis is mitochondria.

49. Stem cells also have the ability to repair the damaged cells. These cells have strong healing power. They can evolve into any types of cell.
Stem cells are of the following different types:

- Embryonic Stem Cells
- Adult Stem Cells
- Induced Pluripotent Stem Cells
- Mesenchymal stem cells

The embryonic stem cells can be further classified as:

- **Totipotent Stem Cells:** These can differentiate into all possible types of stem cells.
- **Pluripotent Stem Cells:** These are the cells from an early embryo and can differentiate into any cell type.
- **Multipotent Stem Cells:** These differentiate into a closely related cell type. For eg., the hematopoietic stem cells differentiate into red blood cells and white blood cells.
- **Oligopotent Stem Cells:** Adult lymphoid or myeloid cells are oligopotent. They can differentiate into a few different types of cells.
- **Unipotent Stem Cells:** They can produce cells only of their own type. Since they have the ability to renew themselves, they are known as unipotent stem cells. For eg., Muscle stem cells.

Applications of Stem Cells

(i) Tissue Regeneration.
(ii) Treatment of cardiovascular disease.
(iii) Treatment of Brain Disease.
(iv) Treatment of Blood disease.

Stem Cells originate from different parts of the body. Adult stem cells can be found in specific tissues in the human body. Matured cells are specialized to conduct various functions. Generally, these cells can develop the kind of cells found in tissues where they reside.

51. Cells or tissue donated by a related or unrelated individual are called autologous.

52. The process of cell specialization is called cell differentiation.

53. **Cryopreservation** is the process in which organs can be conserved.

54. Chondrocyte is the cell which secretes cartilage cells.

55. **Tissue engineering** is the use of a combination of cells, engineering, and materials methods, and suitable biochemical and physicochemical factors to improve or replace biological tissues. Tissue engineering involves the use of a **tissue scaffold** for the formation of new viable tissue for a medical purpose.

Tissue engineering utilizes living cells as engineering materials. Examples include using living fibroblasts in skin replacement or repair, cartilage repaired with living chondrocytes, or other types of cells used in other ways.

Cells are often categorized by their source.

Autologous cells are obtained from the same individual to which they will be reimplanted. Autologous cells have the fewest problems with rejection and pathogen transmission, however, in some cases might not be available. For example, in genetic disease suitable autologous cells are not available. These cells can differentiate into a variety of tissue types, including bone, cartilage, fat, and nerve. A large number of cells

can be easily and quickly isolated from fat, thus opening the potential for large numbers of cells to be quickly and easily obtained.

Allogeneic cells come from the body of a donor of the same species. While there are some ethical constraints to the use of human cells for *in vitro* studies, the employment of dermal fibroblasts from human foreskin has been demonstrated to be immunologically safe and thus a viable choice for tissue engineering of skin.

Xenogeneic cells are these isolated from individuals of another species. In particular animal cells have been used quite extensively in experiments aimed at the construction of cardiovascular implants.

Syngeneic or *isogenic* cells are isolated from genetically identical organisms, such as twins, clones, or highly inbred research animal models.

Primary cells are from an organism.

Secondary cells are from a cell bank.

Stem cells are undifferentiated cells with the ability to divide in culture and give rise to different forms of specialized cells. According to their source stem cells are divided into "adult" and "embryonic" stem cells, the first class being multipotent and the latter mostly pluripotent; some cells are totipotent, in the earliest stages of the embryo. While there is still a large ethical debate related with the use of embryonic stem cells, it is thought that another alternative source - induced stem cells may be useful for

the repair of diseased or damaged tissues, or may be used to grow new organs.

Scaffolds

Scaffolds are materials that have been engineered to cause desirable cellular interactions to contribute to the formation of new functional tissues for medical purposes. Cells are often 'seeded' into these structures capable of supporting three-dimensional tissue formation. Scaffolds mimic the extracellular matrix of the native tissue, recapitulating the *in vivo* milieu and allowing cells to influence their own microenvironments. They usually serve at least one of the following purposes: allow cell attachment and migration, deliver and retain cells and biochemical factors, enable diffusion of vital cell nutrients and expressed products, exert certain mechanical and biological influences to modify the behaviour of the cell phase.

56. Stem cells are present in multicellular.

57. Totipotent cells form a complete organism.

58. Programmed cell death is called apoptosis.

59. Interphase has longest duration.

60. The main function of tRNA in term of protein synthesis is to identifies amino acids and transport them to ribosomes.