

Cell is a basic structural and functional unit of life.

- **Robert Hooke** in 1665 coined the word 'cell'.
- **Anton von Leeuwenhoek** first saw and described a live cell.
- **Robert Brown** later had discovered the nucleus.
- Cell theory was proposed by **Schleiden** and **Schwann** in 1855 to explain the concept of the cellular nature of living organism.

Prokaryotic Cells

- Prokaryotic cells are morphologically most primitive.
- Prokaryotic cells are devoid of membrane bound organelles like plastids, mitochondria and advanced (9+2) flagella.
- Prokaryotic cells are represented by bacteria, cyanobacteria (blue green algae) mycoplasma and PPLO (pleuropneumonia like organisms).

Eukaryotic Cells

- A eukaryotic cell consists of the following components:

Cell Wall

- The cell wall is a non-living, semi-rigid, external protective covering of the cell.
- Cell wall is entirely lacking in animals.
- It is made up of cellulose secreted by the cell itself.

Cell Membrane

- The cell membrane is a living, thin, elastic and semi-permeable membranous covering of plant and animal cells.

Fluid mosaic model of plasma membrane

- **S.J.Singer** and **G. Nicolson** in 1972 proposed the most accepted model of membrane structure. The plasma membrane is a lipid-bilayer with proteins embedded in it.
- Lipids are amphipathic, *i.e.*, they are structurally asymmetric with polar hydrophilic and non-polar hydrophobic group.
- One of the most important function of plasma membrane is the transport of the molecules across it.

Endoplasmic Reticulum (ER)

There are two types of endoplasmic reticulum *i.e.*,

- **Smooth or agranular ER** – They do not have attached ribosomes on their surface.
- **Rough or granular ER** – They bear ribosomes on their surface, for protein synthesis.

Golgi Apparatus

- Golgi apparatus or Golgi complex is a stack of flattened, membrane bounded, parallelly arranged organelles that occur in the association of endoplasmic reticulum in the cytoplasmic matrix.

- The golgi apparatus principally performs the function of packaging materials to be delivered either to the intra-cellular targets or secreted outside the cell.

Lysosomes

- Lysosomes are popularly called “suicide bags”.

Vacuoles

- In plant cells, the vacuoles can occupy up to 90 percent of the volume of the cell. The vacuole is bound by a single membrane called **tonoplast**. They are responsible for maintenance of turgour pressure.

Mitochondria

- Mitochondria are also called as powerhouse of cells.

Plastids

- Plastids are found in plants and few protists *Euglena*.

Ribosomes

- Ribosomes are smallest cell organelles. They are protein synthesising factories.

There are two types of ribosomes *viz.*,

- Prokaryotic or 70S ribosomes
- Eukaryotic or 80S ribosomes

Nucleus

- Nucleus is centrally located, spherical and largest component of the all eukaryotic cell. It contains the genetic material of the cell.

Structure of Nucleus

- A typical nucleus consists of four structures: (i) nuclear membrane, (ii) nucleoplasm (iii) chromatin and (iv) the nucleolus.

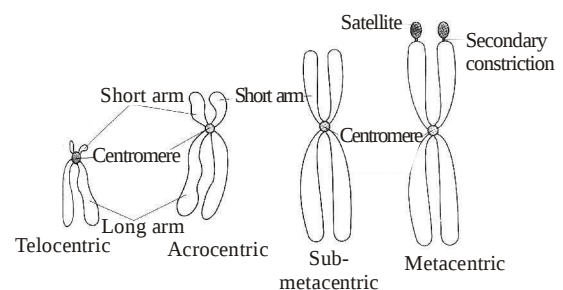


Fig. : Types of chromosomes based on the position of centromere

Cells and Tissues

Nucleolus

- It is present inside the nucleus.
- It is the site of active ribosomal RNA synthesis.

Cell Cycle

- Cell cycle consists of two basic phases. There is a long non-dividing growing I-phase (Inter-phase) and a short-dividing M-phase.

Phases of Cell Cycle

Interphase :

- It has following three sub-phases:
- **G₁ phase:** It (G stands for gap) includes the synthesis of substrate and enzyme necessary for DNA synthesis.
- **S phase:** During this phase the amount of DNA per cell doubles.
- **G₂ phase:** Proteins are synthesized in preparation for mitosis while cell growth continues.
- **G₀ phase :** Cells that do not divide further exit G₁ phase to enter an inactive stage known as G₀.

M Phase (Mitosis Phase)

It is also called as equational division as the number of chromosomes in the parent and progeny cells is the same. The 4 Stages of M phase are : (usually divided into several stages or phases)

Prophase : Initiation of assembly of spindle formation begins.

Metaphase : Chromosomes align at the equatorial plate of cells.

Anaphase : The two daughter chromatids, now free of each other, move towards their respective poles.

Telophase : The nucleolus condense and reappear. The spindle fibres disperse. The nuclear envelope is assembled around the chromatin mass endoplasmic reticulum reform again.

Cytokinesis : Karyokinesis (division of nucleus into two) is followed by cytokinesis *i.e.*, division of cytoplasm into two daughter cells.

Meiosis

It occurs in reproductive cells and has two parts:

Meiosis I

Prophase I : It is the longest stage and includes 5 stges : –

Leptotene : The chromosomes become gradually visible under the light microscope.

Zygotene : The pairing of homologous chromosomes takes place.

Pachytene : Crossing over is the exchange of genetic material between two homologous chromosomes.

Diplotene : The participating chromatids of the paired homologous chromosomes physically joined at one or more discrete points having X-shaped structure called **chiasmata**.

Diakinesis : During diakinesis, the terminalisation of chiasmata take place.

Metaphase I : Spindle fibres attach themselves to chromosomes and chromosomes align at the equator.

Anaphase I : Homologous chromosome with its two chromatids moves towards the opposite poles of the cell and separate from each other.

Telophase I : The nuclear membrane and nucleolus reappear.

Meiosis II

Prophase II : The nuclear membrane and the nucleolus disappear. The chromosomes condense further.

Metaphase II : The chromosomes get arranged on the equator of the spindle.

Anaphase II : The daughter chromosomes move towards the opposite poles.

Telophase II : Cytoplasm divides and 4 haploid daughter cells arise.

Tissues

A group of structurally similar or dissimilar cells that perform a common function and have a common origin is called a **tissue**.

Simple Permanent Plant Tissue

These tissues are of 3 types:

Parenchyma : The cell wall is thin and made up of cellulose. It helps in storage of food, conduction of substances, provides turgidity to softer parts of plants.

Collenchyma : It provides mechanical support to the organs and resists bending in wind.

Sclerenchyma : These are dead, mechanical and act as skeleton in plants. It is hardest plant tissue, made up of highly thick walled cells with no nucleus and no cytoplasm. This uniform thickening is made up of mainly lignin and cellulose or both.

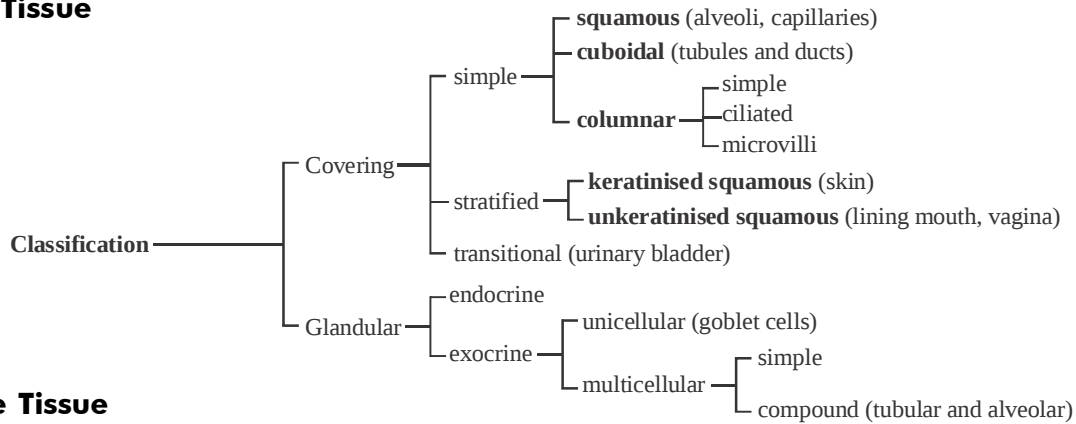
Conducting tissue in plants

- **Xylem cells** conduct water and minerals from roots to shoots.
- **Phloem cells** transport food or photosynthates from leaves to all parts of plants.

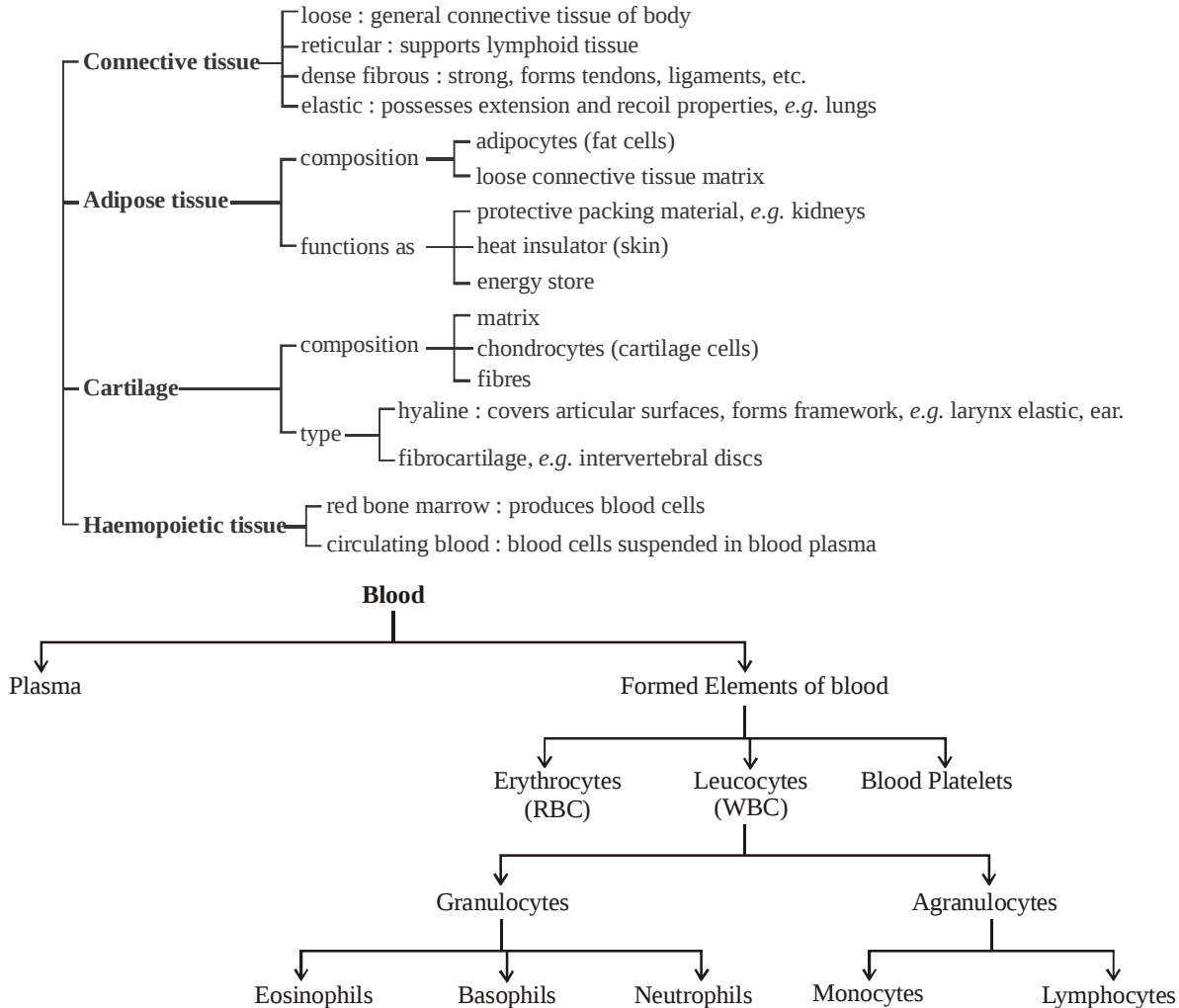
Animal Tissues

The structure of the cells vary according to their function. Therefore, the tissues are different and are broadly classified into four types:

Epithelial Tissue

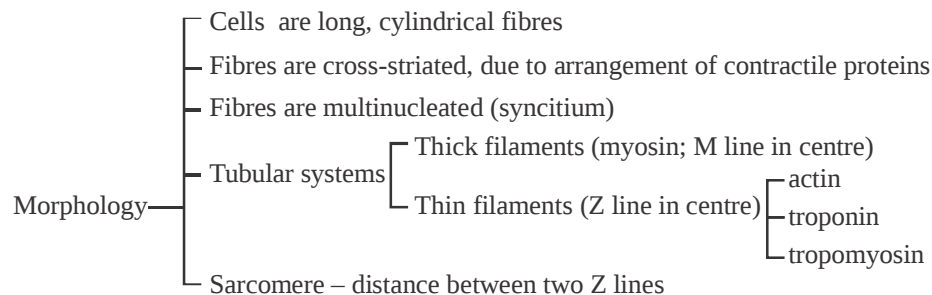


Connective Tissue



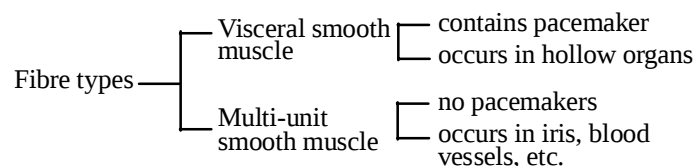
Muscle Tissue

(i) Skeletal muscle



Location : Cardiac wall
Function : Pumps blood
Contraction : Comparable to skeletal muscle, but slower
Regeneration : None

Location : Walls of hollow organs, eye, skin, etc.
Function : Contraction of hollow muscular organs
Morphology – [Non-striated fibres shorter with single nucleus
Contractile proteins = actin and myosin



EXERCISE

1. Difference between the prokaryotic and eukaryotic cells is in having
 - (a) cell wall
 - (b) nuclear membrane
 - (c) ribosome
 - (d) None of these
 2. The function of nucleolus is the synthesis of
 - (a) DNA
 - (b) m-RNA
 - (c) r-RNA
 - (d) t-RNA
 3. Which one of the following has its own DNA?
 - (a) Mitochondria
 - (b) Dictyosome
 - (c) Lysosome
 - (d) Peroxisome
 4. Regarding the sequence of cell cycle, which one is correct
 - (a) G_1 , G_2 , S and M
 - (b) S, G_1 , G_2 and M
 - (c) G_1 , S, G_2 and M
 - (d) G_2 , S, G_1 and M
 5. The exchange of genetic material between chromatids of paired homologous chromosomes during first meiotic division is called
 - (a) transformation
 - (b) chiasmata
 - (c) crossing over
 - (d) synapsis
 6. Chloroplast containing parenchyma is called
 - (a) chlorenchyma
 - (b) collenchyma
 - (c) aerenchyma
 - (d) amyloenchyma
 7. Chromosomes contain hereditary units called
 - (a) genes
 - (b) ribosomes
 - (c) DNA
 - (d) RNA
 8. Which cell organelle is known as the control centre of the cell ?
 - (a) Nucleus
 - (b) Chloroplast
 - (c) Mitochondria
 - (d) Endoplasmic reticulum
 9. Who observed and coined the word 'cell' for the first time?
 - (a) Robert Cook
 - (b) Robert Brown
 - (c) Robert Hooke
 - (d) Leeuwenhoek
 10. What part of the cell serves as the intracellular highway?
 - (a) Endoplasmic reticulum
 - (b) Golgi apparatus
 - (c) Cell membrane
 - (d) Mitochondria
 11. Which of the following would you not find in a bacterial cell ?
 - (a) DNA
 - (b) Cell membrane
 - (c) Golgi apparatus
 - (d) Ribosomes
 12. Which of the following could be found in both the nucleus and the cytoplasm?
 - (a) Nucleolus
 - (b) Ribosomes
 - (c) RNA
 - (d) Both RNA & ribosomes
 13. Which one of the following structures is an organelle within an organelle?
 - (a) Ribosome
 - (b) Peroxisome
 - (c) ER
 - (d) Mesosome
 14. The process of mitosis is divided into 4 phases. Identify the correct order in which these phases appear in mitosis
 - (a) Anaphase, metaphase, telophase and prophase
 - (b) Telophase, anaphase, metaphase and prophase
 - (c) Metaphase, prophase, anaphase and telophase
 - (d) Prophase, metaphase, anaphase and telophase
 15. Which of the following cells is found in the cartilaginous tissue of the body?
 - (a) Mast cells
 - (b) Basophils
 - (c) Osteocytes
 - (d) Chondrocytes
 16. Survival of plants in terrestrial environment has been made possible by the presence of
 - (a) intercalary meristem
 - (b) conducting tissue
 - (c) apical meristem
 - (d) parenchymatous tissue
 17. The tissues that helps in the movement of our body is
 - (a) muscular tissue
 - (b) skeletal tissue
 - (c) nervous tissue
 - (d) All of these
 18. The connective tissue that connects muscle to bone is called
 - (a) ligament
 - (b) tendon
 - (c) cartilage
 - (d) areolar

19. Cartilage and bone are types of
 - (a) muscular tissue
 - (b) connective tissue
 - (c) skeletal tissue
 - (d) epithelial tissue
20. Intercalated disc is present in
 - (a) striated muscle
 - (b) smooth muscle
 - (c) cardiac muscle
 - (d) Both (b) and (c)
21. Cells which take part in secondary growth are named as
 - (a) phloem
 - (b) xylem
 - (c) cambium
 - (d) medullary ray
22. Which of the following is responsible for mechanical support and enzyme transport ?
 - (a) Dictyosome
 - (b) Cell membrane
 - (c) ER
 - (d) Mitochondria
23. Cell wall in higher plants is made up of
 - (a) Cellulose + lignin
 - (b) Cellulose + pectin
 - (c) Cellulose + suberin
 - (d) Cellulose + lipid
24. ATP molecule is a
 - (a) Nucleosome
 - (b) Nucleoside
 - (c) Nucleotide
 - (d) Deoxyribose sugar
25. Which one is not a carbohydrate?
 - (a) Chitin
 - (b) Methionine
 - (c) Glycogen
 - (d) Starch
26. Branches of botany dealing with the internal organization of plants known as
 - (a) Physiology
 - (b) Ecology
 - (c) Anatomy
 - (d) Cytology
27. Xylem functions as a conducting tissue for water and minerals from _____ to the _____ and _____.
 - (a) roots, stems, leaves
 - (b) stems, roots, leaves
 - (c) leaves, stems, roots
 - (d) leaves, stems, leaves
28. Most diverse macromolecules, found in the cell both physically and chemically are
 - (a) proteins
 - (b) carbohydrates
 - (c) nucleic acids
 - (d) lipids.
29. Lipids are insoluble in water because lipid molecules are
 - (a) hydrophilic
 - (b) hydrophobic
 - (c) neutral
 - (d) zwitter ions
30. Which one is the most abundant protein in the animal world?
 - (a) Trypsin
 - (b) Haemoglobin
 - (c) Collagen
 - (d) Insulin

ANSWER KEY							
1	(b)	9	(c)	17	(d)	25	(b)
2	(c)	10	(a)	18	(b)	26	(c)
3	(a)	11	(c)	19	(b)	27	(a)
4	(c)	12	(d)	20	(c)	28	(a)
5	(c)	13	(a)	21	(c)	29	(b)
6	(a)	14	(d)	22	(c)	30	(c)
7	(a)	15	(d)	23	(b)		
8	(a)	16	(b)	24	(c)		

HINTS AND SOLUTIONS

1. (b) The prokaryotic cells do not have nuclear membrane while eukaryotic cell have well organised nuclear membrane.
3. (a) Mitochondria has its own DNA. It is a structure within cytoplasm of eukaryotic cells that carries out aerobic respiration. It is the site of Krebs's cycle and ETS. Therefore, it is also called as cell's energy production site.
5. (c) The points of attachment between homologous chromosomes after their separation in diplotene are called chiasmata. The process of pairing of homologous chromosomes is called synapsis, the phenomenon by which DNA isolated from one type of cell, when introduced into another type, is able to bestow some of the properties of the former to the latter is known as transformation.
6. (a) Chloroplast containing parenchyma (chlorenchyma) are mostly present in leaf.
13. (a) Ribosomes are small protein complexes made of r-RNA and proteins. Ribosomes are also seen in the organelles like mitochondria and chloroplasts.
27. (a) Xylem is a complex permanent tissue mainly responsible for conduction of water and minerals from the roots to the top of plants (unidirectional).
28. (a) Proteins are polymers of amino acids. There are only 20 amino acids which can be arranged in different orders in a polypeptide chain to form a wide array of proteins.
29. (b) Water attracting molecules are called hydrophilic. Water repelling molecules are called hydrophobic. Amino acids carry simultaneously positive and negative charges. Such molecules are called zwitter ions. Lipids are compounds of C, H, O but the ratio of H and O is more than 2 : 1 that is the ratio of oxygen is lesser than carbohydrates. Lipids are insoluble in water but soluble in non-polar solvents such as benzene, chloroform etc. Commonest lipid found in a cell is phospholipid. It contains a hydrophilic (polar) head and a hydrophobic (non-polar tail).
30. (c) Collagen is the most abundant protein of animal world. Rubisco (ribulose biphosphate carboxylase - oxygenase) is not only the most abundant protein in plants but also the whole biosphere.