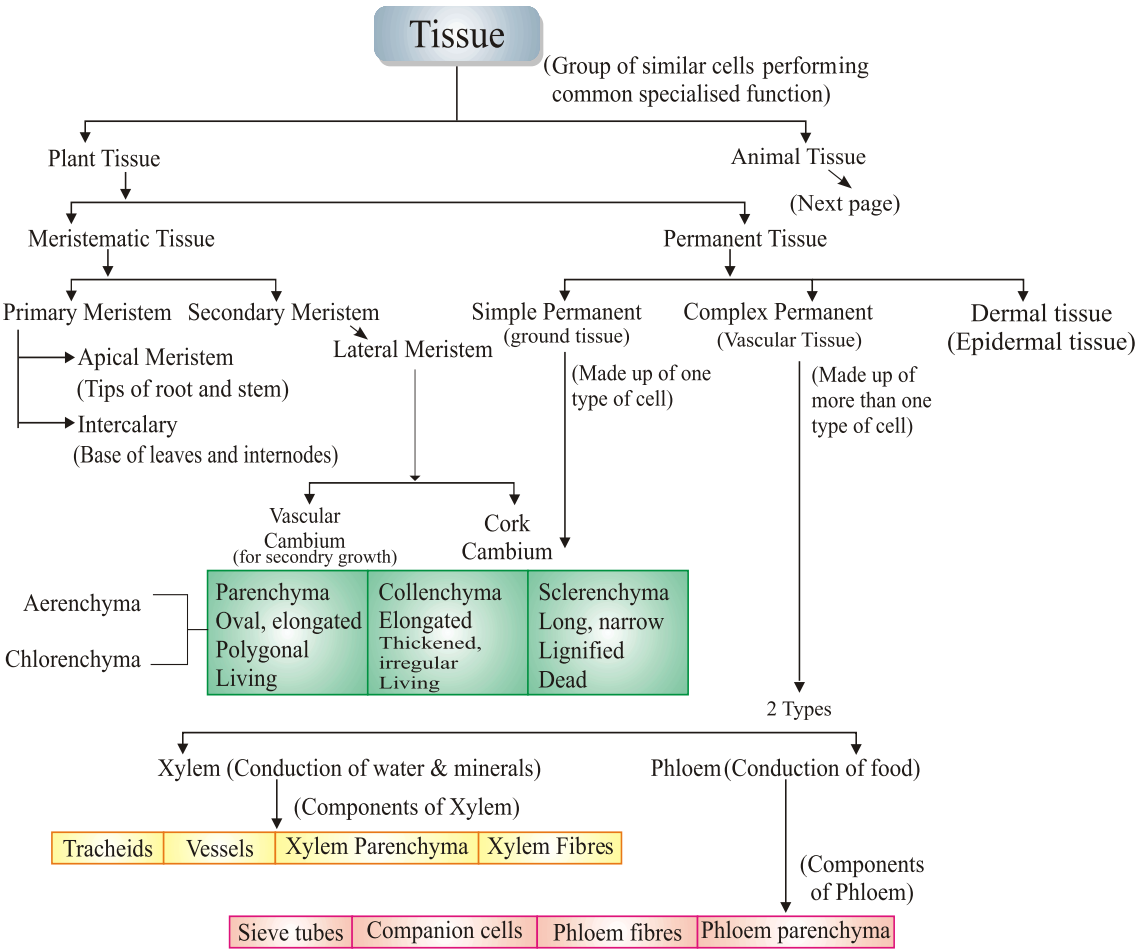
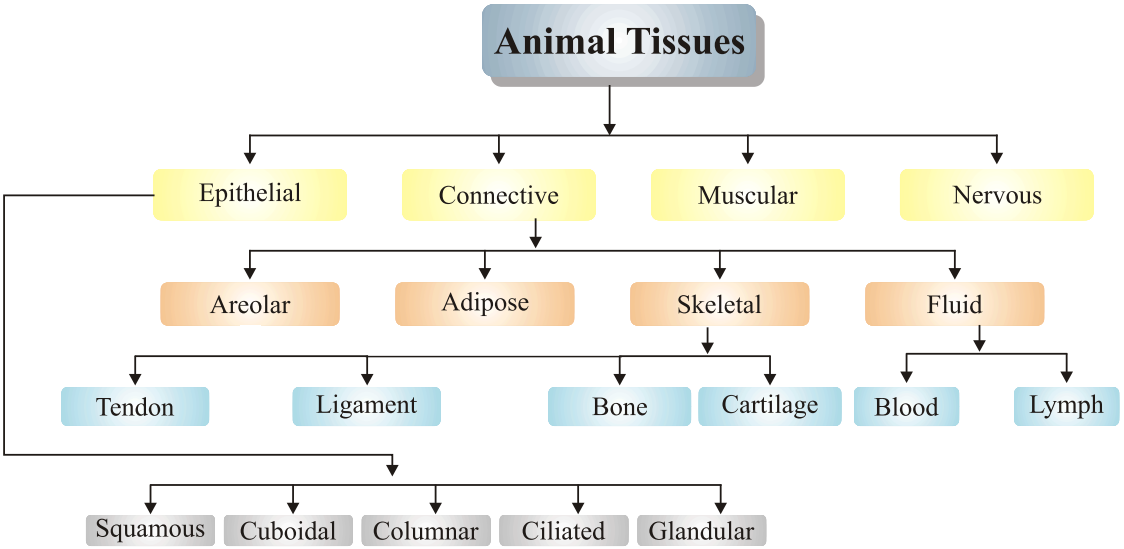
Chapter - 6

Tissue

CONCEPT MAPPING



ANIMAL TISSUE



Tissue : A group of cell that are similar in structure and work together to achieve a particular function is called Tissue.
Histology : The microscopic study of tissue is called Histology.

PLANT TISSUE- Meristematic & Permanent Tissues

Meristematic Tissue (growth tissue)

These are simple living tissues having thin walled compactly arranged immature cells which are capable of division and formation of new cells.
Main features of Meristematic tissues are :

- Thin primary cell wall (cellulosic).
- Intercellular spaces are absent (compact tissue).
- Generally vacuoles are absent, dense cytoplasm & prominent nuclei are present.
- Actively dividing cells are present in growing regions of plants e.g., root & shoot tips.

Classification on the Basis of Origin

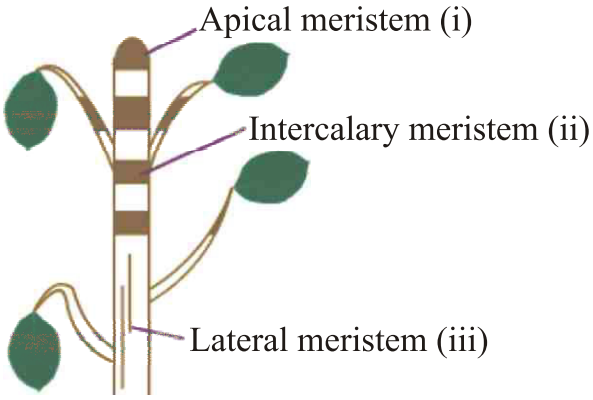
(A) *Primary Meristem (Promeristem)*

- Derived directly from the meristems of embryo.
- They consist of cells derived from primary meristem.
- They add to primary growth of plants.

(B) *Secondary meristem*

- These are having cells derived from primary permanent tissue.
- They usually add to the diameter of plants.

Classification on the Basis of Location



(A) *Apical Meristem*

- It is present at the growing tips of stems and roots.
- Cell division in this tissue leads to the elongation of stem & root, thus it is involved in primary growth of the plant.

(B) *Intercalary Meristem*

- It is present behind the apex. It helps in longitudinal growth.
- It is the part of apical meristem which is left behind during growth period.
- These are present at the base of leaf and internode region.
- These lead to the increase in the length of leaf (Primary) eg., in grass stem, bamboo stem, mint stem etc.

(c) *Lateral Meristem (Cambium)*

- It is also called as secondary meristem.
- It occurs along the side of longitudinal axis of the plant.
- It gives rise to the vascular tissues.
- Causes growth in girth of stem and root.
- They are responsible for secondary growth by increasing the girth.

PERMANENT TISSUE

- The permanent tissues are formed from those meristematic cells which are left behind and have lost their capability to divide.
- The division and differentiation of the cells of meristematic tissues give rise to permanent tissues.
- They have definite shape, size and thickness. The permanent tissue may be dead or living.

- As a result of cell differentiation the meristematic tissues tend to form different type of permanent tissues.
- In cell differentiation, developing tissues changes from simple to more complex forms to perform various specialized functions.

Depending upon the stucture and composition the permanent tissue are classfied into two types :

(A) Simple Permanent Tissues (Supporting tissue and protective tissue)

(B) Complex Permanent Tissue

(C) Dermal (Protective) Tissue

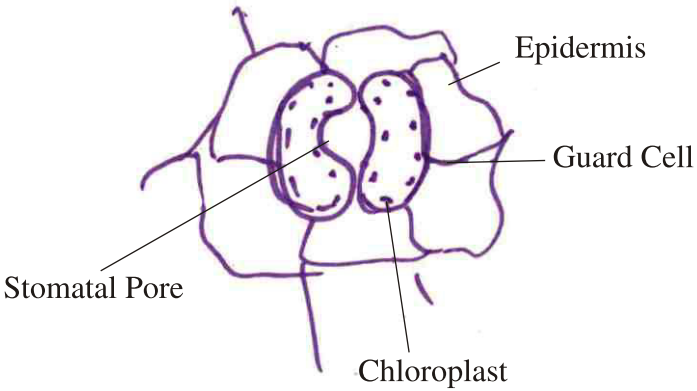
(A) Simple Permanent Tissues :

- These are made up of one type of cells which are similar structurally and functionally.

  Protective Tissues: These tissues are primarily protective in function. They consist of :

  (i) Epidermis

  - Epidermis forms one cell thick outermost layer of various body organs of plants such as leaves, flowers, stems and roots.
  - Epidermis is covered outside by cuticle. Cuticle is a water proof layer of waxy substance called as cutin which is secreted by the epidermal cells and provide protection against provide protection against loss of water and also invasion by microbes.
  - Cells of epidermis of leaves are not continuous at some places due to the presence of small pores called as stomata.
  - Each stomata is guarded by a pair of bean-shaped cells called as guard cells. These are the only epidermal cells which possess chloroplasts, the rest being colourless.



STOMATA

Functions of Epidermis

- The main function of epidermis is to protect the plant from desiccation and infection.
- Cuticle of epidermis cuts the rate of transpiration and evaporation of water and prevents wilting.
- Function of Stomata : It allows gaseous exchange to occur during photosynthesis, respiration and also helps in transpiration.

(ii) **Cork or Phellem**

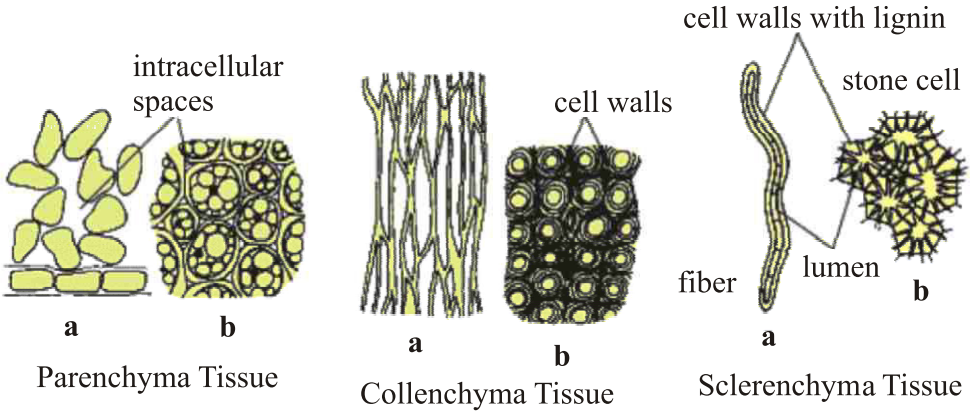
- In older roots and stems, tissues at the periphery become cork cells or phellem cells.
- Cork is made up to dead cells with thick walls and do not have any intercellular spaces.
- The cell wall in cork deposit waxy substance called as suberin.
- The cells of cork become impermeable to water and gases due to the deposition of suberin.
- The cork cells are without any protoplasm but are filled with resins or tannins.

Functions of Cork :

- Cork is protective in function. Cork cells prevent desiccation, infection and mechanical injury.
- Imperviousness, lightness, toughness, compressibility and elasticity make the cork commercially valuable.

(iii) **Simple Permanent:** These are supportive in function and are of three types :

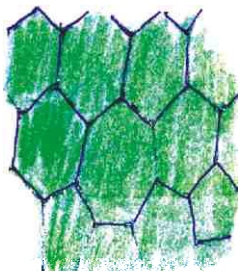
The Three Basic Types of Plant Tissue (Supporting Tissue)



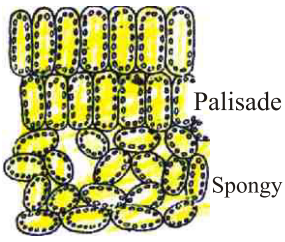
[a. longitudinal section (LS) c. Transverse Section (TS)]

(i) Parenchyma : It is the fundamental backing tissue.

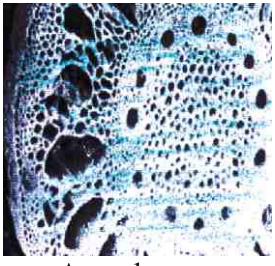
- Loosely packed thin walled cells, oval or spherical in structure with large space between cells
- Cell wall mainly composed of cellulose & pectin.
- Large central vacuole for food & water storage.
- Primary function is food storage and packing.



Parenchyma



Chlorenchyma



Arenchyma

Parenchyma and its type :

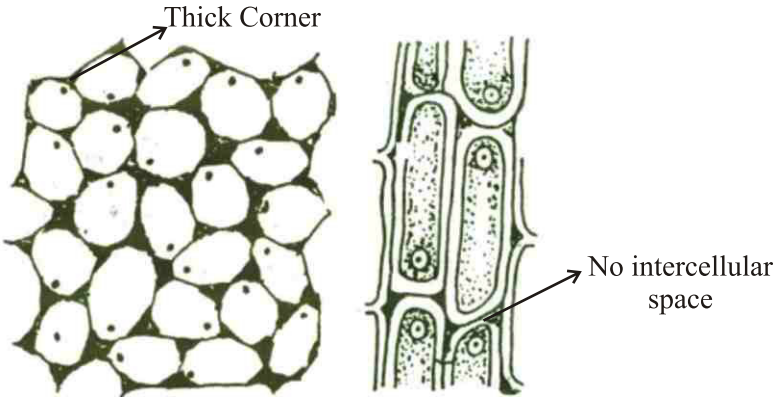
Idioblast : Some parenchyma involved in storage of excretory substances such as resin, tannin, gum and oils called as idioblast.

- In typical parenchyma chlorophyll is absent.

Chlorenchyma : Chloroplast containing parenchyma tissues are called as chlorenchyma which perform photosynthesis e.g., mesophyll of leaves.

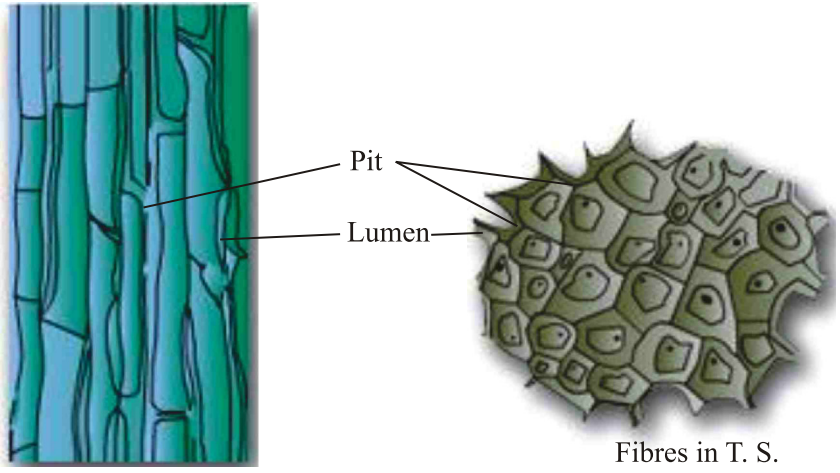
Aerenchyma : In hydrophytic plants aerenchyma (a type of parenchyma containing air spaces) provides buoyancy.

(ii) Collenchyma : It is the living mechanical tissue.



Collenchyma

- Elongated cells with thick corners.
- Localized cellulose and pectin thickening.
- Provides flexibility to plant parts & easy bending of various parts of plant.
- Few chloroplasts may be present.
- Give mechanical strength elasticity to the growing stems.
- They have no or very little intercellular spaces.



Fibres in L. S.

Fibres in T. S.

Fibres in L.S.

- Composed of extremely thick walled cells with little or no protoplasm.
- Cells are dead & possess very thick lignified walls.
- Lignin is water-proof material.
- Intercellular spaces are absent.

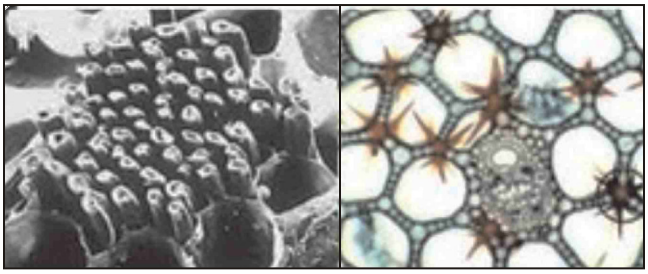
(iii) Selerenchyma

Cells of sclerenchyma are of two types :

Sclereids :

- These are also called grit cells or stone cells.
- These are small cells, where lumen is so small due to higher thickening of cell wall, as present in drupe fruit (mango, coconut, walnut) legume seeds (Macrosclereid).

Fiber Sclereids



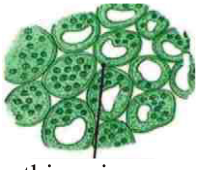
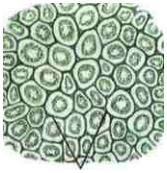
Fibres :

- They are very long, narrow, thick, lignified cells. Lumen is large as compared to sclereids. Generally 1-3 mm long.
- In the thick walls of both the fibres and sclereids are present thin areas called as pits.

Uses of Sclerenchyma Fibres

- These are used in the manufacture of ropes, mats & certain textile fibres.
- Jute and coir are obtained from the thick bundle of fibres.

Difference between Parenchyma, Collenchyma and Sclerenchyma

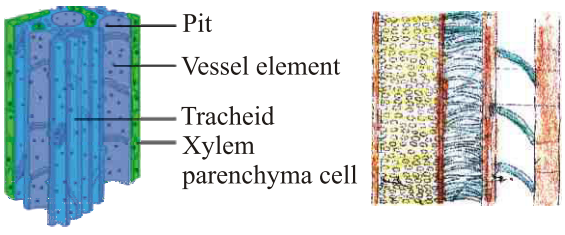
Features	Parenchyma	Collenchyma	Sclerenchyma
	 thin primary cell wall	 irregularly thickened primary cell wall	 thick secondary cell wall primary cell wall

1. Cell shape	Isodiametric cells which are oval, spherical or polygonal in shape.	Circular, oval or polyhedral.	Variable in shape. Fibres and sclereids.
2. Cell Wall	Thin cellulosic cell wall.	Uneven thickening on their cell wall.	Lignified secondary cell wall present.
3. Cytoplasm	Abundant	Presnent	Absent
4. Nucleus	Present (Living tissue)	Present (Living tissue)	Absent (Dead tissue)
5. Vacuoles	Large vacuole	Vacuolated	Absent
6. Intercellular spaces	Present	Absent	Absent
7. Occurrence	Basically packing tissue, all soft part of plant-pith, cortex, medullary rays.	Dicot stems, petiole and beneath the epidermis. Absent in monocot and roots.	Dicot hypodermis, bundle sheath, pericycle, seed, pulp of fruits.
8. Functions	Food storage, photosynthesis, provide buoyancy to hydrophytes	Provide tensile strength, mechanical support, phtosynthesis	Protection from stress and strain, mechanical strength.

(B) Complex permanent Tissues

- It consists of more than one type of cells which work together as a unit.
- It helps in transportation of organic materials, water and minerals.
- It is also known as conducting or vascular tissue.
- Xylem and phloem together form vascular bundles.

Xylem: Also known as wood and is a vascular and mechanical tissue.
Xylem help in Transportation of water and minerals from soil to plant.



Xylem consists of four types of cells called as components or elements :

(i) Tracheids :

- They are elongated dead cells (primitive elements) mainly involved in conduction of water and minerals in gymnosperms.

(ii) Vessles :

They are advance element (generally found in angiosperms).

- Vessels are cylindrical tube like structures placed one above the other end to end which form a continuous channel for efficient conduction of water.

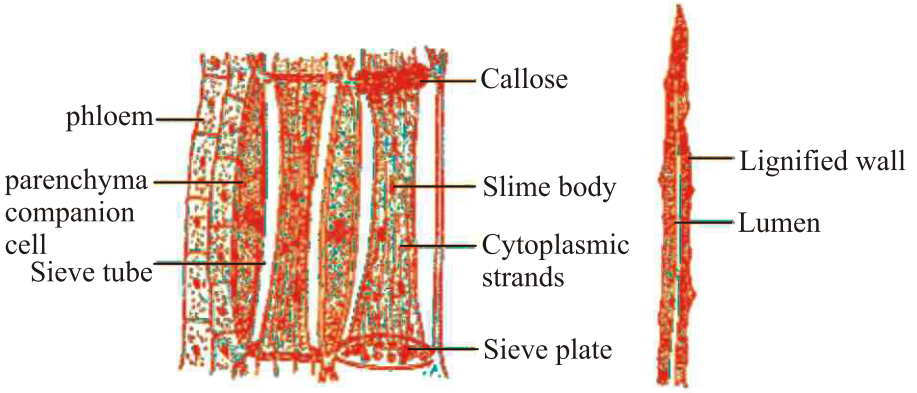
(iii) Xylem parenchyma :

- They are small and thick walled parenchymatous cells designed for storage of starch (food).

(iv) Xylem sclerenchyma (fibres)

- They are non-living fibers with thick walls and narrow cavities which provide mechanical support.
- Except xylem parenchyma all other xylem elements are dead.
- The annual rings present in the trunk of a tree are xylem rings.
- By counting the number of annual rings, we can determine the age of a tree.

Phloem : It transport (translocation) food from leaves to other parts of the plant. All phloem cells are living except phloem fibres.



Phloem fibre (bast fibre)

Phloem consist of four types of components/elements :

(i) Sieve tubes :

- Sieve tubes are tubular structures made up of elongated, thin walled cells placed end to end.
- The end walls of sieve tube cells are perforated by numerous pores, called as sieve plates.

- Nucleus of sieve cell degenerates at maturity. However, cytoplasm persists, because of protoplasmic continuation of sieve tube with companion cell through plasmodesmata.

(ii) **Companion cells :**

- Companion cells have dense cytoplasm and prominent nuclei.
- Sieve tubes & companion cells are also called sister cells because they originate from single mother cell.

(iii) **Phloem fibre/Phloem Sclerenchyma :**

- They give mechanical support to sieve tubes and are dead.

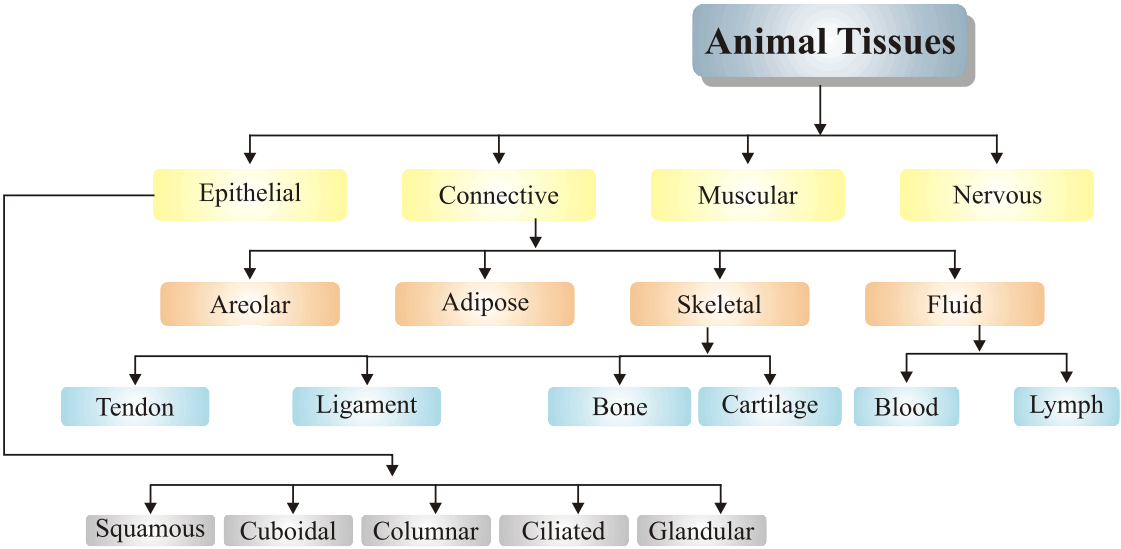
(iv) **Phloem parenchyma :**

- They store food and help in radial conduction of food.

Difference Between Xylem and Phloem

Features	Xylem	Phloem
Cells : Living/dead	Dead (Except-xylem parenchyma)	Living (Except phloem fibre)
Cells : Thickness	Thick	Thin
Material	Lignin	Cellulose
Permeability	Impermeable	Permeable
Cross walls	None	Sieve plates
Cytoplasm	None	Yes
Function	Carries water and minerals	Carries sugars (Food)
Direction of flow	Upwards (Unidirectional)	Down and up (bidirectional)
Special features	Fibres	Companion cells

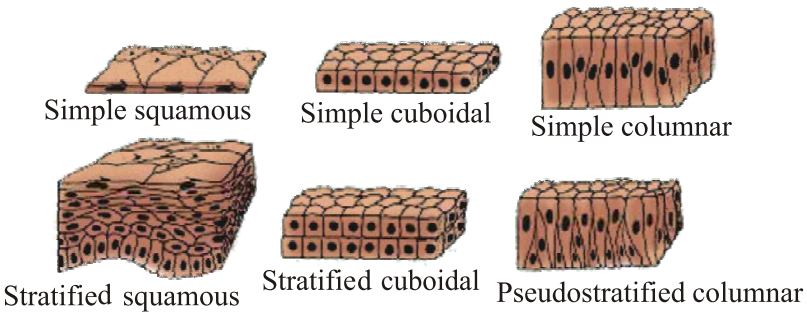
ANIMAL TISSUE



EPITHELIAL TISSUE

- Cells of epithelium are set very close to each other tightly packed and the tissue rests on a non-cellular basement membrane & consists of single layer of cells.
- It covers all the organs and line the cavities of hollow organs like stomach.
- It is primarily protective in function.

Type of Epithelium



Epithelium tissues are classified as :

(a) *Squamous epithelium :* Also called pavement epithelium.

- Cells arranged end to end like tiles on a floor.
- Cells are polygonal in surface view.
- It forms the delicate lining of cavities (mouth, oesophagus, nose, pericardium, alveoli etc.) blood vessels and covering of the tongue and skin.

- Epithelial cells are arranged in many layers (stratum) to prevent wear and tear in skin. This pattern is stratified squamous epithelium.

(b) Cuboidal epithelium :

- They are cube like cells that fit closely, cells look like squares in section, but free surfarce appears hexagonal.
- It is found in kidney tubules, thyroid vesicles and in glands (salivary glands, sweat glands).
- It forms germinal epithelium of gonads (testes and ovaries).
- It is involved in absorption, excretion and secretion. It also provides mechanical support.

(c) Columnar epithelium :

- Columnar means 'pillar-like' epithelium. It forms lining of stomach.
- Small intestine and colon, forming mucous membranes.
- Border of micro villi is present at the free surface end of each cell which increases absorption efficiency in small intestine.

(d) Ciliated epithelium :

- Cells may be cuboidal or columnar.
- Found in respiratory tract, living of spermduct, oviduct & kidney tubules etc.
- On its free surface are present protoplasmic outgrowths called cilia.
- It helps in the movement of ova in the fallopian tube.

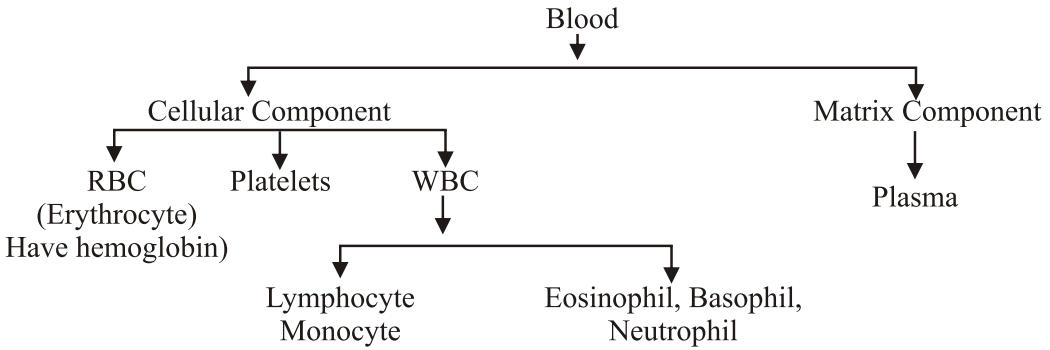
(e) Glandular epithelium :

- Gland cells secretes substances at the epithelial surface.
- Sometimes position of epithelial tissue folds inward and form multicellular gland it is called Glandular epithelial.

CONNECTIVE TISSUE

- The cells of the connective tissue are widely spaced and embedded in an intercelluar matrix.
- Their basic function is to provide support to different organs and keeping them in place.
- Connective tissue have two components : matrix and cellular part.

(a) *Fluid or vascular tissue :*



Blood and lymph

- Blood is a connective tissue, fluid matrix of blood is plasma having wandering or floating cells, called corpuscles, blood helps in the transportation of various materials such as nutritive substances, gases, excretory products, hormones etc.

(a) Plasma

- Form 55% part of blood. Constitution : 90-92% : water, 7% : Protein (Albumin, fibrinogen, globulin), 0.9% : inorganic salt etc.

(b) Corpuscles

- Forms 45% part of blood.

(i) RBCs

- They are also called as erthyrocytes, containing red coloured respiratory pigment called haemoglobin that helps in transportation of oxygen.

(ii) WBCs (Leucocytes : They are also called as 'Soldiers of the body'.) Provide immunity.

- They are irregular, amoeboid, phagocyte cells that protect our body by engulfing bacterial & other foreign particles. they are of five types : Monocytes, Lymphocytes, Basophils, Neutrophils, Eosinophils.

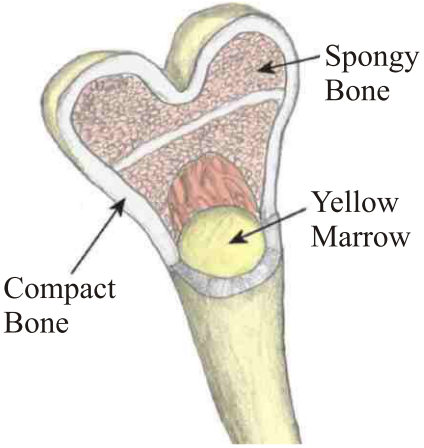
(iii) Blood platelets or thrombocytes

- They are spindle shaped cells which are involved in clotting of blood.

(b) *Skeletal Tissue*

BONE :

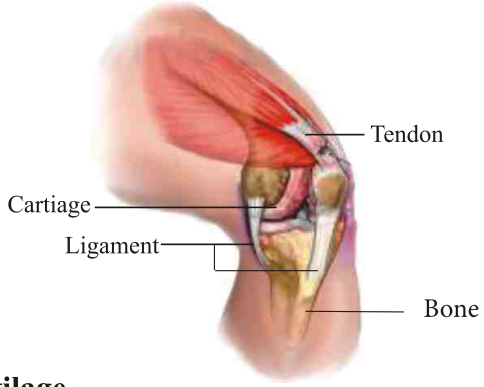
It is hard connective tissue that forms supportive framework i.e. skeleton of the body. It is of two types :

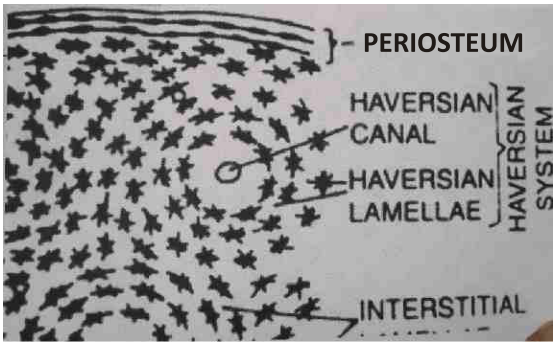


Structure of bone

Bone

- Matrix of bone is very hard because of salts such as calcium phosphate, $CaCO_3$ (60-70%) etc. and a protein ossein.
- Bone cells (osteoblasts) are embedded in this hard matrix.
- Matrix is deposited in the form of concentric layers of lamellae formed around a central canal, the bone cells occupy small spaces between the concentric layers of matrix.

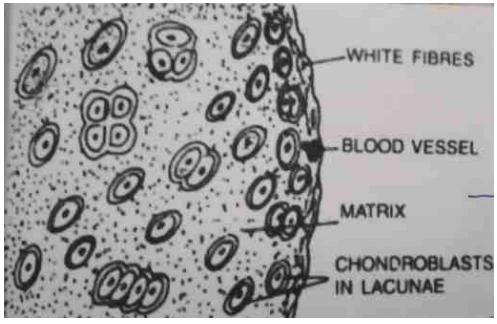




T.S. of Bone

Cartilage

- This tissue is elastic, less harder as compared to bones.
- Elasticity is due to presence of chondrin (protein). Cells are called as chondrocytes which are widely spaced and matrix is reinforced by fibres.
- It is found at joint of bones, in the nose, ear, trachea and larynx.
- It provides flexibility and great tensile strength.



T.S. of Cartilage

(c) *Dense regular connective Tissue (Fibrous Tissue)*
(i) Ligament *(ii) Tendon*

It is most abundant type of connective tissue. It is further divided into following types :

(i) Yellow fibrous connective tissue (Ligament)

- They are very elastic due to the presence of a network of yellow fibres in its matrix called as ligament which attaches bone to bone.

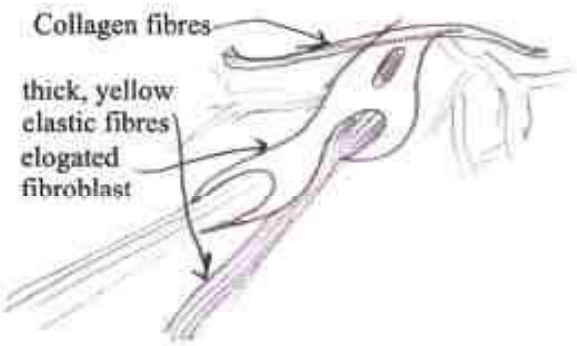
(ii) White fibrous connective tissue (Tendon)

- They have very little matrix containing abundant white fibres forming layers and non-elastic in nature.
- Bundles of this tissue are called as tendons, which attaches muscles to the bones.

Tendons	Ligaments
1. Inelastic 2. Join muscles to bone. 3. Made up of white collagen fibres.	1. Elastic 2. Connect bones to bones. 3. Made up of white collagen as well as yellow elastin fibres

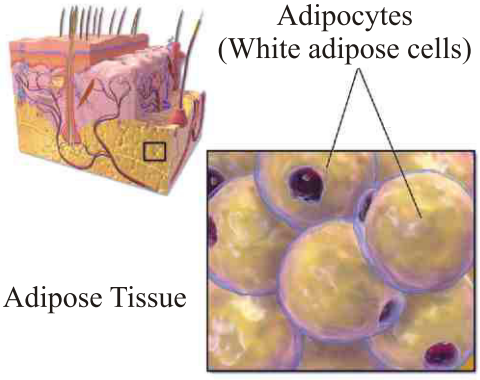
Bone	Cartilage
1. Hard and inflexible 2. Porous. 3. Blood vessels present. 4. Matrix made up of protein and mineral sells (e.g., calcium phosphate)	1. Flexible 2. Non-porous 3. Blood vessels absent. 4. Matrix made up of protein.

(d) Areolar tissue :



- This tissue fills spaces inside organs and is found between the skin & muscles, around blood vessels, nerves and in the bone marrow.
- It is a supporting and packing tissue.
- It also helps in repair of tissues after injury.

(e) Adipose tissue :



- These are oval and round cells, filled with fat globules called adipocytes.
- It is found in subcutaneous layer below the skin, around the heart, brain and below the eyeballs. It acts as an insulator and prevents loss of heat from the body.
- It serves as a fat reservoir and keeps visceral organs in position.

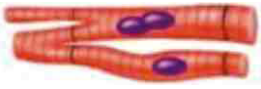
MUSCULAR TISSUE

- Movements are brought about in our body with the help of muscular tissue.
- They are long fibre-like cells called muscle fibres.
- They are capable of contraction or relaxation because they are made up of contractile proteins. (actin and myosin)

Types of Muscu

Skeletal Muscle

Cardiac Muscle



Smooth Muscle

(a) *Striated muscles*

- These muscles shows alternate light and dark bands hence the name is striped or skeletal muscles.
- They are also called as voluntary muscles because these are under the control of one's will.
- Muscle fibers or cells are multinucleated and unbranched.
- Each fibre is enclosed by thin membrance which is called as sarcolemma.

  Cytoplasm is called as sarcoplasm.
- These muscles get tired and need rest.

(b) *Cardiac muscle fibres*

- They are involuntary muscles.
- Only found in the walls of heart.
- They are uninucleated and branched. Branches are united by intercalated disc.
- In these muscles rhythmic contraction and relaxation occurs throughout the life and never get tired.

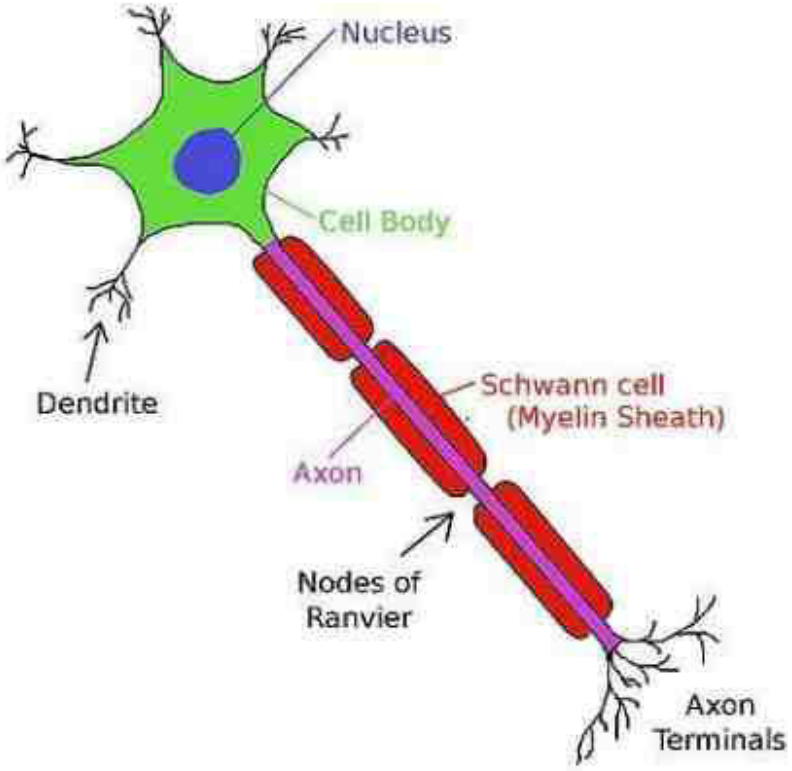
(c) *Non-striated muscles or smooth muscle*

- They are involuntary muscles also called as smooth muscles.
- These muscle fibres are uninucleated and spindle shaped.
- They are not enclosed by membrane but many fibres are joined together in bundles. They constitute internal organs.
- Such muscles are found in the walls of stomach, intestine, urinary bladder, bronchi, iris of eye etc.
- Peristaltic movements in alimentary canal are brough about by smooth muscles.

Striated	Non-striated	Cardiac
1. They are present in the limbs, body walls, tongue, pharynx and beginning of oesophagus.	1. They are present in the oesophagus (posterior part only). urino-gential tract, urinary bladder, vessels, iris of eye, dermis of skin, and arrector pili muscles of hair.	1. They are present in the wall of the heart, pulmonary veins and superior vena cava.
2. Cylindrical	2. Spindle shaped.	2. Cylindrical.
3. Fibres unbranched.	3. Fibres unbranched	3. Fibres branched.
4. Multinuclecate.	4. Uninucleate	4. Uninucleate.
5. Bounded by sarocolemma.	5. Bounded by plasmalemma.	5. Bounded by sarcolemma
6. Light and dark bands present	6. Light and dark bands absent	6. Faint light and dark bands present.
7. No oblique bridges and intercoalated discs	7. No oblique bridges and intercalated discs.	7. Oblique bridges and intercalated discs present.
8.Nerve supply from central nervous system.	8. Nerve supply from autonomic nervous system.	8. Nerve supply from the brian and autonomic nervous system.
9. Blood supply is abundant.	9. Blood supply is scanty.	9. Blood supply is abundant.
10. Very rapid contraction.	10. Slow contraction.	10. Rapid contraction.
11. They soon get fatigued.	11. They donot get fatigued.	11. They never get fatigued.
12. Voluntary	12. Involuntary	12. Involuntary

NERVOUS TISSUS

- They are highly specialized tissues due to which the animals are able to perceive and respond to the stimuli.
- Their functional unit is called as nerve cell or neuron.
- Cell body is cyton covered by plasma membrane.
- Short hair like extensions rising from cyton are dendrons which are further subdivided into dendrities.
- Axon is long, tail like cylindrical structure with fine branches at the end Axon is covered by a sheath, which is known as myelin sheath.
- Nerve ending of one neuron is very closely placed to the dendrons of another neuron to carry impulses from one neuron to another neuron in the form of electrochemical waves. This close proximity is called as synapse.



Structure of Neuron

OBJECTIVE TYPE QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS

1. The tissue derived directly form the meristem of embryo is called as .....
2. A group of cells with similar structure organized to do a common function is called as .....
3. Which plant tissue remains in active metabolic state always ?
4. Sieve tubes and companion cells are found in ..... tissue. (Xylem/ phloem/ collenchyma)
5. Long, narrow, dead cells having a thick deposition of lignin in the cell wall are called ..... cells.
6. Which tissue is responsible for transport of water in plants ?
7. The special property of muscle fibres to contract forcefully and return to relaxed state is called ..... . (excitability / contractibility / flexibility)
8. A branch of science dealing with the study of bones is called..... . (Ornithology/ physiology/ osteology)
9. The fluid matrix of blood is called ..... .
10. Spindle-shaped, non-striated, involuntary muscle fibres present in hollow internal organs like urinary bladder are called ..... . (smooth muscle fibres/ streiated muscle fibres/ cardiac muscle fibres.)

Q3. MCQ

1. In plants which of the following have the capability of cell division ?
   (a) Parenchyma (b) Sclerenchyma
   (c) Xylem (d) Apical Meistem
2. The growth in plants is
   (a) limited to certain regions (b) uniform in all parts
   (c) limited to top region (d) limited to roots only.
3. Intercalary meristems are found
   (a) at internodes and base of leaves (b) at growing tips of roots
   (c) beneath the bark (d) at the tips of stem
4. Cells of the tissue have dense cytoplasm, thin cellulose walls and prominent nuclei. Identify the tissue.
   (a) Collenchyma (b) Sclerenchyma
   (c) Meristem (d) Parenchyma
5. Dead long and narrow cells in a plant belong to which tissue ?
   (a) Parenchyma (b) Sclrenchyma
   (c) Collenchyma (d) Phloem
6. Bone is an example of _____
   (a) Muscular tissue (b) Connective tissue
   (c) Epithelial tissue (d) Nervous tissue
7. Which animal tissue is usually separated from the underlying tissue by an extracellular fibrous basement membrane ?
   (a) Muscular tissue (b) Connective tissue
   (c) Epithelial tissue (d) Nervous tissue
8. Oesophagus and the lining of the mouth are also covered with which tissue ?
   (a) Squamous epithelium (b) Ciliated epithelium
   (c) Areolar conneective (d) Striated muscle tissues
9. Husk of a coconut is made of which tissue ?
   (a) Parenchyma tissue (b) Sclerenchymatous tissue
   (c) Collenchyma (d) Xylem
10. Muscles contain special proteins called _____that help in muscle movement.
   (a) receptor proteins (b) enzymes
   (c) nucleo proteins (DNA, RNA) (d) contractile proteins (actin and myosin)

VERY SHORT ANSWER TYPE QUESTIONS

1. Which meristem increases the girth of the plant ?
2. Name the epidermal tissue which helps in movement of ova in the oviduct.
3. Suggest a term for " The signal which passes along the nerve fibre :-
4. Which tissue helps in buoyancy in aquatic plants ?
5. "I am an animal tissue which fills the space inside the body organs and also supports them". Identify me and write my name.
6. Blood has a fluid matrix. Name thin matrix.
7. Name the tissues which enables animals to move rapidly in response to stimuli.

SHORT ANSWER TYPE QUESTION (2 MARKS)

1. Name the outermost layer of cells in plants. State any two functions of this layer.
2. What is cutin ? Where is it found ?
3. What is the speciality of ciliated columnar epitheium tissue ?
4. Which animal tissue is responsible for transportation of various materials in body ? Name various components / Cells of this tissue.
5. Where is suberin found in plants ? What is its function ?

SHORT ANSWER TYPE QUESTION (3 MARKS)

1. Draw a well labelled diagram of small pores present in epidermis of a leaf. State any two functions of these pores.
2. Broadly classify animal tissues.
3. Write the composition of mammalian blood. State any two main functions of blood.
4. Write down the identifying features of connective tissue. State any one major difference between ligament and tendon.
5. With the help of diagram explain the structure of neuron.
6. Name the cells of adipose tissue. Where is adipose tissue found in an animal body ? State its function also.

LONG ANSWER TYPE QUESTION (5 MARKS)

1. What is meristematic plant tissue ? Categorise and explain various meristematic tissues. Also show the location of these meristermatic tissues with help of a well labelled diagram.
2. (i) Write characteristic features of complex permanent tissues.
   (ii) Name two complex permanent tissues found in plants.
   (iii) What do these two complex permanent tissues constitute together ?
   (iv) Write the composition and function of these complex permanent tissues.
3. Differentiate between three types of muscles on the basis of their structure and function. Draw a neat well labelled diagram of these three types of muscles.
4. What are different kind of connective tissues ? State their functions.
5. Differentiate between parenchyma, collenchyma and sclerenchyma tissue on the basis of following :-
   (i) Cell Well
   (ii) Cytoplasm
   (iii) Nucleus
   (iv) Occurance
   (v) Function

ASSERTION AND REASON BASED QUESTION

Directions – In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Mark the collect choice as :

(a) Both assertion (A) and reason (R) true and reason (R) is the collect explanation of assertion (A)

(b) Both assertion (A) and reason (R) are true but season (R) is not the collect explanation of assertion (A).

(c) Assertion (A) is true but reason (R) is false.

(d) Assertion (A) is false but reason (R) is true.

Q1. Assertion - Water Hyacinth floats on water surface.

Reason - Inter-cellular spaces are absent in between the cells of sclerenchyma.

Ans. (b) Water Hyacinth floats on water surface because it has spongy petioles that enclose a lot of air in its aerenchyma. This air makes the plant lighter than water so that it is able to float on the water surface.

Q2. Assertion – Blood is considered to be 'connective tissue'.

Reason – During circulation, blood passes through all the organs of the body.

Ans. (a) Blood is circulated through all the organs of the body and therefore connects different tissues and organs of the body.