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TISSUE

"A group of cells that are similar in origin and performing a common function is called tissue."

- Study of internal structure of plants or animals is called Anatomy.
- Study of tissues is known as Histology.

Importance of tissues :

- Workload of individual cell decreases.
- Multicellular organisms have higher survival due to improved body organization and higher efficiency of functions.

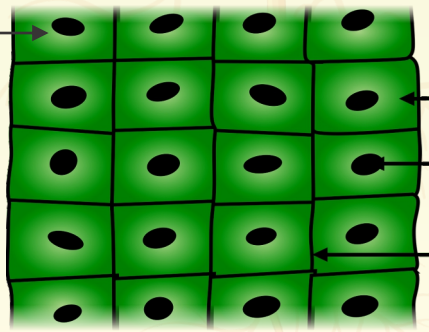
Plant tissues

On the basis of Capacity to divide
- Meristematic tissue
- Permanent tissue

A. Meristematic tissues

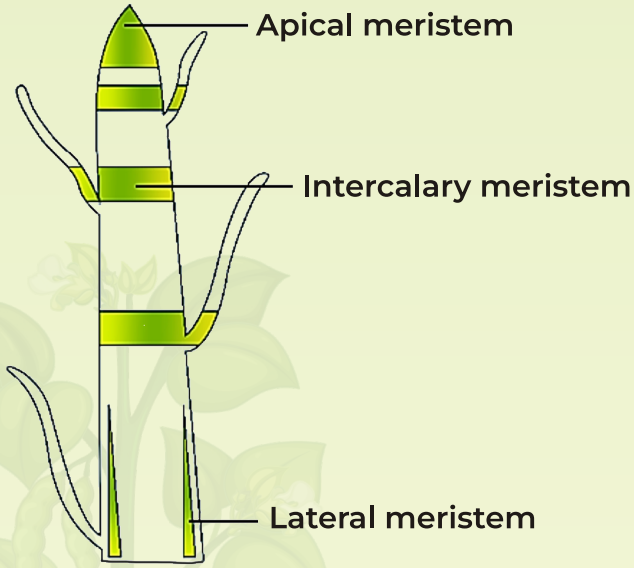
- living tissues which are capable of division throughout life.
- Meristematic tissue are free from virus because meristem has continuously and rapidly dividing cells. These cells have a high rate of metabolism and viruses cannot replicate in such cells.
- Meristematic tissue is responsible for the growth in length and width(girth) of plant body.

Cell
- Dividing indefinitely
- No intercellular spaces
- Small and thin-walled cells



Meristematic Tissue

Location of meristematic tissue in the plant body



Classification of Meristematic tissue

	Apical meristem	Intercalary meristem	Lateral meristem
Position	At the apex part of shoot and root.	At the base of leaves and internode.	Lateral sides of stem and root.
Function	Growth in length.	Growth in length of leaves and internode.	Growth in diameter or girth.

Note

- Apical and intercalary meristem are responsible for primary growth of plant (growth in length).
- Lateral meristem is of two types, vascular cambium and cork cambium. Vascular cambium produces secondary phloem and secondary xylem. Cork cambium (phellogen) produces a protective cork on the outside.
- Differentiation is the development process in which cells take up a permanent shape, size and perform a specific function.

B. Permanent tissues

- Formed by the division and differentiation of meristematic tissue.
- Cells of permanent tissues have lost the power of division temporarily or permanently.

1. Simple permanent tissue

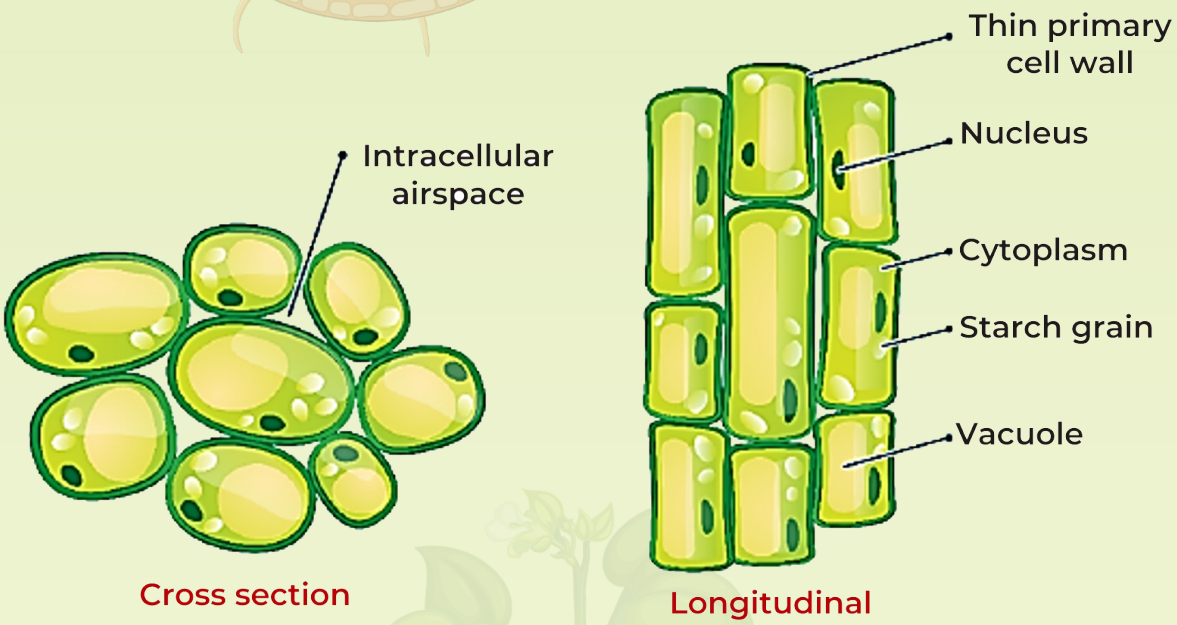
- perform a common function
- Made up of similar type of cells

Types of Simple permanent tissue		
Parenchyma	Collenchyma	Sclerenchyma
It consists of living cells.	It consists of living cells.	It consists of dead cells.
Intercellular spaces are usually present or may be absent.	Intercellular spaces are usually absent.	Intercellular spaces are absent.
Cell wall is thin without having secondary deposition.	Cell wall is thick as it has pectin deposition.	Cell wall is thick as it has lignin deposition.
Cells contain cytoplasm.	Cells contain cytoplasm.	Cells are devoid of cytoplasm.
They have vital functions like synthesis and storage of food.	They have both vital as well as mechanical functions, providing support and elasticity to plant body.	It is chiefly a mechanical tissue.

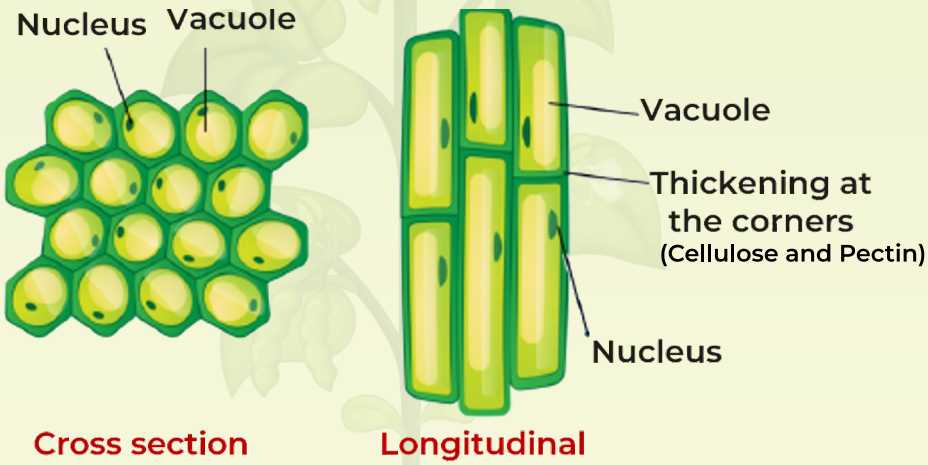
Note

Chlorenchyma :
Parenchyma cells may contain chloroplast to take part in photosynthesis, such cells are called chlorenchyma. It is present in mesophyll of leaves.

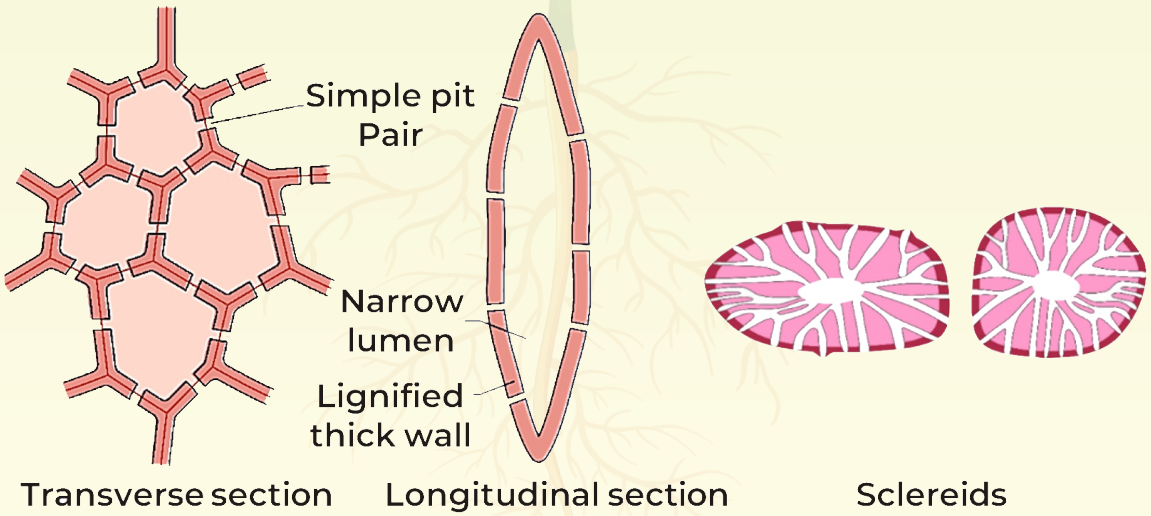
Aerenchyma :
In aquatic plants, the parenchyma consists of loosely arranged cells with large air cavities, it is known as aerenchyma which provides buoyancy.



(a) Parenchyma



(b) Collenchyma



(c) Sclerenchyma

2. Complex permanent tissues

- Made up of more than one type of cells, working together as a unit.

Xylem + phloem = Conductive or vascular tissue

(a) Xylem :

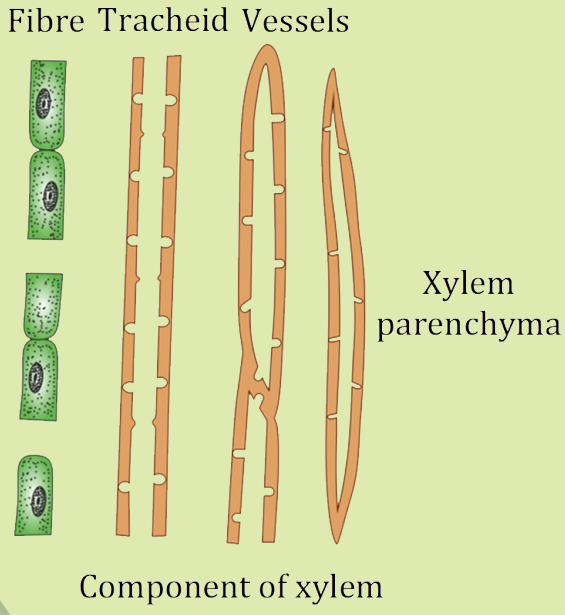
- Help in Conduction of sap (water and minerals) in the plant.
- Provides mechanical support.
- Xylem is called wood and forms the bulk of root and stem of vascular plants.
- Xylem consists of four types of cells
  (i) Tracheids (Dead) (ii) Vessels (Dead)
  (iii) Xylem parenchyma (Living) (iv) Xylem fibres (Dead)
- Tracheary elements = Tracheids + Vessels

(i) Tracheids :

- Elongated, tubular, dead cells
- Do not have open ends
- Some unthickened areas called pits are present for movement of sap from one cell to another
- Chief water conducting elements in non-flowering plants

(ii) Vessels/tracheae :

- Much elongated tubular channels with wide lumen.
- A vessel is composite structure made up of number of vessel elements.
- These are joined together and allow quick movement of water or sap.
- End walls of xylem vessels are highly perforated hence they form a channel which allows continuous rise of water.
- They are present in flowering plants.



Component of xylem

(iii) Xylem parenchyma :

- Store food and help in radial conduction of water and mineral.

(iv) Xylem fibres :

- Dead and lignified sclerenchymatous cells.
- Provide mechanical support to the xylem.

(b) Phloem (bast/leptons) :

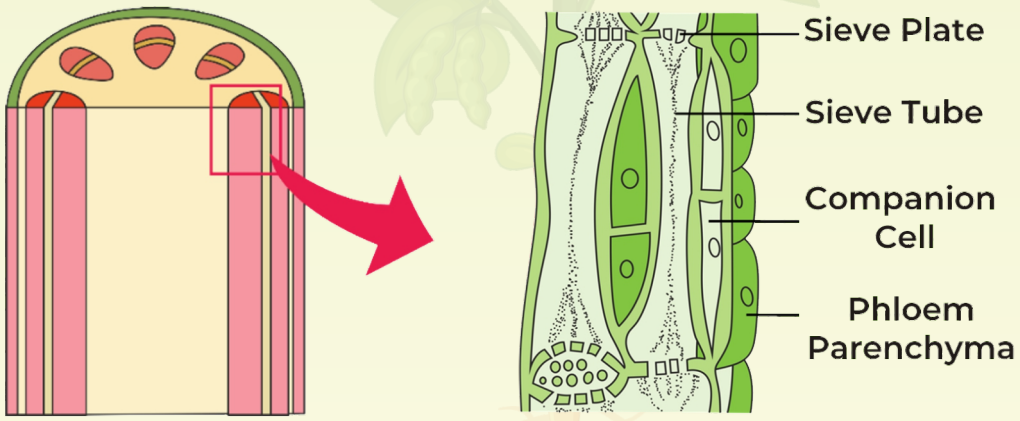
- Main food conducting elements.
- Phloem consists of four types of cells.

(i) Sieve tubes :

- Elongated tubular channels.
- Each sieve tube is made up of several cells called sieve tube members, joined end to end.
- End walls of sieve tubes are perforated by numerous pores are called sieve plate.
- The nucleus of each sieve tube degenerates at maturity, however cytoplasm persists in the mature sieve tube. Thus, nuclei are absent in mature sieve tube elements.

(ii) Companion cells

- Associated with sieve tubes.
- Smaller cells having dense cytoplasm and prominent nucleus.
- Companion cells help the sieve tubes in the conduction of food material.



Phloem tissue

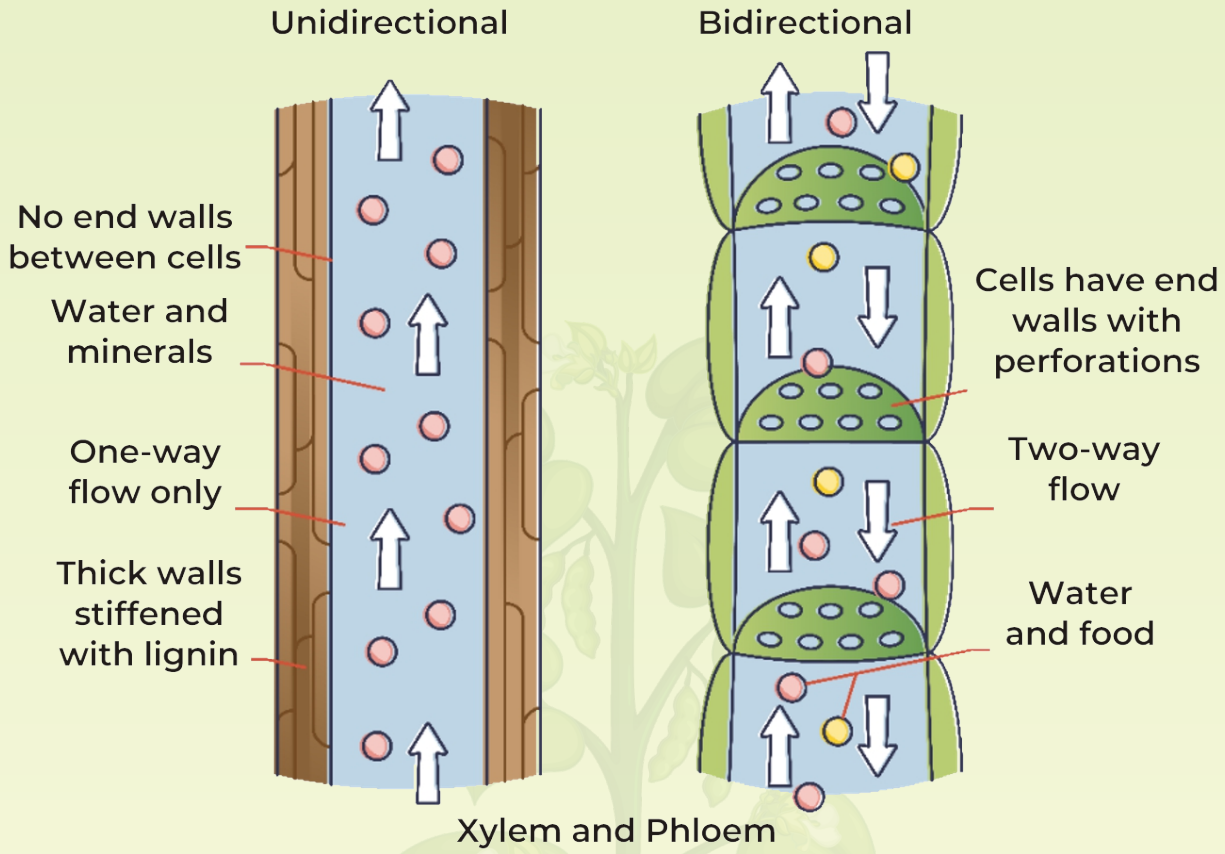
(iii) Phloem parenchyma

- Ordinary cells which store food and assist in the conduction of food in lateral direction.

(iv) Phloem fibres (Bast fibres)

- Dead Sclerenchymatous cells, provide mechanical strength used for making ropes, twines, threads and course textiles.

Flow of materials in xylem and phloem



Xylem and Phloem

Differences between Meristematic tissue and Permanent tissue

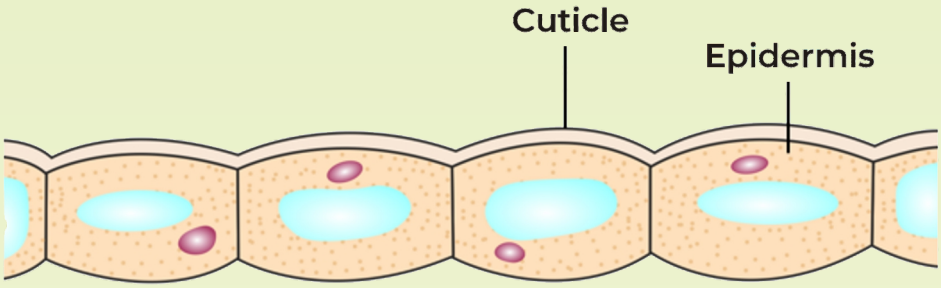
Meristematic Tissue	Permanent Tissue
The cells of meristematic tissue are small. isodiametric and undifferentiated.	The cells of permanent tissue are large, differentiated with different shapes.
These are generally found at the tips of root and stem.	These are found in different parts of the plant.
They do not have intercellular space.	Inter cellular spaces are often present.
In such type of tissue cell wall is thin.	Cell wall is thin or thick.
These cells undergo regular divisions.	The cells do not normally divide.
Meristematic tissue is a simple tissue.	Permanent tissue may be simple or complex.
Metabolic rate is high.	Metabolic rate is comparatively slower.
The cells lack vacuoles.	Large central vacuole is found in living permanent cells.
The cells are living.	Cells may be living or dead.
Meristem takes part in growth.	Permanent tissue takes part in protection, photosynthesis, transportation, storage etc.

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Protective tissues in plants

Protects the plant from mechanical injury, heat and cold and from undue loss of water. These are epidermis and cork.

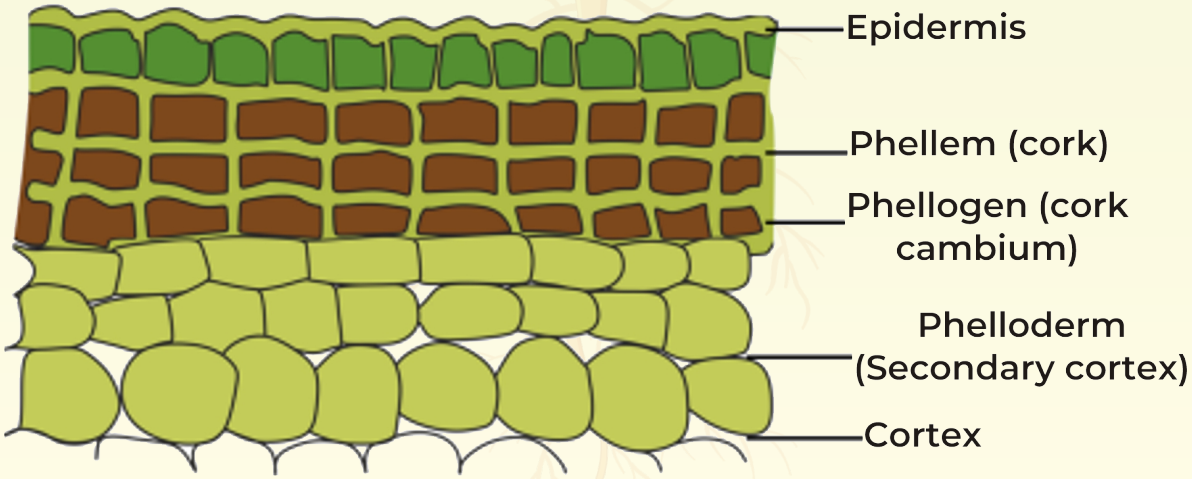
1. Epidermis



- Outermost layer of all organs of plant body which is formed from parenchyma cells.
- In epidermal cells outer wall are thicker than inner wall.
- **Cuticle** - Outer wall of cells has a thin coat of waterproof layer called cuticle.
- **Root hairs** - Many cells bear unicellular and multicellular outgrowths i.e. hair or glands (Trichomes).
- **Stomata** - Leaves and green stems often have minute opening called stomata in epidermis.

2. Cork or Phellem

- Outermost waterproof tissue present in older or mature woody stems and roots
- Formed due to activity of cork cambium or phellogen
- Cork cambium produces cork on the outer side and secondary cortex on the inner side.
- Made up of dead cells with thick wall
- No intercellular spaces



Note The walls of cork cells are heavily thickened by the deposition of an organic substance (a fatty substance), called suberin. Suberin makes these cells impermeable to water and gases and it also helps in conservation of water in the trees.

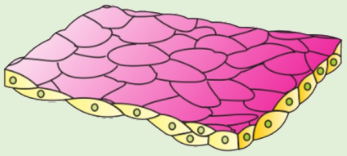
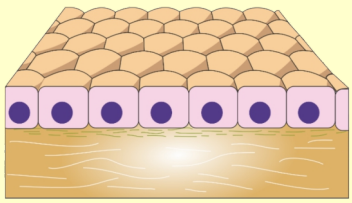
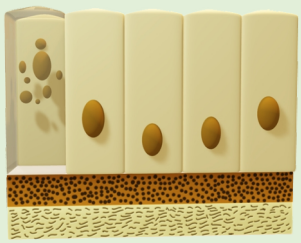
Animal tissues

- It is classified into four major types depending on the function they perform.
  (A) Epithelial tissue (B) Connective tissue (C) Muscular tissue (D) Nervous tissue

A. Epithelial tissue

1. Simple epithelium

It is made up of single layer of cells which rest on the basement membrane.

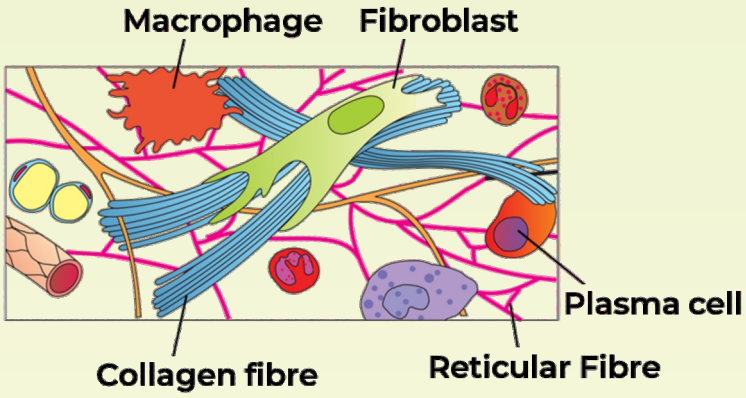
S. No.	Name	Diagram	Location	Function
1	Simple Squamous epithelium (Pavement epithelium)		Walls of blood vessel, air sacs of lungs, oesophagus, lining of mouth.	Diffusion
2	Simple Cuboidal epithelium / germinal epithelium		Lining of kidney tubules, ducts of salivary glands. It also forms germinal epithelium of gonads.	Secretion, absorption, mechanical support, excretion.
3	Simple columnar epithelium	 Glandular epithelium	Lining of intestine & glands, trachea, bronchi.	Secretion of mucus and other secretions.
		 Ciliated columnar epithelium	Lines the nasal passages, oviducts, terminal bronchioles.	Protection, movement of substances in a particular direction for e.g. of mucus in nasal passages, egg in oviduct.

B. Connective tissue

- The cells of connective tissue are loosely spaced and embedded into a noncellular matrix. The matrix may be solid (as in bone), soft (as in loose connective tissue), or liquid (as in blood)

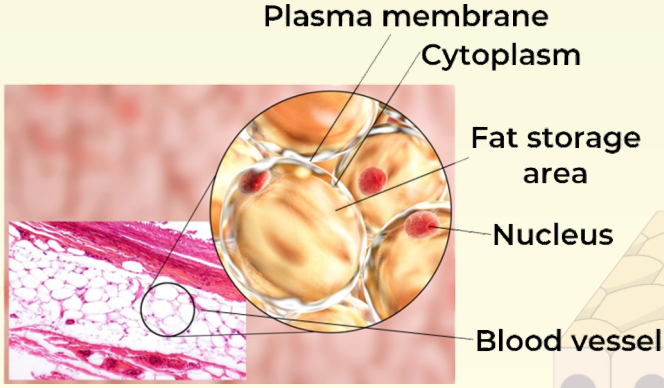
1. Areolar or loose connective tissue

- Mass of widely scattered cells whose matrix is a loose weave of fibres. Many of the fibres are strong protein fibres called collagen.
- Found beneath the skin and between organs.
- It is a binding and packing material whose main purpose is to provide support to hold other tissues and organs in place.



2. Adipose tissue

- It consists of adipose cells (Adipocytes) filled with fat globules in loose connective tissue.
- Each adipose cell stores a large droplet of fat that swells when fat is stored and shrinks when fat is used to provide energy.
- Adipose tissue pads and insulates the animal body.

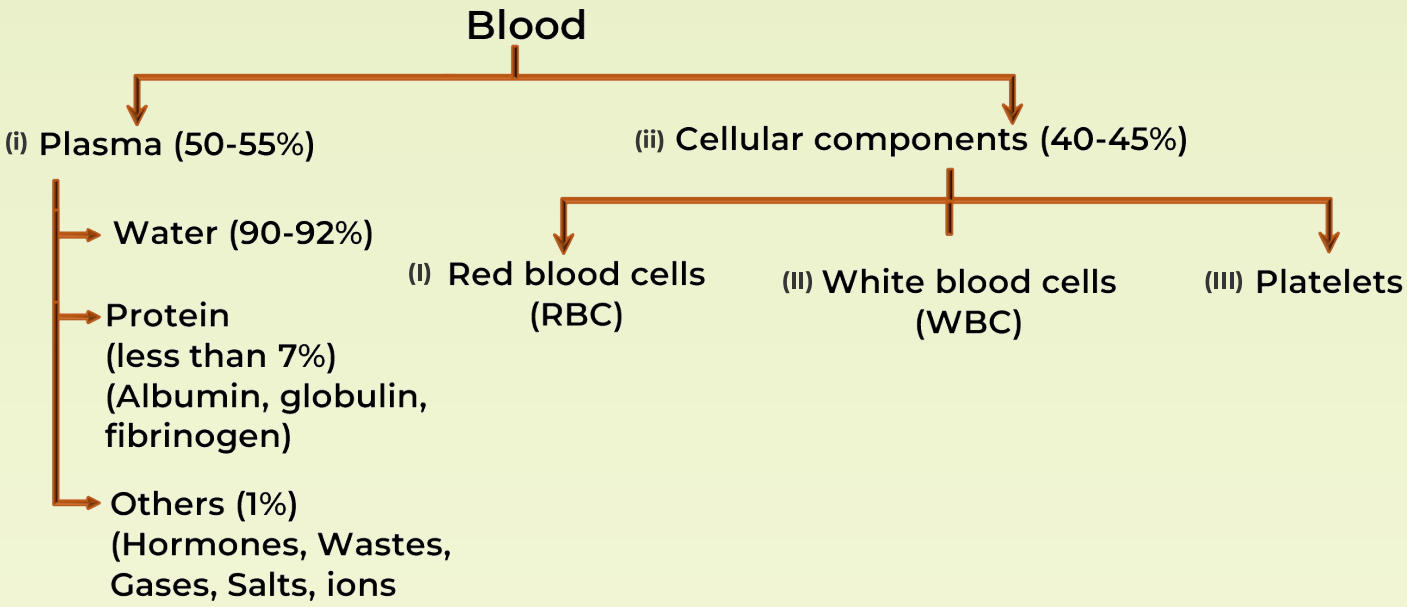


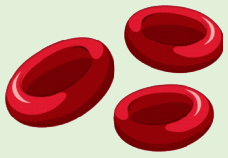
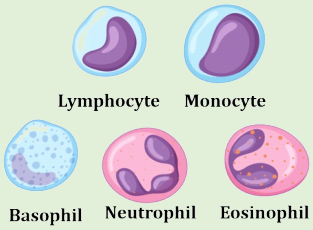
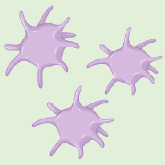
3. Vascular tissue

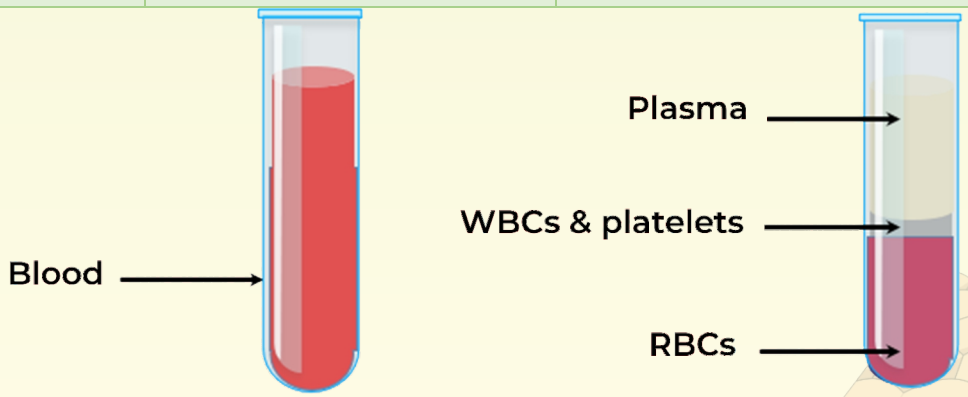
- These are fluid connective tissues. The matrix is without fibres. The vascular tissues are of two types: blood and lymph.

(a) Blood :

It is mobile connective tissue composed with plasma and the cells.



Components	Erythrocytes (RBCs)	Leucocytes (WBCs)	Platelets
			
Number per mm^3 of blood	5-6 million	5,000-10,000	2,50,000-4,00,000
Function	Transport oxygen and carbon dioxide	Destroy foreign cells, produce antibodies, roles in allergic responses	Blood clotting



Blood and its components

(b) Lymph :

- Colourless due to absence of haemoglobin.

  Lymph = blood minus RBC, platelets and plasma proteins

- Made up with colourless matrix and WBC, mostly lymphocytes.

Functions of lymph

- (i) Helps in the transport of nutrients. Nutrients that filter out from blood capillaries into lymph are transported back by lymph into blood through heart.

  (ii)Helps in the transportation of fat absorbed from intestine to the blood.

  (iii) Keeps the tissues and organs of the body moist.

  (iv) Lymphatic organs (lymph nodes, spleen) produce lymphocytes which in turn produce antibodies to strengthen the immune system of the body.

4. Fibrous/Dense regular connective tissue

This tissue consists mainly of fibres. The fibres are of 2 types :

Collagen white fibres

The dominance of the (white inelastic) collagen fibres contribute to the considerable mechanical strength of white fibrous tissue.

Elastin yellow fibres

It can stretch upto one and a half times their length then snaps back to its original length when relaxed.

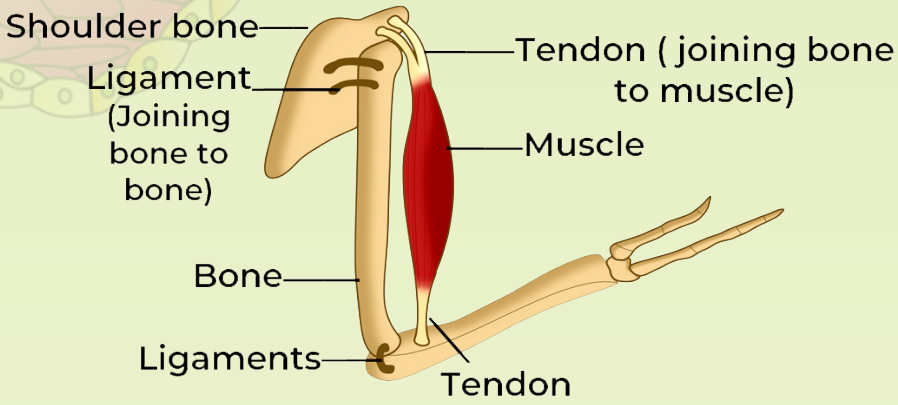
Dense regular connective tissue occurs in two forms

Tendons

- Cords of dense (white fibres) connective tissue
- Attach skeletal muscles to bones.
- Great strength, but its flexibility is limited.

Ligaments

- Cords of yellow fibrous connective tissue.
- Containing elastin and collagen fibres having little matrix connect one bone to the another.



5. Skeletal tissues

- The skeletal tissues form the endoskeleton of the vertebrates.
- Form rigid frame work which support the body, protects the vital organs and helps in locomotion.

(a) Cartilage

- Flexible connective tissue.
- Matrix made up of proteins and sugar
- Haversian system absent.
- Found at the ends of bone, tip of nose, in external ear, voice box (larynx), trachea etc.

(b) Bone

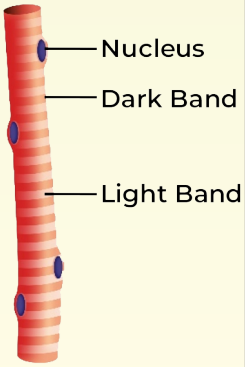
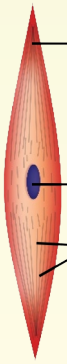
- Hard connective tissue.
- Matrix made up of collagen fibres and salt of Ca and P compounds.
- Haversian system present.

Note

Bone consists of haversian canals, haversian lamellae and osteocytes.

C. Muscular tissue

- Made up of highly specialized thin and elongated cells called muscle fibres.
- The special property is contractility.
- Based on structure, location and function, these are of three types:

Striated muscle	Non - striated muscle	Cardiac muscle
		

Types of Muscle Tissue	Skeletal Muscle Tissue	Cardiac Muscle Tissue	Smooth Muscle Tissue
Location in body	Attached to bones of the skeleton. In the case of facial muscles, attached to other tissues including skin- hence also called as “muscles of facial expression”.	Wall of the heart only	Walls of hollow internal structures, including – Blood Vessels, Stomach, Intestines, Gall Bladder, Urinary Bladder, Airways to the lungs, Iris of the eye.
Voluntary or involuntary	Voluntary	Involuntary	Involuntary
Striations (alternate light and dark bands)	Present, Striated muscle	Present, Striated muscle	Absent, Nonstriated muscle
Cell Nuclei	Many nuclei (located at periphery of long cylindrical muscles fibre)	One (centrally located) nucleus	One (centrally located) nucleus
Cell Shape	Elongated cylindrical and unbranched	Cylindrical and branched	Spindle shaped and unbranched

D. Nervous tissue

- The nervous tissue, contains densely packed cells called nerve cells or neurons, is present in the brain, spinal cord and nerves.
- The neurons are specialised for conduction of nerve impulses.
- They receive stimuli from within or outside the body and conduct impulses (signals) which travel from one neuron to another neuron. Nerve impulse allow us to move our muscles when we want to.
- The functional combination of nerve and muscle tissue is fundamental to most animals.
- This combination enable animals to move rapidly in response to stimulus.

