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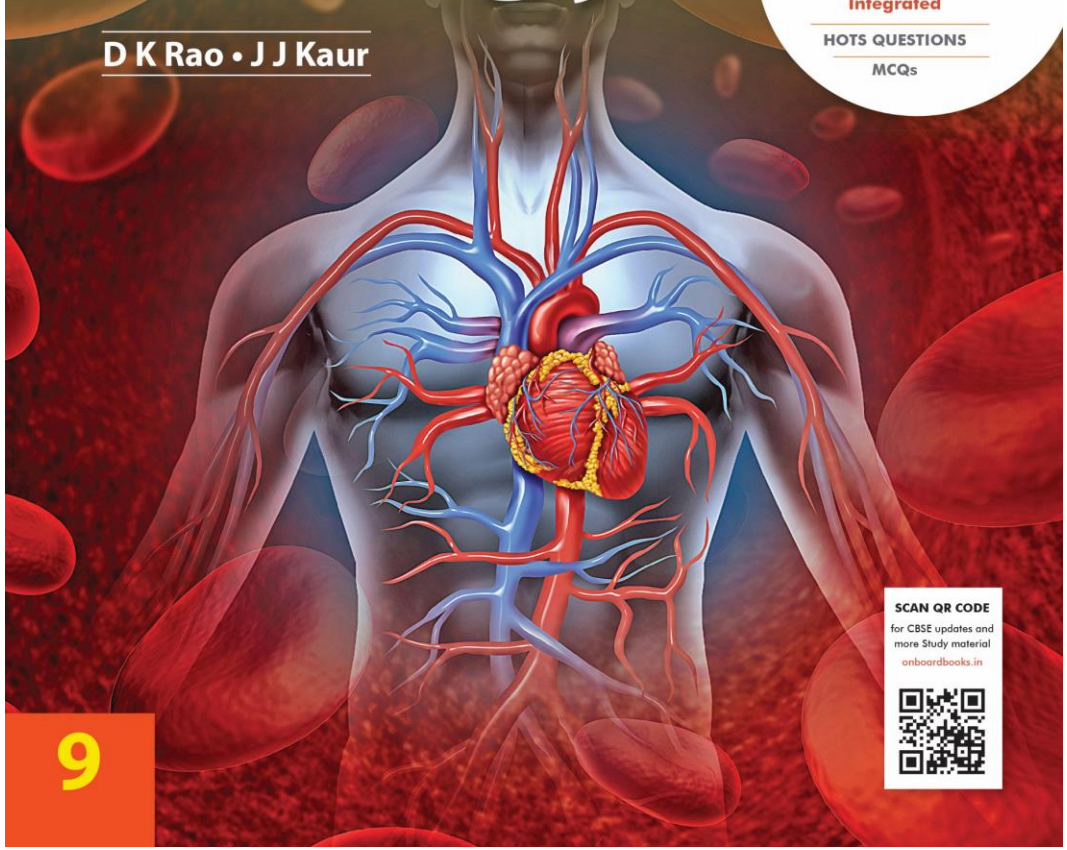

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9

CBSE
Living Science
Biology

Class 9

Chapter 2 Tissues

LEARNING OBJECTIVES

What are Tissues?

Plant Tissues

- Meristematic tissue
- Permanent tissue

Animal Tissues

- Epithelial tissue
- Connective tissue
- Muscular tissue
- Nervous tissue

What Are Tissues?

Each specialized function in the body of multicellular organisms is performed by a group of cells arranged in a cluster called tissue.

Tissues can be defined as a group of cells that are similar in structure and/or perform the same function.

Are plants and animals made of same type of tissues?

Plants and animals have different types of tissues since they differ structurally and perform different functions.

Plant Tissues

Plant tissues are divided into two types on the basis of their stage of development and dividing capacity . These are:

1. meristematic tissue, and 2. permanent tissue.

Meristematic Tissue

A meristematic tissue is a group of young cells that have the capacity of active cell division. This tissue is found in all the growing regions of a plant, such as root tip, shoot tip, etc.

Characteristics of meristematic tissues

- They are composed of living cells, and are very active. The cells are thin-walled, small sized and undifferentiated.
- The cells have dense granular cytoplasm. The nucleus is large, prominent and centrally located.

Note: Refer to Table 2.1 for Comparison between plant and animal tissue organization

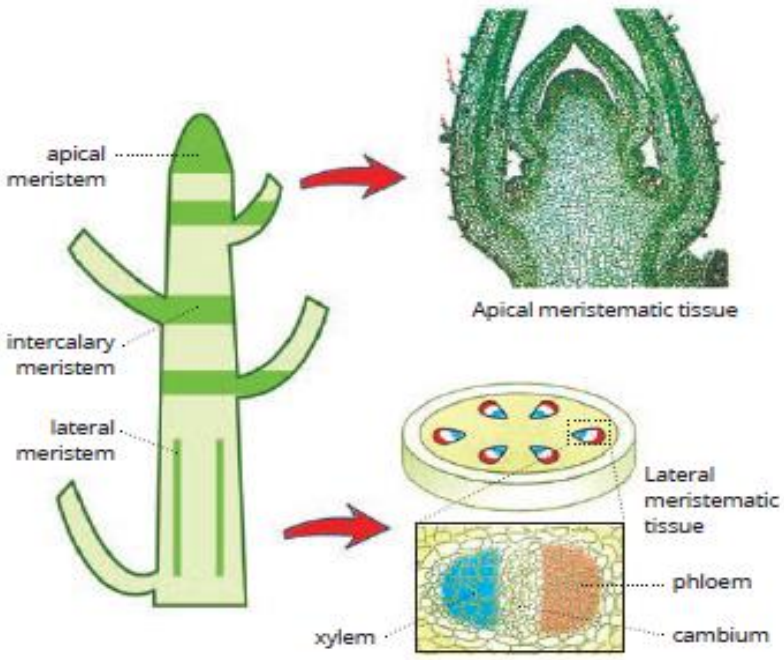
- They have compactly arranged cells without intercellular spaces.
- They are capable of dividing indefinitely, i.e. active cell division. New cells produced by meristematic tissues are initially like those of meristem but later on as they mature and grow, they become differentiated as components of other tissues.
- They don't store reserve food material.
- They lack vacuoles.

Types of meristems

According to their positions in the plant body, meristems are divided into three types – apical meristem, lateral meristem and intercalary meristem.

Apical meristem

Apical meristem is found at the **growing tips of stem**, **root and their growing branches**. It is also called **primary meristem**. Due to the growth of apical meristems, there is increase in the length of stems and roots.



Meristematic tissue

Lateral meristem

Lateral meristem occurs on the sides of roots and stem and is responsible for increase in the girth (diameter) of the roots and stem. These tissues are also responsible for growth in thickness by the addition of secondary tissue and this phenomenon is called secondary growth.

Intercalary meristem

This is the part of apical meristem which gets separated from the apex due to the development of permanent tissue in-between. **Intercalary meristem helps in elongation of the organs.** It is present mostly at the base of nodes, internodes (space on either side of node) and base of leaves.

Permanent Tissue

A permanent tissue is a group of cells in which growth has either stopped completely or for the time being. These are formed by cells that have lost the capacity to divide. These cells may be dead or alive, thin-walled or thick-walled. On the basis of the function performed permanent tissues can be categorized as: simple permanent tissues, and complex permanent tissues.

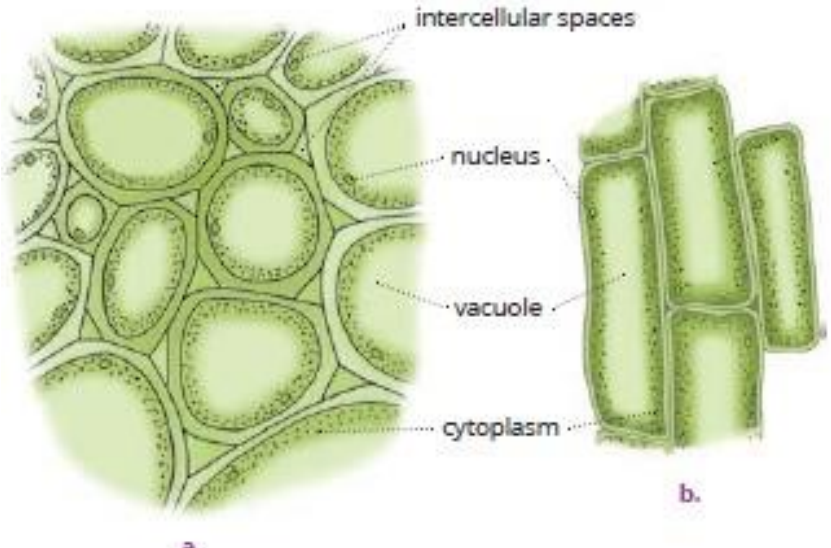
Simple permanent tissue (supportive tissue)

The tissues made up of one type of cells, which resemble each other and perform similar function are called simple permanent tissues**.**

These tissues are specialized to perform supportive and protective function. There are three types of simple permanent tissues in plants – parenchyma, collenchyma and sclerenchyma.

Parenchyma

Parenchyma is a simple permanent living tissue which is **made up of unspecialized thin-walled cells.** The cells of parenchyma tissue are live and oval, rounded or polygonal in outline. Their wall is made up of cellulose. The cells in these tissues are usually loosely packed.



Thus, large intercellular spaces are present in between the parenchyma cells. Each parenchyma cell encloses a large central vacuole, cytoplasm and a prominent nucleus.

Parenchyma is found universally in all the plants. It forms the major tissue of softer parts like the epidermis, cortex, pith and leaf mesophyll. It is also found in xylem and phloem.

Functions of parenchyma

1.It stores food material in the form of proteins, starch, oil and fats.

2.Parenchyma of stems and roots also stores nutrients and water.

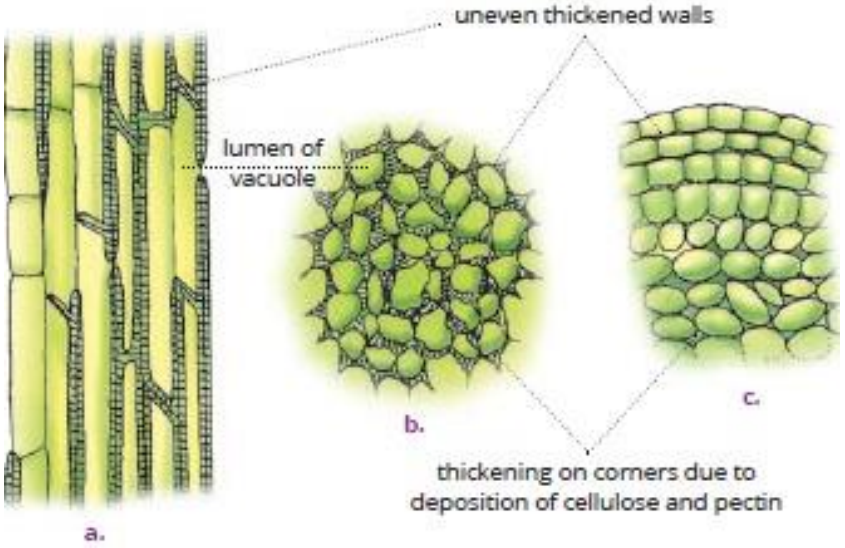
3.Parenchyma cells provide support and rigidity to the plants. .

4.Parenchyma cells form the basic packing tissue and protect the internal tissues.

In the leaves of green plants, parenchyma tissue contains chlorophyll, and is called **chlorenchyma**. **Chlorenchyma** thus helps in **photosynthesis.**

Collenchyma

The cells of collenchyma are living, somewhat elongated with cellulose thickening at the corners. They are found as longitudinal strips. Collenchyma cells appear circular or oval in transverse section. Internally, each cell possesses a large central vacuole, peripheral cytoplasm and a nucleus. There is very little intercellular space between cells of collenchyma tissue due to cellulose thickening.



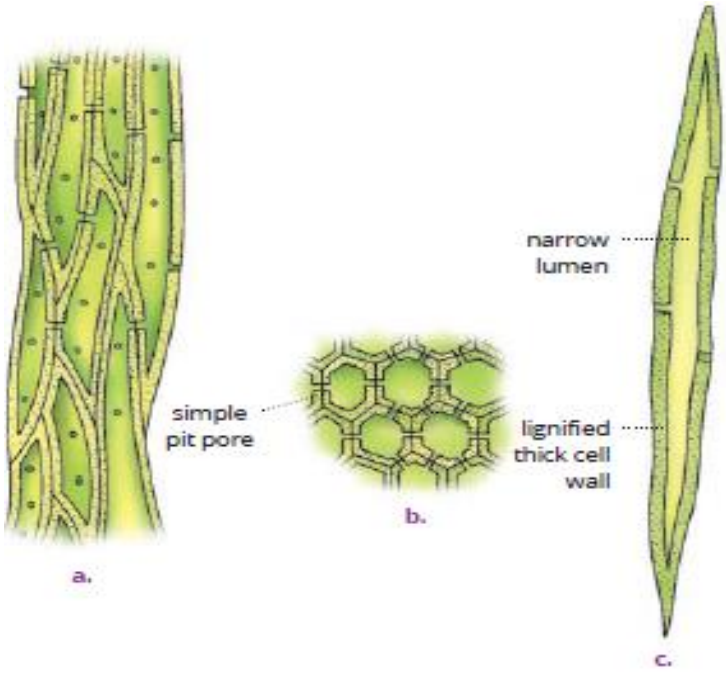
Collenchyma tissue is usually found below the epidermis in stem and stalks of leaves (petiole) and midrib of leaves of dicot plants. Collenchyma is absent in monocot stems.

Functions of collenchyma

- It **provides tensile strength and rigidity to the plants** due to thickening of the walls.
- Collenchyma also **provides elasticity to the plant organs**. The flexibility in plants is due to collenchyma tissues. It **provides bending of leaves and stems without breaking them**.
- Collenchyma being alive also stores food.

Sclerenchyma

It is also a simple permanent tissue. The cells of this tissue are dead. These are long, narrow with tapering ends. Their cell walls are thickened due to lignin which is a chemical substance that acts as a cement and hardens them. Central cavity of the cells is greatly reduced due to this thickening. Sclerenchyma tissues are of two types—fibres and sclereids.



These tissues occur in the veins of leaves and in hard covering of seeds and nuts. They form the major part of walnut shells and other nuts. They form an important part of the bark of trees.

Functions of sclerenchyma

- Sclerenchyma provides mechanical strength to the plant and its parts.
- They protect the plant from environmental forces like strong winds.
- They make the plant hard and stiff. The husk of coconut is made up of sclerenchyma tissue.

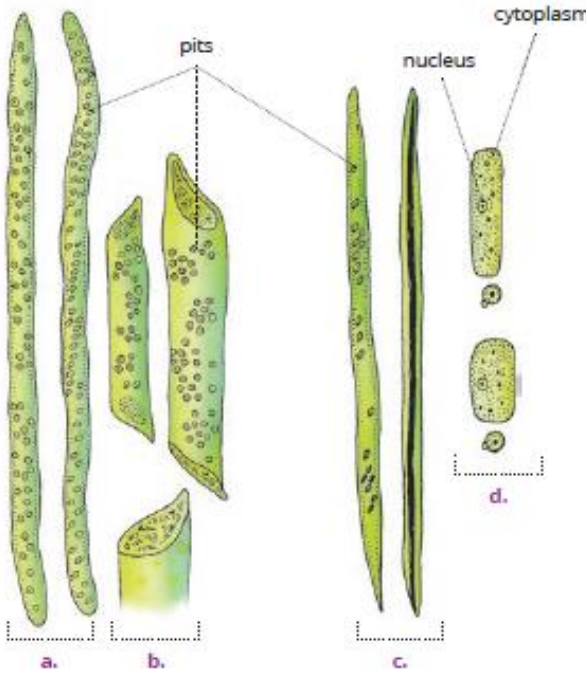
Complex permanent tissue (conducting tissue)

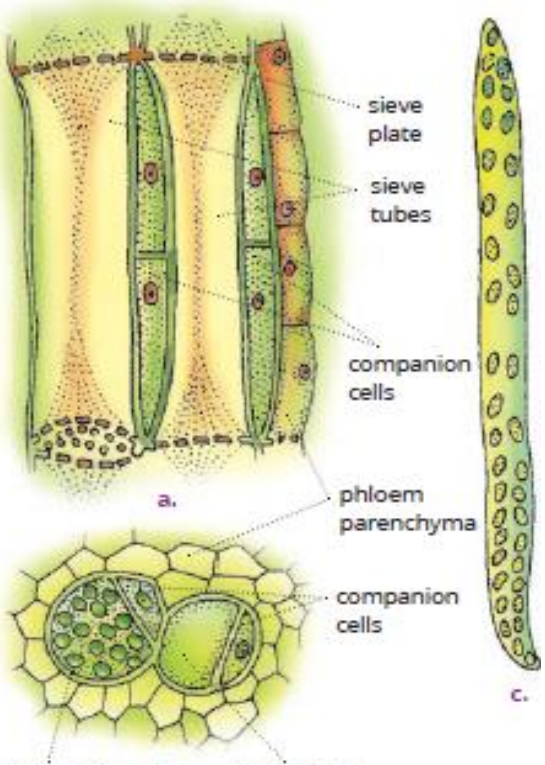
Cells of the complex tissues work together as a unit and have a common origin. Complex tissues are made up of more than one type of cells which work in close coordination to perform a common function. The main complex tissues in vascular plants are **xylem** and **phloem**. Both xylem and phloem are assemblage of living and dead cells. They are conducting tissue and together constitute a **vascular bundle**.

Xylem

Xylem is a complex tissue . The cells are thick-walled and many of them are dead. **Xylem is mainly concerned with the conduction of water and minerals.** It also provides mechanical support to the plant.

As a conducting strand, xylem forms a continuous channel through the roots, stem, leaves and other aerial parts. Xylem consists of four types of cells – xylem vessels, tracheids, xylem fibres and xylem parenchyma. Xylem parenchyma are the only living components of xylem. They are present in primary and secondary xylem. These are concerned with the storage of food and sideways conduction of water.





Phloem

Phloem is the chief food-conducting tissue of plants. Unlike xylem, materials can move in both directions in phloem. Phloem is responsible for the transport of food prepared by leaves to other parts of the plant.

There are four types of phloem elements – **sieve tubes, companion cells, phloem parenchyma** and **phloem fibres**.

Types of Animal Tissues

On the basis of functions performed by them in our body, there are four major types of tissues in animals . They are

1. Epithelial tissue 2. Connective tissue 3. Muscular tissue 4. Nervous tissue

1. Epithelial Tissue

Epithelial tissue is the simplest tissue. **An epithelial tissue is composed of one or more layers of cells covering and protecting the external surface and internal body organs.**

Epithelium is a protective tissue. It covers most of the organs and cavities of hollow body organs, blood vessels and ducts.

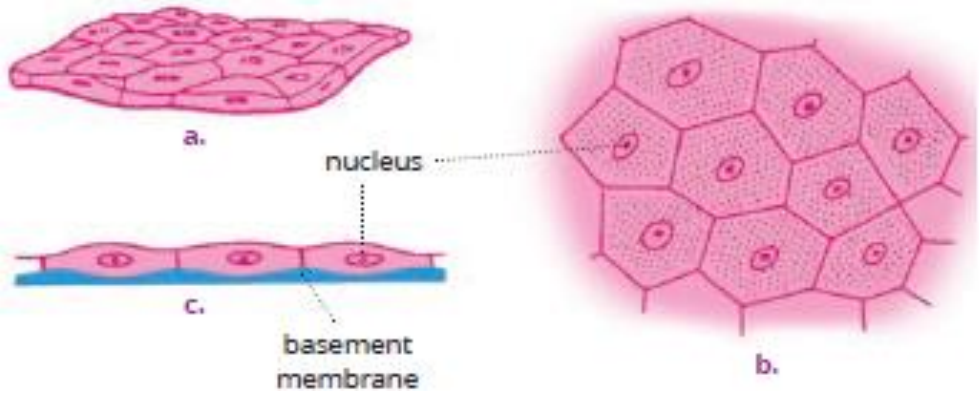
Types of epithelial tissue

Based on the structure and organization of the component cells, the epithelial tissue may be classified as follows: a. Squamous epithelium b. Columnar epithelium c. Cuboidal epithelium d. Glandular epithelium

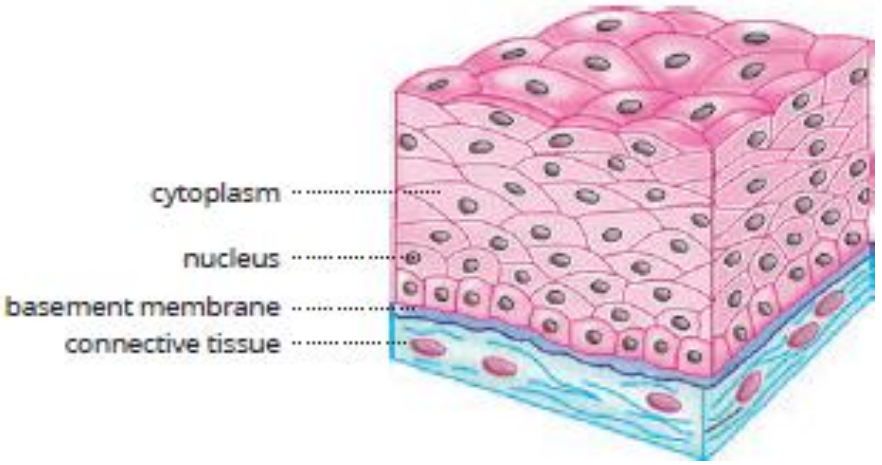
a. Squamous epithelium

It is formed by flattened, scale-like polygonal cells closely fitted together like tiles in a mosaic floor. The squamous epithelium forms the lining of the blood vessels, oesophagus, mouth, nose, skin, alveoli of lungs, etc. Skin is also made up of squamous epithelium.

It protects the underlying body parts from mechanical injury, germs, drying up, etc. There are two types of squamous epithelium – simple squamous epithelium and stratified squamous epithelium.



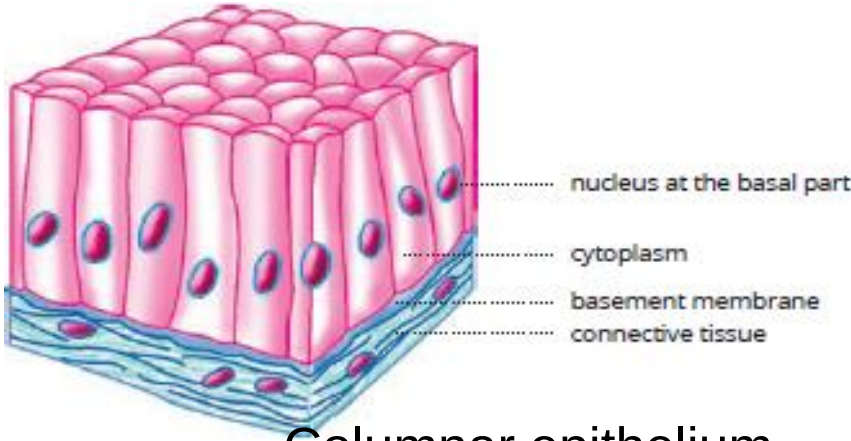
Squamous epithelium



Stratified squamous epithelium

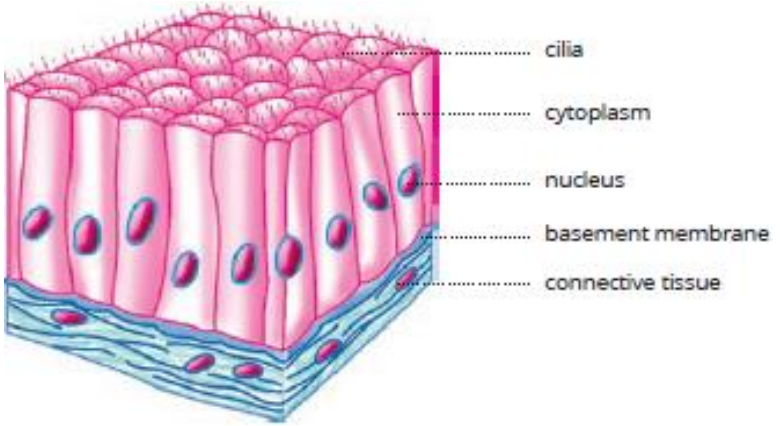
b.Columnar epithelium

Columnar means pillar-like. Therefore, as the name suggests, it is formed of tall pillar-like cylindrical cells lying side by side. The columnar epithelium helps in absorption through the lining of stomach and intestine and secretion of mucus through the goblet cells or mucous membrane.

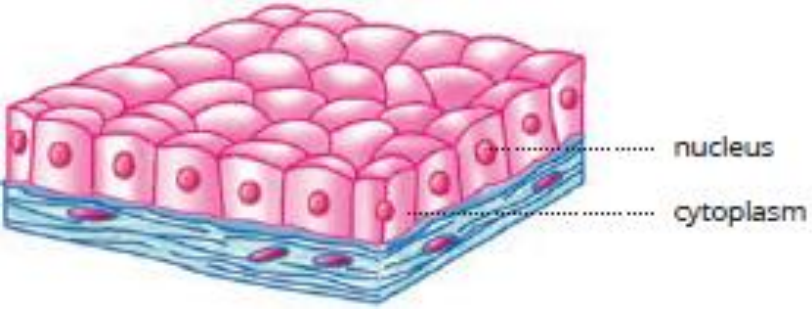


Columnar epithelium

In the respiratory tract there are simple hair-like projections called cilia or microvilli or brush border on the outer surfaces of columnar epithelial cells. These cilia or brush border can move and push the mucus forward to clear it of any unwanted particles like dust. This is known as **ciliated columnar epithelium**.



Ciliated columnar epithelium



Cuboidal epithelium

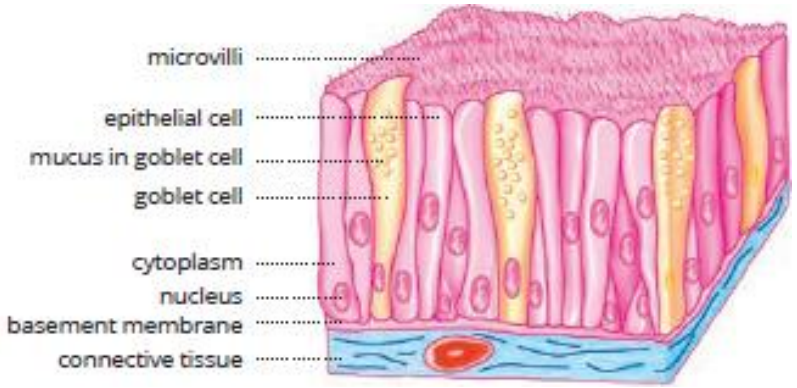
c. Cuboidal epithelium

It is made up of cube-shaped cells of almost equal height and width. In the surface view, they look polygonal in shape. The nuclei are round in shape and lie in the centre of the cells.

It is present in the lining of kidney tubules and ducts of salivary glands, where it provides mechanical strength. It also lines sweat glands, thyroid glands and germinal epithelium of testes and ovaries. It helps in absorption, excretion as well as secretion other than providing mechanical support.

d. Glandular epithelium

Sometimes there is inward folding of epithelial tissue forming multicellular gland, called glandular epithelium. Goblet cells in the mucou membrane of alimentary canal, sweat glands and sebaceous glands in the skin, mammary glands, salivary glands in the mouth etc.



Glandular epithelium

Glandular epithelium is a modified columnar epithelium. Cells of glandular epithelium are modified and specialized to secrete certain substances. Glandular epithelium helps in secretion of hormones, sweat, saliva, digestive enzymes, etc.

Connective Tissue

Connective tissue is a binding and supporting tissue. Cells of connective tissue are loosely spaced and embedded in an intercellular matrix. Basically, connective tissue consists of matrix, connective tissue cells and connective tissue fibres. Matrix is homogeneously fibrous in nature and binds other tissues. It is also called **packing tissue**. It is distributed throughout the body and forms about 30% of the body weight.

Types of connective tissue

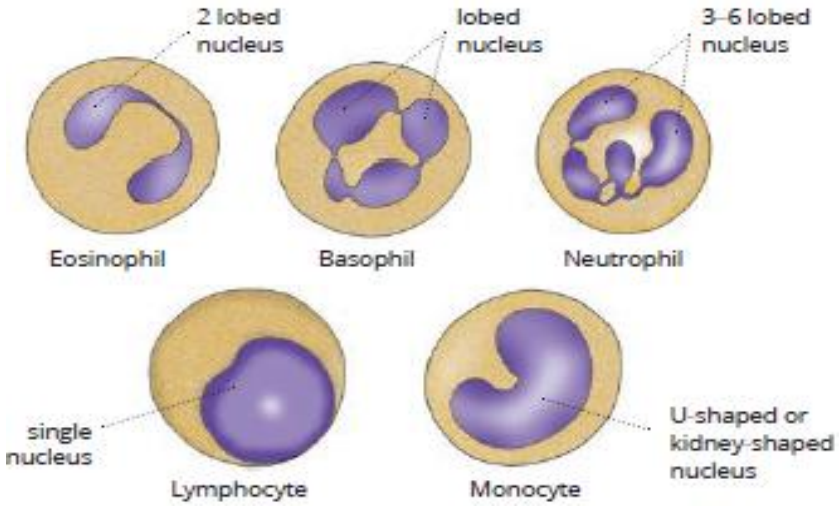
There are following types of connective tissues in the human body

a. Fluid connective tissue – blood and lymph
b. Skeletal tissue – bone and cartilage
c. Fibrous connective tissue – tendons and ligaments
d. Areolar connective tissue
e. Adipose tissue

a. Fluid connective tissue – blood and lymph

Both blood and lymph are fluid connective tissues. They help in transportation of oxygen, vitamins, nutrients and hormones to various cells and tissues and also remove CO_2 and other waste from the cells

Red blood cells



Types of white blood cells

Blood consists of blood corpuscles suspended in blood plasma. **Plasma** is a straw-coloured fluid which contains water, inorganic salts, organic substances like blood proteins and hormones. Red blood cells (RBCs), white blood cells (WBCs) and platelets are suspended in the plasma. RBCs and WBCs are living while platelets and plasma are non-living.

Blood flows to all parts of the body and connects different parts of the body. Blood plasma transports gases, digested food, hormones and waste materials to different parts of the body.

b. Skeletal tissue – bone and cartilage

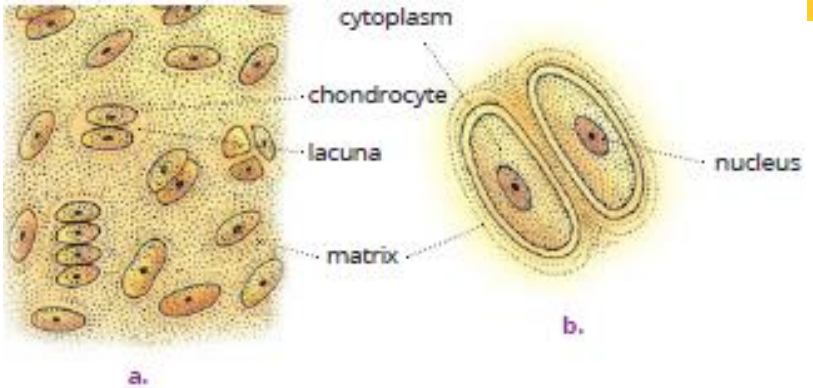
The bone and cartilage form skeletal tissue. Skeletal tissue forms the endoskeleton of vertebrate body.

Bone: Bone is a rigid and hard skeletal connective tissue. It forms the skeletal framework that supports the body. It also supports the muscles and main organs of the body. The bone cells are called osteocytes.

Cartilage

Cartilage is a compact, relatively soft and elastic skeletal tissue. It consists of elastic matrix having proteins (condrin), collagen fibres, sugar and is slightly hardened by calcium. Cartilage cells, called **chondrocytes**, are present in fluid-filled spaces called lacunae.

Cartilage smoothens bone surface at joints and provides support and flexibility to the body parts where it is found. It prevents wear and tear of long bones, where it is present at the end.

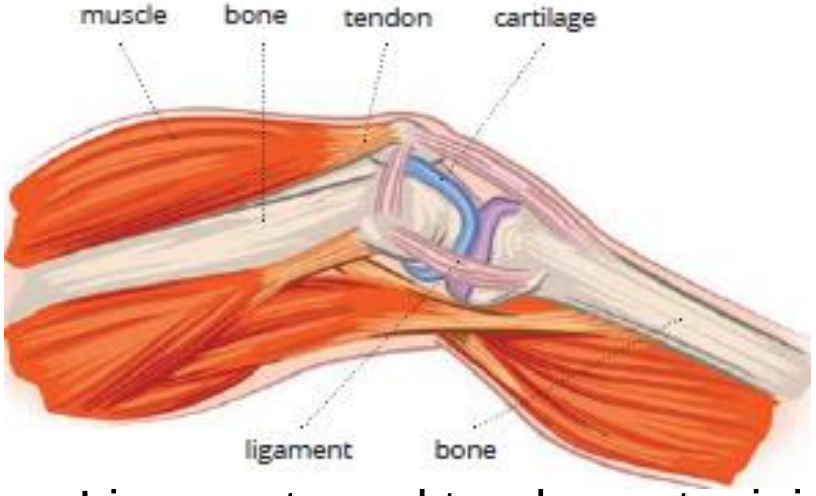


a. T.S. of cartilage **b.** Cartilage cell magnified

c. Fibrous connective tissue – tendons and ligaments

Tendons are dense fibrous connective tissues with great strength and flexibility. It occurs in the form of tendons or sheets. Tendons **join muscles with bones**.

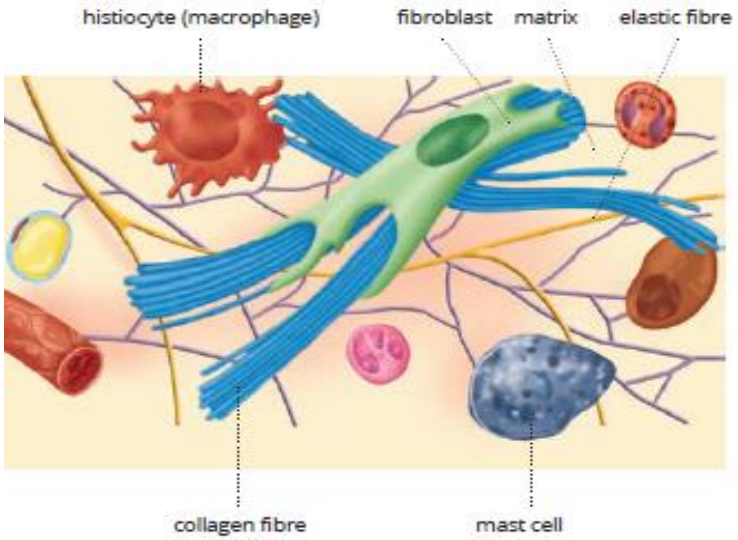
Ligaments contain very little matrix with many closely-packed yellow or elastic fibres. Due to the presence of yellow elastic fibres in matrix, they are very elastic and **connect one bone with the other**. They have appreciable strength and permit bending and rotational movement of bones over joints.



Ligaments and tendons at a join

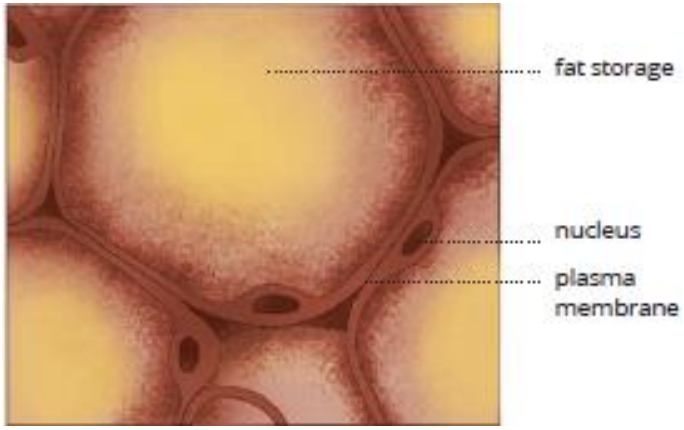
d. Areolar connective tissue

It is the simplest and most widely distributed connective tissue in the body. In this tissue, fibres are loosely arranged in a meshwork. Its matrix is jelly-like and contains large star-shaped **fibroblast** cells.



Areolar connective tissue

Areolar connective tissue binds the skin with muscles and attaches blood vessels and nerves to the surrounding tissues. It also helps in repair of tissues. Overall, it acts as a supporting and packing tissue between organs lying in the body cavity.



Adipose tissue

e. Adipose tissue

It is an aggregation of fat cells called **adipocytes**. It is found below the skin and between internal organs, around kidneys and in yellow bone marrow. The cells of adipose tissues are filled with fat globules. **Thus, it stores fat which acts as an insulator.** It also acts as a cushion for shock absorption.

Muscular Tissue (The Contractile Tissue)

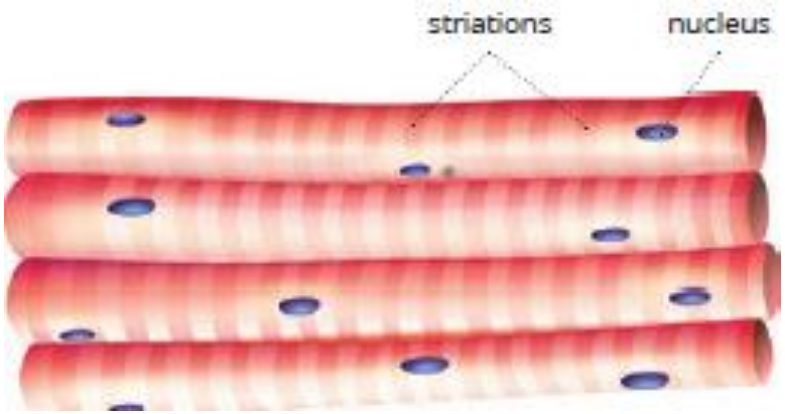
The muscle tissue consists of long, narrow cells called **muscle fibres**. The adjacent muscle fibres are held together by connective tissue. Muscles bring about movement of body parts and locomotion in organisms.

Types of muscular tissue

In human beings, three types of muscles are present – voluntary muscles, involuntary muscles and cardiac muscles.

Voluntary or striated muscles

A voluntary or striated muscle consists of cells with long, narrow, cylindrical and unbranched fibres with blunt ends. These muscles when stained show alternate dark and light bands or striations.

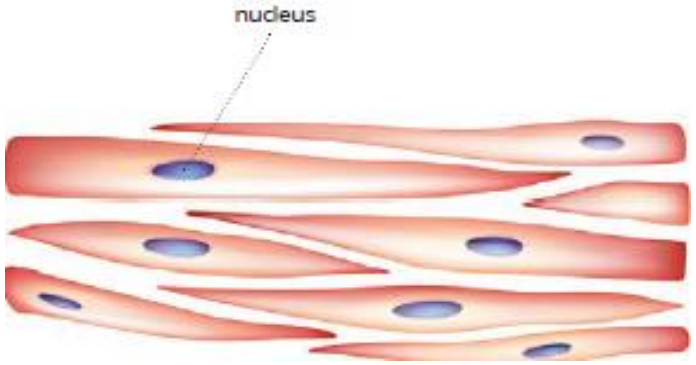


Striated muscle

Striated muscles are present in body wall, limbs, tongue, pharynx and at the tip of oesophagus. These muscles can be moved at our will. As their movement is under our will, they are popularly called **voluntary muscles**. These muscles are also called skeletal muscles as these are attached to bones. They form almost 50% of body weight.

Involuntary or unstriated muscles

These muscles are also called smooth muscles as they lack transverse striations. These muscle cells are spindle-shaped and are arranged in bundles. They have only one nucleus. They are also called **unstriated muscles** as they do not contain any striations or bands.

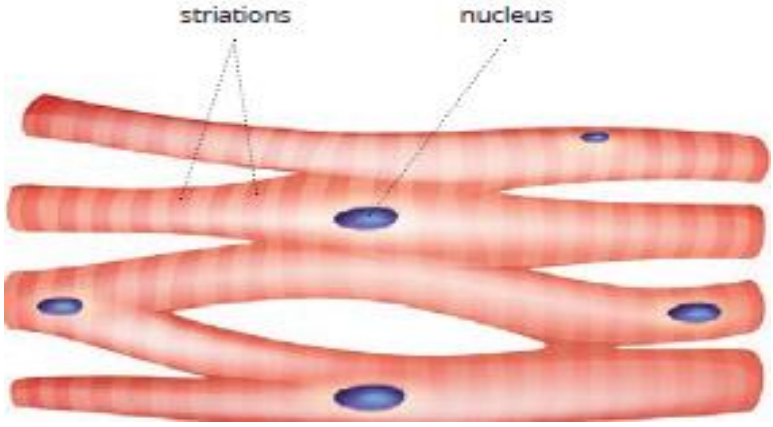


Unstriated muscles

These muscles are found in the iris of eye, in ureter and in the bronchi of lungs. Their movement is not under our will and hence these are called involuntary muscles. We cannot start or stop their action.

Cardiac muscles

Structurally, these muscles are cylindrical, branched and uninucleated. They form an interconnecting network. The muscle filaments are connected by dark junctions called **intercalated disc**.



These act as impulse boosters. These muscles are exclusively present in the heart. These muscles work rapidly, rhythmically and tirelessly, contracting and relaxing endlessly from early embryonic stage until death.

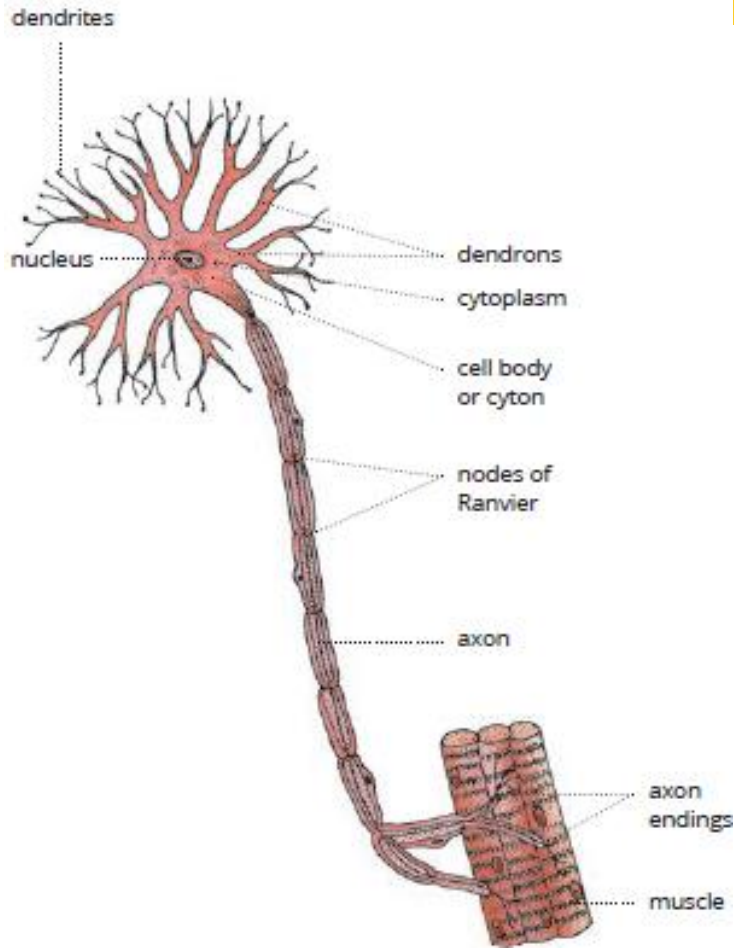
Nervous Tissue

Nervous tissue consists of nerve cells or neurons. They are specialized to respond to stimuli and transmit stimulus very rapidly from one part to another within the body. The brain, spinal cord and nerves are composed of nervous tissue.

A neuron or nerve cell is the structural and functional unit of the nervous system.

A typical nerve cell consists of cell body or cyton, axon, dendrons and dendrites.

Both nerve and muscle tissue work in coordination and help animals to move in response to stimuli.



Nervous Tissue

SUMMARY...

- Tissue is a group of cells similar in structure and function.
- The microscopic study of tissues and their functions is known as histology.
- Plant tissues are of two types – meristematic tissue and permanent tissue.
- Meristematic tissue is dividing tissue present in the growing regions of plants such as root apex and stem apex.
- According to their positions in plants, meristems are divided into – apical meristem, intercalary meristem, and lateral meristem.
- A permanent tissue is a group of cells in which growth is either stopped completely or for the time being. Permanent tissues are classified as simple and complex tissues.
- Parenchyma, collenchyma and sclerenchyma are three types of simple permanent tissues.
- A group of more than one type of cells working together as a unit and having a common origin is called a complex tissue. Xylem and phloem are complex permanent tissues.
- Xylem is a complex plant tissue. Its components are xylem vessels, tracheids, xylem fibres and xylem parenchyma. Only xylem parenchyma is the living component.

- Phloem is a chief food-conducting tissue of a plant. Its components are sieve tubes, companion cells, phloem parenchyma and phloem fibres.
- There are four major types of animal tissues – epithelial, connective, muscular and nervous.
- In epithelial tissue, cells are closely-packed and form a continuous sheet. Depending upon shape and function, epithelial tissue is classified as squamous, cuboidal, columnar and glandular.
- Connective tissue is a binding and supporting tissue. In our body, connective tissue includes blood, lymph, bone, cartilage, tendons, ligaments, areolar tissue and adipose tissue.
- Bone cells are star-shaped and are called osteocytes. In mammalian bone, the bone cells are present in concentric rings around the Haversian canal.
- Cartilage cells are present in fluid-filled spaces called lacunae.
- Striated, unstriated and cardiac muscles are the three types of muscle tissues.
- Smooth muscles and cardiac muscles are involuntary.
- Nervous tissue consists of nerve cells. Each nerve cell consists of – cell body or cyton, axon, dendrons and dendrites.

THANK YOU