

TISSUES

INTRODUCTION

The new cells formed after cell division normally enlarge and become specialised for a particular function. Multicellular organisms consist of many groups of specialised cells, making up their tissues and organs.

A group of cells similar or dissimilar in structure, having a common origin and performing similar functions is called a tissue.

- **How the cells become specialised?**
- **Differentiation** is the process by which unspecialized structures become modified and specialised for performing specific functions. Differentiation begins as soon as cells have been formed by cell division. Differentiation also results in **division of labour**. When cells become specialised to perform a particular function they often lose the ability to carry out other functions.
- **Advantage of Division of Labour**
The advantage is that specialised cells perform specific tasks more effectively than the unspecialized cells, as the specialised cells have become specifically modified in order to perform the specific function.

**The study of the structure of Tissues and organs is known as Histology.
Histology is largely earned out by microscopy.**

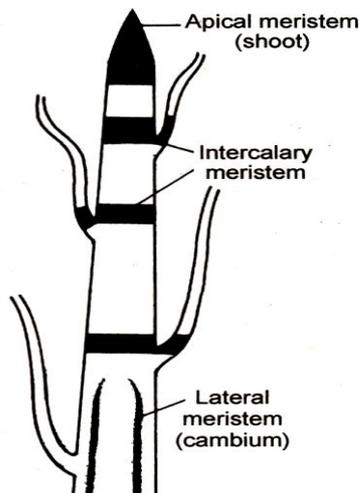
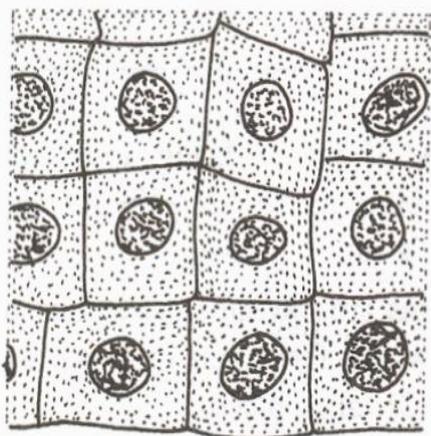
PLANT TISSUES

The plant body is made up of several different kinds of tissues.

On the basis of their ability to divide, plant tissues are of two main types.

- (i) **Meristematic** tissues which consist of undifferentiated actively dividing cells, and
- (ii) **Permanent tissues**, consisting of differentiated cells which have lost the ability to divide.

MERISTEMATIC TISSUES



The meristematic tissues are tissues responsible for **growth** in plants. These are present at the growing regions like the **tips of roots and shoots** and **cambium**. While the root tips and shoot tip bring about increase in **length**, cambium is responsible for increase in thickness or **girth**. Meristems are the sites or regions within the plant body where formation of new meristematic cells takes place.

CHARACTERISTICS

- (i) The meristematic cells are **similar** in structure.
- (ii) These consist of **small, thin-walled** cells.
- (iii) In shape, the cells may be **spherical, oval, polygonal or rectangular**.
- (iv) They are compactly arranged and **lack intercellular spaces**.
- (v) The cells contain a **prominent nucleus** and dense cytoplasm. **Vacuoles** are generally **absent**.
- (vi) Cells are **living**.
- (vii) The cells possess the **power of cell division**; divide repeatedly and produce new cells. These cells later on after differentiation give rise to the permanent tissues.

FUNCTIONS

To form new cells and bring about increase in length and girth of the plant body

- **Types of Meristems**

Based on their location in the plant body, Meristems are of three types

- (a) **Apical Meristems** (b) **Lateral Meristems** (c) **Intercalary Meristems**

- **Apical Meristem**

- (i) Occurs at the tips of shoots
- (ii) Brings about an increase in length of the plant.

- **Lateral Meristems**

- (i) Occurs on the sides almost parallel to the long axis of the root, stem and its branches (as the cambium).
- (ii) Brings about an increase in the width or girth of the organs.

- **Intercalary Meristems**

- (i) Occurs at the base of the internodes in monocots (grass)
- (ii) Brings about increase in the length of the internodes.

CPP

A. Write True (T) or False (F) against following statements

- | | |
|--|--|
| (i) Differentiation results in specialization. () | (ii) Cells lack intercellular spaces. () |
| (ii) Differentiation results in division of labour. () | (iii) Cells are living and thin-walled. () |
| (iii) A specialised cell can do many different jobs. () | (iv) Cells possess dense cytoplasm. () |
| (iv) Tissues are made up of similar cells which have similar functions. () | (v) The tissue is responsible for growth. () |
| (v) Cells in a tissue do not have a common origin. () | |

B. Following are some statements which describe the plant tissues. Tick mark (✓) the ones which refer to meristematic tissues.

- (i) Cells are differentiated. ()

C. Fill in the blanks:

- (i) _____ tissues are present at the growing tips of root and stem. (meristematic / permanent)
- (ii) A _____ tissue is a group of cells which possess the power of cell division. (meristematic/permanent).
- (iii) On the basis of their ability to divide, plant tissues may be _____ or _____

PERMANENT TISSUES

The permanent tissues arise from the meristematic tissues and form the bulk of the plant body. The cells of these tissues **have lost the capacity to divide** and have assumed final shape size and function after the process of differentiation.

A. CHARACTERISTICS

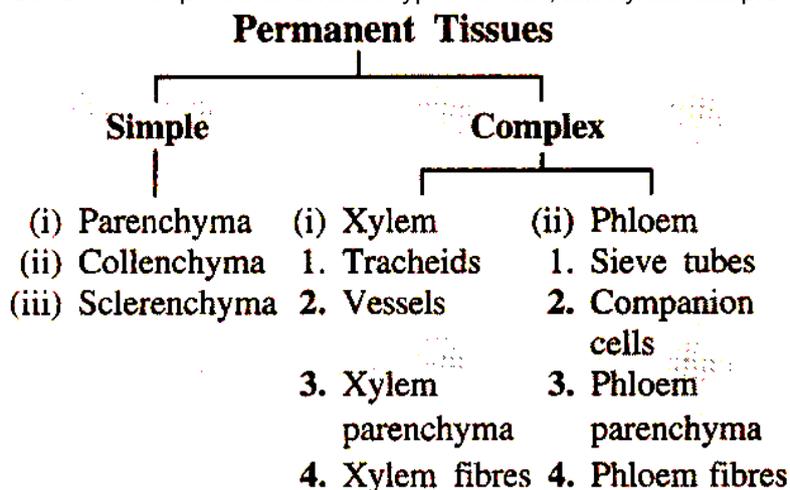
- (i) Cells may be thin or **thick-walled**; cells have undergone differentiation and assumed **definite shape**, size and function.
- (ii) Cells may **possess intercellular** spaces.
- (iii) **Nucleus is small** in relation to cell size, and cytoplasm is present on the periphery with a big central vacuole.
- (iv) Cells may be **living or dead**.
- (v) Cells **have lost the capacity to divide**.

Differences between Meristematic and Permanent Tissues

Meristematic Tissue	Permanent Tissue
1. Cells are small and may be rounded, oval, rectangular or polygonal.	Cells are large and of different shapes according to the type of tissue.
2. Cells are thin-walled (cell wall is thin).	Cells are thin or thick – walled (cell walls – thin or thick).
3. Cells are rich in cytoplasm.	Cytoplasm is present as a layer along the cell wall.
4. A prominent nucleus is present.	Nucleus is relatively small in size.
5. Vacuoles are small; may even be absent.	Usually a large central vacuole is present.
6. Intercellular spaces are absent.	Intercellular spaces often present.
7. Cells are undifferentiated and give rise to different permanent tissues.	Cells are differentiated.
8. Power of cell division is present.	Lack the power of cell division.
9. Always living.	May be living or dead.

B. TYPES OF PERMANENT TISSUES

- I. Depending on **the basis of the type of cells composing** a tissue, permanent tissues are of two types:
 - (a) **Simple tissue** — composed of a single type of cells, like parenchyma, collenchyma and sclerenchyma.
 - (b) **Complex tissue** — composed of different types of cells, like xylem and phloem.



- II. **Based on function**, permanent tissues are classified as **protective tissues, supportive tissues, conducting tissues and secretory tissues**.

SIMPLE TISSUES

1. PARENCHYMA

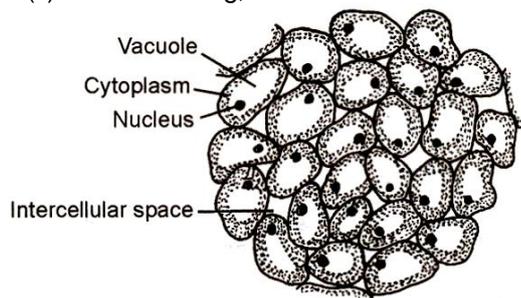
Parenchyma is a widely distributed tissue the plant body, exhibiting following characteristics:

CHARACTERISTICS

(a) Structure

(i) Parenchyma is a **primitive simple tissue** made up of cells which are similar in structure and function; it has **given rise to the other types of tissues**.

(ii) Cells are living, thin-walled and contain dense cytoplasm cell wall is made up of **cellulose**.



(iii) Cells are usually isodiametric; sometimes they may be lobed or elongated.

(iv) Intercellular spaces may or may not be present.

(v) In leaves, and tender stems parenchyma cells may contain **chloroplasts** and in such a case, parenchyma is called **chlorenchyma**.

(vi) In aquatic plants, fairly large air cavities are present between the parenchyma cells; such a parenchyma is called **aerenchyma** and helps in providing buoyancy to the plants. (Hydrophytes)

(B) OCCURRENCE

(i) In small **herbaceous plants**, parenchyma makes up the bulk of the plant body.

(ii) It is mainly found in the **cortex, pith, ground tissue of petioles, mesophyll** of leaves and also in vascular bundles.

(C) FUNCTIONS

(i) **Food storage parenchyma** the cells in a potato tuber, for example, are parenchymatous cells filled with starch, particularly in the leaves.

(ii) **Chlorenchyma** (parenchyma cells containing chlorophyll) helps in photosynthesis and thereby manufacture starch.

(iii) **Aerenchyma**, whenever present, helps in providing buoyancy to the aquatic plants.

(iv) **Waste products** such as **tannin, gum, crystals** etc. are stored in parenchyma.

(v) **Parenchyma cells possess the ability to divide even when mature**; because of this ability it plays a role in **wound healing, regeneration and grafting**.

2. COLLENCHYMA

Collenchyma, being a **strong and flexible tissue**, is a **strengthening** (mechanical) tissue of the growing organs.

CHARACTERISTICS

(a) Structure

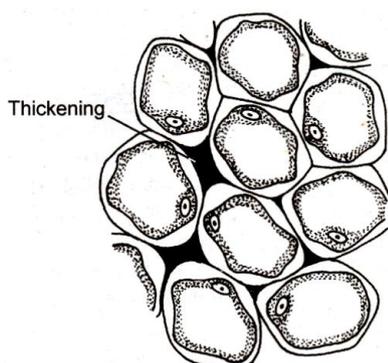
(i) Collenchyma, like parenchyma, is a **simple tissue**.

(ii) Cells are living and **thick-walled**; thickenings are present **at the corners** of the cells, and contain **cellulose and pectin**; lignin is never present.

(iii) **Intercellular spaces are absent**.

(iv) Cells may be **circular, oval or polygonal in shape**.

(v) A few **chloroplasts** may be present in the cells.

**(b) Occurrence**

Collenchyma is present in the **peripheral regions of stems and leaf stalks**.

(c) Functions

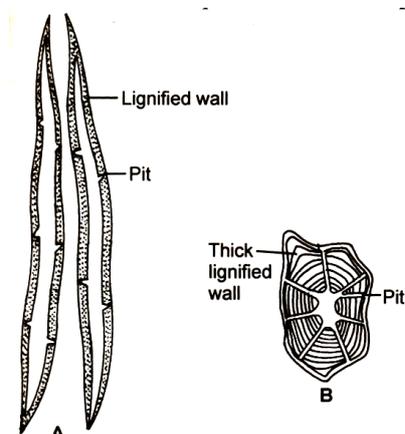
- (i) Collenchyma is mainly a mechanical tissue and provides **mechanical strength** and **elasticity** to the growing stems. As a result, the stems can stand **bending** or **swaying** by wind or passing animals.
- (ii) Collenchyma is also the **supporting tissue** of leaves.

3. SCLERENCHYMA

Like collenchyma, sclerenchyma is a **strengthening** (mechanical) tissue.

CHARACTERISTICS**(a) Structure**

- (i) Like parenchyma and collenchyma, sclerenchyma is also a **simple tissue**.
- (ii) Cells are dead and possess hard, rigid, very thick lignified walls; **lignin** is a waterproof material.
- (iii) **Intercellular spaces are absent**.
- (iv) Sclerenchyma cells are of two types – **fibres** which are long, narrow, pointed cells and **sclereids** which are shorter, isodiametric or irregular cells; sclereids are also called **stone cells** or **grit cells**.
- (v) The walls of sclerenchyma cells contain oblique thin areas called **pits**.

**(B) OCCURRENCE**

- (i) Fibres occur in and around the vascular tissue, and may also occur below the epidermis as a supporting tissue. (ii) Sciereids occur singly or in groups in stems, leaves, fruits and seeds.

**Jute and coir are obtained from the thick bundles of fibres.
The hard grit in a pear fruit is due to the presence of sclerenchyma.**

(C) FUNCTION

Sclerenchyma is a **mechanical and protective** tissue.

Differences between Sclerenchyma and Collenchyma

Sclerenchyma	Collenchyma
1. Cells have hard lignified secondary walls.	Cells have soft, pliable primary walls.
2. Cells have low percentage of water .	Water content is high .
3. Walls are uniformly thickened .	Walls are unevenly thickened .
4. At maturity, cells are dead .	Cells are living .
5. It is composed of two types of cells sclereids and fibres .	It is composed of only one type of cells .

COMPLEX TISSUES

Xylem and **Phloem** are the **conducting tissues** in the plant body. While xylem conducts water and minerals, phloem conducts food materials. Xylem and phloem together constitute the **vascular tissues**.

1. XYLEM

(A) CHARACTERISTICS

- (i) Xylem is a complex tissue, as it consists of both parenchymatous and sclerenchymatous cells.
- (ii) Xylem consists of **living and non- living cells**.
- (iii) Xylem is composed of four elements —

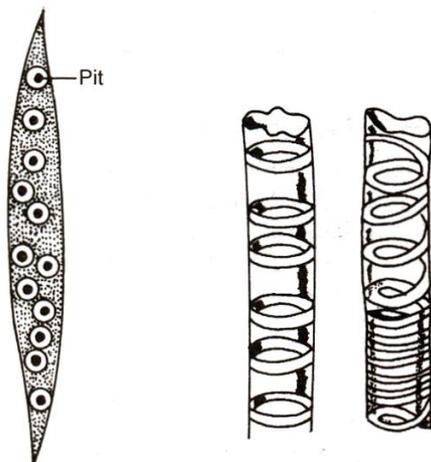
(a) **Tracheids**

(b) **Vessels**

(c) **Xylem parenchyma**

(d) **Xylem fibres, also called xylem sclerenchyma**

Xylem is popularly known as wood.



A **tracheid** is a **non-living**, elongated cell with tapering ends. The wall is highly thickened with **lignin**, except at certain circular spots known as **pits**.

A **vessel** is a cylindrical tube-like structure placed one above the other end to end. The end walls of vessels dissolve partially or completely forming a continuous channel. A vessel is also a **non-living cell** with lignified walls.

Tracheids and **vessels** elements in the xylem are the main conducting tissues.

Xylem parenchyma consists of living cells and performs the function of storage.

Xylem fibre is a non-living, thick walled cell providing mechanical support.

(B) OCCURRENCE

In the roots, stems and leaves of higher plants, **xylem and phloem usually occur together**, forming vascular bundles.

(C) FUNCTIONS

- (i) The main function of xylem is **conduction of water** and minerals from the roots to different parts of the plant body.
- (ii) **Tracheids** and xylem fibres provide **mechanical support**.
- (iii) **Xylem parenchyma** helps in **storage of starch** and other materials.

2. PHLOEM

(A) CHARACTERISTICS

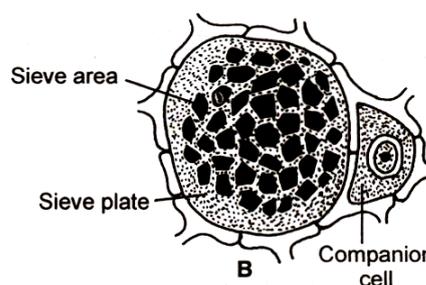
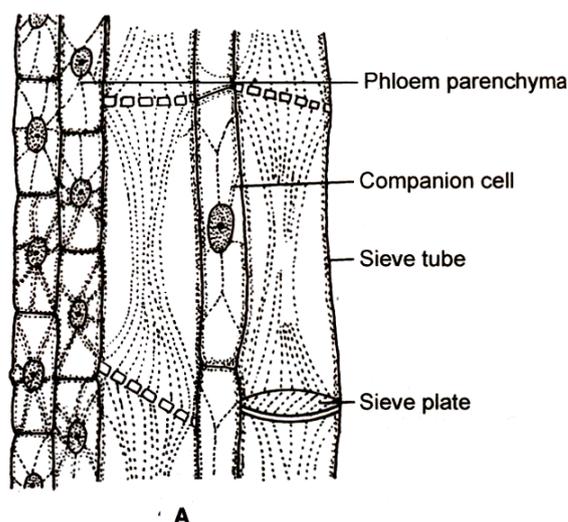
- (i) Phloem, like xylem, is a **complex tissue**, consisting of both parenchymatous and sclerenchymatous cells.

(ii) Phloem also consists of both **living and non-living** cells.

(iii) Phloem is composed of four elements

- (a) Sieve tubes (b) Companion cells (c) Phloem parenchyma (d) Phloem fibres.

- **Sieve tubes** are the main **conducting elements** in the phloem. These are elongated, cylindrical, thin walled cells arranged in vertical rows. The end wall of each sieve tube is **perforated**, i.e., it has **fine pores**, like those in a sieve. The perforated end walls are therefore termed **sieve plates**. The pores or perforations are called **sieve areas**. Food materials can easily pass through sieve areas. At maturity, **sieve tubes lack the nucleus**. Yet, the sieve tubes remain living, dependent on the adjacent companion cell.
- **Companion cells**, as stated above, are associated with the sieve tubes. These are smaller cells having dense cytoplasm and **prominent nuclei**. There are direct **connections between the sieve tubes** and companion cells. The companion cells help the sieve tubes in the conduction of food material.
- **Phloem parenchyma** is concerned with storage, while the **phloem fibres** (consisting of elongated, lignified cells) provide mechanical support



(b) Occurrence:

Present in all plant parts.

(c) Functions

- The main function is to **conduct food material from the leaves to the other regions** of plants and also to storage organs.
- Phloem parenchyma helps in **storage** of organic matter.
- Phloem fibres provide **mechanical support**.

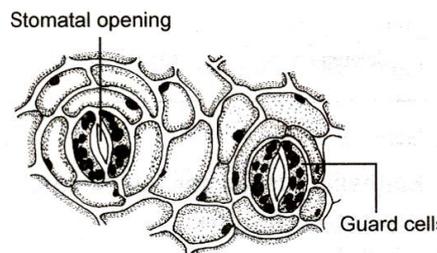
PROTECTIVE TISSUES

Protective tissues, as the name suggests, are preliminarily protective in function and include **epidermis** and **cork**.

EPIDERMIS

- It is present as the **outermost layer** of the plant body, in the **roots, stem, leaves, flowers and fruits**.
- It is usually one cell thick and is covered with a waterproof coating or layer called **cuticle**. Cuticle is made up of a waxy substance called **cutin**.

- (iii) The epidermis is not continuous at some places. At these places, small pores called **stomata** are present. Stomata consist of an opening called **stomatal opening** which is surrounded by two specialised kidney-shaped cells called **guard cells**. Stomata perform a number of **functions**, such as

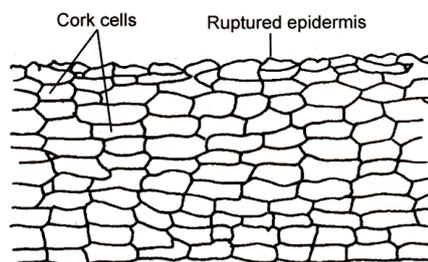


FUNCTIONS

- (i) **Protects** the plant body.
- (ii) Cuticle helps to **reduce evaporation** of water.
- (iii) In the roots, it helps in the absorption of water and minerals from the soil through root hairs.
- (iv) Helps in **exchange of gases**; thus important for photosynthesis.
- (v) Helps in **transpiration**

Cork

In old roots and stem, the epidermal tissue at the periphery is replaced by **cork**. The cork cells are dead and lack intercellular spaces. The walls of cork cells are heavily thickened by the deposition of **suberin**, which makes cork cells impermeable to water and gases



FUNCTIONS

- (i) Protective in function.
- (ii) Prevents desiccation, by preventing loss to water from the plant body.
- (iii) Prevents infection and mechanical injury.

USES

Cork is light, highly compressible and does not catch fire easily. Due to these properties, it is used for insulation, as shock absorbers, in linoleum and sports goods.

CPP

A. Read the following statements. Tick mark (✓) the ones which refer to the permanent tissues.

- | | | |
|-------|---|---------|
| (i) | This tissue forms the bulk of the plant body. | () |
| (ii) | The tissue has undergone differentiation. | () |
| (iii) | Power of cell division is present. | () |
| (iv) | Cells are no longer living. | () |
| (v) | Cells may be thin or thick-walled. | () |
| (vi) | Cells are rich in cytoplasm. | () |
| (vii) | A large central vacuole is usually present. | () |

B. Fill in the blanks:

- (i) A tissue consisting of a single type of cells is called a _____ tissue.
- (ii) A tissue composed of different types of cells is called a _____ tissue.
- (iii) The three simple tissues are _____ and _____
- (iv) The two complex tissues _____ and _____
- (v) The food conducting tissue in plants is _____
- (vi) The protective tissue in young roots and stem is called _____.
- (vii) The small pores present in the epidermis are called _____.
- (viii) Cork is a protective tissue formed in _____

- (ix) The cork cells are _____. (Dead or living)
 (x) The walls of cork cells are thickened by the deposition of _____.

C. Multiple choice questions:

- (i) Which of these types of cells is most likely to divide?
 (a) Epidermis (b) Parenchyma
 (c) Meristem (d) Xylem
- (ii) Which of these tissues in a plant consist of dead cells?
 (a) Parenchyma (b) Collenchyma
 (c) Sclerenchyma (d) Epidermis.
- (iii) Lignified elongated cells with pointed ends are those of
 (a) Parenchyma (b) Collenchyma
 (c) Sclerenchyma (d) Vessels
- (iv) Nucleus does not occur in
 (a) Tracheids (b) Sieve tubes
 (c) Vessels (d) Companion cells
- (v) Simple mechanical tissue devoid of lignin & represented by
 (a) Parenchyma (b) Sclerenchyma
 (c) Collenchyma (d) Tracheids.
- (vi) Companion cells are associated with
 (a) Sieve tubes (b) Sclerenchyma
 (c) Vessels (d) Parenchyma
- (vii) The tissue that takes part in the transport of food materials is
 (a) Parenchyma (b) Phloem
 (c) Xylem (d) None of the above
- (viii) Eucleate thin-walled cells with perforated end walls are
 (a) Companion cells (b) Tracheids
 (c) Sieve tubes (d) Vessels
- (ix) Xylem takes part in
 (a) Conduction of water in the plant body. (b) Conduction of food material.
 (c) Providing mechanical support. (d) Both (a) and (b).
- (x) Aerenchyma is a kind of
 (a) Collenchymas (b) Sclerenchyma
 (c) Parenchyma (d) Epidermis tissue
- (xi) You have been provided with narrow thick walled living cells, elongated in shape and possessing thickenings of cellulose and pectin. These cells belong to
 (a) Parenchyma (b) Collenchyma
 (c) Sclerenchyma (d) Periderm

ANIMAL TISSUES

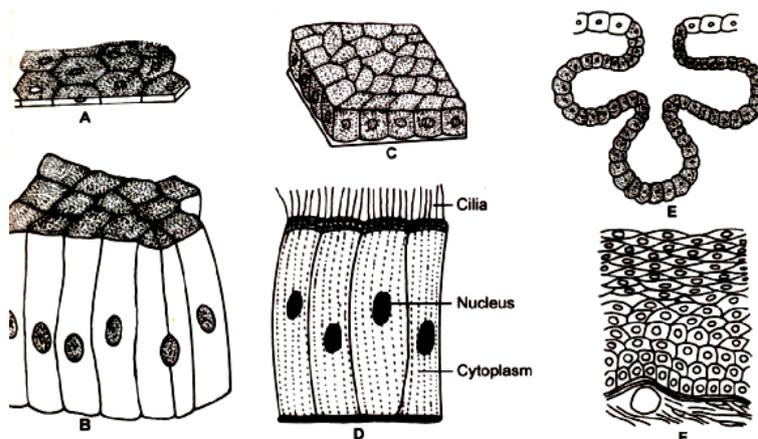
In animals, four basic types of tissues are found. These are as follows

1. **Epithelium** or epithelial tissue (covering tissue)
2. **Connective** tissue (supporting tissue)
3. **Muscular** tissue (contractile tissue)
4. **Nervous** tissue.

EPITHELIAL TISSUE (OR EPITHELIUM)

CHARACTERISTIC FEATURES

(i) Epithelium forms



(a) The outer **protective covering** all over the body.

(b) **Lines the inside of all cavities** such as those of the mouth, throat, stomach, intestines, wind pipe and lungs.

(ii) The epithelial cells lie close together with little or no **intercellular substance or matrix** between them.

(iii) There is no blood or lymph supply.

(iv) Nerve supply is present.

(v) Epithelial cells are attached to the underlying tissues by a **basement membrane**, which is made of a network of white, non-elastic **collagen fibres**.

(vi) Epithelium may be one-cell thick, that is, single layered (**simple epithelium**), or it may be several-cell thick, that is, many-layered (**compound or stratified epithelium**).

FUNCTIONS

1. Protection

(a) Most epithelia protect the underlying tissues against mechanical injury such as abrasion.

(b) Some epithelia protect against water loss and dehydration and against infection by micro-organisms.

2. Role in physiological processes

Some epithelia are involved in physiological processes such as

(a) Respiratory gas exchange, (b) elimination of waste products, and (c) some cells become glandular in nature and perform secretory function.

3. Sensory role by sensory epithelium

4. **Transport of materials** by ciliated epithelium.

TYPES OF EPITHELIAL TISSUES

Depending upon the shape and function of the constituent cells, epithelial tissues are of following types:

1. **Squamous (cells flattened,)**
2. **Columnar (cells tall, column or pillar like,)**

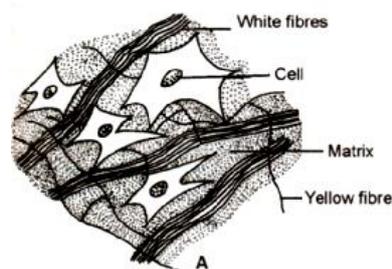
CONNECTIVE TISSUE

CHARACTERISTIC FEATURES

- (i) As the name suggests, this tissue serves to “**connect**” or **bind** the cells of other tissues in the body, and gives them rigidity and support.
- (ii) It is composed of cells and numerous, thick structures called **fibres**.
- (iii) The cells which are living are embedded in a non-living, intercellular matrix.
- (iv) Based on the nature of matrix, the connective tissue is divided into three general types
 - (a) **Connective tissue** proper where the matrix is relatively less rigid,
 - (b) **Supportive connective tissue** (skeletal tissue) — where the matrix is rigid.
 - (c) **Fluid connective tissue** — where the intercellular matrix is a fluid called plasma.

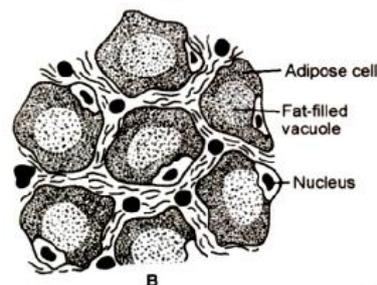
(A) AREOLAR CONNECTIVE TISSUE

- (i) In the matrix, irregular-shaped cells and two kinds of fibres — **white fibres** (made of **collagen**) and **yellow fibres** (made of **elastin** are present).
- (ii) The cells and fibres are scattered in the matrix, crossing each other in every direction.
- (iii) It is the most widely distributed connective tissue in the body.
- (iv) **Function** :
This tissue binds the skin with underlying parts.



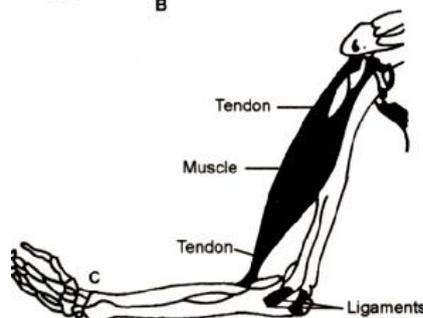
(B) ADIPOSE CONNECTIVE TISSUE

- (1) In this tissue, cells and two kinds of fibres —white and yellow — are present.
- (ii) Cells are modified to **store fat**; each cell consists of a large vacuole filled with fat which is surrounded by a small amount of cytoplasm containing a nucleus towards the periphery.
- (iii) It occurs below the skin, around internal organs and yellow bone marrow.
- (iv) Functions **It acts as a filling tissue; stores fat, and keeps the body warm**



(C) TENDON

- (i) Tendon is made up of **white** fibres.
- (ii) Tendons **connect muscles to bones**.
- (iii) Tendon is tough and **non-elastic**.



(D) LIGAMENTS

- (i) Ligaments consist of **yellow** fibres.
- (ii) Ligaments **connect one bone to another bone**.
- (iii) Ligaments tough strong, are **elastic**.

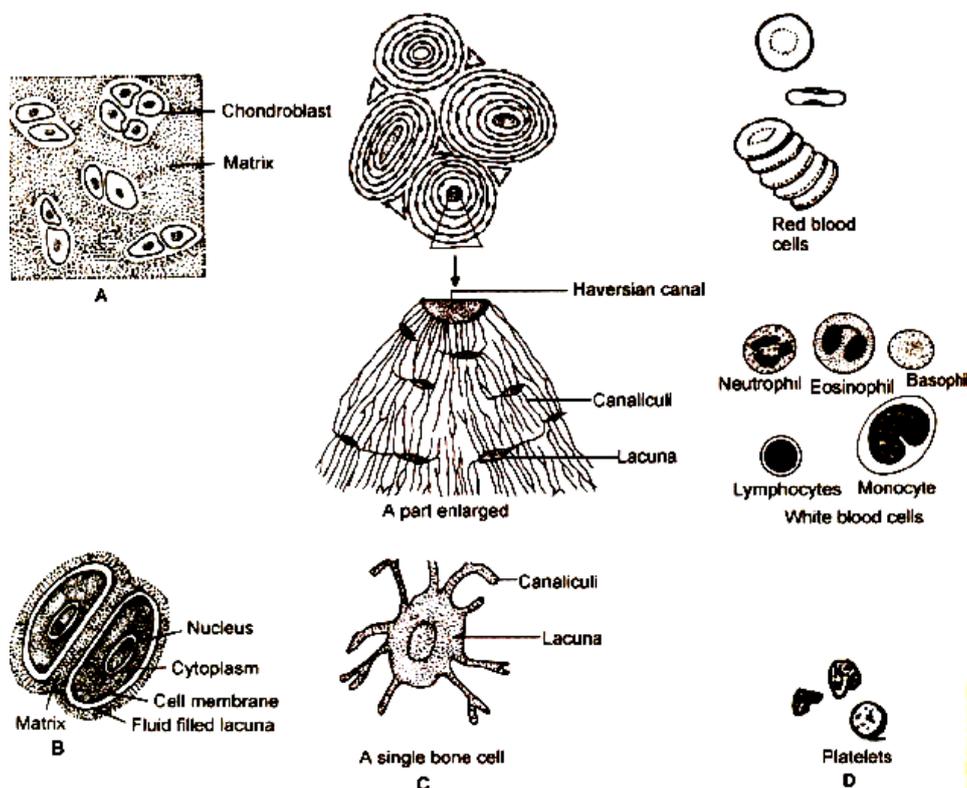
(E) CARTILAGE

- (i) Cartilage is a **nonporous tissue**.
- (ii) Cells of the cartilage called **chondroblasts** are embedded in the matrix in groups of twos, fours or more in fluid-filled spaces called **lacunae**.
- (iii) Cartilage is usually covered by a tough fibrous membrane called **perichondrium**.
- (iv) Cartilage is found in **nose tip**, **ear pinna**, rings of wind-pipe (**trachea**), **end of long bones**, lower ends of ribs. In **shark fish**, the whole skeleton is cartilaginous.

(v) Cartilage performs the function of providing support and **flexibility** in the vertebrate body.

(F) BONE

- (i) Bone is a very strong, rigid and porous tissue.
 (ii) The matrix is impregnated with **phosphates** and **carbonates of calcium and magnesium**.



- (iii) **Blood vessels** and nerves are present.
 (iv) The bone cells (called **osteocytes**) are present in concentric rings between the lamellae.
 (v) Each bone cell is surrounded by a space called **lacuna** from which projections called **canaliculi** arise. One bone is connected to another bone cell through these **canaliculi**.
 (vi) On the outside, a bone is surrounded by a connective tissue called **periosteum**. Blood vessels and nerves are present in it.
 (vii) Bones **protect** the internal organs, **support** the body and **help in locomotion**.
 Bones make up approximately 15 % percent of the body mass of an adult.

Differences between Cartilage and Bone

CARTILAGE	BONE
1. It is soft and flexible.	It is hard and inflexible.
2. It is nonporous.	It is porous.
3. Blood vessels are absent.	Blood vessels are present.
4. Matrix is made up of proteins.	Matrix is made up of salts of calcium and magnesium (mainly calcium phosphate).
5. Bone marrow is absent.	Bone marrow (which produces blood cells) is present.
6. Matrix occurs as a homogeneous mass. it is non-lamellar.	Matrix occurs in lamellae.

FLUID CONNECTIVE TISSUE

1. **Blood and lymph** constitute the fluid tissue and consists of cells and matrix without fibres
2. Matrix is in a fluid state, and is called **plasma**.
3. Transport of materials from one place to another within the body, is brought about by this tissue.

BLOOD

- (i) Blood is a bright-red coloured fluid connective tissue.
- (ii) Blood is contained within a closed system of tubes (arteries, veins and capillaries) through which it is circulated within the body by the pumping action of the heart.
- (iii) It consists of straw-coloured fluid called **plasma** in which various kinds of cells or **corpuscles** are present. The blood cells are
 - (a) **Erythrocytes** (red blood cells or RBCs in short),
 - (b) **Leucocytes** (white blood cells or WBCs in short), and
 - (c) **Blood platelets**.
- (iv) The plasma makes up about 55 per cent of the blood by volume while blood cells make up 45 per cent of the blood by volume. The body of an adult human being contains about 6 litres of blood.

Major Functions of Blood

1. **Transport of food materials:** Blood transports the digested food from the alimentary canal to various organs of the body.
2. **Transport of oxygen and carbon dioxide:** Blood carries oxygen from the respiring organs to the tissues, and carbon dioxide from the tissues to the respiring organs.
3. **Transport of excretory products:** Excretory products are transported by blood to the kidneys, from where they are eliminated.
4. **Temperature regulation** Blood distributes heat within the body and helps in maintaining body temperature.
5. **Protection from diseases:** The white blood cells destroy the disease-causing organisms by engulfing; in some cases antitoxins and antibodies are produced, thus protecting the body from diseases.
6. **Role in blood clotting:** Loss of blood from the body is prevented by the formation of clot, at the site of blood loss.
7. **Wound healing:** WBCs help in healing of wounds.

LYMPH

- (i) Lymph is another fluid connective tissue consisting of plasma and mainly white blood cells.
- (ii) RBCs and platelets are absent.
- (iii) It is a fluid that surrounds the body cells.

Function

It mainly helps in the exchange of materials between blood and tissue fluids.

Differences between Blood and Lymph

	BLOOD	LYMPH
1.	It consists of plasma, RBCs, WBCs and platelets.	It consists of plasma and leucocytes; no RBCs and platelet
2.	It is red in colour due to the presence of haemoglobin in RBCs.	It is colourless; haemoglobin is absent.
3.	It mainly transports oxygen and carbon dioxide.	It transports materials from the blood to tissue fluids and vice versa.

CPP

Mark the following statements as True (T) or False (F):

- (i) Connective tissue is composed of cells and fibres.
- (ii) In cartilage and bone, the intercellular matrix is rigid.
- (iii) In tendons and ligaments, the intercellular matrix is a fluid.
- (iv) Cartilage and bones are the two skeletal tissues
- v) Tendons connect muscles to bones, while ligaments connect bones together.
- (vi) Rings of windpipe are made up of cartilage.
- (vii) Adipose connective tissue helps to keep the body warm.
- (viii) Chondroblasts are present in a bone.

MUSCULAR TISSUE

Salient features

- (i) Muscular tissue is a **contractile tissue** consisting of large elongated cells or fibres. The muscle cells are able to shorten to a half or even a third of their “**resting**” length, and return to their original state. **Contractility** is the special property of this tissue. The contraction and relaxation is due to the contractile proteins present in muscle cells.
- (ii) The muscle tissue is held together by connective tissue.
- (iii) The cells of the muscular tissue **do not secrete any intercellular matrix**.
- (iv) The cytoplasm of a muscle cell (or fibre) contains a large number of fine longitudinally running fibrils called **myofibrils**. The myofibrils are contractile. The cytoplasm is called the **sarcoplasm**. Sometimes the muscle fibre is externally covered by a sheath or membrane called **sarcolemma**.
- (v) **Main function** is to bring about **movement of body** parts and **locomotion** of the individual.

- Do you know that our body has more than 600 muscles which control the various movements?

• Types of Muscular tissues

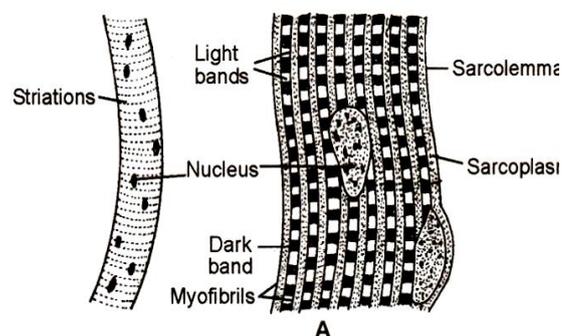
- (i) Striated or striped or skeletal or voluntary muscles,
- (ii) Unstriated or smooth or involuntary muscles, and
- (iii) Cardiac muscles.

(a) Striated Muscles

- (i) Also known as **striped, skeletal or voluntary muscles**, these occur in bundles, normally attached to the bones and help in body movement.
- (ii) Each muscle fibre is long, cylindrical, **unbranched and non-tapering, with multinucleate (coenocytes)** condition.
- (iii) **Sarcolemma** (the membrane around the muscle cell) is present.
- (iv) The **myofibrils are tightly packed**.
- (v) Under the microscope, each striated muscle fibre shows **striations**. These are just alternating light and dark bands placed at right angles to the long axis.
- (vi) These muscles can contract rapidly and are responsible for the quick movements.

(vii) These muscles are called **voluntary** because their contraction is under the control of mind or will.

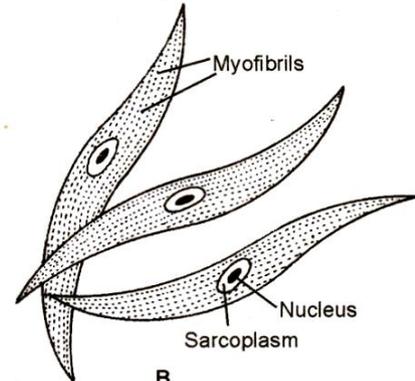
(viii) These occur in the limbs, body wall, face and neck.



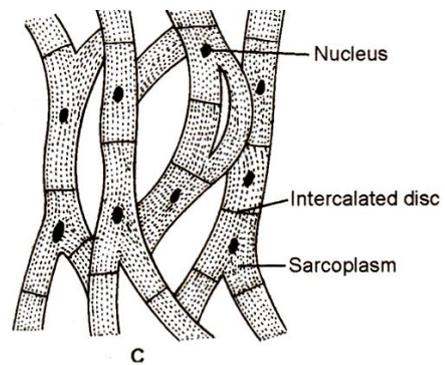
(b) Unstriated Muscles

- (i) Also known as smooth or **involuntary muscles**.
- (ii) Each Unstriated muscle fibre is a long, flattened, spindle-shaped, tapering and **uninucleate cell**. The nucleus is present in the centre.
- (iii) **Sarcolemma** is absent,
- (iv) Longitudinally running myofibrils are present.
- (v) The muscle fibres do not show striations.
- (vi) These muscles contract and relax very slowly.
- (vii) These are called **involuntary muscles** as their movements are not controlled by the mind.
- (viii) Such muscles are found in the **walls** of all tubular organs such as the **stomach, intestines, blood**

vessels, breathing passages and the organs concerned with urination and reproduction (urinogenital ducts).

**(c) Cardiac Muscles**

- (i) Cardiac muscles are composed of branching and anastomosing network of fibres.
- (ii) The fibres have centrally located one or **two nuclei** and transverse striations with **light and dark bands**.
- (iii) Special electrical junctions called **intercalated discs** are present at intervals in the fibres.
- (iv) Each fibre is surrounded by **sarcolemma**.
- (v) Cardiac muscles show **characters of both striated and Unstriated muscles**.



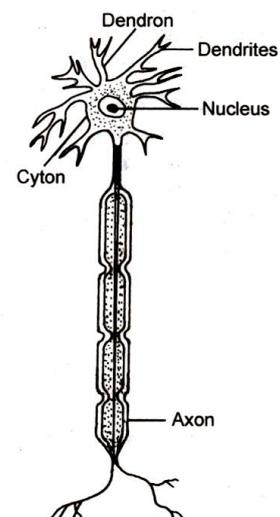
- (vi) **Cardiac muscles** are **richly supplied with blood**.
- (vii) These muscles occur only in the walls of the **heart**.
- (viii) The muscles show **rhythmic contraction**. All the muscles contract in unison, creating an efficient pumping action of the heart.
- (ix) Cardiac muscles (**though striated in structure**) are **involuntary** in nature. They are not under the control of one's will. They keep on performing their function throughout life.

NERVOUS TISSUE**Characteristic features:**

- (i) Nervous tissue is a much specialised tissue for **receiving stimuli** or sensations and transmitting messages. It is present in brain, spinal cord and nerves.
- (ii) **Nerve cells** or **neurons** form the most important elements of the nervous tissue.
- (iii) Each neuron consists of three parts -
 1. The main body called the cell body or **cyton**,
 2. The **dendrons**, and 3. The **axon**.

The dendrons are one or more short processes arising from the cyton.
Dendrons branch further into many thin dendrites. The **dendrites receive impulses**.

The **axon** is a single, long, cylindrical process arising from the cyton.
The axon forms fine branches at its terminal end, and **takes impulses away from the cell body**.
- (iv) Nerve cells are joined end to end forming long nerve fibres. Nerve fibres branch out to every part of the body.



(v) **Function:** The nerves in our body are like cables, made up of many nerve cell fibres. The nerve fibres conduct messages from one part of the body to the other. They also receive stimuli from the outside environment and send the message to the brain and spinal cord. In turn, impulses from the brain and spinal cord are carried to the various organs.

CPP

Mark the following statements as True (T) or False (F):

- (i) Muscular tissue consists of small rounded cells
- (ii) Contractility is a special property of muscular tissue
- (iii) Cells of muscular tissue do not secrete any intercellular matrix.
- (iv) The cytoplasm of a muscle cell is called sarcoplasm.
- (v) Myofibril is the sheath covering the muscle cells.
- (vi) Cardiac muscles are a type of muscular tissue.
- (vii) Striated muscles are also called involuntary muscles.
- (viii) Striations (or cross bands) are present in voluntary muscles.
- (ix) The myofibrils run longitudinally in unstriated muscles.
- (x) Involuntary muscles are found in the stomach wall
- (xi) Characters of both striated and unstriated muscles are found in cardiac muscles.
- (xii) Muscular tissues are of three types.
- (xiii) Nerve cells are also called dendrons.
- (xiv) A neuron consists of three parts.
- (xv) The dendrites receive impulses while the axon takes impulses away from the cell body.
- (xvi) The dendrons are short processes arising from the cell body.
- (xvii) Nerve cells join together to form nerve fibres.
- (xviii) Nervous tissue is found in brain and spinal cord.

ASSIGNMENT

1. Define a tissue.
2. What is meant by differentiation?
3. How is it advantageous for an organism to be made of different kinds of cells instead of only one kind?
4. **Define the following:** (I) Meristematic tissue (ii) Permanent tissue (iii) Aerenchyma
(iv) Chlorenchyma (v) Vascular tissues
5. **Name the following:**
(i) Two main types of plant tissues. (ii) Thick-walled isodiametric dead cells.
(iii) Two simple tissues which provide mechanical support to plants.
(iv) Different types of permanent tissues in plants.
(v) Growing regions which cause increase in girth of the plant body.
(vi) Growing regions which produce growth in length.
(vii) Components of xylem. (viii) Components of phloem.
(ix) Protective tissue found in old stems.
6. Mention **five important characteristics** and functions of
(i) Meristematic tissues (ii) permanent tissues.
7. Mention the regions of the plant body where following tissues are **found**
(a) Parenchyma (b) Collenchyma (c) Sclerenchyma
(d) Xylem (e) Phloem (f) Protective tissues
8. Mention the characteristic features of parenchyma, collenchyma and sclerenchyma.
9. Which components of xylem tissue are living and which ones are dead?
10. Which components of phloem tissue are living and which ones are dead?
11. Name thin-walled living cells associated with sieve tubes.
12. Give differences between the following
(i) Meristematic tissues and Permanent tissues (ii) Simple and Complex tissues
(iii) Parenchyma and Collenchyma (iv) Parenchyma and Sclerenchyma
(v) Collenchyma and Sclerenchyma (vi) Sclereid and Fibre
(vii) Xylem and Phloem (viii) Tracheid and Vessel
(ix) Vessel and Sieve tube
13. Mention important properties of cork.
14. Write, in brief, about the following
(i) Epidermis (ii) Cork

CPP

1. **Name the following**

(i) Different types of animal tissues	(ii) Different types of epithelium
(iii) Different types of connective tissue	(iv) Components of blood
(v) Different types of muscular tissue	(vi) Cells composing the nervous tissue

2. Mention the **characteristic** features of:

(i) Epithelial tissue	(ii) Connective tissue	(iii) Muscular tissue	(iv) Nervous tissue
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3. Describe the **functions** of:

(i) Epithelium	(ii) Blood	(iii) Lymph	(iv) Cardiac muscle tissue
(v) Nervous tissue	(vi) Ligament	(vii) Tendon	(viii) Cartilage
(ix) Bone			

4. Describe the **structure and functions** of

(i) Different types of connective tissue.	(ii) Different types of muscular tissue.
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5. Give **examples** of the type of epithelium which respectively

(a) Bear cilia	(b) protect the body from mechanical injury.
(c) Help in absorption.	(d) Occur where there is wear and tear.

6. On what **basis** are the connective tissues generally **classified**?

7. Where are the following tissues located in an organism?

(i) Cartilage	(ii) Areolar tissue
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8. Which kind of muscle is involved in the following processes?

(i) Movement of the arm	(ii) Contraction of blood vessels
(iii) Movement of food along the alimentary canal	

9. What are the two types of fibres found in a connective tissue? Differentiate between the two.

10. Give differences between the following:

(i) Blood and Lymph	(ii) Bone and Cartilage
(iii) Striated and Unstriated muscles	(iv) Striated and Cardiac muscles

11. In what ways does the structure of loose connective tissue facilitate its functions?

12. How does cardiac muscle differ from both voluntary muscle & smooth muscle in its structure and its function?

13. If you are provided 3 slides, each containing one type of muscle fibre, how will you identify them?

14. Describe the structure of a neuron.

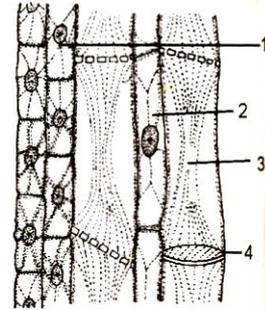
15. Outline the structure of a neuron by means of a diagram.

16. What is a nerve fibre?

17. Write **the odd one** out and give a reason in support of your answer.
- (i) **Collenchyma, sclerenchyma, parenchyma, cambium.**
 - (ii) **Tracheid, vessel, sieve tube, cork.**
 - (iii) **Bone, cartilage, tendon, blood.**
 - (iv) **RBC, WBC, platelets, lymph.**
 - (v) **Myofibril, sarcoplasm, sarcolemma, osteocyte.**

18. Observe the figure given alongside and answer the following:

- (i) Label the parts numbered 1 – 4.
- (ii) What does the figure show?
- (iii) Give the function of part 3.



19. Which of the following is mismatched?
- (a) Epithelial tissue – protection and absorption
 - (b) Muscular tissue – contraction and conduction
 - (c) Connective tissue – binding and support
 - (d) Nervous tissue – conduction and message sending.
20. Which of these is not an epithelial tissue?
- (a) Bone and cartilage
 - (b) Simple cuboidal and stratified columnar
 - (c) Stratified squamous and simple squamous
 - (d) All of these are epithelial tissue.
21. Which tissue is more suited to line a lumen?
- (a) Epithelial tissue
 - (b) Connective tissue
 - (c) Muscular tissue
 - (d) Nervous tissue
22. Which tissue has cells in lacunae?
- (a) Epithelial tissue
 - (b) Cartilage
 - (c) Bone
 - (d) Both (b) and (c)
23. Tendons and ligaments are
- (a) Connective tissue
 - (b) Associated with the bones
 - (c) Found in vertebrates
 - (d) All of these are correct.
24. Cardiac muscle is
- (a) Striated
 - (b) Involuntary
 - (c) Smooth
 - (d) both (a) and (b)
25. Which of these components of blood fights infection?
- (a) Red blood cells
 - (b) White blood cells
 - (c) Platelets
 - (d) All of these
26. Tendons connect
- (a) Nerve to muscle
 - (b) Muscle to muscle
 - (c) Bone to bone
 - (d) Bone to muscle