

Living tissues

You have studied about tissues as one of the organisational levels of a multicellular organisms in grade 10. You will learn more about tissues in this chapter.

1.1 Plant tissues

Let's do the activity given below to study about plant tissues.

Activity 1.1

Materials required :- Thin peel of lower epidermis of betel leaf, thin section of a potato tuber, thin cross section of a stem of a plant like *Balsam*

- Method :-**
- Prepare temporary slides using above plant materials.
 - Observe them under microscope.
 - Try to identify tissues formed by cells with the help of your teacher.

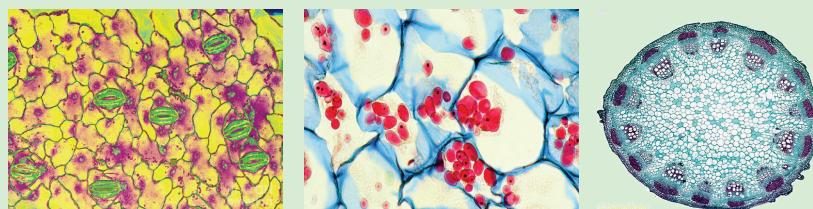


Figure. 1.1 - View of different plant tissues under optical microscope

You may have observed that plant tissues are of different forms. Animal tissues are also of different forms. It is observable that different cell types are present in living beings and similar cells are arranged together.

A group of cells with a common origin that has been modified to perform a specific function in the body is known as a tissue.

Classification of plant tissues

Let's do the following activity to study further about how tissues are organized in plant organs.

Activity - 1.2

Materials required :- Prop root of Banian/ Stilt root of Pandanus/ Stilt root of Rampe



Figure 1.2 - External view of a root

Method :-

- Observe the external view of the growing tips of above roots
- Use a hand lens to observe them

We can identify the nature of growing root from the above observation. Growing part is soft and light coloured. Mature part is rough and dark coloured. This is because of the nature of tissues.

Figure 1.3 shows the microscopic view of longitudinal section of such root.

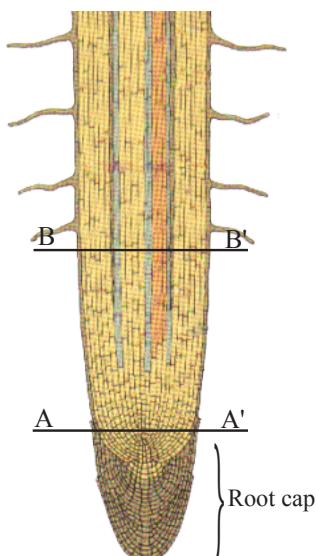


Figure 1.3 - Microscopic view of longitudinal section of root apex

It is observed that region A-A' has cells with the ability of cell division. Region B-B' contain different cell types that are different in nature from cells in region A-A'.

Plant tissues can be categorised using different criteria. Plant tissues can be divided into two groups according to the ability of cell division.

- Meristematic tissues
- Permanent tissues

Permanent tissues can be found in region B-B' and Meristematic tissues in region A-A' as shown in figure 1.3.

1.1.1 Meristematic tissues

The tissues with cells that divide actively by mitosis to produce new cells are called meristematic tissues. These cells are not differentiated. The growth of plants takes place due to activity of meristematic tissues.

Features of meristematic tissues

- This tissue consists of small sized living cells
- No inter cellular spaces or intercellular spaces are not prominent
- There is a distinct nucleus in each cell
- Absence of large central vacuole but small vacuoles may be present
- Large number of mitochondria are present

Meristematic tissues are present in specific locations of the plant. They are of three types.

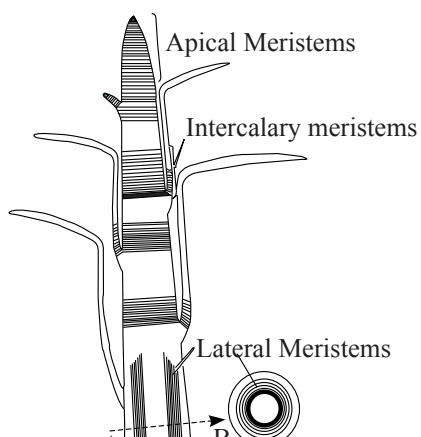


Figure 1.4 - Locations of meristematic tissues

Apical meristems

Apical meristems are found in shoot apex, root apex and axillary buds. Plant increases its height due to the activity of this tissue.

Intercalary meristems

Intercalary meristems are found at nodes. The length of internode increases due to the activity of the above tissue. They are found in plants of grass family

Lateral meristems

Lateral meristems are present laterally in the stem and roots of plant. They are found parallel to the longitudinal axis of plant. The diameter of the plant increases due to the activity of this tissue. Cambium tissue found in dicots is a lateral meristematic tissue.

1.1.2 Permanent tissues

Do the following activity to identify different types of tissues of plant stem.

Activity - 1.3

Materials required :- Pumpkin / Tridex plant stem, A glass slide, A microscope

Method :-

- Observe the cross section of above plant stem using a microscope
- Identify the different tissue types present in them

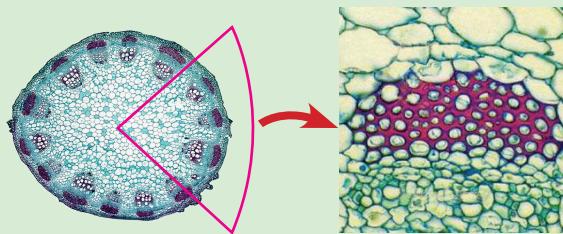


Figure 1.5 - Microscopic view of cross section of dicot stem

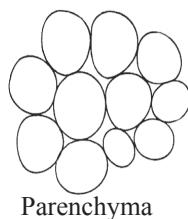
A specialized tissue that lost its ability to divide and perform a particular function is known as a permanent tissue.

According to the nature of the permanent tissues, it can be grouped into two.

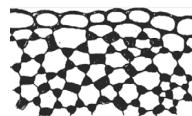
- Simple Permanent tissues - One type of cells collected together
- Complex Permanent tissues - Different types of cells collected together

• Simple permanent tissues

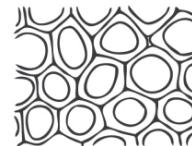
The tissue is composed of similar cells. According to the shape of cell and the nature of cell wall, three types of simple permanent tissues as parenchyma, sclerenchyma, and collenchyma can be identified in plants (Figure 1.6).



Parenchyma



Collenchyma



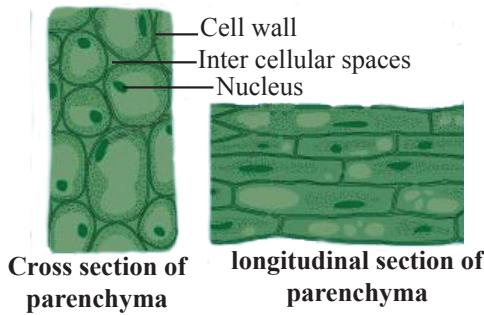
Sclerenchyma

Figure 1.6 - Simple permanent tissue types

- **Parenchyma**

The tissue that forms the soft parts of the plant body is the parenchyma tissue. This is the most abundant tissue found in the plant.

Features of Parenchyma tissue



- Parenchyma tissue consists of living cells.
- Cells are isodiametric (spherical) with a large central vacuole.
- Nucleus is present peripherally in the cytoplasm
- The cell wall is thin and made up of cellulose.
- Inter cellular spaces are present.

Locations of parenchyma tissues

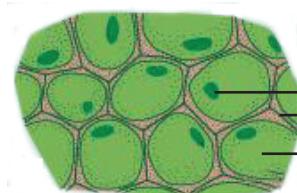
- Cortex and pith of plant stem
- Fleshy parts of fruits
- Leaves (mesophylls)
- Pith and cortex of roots
- Seeds (endosperm)

Functions of parenchyma

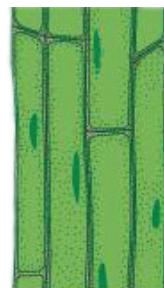
- Photosynthesis
 - Palisade and spongy mesophylls in plant leaves contain chlorophyll within chloroplasts. Photosynthesis takes place within these chloroplasts.
- Food storage
 - Food is stored in some parenchyma tissues and they are called as storage tissues.
E.g. : Potato tuber, Carrot and Sweet potato roots, Papaw and Banana fruits.
- Storage of water
 - Specially xerophytic plants store water in parenchyma tissue
E.g. : *Aloe* leaves, *Bryophyllum* leaves, *Cactus* cladode
- Providing support
 - Herbaceous plants like *Balsam* absorb water into vacuoles of the parenchyma cells. Thereby cells become turgid and provide mechanical support to the plant.

- **Collenchyma**

Collenchyma tissue provides mechanical strength and support to the plant body. They are modified parenchyma cells.



Cross section of a collenchyma tissue



Longitudinal section of a collenchyma tissue

Figure 1.8 - Collenchyma tissue

Features of collenchyma tissue

- Collenchyma tissue consists of living cells
- Cells possess a cytoplasm, nucleus and central vacuole
- Generally cells are elongated and polygonal in cross section
- The corners of the cell walls are thickened.
- Intercellular spaces may present or may not present

Locations of collenchyma

The collenchyma forms a cylindrical tissue inner to the epidermis of herbaceous stems. They are found in the veins of dicot leaves.

Functions of collenchyma

1. Support - Collenchyma provides mechanical support to dicot plant stem, before the formation of wood. (Provides mechanical support to herbs)
This tissue provides support to the plant leaves by the collenchyma in veins.
2. Photosynthesis - Chloroplasts are found in the collenchyma of immature dicot stems. Photosynthesis is carried out by those cells.

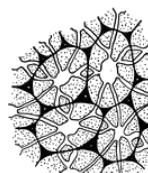
- **Sclerenchyma**



Cross section of fibers



Longitudinal section of sclerenchyma tissue



sclereid

Figure 1.9 - Sclerenchyma tissue

Sclerenchyma tissue helps in providing mechanical strength and support to the plant body. This tissue has two types of cells as sclereids and sclerenchyma fibres.

Features of sclerenchyma tissue

- Sclerenchyma tissue consists of dead cells
- Lignin is deposited on the cellulose cell wall
- Cells are tightly packed. Therefore, no intercellular spaces
- Cell wall is evenly thickened and forms a central lumen

Locations of sclerenchyma tissue

Fibres present in xylem are called as xylem fibres and in phloem as phloem fibres. Other than above, coconut fibres, agave fibres and cotton wool are made up of fibres (sclerenchyma)

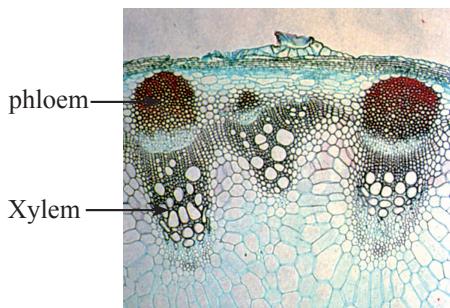
Sclereids are found in endocarp of coconut, camphor and mango fruits, the pericarp of guava fruit and in pear fruit and seed coat of coffee and dates.

Functions of sclerenchyma

- Provide support to the plant body

- Complex permanent tissues

Different types of cells together form a complex permanent tissue. Two complex permanent tissues as xylem and phloem can be identified in plants (Figure 1.10).



Xylem and phloem are found in vascular systems of root, stem and leaves of the plant.

Figure 1.10 - Complex permanent tissues

Xylem tissue

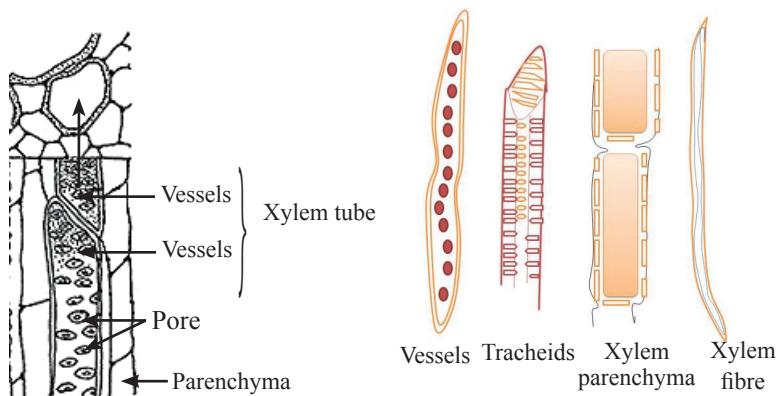


Figure 1.11 - Xylem tissue

This tissue is composed of four different types of cells.

- Xylem vessel element
- Tracheids
- Fibres
- Parenchyma cells

Xylem vessel elements are cylindrical elongated cells. Xylem vessel element stack on top of the others and the cross walls are dissolved to form a continuous xylem vessel. This tubular structure helps in transportation of water in plants. Tracheids are elongated, spindle shaped cells. They also help in transportation

of water. Xylem fibers are narrower and shorter than tracheids. Xylem vessels, tracheids and xylem fibers become dead due to lignification of cell walls. They provide support to the xylem tissue. Xylem parenchyma are living cells with a thin cell wall. They involve in food storage.

Functions of xylem

- Transportation of water and minerals to the plant body which are absorbed by plant roots.
- Providing of mechanical support to plant body.

Phloem tissue

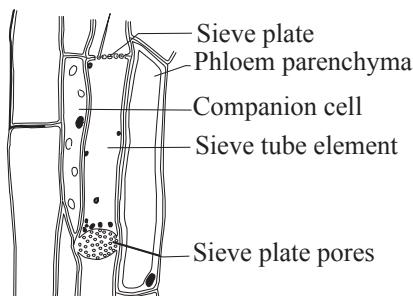


Figure. 1.12 - Longitudinal section of the phloem tissue

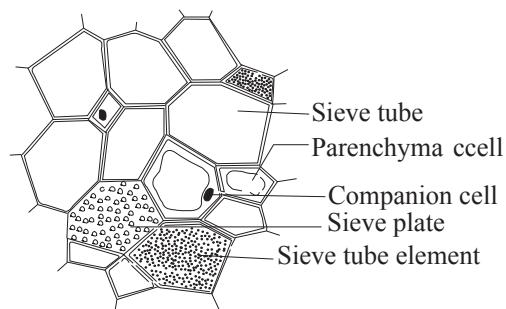


Figure. 1.13 - Cross section of the phloem tissue

Phloem tissue is composed of four different types of cells.

- Sieve tube elements
- Companion cells
- Phloem fibres
- Phloem parenchyma

The sieve tube elements fuse end to end and the cross walls are incompletely dissolved to form a sieve tube. The cross walls in these sieve tubes are called sieve plates. Sieve tubes transport food (mainly sucrose) throughout the plant, as a solution.

Companion cells are elongated cells associated with sieve tube elements. The nucleus of the companion cell controls the activities of the sieve tube elements (sieve tube elements lack a nucleus). Sieve tube elements, companion cells and phloem parenchyma are living cells whereas phloem fibres are dead and found scattered in phloem tissue.

Functions of phloem tissue

The food synthesized in the leaves are transported throughout the plant body by this tissue (Translocation).

Assignment 1.1

Compare structural and functional characteristics of phloem and xylem.
Include them in a table.

1.2 Animal tissues

The animal body is also made up of different types of cells.

Example :- The human body is made up of about 210 different types of cells.

There are groups of cells with common origin to perform a specific function in the multicellular animal body. Main types of animal tissues are given below.

- Epithelial tissue
- Connective tissue
- Muscle tissue
- Nervous tissue

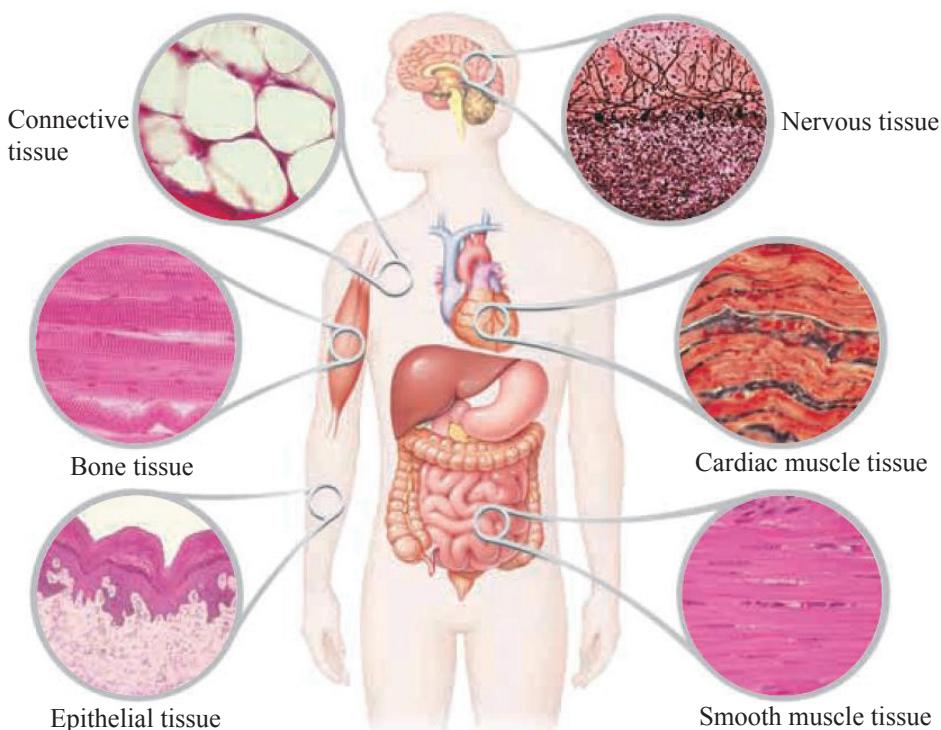


Figure 1.14 - Different tissues in human body

1.2.1 Epithelial tissue

This is the tissue that lines up the free surfaces (internal and external) of the vertebrate body. Some of them are composed of single layer of cells and the others are with several cell layers.

Features of epithelial tissues



Figure 1.15 - epithelial tissue

- The cells are placed on a basement membrane
- The cells are tightly packed
- A nerve supply is present within the tissue but there is no blood supply

The epithelial tissue is classified according to the shape of the cell and the number of cell layers.

Examples for several locations of epithelial tissues are given below.

- Wall of blood capillaries
- Thyroid gland
- Lining of nasal cavity
- Wall of urinary bladder
- Skin (Epidermis)

Functions of epithelial tissue

- Lining up of free surfaces and protection - Protects the internal organs from pressure, friction and microbes
- Absorptive function - The epithelium of digestive tract absorbs digestive end products
- Perception of stimuli - The epithelium of tongue and nose, detect taste and smell senses
- Secretory function - Secretion of mucous by the lining epithelium of respiratory tract
- Filtering - Epithelium of Bowman's capsule in nephrons, filters blood

1.2.2 Connective tissue

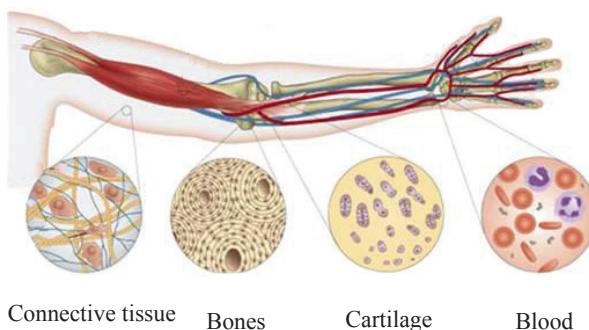


Figure 1.16 - Different Connective tissue present in human arm

The connective tissues provide connection between tissues and organs and provide support too.

E.g. :- Blood tissue, Bone tissue

Blood tissue

Blood is a special connective tissue. The speciality is that the matrix (plasma) is not secreted by the blood cells. Blood tissue helps in maintaining proper connection between organs and tissue of the human body.

Features of blood tissue



Figure 1.17 - Blood tissue

- Blood is composed of a fluid matrix called plasma and cells
- The matrix contains cells called red blood cells (erythrocytes) and white blood cells (leucocytes) and cellular fragments called platelets
- Fibres are not found always but during blood clotting they appear

Functions of blood tissue

- Transportation of materials - Nutrients, respiratory gases, excretory materials and hormones are transported to the relevant organs
- Protection - White blood cells destroy foreign bodies (Microbes) by phagocytosis and by producing antibodies
- Maintenance of homeostasis

1.2.3 Muscle tissue

Muscle tissue is one of the main tissues that makes up the human body. Muscle tissue is made up of muscle cells or muscle fibres. These muscle fibres possess contraction and relaxation ability. Not like epithelium, the muscle tissue possesses a good blood supply. Therefore muscle tissue receives oxygen and nutrients at a high rate. Muscle tissue acts as one of the effectors in responding in coordination.

Muscle tissue is of three types,

- Smooth muscle tissue
- Skeletal muscle tissue
- Cardiac muscle tissue

Assignment 1.2

Compare the characteristics of different muscle tissues.

Smooth muscle tissue

Smooth muscle tissue is made up of smooth muscle cells. This tissue is found in the walls of organs with cavities.

Example :- Walls of digestive tract, uterus, blood vessels and bladder

Features of smooth muscle cell

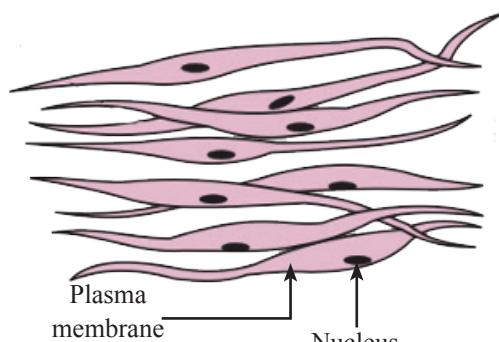


Figure 1.18 - smooth muscle cell

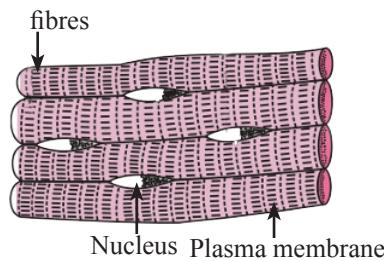
- These cells are spindle shaped and present separately. The cells are unbranched
- These cells have one nucleus at the centre. No striations
- These cells do not become fatigued quickly. They are controlled involuntarily

Skeletal muscle tissue

Skeletal muscle tissue is made up of skeletal muscle fibres. These are mostly associated with skeletal system. The skeletal muscles help in locomotion and movements of chordates.

Features of skeletal muscle fibres

Skeletal muscular



- Skeletal muscle fibres are long, cylindrical, unbranched cells.
- They are multinucleate cells with striations. The nuclei present peripherally, and many mitochondria are present in them.
- These cells are voluntarily controlled and become fatigued easily.

Figure 1.19 - Skeletal muscular tissue

E.g. :- Bicep muscle, Tricep muscle, Muscles in leg, Facial muscles

Cardiac muscle tissue

Cardiac muscle tissue is made up of cardiac muscle cells. It is exclusively found in the vertebrate heart.

Features of cardiac muscle fibres

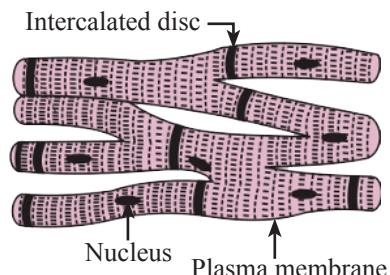


Figure 1.20 - Cardiac muscle tissue

- Cardiac muscle cells are uninucleate, striated and short cells
- Intercalated discs are present among cells
- They never become fatigued. They contract rhythmically
- They are involuntarily controlled

1.2.4 Nervous tissue

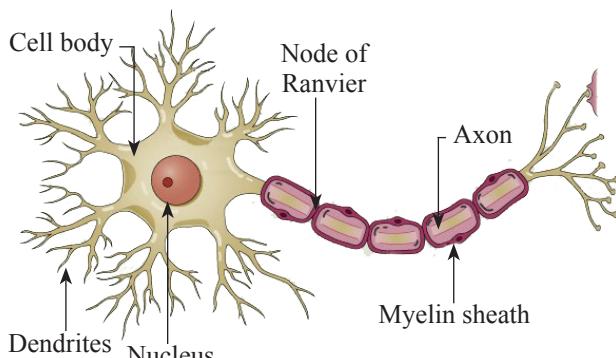


Figure 1.21- Structure of a typical neuron

It is an important tissue found in chordates body. The structural unit of nervous tissue is nerve cell or neuron. Neurons are specialised to transmit impulses.

Features of neuron

- Neuron is composed of two parts. They are cell body and nerve fibres
- Nucleus, mitochondria, golgi body and endoplasmic reticulum are found in the cell body
- Axon arises from the cell body as a single process. The axon transmits impulses away from the cell body.
- Dendrons branch out to form dendrites. Dendrites receive stimuli and transmit impulses to the cell body

Most of the axons in chordates are myelinated. Myelin sheath is not continuous and the interrupted places are known as nodes of Ranvier. The myelin sheath increases the speed of transmission.

Functions of neurons

The function of the neuron is to receive the information from the receptors (eye, ear, nose tongue, skin) or another neuron and to transmit them to the effector (muscles) or to another neuron.

According to the function of the neuron, they can be divided into three types as follows,

- Sensory neuron
- Inter neuron
- Motor neuron

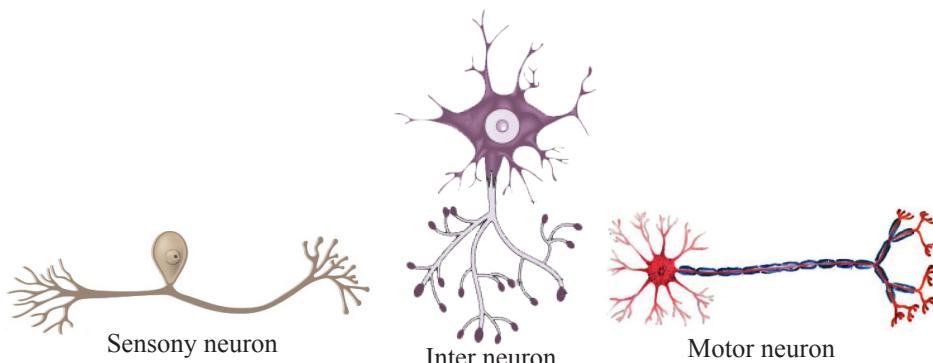


Figure 1.22 - Types of neurons

• Extra knowledge •

Sensory neuron

They transmit impulses from sensory organs to the central nervous system. The cell body of the sensory neuron is present at the centre of the nerve fibres. The cell bodies are present inside ganglion. The dendrites are present at the sensory organs. Ganglion is a structure formed by the collection of cell bodies.

Motor neuron

The function of the motor neuron is to transmit impulses from central nervous system to effector (muscles).

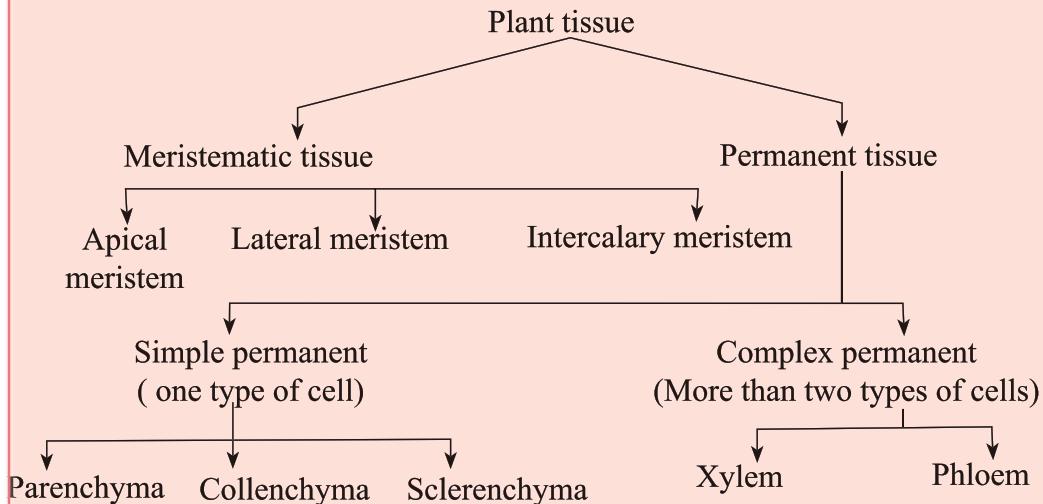
A motor neuron possesses a star shaped cell body with many fibres. One of them is the axon and it is long. Sometimes it is greater than 1m in length. The other fibres and cell body are found within the central nervous system.

Inter neuron

The whole neuron is present within the central nervous system. The axons are short. Many dendrites are present.

The inter neuron connects the sensory neuron with motor neuron.

Summary



- A group of cells with a common origin adapted to perform a specific function in living body is known as a tissue.
- Chordate body is composed of four main tissues such as epithelial tissue, connective tissue, muscle tissue and nervous tissue.
- Epithelial tissue lines up the free surfaces of chordates and performs absorption, secretion, filtration, perception of senses and protection.
- The connective tissue is made up of different types of cells, fibres and a large matrix. It connects the organs and tissues together and provides support to them.
- Smooth muscles, skeletal muscles and cardiac muscles are present in the human body. The contraction and relaxation of those help in different movements in the body.
- Transmission of impulses is carried out by the nervous system. There are three types of neurons. They are sensory neurons, motor neurons and inter neurons.

Exercise

(1) Underline the correct answer

I. Out of the cells and tissues given below which type is of dead cells?

- 1. Fibres
- 2. Parenchyma
- 3. Collenchyma
- 4. Sieve tube element

II. Which is the complex tissue out of the following?

- 1. Parenchyma
- 2. Xylem
- 3. Sclerenchyma
- 4. Collenchyma

III. Features mentioned below could be observed in a plant tissue under a microscope. Identify the tissue.

- Isodiametric cells
- Large vacuoles
- Living cells

- 1. Sclerenchyma
- 2. Collenchyma
- 3. Xylem
- 4. Parenchyma

iv. A characteristic of skeletal muscle fibre is,

- 1. Spindle shaped
- 2. Possesses cross striations
- 3. Uninucleate
- 4. Never becomes fatigued

v. When a student observes an animal tissue under the microscope, he observed the cells present on a basement membrane. The tissue is,

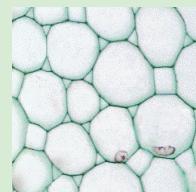
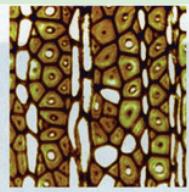
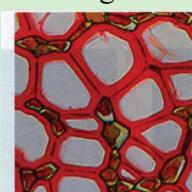
- 1. Epithelial tissue
- 2. Possesses connective tissue
- 3. Muscular tissue
- 4. Nervous tissue

vi. Which is correct about cardiac muscle fibres?

- 1. Non striated
- 2. Possesses intercalated discs
- 3. Multinucleate
- 4. Long, cylindrical cells

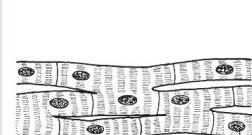
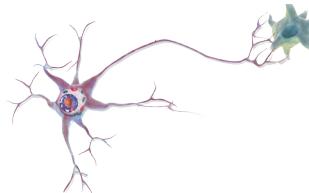
(2) State two differences between meristematic and permanent tissues.

(3) Name the tissues given below



(4) State two structural differences between a cardiac muscle fibre and a skeletal muscle fibre.

(5.) Name the animal tissues given below in diagrams.



Technical terms

Meristematic tissues	විභාගක පටක	පිරියිමේයම
Apical meristems	අගුස්ථි විභාගක	ශ්‍රීප පිරියිමේයම
Lateral meristems	ජාග්‍රිතික විභාගක	ඹිංඟප පුහුන්ත පිරියිමේයම
Intercalary meristems	අන්තරස්ථි විභාගක	පක්කප පිරියිමේයම
Parenchyma tissue	මධුස්තර පටකය	ප්‍රාග්‍රැක්ස කලවිමේයම
Collenchyma tissue	ස්ලුලකෝණ්ස්තර පටක	ඉත්තුක කලවිමේයම
Sclerenchyma tissue	දෙප්ප්ස්තර පටකය	වල්ලරුක් කලවිමේයම
Xylem tissue	යොලම පටකය	කාම්
Phloem tissue	ප්ලෝයම පටකය	ශ්‍රීයම
Fibres	තන්තු	නාර්ක්ස්
Sclereids	ලපල	වල්ලරුක්කස්
Animal tissues	සත්ත්ව පටක	විළංකිමේයම
Epithelial tissues	අපිටිජ්ද පටක	විළංකිමේයම
Muscle tissues	පේඩ පටක	තැසයිමේයම
Connective tissues	සම්බන්ධක පටක	ජොංප්පිමේයම
Nervous tissues	ස්නෑයු පටක	නරම්පිමේයම