Class IX Science Notes

Tissues

All living organisms are made of cells. In unicellular organisms, a single cell performs all basic functions. In multicellular organisms with millions of cells, many cells are specialised to carry out specific functions. Each specialised function is taken up by a different group of cells. For example in human beings

a) Muscle cells contract and relax to cause movement,
b) Nerve cells carry messages,
c) Blood flows to transport oxygen, food, hormones and waste material and so on.

In plants,

d) Vascular tissues conduct food and water from one part of the plant to other parts.

So, multi-cellular organisms show division of labour. Cells specialising in one function are often grouped together in the body.

A group of cells that are similar in structure and/or work together to achieve a particular function forms a tissue.

Cluster of cells, called a tissue, is arranged and designed so as to give the highest possible efficiency of function. Blood, phloem and muscle are all examples of tissues.

Difference between Plants and Animals Made Tissues

There are noticeable differences between the plants and animals. A)

a) Plants are stationary or fixed and since they have to be upright, they have a large quantity of supportive tissue. The supportive tissue generally has dead cells. Animals on the other hand move around in search of food, mates and shelter. They consume more energy as compared to plants. Most of the tissues they contain are living.
b) Animals and plants also differ in the pattern of growth. The growth in plants is limited to certain regions, while this is not so in animals.

There are some tissues in plants that divide throughout their life. These tissues are localised in certain regions. Based on the dividing capacity of the tissues, various plant tissues can be classified as growing or meristematic tissue and permanent tissue.

Cell growth in animals is more uniform. So, there is no such demarcation of dividing and non dividing regions in animals.

c) The structural organisation of organs and organ systems is far more specialised and localised in complex animals. This fundamental difference reflects the different modes of life pursued by these two major groups of organisms, particularly in their different feeding methods.

d) Plants have sedentary existence and animals have active locomotion, contributing to this difference in organ system design.

Q) What is the utility of tissues in multi-cellular organisms?

Answer: A tissue is a cluster of cells that work together to perform a particular task and are also structurally similar. In multicellular species, the use of tissues **provides structural and mechanical strength and enables division of labour**.

MERISTEMATIC TISSUE

Tissues that contain undifferentiated cells and have the ability to divide actively throughout its life

Cell differentiation is **the process by which dividing cells change their functional type**. All cells presumably derive from stem cells and obtain their functions as they mature.

An example of cell differentiation is the development of a single-celled zygote into a multicellular embryo that further develops into a more complex multisystem of distinct cell types of a fetus

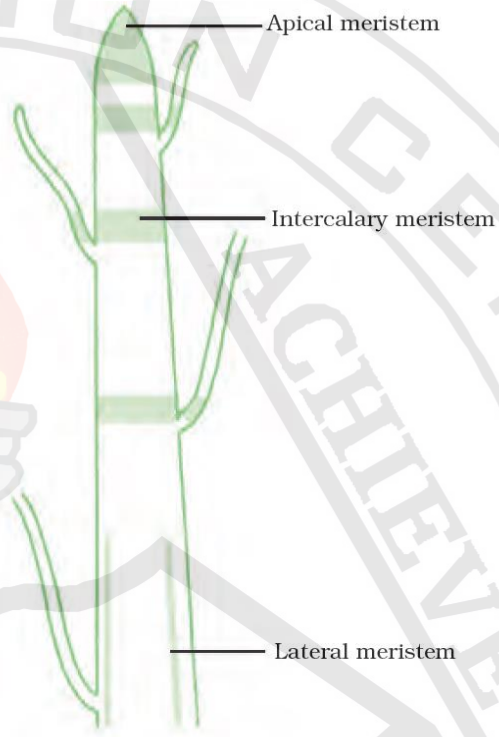
The growth of plants occurs only in certain specific regions, because the dividing tissue – meristematic tissue, is located only at these points. Meristematic tissues are classified as apical, lateral and intercalary depending on their location

New cells produced by meristem are initially like those of meristem itself, but as they grow and mature, their characteristics slowly change and they become differentiated as components of other tissues.

a) **Apical meriste**m is present at the growing tips of stems and roots and increases the length of the stem and the root.

b) **Lateral Meristem:** The girth of the stem or root increases due to lateral meristem (cambium).

c) Intercalary meristem seen in some plants is local



CELLS OF MERISTEMATIC TISSUE

- Are very active,
- Have dense cytoplasm, T
- hin cellulose walls and prominent nuclei.
- They lack vacuoles.

Q) Why do cells of meristematic tissue lack vacuoles?

Ans: Meristematic cells divide frequently and give rise to new cells and hence they need dense cytoplasm and thin cell wall. Vacuoles causes hindrance in cell division as it is full of cell sap to provide turgidity and rigidity to the cell. Also vacuoles basically serve the purpose of storing of nutrients, excess salts etc. Meristematic cells do not need to store these nutrients as they have compact shape.

PERMANENT TISSUE

The cells formed by meristematic tissue take up a specific role and lose the ability to divide. As a result, they form a permanent tissue. This process of taking up a permanent shape, size, and a function is called **DIFFERENTIATION**.

Differentiation leads to the development of various types of permanent tissues.

SIMPLE PERMANENT TISSUE

A few layers of cells beneath the epidermis are generally simple permanent tissue.

a) PARENCHYMA is the most common simple permanent tissue. It consists of unspecialised cells with thin cell walls. They are living cells.
   - They are usually loosely arranged, thus large spaces between cells (intercellular spaces) are found in this tissue.
   - This tissue generally stores food
   - In some situations, it contains chlorophyll and performs photosynthesis, and then it is called CHLORENCHYMA.
   - In aquatic plants, large air cavities are present in parenchyma to help them float. Such a parenchyma type is called AERENCHYMA.

b) COLLENCHYMA The flexibility in plants is due to another permanent tissue, collenchyma. It allows bending of various parts of a plant like tendrils and stems of climbers without breaking.
   - It also provides mechanical support. We can find this tissue in leaf stalks below the epidermis.
   - The cells of this tissue are living, elongated and irregularly thickened at the corners. There is very little intercellular space.

c) SCLERENCHYMA - It is the tissue which makes the plant hard and stiff. We have seen the husk of a coconut. It is made of sclerenchymatous tissue.
   - The cells of this tissue are dead.
   - They are long and narrow as the walls are thickened due to **lignin**. Often these walls are so thick that there is no internal space inside the cell.
   - This tissue is present in stems, around vascular bundles, in the veins of leaves and in the hard covering of seeds and nuts.
   - It provides strength to the plant parts.

d) On the outermost layer is epidermis. The epidermis is usually made of a single layer of cells. In some plants living in very dry habitats, the epidermis is thicker since protection against water loss is critical. The entire surface of a plant has an outer covering epidermis. It protects all the parts of the plant.

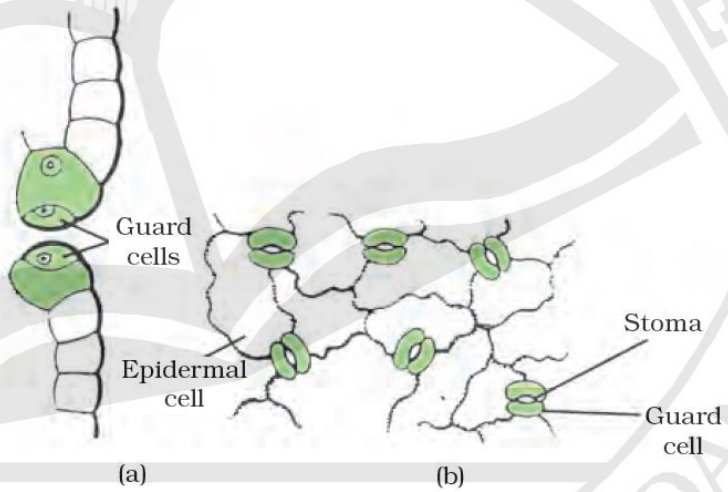
e) Epidermal cells on the aerial parts of the plant often secrete a waxy, water resistant layer on their outer surface. This aids in protection
   - Against loss of water
   - Mechanical injury and
   - Invasion by parasitic fungi.

f) Since it has a protective role to play, cells of epidermal tissue form a continuous layer without intercellular spaces.

g) Most epidermal cells are relatively flat. Often their outer and side walls are thicker than the inner wall.

Stomata

These are small pores in the epidermis of the leaf. Stomata are enclosed by two kidney-shaped cells called guard cells.



Stomata is necessary for exchanging gases with the atmosphere.

Transpiration (loss of water in the form of water vapour) also takes place through stomata.

Q1) What is the role of transpiration in plants?

Ans: It has two main functions:
- Cooling the plant and
- Pumping water and minerals to the leaves for photosynthesis.

Epidermal cells of the roots

Its function is water absorption

They commonly bear long hair like parts that greatly increase the total absorptive surface area.

In some plants like desert plants, epidermis has a thick waxy coating of **cutin** (chemical substance with waterproof quality) on its outer surface.

Q) Why do plants of desert plants have coating of cutin?

Ans: Desert plants are subjected to high temperatures and scarcity of water. To prevent the loss of water through transpiration or evaporation desert plants have **leaf modified into spines** and the epidermis is covered with a thick waxy coating.

Cutin is a waxy-water repellent substance Its main function is **protection of underlying layers** , Desert plants have an excess of cutin on their leaves so as to prevent loss of water by transpiration.

The CORK

As plants grow older, the outer protective tissue undergoes certain changes. A strip of secondary meristem located in the cortex forms layers of cells which constitute the cork.

- Cells of cork are dead and compactly arranged without intercellular spaces.
- They also have a substance called **suberin** in their walls that makes them impervious to gases and water

COMPLEX PERMANENT TISSUE

Complex tissues are made of more than one type of cells. All these cells coordinate to perform a common function.

a) Xylem and phloem are examples of such complex tissues.

b) They are both conducting tissues and constitute a vascular bundle.

c) Vascular tissue is a distinctive feature of the complex plants, one that has made possible their survival in the terrestrial environment.

d) Xylem consists of tracheids, vessels, xylem parenchyma and xylem fibres.

e) Tracheids and vessels have thick walls, and many are dead cells when mature. Tracheids and vessels are tubular structures. This allows them to transport water and minerals vertically.

f) The parenchyma stores food. Xylem fibres are mainly supportive in function.

g) Phloem is made up of five types of cells: sieve cells, sieve tubes, companion cells, phloem fibres and the phloem parenchyma.

h) Sieve tubes are tubular cells with perforated walls. Phloem transports food from leaves to other parts of the plant. Except phloem fibres, other phloem cells are living cells.

Questions

Q1) Name types of simple tissues.

Q2) Where is apical meristem found?

Ans: Apical meristem is found at **the root tip and shoot tip**.

The root apical meristem, or root apex, is **a small region at the tip of a root in** which all cells are capable of repeated division and from which all primary root tissues are derived.

Q3) Which tissue makes up the husk of coconut?

Q4) What are the constituents of phloem?

Animal Tissues

On the basis of the functions they perform different types of animal tissues are

a) Epithelial tissue
b) Connective tissue
c) Muscular tissue and
d) Nervous tissue.

EPITHELIAL TISSUE

The covering or protective tissues in the animal body are epithelial tissues.

a) Epithelium covers most organs and cavities within the body.
b) It also forms a barrier to keep different body systems separate.

c) The skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules are all made of epithelial tissue.

d) Epithelial tissue cells are tightly packed and form a continuous sheet. They have only a small amount of cementing material between them and almost no intercellular spaces.

Phloem versus Xylem comparison chart		
	Phloem	**Xylem**
Function	Transportation of food and nutrients such as sugar and amino acids from leaves to storage organs and growing parts of plant. This movement of substances is called translocation.	Water and mineral transport from roots to aerial parts of the plant.
Movement	Bidirectional (Moves up or down the plant's stem from "source to sink")	Unidirectional (Moves up the plant's stem)
Occurrence	Roots, stems and leaves. transports sucrose to growth (roots and shoots) and storage regions of the plant (seeds fruit and swollen roots)	Roots, stems and leaves
Additional Functions	Forms vascular bundles with xylem	Forms vascular bundles with phloem and gives mechanical strength to plant due to presence of lignin cells. The lignified secondary wall also makes the xylem waterproof and prevent it from collapsing under the pressure of water transpiration

Phloem versus Xylem comparison chart		
	Phloem	**Xylem**
Structure	Elongated, tubular shape with thin walled sieve tubes. The sieve tubes have pores at each end in the cross walls and microtubules that extend between sieve elements allowing longitudinal flow of material.	Tubular shape with no cross walls which allows a continuous column of water + facilitates more rapid transport within the xylem vessels. There are two types - protoxylem (first formed xylem) + metaxylem (mature xylem) depending on pattern of lignin.
Elements	Sieve tubes, companion cells, phloem parenchyma (loosely packed resulting in intercellular spaces which allows gas exchange), bast fibers, intermediary cells,	Tracheids, vessel elements, xylem parenchyma (loosely packed resulting in intercellular spaces which allows gas exchange), xylem sclerenchyma
Nature of tissue	Living tissue with little cytoplasm but no nucleus/tonoplast.	Dead tissue at maturity so it is hollow with no cell contents
Shape	Phloem is not star shaped.	Xylem is star shaped.
Location in vascular bundle	Phloem occur on outer side of the vascular bundle.	xylem occupy the center of the vascular bundle.

e) Anything entering or leaving the body must cross at least one layer of epithelium. As a result, the permeability of the cells of various epithelia play an important role in regulating the exchange of

materials between the body and the external environment and also between different parts of the body.

f) Regardless of the type, all epithelium is usually separated from the underlying tissue by an extracellular fibrous basement membrane.

g) Epithelia are classified on the base of their differing structures that correlate with their unique functions.

h) In cells, lining blood vessels or lung alveoli, where transportation of substances occurs through a selectively permeable surface, there is a simple flat kind of epithelium. This is called the **simple squamous epithelium** (squama means scale of skin). its cells are extremely thin and flat forming a delicate lining.

Example: The oesophagus , the lining of the mouth and the skin.

i) Skin epithelial cells are arranged in many layers to prevent wear and tear. Hence, the epithelium is called **stratified squamous epithelium.**

j) In places where absorption and secretion occur, like inner lining of the intestine, tall epithelial cells are present. They form **columnar** (meaning 'pillar-like') **epithelium** facilitates movement across the epithelial barrier.

k) In the respiratory tract, the columnar epithelial tissue also has cilia, which are hair-like projections on the outer surfaces of epithelial cells. These cilia can move, and their movement pushes the mucus forward to clear it. This type of epithelium is thus **ciliated columnar epithelium.**

l) **Cuboidal epithelium** (with cube-shaped cells) forms the lining of kidney tubules and ducts of salivary glands, where it provides mechanical support. Epithelial cells often acquire additional specialisation as gland cells, which can secrete substances at the epithelial surface.

m) Sometimes a portion of the epithelial tissue folds inward, and a multicellular gland is formed. This is **glandular epithelium.**

CONNECTIVE TISSUE

Blood is a type of connective tissue.

Blood is called a connective tissue because it carries with lots many digestive substances, respiratory gases, and hence connects heart, lungs and small intestine with other cells of the body. It also works as a medium between them.

a) The cells of connective tissue are loosely spaced and embedded in an intercellular matrix which may be jelly like, fluid, dense or rigid.
b) The nature of matrix differs in concordance with the function of the particular connective tissue.
c) Blood has a fluid (liquid) matrix called plasma, in which red blood corpuscles (RBCs), white blood corpuscles (WBCs) and platelets are suspended.
d) The blood plasma contains proteins, salts and hormones. Blood flows and transports gases, digested food, hormones and waste materials to different parts of the body.

Bone

a) It forms the framework that supports the body.
b) It also anchors the muscles and supports the main organs of the body.
c) It is a strong and nonflexible tissue.
d) Bone cells are embedded in a hard matrix that is composed of calcium and phosphorus compounds.
e) Two bones can be connected to each other by another type of connective tissue called the **ligament**. This tissue is very elastic. It has considerable strength. Ligaments contain very little matrix
f) **Tendons** connect muscles to bones and are another type of connective tissue. Tendons are fibrous tissue with great strength but limited flexibility.

Cartilage is a connective tissue, which has widely spaced cells. The solid matrix is composed of proteins and sugars. Cartilage smoothens

bone surfaces at joints and is also present in the nose, ear, trachea and larynx.

Q2) We can fold the cartilage of the ears, but we cannot bend the bones in our arms. Why?

This is because our ears have cartilage matrix that provides **flexibility** as it is made of sugar and proteins which means they can be bent whereas, the bone matrix does not allow any kind of flexibility as it is made of calcium and phosphorus compounds and hence, cannot be bent.

Areolar connective tissue

a) It is found between the skin and muscles, around blood vessels and nerves and in the bone marrow.
b) It fills the space inside the organs, supports internal organs
c) It helps in repair of tissues.

Adipose Tissue

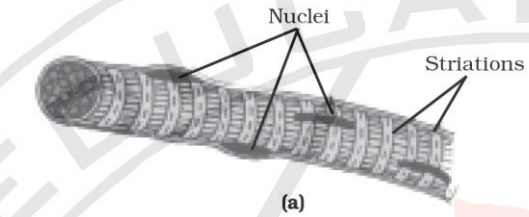
a) They are fat storing tissues
b) Adipose tissue is found below the skin and between internal organs.
c) The cells of this tissue are filled with fat globules.
d) Storage of fats also lets it act as an insulator.

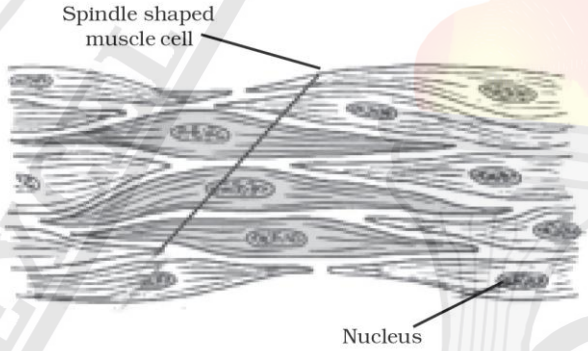
MUSCULAR TISSUE

a) They consists of elongated cells, also called muscle fibres. They are responsible for movement in our body.
b) Muscles contain special proteins called contractile proteins, which contract and relax to cause movement
c) I) We can move some muscles by conscious will. Muscles present in our limbs move when we want them to, and stop when we so decide. Such muscles are called **voluntary muscles**

II) They are also called SKELETAL MUSCLES as they are mostly attached to bones and help in body movement.

III) These Skeletal muscles show alternate light and dark bands or striations when stained appropriately and seen under a microscope. Hence they a re also called striated muscles.



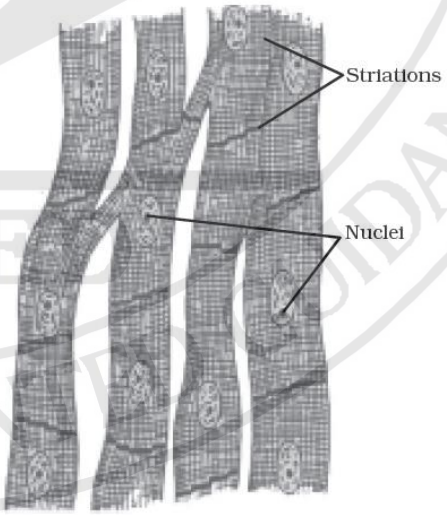


d) The cells of this tissue are long, cylindrical, unbranched and multinucleate (having many nuclei).

e) The movement of food in the alimentary canal or the contraction and relaxation of blood vessels are involuntary movements. We cannot really start them or stop them simply by wanting to do so! Smooth muscles or involuntary muscles control such movements.

f) They are also found in the iris of the eye, in ureters and in the bronchi of the lungs.

g) The cells are long with pointed ends (spindle-shaped) and uninucleate (having a single nucleus). They are also called Unstriated muscles



h) The muscles of the heart are known as cardiac muscles. These show rhythmic contraction and relaxation throughout life. They are involuntary muscles

i) Heart muscle cells are cylindrical, branched and uninucleate.

NERVOUS TISSUE

a) The cells of the nervous tissue are specialised for being stimulated and then transmitting the stimulus very rapidly from one place to another within the body.
b) These cells are called nerve cells or neurons
c) The brain, spinal cord and nerves are all composed of the nervous tissue.
d) A neuron consists of a cell body with a nucleus and cytoplasm, from which long thin hair-like parts arise.
e) The single long part is, called the axon, and the many short, branched parts called dendrites.
f) An individual nerve cell may be up to a metre long. Many nerve fibres bound together by connective

tissue make up a nerve.

The signal that passes along the nerve fibre is called a nerve impulse. Nerve impulses allow us to move our muscles when we want to. The functional combination of nerve and muscle tissue is fundamental to most animals. This combination enables animals to move rapidly in response to stimuli.

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Name the tissue responsible for movement in our body.

What does a neuron look like?

Give three features of cardiac muscles.

What are the functions of areolar tissue?