The Galaxy
Education System

Tissue and Tissue System

ICSE Biology

Grade 9

Contents

Tissue and Tissue system

Every organism, whether its body consists of a single cell (unicellular) or a mass of cells (multicellular), can perform all vital life activities. It can respire, feed, excrete and reproduce.

1. **Tissue:** In multicellular organisms, the increase in body size makes it difficult for each cell to efficiently cope with the vast physiological requirements of the organism. Therefore, the cells, although potentially capable of performing all essential activities are assigned special functions.

As cells grow, they acquire specific shapes and characteristics to enable them to perform definite functions i.e., the cells get differentiated.

Generally cells of the same shape and characteristics grow together and combine into a group for carrying out a common function. Each group of such cells give rise to 'a tissue'.

A tissue is defined as a group of cells of the same type or of the mixed type, having a common origin and performing an identical function.

2. **Tissue System**: Several tissues, which may be structurally similar or different, may collectively perform the same function. The grouping of specialised cells forms tissues and the division of labour resulting from the grouping of cells gives rise to the tissue system.

A tissue system can be defined as a collection of tissues of common origin performing the same general function.

Example: There are three systems recognised in the organisation of plant bodies:

a. The outermost layer of cells of any organ, root, stem or leaf is primarily protective in function. The "Epidermal Tissue System" makes up this layer.

b. The xylem and phloem tissues in plants (roots, stems or leaves) conduct or transport water or food from one part ' to another. These form the "Vascular Tissue System"

c. "The Ground or Fundamental Tissue System" forms the main bulk of the plant body and extends below the epidermis to the centre (excluding the vascular bundles). Its primary functions are manufacture and storage of food material. It also has a mechanical function.

Types of plant tissue

1. **Meristematic tissue**

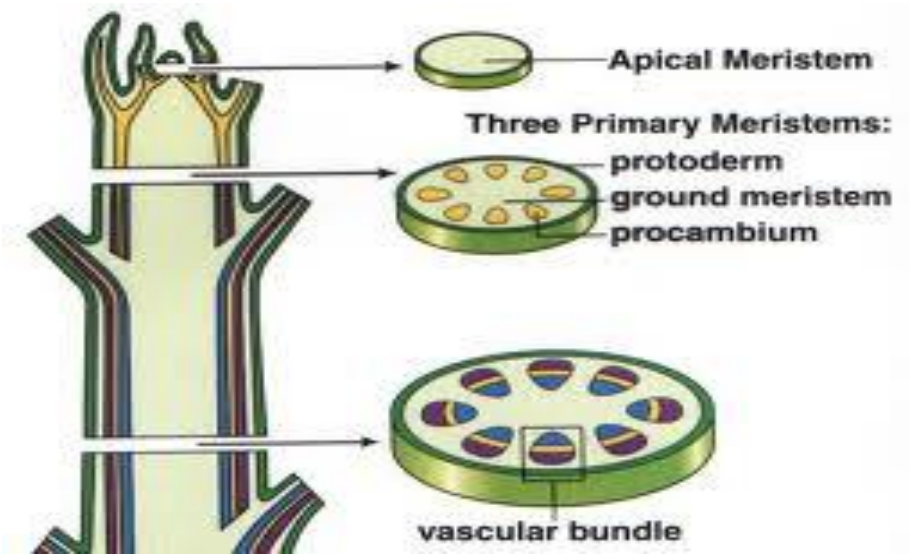
    a. **Apical Meristem**
    b. **Lateral Meristem**
    c. **Intercalary Meristem**

2. **Permanent tissue**

    a. **Simple tissue (Parenchyma , Collenchyma and Sclerenchyma)**
    b. **Complex tissue (Xylem and Phloem)**

Meristematic Tissues

Tissues where cells are constantly dividing are called meristems or meristematic tissues. These regions produce new cells. These new cells are generally small, six-sided boxlike structures with a number of tiny vacuoles and a large nucleus, by comparison. Sometimes there are no vacuoles at all. As the cells mature the vacuoles will grow to many different shapes and sizes, depending on the needs of the cell. It is possible that the vacuole may fill 95% or more of the cell's total volume.



Apical meristems are located at or near the tips of roots and shoots. As new cells form in the meristems, the roots and shoots will increase in length. This vertical growth is also known as primary growth. A good example would be the growth of a tree in height. Each apical meristem will produce embryo leaves and buds as well as three types of primary meristems: protoderm, ground meristems, and procambium. These primary meristems will produce the cells that will form the primary tissues.

Lateral meristems account for secondary growth in plants. Secondary growth is generally horizontal growth. A good example would be the growth of a tree trunk in girth. There are two types of lateral meristems to be aware of in the study of plants.

The vascular cambium, the first type of lateral meristem, is sometimes just called the cambium. The cambium is a thin, branching cylinder that, except for the tips where the apical meristems are located, runs the length of the roots and stems of most perennial plants and many herbaceous annuals. The cambium is responsible for the production of cells and tissues that increase the thickness, or girth, of the plant.

The cork cambium, the second type of lateral meristem, is much like the vascular cambium in that it is also a thin cylinder that runs the length of roots and stems. The difference is that it is only found in woody plants, as it will produce the outer bark.

Both the vascular cambium and the cork cambium, if present, will begin to produce cells and tissues only after the primary tissues produced by the apical meristems have begun to mature.

Intercalary meristems are found in grasses and related plants that do not have a vascular cambium or a cork cambium, as they do not increase in girth. These plants do have apical meristems and in areas of leaf attachment, called nodes, they have the third type of meristematic tissue. This meristem will also actively produce new cells and is responsible for increases in length. The intercalary meristem is responsible for the regrowth of cut grass.

There are other tissues in plants that do not actively produce new cells. These tissues are called nonmeristematic tissues. Nonmeristematic tissues are made of cells that are produced by the meristems and are formed to various shapes and sizes depending on their intended function in the plant. Sometimes the tissues are composed of the same type of cells throughout, or sometimes they are mixed. There are simple tissues and complex tissues to consider, but we will start with the simple tissues for the sake of discussion.

Simple Tissues

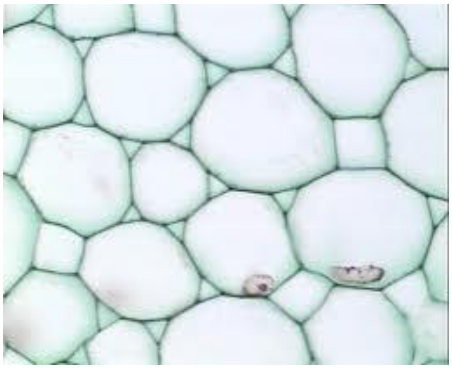
There are three basic types, named for the type of cell that makes up their composition.

Parenchyma cells form parenchyma tissue. Parenchyma cells are the most abundant of cell types and are found in almost all major parts of higher plants (we will discuss higher plants later in the tutorial). These cells are basically sphere shaped when they are first made. However, these cells have thin walls, which

flatten at the points of contact when many cells are packed together. Generally, they have many sides with the majority having 14 sides. These cells have large vacuoles and may contain various secretions including starch, oils, tannins, and crystals. Some parenchyma cells have many chloroplasts and form the tissues found in leaves.

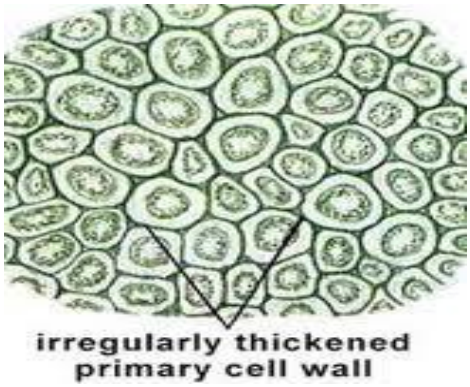
This type of tissue is called chlorenchyma. The chief function of this type of tissue is photosynthesis, while parenchyma tissues without chloroplasts are generally used for food or water storage. Additionally, some groups of cells are loosely packed together with connected air spaces, such as in water lilies, this tissue is called aerenchyma tissue. These type of cells can also develop irregular extensions of the inner wall which increases overall surface area of the plasma membrane and facilitates transferring of dissolved substances between adjacent cells.

Parenchyma cells can divide if they are mature, and this is vital in repairing damage to plant tissues. Parenchyma cells and tissues comprise most of the edible portions of fruit.



Parenchyma

Collenchyma cells form collenchyma tissue. These cells have a living protoplasm, like parenchyma cells, and may also stay alive for a long period of time. Their main distinguishing difference from parenchyma cells is the increased thickness of their walls. In cross section, the walls looks uneven. Collenchyma cells are found just beneath the epidermis and generally they are elongated and their walls are pliable in addition to being strong. As a plant grows these cells and the tissues they form, provide flexible support for organs such as leaves and flower parts. Good examples of collenchyma plant cells are the ‘strings’ from celery that get stuck in our teeth.

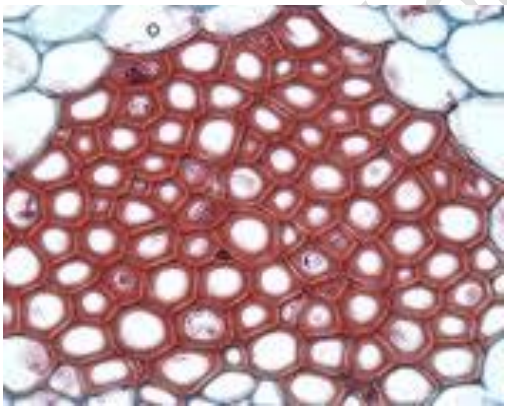


Collenchyma

Sclerenchyma cells form sclerenchyma tissue. These cells have thick, tough secondary walls that are imbedded with lignin. At maturity, most sclerenchyma cells are dead and function in structure and support. Sclerenchyma cells can occur in two forms:

1. **Sclereids** are sclerenchyma cells that are randomly distributed throughout other tissues. Sometimes they are grouped within other tissues in specific zones or regions. They are generally as long as they are wide. An example, would be the gritty texture in some types of pears. The grittiness is due to groups of sclereid cells. Sclereids are sometimes called stone cells.

2. **Fibers** are sometimes found in association with a wide variety of tissues in roots, stems, leaves and fruits. Usually fiber cells are much longer than they are wide and have a very tiny cavity in the center of the cell. Currently, fibers from over 40 different plant families are used in the manufacture of textiles, ropes, string and canvas goods to name a few.



Sclerenchyma

Secretory Cells and Tissues

As a result of cellular processes, substances that are left to accumulate within the cell can sometimes damage the protoplasm. Thus it is essential that these materials are either isolated from the protoplasm in which they originate, or be moved outside the plant body. Although most of these substances are waste products, some substances are vital to normal plant functions. Examples: oils in citrus, pine resin, latex, opium, nectar, perfumes and plant hormones. Generally, secretory cells are derived from parenchyma cells and may function on their own or as a tissue. They sometimes have great commercial value.

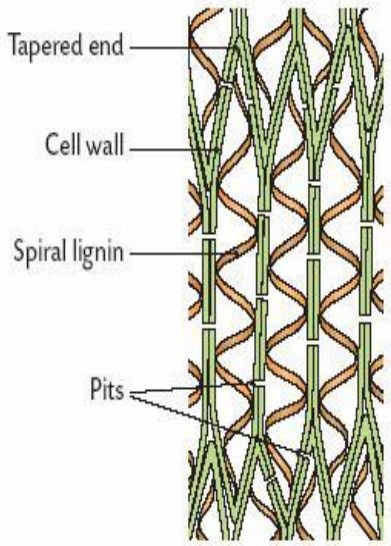
Complex Tissues

Tissues composed of more than one cell type are generically referred to as complex tissues**. Xylem** and **phloem** are the two most important complex tissues in a plant, as their primary functions include the transport of water, ions and soluble food substances throughout the plant. While some complex tissues are produced by apical meristems, most in woody plants are produced by the vascular cambium and is often referenced as vascular tissue. Other complex tissues include the epidermis and the periderm.

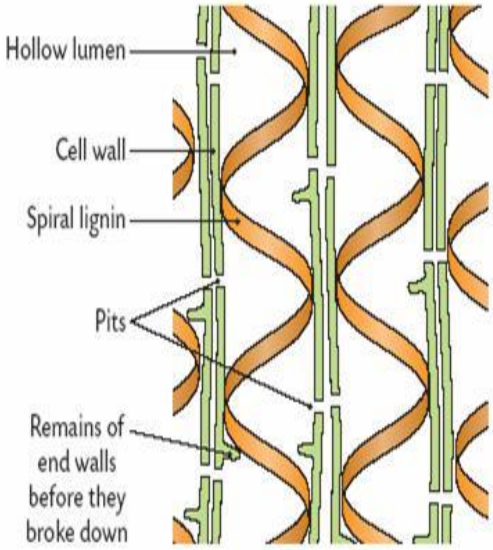
The epidermis consists primarily of parenchyma-like cells and forms a protective covering for all plant organs. The epidermis includes specialized cells that allow for the movement of water and gases in and out of the plant, secretory glands, various hairs, cells in which crystals are accumulated and isolated, and other cells that increase absorption in the roots. The periderm is mostly cork cells and therefore forms the outer bark of woody plants. It is considered to be a complex tissue because of the pockets of parenchyma cells scattered throughout.

Xylem

Xylem is an important plant tissue as it is part of the 'plumbing' of a plant. Think of bundles of pipes running along the main axis of stems and roots. It carries water and dissolved substances throughout and consists of a combination of parenchyma cells, fibers, vessels, tracheids and ray cells. Long tubes made up of individual cells are the vessels, while vessel members are open at each end. Internally, there may be bars of wall material extending across the open space. These cells are joined end to end to form long tubes. Vessel members and tracheids are dead at maturity.

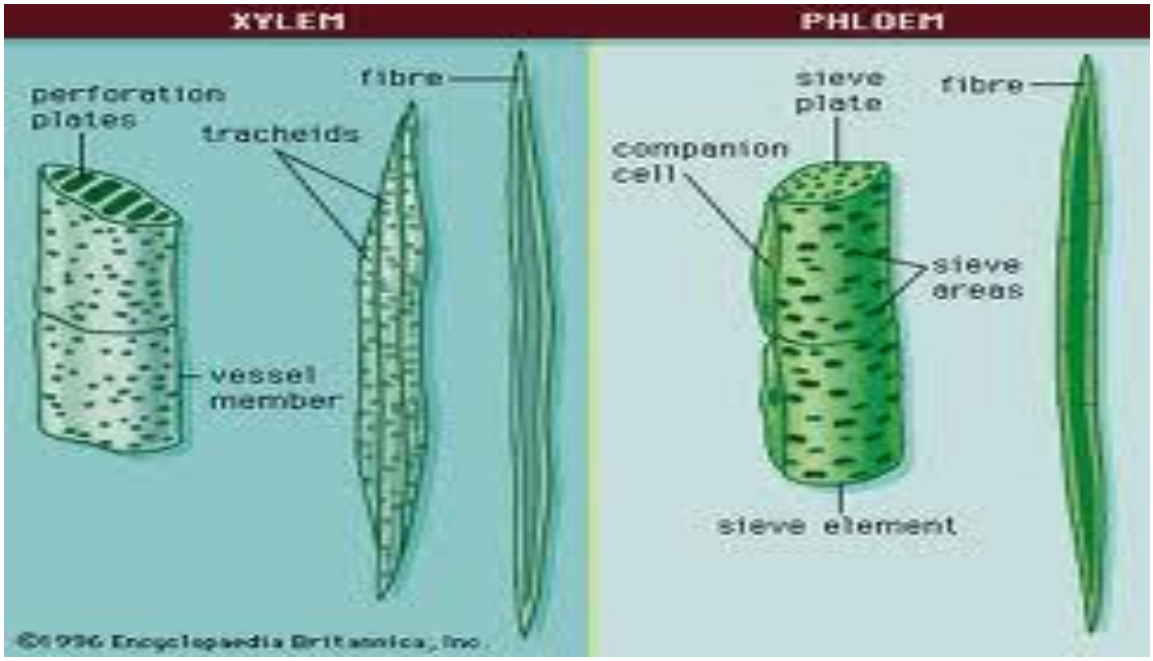


Tracheids



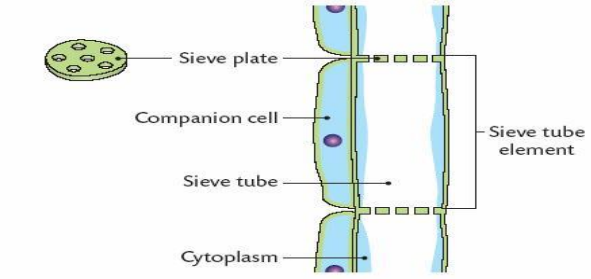
Vessels

Tracheids have thick secondary cell walls and are tapered at the ends. They do not have end openings such as the vessels. The tracheids ends overlap with each other, with pairs of pits present. The pit pairs allow water to pass from cell to cell. While most conduction in the xylem is up and down, there is some side-to-side or lateral conduction via rays. Rays are horizontal rows of long-living parenchyma cells that arise out of the vascular cambium. In trees, and other woody plants, ray will radiate out from the centre of stems and roots and in cross-section will look like the spokes of a wheel.



Phloem

Phloem is an equally important plant tissue as it also is part of the 'plumbing' of a plant. Primarily, phloem carries dissolved food substances throughout the plant. This conduction system is composed of sieve-tube member and companion cells, that are without secondary walls. The parent cells of the vascular cambium produce both xylem and phloem. This usually also includes fibers, parenchyma and ray cells. Sieve tubes are formed from sieve-tube members laid end to end. The end walls, unlike vessel members in xylem, do not have openings. The end walls, however, are full of small pores where cytoplasm extends from cell to cell. These porous connections are called sieve plates. In spite of the fact that their cytoplasm is actively involved in the conduction of food materials, sieve-tube members do not have nuclei at maturity. It is the companion cells that are nestled between sieve-tube members that function in some manner bringing about the conduction of food.



L.S. of Phloem

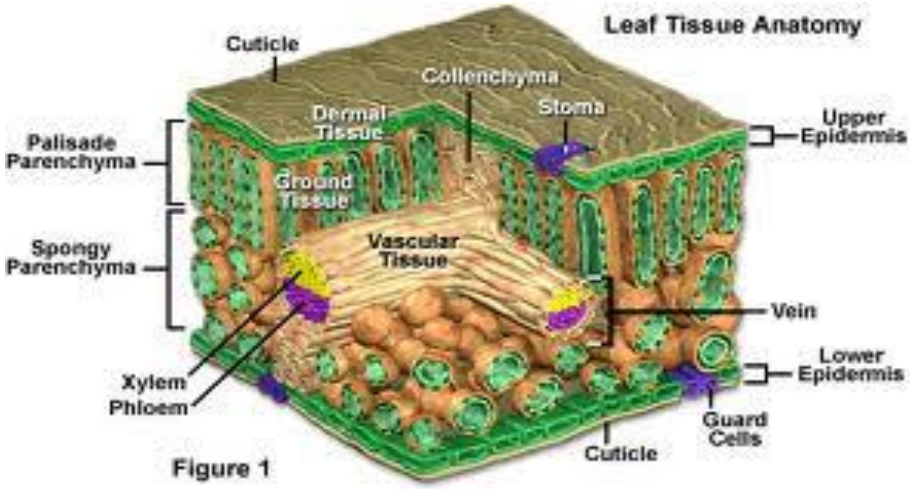
Sieve-tube members that are alive contain a polymer called callose. Callose stays in solution as long at the cell contents are under pressure. As a repair mechanism, if an insect injures a cell and the pressure drops, the callose will precipitate. However, the callose and a phloem protein will be moved through the nearest sieve plate where they will for a plug. This prevents further leakage of sieve tube contents and the injury is not necessarily fatal to overall plant turgor pressure.

Epidermis

The epidermis is also a complex plant tissue, and an interesting one at that. Officially, the epidermis is the outermost layer of cells on all plant organs (roots, stems, leaves). The epidermis is in direct contact with the environment and therefore is subject to environmental conditions and constraints. Generally, the epidermis is one cell layer thick, however there are exceptions such as tropical plants where the layer may be several cells thick and thus acts as a sponge. Cutin, a fatty substance secreted by most epidermal cells, forms a waxy protective layer called the cuticle.

The thickness of the cuticle is one of the main determiners of how much water is lost by evaporation. Additionally, at no extra charge, the cuticle provides some resistance to bacteria and other disease organisms. Some plants, such as the wax palm, produce enough cuticle to have commercial value: carnauba wax. Other wax products are used as polishes, candles and even phonographic records.

Epidermal cells are important for increasing absorptive surface area in root hairs. Root hairs are essentially tubular extensions of the main root body composed entirely of epidermal cells. Leaves are not left out. They have many small pores called stomata that are surrounded by pairs of specialized epidermal cells called guard cells. Guard cells are unique epidermal cells because they are of a different shape and contain chloroplasts. There are other modified epidermal cells that may be glands or hairs that repel insects or reduce water loss.



Section through a leaf showing epidermis

Cork cambium (pl. **cambia** or **cambiums**)

It is a tissue found in many vascular plants as part of the periderm. The cork cambium is a lateral meristem and is responsible for secondary growth that replaces the epidermis in roots and stems. It is found in woody and many herbaceous dicots, gymnosperms and some monocots, which usually lack secondary growth.

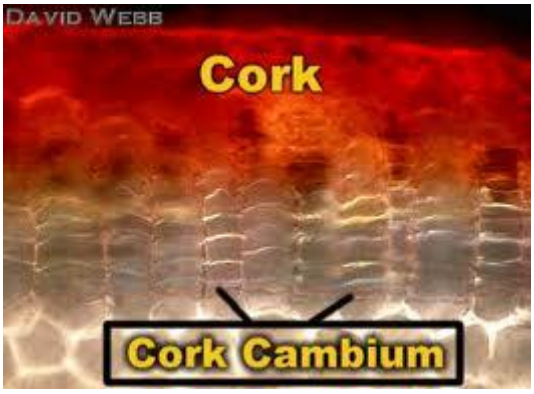
Cork cambium is one of the plant's meristems – the series of tissues consisting of embryonic (incompletely differentiated) cells from which the plant grows. It is one of the many layers of bark, between the cork and primary phloem. The function of cork cambium is to produce the cork, a tough protective material.

Synonyms for cork cambium are **bark cambium**, **pericambium** and **phellogen**. Phellogen is defined as the meristematic cell layer responsible for the development of the periderm. Cells that grow inwards from the phellogen are termed *phelloderm*, and cells that develop outwards are termed *phellem* or cork (note similarity with vascular cambium).

The periderm thus consists of three different layers:

- phelloderm – inside of cork cambium; composed of living parenchyma cells
- phellogen (cork cambium) – meristem that gives rise to periderm
- phellem (cork) – dead at maturity; air-filled protective tissue on the outside

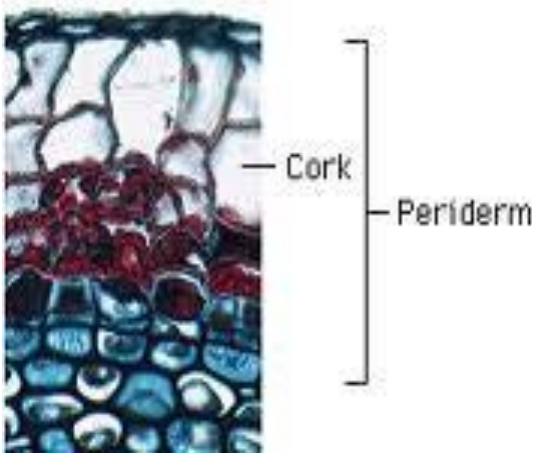
Growth and development of cork cambium is very variable between different species, and is also highly dependent on age, growth conditions, etc. as can be observed from the different surfaces of bark: smooth, fissured, scaly, flaking off, etc.

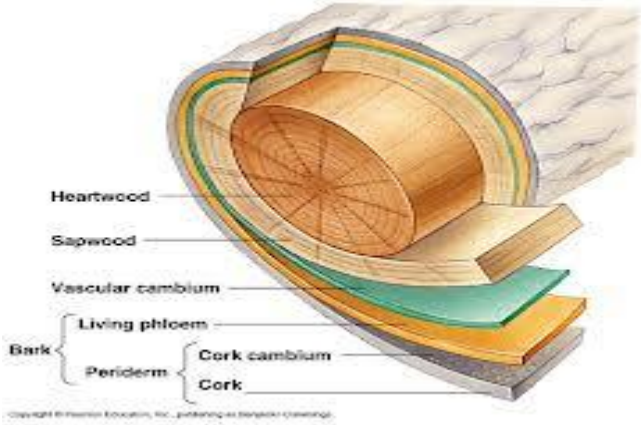


Ref http://www.biologie.uni-hamburg.de

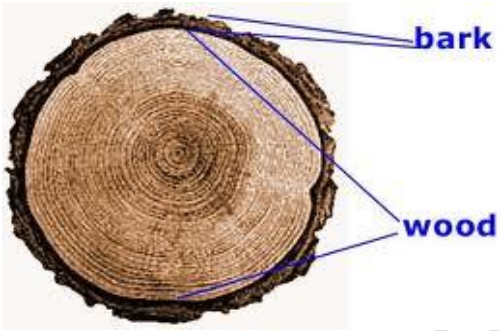
Periderm

In woody plants, when the cork cambium begins to produce new tissues to increase the girth of the stem or root the epidermis is sloughed off and replaced by a periderm. The periderm is made of semi-rectangular and boxlike cork cells. This will be the outermost layer of bark. These cells are dead at maturity. However, before the cells die, the protoplasm secretes a fatty substance called suberin into the cell walls. Suberin makes the cork cells waterproof and aids in protecting tissues beneath the bark. There are parts of the cork cambium that produce pockets of loosely packed cork cells. These cork cells do not have suberin imbedded in their cell walls. These loose areas are extended through the surface of the periderm and are called lenticels. Lenticels function in gas exchange between the air and the stem interior. At the bottom of the deep fissures in tree bark are the lenticels.





Bark



Bark is the outermost layers of stems and roots of woody plants. Plants with bark include trees, woody vines, and shrubs. Bark refers to all the tissues outside of the vascular cambium and is a nontechnical term. It overlays the wood and consists of the inner bark and the outer bark. The inner bark, which in older stems is living tissue, includes the innermost area of the periderm. The outer bark in older stems includes the dead tissue on the surface of the stems, along with parts of the innermost periderm and all the tissues on the outer side of the periderm. The outer bark on trees is also called the rhytidome.

Products used by people that are derived from bark include: spices and other flavorings, tanbark for tannin, resin, latex, medicines, poisons, various hallucinatory chemicals and cork. Bark has been used to make cloth, canoes, ropes and used as a surface for paintings and map making.

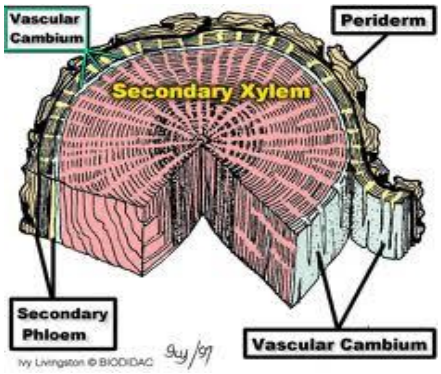
A number of plants are also grown for their attractive or interesting bark colorations and surface textures or their bark is used as landscape mulch.

From the outside to the inside of a mature woody stem, the layers include:

- (1) Cork (Phellem)
- (2) Cork cambium (Phellogen)
- (3) Phelloderm
- (4) Cortex
- (5) Phloem
- (6) Vascular cambium
- (7) Xylem.

The bark includes (1) through (5), and is composed of periderm and phloem and the cells that produce these tissues. The periderms include (1), (2) and (3).

In young stems, which lack what is commonly called bark, the tissues are from the outside to the inside: epidermis, periderm, cortex, primary phloem, secondary phloem, vascular cambium, secondary xylem, and primary xylem. As the stem ages and grows, changes occur that transform the surface of the stem into the bark. The epidermis, which is a layer of cells that cover the plant body, including the stems, leaves, flowers and fruits, that protects the plant from the outside world. In old stems the epidermal layer, cortex, and primary phloem become separated from the inner tissues by thicker formations of cork. Due to the thickening cork layer these cells die because they do not receive water and nutrients. This dead layer is the rough corky bark that forms around tree trunk and other stems.



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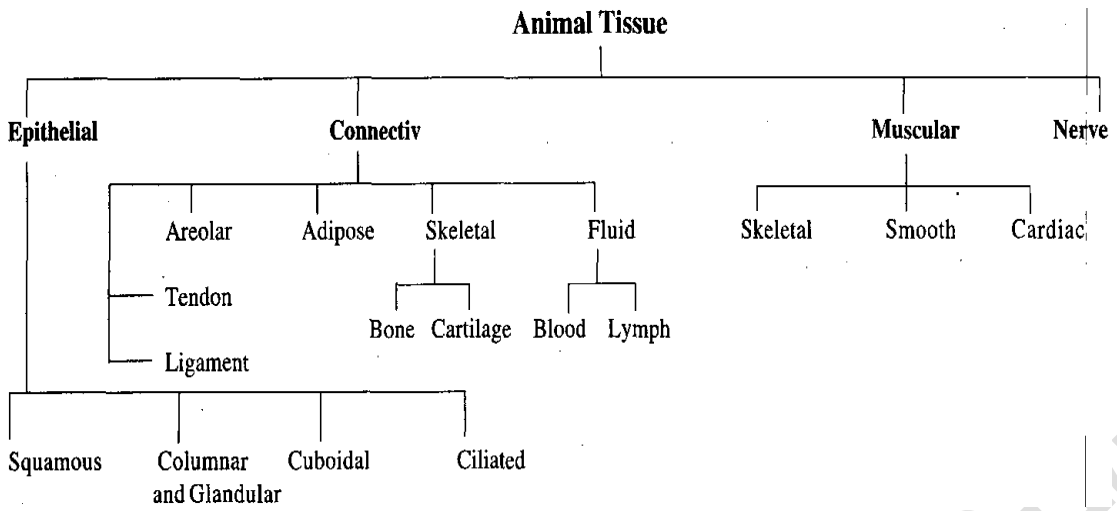
Animal Tissue

When we breathe we can actually feel the movement of our chest. How do these body parts move? For this we have specialised cells called muscle cells. The contraction and relaxation of these cells result in movement.

During breathing we inhale oxygen. Where does this oxygen go? It is absorbed in the lungs and then is transported to all the body cells through blood. Why would cells need oxygen? Blood flows and carries various substances from one part of the body to the other. For example, it carries oxygen and food to all cells. It also collects wastes from all parts of the body and carries them to the liver and kidney for disposal.

Blood and muscles are both examples of tissues found in our body. On the basis of the functions they perform we can think of different types of animal tissues, such as epithelial tissue, connective tissue, muscular tissue and nervous tissue. Blood is a type of connective tissue, and muscle forms muscular tissue.

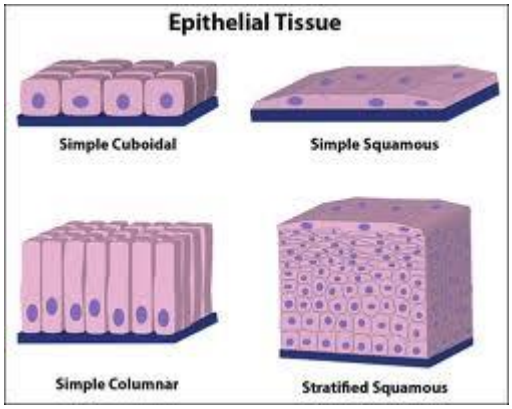


EPITHELIAL TISSUE

The covering or protective tissues in the animal body are epithelial tissues. Epithelium covers most organs and cavities within the body. It also forms a barrier to keep different body systems separate. The skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules are all made of epithelial tissue. 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. Obviously, 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. Regardless of the type, all epithelium is usually separated from the underlying tissue by an extracellular fibrous basement membrane.

Types of epithelial tissue

1. Squamous epithelial tissue
2. Cuboidal epithelial tissue
3. Columnar epithelial tissue
4. Ciliated epithelial tissue



Characteristics of epithelial tissue

1. The epithelial tissue is composed of one or more layers of cells which cover the external and internal body surface.

2. The cells lie closely connected with no intercellular spaces, on a thin gelatinous membrane and adhere to each other with considerable force.

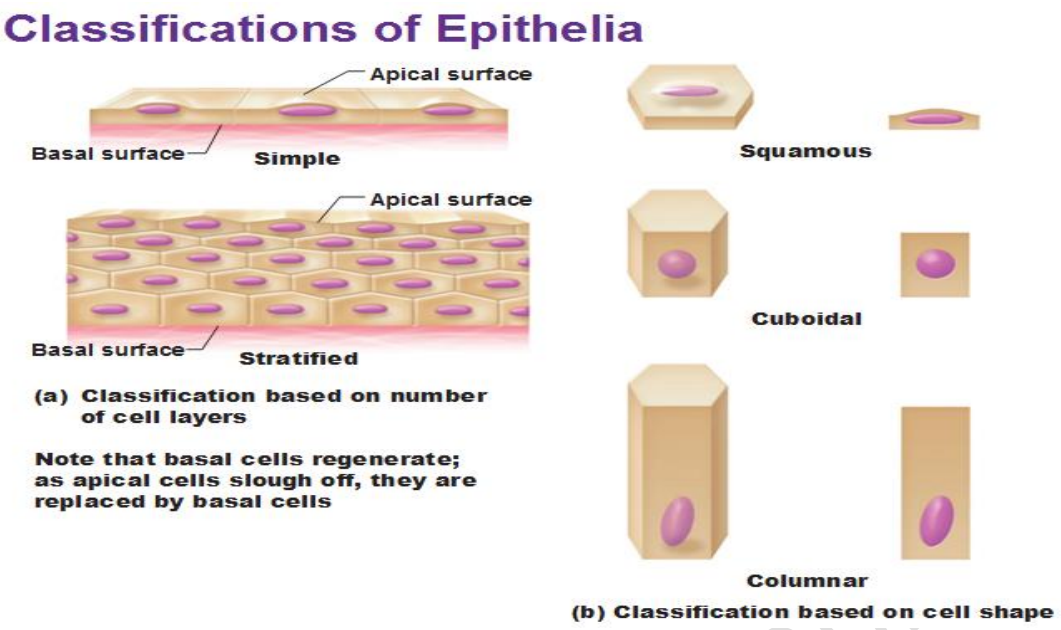
3. The free surface of the cells may be smooth or may have hair-like cytoplasmic extensions such as cilia or microvilli.

4. Epithelial tissue may be simple, i.e., composed of a single layer of cells, or stratified, i.e., made up of several layers.

5. Blood vessels are absent in epithelial tissues.

6. Epithelial tissue are concerned with the following function

a. Protection of underlying tissues from injury, microbes, desiccation.
b. Secretion of enzymes and hormones.
c. Sense perception by sensory cells lining sense organs.
d. Respiration (i.e., exchange of respiratory gases).
e. Absorption of digested food and removal of metabolic wastes.



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First name of tissue indicates number of cell layers

- Simple—one layer of cells
- Stratified—more than one layer of cells

Last name of tissue describes shape of cells

- Squamous—cells are wider than tall (plate-like) – "squashed"
- Cuboidal—cells are as wide as tall, like cubes
- Columnar—cells are taller than they are wide, like columns

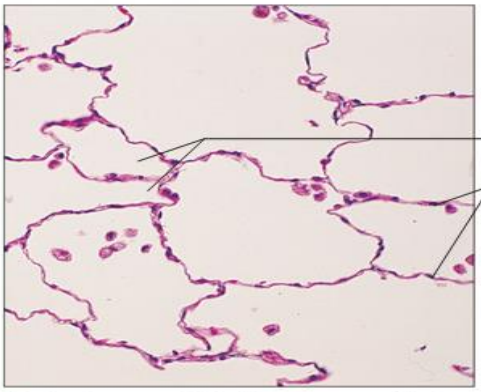
Simple Squamous Epithelium

(a) Simple squamous epithelium

Description: Single layer of flattened cells with disc-shaped central nuclei and sparse cytoplasm; the simplest of the epithelia.

Function: Allows passage of materials by diffusion and filtration in sites where protection is not important; secretes lubricating substances in serosae.

Location: Kidney glomeruli; air sacs of lungs; lining of heart, blood vessels, and lymphatic vessels; lining of ventral body cavity (serosae).

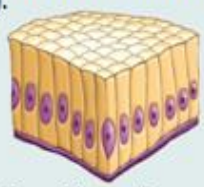


Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (200×).

Simple Columnar Epithelium

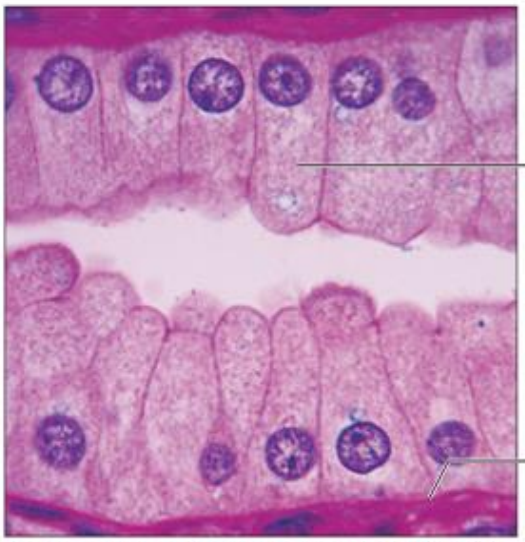
(c) Simple columnar epithelium

Description: Single layer of tall cells with round to oval nuclei; some cells bear cilia; layer may contain mucus-secreting unicellular glands (goblet cells).



Function: Absorption; secretion of mucus, enzymes, and other substances; ciliated type propels mucus (or reproductive cells) by ciliary action.

Location: Nonciliated type lines most of the digestive tract (stomach to anal canal), gallbladder, and excretory ducts of some glands; ciliated variety lines small bronchi, uterine tubes, and some regions of the uterus.



Photomicrograph: Simple columnar epithelium of the stomach mucosa (1150×).

Pseudostratified Ciliated Columnar Epithelium

(d) Pseudostratified columnar epithelium

Description: Single layer of cells of differing heights, some not reaching the free surface; nuclei seen at different levels; may contain mucus-secreting goblet cells and bear cilia.

Function: Secretion, particularly of mucus; propulsion of mucus by ciliary action.

Location: Nonciliated type in male's sperm-carrying ducts and ducts of large glands; ciliated variety lines the trachea, most of the upper respiratory tract.

Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (780×).

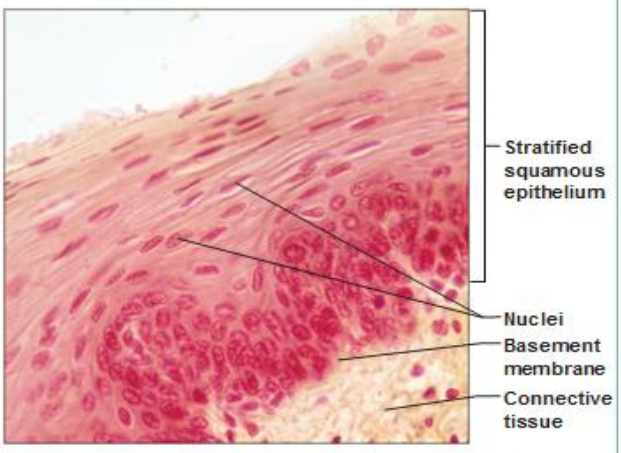
Stratified Squamous Epithelium

(e) Stratified squamous epithelium

Description: Thick membrane composed of several cell layers; basal cells are cuboidal or columnar and metabolically active; surface cells are flattened (squamous); in the keratinized type, the surface cells are full of keratin and dead; basal cells are active in mitosis and produce the cells of the more superficial layers.

Function: Protects underlying tissues in areas subjected to abrasion.

Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina, urethra and anus; keratinized variety forms the epidermis of the skin, a dry membrane.

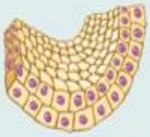


Photomicrograph: Stratified squamous epithelium lining the esophagus (430×).

Stratified *Cuboidal* Epithelium

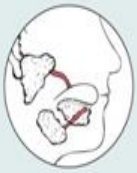
(f) Stratified cuboidal epithelium

Description: Generally two layers of cubelike cells.



Function: Protection

Location: Largest ducts of sweat glands, mammary glands, and salivary glands.

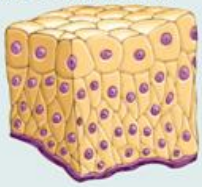


Photomicrograph: Stratified cuboidal epithelium forming a salivary gland duct (285×).

Transitional Epithelium

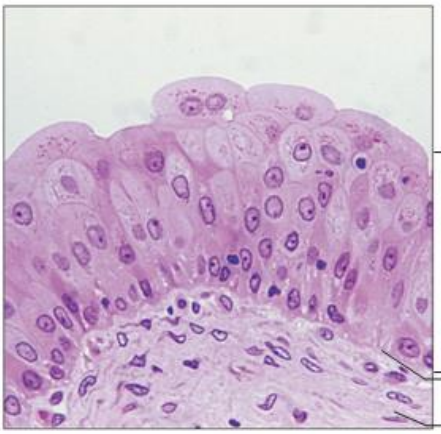
(h) Transitional epithelium

Description: Resembles both stratified squamous and stratified cuboidal; basal cells cuboidal or columnar; surface cells dome shaped or squamous-like, depending on degree of organ stretch.



Function: Stretches readily and permits distension of urinary organ by contained urine.

Location: Lines the ureters, bladder, and part of the urethra.



Photomicrograph: Transitional epithelium lining the bladder, relaxed state (390×); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Sincere thanks http://antranik.org for the images of epithelial tissue

Connective tissue

Connective tissue' is the term traditionally applied to a basic type of tissue of mesodermal origin which provides structural and metabolic support for other tissues and organs throughout the body, also known as "Supporting tissue".

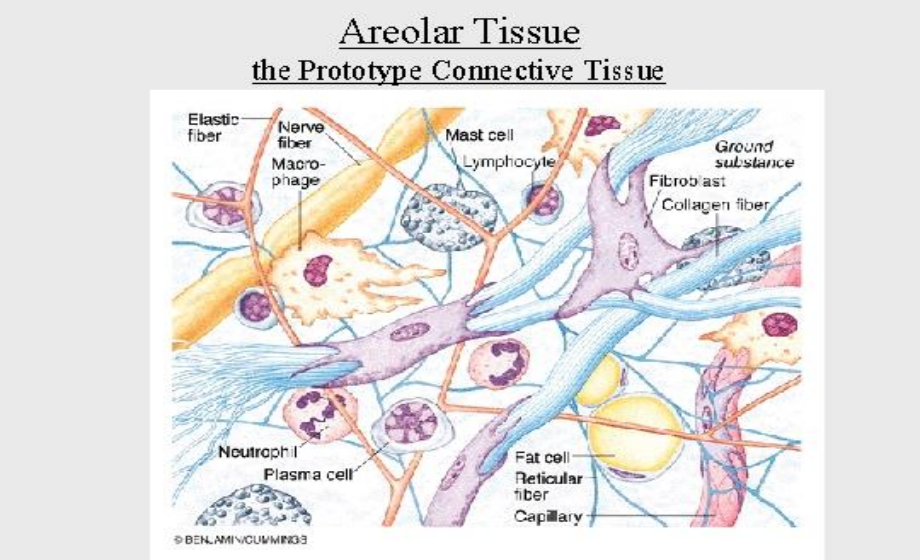
Functions

- Establishing a structural framework
- Supporting, surrounding and interconnecting tissues
- Transporting fluids and dissolved materials between cells & their blood supply
- Storing energy reserves
- Defending the body from microorganisms
- Protecting delicate organs

Connecting tissue is broadly classified in to

1) Connective tissue proper
2) Embryonic connective tissue

1. Areolar connective tissue



Characteristics:

1. The simplest and most widely distributed connective tissue.

2. It lies under the skin , fills space between adjacent tissues , connects various body organs and surrounds muscles bundles , blood vessels etc…

3. The matrix is jelly like and is formed of glycoprotein.

4. It contains four types of cells and two types of fibres.

5. Large stellate fibroblasts or fibrocytes that secrete fibres.

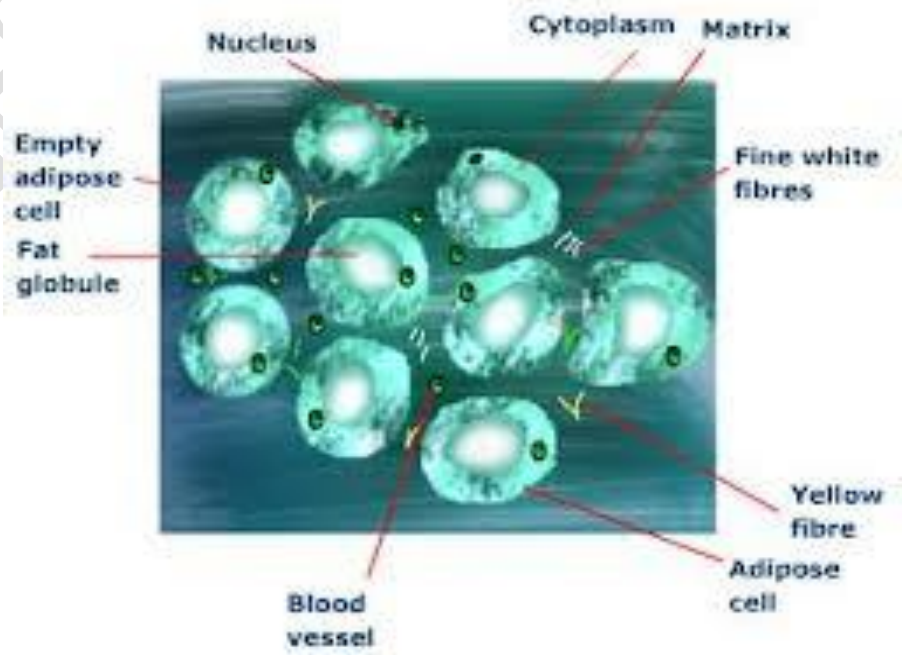
6. Large amoeboid histiocytes or macrophages move in the matrix and ingest foreign substances.

7. Irregular mast cells which secrete matrix and heparin.

8. Small lymphoid cells.

9. The fibres present in the matrix are unbranched , tough , white collagen fibres and branched elastic , yellow elastin fibres.

2. Adipose connective tissue



Characteristics

1. It is a fat storing connective tissue.
2. Its matrix is homogeneous and semifluid.
3. The fibres are only a few.
4. The cells are large and spherical and store large fat globules.
5. The adipose tissue is found in the deeper parts of the skin , bone marrow and around certain delicate organs**.**

Functions

1. Stores reserve food in the form of fat globules
2. Acts as the heat insulator and shock absorber

3. Skeletal connective tissue

Characteristics:

1. It is the supporting tissue. It forms endoskeleton of the body.

2. It gives definite shape to the body.

3. Protects delicate organs like brain, heart , lungs etc…

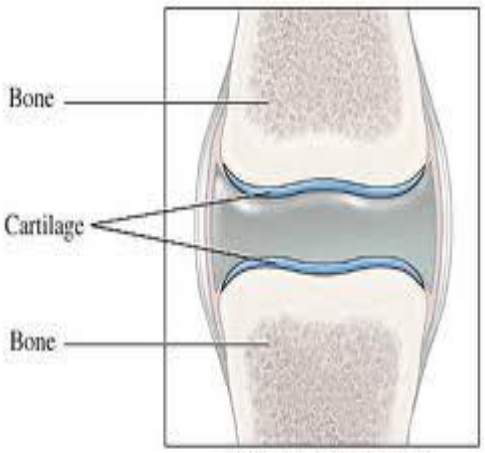
4. Helps in locomotion and other body movements .

5. It is of two types

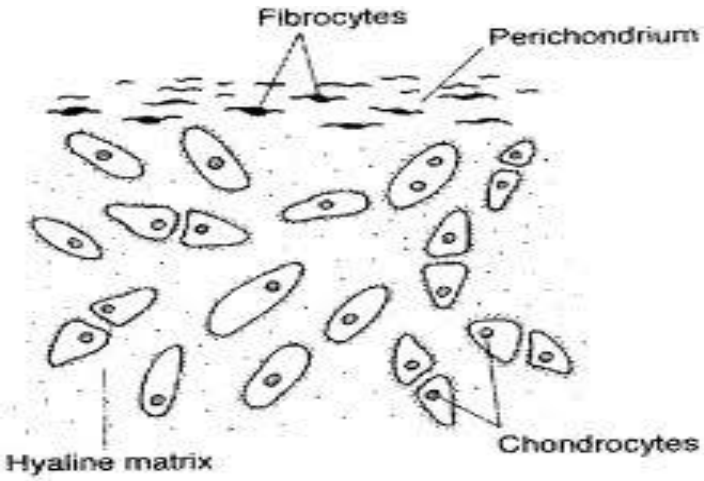
   a. Cartilage

   b. Bone

a. Cartilage



Cross section of a joint

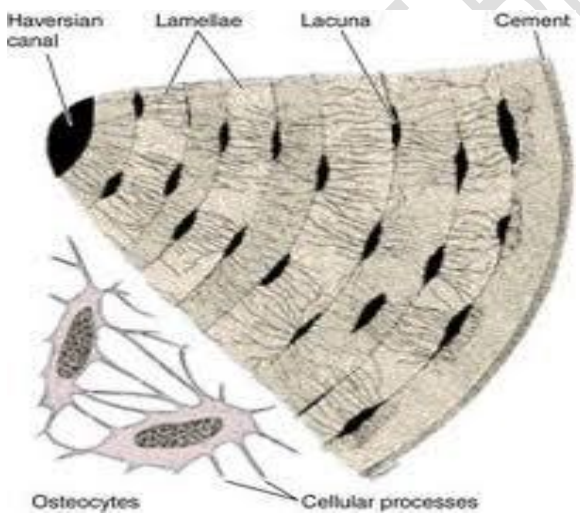


Hyaline cartilage

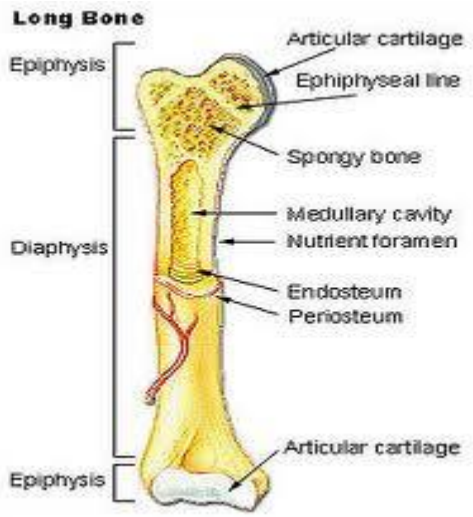
- It is relatively soft and flexible supporting tissue.
- Its matrix is dense with a special protein chondrin.
- Chondrin is secreted by the cartilage cells known as chondrioblasts.
- These cells occur in groups of two or four and are enclosed in fluid filled spaces called lacunae.
- The cartilage in enveloped with tough fibrous perichondrium**.**

b. Bone

- Bone is harder than cartilage.
- It forms endoskeleton in all land vertebrates and bony fish.
- The matrix is hard and brittle due to the presence of salts of calcium and magnesium (carbonates , phosphates and chlorides).
- These inorganic and mineral components constitute about 2/3 of the weight of bone.
- It is arranged in concentric rings called lamellae around the Haversian canals.
- The bone cells called osteocytes are enclosed in small spaces called lacunae.
- The lacunae are arranged in concentric rings on the lamellae.
- The bones are hollow and botht he surfaces of bone s are covered by tough membrane.
- The outer membrane is periosteum and inner membrane is endosteum.



Section through a bone



A typical bone

4. Fluid connective tissue

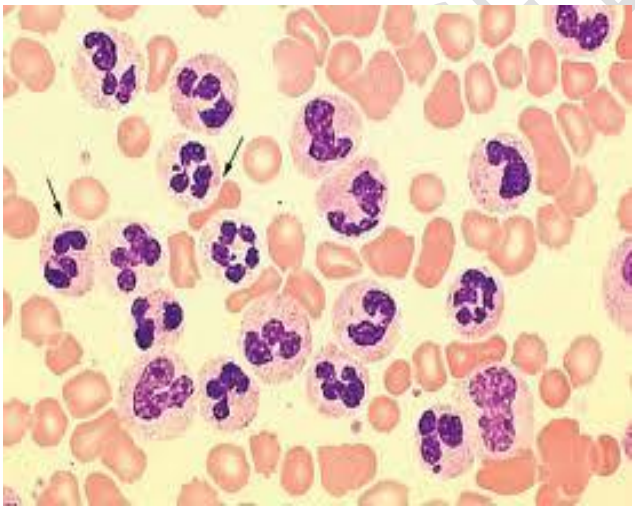
Blood and lymph are fluid connective tissues. These transport nutrients , oxygen , vitamins and hormones to the cells and remove nitrogenous wastes ,CO_2 and other products from the cells.

1. Blood :

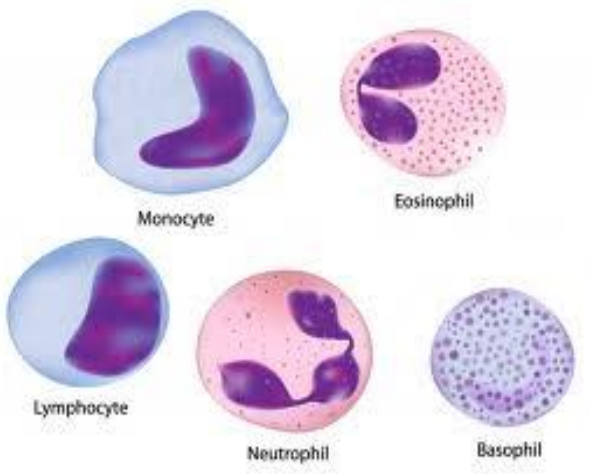
Blood is a specialized bodily fluid in animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells.

In vertebrates, it is composed of blood cells suspended in a liquid called blood plasma. Plasma, which constitutes 55% of blood fluid, is mostly water (92% by volume), and contains dissipated proteins, glucose, mineral ions, hormones, carbon dioxide (plasma being the main medium for excretory product transportation), and blood cells themselves. Albumin is the main protein in plasma, and it functions to regulate the colloidal osmotic pressure of blood. The blood cells are mainly red blood cells (also called RBCs or erythrocytes) and white blood cells, including leukocytes and platelets. The most abundant cells in vertebrate blood are red blood cells.

These contain hemoglobin, an iron-containing protein, which facilitates transportation of oxygen by reversibly binding to this respiratory gas and greatly increasing its solubility in blood. In contrast, carbon dioxide is almost entirely transported extracellularly dissolved in plasma as bicarbonate ion



Blood smear



Types of leucocytes

Lymph

Lymph is a clear to yellowish watery fluid that is found throughout the body. It circulates through body tissues picking up fats, bacteria, and other unwanted materials, and filtering them out through the lymphatic system. It is sometimes possible to see this fluid; cuts sometimes weep it rather than blood, for example. Its circulation through the body is an important part of immune system health.

This fluid contains white blood cells, known as lymphocytes, along with a small concentration of red blood cells and proteins. It circulates freely through the body, bathing cells in needed nutrients and oxygen while it collects harmful materials for disposal. People can think of it as the milkman of the body, dropping off fresh supplies and picking up discarded bottles for processing elsewhere.

As lymph circulates, it is pulled into the lymphatic system, an extensive network of vessels and capillaries that is linked to lymph nodes, small nodules that act as filters to trap unwanted substances. The nodes also produce more white blood cells, refreshing the fluid before it is pumped back into the body. The fluid may not be as showy as blood, but it is related to an equally complex and ornate system of vessels.

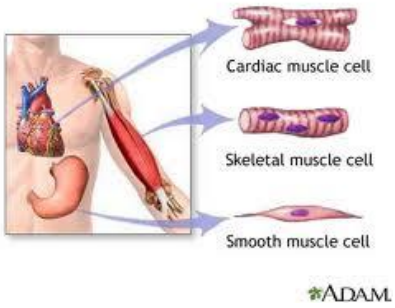
Lymph…

- ✓ Straw coloured fluid similar to blood in composition but devoid of red blood cells, platelets and proteins.
- ✓ Circulates in lymph vessels
- ✓ Transports nutrients into the heart.
- ✓ Forms defensive mechanism of the body

3. Muscular tissue

Muscular tissue consists of elongated cells, also called muscle fibres. This tissue is responsible for movement in our body.

Muscles contain special proteins called contractile proteins, which contract and relax to cause movement.



Smooth muscles

- ✓ Involuntary muscles
- ✓ Non striated
- ✓ Uni nucleated
- ✓ Spindle shaped fibres
- ✓ Nucleus in the centre
- ✓ Occur in sheets in the walls of hollow viscera like stomach , intestine , blood vessels…
- ✓ Not under control of our will

Skeletal muscles

- ✓ Voluntary muscles
- ✓ Striated
- ✓ Multi nucleated
- ✓ Unbranched fibres
- ✓ Shows alternate light and dark stripes and fibres are enclosed in a thin memebrane known as sarcolemma
- ✓ Provide force for locomotion and other voluntary movements of the body
- ✓ Can get tired and need rest.

Cardiac Muscles

- ✓ Striated
- ✓ Uni nucleated
- ✓ Branched fibres
- ✓ Show characteristics of both smooth and skeletal muscles
- ✓ Each fibre is surrounded by sarcolemma and has cytoplasm with myofibrils
- ✓ Contract rapidly but rhythmically and involuntarily
- ✓ Do not tire

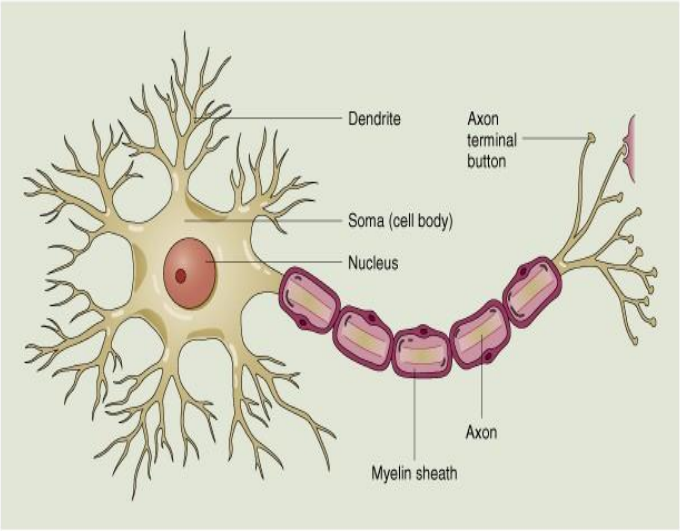
- ✓ The contraction and relaxation help to pump the blood and distribute it into the various parts of the body

4. Nervous tissue

All cells possess the ability to respond to stimuli. However, cells of the nervous tissue are highly specialised for being stimulated and then transmitting the stimulus very rapidly from one place to another within the body. The brain, spinal cord and nerves are all composed of the nervous tissue. The cells of this tissue are called nerve cells or neurons.

A neuron consists of a cell body with a nucleus and cytoplasm, from which long thin hair-like parts arise. Usually each neuron has a single long part, called the axon, and many short, branched parts called dendrites. An individual nerve cell may be up to a metre long. Many nerve fibres bound together by connective tissue make up a nerve.

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.



Neuron

WHAT YOU HAVE LEARNT ?

- *Tissue is a group of cells similar in structure and function.*
- *Plant tissues are of two main types – meristematic and permanent.*
- *Meristematic tissue is the dividing tissue present in the growing regions of the plant.*
- *Permanent tissues are derived from meristematic tissue once they lose the ability to divide. They are classified as simple and complex tissues.*
- *Parenchyma, collenchyma and sclerenchyma are three types of simple tissues. Xylem and phloem are types of complex tissues.*
- *Animal tissues can be epithelial, connective, muscular and nervous tissue.*
- *Depending on shape and function, epithelial tissue is classified as squamous, cuboidal, columnar, ciliated and glandular.*
- *The different types of connective tissues in our body include areolar tissue, adipose tissue, bone, tendon, ligament, cartilage and blood.*
- *Striated, unstriated and cardiac are three types of muscle tissues.*
- *Nervous tissue is made of neurons that receive and conduct impulses.*