

→ **Tissue**: A group of cells that are similar or dissimilar in structure but similar in origin which work together to perform a particular function is called a tissue.

→ Blood, Phloem, muscles

→ Importance of Tissue:

- (1) Tissue organise to form organs and organs organise to form organ system.
- (2) Division of labour in multicellular organisms.
- (3) Work load of individual cells is decreased.

Tissue .

Plant tissue

Animal tissue

Meristematic tissue

Permanent tissue.

Primary M.T.

- Apical Meristem
(tip of root & stem)
- Intercalary.
(Base of leaves & internodes)

Secondary M.T.

- ↓
- Lateral M.T.
- Vascular cambium
(secondary growth)
- Cork cambium

Simple tissue

- [Ground tissue]
- Made up of one type of cell]

Complex permanent

- [Vascular tissue]

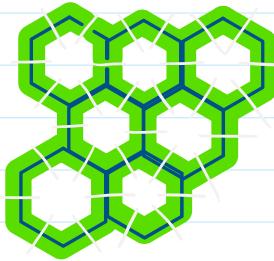
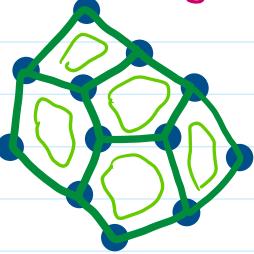
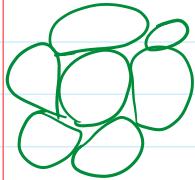
- Made up of more than one type of cell]



(1) Parenchyma (2) Collenchyma (3) Sclerenchyma

- | | | |
|-------------------|-------------|-------------|
| - oval, elongated | - Elongated | - long |
| - Polygonal | - Thickened | - Narrow |
| - Living tissue | - irregular | - lignified |
| - Intracellular | - Living | - Dead |

- + living tissue
- irregular
- intracellular
- living.
- lignified
- dead



- (4) Aerenchyma
(5) Chionenchyma

xylem

[conduction of water & minerals]

- tracheids
- vessels
- xylem parenchyma
- xylem fibres

Phloem

[conduction of food]

- sieve tubes
- companion cells
- phloem fibres
- phloem parenchyma

Animal tissue.

Epithelial

- squamous
- simple
- stratified
- cuboidal
- columnar
- glandular
- ciliated
- cuboidal
- columnar

Connective

- connective
 - cartilage
 - hyaline c.
 - yellow elastic
 - white fibrous
 - loose c.t.
 - areolar
 - adipose
 - dense c.t.
 - tendons
 - ligaments

skeletal

Bone

Fluid conn.

- blood
- lymph.
- RBCs
- WBCs
- platelets

Muscular Nervous

- striated
 - (striped, skeletal or voluntary)
- smooth
 - (unstriated, visceral, involuntary)
- cardiac
 - (involuntary & faintly striated)

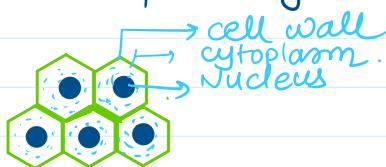


MERI STEM Growing tissue.
Divided \rightarrow stem / tissue

- \rightarrow It divide continuously.
- \rightarrow Increase the length & girth. of plant.

\Rightarrow characteristic of meristematic tissue :-

- (1) It is similar in structure & have thin cellulose cell walls.
- (2) Each cell contains dense & abundant cytoplasm with large nucleus. / few or no vacuoles
- (3) Tissue contains undifferentiated cells
- (4) Shape:- spherical, oval, polygonal or rectangular.
- (5) compactly arranged, no any intracellular cells b/w them.
- (6) metabolically active
- (7) cells grow & divide repeatedly.



\Rightarrow Types of meristematic tissue:-

\Rightarrow On the basis of origin

Primary meristem (Promeristem)

- \rightarrow Derived from the meristem of embryo
- \rightarrow They consist of cells derived from primary meristem
- \rightarrow They add to primary growth of plants.

Secondary meristem.

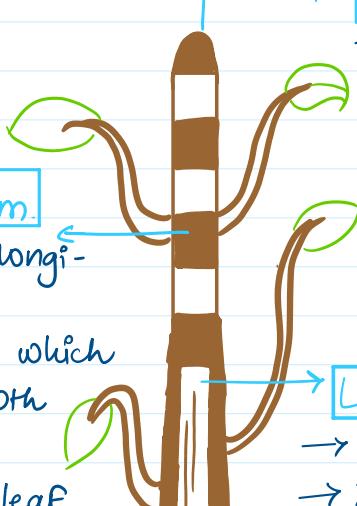
- \rightarrow cells derived from primary tissue.
- \rightarrow usually add to the diameter of plants.

Apical Meristem.

- present at growing tips of stem & root
- cell division \rightarrow elongation of stem & root, \rightarrow primary growth of plant

Intercalary meristem.

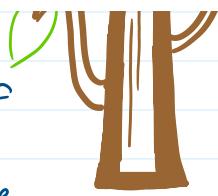
- \rightarrow Behind apex \rightarrow help in longitudinal growth.
- \rightarrow part of apical meristem which left behind during growth period.
- \rightarrow present at the base of leaf



Lateral Meristem (Cambium)

- \rightarrow It is called secondary meristem.
- \rightarrow It occurs along the side of

- period.
- present at the base of leaf & internode region.
- These lead to the increase in the length of leaf (primary).
- Ex :- Grass, bamboo stem. etc.



- It is called secondary meristem.
- It occurs along the side of longitudinal axis of the plant
- Gives rise to the vascular tissue.
- Causes growth in girth of stem & root.
- Responsible for secondary growth by increasing the girth.

- When meristematic tissue lost their ability to divide and get differentiated.
- They have definite shape, size and thickness. The permanent tissue may be dead or living.
- Developing tissues changes from simple to more complex forms to perform various specialized functions.

Depending upon the structure & composition the permanent tissue is classified into two types:

Simple permanent

Protective t.

1. Epidermis
2. cork/phellem

supportive t.

1. Parenchyma
 - Idioblast
 - Chlorenchyma
 - Aerenchyma
2. Collenchyma
3. Sclerenchyma
 - It's cell
 - Sclereids.
 - Fibres.

Complex permanent.

xylem

- (1) Tracheids
 - (2) Vessels
 - (3) Xylem
- Parenchyma
- (4) Xylem
- sclerenchyma
(fibres)

Phloem

- (1) sieve tubes
 - (2) companion cell
 - (3) Phloem
- Parenchyma
- (4) Phloem
- sclerenchyma
(fibres)

SIMPLE PERMANENT

→ **Supportive tissue:-**

	Parenchyma	Collenchyma	Sclerenchyma
1. Cell shape.	Oval, spherical or polygonal	Circular, oval or polygonal, elongated	Variable in shape
2. Cell wall	Thin cellulosic, pectin cell wall	Uneven thickening on their cell wall.	Fibres & sclereids.
3. Cytoplasm	Abundant	Cellulose & pectin present	Lignified secondary cell wall.
4. Nucleus	Present (living)	Present (living)	Absent
5. Vacuoles	Large vacuole	Vacuolated	Absent (dead)
6. Intercellular space	Food & water store	Absent	Absent
7. Occurrence	- Packaging tissue - all soft part of	- Dicot stem, petiole & beneath the	Absent, Dense. - Dicot hypodermis, bundle sheath,

7. Occurrence	- Packaging tissue - all soft part of plant pith, cortex, medullary rays.	- Dicot stem, petiole & beneath the epidermis, Absent in monocot	- Dicot hypodermis, Bundle sheath, pericycle, seed, pulp of fruits.
8. Functions	Food storage, Photosynthesis, [Chlorenchyma] Provide buoyancy to hydrophytes. [Aerenchyma]	provide tensile strength, mechanical strength (support), photosynthesis.	protection from stress & strain, mechanical strength.

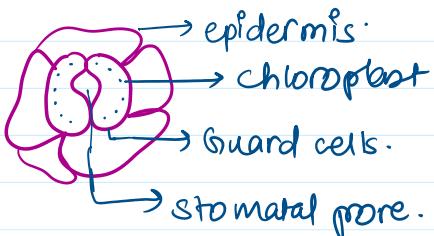
→ Protective tissue:-

Epidermis.

- Epidermis forms outermost layer of various body organs of plants such as leaves, flowers, stems & roots
 - Covered by cuticle layer which is water proof and layered by waxy substance called cutin which is secreted by the epidermal cells.
 - Provide protection against loss of water & also invasion by microbes.
- epidermis of leaves are not continuous at some places due to small pores called stomata.
- stomata helps in gaseous exchange during photosynthesis, respiration and also helps in transpiration.

Cork or phellem

- In older roots & stems, tissues at the periphery become cork cells or phellem cell.
 - cork is made up of dead cells thick cell wall, no intracellular space.
 - Cell wall in cork deposit waxy substance called as suberin.
 - The cells of cork become impermeable to water & gases due to the deposition of suberin.
 - Cork cells are without any protoplasm but are filled with resins or tannins.
- cork is protective in function. cork cells prevent desiccation, infection & mechanical injury.
→ commercially valuable.



⇒ Complex tissue consist of more than one type of cells and it transport water, mineral and food material to various parts of the plant body. Xylem and phloem are complex conductive tissue also known as **Vascular tissues**. → **Vascular Bundle**.

Xylem (Wood)

- Vascular & Mechanical tissue.

- Composed of 4 types of tissue:-

- (1) Tracheids (Dead)
- (2) vessels (Dead)
- (3) xylem parenchyma (Alive)
- (4) xylem sclerenchyma / Fibres (Dead)

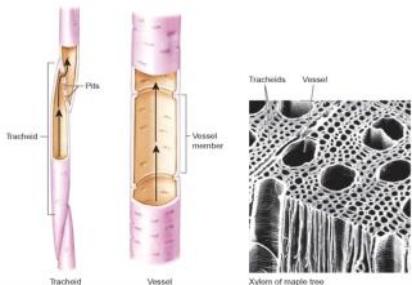
⇒ All Dead tissues are **Lignified**.

Tracheids

- elongated, dead cells with hard lignified walls
- empty lumen & tapering (spindle) ends.
- Conduct water & do not have open ends like the vessels.
- The water passes from one cell to another via pits.

Vessels

- Vessels are shorter and wider than tracheids. The vessel cells gradually become thick and lignified to provide mechanical support to the plant body.
- They arrange themselves in a row placed one upon the other, forming long tube like structures for long distance transport.



Xylem parenchyma

- It is the only **living element** in the xylem tissue.
- It stores food & helps in **lateral (sideways) conduction** of water.

Brown Cohesive

(inner bark) Phloem (Bast)

- Vascular tissue but it doesn't play major role in providing mechanical strength

- Composed of 5 types of tissue:-

- (1) sieve cells . } (Alive).
- (2) sieve tubes . }
- (3) companion cells . }
- (4) phloem parenchyma . }
- (5) phloem sclerenchyma / fibres (dead)

Sieve cells

- less specialized and primitive type of sieve elements.
- occur in phloem of non-flowering plants.
- They are elongated cells with steep inclined end walls.

Sieve tubes

- slender, tube like structure which is composed of elongated, thin walled cells called sieve tube elements.
- These cells are placed end to end and their end walls are generally bulged out and perforated by numerous pores.
- This area is collectively known as **sieve plate**.

Companion cells

- They lie on the sides of the sieve tubes, which is small, thin walled living cells containing a large elongated nucleus & dense cytoplasm.

Phloem parenchyma

- Living cells which store food, resins, latex etc. The cells help in slow conduction of food, especially to the sides.

Ohionum sclerenchyma / Fibres

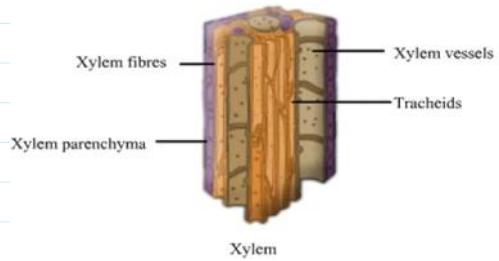
(sideways) conduction of water.

Xylem fibres

- Supportive in function & provide mechanical strength. Do not conduct water.

FUNCTIONS:-

- Upward conduction of water & minerals
- Roots → Diff. parts of shoot
- Unidirectional
- Walls of tracheids, vessels & fibres of xylem are lignified. which provide mechanical strength to the plant body.
- Xylem parenchyma helps to store food & sideways conduction of water.



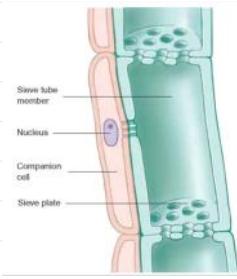
the sides.

Phloem sclerenchyma/fibres

→ Dead sclerenchymatous fibres which provide mechanical strength.

FUNCTIONS:-

- Materials can move in both direction (Upwards & Downwards)
- phloem transports photosynthetically prepared food materials from the leaves to the storage organs & later from storage organs to the growing regions of the plant body.
- Some plants are commercial fibres
Ex:- jute, hemp, flax.



○ Epithelial Tissue ○

- set very close to each other, tightly packed and the tissue rests on a non-cellular basement membrane & consists of single layer of cells.
- It covers all organs & line the cavities of hollow organs.
- Protective in function.

(A) Squamous epithelium:-

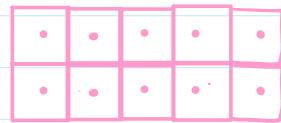
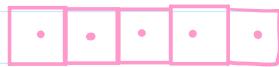
- Pavement epithelium
- cells arranged end to end like tiles.
- Polygonal in surface view.
- When it arranged in many layers (stratum) to prevent wear & tear in skin. This pattern is stratified squamous epithelium.



- Ex:- Delicate lining of cavities (mouth, oesophagus, nose, pericardium, Alveoli. etc.
- Blood vessels & covering of the tongue & skin.

(b) Cuboidal epithelium:-

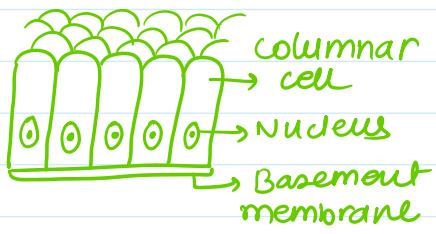
- cube like cells that fits closely, looks square in section but free surface appears hexagonal.
- Function :- Absorption, excretion and secretion
- Provides mechanical support.



- Ex:- Kidney tubules, thyroid vesicles and in glands (salivary gland & sweat gland).
- Forms the germinal epithelium of gonads (testes & ovaries)

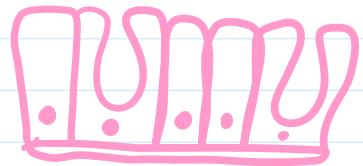
(c) Columnar epithelium :-

- pillar like epithelium.
- forming mucous membrane & increases absorption efficiency in small intestine.
- Goblet cell.
- Ex:- Lining of stomach, colon, border of microvilli in small intestine.
- Gall bladder & oviduct.



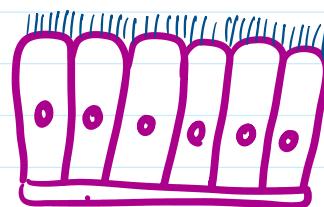
(4) Glandular epithelium :-

- Portion of the columnar epithelium folds inward to form a multicellular gland.
- Function:- secretion
Ex:- Gastric glands, intestinal glands, Pancreatic glands



(5) Ciliated epithelium:-

- Cuboidal or columnar cells have cilia ,
- Cilia can move & transport the material which comes in contact with them.
Ex:- Respiratory tract (push the mucus forward to clear it).



- Nephron.
- Inner surface of some hollow organs such as trachea, small bronchi & oviducts. (Fallopian tubes)

⇒ Summary of functions of epithelial Tissues:-

- protects the body from drying up, disease causing microbes, chemicals & injuries. (Ex:- surface epithelium & lining of mouth, nasal tract & alimentary canal).
- Absorption of water & nutrients (Ex:- Intestinal mucosa).
- Lining of uriniferous tubules takes part in ultrafiltration, secretion & reabsorption to produce urine.
- Secretory function. Ex:- glandular epithelium
- Aids in healing & injuries due to its high regeneration activity.
- Outer epithelium produces exoskeletal structures like nails, claws, scales, feathers etc.

CONNECTIVE TISSUE

→ A specialised tissue which connects various body tissues or organs.

- Bone to bone / Muscle to bone/ Binds tissues.
- Supports various parts by forming packing around the organs. to prevent them to get displaced by the body movements
- Main Functions - Binding, Supporting & Packing.

→ Main functions - Binding, Supporting & Packing.

General structure :- Very less in number and loosely packed.
- Cells are embedded in homogeneous matrix.
jelly like, fluid, dense or rigid.

[1] Loose connective tissue :-

Matrix - Carbohydrates, proteins & three types of protein fibres.

White collagen Yellow elastin Reticular

→ It has more matrix & less fibres.

→ Two types of loose connective tissue :-

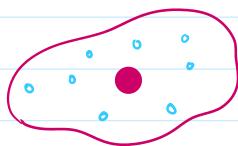
Areolar connective tissue

- Along with some components with matrix, it also have various type of cells are present in areolar connective tissue :-

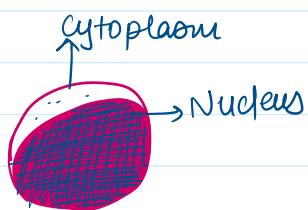
(1) Fibroblast (secrete fibres & matrix).



(2) Mast cells (secrete matrix, anticoagulant heparin, histamine (vasodilator) and serotonin (vasoconstrictor))



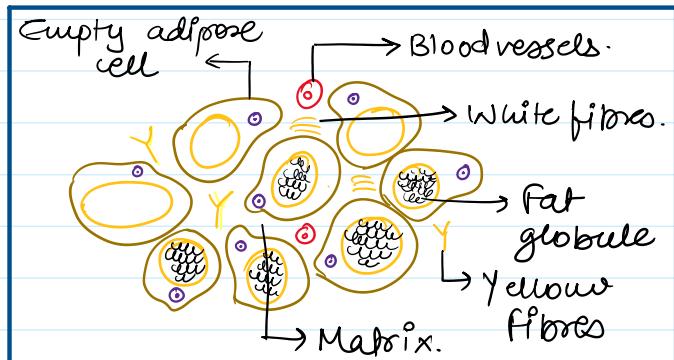
(3) Plasma cells (antibody producing lymphocytes)



(4) Macrophages (Ingest cell debris, microbes) macrophages of the areolar connective tissue are also called histiocytes.

Adipose connective tissue.

- It is a collection of various spherical or oval fat cells or adipocytes.



⇒ Occurrence:- Adipose tissue is abundant below the skin (subcutaneous region), between the internal organs and inside yellow bone marrow.

- Provides cushion around to the eyes, heart, kidneys and blood vessels.

→ It serves as a fat reservoir

→ Act as insulator

→ Reduces the heat loss from the body

→ Regulates the body temperature.

areolar connective tissue are also called **histiocytes**:



(5) Adipose or fat cells (stores fat molecules in fat globules)

- fibroblast secrete the fibres, are the principal cells of the areolar connective tissue.
- Collagenous or white fibres are made up of a protein called **Collagen**. (long, wavy, unbranched fibres & are seen in bundles)
- Reticular fibres form a fine branching network made up of a protein called **reticulin**.
- elastic or yellow fibres are long, straight, branched & made up of a protein called **elastin**.

→ Occurrence:- found between the skin and the muscles, around the blood vessels, Nerves & in the bone marrow.

- fills the space inside the organs, supports internal organs & helps in repair of the tissue.
- Also known as packing tissue.
- Similar to the **parenchyma of plants**.
- provides strength, elasticity & support to the parts where this tissue is present.

[2]. Dense Connective tissue:-

Fibrous connective tissue with more fibres and less matrix. Orientation of the fibres show

[2]. Dense Connective tissue :- Fibrous connective tissue with more fibres and less matrix. Orientation of the fibres show a regular pattern in these tissues, that is why these are called dense regular connective tissue.

Tendons.

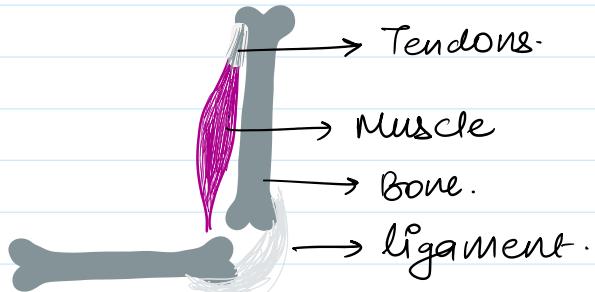
- strong, inelastic, white fibrous tissues that join skeletal muscles to bones. They have great strength but its flexibility is limited.

→ Muscle to bone

Ligaments.

- This elastic structures which connect one bone to another bone.
- A ligament is highly elastic & has considerable strength but contains very little matrix.

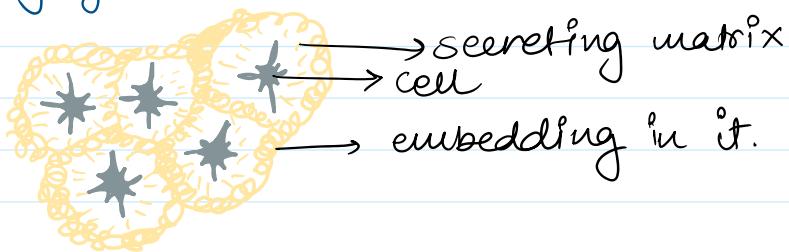
→ Bone to bone



(3) Skeletal tissue :-

It contains the special resident cells called chondroblast and osteoblast. They secrete matrix.

- Initially the tissue cells are superficial then after secreting matrix, they get embedded in the same.

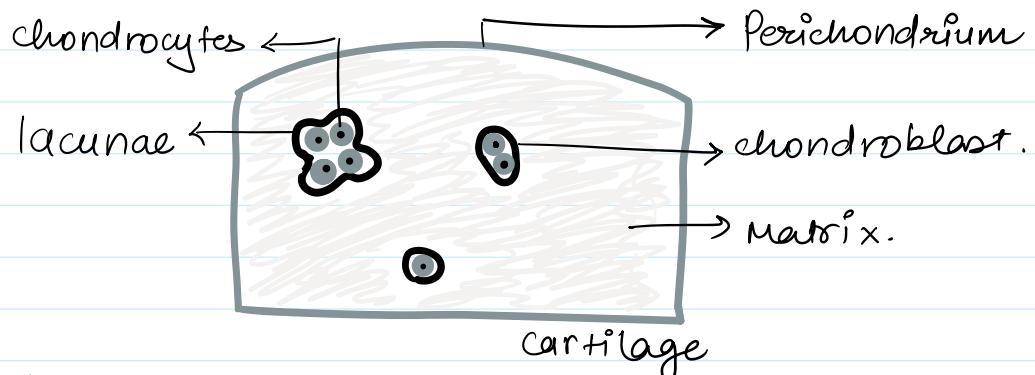


- This form the endoskeleton of the vertebrate body. which provides support and protection to the body.

(A) Cartilage :- soft, firm, flexible and compact connective tissue.

- In which 1-4 living cartilaginous cells called **chondrocytes** are present in fluid filled spaces **lacunae**, within the matrix (water, proteins, carbohydrates, collagen fibres and calcium salts.) produced by chondrocytes.
- It forms the soft endoskeleton of the body.

- It forms the soft endoskeleton of the body.



→ Types of cartilage :-

- 1) Hyaline cartilage :- larynx, tracheal rings, Nasal septum, covers articular surface of long bones. [slightly elastic].
- 2) Yellow elastic cartilage :- tip of nose and ear pinna [More flexible].
- 3) White fibrous cartilage :- Present in the intervertebral disc (act as a cushion) and in the pubic symphysis.

→ Functions :-

- Provides support and flexibility
- Prevents frictional wear and tear of the bone tips by forming articular surfaces Ex:- Hyaline cartilage.

(B) Bone :- Very strong, solid, rigid, highly vascular, mineralised and non flexible connective tissue.

- Bone cell (Osteocytes) are embedded in a hard matrix that is made up of ossein protein & inorganic mineral salts (phosphate & CaCO_3 , magnesium)
- Matrix of the bone is in the form of thin concentric layers called lamellae. which are laid down around narrow channels called Haversian canals. that run parallel to the length of the bone.

→ Haversian system :- It is the structural unit of the mammalian long bone. which contains blood vessels, Nerve fibres and some bone cells.

- These are interconnected by transverse channels called Volkmann's canals.
- The individual spaces in which osteocytes are present are called lacunae
- One osteocyte is present in one lacuna, which leads into fine canalicular network.

- One osteocyte is present in one lacuna, which leads into fine radiating channels, called **canaliculari**
- ↓
- With this they get in contact with other osteocyte.

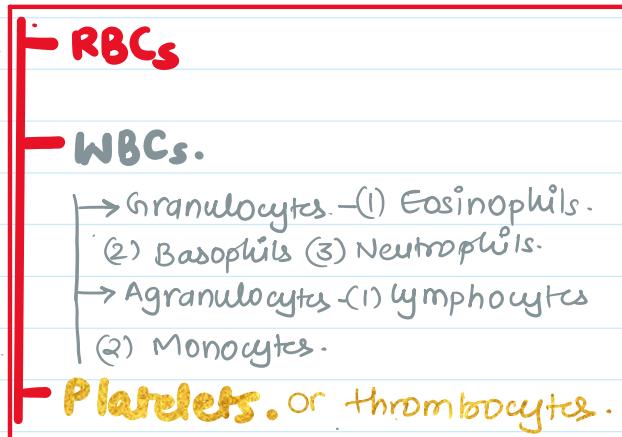
⇒ Functions:-

- (1) Bones form the endoskeleton of human & vertebrates except, shark
- (2) It form the frame work of the body.
- (3) Provide shape of the body.
- (4) Protects vital organs of body such as brain, lungs, heart, kidneys etc.
- (5) They serve as storage sites of calcium, phosphorus & other minerals.
- (6) Bones provide surface for attachment to many muscles.
- (7) It form various types of joints which take part in body movements including locomotion -

(4) Fluid or Vascular Connective Tissue.

Plasma + Blood cells = Blood.

- slightly alkaline, non-living, intercellular pale yellow component of blood
- 90-92% water.
- protein, glucose, cholesterol, urea, hormones, vitamins & inorganic salts.
- It transports food, CO_2 , & N_2 waste in dissolved form.



⇒ What is blood ? pH is **7.4**

⇒ fluid connective tissue.

⇒ two main components → Plasma and blood cell/corpuscles.

⇒ **Plasma** :- slightly alkaline, non-living, intercellular pale yellow

- 90-92% of plasma is of water.
- Several organic & inorganic substances are dissolved in it.

- Several organic & inorganic substances are dissolved in it.

Blood corpuscles.

Erythrocytes
or

RBCs

(Transport of Respiratory gases)

Leucocytes
or

WBCs (protects

from diseases)

Thrombocytes.
Or

Platelets.

(Help in blood clotting)

Agranulocytes.

(No any granules in nucleus)

Lymphocytes
provide
immunity

Monocytes.

(Phagocytosis) (Associated with allergy)

Eosinophils

(Release chem. for inflammation)

Basophils.

Neutrophils.

Granulocytes.

(Granules in nucleus).

→ Functions of Blood

(1) helps in transport of food & respiratory gases.
hormones, excretory matter and salts.

(2) helps in maintaining temperature (Thermoregulation).

(3) helps in defence against infection.

MUSCULAR TISSUE

- Muscular tissue forms the **contractile tissue** of the body which made up of elongated muscle cells hence it is known as **muscle fibres**.
- The muscle cells contain special proteins, **actin and myosin**, known as contractile proteins. which contract & relax to bring about movement.
- On the basis of location it is divided into 3 types:-

(1) **Skeletal muscles**

(Striated / striped / voluntary muscles)

(2) **Smooth muscles**

(Unstriated / visceral / involuntary) muscles.

(3) **Cardiac muscles**

(Faintly striated / involuntary) muscles.

(1) Striated muscles :- **Structure :-**

- entire muscle has alternate dark & light stripes, thus it is known as **striated muscle**.
- They are mostly attached to bones and therefore it is called as **skeletal muscle**.
- These muscles are responsible for voluntary action thus, called as **voluntary muscle**. as they work according to our conscious will.

How it looks :- Striated muscle fibres are long or elongated, non tapering, cylindrical and unbranched.

- Multinucleated.

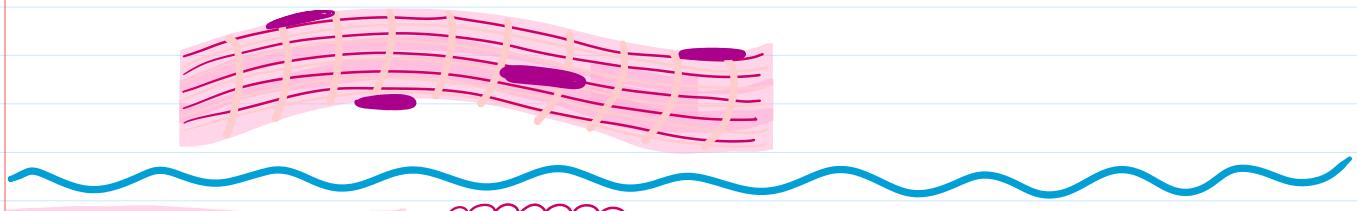
Occurrence :- at limbs, body wall, tongue, pharynx and beginning of oesophagus.

- Muscle undergo rapid and powerful contractions, so can get tired or fatigued and need rest to recover.

Functions :-

- This muscles attached to bones to form lever systems for body movements.
- Responsible mainly for voluntary movements of the body like swallowing of food, breathing, blinking of eyes.





(2) Smooth muscles:- Structure

- It occurs as bundles or sheets of spindle shaped cells.
- There is a single central nucleus (uninucleated).
- Cells do not bear any bands, strips, striations across the muscle, that's why these muscles are known as **smooth** or **Unstriated muscles**. Do not work according to our will, so they are also known as **Involuntary muscles**.
- ⇒ This muscle fibres are capable of prolonged activity as well as sustained contraction without getting fatigued.
- So, these muscles contract and relax slowly.

Occurrence:- Found in the walls of hollow visceral organs except heart & visceral muscles.

- Occurs in alimentary canal, internal organs, urinogenital tract and blood vessels.
- Also found in the bronchi and iris of eye.
- Smooth muscles are not attached to the skeleton.

Functions:- (1) Movement of alimentary canal, or constriction and dilation of blood vessels are involuntary movements.

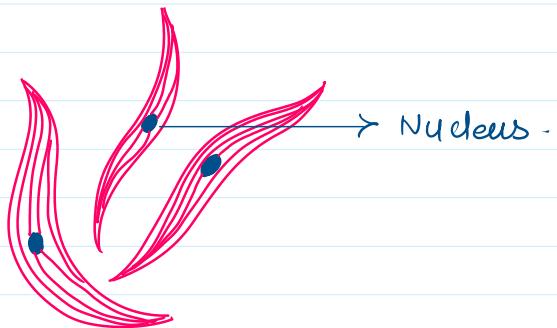
- Work as per the body's requirements.

(2) Involuntary muscles of iris and ciliary body of the eye bring about an automatic adjustment of light entering the eye and focussing of object based on distance.

(3) peristaltic movements which include rhythmic progressive waves of muscular contraction and relaxation.

- Occur in gastrointestinal tract.

(4) Emptying of an organ like urinary bladder occurs due to high contractility of its smooth muscles.





(3) Cardiac Muscles:- Structure:

- present in the walls of the heart.
 - cardiac muscle fibres which join end to end to form a network.
 - Each fibre or cell uninucleated with a centrally located nucleus.
- These muscle fibres contract and relax rhythmically (continuously) and never get fatigued.

Occurrence:-

They show features of both striped and unstriped muscles.

- Cardiac muscles resemble striated muscles in bearing striae and unstriped muscles.

Nervous system

→ Nervous system consists of highly specialized cells Neurons.

Neurons form a network → conduct information via electrical impulse. It controls voluntary activities & regulates involuntary activities.

Terms of Nervous system

Stimulus Response Receptor Impulse Effector.

→ Nerve cell formed from neuroblast. It is the longest cell.

