

## TISSUE (French word, Tissue = Woven / Texture)

It is a group of cells which are similar in origin, structure and function.

→ The term tissue was proposed by Bichat.

Study of tissue is called Histology.

→ The term histology was given by Mayer.

→ The father and founder of branch histology is known as Marcello Malpighi.

→ Similar types of tissue organised into organ like heart, liver, lungs, stomach etc.

→ Different types of organs combined and form a system like digestive system, respiratory system, excretory system, nervous system etc.

## TYPES OF TISSUE

On the basis of function, tissue is divided into 4 types

1. Epithelial Tissue
2. Connective Tissue
3. Muscular Tissue
4. Neural / Nervous Tissue

# 1. EPITHELIAL TISSUE

- It is Ectodermal, Mesodermal & Endodermal in origin
- It forms outer covering and inner lining for some part.
- Cells are compactly packed with little amount of matrix.
- Cells are arranged on basement membrane.
- Three types of Junctions are present called Tight Junction, Adhering Junction and Gap Junction

## TYPES OF EPITHELIAL TISSUE

It is of two types

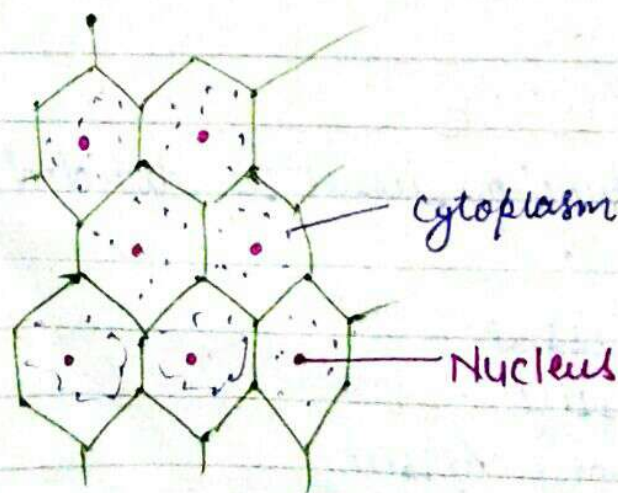
- (i) Simple Epithelium
- (ii) Compound Epithelium

### (i) Simple Epithelium

- Cells are arranged in one layer

It is of following types

#### (1) Simple Squamous



- Cells are minimum in height
- Cells are flat with flat nucleus
- Cells are closely fitted like tiles on a floor so also called Pavement cells
- Ex:- ① Lining of blood vessel called Endothelium
- ② Lining of alveoli of lungs.
- ③ Covering of lungs called Pleura.
- ④ Lining of Bowman's capsule of kidney.

## (2) Simple Cuboidal.



- Cells are cube shaped are normal in height.
- ex:- ① Lining of PCT (Proximal Convulated Tubules) of nephron of kidney.
- ② Lining of thyroid follicles.
- ③ Lining of seminiferous tubules of testis and ovary.

## (3) Simple Columnar

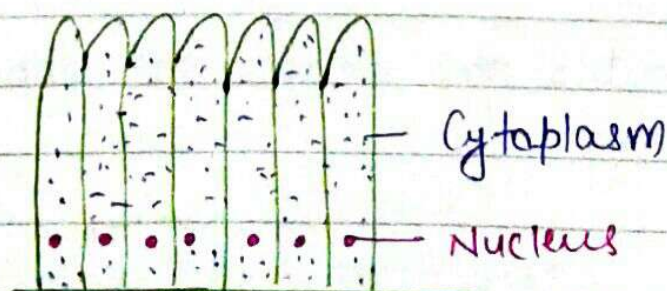


Fig: Simple Columnar

→ Cells are maximum in height or pillar like.

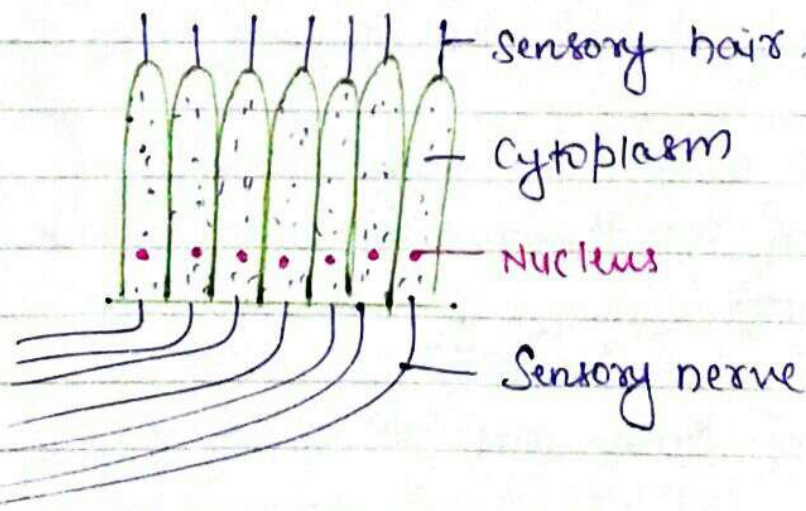
→ Nucleus is present at the base

Ex: - Lining of alimentary Canal from Stomach to intestine (upper surface, contains many hairs like structure called microvilli looking like brush border in small intestine)

## Modification of Simple Columnar

① ~~Simple Epith~~

① Sensory Epithelium



• Sensory hair present at the tip and base is connected with sensory nerve.

• It receives the stimulus and conduct the ampulse upto brain through nerves

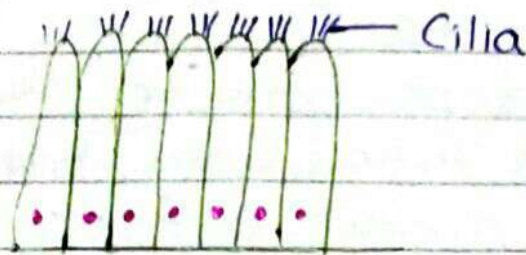
ex: ① Retina of Eye

② 'Organ of Corti' of internal ear.

③ Taste buds of Tongue.

④ Olfacto epithelium (Schneideria membrane) of nasal chamber

## ② Ciliary Epithelium



- Cilia present at the upper surface
- Ex: - ① Lining of respiratory tract (Larynx, Trachea, Bronchus, Bronchioles).
- ② Lining of fallopian tubes / oviducts

## ③ Glandular Epithelium

- These epithelium secrete sometimes secretion and modified into glands.

### Types of Glands

(A) On the basis of kind of secretion and duct, Glands are of two types

#### 1. Exocrine Gland.

Secretion is transported by definite duct so also called Duct with Gland

Ex: Salivary gland, sweat gland, Sebaceous gland

## 2. Endocrine Gland

→ It is also called Ductless Gland.

→ Its secretion is called hormone

Ex:- Pituitary Gland, Thyroid Gland, Parathyroid Gland, Adrenal Gland, Thymus Gland etc.

## \* Heterocrine / Mix Gland

It contains exocrine part and endocrine part

Ex:- Pancreas.

B. On the Basis of No. of cells glands are of two types

### 1. Unicellular Gland.

Gland consist of single cell

Ex:- Mucous Gland

### 2. Multicellular Gland

Gland consists of many cells.

Ex:-

It is of two types

① Simple Gland:- secretory unit consists of single duct

It is of five types.

(i) Simple Straight Tubular :-

Secretory unit is straight tube like.

Ex: - ① Crypts of Lieber Kuhn (Intestinal Gland).

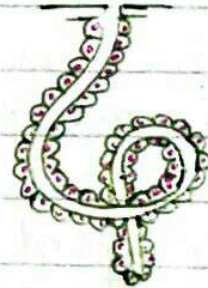
② Nuptial gland in copulatory pad of frog.



(ii) Simple Coiled Tubular.

Secretory unit is coiled tube like.

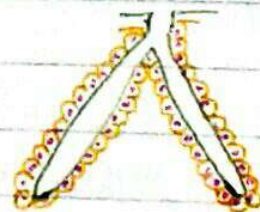
Ex: - Sweat Gland



(iii) Simple Branched Tubular

Secretory unit is branched tube like

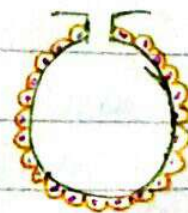
Ex: - Cardiac gland, pyloric gland & fundic gland of stomach



(iv) Simple Saccular

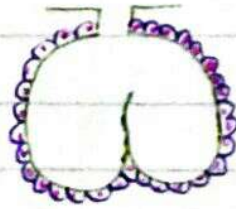
Secretory unit is small sac like

Ex: - Cutaneous gland of frog.



(v) Simple Branched Saccular :-

Secretory unit is branched sac like.  
Ex: - Sebaceous gland of human



(2) Compound Gland :- Secretory unit consists of system of ducts

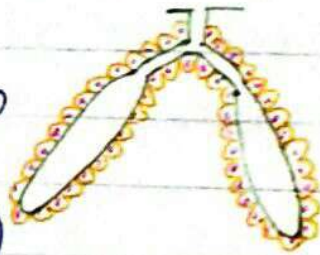
It is of three types.

(a) Compound Tubular Gland

Secretory unit consists of system of tubes

Ex: ① Brunner's gland (Intestine gland)

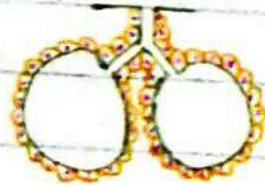
② Mammary of prototherians (Echidna & Platypus)



(b) Compound Saccular Gland

Secretory unit consists of system of sacs.

Ex: - human mammary gland,  
submaxillary & Sublingual Salivary gland

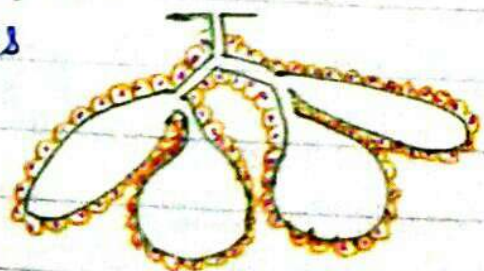


(c) Compound Tubulo-saccular Gland

Secretory unit consist of tubes

& system of sacs

ex: - parotid salivary glands





C. On the basis of mode of Secretion glands are of three types.

### I Holocrine Gland

- Secretion release out by complete destruction of cell.
- Fully loss of cell and cytoplasm.
- Ex:- Sebaceous gland (oil gland)

### II Apocrine Gland

- Secretion release out by only apical part of the cell.
- Half loss cell and cytoplasm.
- Ex:- Mammary gland

### III Eccrine / Merocrine Gland

- Secretion release out by simple diffusion.
- No loss of cell and cytoplasm.
- Ex:- Sweat Gland, Salivary Gland etc.

### (ii) Compound Epithelium

- Cells are arranged on more than one layer.
- Cells of basal layer may be columnar or cuboidal never be squamous.

On the basis of cells of uppermost layer  
It is of three types

(1) Compound Squamous or Stratified Squamous epithelium  
Cells of uppermost layer are flat cells.

It is of two types.

(a) Keratinized Compound Squamous Epithelium:-  
Flat cells are filled with Keratin protein  
Ex: Epidermis of skin

(b) Non-Keratinized Compound squamous Epithelium.  
Flat cells absence of keratin  
Ex: Lining of buccal cavity, Oesophagus, Vagina & Cervix

(2) Compound Cuboidal Epithelium.  
Cells of uppermost layer are cuboidal cells.  
Ex: Lining of Anus, Female urethra & Conductiva of eye

(3) Compound Columnar Epithelium  
Cells of uppermost layer are columnar cells/long cells.  
Ex: Lining of duct of Parotid Salivary gland  
& mammary gland

## 2 CONNECTIVE TISSUE

- It is mesodermal in origin
- It connects one tissue with other and one organ with other organ.
- It forms about 30% organ of the body
- It is widely distributed in the body
- It acts as packing material and support the body.
- Connective tissue consist of three components

### ① Cells

- Cells are present in matrix which is secreted by them
- Different types of cells are present for different function

### ② Fibres

- Fibres are secreted by FIBROBLAST
- Different types of fibres are present in the connective tissue like white collagen fibres, yellow elastin fibres & reticular fibres.

### ③ Matrix

- It is intercellular semi-liquid or jelly like substance which is secreted by cells.
- It is homogenous and consist of mainly water, mucopolysaccharide, hyaluronic acid & Sulphuric acid
- It provides space for attachment with fibres and cells.

# TYPES OF CONNECTIVE TISSUE

It is divided into three types.

- I Loose Connective Tissue
- II Dense Connective Tissue
- III Specialised Connective Tissue.

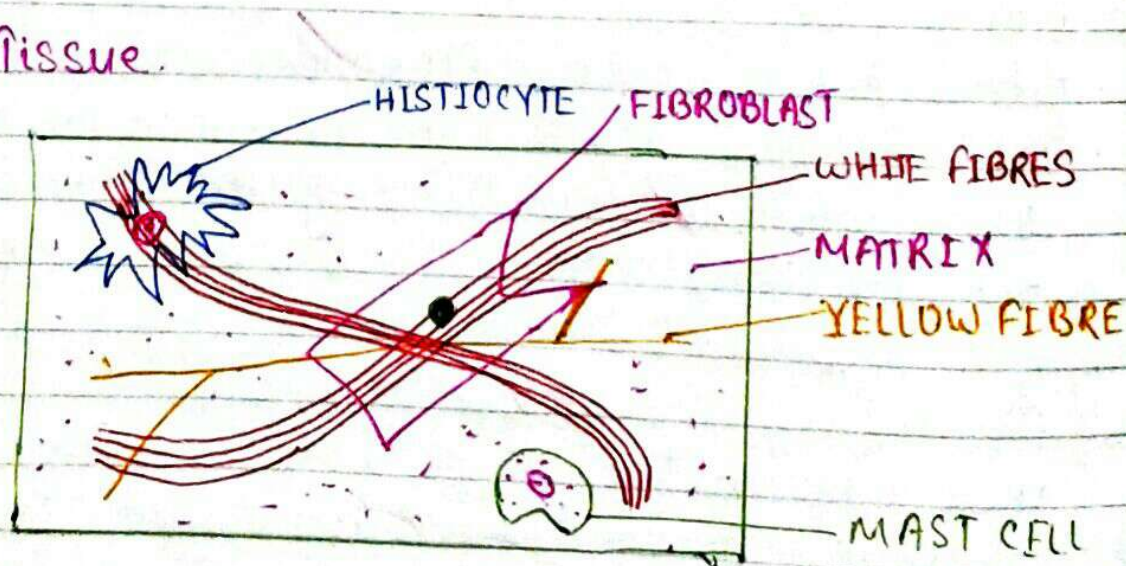
## I LOOSE CONNECTIVE TISSUE

- It contains few number of fibres.
- It contains large intercellular space.

It is also divided into three types.

### ① Areolar Tissue.

Fig:- Areolar Tissue



- It contains large amount of extra cellular fluid
- It acts as filling material around the kidney, nerve fibres, muscle fibre etc.
- It contains different types of cells and fibres.

## ii) Fibroblast cells.

It is spindle shaped cell which secretes different types of fibres

Old and inactive fibroblast is called **FIBROCYTE**

## iii) Histiocyte / Macrophage

Many histiocytes combined and form a Giant Macrophage for engulfing the large foreign particles

## iii) Mast Cell

It is oval shaped cell which secretes three types of chemicals.

### ① Heparin.

It is an anti-coagulant which prevents blood clotting in the blood vessel.

### ② Histamin.

It produces inflammation at the site of injury. It swells the blood vessel so also called **VESODIALATOR**.

### ③ Serotonin.

It constricts the blood vessel during hypotension (low B.P.)

## iv) FIBRES

### ① White Collagen fibres

These fibres occur in bundles form Fasciculi

These fibres are long, unbranched, wavy and glistening in nature

It is made up of Collagen protein

- It is white in colour and provide tensile strength or Tenacity.

### ② Yellow Elastin fibre

- It is yellowish in colour, unbranched, straight fibre occur in single

• It is made up of elastin protein

- It provides stretching capacity or elasticity.

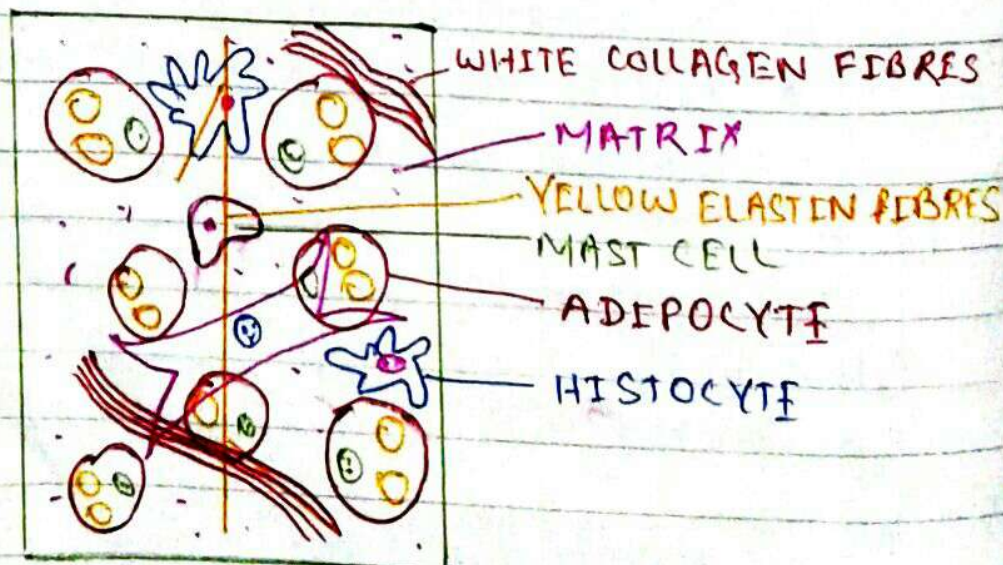
### ③ Reticular fibres.

- It is small unbranched white fibre

• It is made up of reticuline protein

## ④ Adipose Tissue

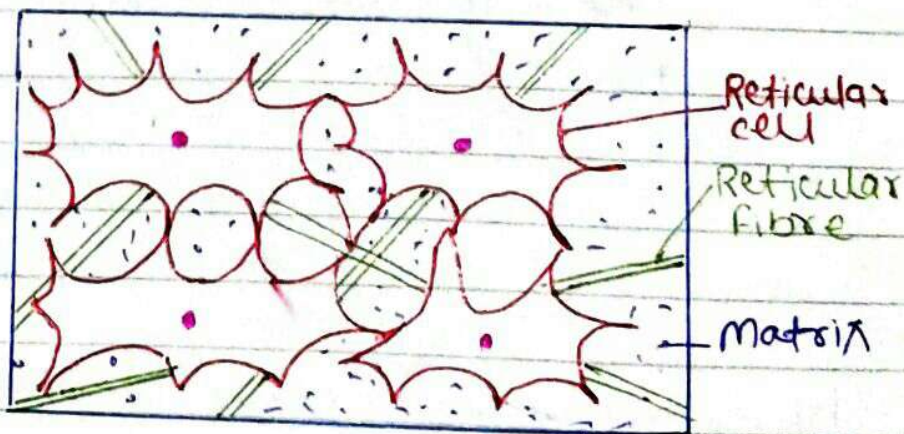
Fig: Adipose Tissue



- It is modification of Areolar Tissue
- It is specialised for fat storing so also called FAT STORING TISSUE.
- Fat is present as lobule in the adipose site.
- Same types of cells are present as that of areolar tissue
- Ex :- It is found in the cushion around the kidney, heart, blood vessel etc.
- In the case of whale and elephant BLUBBER is thick adipose tissue.
- It is present in the hump of camel and fat bodies of frog.

### ③ Reticular Tissue

Fig:- Reticular Tissue.



- It is made up of reticular cells or stellate cells (star shaped cells)
- These cells are phagocytic in nature
- Reticular fibres cross each other and form a net like structure
- It helps in protection from pathogens

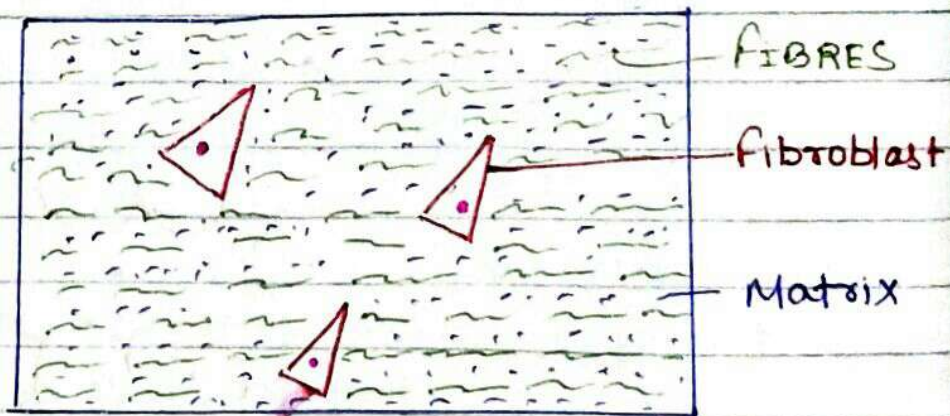
- It is found in the lymph node, thymus gland, spleen etc.

## II DENSE CONNECTIVE TISSUE

- It contains large no. of fibres than cells
- fibres are arranged in regular fashion / pattern or irregular pattern.
- On the Basis of Pattern Dense Connective tissue is of two types

### ① Dense Regular Connective tissue.

Fig.: Dense Regular Tissue



- fibres are arranged in regular / parallel fashion / pattern.
- It is found in the Tendons & Ligament.

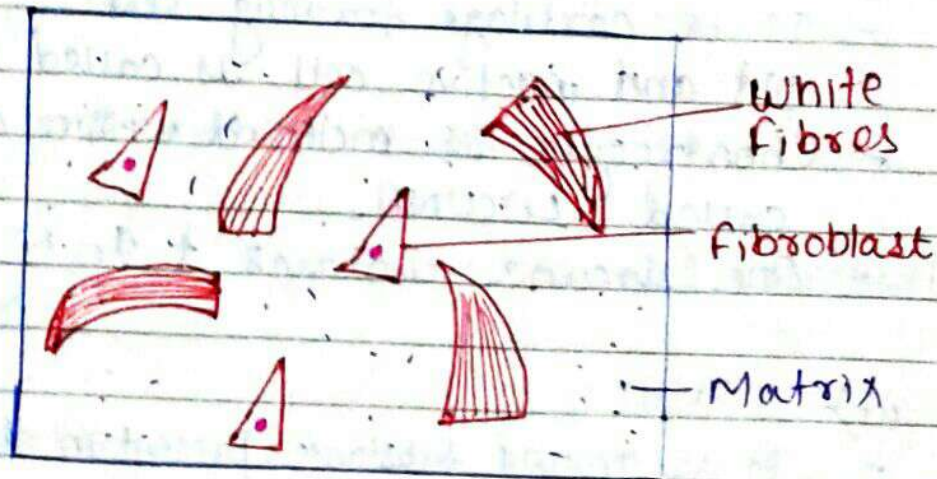
① **Tendon**: It is made up of thick white collagen fibres and help in connection of muscle to Bone.

② **Ligament**: It is made up of thick yellow elastic fibres and help in connection of bone to bone



## ② Dense Irregular Connective Tissue

Fig: Dense Irregular Tissue



- It is made up of thick sheet of white fibres
- Fibres are arranged in irregular pattern
- Ex:- It is found in epidermis of skin, Tunica albuginea of testis, Perichondrium, Periosteum.

## III ③ Specialised Tissue / III SPECIALISED CONNECTIVE TISSUE

- It includes Cartilage, Bone and Blood

### 1. CARTILAGE

= It is hard but flexible ~~not~~ tissue

- It is made up of three components

#### i) Perichondrium

- It is outermost layer of ~~membrane~~ cartilage / covering of ~~membrane~~ cartilage made up of dense irregular tissue
- It is made up of two layers, outer protective layer and inner chondrogenic layer.

## ii) Chondroblast

- It is cartilage forming cell
- Old and inactive cell is called Chondrocyte
- Chondrocyte is enclosed within a fluid filled space called LACUNA.
- One lacuna contains 1, to 4 chondrocytes

## iii) Matrix

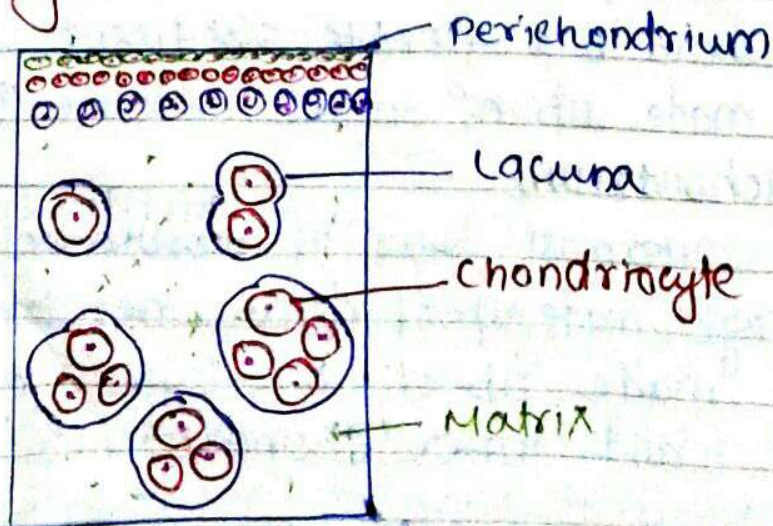
- It is ground substance present in the cartilage secreted from cells.
- It is semi-liquid or jelly like containing Chondrin Protein.
- fibres are present in the matrix

## TYPES OF CARTILAGE

On the Basis of Deposition of fibres in the matrix, Cartilage are of four Types:-

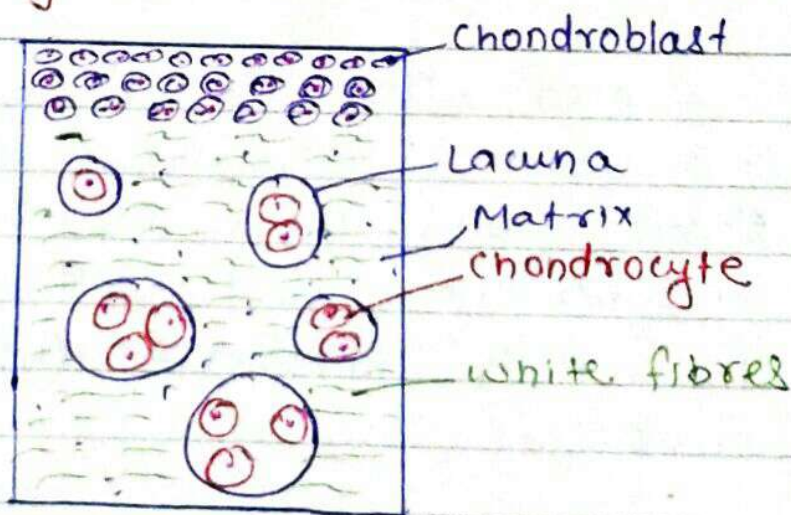
### 1. Hyaline Cartilage.

Fig: Hyaline Cartilage



- It is also called Common (Typical) Cartilage.
- Perichondrium is present
- Fibres are absent
- It is transparent and slightly bluish in colour
- Ex: - ① Tip of limb/long bone,  
 ② Respiratory Tract (Larynx, Trachea and Bronchus),  
 ③ Nasal Septum.

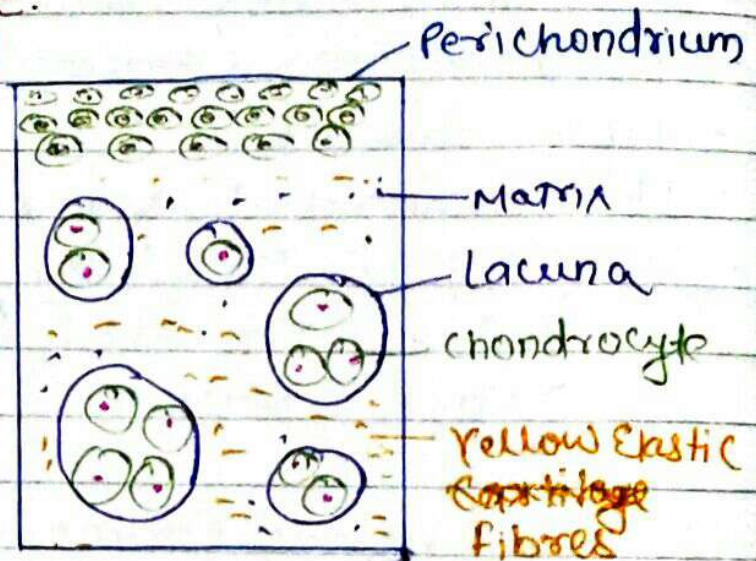
## 2. White Fibrous Cartilage



- It is also called Strongest Cartilage
- It is white in colour due to deposition of white fibres in the matrix.
- Ex: - Pubic Symphysis, Intervertebral disc.

### 3. Yellow Fibrous Elastic Cartilage.

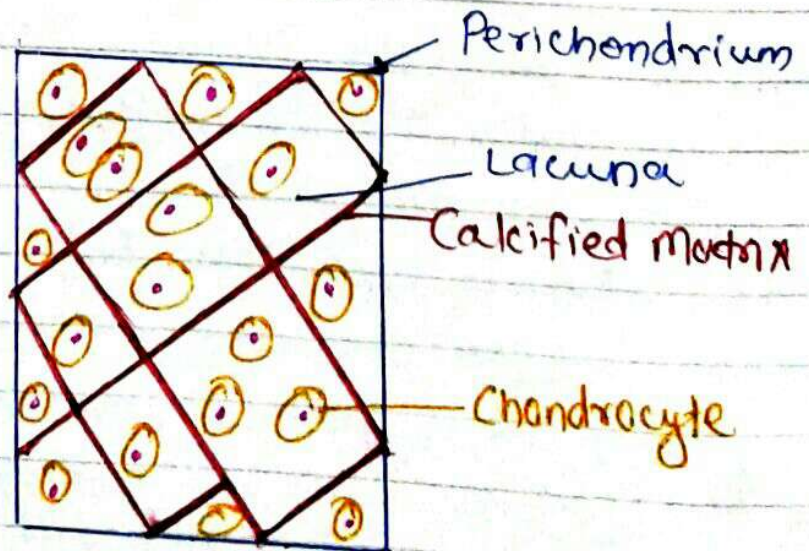
Fig: Yellow Fibrous Cartilage



- It is also called Elastic Cartilage
- It is yellow in colour due to deposition of yellow elastic fibres in the matrix.
- Perichondrium is present.
- Ex: - Pinna, EAM (External Auditory Meatus), Epiglottis, Eustachian Tube,

### 4. Calcified Cartilage.

Fig: Calcified Cartilage



- It is also called Hardest Cartilage
- Its matrix is hard due to deposition of Calcium.
- Perichondrium is present
- Ex: Supra scapula (Pectoral girdle), Pubis (Pelvic girdle) of frog, vertebrae of Shark.

## 2. BONE

- It is the hardest tissue of the body.
- It protects important organs of the body.
- It provides definite shape and support to the body.
- It consists of five parts

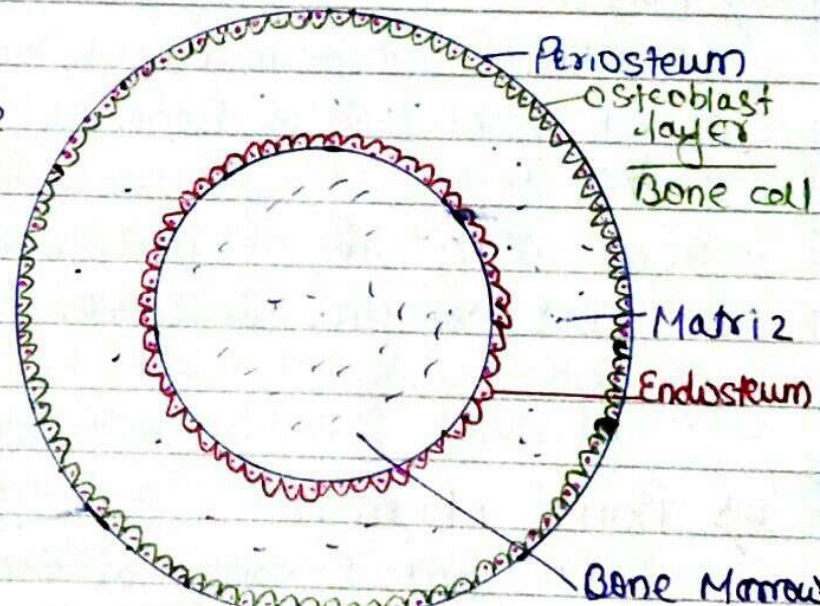


fig: Parts of Bone

### 1) Periosteum

- It is outermost covering of bone.
- It is made up of thick sheet of white fibres or dense irregular connective tissue.
- A thin layer of OSTEOLAST is present just below the periosteum.

### 2) Endosteum

- It is inner covering of bone, which is thinner than periosteum.
- It also contains thin layer of OSTEOLAST.

### 3) Bone Cells

- It is bone forming cell.
- Inactive and old cell is called Osteocyte.
- Osteocyte is enclosed within a fluid filled space called Lacuna. One lacuna contains only one osteocyte.

### 4) Matrix

- It is hard intercellular substance of bone.
- About 35% part of bone is organic material mainly contains Ossein Protein (Bone Protein).
- About 65% part of matrix is inorganic material mainly contains calcium phosphate, calcium chloride and calcium fluoride.

### 5) Bone Marrow

- It is central cavity of bone
- It is of two types

#### i) Red Bone Marrow

- It is reddish in colour containing mainly reticular tissue
- It is site for formation of blood cells process is called haemopoiesis.

#### ii) Yellow Bone Marrow

- It is yellow coloured present in the shaft of Bone of Adult Person.
- It is site for storage of adipose tissue / fat

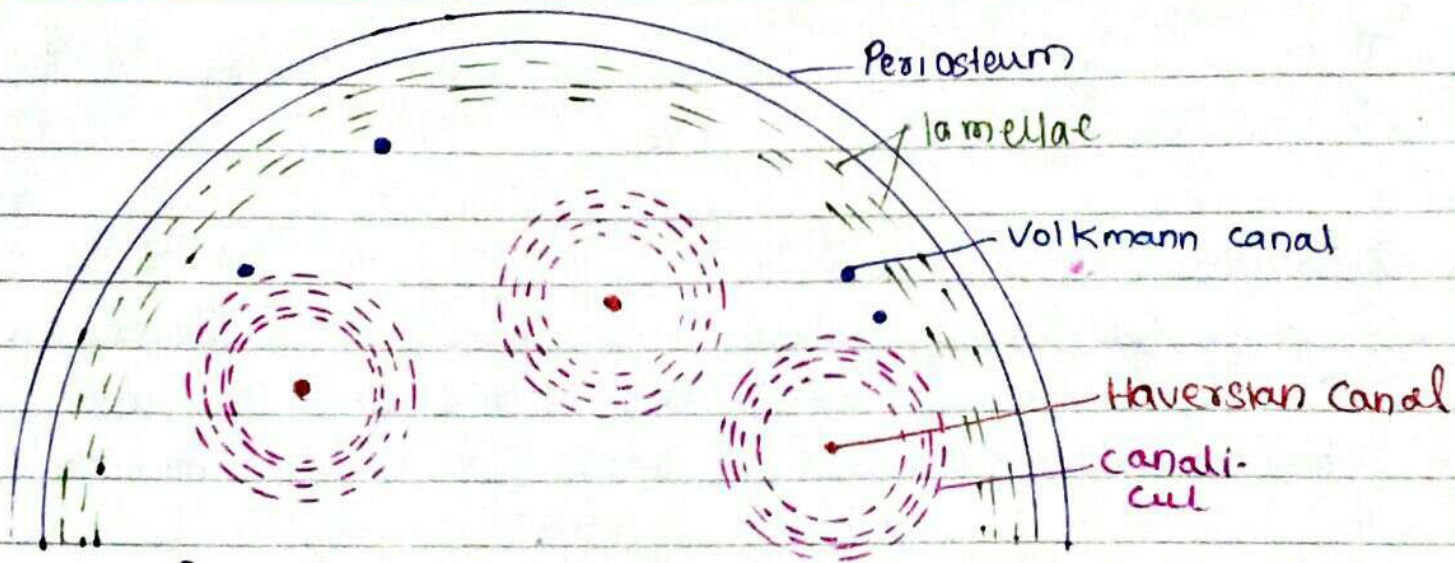


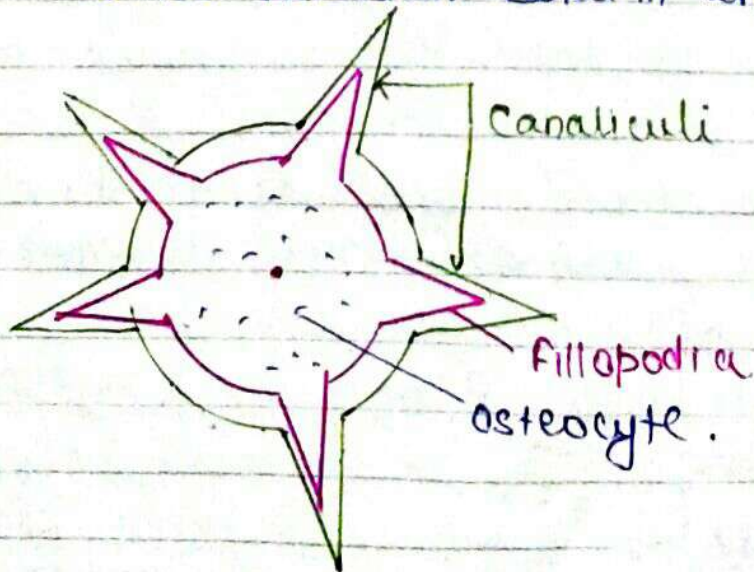
Fig:- Parts of Mammalian Bone (magnified view)

1) **Bone lamellae** :- These are circular plate of matrix present in whole length of bone.

2) **Haversian Canal** :- These are longitudinal canal present in the whole length of bone.

3) **Volkman Canal** :- These are transverse oblique canal connect Haversian canal in whole length of bone.

4) **Canaliculi  
Lacuna**



These are finger like projections of lacuna containing fillopodia of osteocyte.

### 5) Osteon / Haversian system

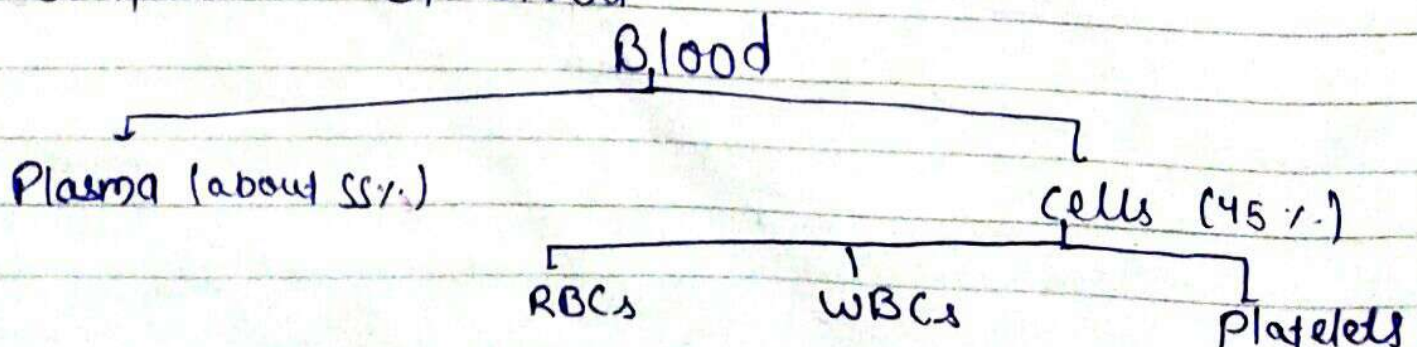
It is system of hollow tubes made up of Haversian canal, Volkmann canal and Bone lamellae and present whole length of bone but only in mammals

- \*\* If bone is heated its organic material turn into smell and inorganic material left as ashes.
- \*\* If bone kept in dilute acid. Its inorganic material dissolve and such bone is called Decalcified Bone / Soft bone (weak Bone)
- \*\* If bone kept in KOH solution, bones remain unaffected but becomes clean due to dissolution of muscles

## 3. BLOOD (Vascular tissue)

- It is red due to presence of Haemoglobin.
- It is saltish in taste due to presence of NaCl.
- It is about 5.6 litre in amount.
- It is 4 to 5 times more viscous than water.
- It is slightly alkaline (about 7.4 - 7.6 pH).

Components of Blood





## 1) Plasma

It is slightly alkaline fluid forming about 55% part of blood.

### Components of Plasma.

i) **Water**: - It is about 90 - 92% part of Plasma.

ii) **Protein**: - It forms about 6 - 8% part of plasma.

a) **Albumin Protein**: - It is smallest protein essential for maintain the osmotic pressure.

b) **Globulin**: - It is essential for formation of antibodies and destroying toxins.

c) **Prothrombin** } These proteins are essential for

d) **Fibrinogen** } blood clotting.

iii) **Glucose**: - It is essential for energy production.

- Normal range of glucose is about 80 mg to 100 mg per 100 mL of blood (fasting).

iv) **Waste Product** → - mainly waste product is urea, ammonia, uric acid.

- Normal range of urea is about 17 - 30 mg per 100 mL of blood which is main waste product.

v) Plasma contains small amount of enzymes, cholesterol, respiratory gases, anticoagulant (**heparin**), etc.

## Function of Blood Plasma

Plasma help in transportation of nutrients, respiratory gases, hormones, distribution of heat to other part of body, elimination of waste product, help in blood clotting, maintains the osmotic pressure etc.

## 2) Cells

### 1) RBC

- RBC, WBC and platelets are called formed Elements.
- It forms about 90% of cells.
- It is formed in the Red Bone Marrow process is called Erythropoiesis.
- Number of RBC is about 5 million/ $\text{mm}^3$  blood in adult male
- \*\* In the case of adult female, it is about 4.5 million/ $\text{mm}^3$  blood.
- \*\* In the case of infant it is about 6-7 m/ $\text{mm}^3$  of blood.

### Size of RBC

- In the case of human it is about  $7.5 \mu$  in diameter.
- Smallest RBC is found in musk deer. ( $2.5 \mu$ )
- Largest RBC is found in Amphiuma ( $7.5 \mu$ ).

### Shape of RBC

It is spherical and biconcave except family Camelidae (camel and Mamas) In the case of frog it is Biconvex due to presence of nucleus.

## Life Span of RBC

Life span of RBC is about 120 days (4 months)

## Site of storage of RBC

Spleen (Blood Bank)

## Site of destruction of RBC

- Spleen (Grave yard)

\*\* RBC contain Haemoglobin which transport the respiratory gases so also called Respiratory pigment.

\*\* 1 RBC contain 26 crore molecules of Haemoglobin.

Haemoglobin is made up of Heme (Iron) and Globin (Protein).

\*\* Haemoglobin having a tendency to stick together their concave side like a pile of coins and its formation is called Rouleaux formation.

\*\* Increase the no. of RBC called Polycythemia.

\*\* Decrease the no. of RBC called Erythrocytopenia.

## ii) White Blood Corpuscles (WBC) or Leucocytes

→ They are colourless, mobile and amoeboid movement nucleated.

→ They are much less in no. about 6000-8000 /mm<sup>3</sup> of blood (by NCERT) and 5000-11000 /mm<sup>3</sup> of blood (by other books).

→ They are larger than RBC (8μ - 20μ)

→ Granules<sup>are</sup> present in the cytoplasm

- Life span is about 1-4 days
- On the Basis of Shape of Nucleus and Granules present in the Cytoplasm, WBCs are of mainly two types.

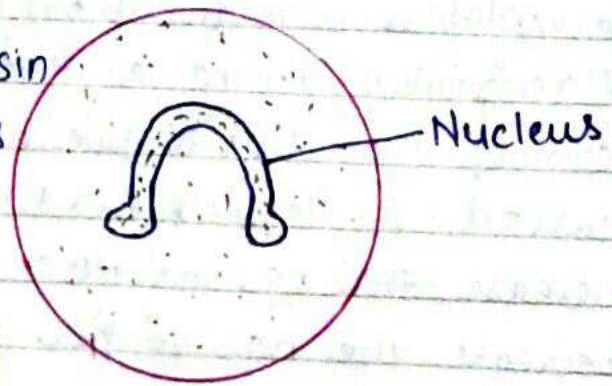
### 1 Granulocytes (Granular Leucocytes)

- Granules are present in cytoplasm
- Nucleus is made up of two to more lobes so also called Polymorphonuclear leucocytes
- They are formed in the Red Bone Marrow
- Granules are stainable

They are of 3-types

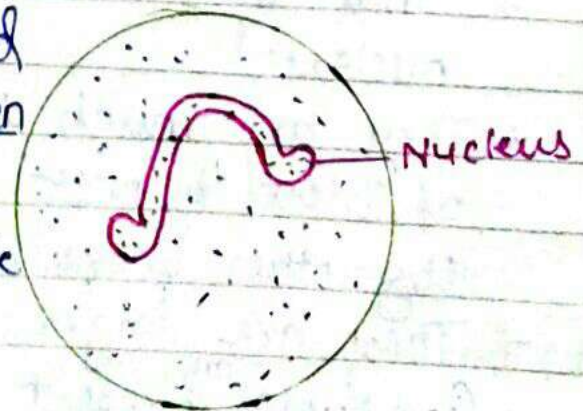
#### a. Acidophils / Eosinophil cells

- Granules are present and stainable with acid dye/Eosin
- Nucleus is made up of 2-lobes
- They are about 2-3% of total no. of WBC.
- They are related with allergy & immunity.



#### b. Basophil cells

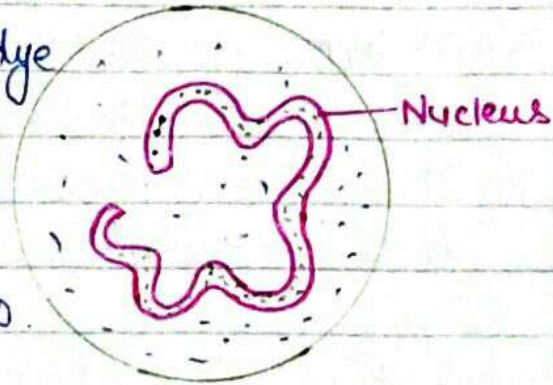
- Cytoplasm contains granules and stains with basic dye like Methylene blue
- Granules are stainable with basic dye like Methylene blue
- Nucleus is S-shaped



- They are about 0.5 - 1% total no. of WBC
- They are related with inflammation

### c. Neutrophils

- Granules are stainable with neutral dye like Giemsa stain & Leishmann stain
- Nucleus is made up of many lobes and irregular in shape
- They are about 60-70% of total no. of WBC
- They are phagocytic in nature

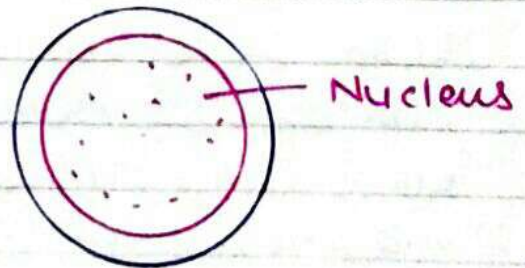


## 2. Non-Granular / Agranular leucocytes

- Granules are absent
- Nucleus is made up of single lobe so also called mononuclear leucocytes
- They are formed in the lymphoid organs
- They are of 2 types

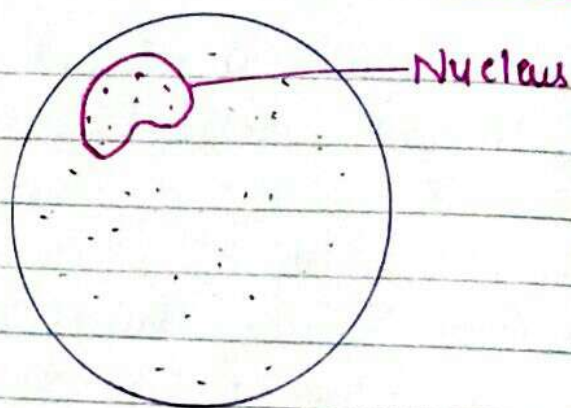
### a. Monocytes

- They are smallest WBC
- Nucleus is capture about whole body/area of cell.
- They are about 20-25% of total no. of WBC.
- They help in formation of Antibodies.



## b. Lymphocytes

- They are largest in size
- They are about 4-8% of total no. of WBC
- Nucleus is bean shaped and present on periphery.
- They are phagocytic in nature and engulf the foreign particles and dead cells.



## iii) Platelets / Thrombocytes

- These cells are colourless, non-nucleated and oval or flat shaped cells also called THROMBOCYTES.
- They are about 1.5 lakh - 3.5 lac /mm<sup>3</sup> of blood.
- Life span of platelets is about 1 week.
- They help in blood clotting
- They are form in the Megakaryocytes cells in the bone marrow

## BLOOD CLOTTING

It is conversion of fluid like blood into Jelly like clot. It prevents from extra loss of blood from body.

- Average Blood Clotting time is about 2-8 minutes.
- Blood Clotting essentially involves in three phases

Phase 1: Thromboplastin formation

Phase 2: Thrombin formation

### Phase 3: Fibrin formation.

- Thromboplastin is secreted from platelets at the ~~site~~ site of injury
- Thromboplastin changes the inactive prothrombin into active thrombin in the presence of calcium
- This active thrombin changes the soluble fibrinogen into insoluble fibrin fibres at the site of injury.  
RBC, WBC get entangled in the network work fibrin fibres to form a clot
- Loss of blood clotting causes a disease called HAEMOPHILIA.

### BLOOD GROUP

- Landsteiner divided the human population into 4 groups on the basis of Antigens in the blood group so four types of blood group present in human
- Blood contains two types of proteinous substances
  1. antigen / Agglutinogen
    - It is protein present in the membrane of RBC
  2. Antibody / Agglutinin
    - It is also protein present in the blood plasma.
- Four types of Blood Group present like A, B, AB and O.

- Mixing of blood of different groups causes reaction  
Clumping of RBC also called AGGUTINISATION which may causes death of the person.

Blood Group	Antigen on RBC	Antibody in Plasma	Donor's Group
A	A	antibody b	A, O
B	B	antibody a	B, O
AB	A, B	NIL	A, B, AB, O
O	NIL	A, B, a, b	O

- \*\* Blood Group 'AB' is universal Receptor
- \*\* Blood Group 'O' is universal Donor

### Rh - Factor / Rh - Group

- Landsteiner & Winner discovered a different types of protein in human blood
- This protein is called Rh - antigen or Rh - factor
- Rh - antigen (protein) first time discovered in blood of Rhesus monkey
- Those person having Rh - antigen called Rh positive ( $Rh^+$ ) more than 80%. and some people having no Rh antigen called Rh negative ( $Rh^-$ )
- If  $Rh^-$  mother developing a  $Rh^+$  foetus, first baby will be normal because there is no



- ~~is~~ mixing of blood in between foetus and mother
- In the delivery of first child during placenta cutting there is change of mixing of blood in between mother and foetus (child). This mixing leads to formation of Rh antibodies in the blood of mother
- ~~In~~ When mother ~~present~~ pregnant with second time Rh<sup>+</sup> foetus preformed Rh antibodies destroy the foetal RBC which cause death of the foetus and this condition is called **Erythroblastosis Foetalis**
- This condition can be avoided by Administering anti-Rh antibody to inject <sup>the mother</sup> immediately after placenta cutting in the first delivery

## LYMPH

- Lymph is tissue fluid, flows within vessel called lymph vessel
- It is similar to blood but colourless, due to absence of RBC
- Lymph vessel present in the wall of intestine called **Lacteals** which absorb the digested fat
- Lymph acts as middle man in between tissue fluid and venous blood
- Lymph ultimately drained into venous blood
- Lymph helps in transportation of digested fat.

### 3. MUSCULAR TISSUE

- Muscles are mesodermal in origin except Ciliary & iris muscles of eye are ectodermal in origin.
- It forms about 40% weight of human body
- Contractility is the property of muscular tissue
- It provides movement and locomotion.

#### Types of Muscular Tissue

They are of 3 types

1. Striped muscles
2. Unstriped muscles
3. Cardiac muscles

#### 1. STRIPED MUSCLES / STRIATED MUSCLES / VOLUNTARY MUSCLES / SKELETAL MUSCLES

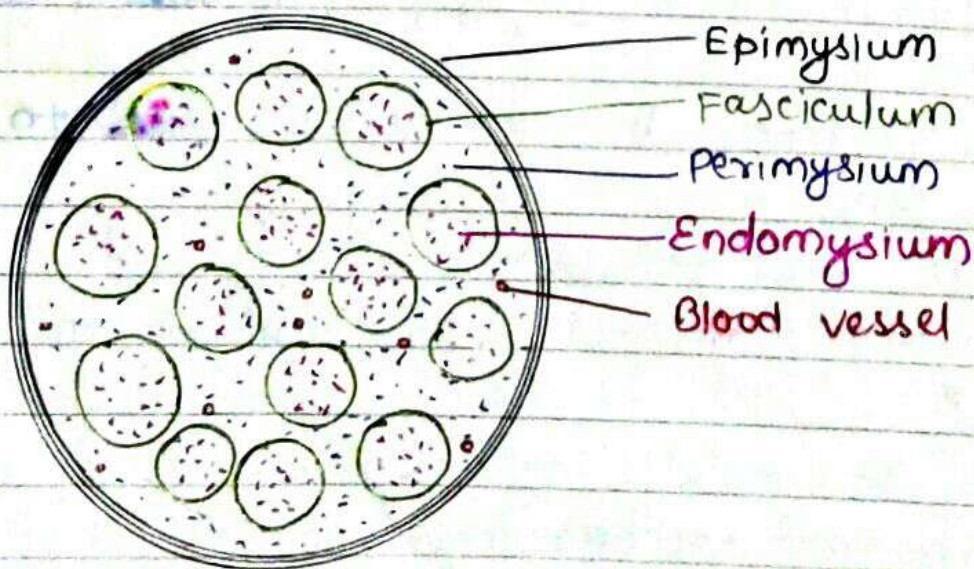


Fig:- T.S of Muscles

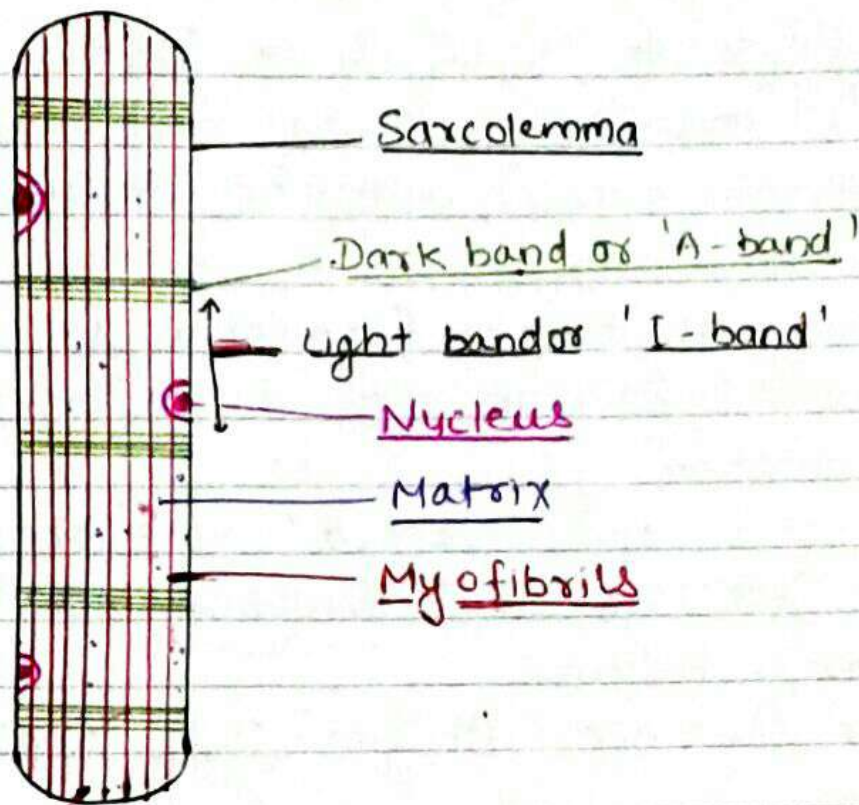


Fig:- LS of muscle fibre

- Muscle is made up of Bundles of Muscles fibres called fasciculi
- These muscles are long and length varies from 2mm to 40mm
- In each fasciculum muscle fibres are surrounded by thin areolar tissue called Endomysium
- All fasciculi are surrounded by Perimysium
- Muscle is externally surrounded by Epimysium
- Each muscle fibre of strip muscles are long, cylindrical with blunt end.
- ~~It is~~ Each muscle fibre is externally surrounded by PM called Sarcolemma.
- Dark band or 'A-band' and Light band or 'I-band'

are present in whole length of muscle fibre

→ "Sarcoplasm" <sup>(cytoplasm)</sup> is granular contains rich number of Sarcosome (mitochondria), Myoglobin Protein and Glycogen granules

→ It contains many proteinous filamentous structures called Myofibrils (Maximum 1000) which having power of contraction.

→ Nucleus are many and arranged on periphery

→ It can work fast but short duration because it become easily fatigue

→ It is found in the neck, Abdomen, legs, hands, fingers etc

## 2. UNSTRIPED MUSCLES / UNSTRIATED / SMOOTH MUSCLES / INVOLUNTARY MUSCLES

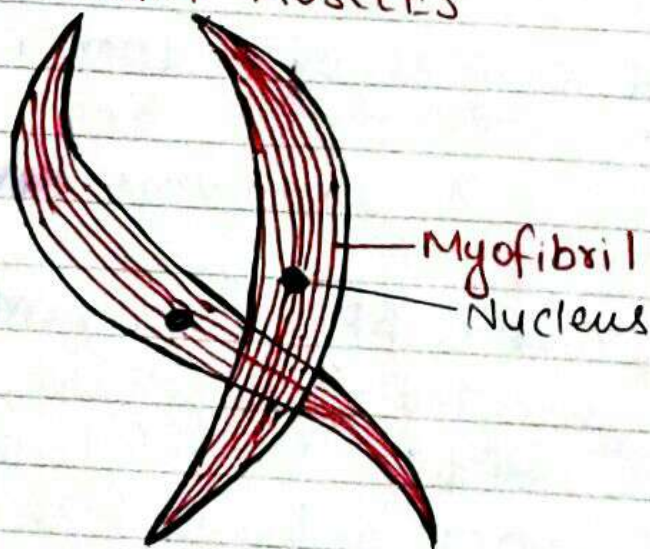


Fig:- Unstriped Muscles

→ These muscles are spindle shaped with pointed end

→ Nucleus is single and centrally placed

→ Dark band and light band are absent

- Sarcoplasm (cytoplasm) is non-granular due to absence of Myoglobin Protein
- Less no. of Sarcosome and glycogen granules
- Myofibrils are minimum in number about 20-30.
- It can work longer duration but slow speed.
- It is found in the alimentary canal, Urinary bladder, Uterus, Vagina etc

### 3. CARDIAC MUSCLES / STRIPED & INVOLUNTARY MUSCLES

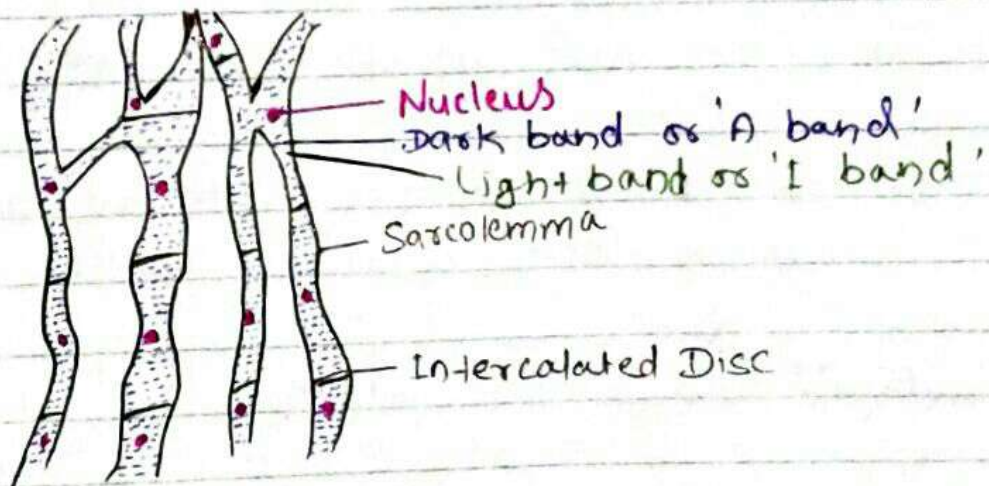


Fig:- Cardiac muscles

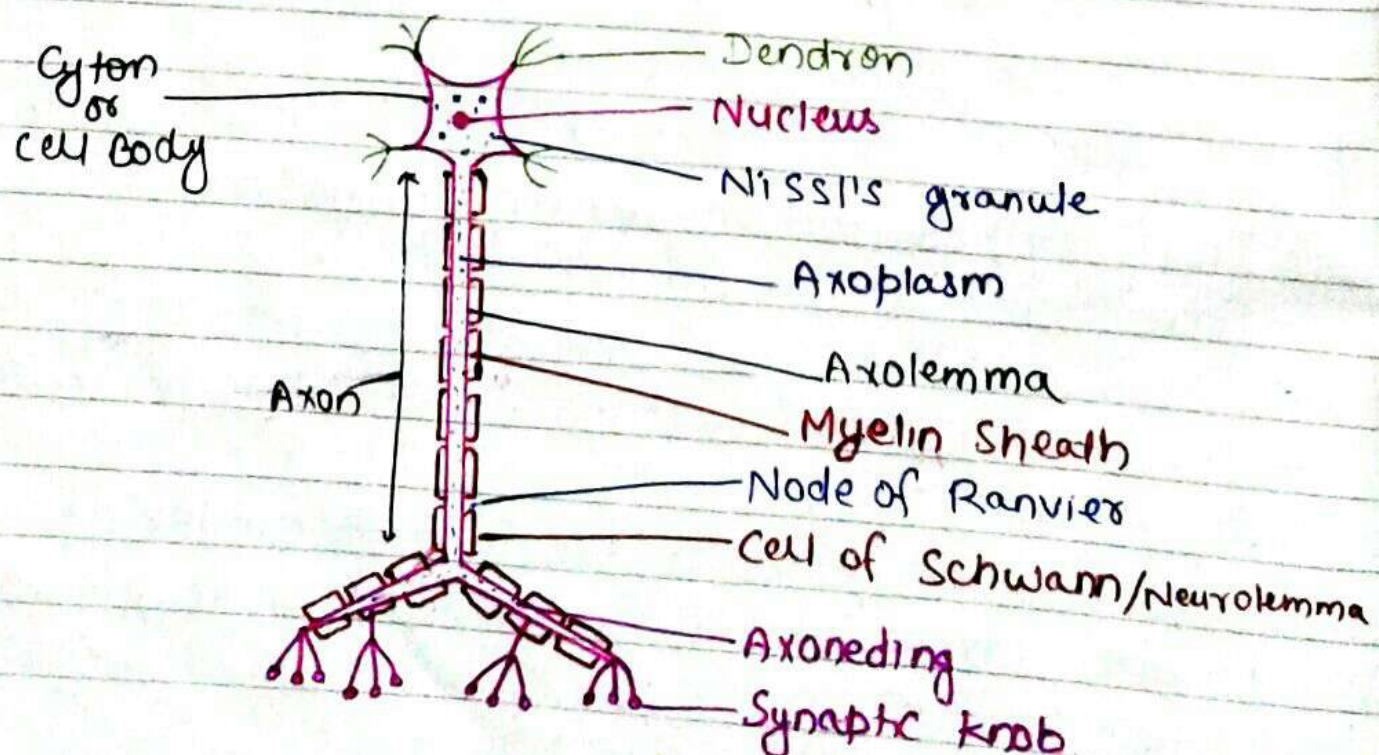
- It is striped and involuntary in nature
- Sarcolemma is present
- Dark and light band are also present
- Intercalated disc (Junction between two adjacent cell) is present
- Sarcoplasm is granular due to rich number of Myoglobin Protein, large number of sarcosome and glycogen granules.

→ It is present in the wall of heart and it is fatigueless muscle

## 4. NERVOUS TISSUE

- It is **ectodermal** in origin
- It receive the stimulus and conducts the impulse which co-ordinates and controlling the different types of activities
- Nervous system consist nervous tissue.
- Nervous tissue made up of Neurons and Neuroglial cells.
- Neuron/Nerve cell is the structural and functional unit of nervous tissue & nervous system.

### STRUCTURE OF A NEURON



→ Neuron (Nerve cell) is made up of mainly 3 parts  
i) Dendron

- It is protoplasmic projections of cyton which having many branching called dendrites
- Dendron receive the impulse from other neuron

### ii) Cyton

- It is also called cell body or Soma
- It contains large nucleus
- Neuroplasm contains mitochondria, Ribosomes, Golgi bodies and Nissl's granules made up of Nucleoprotein

### iii) Axon.

- It is long, filamentous, thread like structure originate from raised part of cyton called **Axon hillock**
- It is covered by Axolemma
- Axoplasm contains mitochondria, RER and Neurofibrils
- It is divided into two parts called Axon ending which contains small knob like structure called **Synaptic knob**
- Axolemma is also covered by one sheath or more sheath

#### a) Myelin Sheath

It is inner covering of axon made up of

## Phospholipid

- It is constricted at short intervals called Node of Ranvier

## by Neurilemma

- It is outer covering of axon made up of cell of Schwann which is type of Neuroglial cell

## Types of Nerve Fibres.

### ① Myelinated

- Nerve fibre is covered with Myelin sheath
- Conduction of impulse occur fast speed

### ② Non-myelinated

- Nerve fibre is without myelin sheath
- Conduction of impulse occur slow speed

## Types of Neurons / Nerve cell (On the Basis of function)

Nerve cell is of 4 types

### ① Sensory Nerves / Afferent Nerve

- It conducts the impulse from receptor to brain (CNS)

### ② Motor / Efferent Nerve

- It conducts the message from CNS to effector



### ③ Mix Nerve

- It conducts the message from receptors to CNS and CNS to effectors

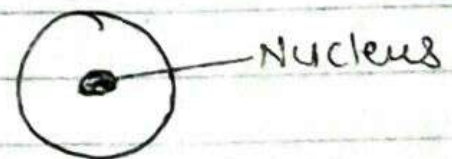
### ④ Adjustor Neuron

It connects the two neurons like Sensory & Motor

On the Basis of Processes Neuron is of 5-Types

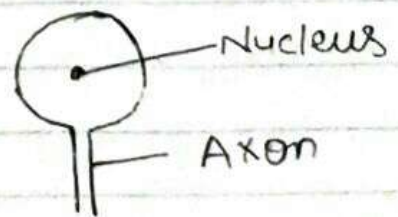
#### ① Non-Polar Neuron

- It absence of Dendron & Axon.
- It is found in the Hydra and immature embryonic nerve cell in vertebrate



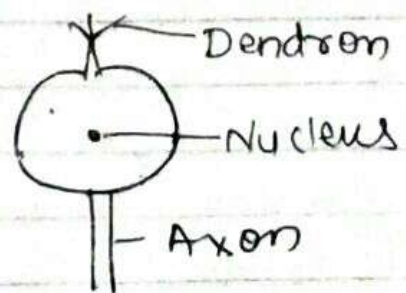
#### ② Unipolar Neuron

- It contains only single process called Axon.
- It is found in the invertebrate.



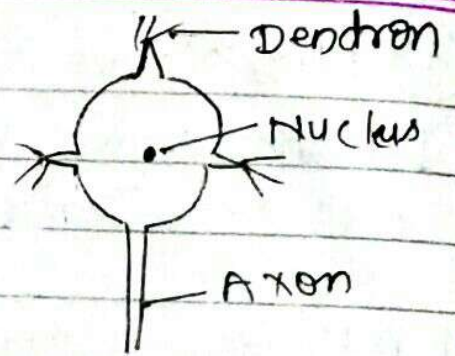
#### ③ Bipolar Neuron

- It contains one axon and one dendron.
- Ex: It is found in the sense organ (Nose, Eye, Ear, Tongue, Skin)



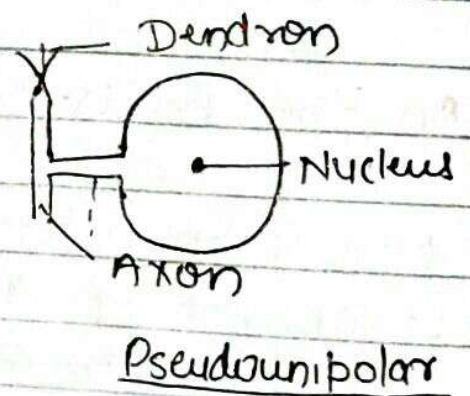
#### ④ Multipolar Neuron

- It contains single axon and many dendrons
- It is found in the grey matter of brain and Ganglia of ANS.

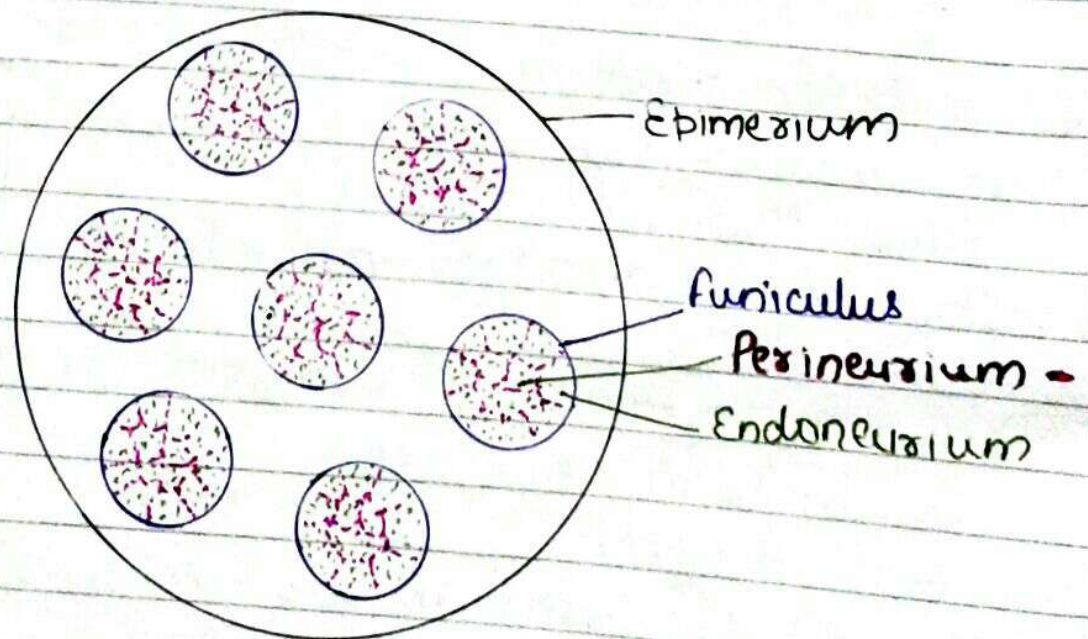


#### ⑤ Pseudo polar Neuron

- It contains single process but further divided into one axon and one dendron
- Ex:- It is found in the dorsal root of spinal nerve (sensory branch)



### T.S OF NERVE



- \* Nerve is made up of bundle of nerve fibres called Funiculi
- \* In each funiculus nerve fibres are surrounded by Endoneurium
- \* All funiculus are surrounded by **Perineurium** and finally nerve is externally surrounded by Epimerium.