



PHARMA

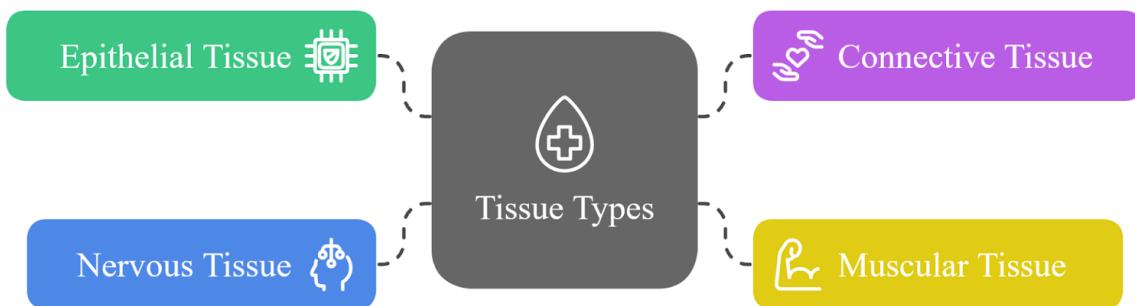
CHAPTERWISE NOTES

Human Anatomy & Physiology

Tissue

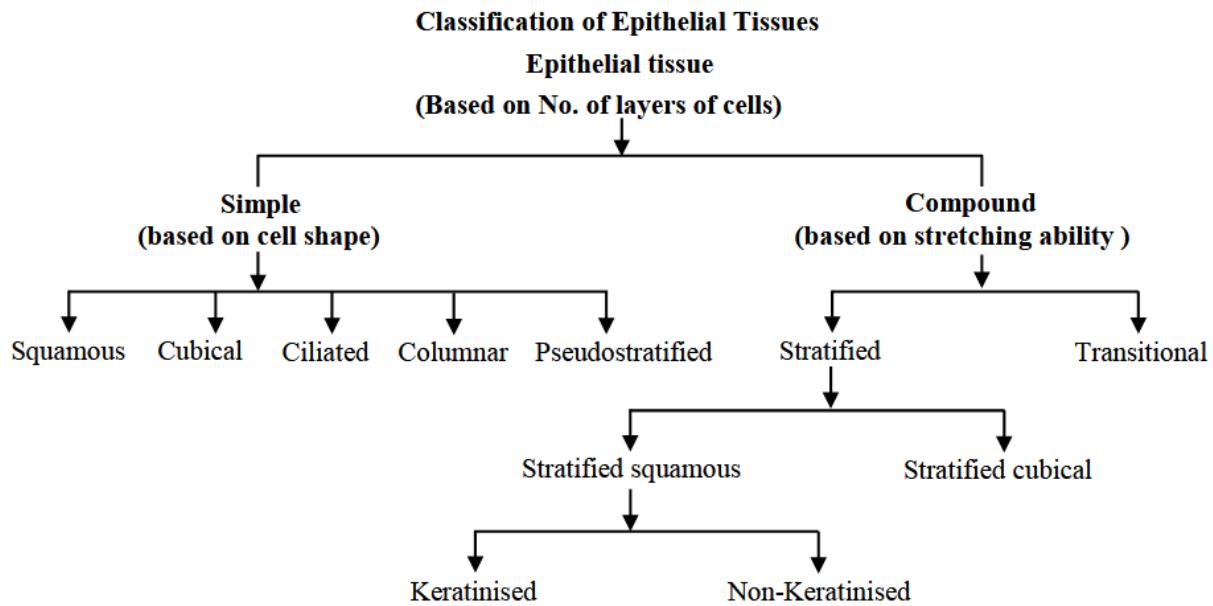
- Group of cells that are similar in structure, origin and function .
- Studying tissue is called **Histology.(Gr. histos-tissue, logos-study)**.
- Bichat (1771-1802) is considered as the “**Father of histology**”.
- There are four types of fundamental tissues found in the animal body - **epithelial, muscular, connective and nervous**.

Tissue Types, Origins, and Functions



Type	Origin	Function
Epithelial tissue	Ectoderm, Mesoderm, Endoderm	Protection, Absorption, Secretion, Excretion
Connective tissue	Mesoderm	Support and Structure, Transport, Immunity and Defense,
Muscular tissue	Mesoderm	Movement, Control of Openings, Movement
Nervous tissue	Ectoderm	Reflex Actions, Homeostasis, Sensory function, Motor function

Types of Epithelial Tissue



Epithelial tissue:-

Epi - Upon

Thelio -grows

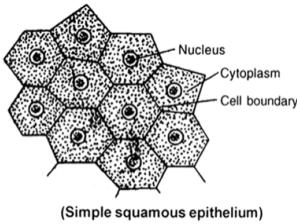
A tissue which grows upon another tissue is called **Epithelium**.

- Cells are either unilayered or multilayered.
- Cells are compactly arranged with no intercellular matrix.
- Epithelial tissue is non-vascularised.
- Free surfaces may have **cilia** or **microvilli** or may be smooth.
- Due to absence/less of intercellular space blood vessels, lymph vessels are unable to pierce this tissue so that the blood circulation is absent in epithelium.
- Between epithelium & connective tissue ,a thin non living acellular basement membrane is present which is highly permeable.

Function:- Protection, secretion, absorption, excretion and gamete formation.

(a) Simple squamous epithelium:-

- Consists of flat, tile-like, polygonal cells with a centrally located flattened nuclei. It is also known as pavement epithelium.

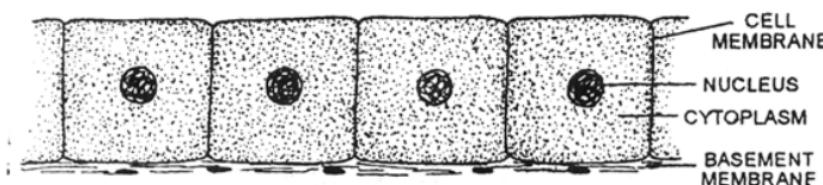


Locations :-

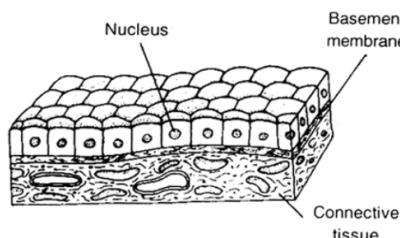
Terminal Bronchioles	Found in the terminal bronchioles and alveoli of the lungs.
Bowman's Capsule	Present in the wall of the Bowman's capsule (kidney).
Membranous Labyrinth	It exists in the membranous labyrinth (inner ear).
Rete Testis	Present in the rete testis (male reproductive system).
Loop of Henle	Located in the descending limbs and thin part of the ascending limb of Henle (kidney).
Mesothelium	Lines thoracic and abdomino-pelvic cavities; covers viscera.

(b) Simple cuboidal epithelium :-

- Basement membrane is present.
- Cells are cube like in shape
- A rounded nucleus is present in the centre of cell
- The cells of cuboidal epithelium often form microvilli on their free surface. This gives a brush-like appearance to their free border called brush-bordered cuboidal epithelium.



- Mostly cuboidal cells are found in glands.



Locations :-

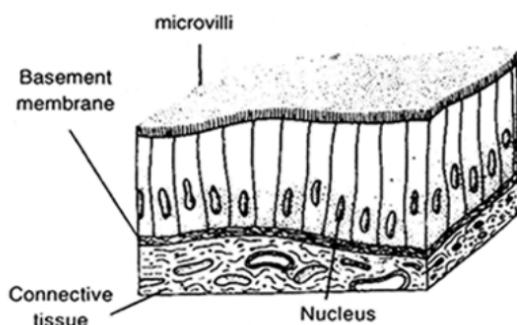
Vesicles of Thyroid Gland	Lined by simple cuboidal epithelium.
Acini of Pancreas	Secretory acini lined by simple cuboidal epithelium.
Pancreatic Duct	Lined by simple cuboidal epithelium.
Secretory Unit of Sweat Glands	Coiled part (secretory unit) lined by simple cuboidal epithelium ; secretory duct is stratified cuboidal .
Secretory Duct of Salivary Glands	Mainly stratified cuboidal epithelium , not simple cuboidal (for differentiation).
Iris	Certain parts lined by simple cuboidal epithelium.
Choroid (eye)	Presence of simple cuboidal epithelium.
Ciliary Body of Eye	Lined by simple cuboidal epithelium.
Thick Part of Ascending Limb of Loop of Henle	Lined by simple cuboidal epithelium.
Distal Convolved Tubule (DCT)	Lined by simple cuboidal epithelium.

Modifications :-

- **Brush bordered cuboidal epithelium** where microvilli are present on free and cuboidal cells
Eg :- PCT of Nephron
- **Ciliated cuboidal epithelium** when cilia present on free end of cuboidal cells then
Eg :- Found in certain part of nephron and in collecting duct

(c) Simple columnar epithelium :-

- Basement membrane is present
- Cells are pillar or column like in shape
- Simple columnar epithelium lines the **stomach, small and large intestine, digestive glands and gall bladder.**



Modifications of Columnar Epithelium :-

Type of Columnar Epithelium	Special Feature	Examples (Location)
Brush Bordered Columnar Epithelium	Microvilli present at free end → increases surface area for absorption.	Gall bladder
Glandular Columnar Epithelium	Goblet cells (unicellular mucus-secreting cells) present between columnar cells.	Stomach, Colon, Rectum
Glandular Brush Bordered Columnar Epithelium	Microvilli at free end + Goblet cells between columnar cells.	Duodenum, Ileum, Caecum
Ciliated Columnar Epithelium	Cilia present at free end → help in movement of particles/fluids.	Fallopian tube, Ependymal epithelium (brain ventricles & spinal cord)
Stereociliated Columnar Epithelium	Stereocilia (long, non-motile) present at free end → absorption & secretion.	Epididymis, Vasa deferens

Pseudo-stratified Epithelium :-

- The cells are columnar, but unequal in size. The long cells extend up to the free surface. The short cells do not reach the outer free surface.
- The long cells have oval nuclei, however, short cells have rounded nuclei. Mucus secreting goblet cells also occur in this epithelium. Although the epithelium is one cell thick, it appears to be multi-layered which is due to the fact that the nuclei lie at different levels in different cells. Hence, it is called **pseudostratified epithelium**.

Compound Epithelium :-

Stratified epithelium possess many layer of epithelial cells, the deepest layers is made up of cuboidal cells.

On the basis of the shape of the cells of the outermost layer it is of four types.

- (1) **Stratified squamous epithelium**
- (2) **Stratified cubical epithelium**
- (3) **Stratified columnar epithelium**
- (4) **Stratified ciliated columnar epithelium**

Stratified Squamous Epithelium :-

- **Innermost layer:** Cuboidal/columnar cells with **high mitotic index** → forms new cells (**Germinativum layer**).
- **Middle layer:** Polygonal cells connected by **desmosomes** → provide rigidity.
- **Outermost layer:** Flat, scale-like (**squamous**) cells.

On the basis of presence or absence of Keratin protein in the outer most cells this epithelium is of two types :-

Type	Key Features	Examples / Location
Keratinized Stratified Squamous Epithelium	- Contains hard, waterproof keratin protein in scaly cells. - Cells become non-nucleated & dead (protective layer).	Epidermis of skin, Scales, Horns, Nails, Feathers
Non-Keratinized Stratified Squamous Epithelium	- Keratin absent. - Cells are nucleated & living.	Buccal/oral cavity, Inner lining of cheeks & lips, Hard & soft palate (lower part), Tonsils, Pharynx, Oesophagus, Anal canal, Vagina lining, Cornea of eye

Stratified cubical epithelium :-

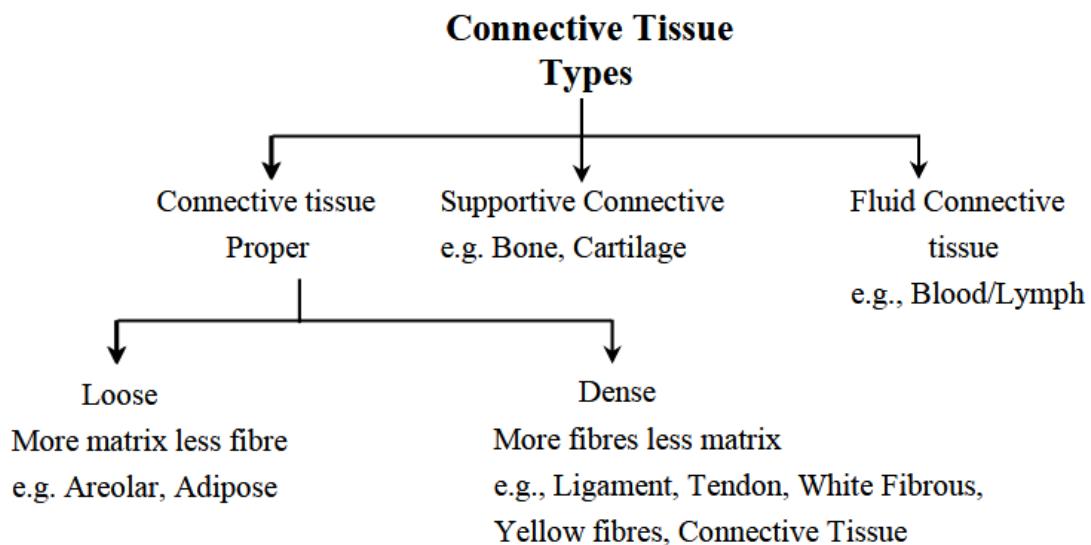
- The outermost layer of cells are cube like & cells are nucleated & living.
- Eg. :- **Secretory duct of sweat glands, mammary glands and sebaceous gland. Secretory unit of salivary glands, sebaceous gland.**

Stratified columnar epithelium :-

- It consists of columnar cells in both superficial basal layers. Cells are nucleated. Cilia absent on free end.
- Eg. – **Distal part of male urethra , Epiglottis**

Connective tissue:-

- **Origin :** Formed by mesoderm of the embryo.
- Most abundant and widely distributed in the human body



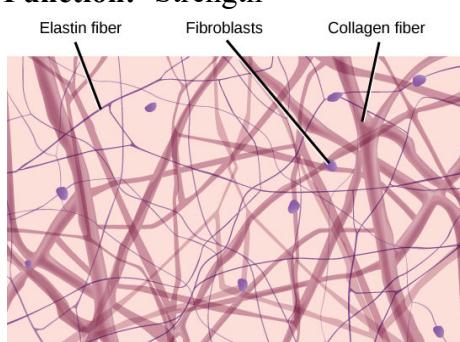
1. Loose connective tissue:-

- Also known as spongy tissue.
- It is the most widely distributed tissue in the body.
- In this tissue maximum intercellular space or substances/matrix is present.
- Due to the irregular arrangement of the bundle of collagen fibres many gaps are present. These spaces are called **Areolae**.
- Further divided into :-
 - (a) **Areolar connective tissue :-**

Fibres :-

- **Collagen :-**
 - White in colour (white fibres)
 - Present in bundles
 - Unbranched

Function:- Strength



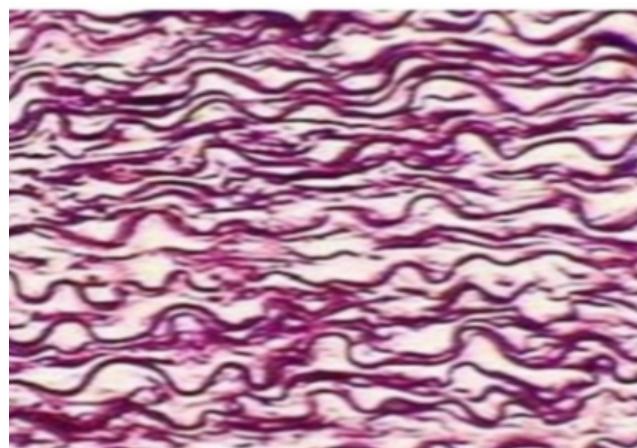
- **Elastic :-**

Yellow in colour

Present individually

Branched

Function :- Elasticity



Location and function :-

Eg. Tela Subcutanea – A thin continuous layer which connects skin with underlying skeletal muscles.

Endomysium – Around single muscle fibre.

Perimysium – Around a bundle of muscle fibre.

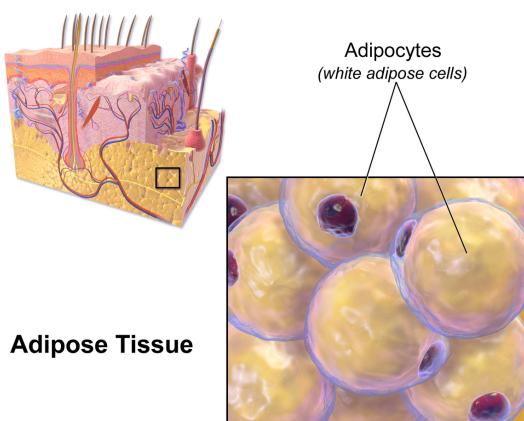
Outside of seminiferous tubules.

Medulla of ovary

Sub mucosa of trachea, Bronchi, Intestine

- The areolar tissue joins different tissues and forms the packing between them and helps to keep the organs in place and in normal shape.

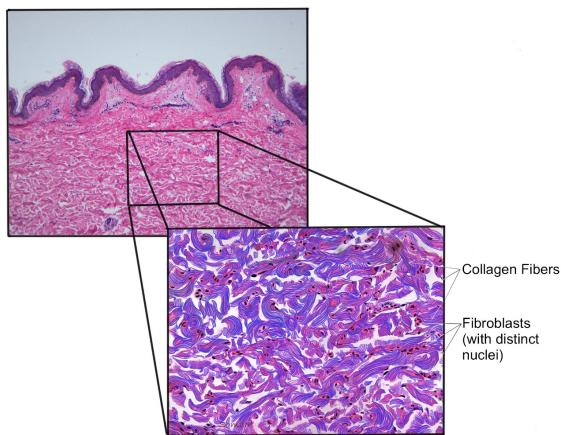
(b) Adipose tissue:-



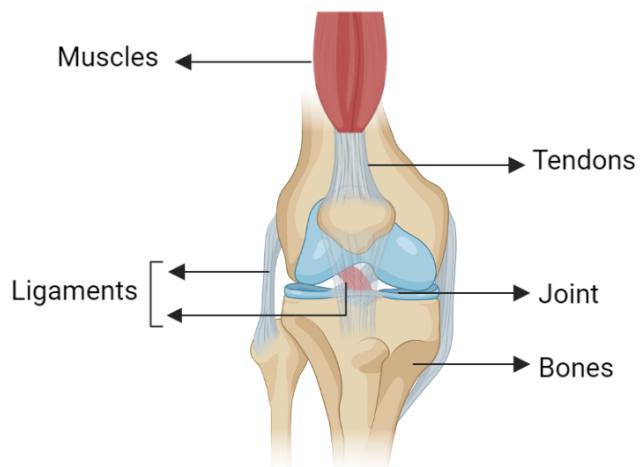
Specialised form of connective tissue whose primary function is for the storage of fats .

Adipocytes:- Fats are stored in the cell called adipocytes.

2.Dense connective tissue :-



- Less matrix is present
- Cells and fibres are compactly packed in the matrix



Tendons and Ligaments

- **Ligament**:- It joins Bone to bone (**Tricks :- BLB Bone Ligament Bone**)
Elastic , collagen fibres
- **Tendon** :- Connects muscle to bone (**Tricks :- MTB :- Muscle Tendon Bone**)

3. Specialised connective tissue:-

(i) Skeletal connective tissue:-

Matrix is solid

Fibres are present

(ii) Fluid connective tissue :-

Fluid matrix

Fibres absent

Skeletal connective tissue :-

Cartilage :- Matrix is solid but soft

Bone :- Matrix is solid and hard

(In detail it has been discussed in the chapter “Osseous system”)

Fluid connective tissue :-

Blood :- For the transport of nutrients,hormones and other substances.

(In detail it has been discussed in the chapter “Cardiovascular system”)

Muscular tissue :-

Each muscle



Muscle bundle (Fascicle)



Muscle fibres (Long cylindrical)



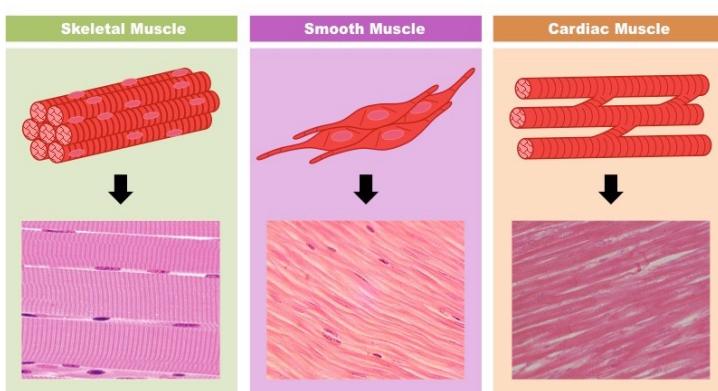
Myofibrils

Properties of muscle :-

1. Contraction
2. Excitability
3. Extensibility
4. Elasticity

Origin :- Mesoderm

Types :-



Skeletal (Striated)	Smooth (Visceral)	Cardiac (Striated)
1.Cylindrical fibre 2.Unbranched 3.Voluntary 4.Fast contraction 5.Rich blood supply 6.Multinucleated	Spindle shaped Unbranched Involuntary Slow contraction Less blood supply Uninucleated	Cylindrical Branched Involuntary Fastest contraction Abundant blood supply. Uninucleated

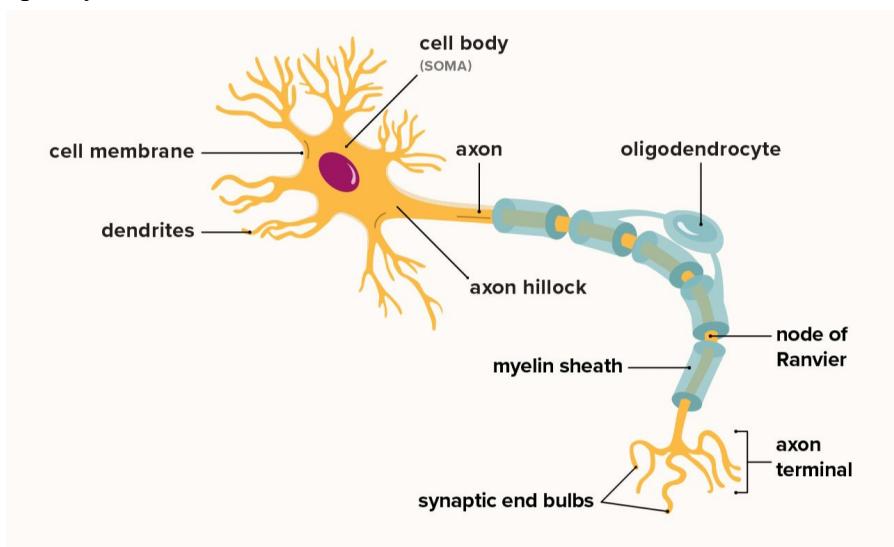
Neural tissue :-

- **Origin** :- Ectoderm
- Structural and functional unit of nervous system
- **Excitable cells** and helps in **conduction** .
- A mature nerve cell cannot divide

Composition :-

Nervous tissue is formed of four types of cells :-

1. Neurons
2. Neuroglia
3. Neuro-secretory cells
4. Ependymal cells



Neurons :-

- **It is the structural and functional unit of the nervous system.**
 - Longest cell of the body.
 - **Structure :- Formed of two parts -**
- (A) Cyton (B) Nerve processes

Cyton :-

- Also called **cell body /Stoma** .
- Granular cytoplasm having a prominent spherical **nucleus,golgi bodies,endoplasmic reticulum,lysosome, and Nissl's granules** is found .
- Nissl's granules are made up of **m-RNA, ER ,ribosomes** and have an affinity for basic dyes.

Nerve processes :-

- The nerve processes are also called **neurites**. Nerve processes can be divided into two parts-
(A) Dendrites (B) Axon

Dendrites -

- Dendrites may be one or several. It is a branched structure.

Axon -

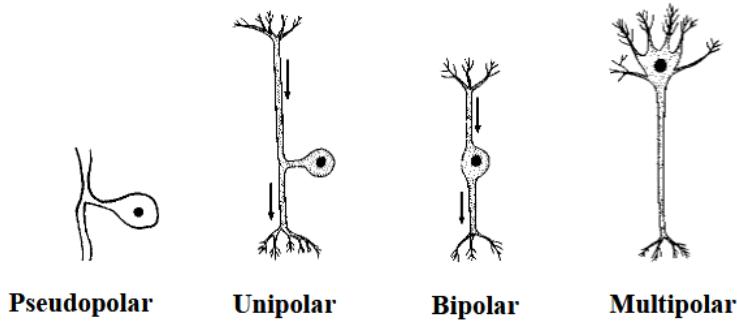
- It is single, long and cylindrical process whose main function is to conduct the nerve impulses away from the cyton, so, the axon is efferent in nature.
- It is the longest nerve process of a neuron.
- The plasmalemma of an axon is called axolemma whereas cytoplasm is called **axoplasm**.
- The axon ends in a group of branched, the terminal **arborization**, ends of terminal arborization possess knob like structure called **synaptic knob**.
- Axon possesses only neuro-fibrils. (Nissl's Granule, Golgi body, Ribosome, fat globules are absent). The part of cyton from where the axon arises is called **axon hillock**.

Synapse –

- A synapse is a specialized junction where a neuron (nerve cell) communicates with another cell. There is a microscopic gap of about 200 Å called **synaptic cleft**.
- The nerve impulses are transmitted from axon to dendron with the help of chemical called neurotransmitters which are either **acetylcholine** or **adrenalin (epinephrine)** or Electrical synapse.

Types of Neurons Based on Structure

Type of Neuron	Definition	Example / Location
Unipolar Neuron	Neurons having a single process (axon) arising from the cell body.	Found in embryonic nervous system ; in adults, in dorsal root ganglia (pseudo-unipolar neurons)
Bipolar Neuron	Neurons have one dendron and one axon at opposite poles of the cell body.	Retina of eye, Olfactory epithelium, Organ of Corti (inner ear), Taste buds
Multipolar Neuron	Neurons have many dendrons and one axon .	Common in adult nervous system (brain and spinal cord)



Types of Neurons Based on Function

Type	Function	Connection / Location
Sensory or Afferent Neuron	Carry sensory impulses from sensory organs to CNS.	Connects sensory organs with brain and spinal cord
Motor or Efferent Neuron	Carry motor impulses from CNS to effectors.	Connects CNS to muscles & glands
Interneurons or Adjustor Neuron	Link between two or more neurons for transmission of impulses.	Present in brain and spinal cord (CNS)

Nerve fibres :-

Feature	Medullated (Myelinated) Nerve Fibre	Non-Medullated (Non-Myelinated) Nerve Fibre
Definition	Nerve fibre covered with a medullary (myelin) sheath around the axon.	Nerve fibre lacking a medullary (myelin) sheath .
Nodes of Ranvier	Present, between myelinated segments.	Absent.
Location	Found in the somatic nervous system (sensory & motor neurons).	Found in autonomic nervous systems (sympathetic & parasympathetic fibres).

Types of Nerve Fibres Based on Function

Type of Nerve Fibre	Function	Direction of Impulse	Examples / Effector Organs
Afferent (Sensory)	Carries sensory impulses	From periphery → CNS	Sensory organs (skin,

Fibre	from receptor organs to the central nervous system (CNS) .		eyes, ears, taste buds, etc.)
Efferent (Motor) Fibre	Carries motor impulses from CNS to effector organs (muscles & glands).	From CNS → periphery	Skeletal muscles, smooth muscles, glands

Neuroglial cells

- It makes up more than 50 percent of the volume of the neural tissue.
- Supporting and packaging unit of neural tissue
- Non excitable cells .
- These act as packing cells between neurons.
- These provide nutrition to neurons
- These act as phagocytes and consume micro organisms.

Type	Shape / Structure	Function	Location
Microglia Cells	Small, spindle-shaped	Phagocytic; remove debris & dead cells	CNS
Astrocytes	Highly branched star-shaped	Provide structural support, form blood-brain barrier	CNS
Oligodendrocytes	Few branched processes (like dendrons)	Form myelin sheath around CNS axons	CNS