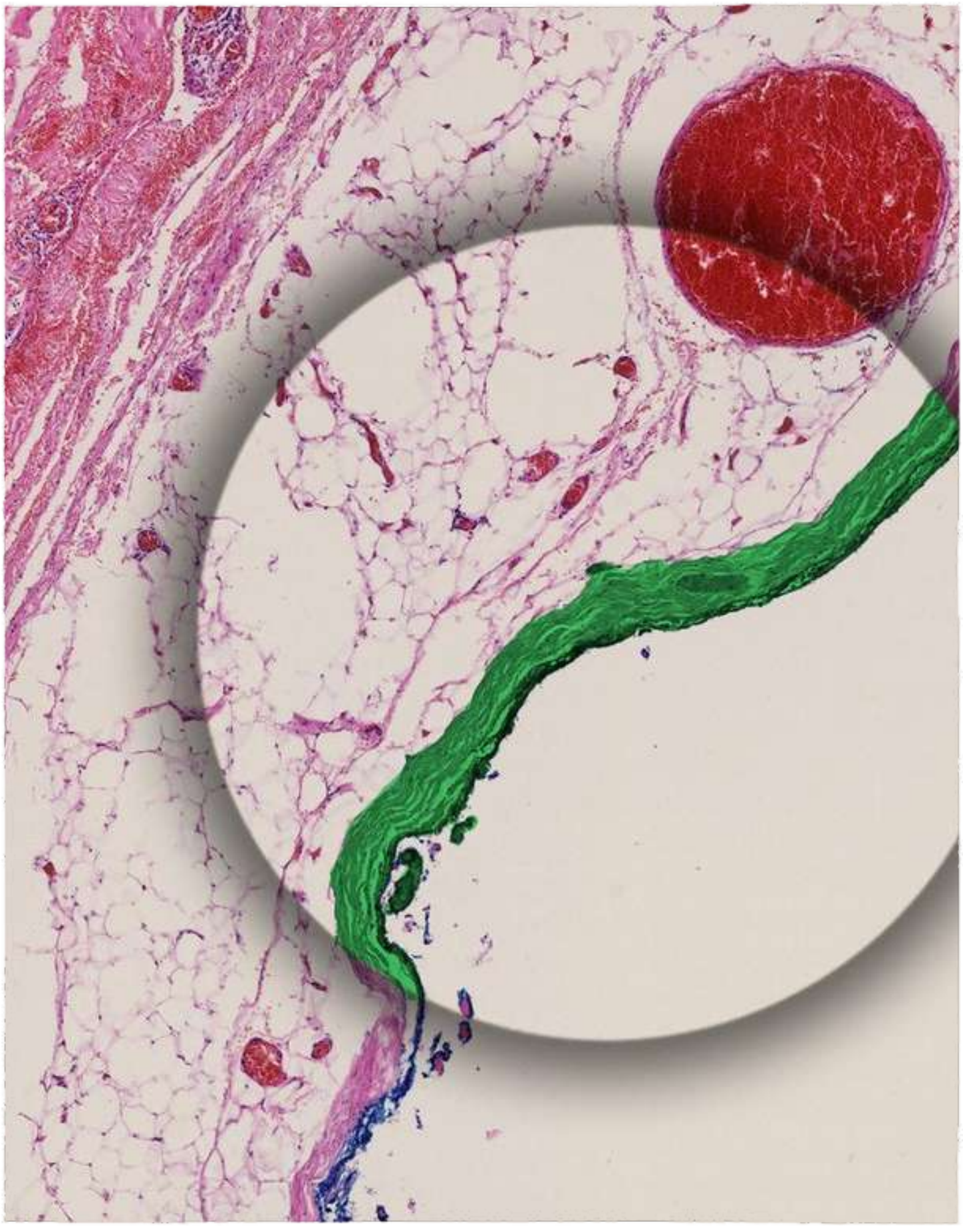
TISSUE



ZOOLOGY (HONS.)

SEMESTER 3
CORE COURSE 6: Animal Physiology:

Controlling and Co-ordinating System

ZOOA-CC3-6-TH

UNIT- 1

Muscular Tissue

Origin

– It develop from the mesoderm of embryo.

Special property

– Contractibility is the special property of muscular tissue. The cells of muscular tissue can shorten considerably and return to original relaxed state. The muscle cells contract in a definate direction.

Functions of muscular tissue

- – Muscles support the bone and other structure.
- – Muscles are responsible for heart beat production of sound, etc.
- – Muscles brings movements of the body parts and locomotion of individual.
- – Muscles are required for delivering a baby.

⇒ 40% to 50% of body weight is contributed by muscles.

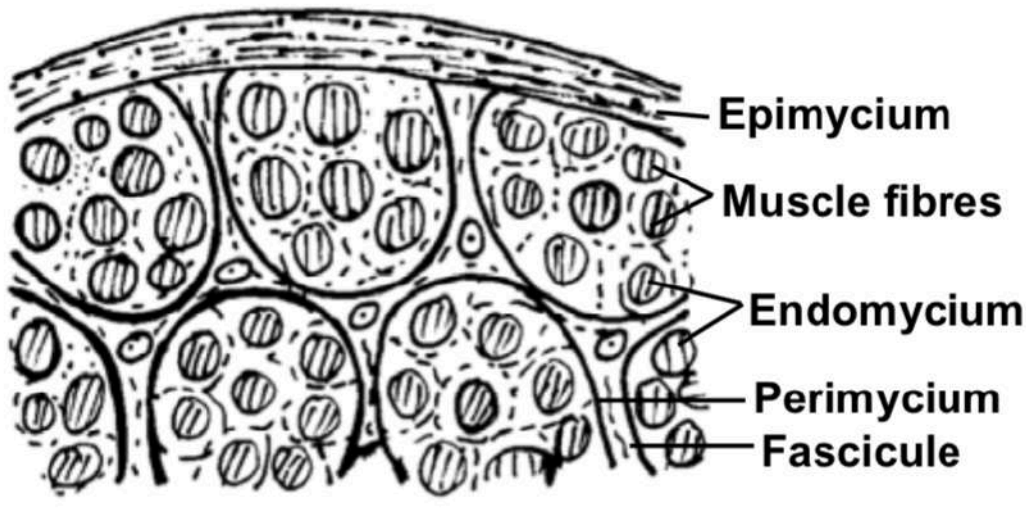


Fig. T.S. Muscle

Types of muscles

Muscles are of three types Striated muscles Unstriated muscles Cardiac muscles

Striated Muscles

Structure

- – Striated muscle fibre is also called stripped. skeletal or voluntary muscle fibre.
- – These muscle fibres occurs in bundles and are attached to the skeleton.
- – Each muscle fibre is surrounded externally by a delicate membrane sarcolemma.
- – In each fibre many nuclei appears at irregular interval, so each fibre is syncytial.
- – The cytoplasm (Sarcoplasm) of each fibre possess large number of myofibrils which are tightly packed.
- – Each myofibril possess dark and light bands alternating with each other.

Detailed structure of a myofibril

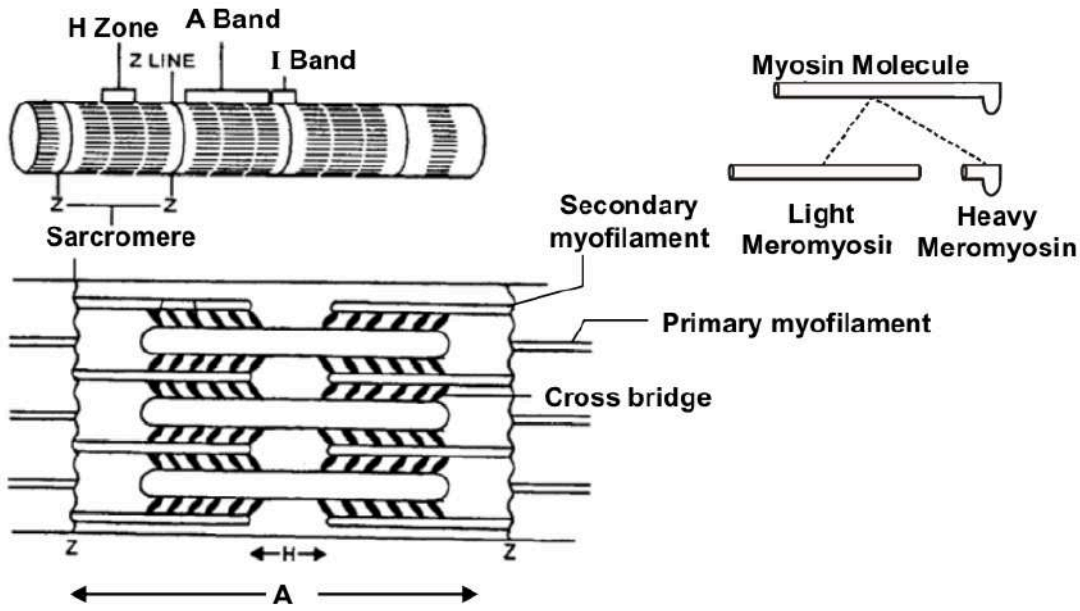


Fig. Structure of Vertebrate Striated Muscle at Magnification

- – The dark band of myofibril is called A-bands (Anisotropic bands). Each A band possess a light zone called H-zone or Henson's membrane in the middle.

- – The light band of myofibril is called I-bands (Isotropic bands). Each I-band possess a thin dark z-disc or krause's membrane in the middle.

⇒ Krause's membrane is also called Dobie's line or Zwischencheibe line.
The portion between two disc is called a sarcomere. Sarcomere are the functional units of myofibrils.

– Each sarcomere has two types of myofilaments; a coarse or primary and fine or secondary myofilaments arranged longitudinally. The primary myofilament is made of a protein called myosin whereas secondary myofilament is made up of 3 protein actin tropomyosin, troponin. Besides actin and myosin muscle fibre also contain calcium ion, a phosphate and adenosine triphosphate (ATP)

The primary filament remain confined to A bands only.

Location

Striated muscles are found in the muscle of limbs, tongue, pharynx, beginning of oesophagus, etc.

Function

These muscles are under control of will.

Differences between striated, non striated and cardiac muscles.

S.No.	Striped	Unstriped	Cardiac
1.	Occur in the body wall, limbs, tongue, pharynxand begining of oesophagus	Occur in the wall of hollow viscera, iris of the eye and dermis of the skin.	Occur in the walls of heart, pulmonary veins and superior venacava.
2.	Have numerous mitochondriaand glycogen granule	Have less numerous itocho-ndria and glycogen granules	Have numerous mitochondria and glycogen granules
3.	T-tubule system well developed	T-tubule system lacking	T-tubule system well developed
4.	No intercalated discs	No intercalated discs	Intercalated discs occur between the end of fibres.
5.	Voluntary	Involuntary	Involuntary
6.	Fibres unbranched	Fibres unbranched	Fibres join by short oblique bridges
7.	Blood supply is abundant, capillaries lie on the surface of fibres	Blood supply is scanty, capillaries lie on the surface of fibres	Blood supply is abundant, capillaries penetrate the fibres, Lymphatic capillaries also present
8.	Multinucleate, nuclei just near the sarcolemma	Uninucleate, nucleus at the centre	Mostly uninucleate, Nucleus at the centre.
9.	Myofibrils large and prominent, show distinct alternating light and dark cross bands, hence striped	Myofibrils indistinct and do not have light and dark bands, hence unstriped	My ofibrils distinct and with faint alternating light and dark bands
10.	Also called striated, skeletal and voluntary muscle fibres	Also called non-striated, smooth, visceral and involuntary muscle fibres	Also called heart muscle Fibres
11.	Contract quickly and power-fully, but cannot maintain contraction for a long time, hence soon get fatigued.	Contract slowly and mildly, but can remain contracted for a long time, are not fati-gued.	Contract quickly, Powerfully and rhythmically, non-fatigue. indefatigable
12.	Innervated by motor nerves from central nervous system (neurogenic)	Innervated by nerves from autonomic nervous system (neurogenic)	Innervated by nerves from central and autonomic nervous systems (neurogenic + Myogenic)

Unstriated muscle

Structure

- – Unstriated muscle fibre is also called smooth, involuntary, unstriped or visceral muscles.
- – Each fibre is elongated or spindle shaped, having single oval nucleus surrounded by cytoplasm.
- – Each muscle fibre possess longitudinally myofibrils arranged.
- – The fibre is enclosed by plasma membrane and unlike striated muscle there is no sarcolemma.
- – Several of muscles fibre are joined together in bundles by loose connective tissue.

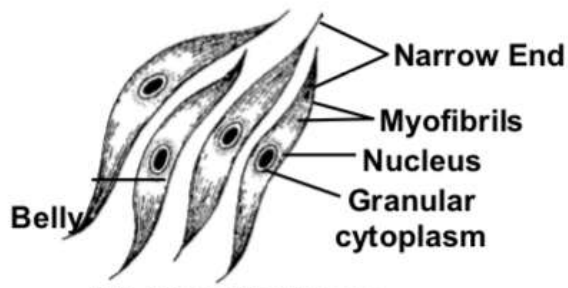


Fig. Smooth Muscle

Location

Unstriated muscles are found in stomach, intestine, lungs, urinary bladder, urinogenital tract, iris of eye, dermis of skin, posterior part of oesophagus and arrector pilli muscles of hairs.

Function

These muscle fibre helps in peristalsis. It causes slow and prolonged contraction which is involuntry i.e. not under control of will but are controlled by autonomic nervous system.

Single-unit smooth muscles	Multi-unit smooth muscles
(i) They have number of muscle fibres closely joined together.	(i) They have number of muscle fibres not so closely joined.
(ii) all the fibres contract together as a single unit, automatically and rhythmically. e.g. Walls of hollow visceral organs like stomach, intestine, urinary balder etc.	(ii) The individual fibres contract s separate units more of less as independent muscle e.g. hair roots, and on the walls of large blood vessels.

Cardiac muscles

Structure

Cardiac muscle fibres shows character of both striped and unstriped muscles, fibres in some characteristic, but also have some peculiar characters of its own.

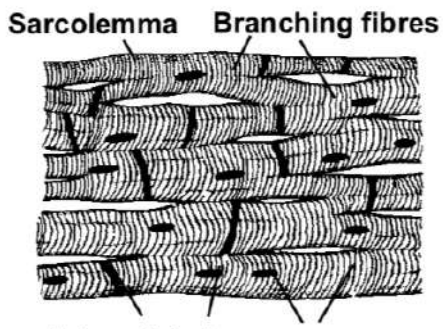


Fig. Cardiac muscle fibre

Similarities with striated muscle fibres :

Cylindrical, high vascularization, having more mitochondria and glycogen granules in the sarcoplasm; and having light and dark bands.

Similarities with smooth muscle fibres :

Uninucleate; involuntary, covered by plasma membrane.

Unique character

- – Cardiac muscles fibre are joined with each other by flat dense zig-zag junctions, called intercalated discs or booster rings.

- – Cardiac muscle fibre is supplied by both central nervous system and autonomic nervous system.

- – These muscles never get fatigued, blood capillaries penetrate the cardiac muscles fibres. They have the property of contraction even when they are isolated from the body temporarily.

- – Shows long refractory period.
  Location :
  These muscle fiber are found in the wall of heart and have very rich blood supply.

Nervous Tissue

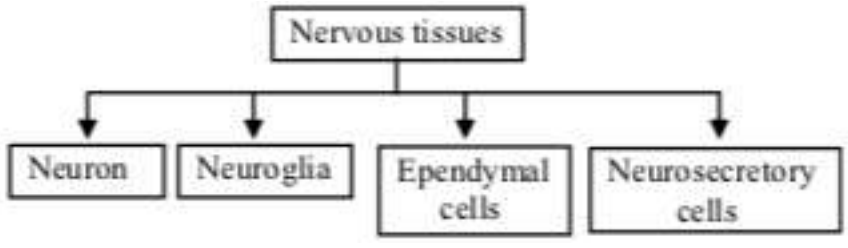
Origin

Nervous tissues originates from ectoderm of embryo.

Special properties

- – The special properties of the cells of nervous tissues are excitability and conductivity.

- – The cells of nervous tissues are specialized for receiving stimuli and transmitting message. These tissue forms nervous system of the body and include the following parts :



Composition

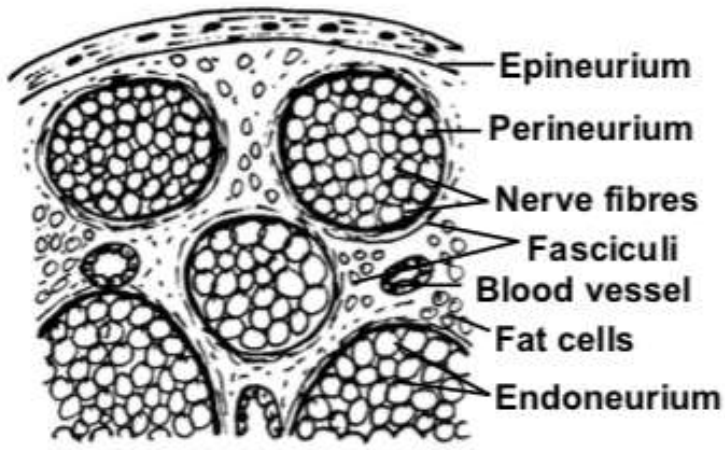
Nervous tissue is formed of four types of cells –

- – Neurons
- – Neuroglia
- – Neuro-secretory cells
- – Ependymal cells

Neurons

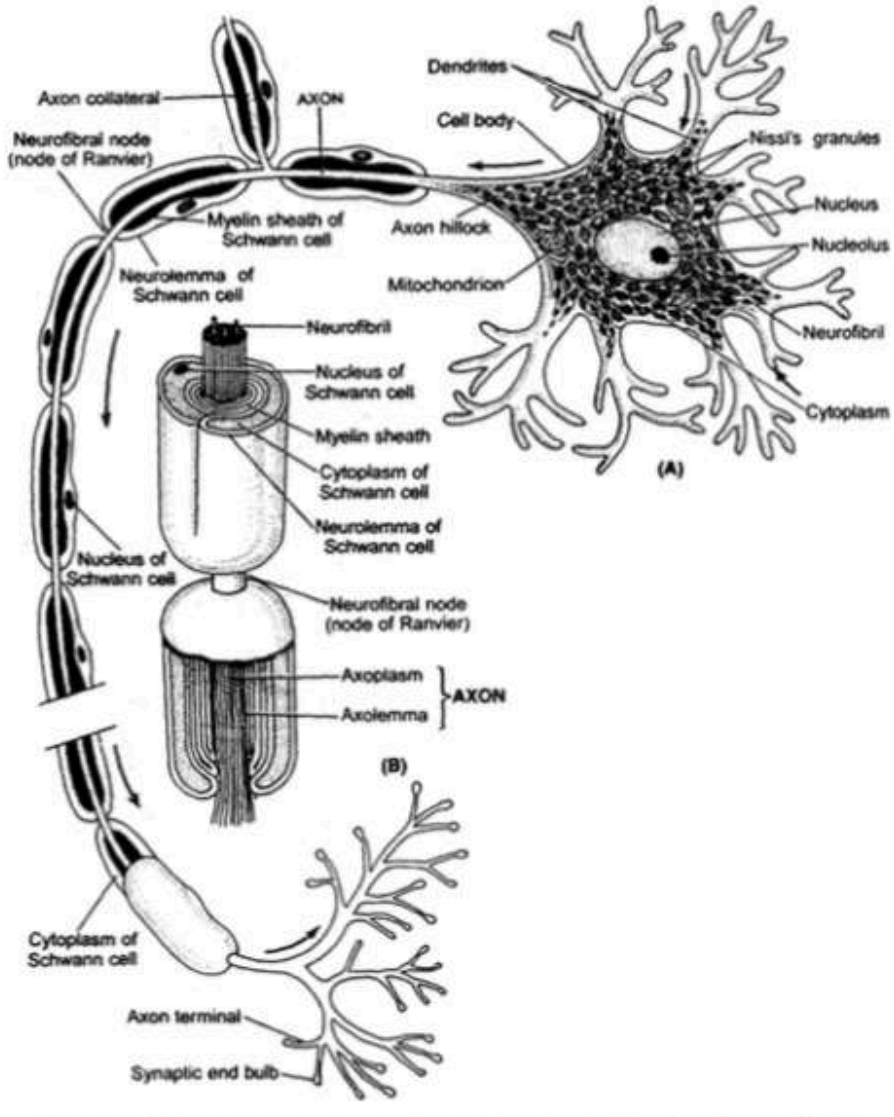
- – A neuron is a nerve cell with all its branches, Neuron is formed from neuroblast.

- – It is structural and functional unit of nervous system.



Neuron is the longest cell of the body. Structure : Neurons is formed of two parts –

(A) Cyton (B) Nerve processes



(A) Basic Structure of a neuron (B) Section through a myelinated fibre

Cyton

- – Cyton is also called cell body or soma, its shape is variable.

- – Its cytoplasm is granular called neuroplasm, within neuroplasm has a prominent spherical nucleus golgibodies, endoplasmic reticulum lysosome, fat globules, Nissl's granules and neurofibril is found.

- – Nissl's granules are comparatively large and irregular masses of ribosomes and rough endoplasmic reticulum. It is believed that nissil's granules synthesize protein in the cell. Nissl's granules are made up of m-RNA, ER, Ribosomes and has affinity for basic dyes.
  A mature neuron cannot divide.

Nerve processes

The nerve processess 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 branched structure.

Axon -

It is single, long and cylindrical process whose main function is to conduct the nerve impulses away from the cyton, so, axon is efferent in nature.

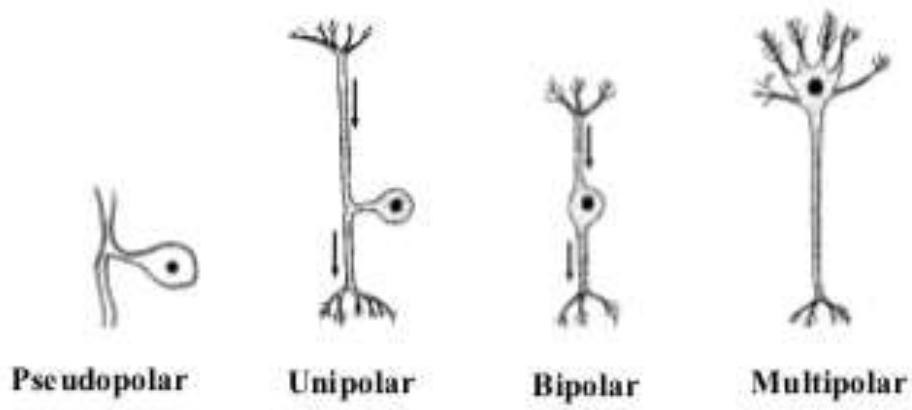
It is the longest nerve process of a neuron.

Note :

- – Giant squid (loligo) has axon of about 1500 μm in diameter.
- – Neurons with very long axon is called golgi type I.
- – Axon possess only neuro-fibrils. (Nissls Granule, Golgi body, Ribosome, fat globules are absent). The part of cyton from where the axon arises is called axon hillock. Some axon also give rise to side branches called collateral fibres.
- – The plasmalemma of 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 or synaptic buttons. Synapse
- – Synaptic knobs comes to lie very close to the dendrons of next neuron to form the synapses. 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 is either acetylcholine or adrenalin (epinephrine) or Electrical symapse (with synaptic cleft of 2 nm)

⇒ Acetylcholine or adrenaline is produced by the secretory vesicles of the synaptic knobs.

Types of neurons



On the basis of number of dendron and axon neurons are of 3 types -

– **Unipolar neuron** - The neuron having a single process the axon are called unipolar neuron.
e.g.Unipolar nervous system occurs in embryo.

– **Bipolar neuron** - The neuron having one dendron and an axon at the opposite pole of the cell are known as bipolar neuron.
e.g. Bipolar neuron occur in retina of eye, Olfactory epithelium, Organ of Corti, Taste bonds.

– **Multipolar neuron** : The neuron which have many dendrons and one axon are termed as multipolar neuron.

e.g. Multipolar neuron occur in nervous system of adults.

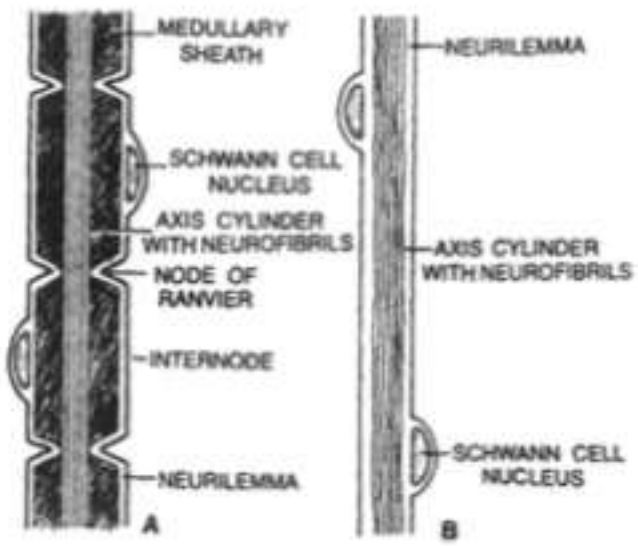
On the basis of functions neurons are of 3 types-

– **Sensory or afferent neuron** - They connect Sensory organs with central nervous system and brings sensory impulses into it.

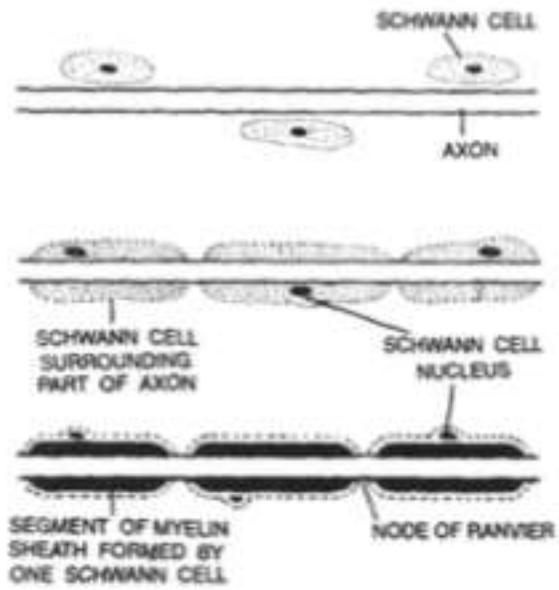
– **Motor or efferent neuron** - They connect central nervous system with the effectors. (muscles and glands) and carry motor impulses to them.

– **Interneurons or adjustor neuron** - They are present in the central nervous system (Brain and spinal cord) and connect two or more neurons for distant transmission of impulses.

Nerve fibres



A - Medullated nerve fibre.
B - Non-medullated nerve



Stages in the formation of the myelin sheath by a Schwann cell

- An axon of a neuron is covered with one or two sheaths.
  On the basis of number of sheaths on nerve fibre, nerve fibres are of two types -

– Medullated or myelinated nerve fibre
– Non medullary nerve fibre

Medullated or myelinated nerve fibre

– In these nerve fibres around the nerve a sheath of fatty substance is formed which is termed as medullary sheath or myelin sheath.

– The medullary sheath is not continuous and point of absence of medullary sheath is called nodes of Ranvier. The part of medullated nerve fibre between two adjacent nodes is called an internode. Medullary sheath forms an insulating coat and prevents loss of energy during conduction of nerve impulse.

– The medullary sheath and node of ranvier are surrounded by a transparent cellular outer covering known as neurolemma of Schwann cell.

– Just beneath the neurolemma a thin layer of cytoplasm lies, which contains nuclei to form Schwann cells (Sheath cells) at intervals. These nuclei are termed nuclei of Schwann cell.

– Medullated nerve fibre are found in brain spinal cord, cranial and spinal nerves. In the central nervous system, medullated nerve fibres form white matter.

Non-medullated (Non myelinated) nerve fibre

– In these nerve fibre no medullary sheath is found. The axon is surrounded by neurilemma and just below neurolemma a layer of cytoplasm containing nuclei at intervals is present. The node of Ranvier and internode are not present.

– The non medullated nerve fibres exists in autonomic nervous system.

– In central nervous system non medullated nerve fibre found in grey matter.

Functionally the nerve fibres are of two types :

– **Afferent or Sensory fibre** - Afferent fibre carries the sensory impulse from the receptor organs to the central nervous system (brain and spinal cord).

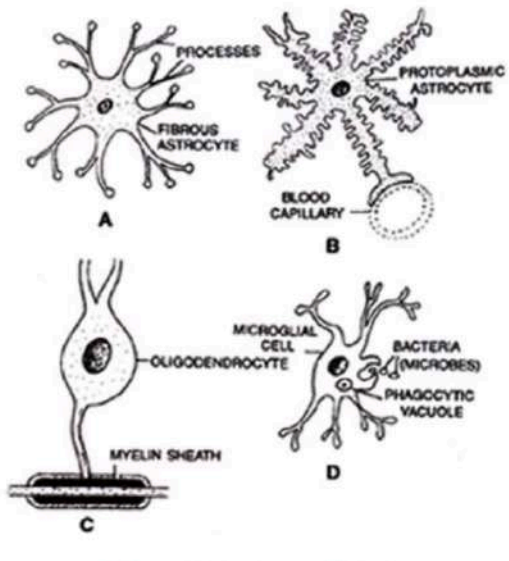
– **Efferent or motor fibre** - Efferent fibre carries impulses from the central nervous system to the various effector organs (muscles and glands).

Neuroglia or Glial Cells

– These are non nervous cells which lie between the neurons of CNS, ganglia and retina of the eye.

– These are many times (10 times approx) more numerous than neurons.

Types of neuroglial cells



Different kinds of neuroglial cells.
A. Fibrous astrocyte. B. Protoplasmic astrocyte C. Oligodendrocyte. D. Microglial cell.

Neuroglia cells are of following types

- – **Microglia cell** - These are spindle shaped small cells.
- – **Astrocytes** - These are highly branched.
- – **Oligodendrocytes** - These have few branched processess which resemble dendrons of the neuron.

Functions

- – These act as packing cells between neurons.
- – These provide nutrition to neurons
- – These act as phagocyte and consume micro organism.
- – These help in memory process
- – These insulate the adjoining neurons.

Ependymal cells

These cells form an epithelium called ependyma that lines the ventricles of brain and the central canal of
the spinal cord. The cells are generally ciliated.

Neurosecretory cells

These are special type of neurons of the hypothalamus of brain. These are endocrine in function and release neurohormone (releasing factor) through portal system to anterior most lobe of pituitary gland where they regulate secretion of harmones TSH, GH, LH, ACTH, FSH and Prolactin.