# ANIMAL TISSUE-2: NERVOUS TISSUE

SUBMITTED BY
DR. SAKSHI VERMA
ASST. PROF.
ZOOLOGY DEPARTMENT

# Nervous tissue

It is specialized tissue found in the central nervous system and the peripheral nervous system.

The nervous system is responsible for the control of the body and the communication among its parts.

**Special Properties of Neural Tissue:**

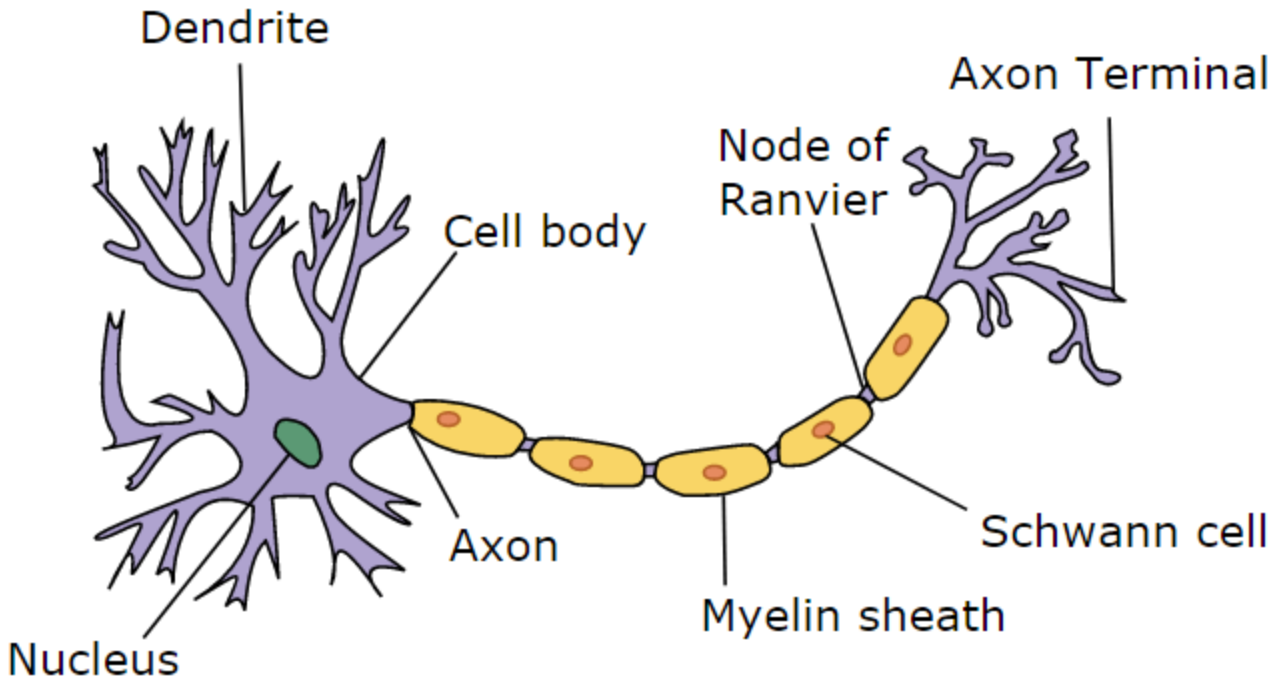
The special properties of the cells of the nervous tissue are, excit-ability and conductivity. Excitability is the ability to initiate nerve impulse in response to stimuli (changes outside and inside the body).

Conductivity means the ability to transmit a nerve impulse (potential change in membrane of a nerve cell). The reaction is called re-sponse. The response may be sensation, such as pain or some activity such as muscle contraction or glandular secretion.

**Components of Neural Tissue**

- Neurons
- Neuroglia
- Ependymal Cells
- Neurosecretory Cells

# Structure of Neuron



# Components of Neural tissue

## NEURON

- The neuron is the basic structural and functional unit of the nervous system. It is a specialized conductor cell that receives and transmits electrochemical nerve impulses.
- A typical neuron has a cell body and long cell processes(axon and dendrons) that conduct impulses from one body part to another body part.

**(i) Cyton (Cell Body):**

The cyton contains cytoplasm (neuroplasm), prominent spherical nucleus, mitochondria, Golgi bodies, endoplasmic reticulum, ribosomes, lysosomes, fat globules, Nissl's granules and neurofibrils. Nissl's granules are comparatively large and irregular masses of ribosomes and rough endoplasmic reticulum. They probably synthesize proteins in the cell.

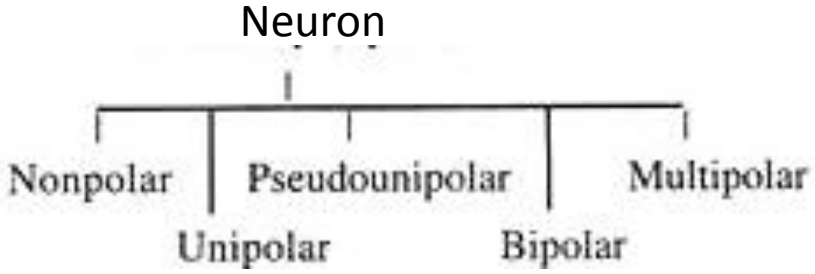
**(ii) Processes of Neuron:**

The processes of neurons are called neurites. The latter are of two types— dendrites (Dendrons) and an axon. Dendrites may be one to several but axon is always one. The dendrites are usually shorter and tapering processes. Axon is usually long process of uniform thickness. The part of cyton from where the axon arises is called axon hillock, which is the most sensitive part of neuron.

The axon ends in a group of branches, called axon endings or presynaptic knob. The latter end on other neuron, muscle fibres or gland cells. Certain axons also give rise to side branches, called collateral fibres.

The plasma membrane and neuroplasm of axon are respectively called axolemma and axoplasm.

Types of neuron
(on the basis of structure)



**(i) Nonpolar or Un-polarized Neurons:**

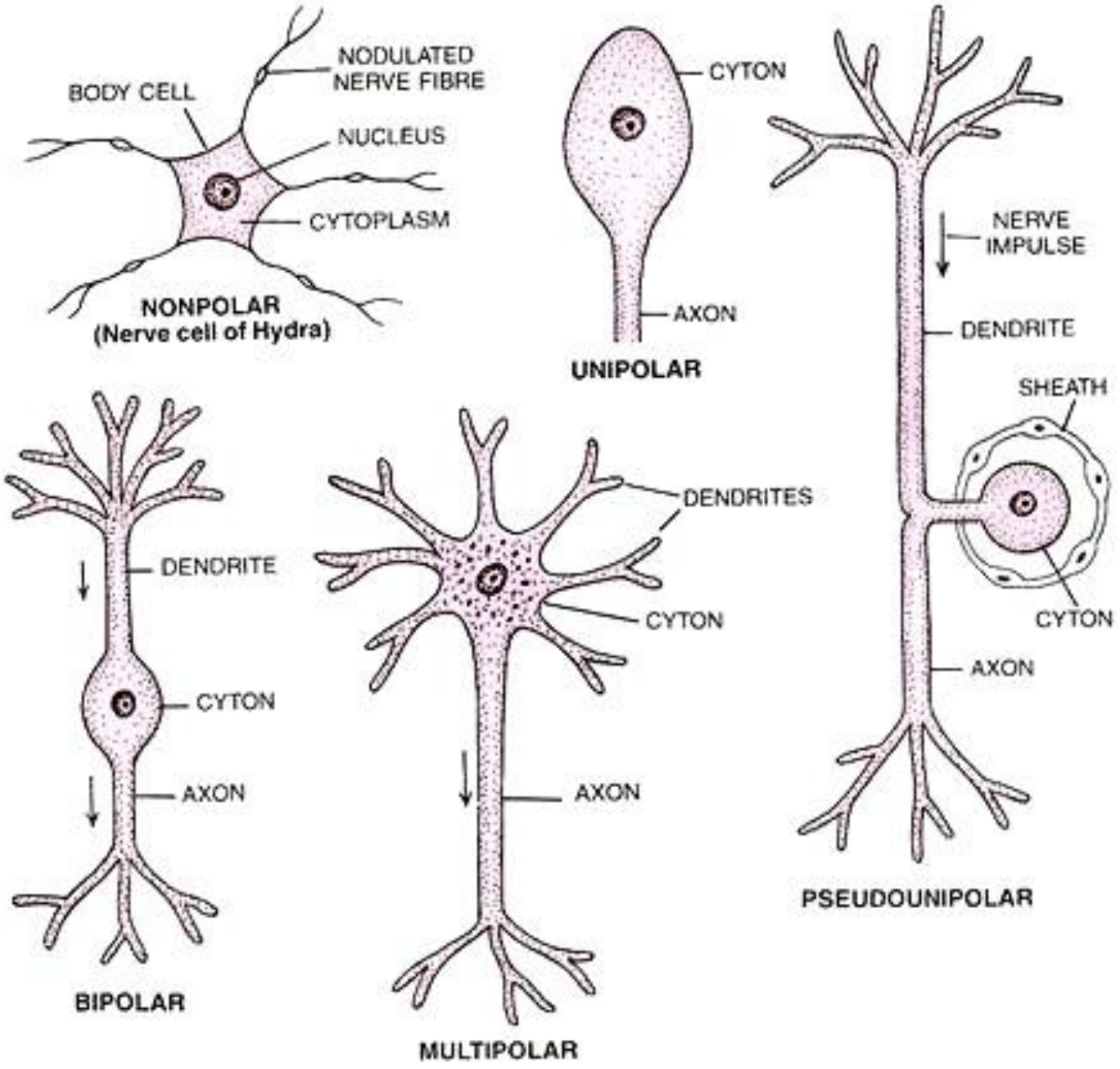
Each neuron bears several branched processes. There is no functional difference between dendrites and axon. Each process can bring an impulse to the cyton, or can take it away from the cyton. These neurons are rare in vertebrates but occur in cnidarians (= coelenterates) such as Hydra.

**(ii) Unipolar Neurons:**

Such neuron has a single process (projection), which arises from cyton. True unipolar neurons with an axon and no dendrite are found in early embryos of invertebrates and vertebrates.

**(iii) Pseudo unipolar Neurons:**

A single process arises from the cyton and then divides into an axon and a dendrite. Such neurons are termed pseudo unipolar neurons. In adult vertebrates, the dorsal root ganglia of spinal nerves possess pseudo unipolar neurons.




Types of neurons on the basis of structure.

**(iv) Bipolar Neurons:**

These neurons have only two processes, an axon at one end and a dendrite at another end. Bipolar neurons are found in the retina of eyes, olfactory epithelium and cochlear and vestibular ganglia (cochlea and vestibule are the parts of membranous labyrinth of internal ear).

**(v) Multipolar Neurons:**

These neurons have several dendrites and an axon. Motor neurons and interneurons are multipolar. They are the most common type of neurons. Multipolar neurons occur in the grey matter of the brain and spinal cord

# Types of neuron (on the basis of function)

**(i) Sensory (= Receptor or Afferent) Neurons:**
They connect sense organs with the central nervous system (brain and spinal cord). They bring sensory impulse from sense organs to the central nervous system.

**(ii) Motor (= Effector or Efferent) Neurons:**
They connect the central nervous system to the effectors (muscles and glands). They carry motor impulses from the central nervous system to the effectors.

**(iii) Interneurons (= Connector or Adjustor Neurons):**
They are present in the central nervous system and occur between the sensory and motor neurons for distant transmission of impulses. They are neither sensory nor motor, but are meant for integrating and analysing the input of information and distributing it to other parts of nervous system.

**Nerve Fibres:**
Axon or dendrite of a nerve cell covered with one, two or three sheaths is called nerve fibre. Dendrites are surrounded only by one sheath. An axon may be surrounded by two or three sheaths.

**Types** (**On the basis of structure**):
(i) Medullated or myelinated and (ii)non medullated or non-myelinated.

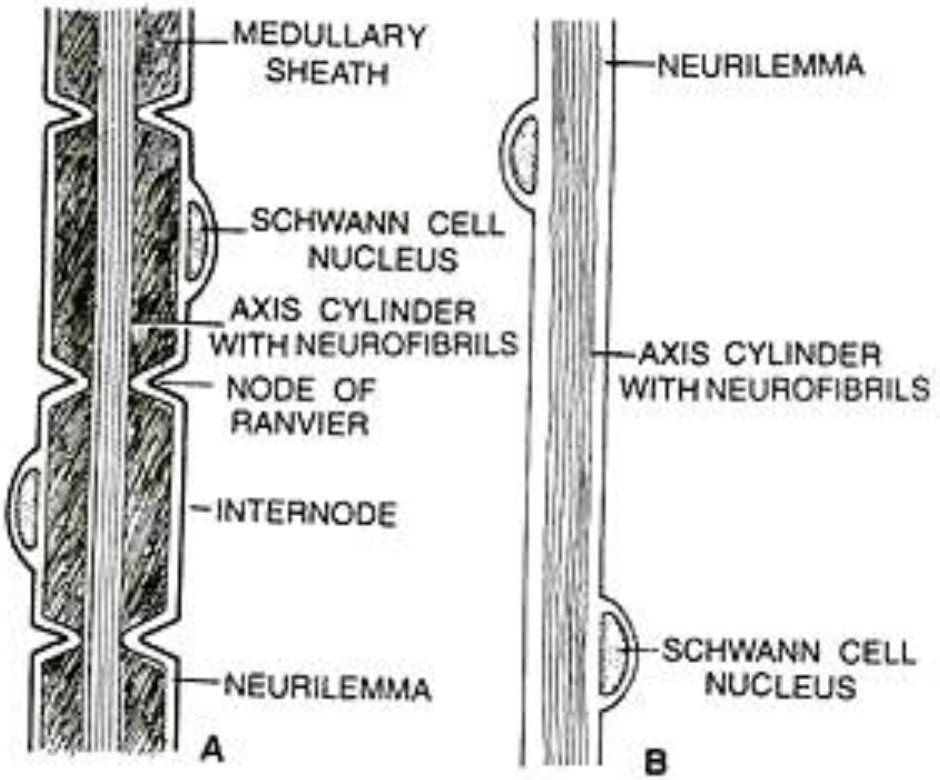
**Medullated (= Myelinated) Nerve fibres:**

Medullated nerve fibre is a nerve fibre with a medullary sheath. The medullary sheath is composed of substance called myelin. Myelin contains lipids, proteins and water. Thus myelin resembles the plasma membranes of a cell. The medullary sheath serves as an insulating layer, preventing loss of energy of the nerve impulse during its passage along the fibre.

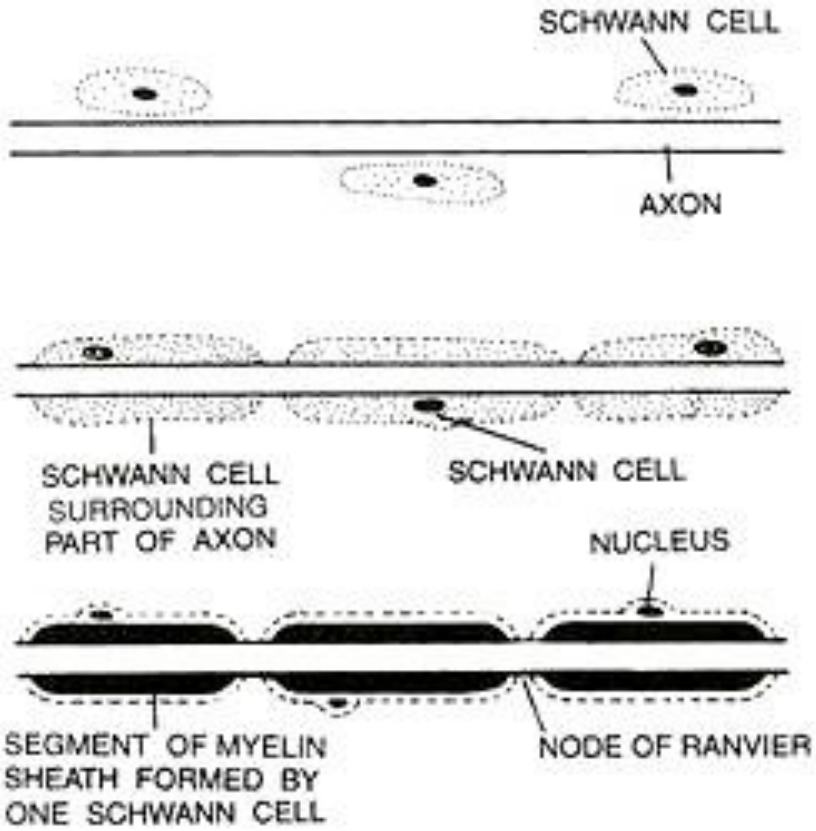
**The medullary sheath** is continuous around the nerve fibres in the central nervous system but in the nerve fibres of the peripheral nerve fibres it is absent at certain points called the nodes of Ranvier. The part of a nerve fibre between two successive nodes of Ranvier is called inter node.

Each segment of the myelin sheath is formed by **one Schwann cell**.

**Neurilemma (= Schwann cell Sheath):**
Outside the myelin sheath there is a layer of Schwann cell cytoplasm which is called neurilemma. A single large and flat nucleus is present in the cytoplasm. The neurilemma is continuous over the nodes of Ranvier.
Neurilemma is present round the peripheral nerve fibres of the cranial and spinal nerves but lack on the nerve fibres of brain and spinal cord.




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




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

**Non-medullated (=Non-myelinated) Nerve Fibres:**

A non-medullated nerve fi-bre consists of an axis cylinder surrounded by neurilemma and connective tissue. Non-medullated nerve fibre is a nerve fibre without medullary sheath. These are found in the gray matter of the brain and in autonomous nervous system.

The conduction of impulse in non-medullated nerve fibres is much slower than in the medullated nerve fibre.

These fibres do not have the nodes of Ranvier and intemodes.

**Types** (**On the basis of Function**):

(i) **Afferent (= Sensory) Nerve Fibres:** They carry nerve impulses from the sense organs to the central nervous system (brain and spinal cord).

(ii) **Efferent (= Motor) Nerve Fibres:** They carry nerve impulses from the central nervous system to the effector organs (muscles and glands).

## Neuron Polarity:

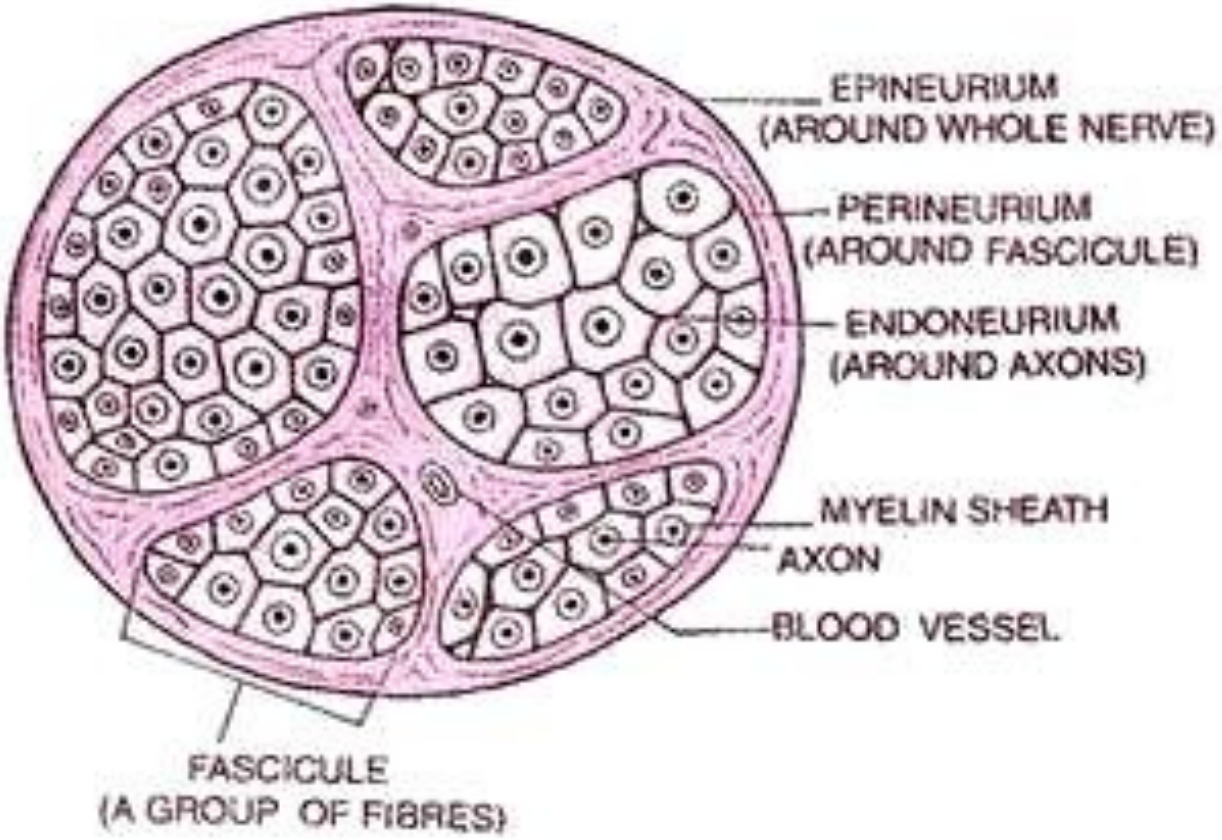
Nerve fibres carry impulses in one direction only from dendrites to cyton and hence to the axon. Thus one end of a neuron receives an impulse and the other end discharges it. This property of neuron is called neuron polarity.

**Nerves:**

A nerve consists of several bundles of nerve fibres called fasciculi. Each fasciculum (sing, of fasciculi) is surrounded by a layer of connective tissue called the perineurium. The perineurium is made up of flattened cells and collagen fibres (white fibres).

Each nerve fibre is surrounded by a layer of connective tissue called the endoneurium. The endoneurium con-tains collagen fibres, fibroblasts, Schwann cells, endothelial cells and macrophages.

A dense layer of con-nective tissue that surrounds the entire nerve is called the epineurium. The epineurium contains fat which cush-ions nerve fibres. Loss of this fat can lead to pressure on nerve fibres and paralysis.


EPINEURIUM
(AROUND WHOLE NERVE)
PERINEURIUM
(AROUND FASCICULE)
ENDONEURIUM
(AROUND AXONS)
MYELIN SHEATH
AXON
BLOOD VESSEL
FASCICULE
(A GROUP OF FIBRES)

T.S. of a nerve.

**Neuroglia (or Neuroglial Cells or Glial Cells:**

Neuroglia (neuro = nerve; glia = glue) or neuroglial cells are specialised cells found in the brain and spinal cord supporting the neurons and their fibres. About 50 percent of all brain cells are neuroglial cells. They may be divided into two major catagories:

**(a) Macroglia (= largeglial cells) and**

**(b) Microglia (= small glial cells).**

**(a) Macroglia: Large glial cells. These are of two types:**

**(i) Astrocytes (astro = Star; cyte = cell):**

These cells are star shaped that give off a number of processes, which help in clinging to the neurons and capillaries. They support and brace the neurons and anchor them to the nutrient supply lines.

Astrocytes also play a role in maintenance of the blood brain barrier. They are also responsible for repair of damaged areas of nervous tissue.

**Oligodendrocytes (Oligo = few; dendro = tree):**

These cells have rounded nucleus. The cytoplasm is rich in mitochondria, microtubules and glycogen. They have fewer and shorter cell processes. They occur in two distinct areas, near the medullated nerve fibres and near the surfaces of the somata (pi. of soma) of neurons.

Oligodendrocytes form myelin sheaths around the axons that lie with the central nervous system (brain and spinal cord).

**(b) Microglia (= Microglial cells or Small glial cells):**

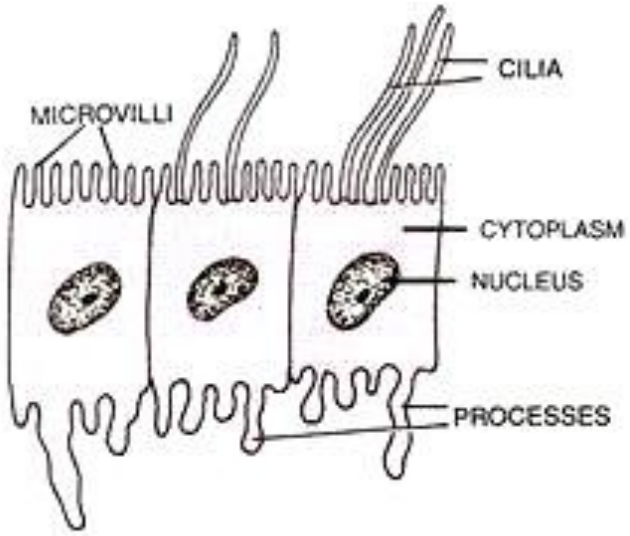
Microglia (micro- small; glia = glue) or microglial cells are formed from the mesoderm of the embryo. They are probably derived from the monocytes that invade the brain during foetal life. These are the smallest neuroglial cells.

They are more numerous in grey matter than in white matter. Microglial cells have short and fine processes. They engulf and destroy microbes and cellular debris. Thus they are phagocytic and also act as scavengers. They may migrate to area of injured nervous tissue and function as small macrophages.

**3. Ependymal Cells (= Ependyma):**

These cells are arranged as an epithelial layer, one cell thick, which lines the ventricles (cavities of the brain) and the central canal of the spinal cord. The cells vary from squamous to co-lumnar according to their location. Their free surface bears numerous microvilli and cilia.

The microvilli help in the absorption of cere-brospinal fluid. The movements of the cilia contribute the flow of the cerebrospinal fluid. The ependymal cells possess one or more long processes towards opposite side which penetrate the nervous tissue.




Ependymal cells

**4. Neurosecretory Cells:**

These specialized nerve cells function as endocrine organs. They release chemicals from their axons into the blood instead of synaptic cleft. Neurosecre-tory cells of the hypothalamus of the vertebrate brain secrete neurohormones