الجمهورية الجزائرية الديمقراطية الشعبية

جامعة جيجل

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HISTOLOGY

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Blood Tissue

Definition

Blood tissue, of mesoblastic origin, constitutes the liquid internal medium of the organism. It is composed of three main elements:

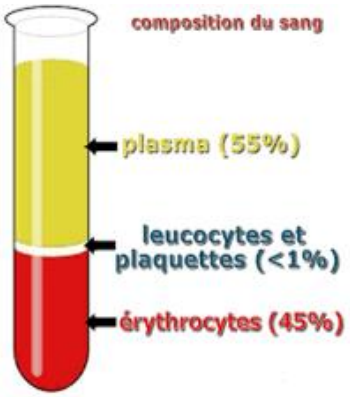
– Blood cells (corpuscles),

– Platelets (cellular fragments),

– Plasma (the liquid component of blood).

This composition enables blood to fulfil its essential functions in the body.

The red colour of blood is due to haemoglobin carried by the red blood cells.



Role

- • Transport of molecules (hormones, nutrients, gases, etc.) and metabolic waste products to the liver, kidneys, and intestines
- • Homeostasis
- • Defence of the organism (white blood cells)

1) Plasma

- • Colour: yellowish.
- • Plasma volume: 55% of total blood volume.
- • Composition:
  - – – Water (91.5%),
  - – – Defence proteins (immunoglobulins),
  - – – Coagulation factors (fibrinogen),
  - – – Enzymes,
  - – – Nutrients (glucose, amino acids, lipids, vitamins),
  - – – Metabolic waste products,
  - – – Respiratory gases,
  - – – Hormones,
  - – – Electrolytes (zinc, copper, iron),
  - – – Mineral elements:

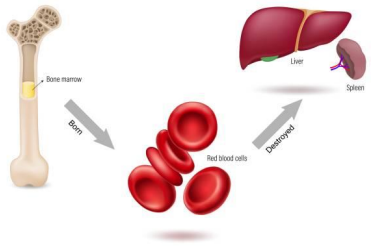
■ Cations (sodium, potassium, chloride, magnesium)

■ Anions (chloride).

Molecules and ions vary under diverse physiological and pathological conditions.

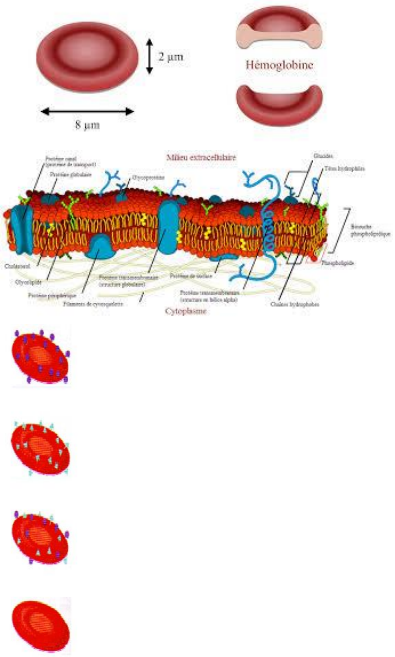
2) Red Blood Cells (Erythrocytes)

- • They are formed in the red haematopoietic bone marrow from stem cells.
- • They are destroyed by macrophagic cells in the liver and spleen.



a) Structure of Red Blood Cells

- ■ They are anucleate cells.
- ■ Shape: biconcave discs.
- ■ Size: diameter 8 µm.
- ■ Under electron microscopy, the plasma membrane has a structure identical to that of cytomembranes.
- ■ Presence of agglutinogens.



b) Blood Count

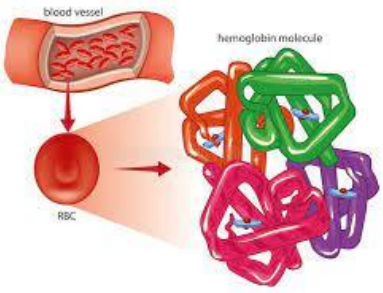
- ■ In males: 4.5 million to 5.4 million/mm^3 of blood.
- ■ In females: 4.2 million to 5 million/mm^3 of blood.
- ■ In newborns: 6 million/mm^3 of blood.

> **Pathology**
> Polycythaemia: Count above normal
> Anaemia: Count below normal

c) Chemical Composition

- ■ Anucleate cells, without cytoplasmic organelles.
- ■ Cytoplasm:
  - – Rich in water.
  - – Rich in haemoglobin (Hb):

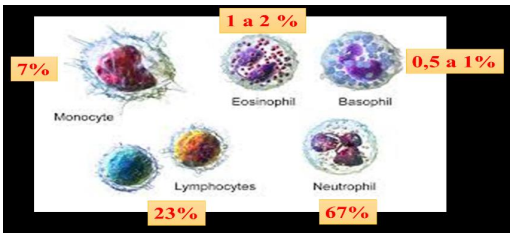
  Protein consisting of globin + 4 haem groups (4 iron atoms). Haemoglobin transports O_2 and CO_2.

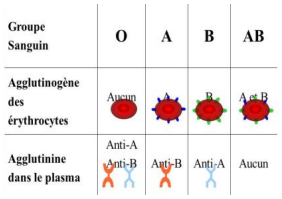


d) Plasma Membrane

Contains:

- ■ Surface enzymes.
- ■ Hereditary and independent agglutinogens A and B, responsible for the agglutination of red blood cells.
- ■ 4 blood groups: A, B, AB (universal recipient), O (universal donor).
- ■ Antigen D:
  - – Subjects carrying antigen D (Rh+) (80% of the population)
  - – Subjects without antigen d (Rh–).





3) White Blood Cells (Leucocytes)

- ■ They are nucleated cells.
- ■ They possess cytoplasmic organelles.
- ■ White blood cells are capable of:
  - – Diapedesis
  - – Phagocytosis
  - – Immune reactions

a) Blood Count:

There are two types of white cell counts:

- ■ Total white cell count: 6,000 to 7,000/mm^3 of blood

Pathology		
Leucopenia	→	Count below normal
Hyperleucocytosis	→	Count above normal

- ■ Differential white cell count:

Determination of the quantity of eosinophilic granulocytes as well as other blood leucocytes.

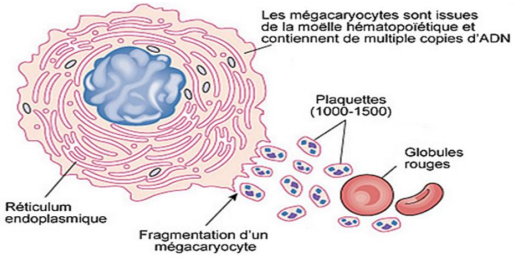
b) Leucocyte Formula

	Petit Lymphocyte	Lymphocyte moyen	Grand lymphocyte
	8µ	10 a 12 µ	15 µ
	arrondi	arrondi ou ovalaire	arrondi ou ovalaire
	Très réduit	Peu abondant Basophile	abondant très basophile

c) Structure and Roles of Leucocytes

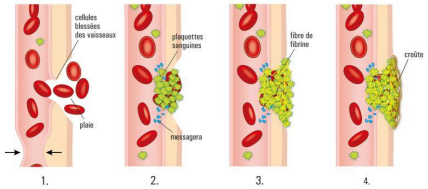
➤ Granulocytes

– – Multilobed nucleus
– – Presence of cytoplasmic granules



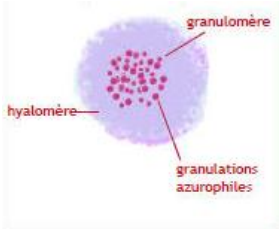
➤ Mononuclear cells

– – Non-segmented nucleus
– – Absence of cytoplasmic granules



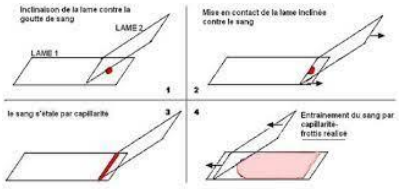
❖ Neutrophilic Granulocytes

- ■ Nucleus:
  3 lobes in young neutrophilic granulocytes
  5 lobes in aged neutrophilic granulocytes
- ■ Cytoplasm: weakly acidophilic
- ■ Role: Phagocytosis



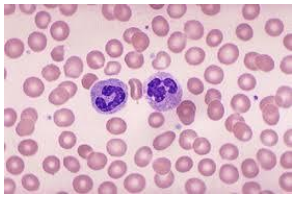
❖ Eosinophilic Granulocytes

- ■ Bilobed nucleus (horseshoe-shaped)
- ■ Acidophilic cytoplasm (proteases)
- ■ Role: poorly understood



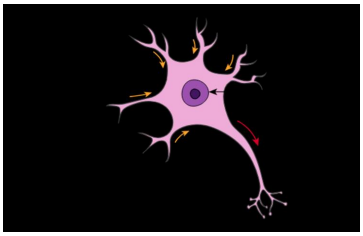
❖ Basophilic Granulocytes

- ■ Large bilobed nucleus (2 oval lobes)
- ■ Basophilic cytoplasm
- ■ Role: unknown



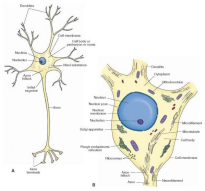
❖ Monocyte

- ■ They are the macrophages of the blood.
- ■ Eccentric and kidney-shaped (reniform) nucleus.
- ■ Cytoplasm rich in lysosomes.
- ■ Role: Phagocytosis.



❖ Lymphocyte

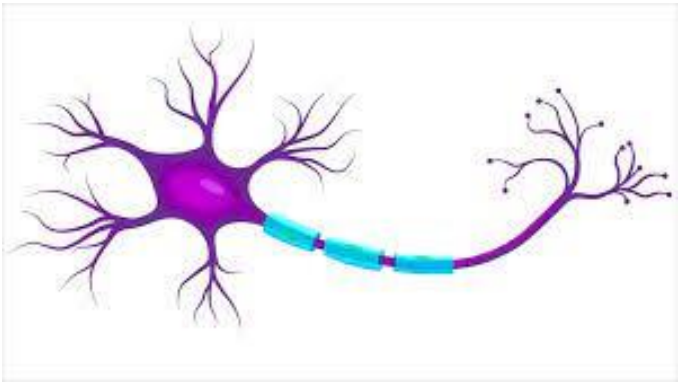
- ■ Role: Immune defence.



	Small Lymphocyte	*Medium Lymphocyte*	*Large Lymphocyte*
Size	8 µm	10 to 12 µm	15 µm
Nucleus	rounded	rounded or oval	rounded or oval
	Occupying nearly the entire cell		
Cytoplasm	Very reduced	Slightly abundant, basophilic	Abundant, strongly basophilic

4) Blood Platelets

Origin: fragmentation of a giant cell called the **platelet megakaryocyte**.

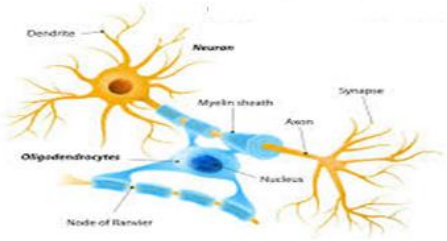


a) Structure

- ■ Size: 2 to 5 µm
- ■ Structure: cell fragments = thrombocytes
- ■ Nucleus absent
- ■ Cytoplasm presenting 2 regions:
  - – → Granulomere

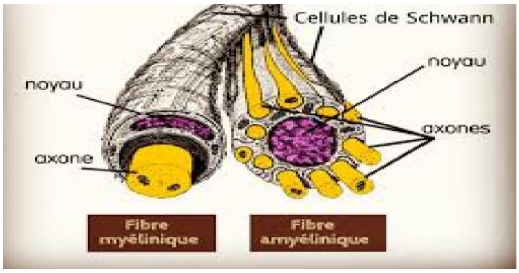
  Central region rich in granules
  - – → Hyalomere

  Cortical region poor in molecules



b) Roles

- ■ Haemostasis and blood coagulation.
- ■ Following a vascular breach, a blood clot is formed to stop bleeding.



c) Count

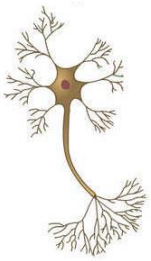
- ■ Ranges from 250,000 to 400,000/mm^3 of blood.
- ■ Pathology:
  - – – Hyperplaquetosis: Count above 400,000/mm^3 of blood.
  - – – Thrombocytopenia (Thrombopenia): Count below 250,000/mm^3 of blood.

The Blood Smear

A blood smear is a microscopic examination of blood consisting of spreading a thin layer of blood on a glass slide, then staining it (often with dyes such as May-Grünwald-Giemsa) to observe the blood cells.

Method:

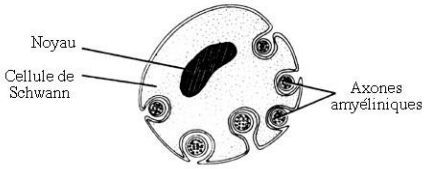
- ■ Collection of a drop of blood
- ■ Uniform spreading of the blood drop on a glass slide
- ■ Formation of a single layer of cells



Purpose:

Observation of the preparation also allows:

- • Detection of abnormalities
- • Enumeration of red blood cells
- • Identification of parasites in the blood



Nervous Tissue

From an embryological standpoint, nervous tissue originates from the neurectoblast.

Anatomically, it is structured into two major components:

The **central nervous system (CNS)**, consisting of the encephalon (brain) and the spinal cord.

The **peripheral nervous system (PNS)**, which encompasses the ganglia and peripheral nerves.

The PNS, in continuity with the CNS, ensures the transmission of sensory information towards the nerve centres and conveys motor commands to the effector organs.

Physiologically, nervous tissue plays a central role in the regulation of organic functions by forming a complex network capable of perceiving, transmitting, and integrating nerve impulses originating from the external or internal environment. The CNS processes this information and generates an appropriate response, which is then relayed by the PNS towards the target cells.

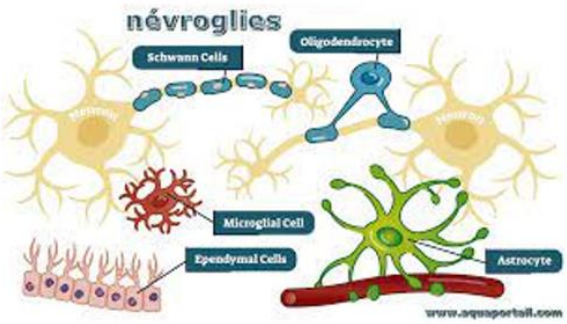
At the cellular level, nervous tissue is composed of **neurons**, responsible for conducting the nerve impulse, and **neuroglial cells**, which provide support, nutrition, and protection to neurons. This organisation allows the nervous system to efficiently coordinate the activities of the organism.

1. Different Types of Nerve Cells

- • Neurons, or typical nerve cells.
- • Neurosensory cells.
- • Neuroglandular cells.

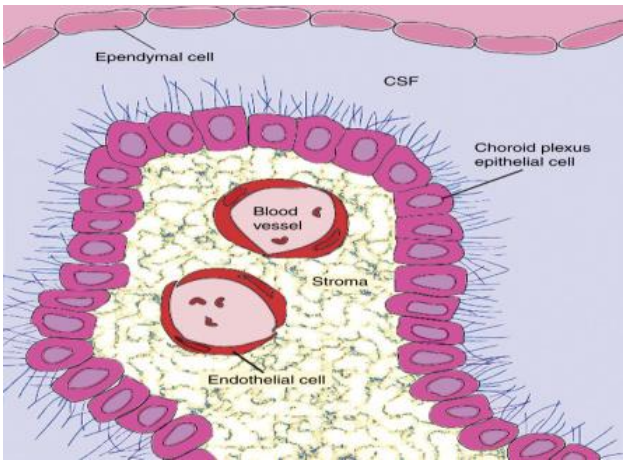
2. Neurons

The neuron is the principal or fundamental cell of nervous tissue. It is characterised by a **cytone** (or cell body) and **processes (neurites)**.



a. The Cytone (Cell Body)

The cell body is surrounded by a plasma membrane called the **neurolemma**. This encloses the fundamental cytoplasm, called **neuroplasm**, which contains a central, spherical, large, and non-mitotic nucleus.



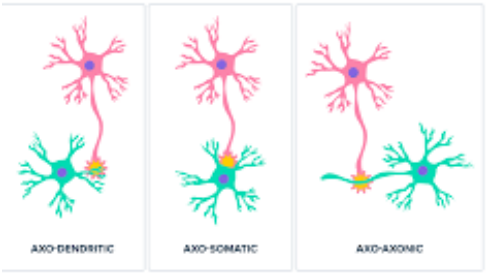
→ **Neurolemma**: plasma membrane.

→ **Neuroplasm**:

- – Central, spherical, large, and non-mitotic nucleus,
- – Neurosomes (mitochondria), short and slender,
- – Well-developed Golgi apparatus,
- – Lipid and pigment inclusions (melanin and lipofuscin),
- – **Nissl bodies**: stacks of rough endoplasmic reticulum (RER) lamellae responsible for the synthesis of neurotransmitters,
- – **Neurofibrils**: neurofilaments that transport neurotransmitters towards the terminal end of the axon.

b. Neurites

The cell body extends into two types of neurites with opposing functional polarity: the **axon** and the **dendrites**.



❖ Dendrites:

- – Thick and branched or unbranched,
- – Receive the nerve impulse.

❖ The Axon:

- – Unique, slender, little or not branched,

- – Transports the nerve impulse (NI) towards the terminal end,
- – It is formed by:
- ■ • Axolemma,
- ■ • Axoplasm.

3. Classification of Neurons

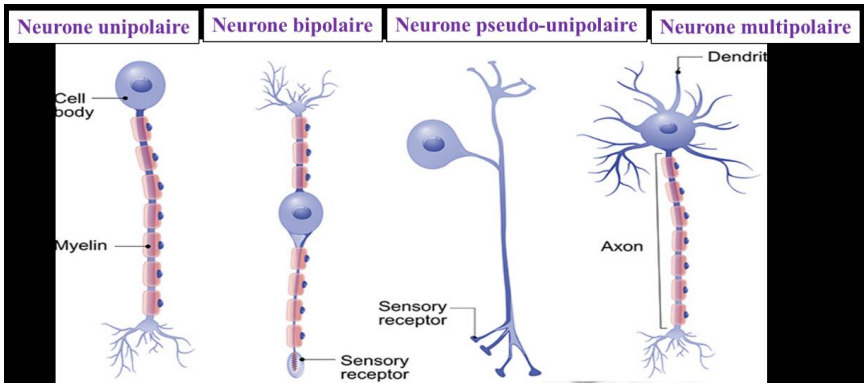
Neurons are classified according to their morphology. This classification is based on the number of processes:

→ **Unipolar neuron**: The cell body emits a single process.

→ **Pseudo-unipolar neuron**: Separates into 2 branches.

→ **Bipolar neuron**: Presents two processes on either side of the cytone.

→ **Multipolar neuron**: Possesses one axon and multiple dendrites.



4. Nerve Fibres

a. Myelinated Nerve Fibres with a Schwann Sheath:

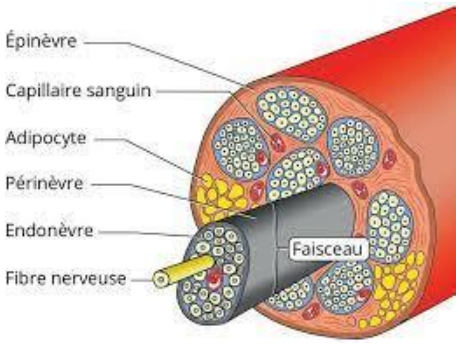
Location: at the level of the PNS.

- ■ Axon
- ■ Myelin sheath,
- ■ Schwann sheath (set of Schwann cells)
- ■ Myelination is carried out by Schwann cells.

b. Myelinated Nerve Fibres without Schwann Sheath:

Location: at the level of the CNS.

- ■ Axon
- ■ Myelin sheath
- ■ Oligodendrocytes
- ■ Myelination is carried out by oligodendrocytes.



c. Unmyelinated Nerve Fibres with Schwann Sheath:

Location: at the level of post-ganglionic fibres of the ANS (Autonomic Nervous System).

- ■ Axon
- ■ Schwann sheath (set of Schwann cells).

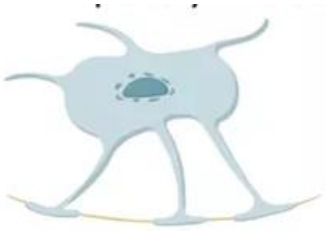
Microglies

Astrocytes

d. Unmyelinated Nerve Fibres without Schwann Sheath:

Location: at the level of the grey matter of the CNS.

- ■ The axon is bare.

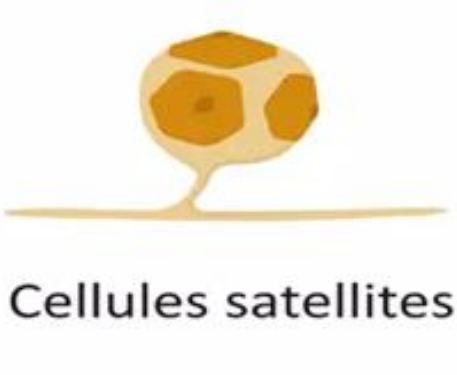


Oligodendrocytes

5. Nerves

Nerves present a complex and hierarchical structural organisation; they are formed of bundles of nerve fibres surrounded by three connective tissue sheaths:

- ■ **Endoneurium**: Connective tissue surrounding individual nerve fibres.
- ■ **Perineurium**: Connective tissue surrounding bundles of nerve fibres.
- ■ **Epineurium**: Connective tissue surrounding the entire nerve.



6. Nerve Synapses

These are connections.

- • Neuro-neuronal. (between 2 neurons — interneuronal synapse)
- • Neuro-somatic (between a neuron and a target cell (muscle, gland))

Role: Transmission and modulation of the nerve impulse (electrical or chemical).

Function: Ensuring communication within the nervous system and with the effectors.

a. Structure

The synapse is formed by:

→ **Pre-synaptic space:**

Chemical transmission of the nerve impulse via neurotransmitters.

→ **Synaptic cleft:**

The site where neurotransmitters bind to specific receptors.

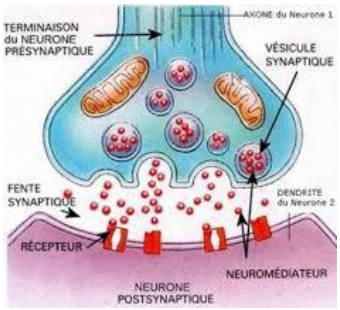
→ **Post-synaptic space:**

Depolarisation of the plasma membrane and transfer of the nerve impulse.

b. Varieties of Synapses

The following types can be distinguished:

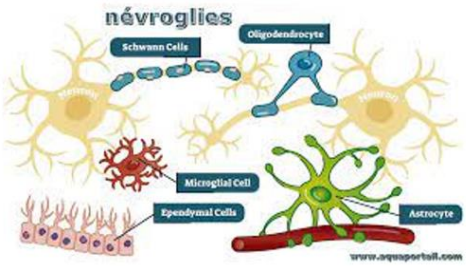
- • **Axo-dendritic synapse:**
  Contact between an axon and dendrites.
- • **Axo-somatic synapse:**
  Contact between an axon and the cell body.
- • **Axo-axonic synapse:**
  Contact between two axons.



7. The Neuroglia

The neuroglia encompasses the entire set of glial cells associated with neurons in nervous tissue. Glial cells are of neurectoblastic origin, with the exception of microgliocytes, which derive from the mesenchyme.

Role: Support and nutrition of neurons.



Neuroglial cells can be classified into 2 major categories:

a. Central Neuroglia Located in the CNS:

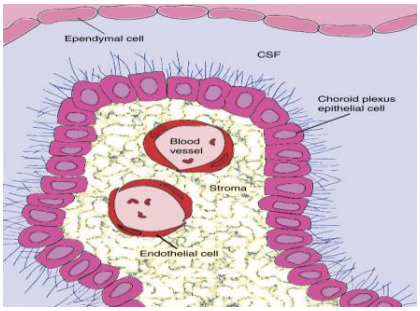
– – **Epithelial neuroglia**:

■ Ependymocytes.

■ Choroid plexus cells.

These are the epithelial cells that line the internal cavities of:

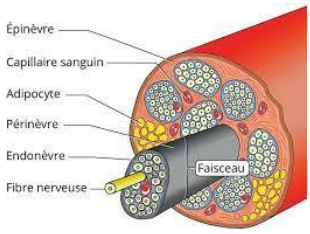
- • The brain
- • The spinal cord.



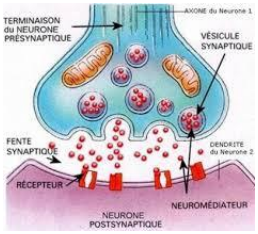
– – **Interstitial neuroglia**:

- Astrocytes.
- Oligodendrocytes.
- Microgliocytes.

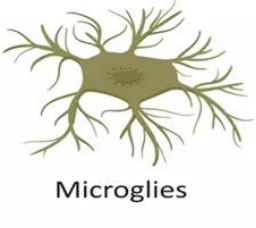
Microglia



Astrocytes

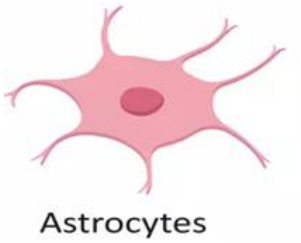


Oligodendrocytes



b. Peripheral Neuroglia Located in the PNS:

- Satellite cells.
- Schwann cells.



Satellite cells

Schwann cells