Introduction to Anatomy

1st Year Medical Students

2025-2026
Second Semester

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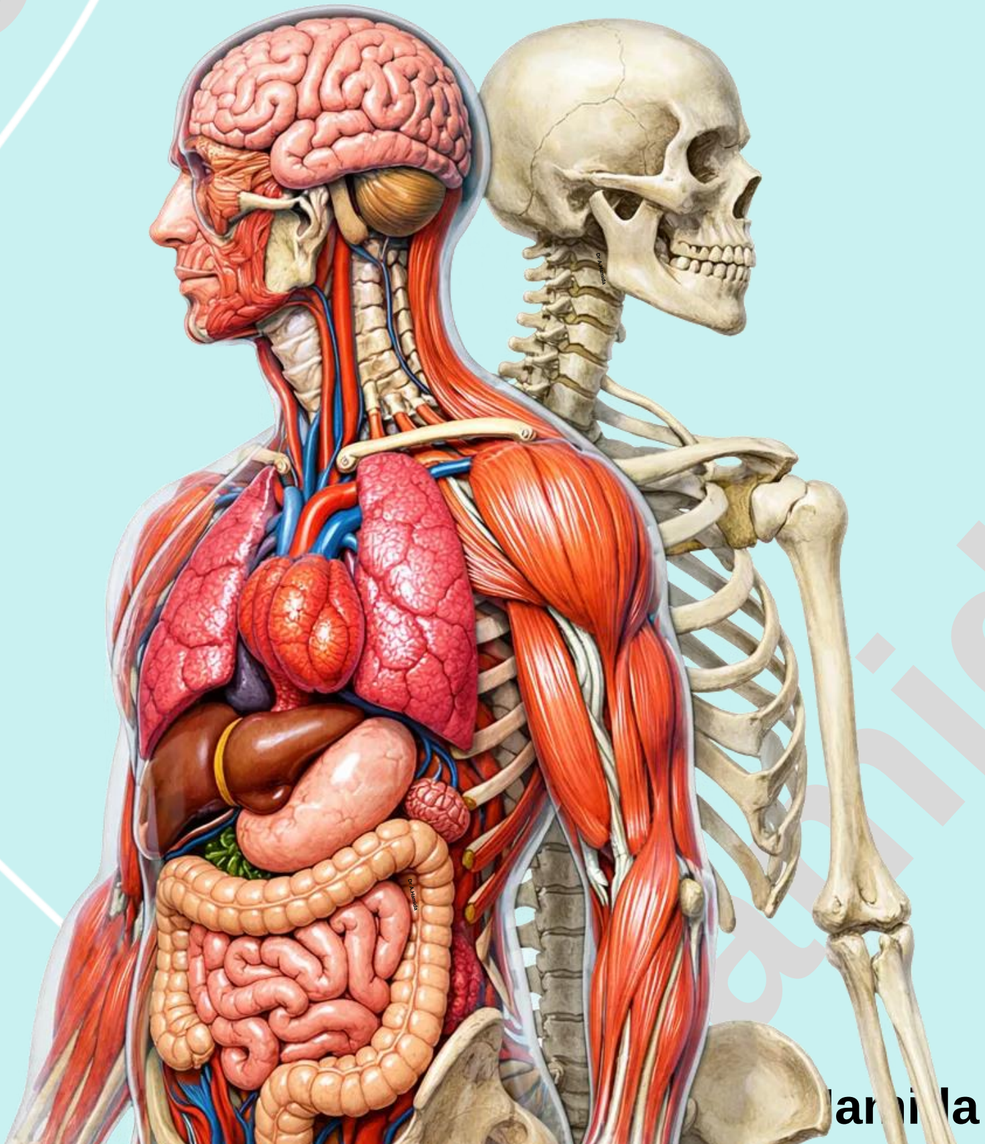
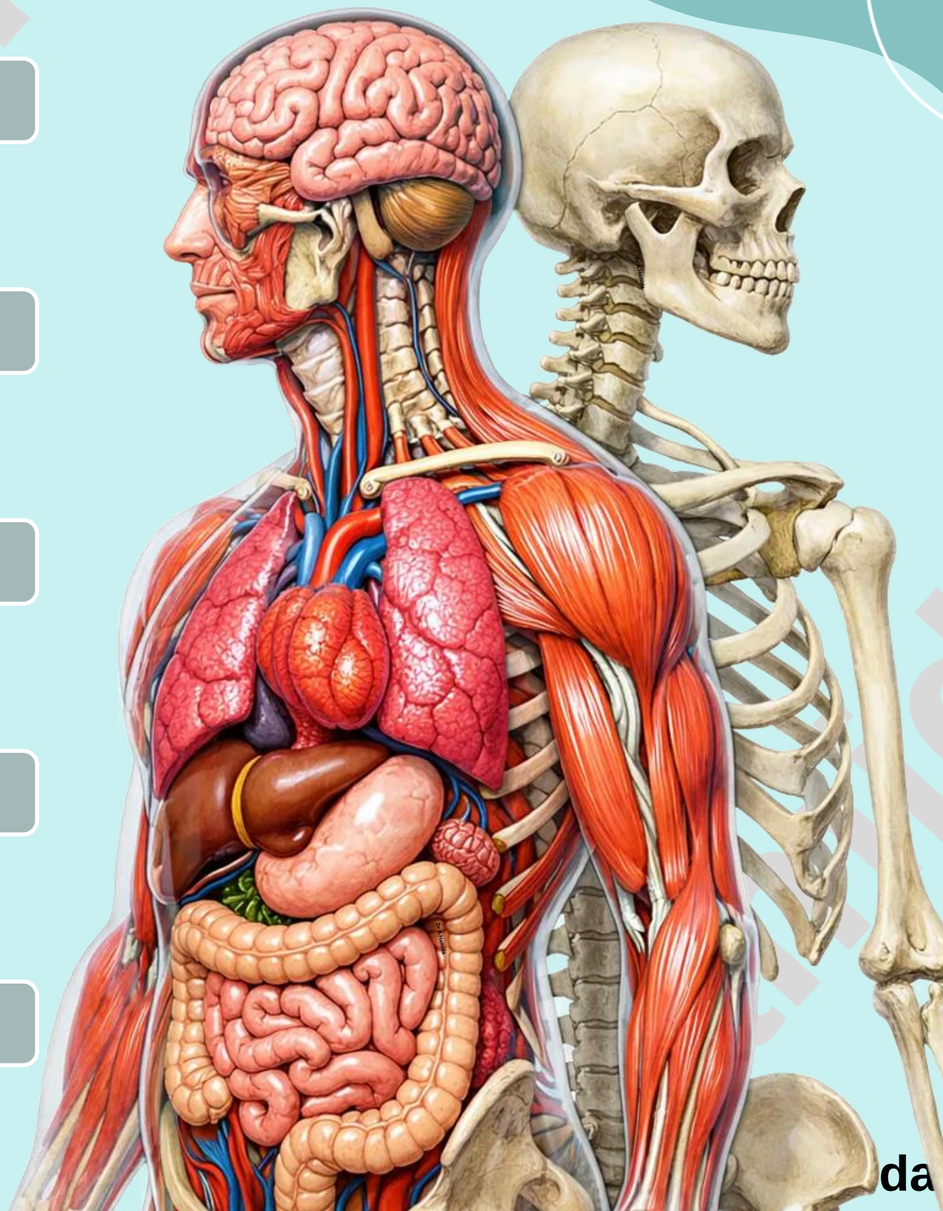


Course Outline:

Gross lecture-7

1. Introduction and Terminology
2. Skeletal System
3. Cardiovascular System
4. Lymphatic System
5. Nervous System
6. Muscular System
7. Respiratory System
8. Digestive System
9. Urinary System
10. Endocrine System



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Gross lecture-7

Nervous System

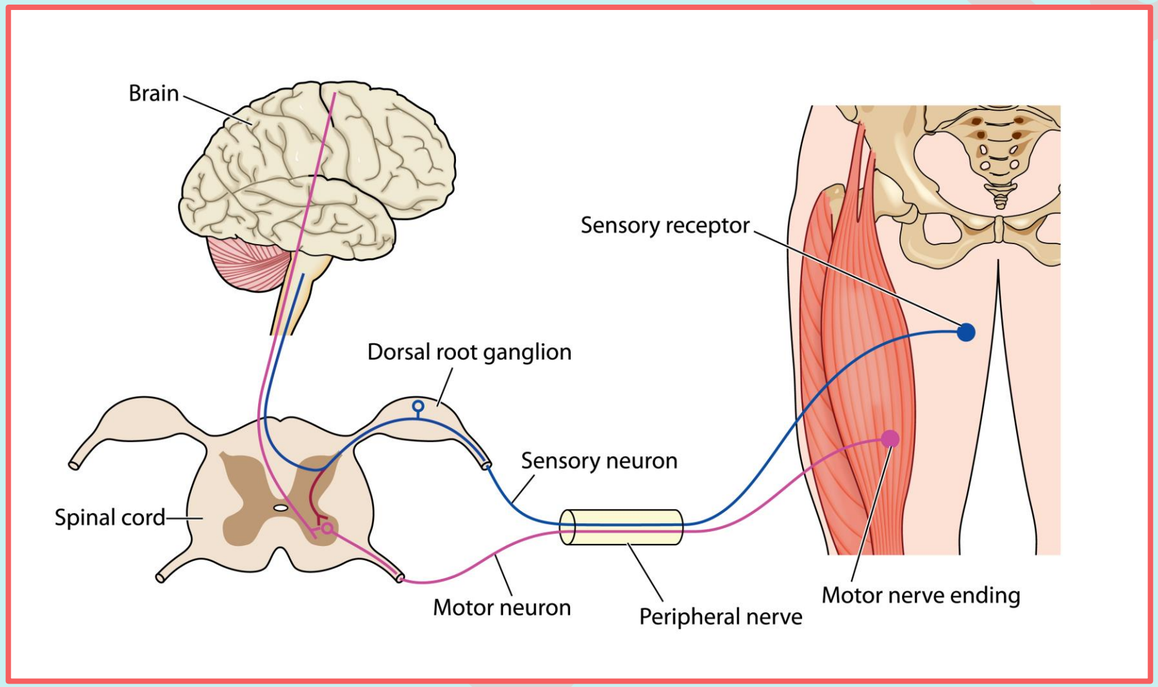
5 Nervous System

Gross lecture-7

➢ The nervous system, along with the endocrine system, regulates the functions of all other body systems.

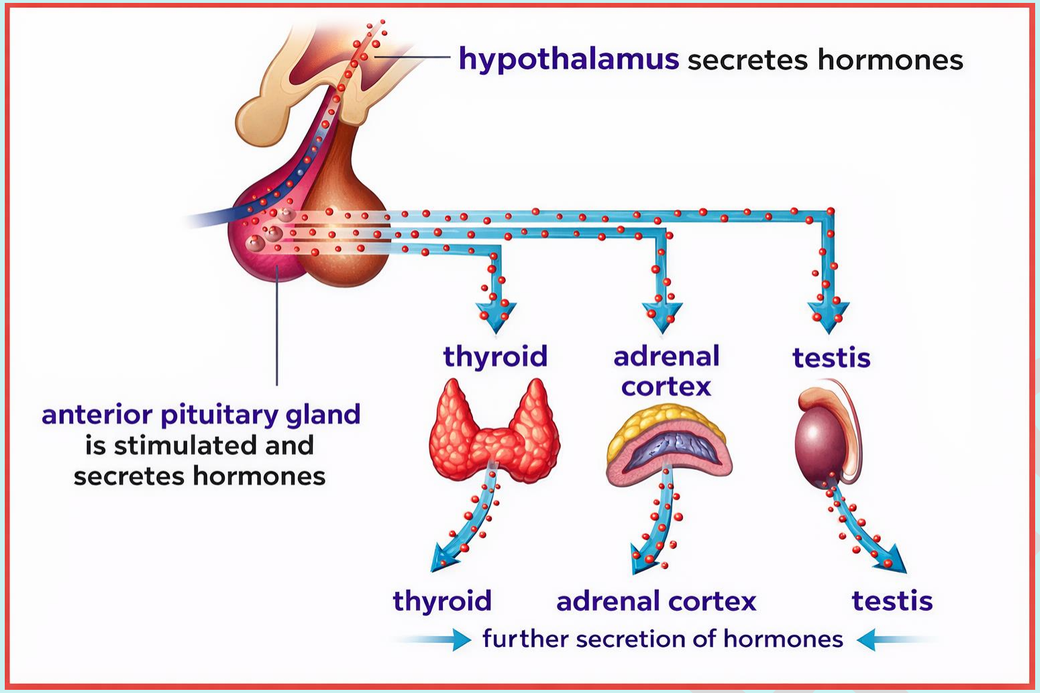
Nervous System

controls body activities by responding rapidly through nerve impulses



Endocrine System

responds more slowly by releasing hormones.



5 Nervous System

Gross lecture-7

❖ Divisions of the Nervous System

➢ Anatomically, the nervous system is divided into two parts:

1. **Central Nervous System (CNS),**

   consists of:

   i. **Brain (located in the cranial cavity)**

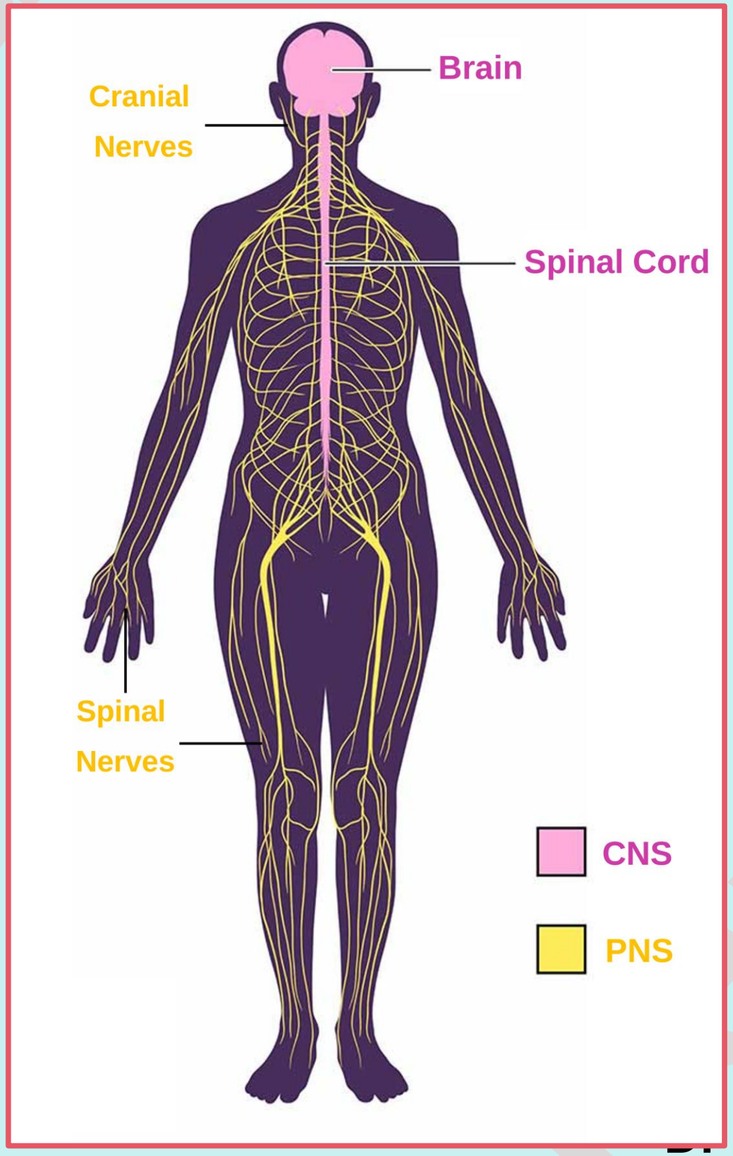
   ii. **Spinal Cord (located in the vertebral canal)**

2. **Peripheral Nervous System (PNS),**

   consists of nerves that exit from CNS:

   i. **Cranial nerves (exit from the brain)**

   ii. **Spinal nerves (exit from the spinal cord)**



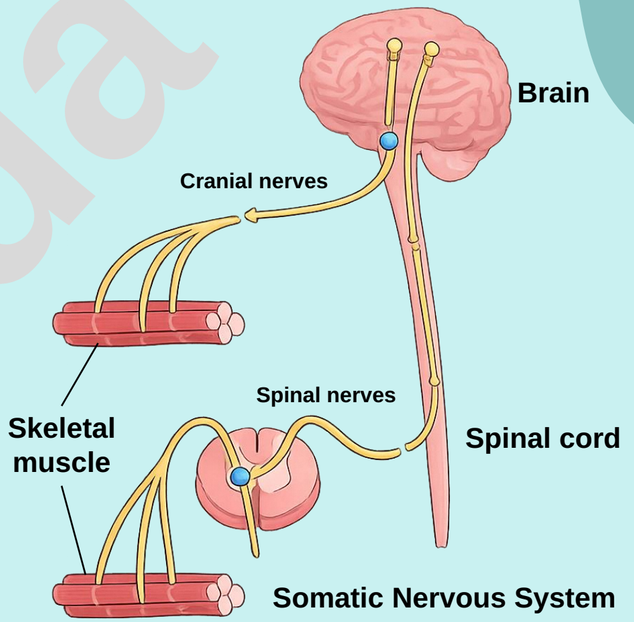
5 Nervous System

Gross lecture-7

❖ Divisions of the Nervous System

➢ Functionally, The PNS is divided into subsystems:

1. Somatic Nervous System:
   - Provides the voluntary control of skeletal muscles.

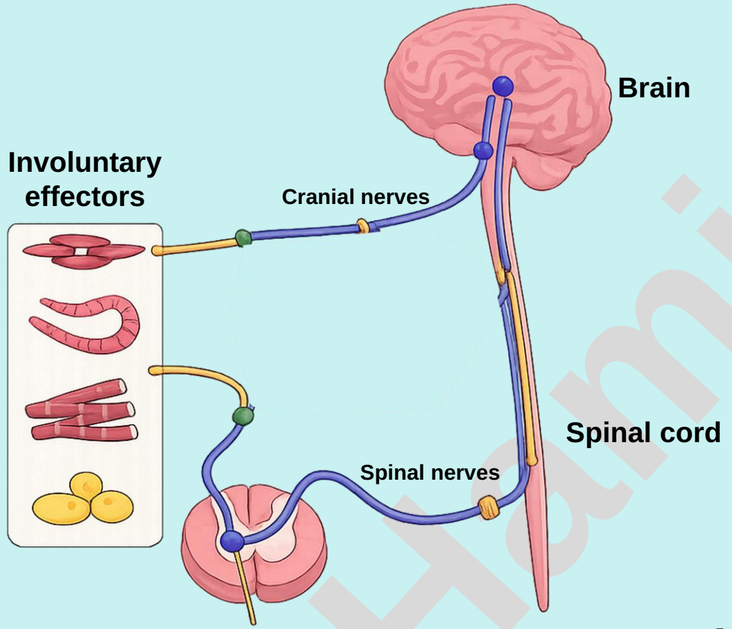


2. Autonomic Nervous System:
   - Provides involuntary control of the smooth muscle (stomach), cardiac muscle (heart), and glands

   - The autonomic nervous system is further subdivided into:

     a. Sympathetic Nervous System:
        - It is activated during stressful stimuli (e.g., fear, pain, exercise).

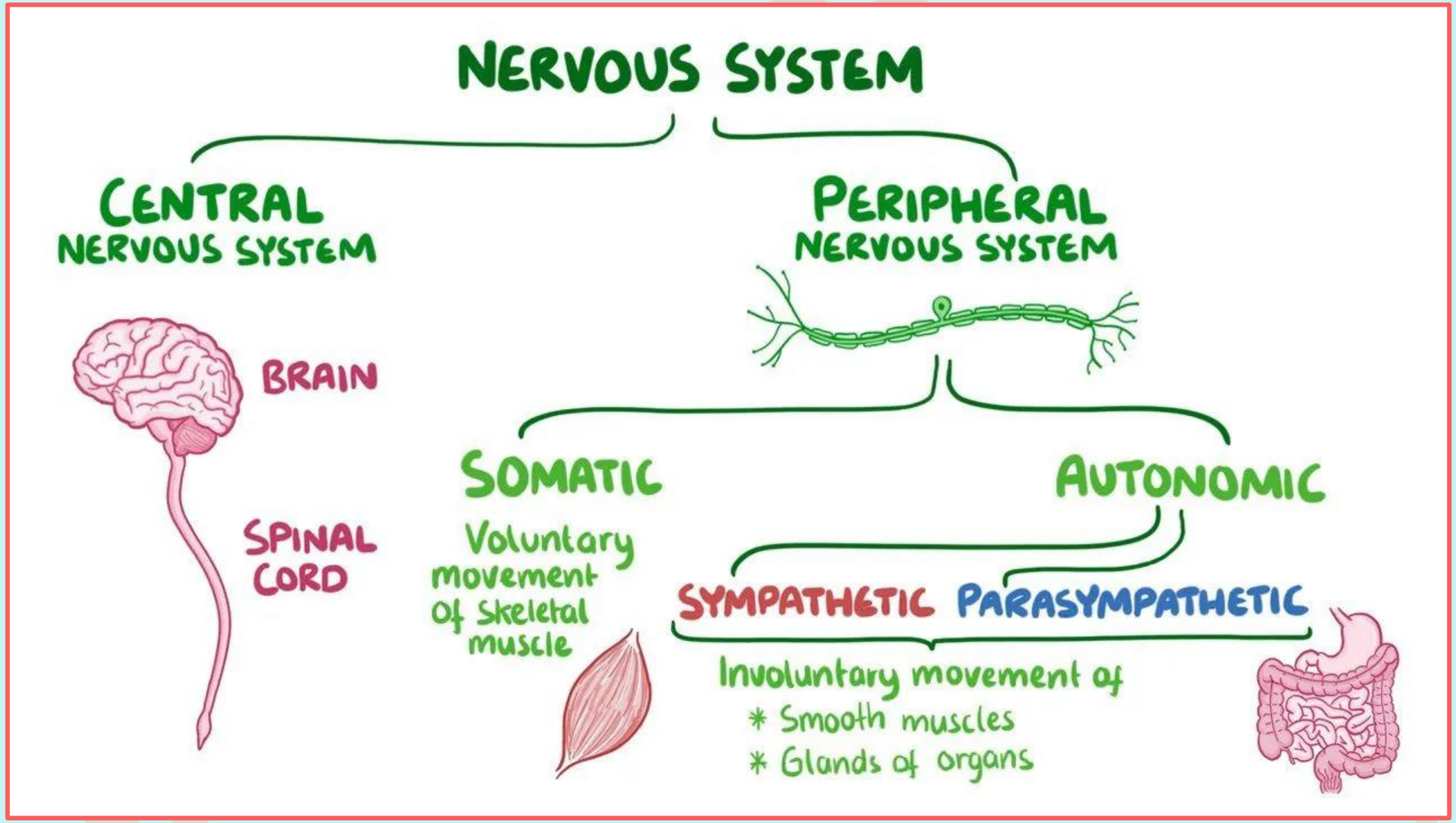
     b. Parasympathetic Nervous System:
        - It is activated during rest and relaxation (e.g., sleep).



5 Nervous System

lecture-11

❖ **Divisions of the Nervous System**

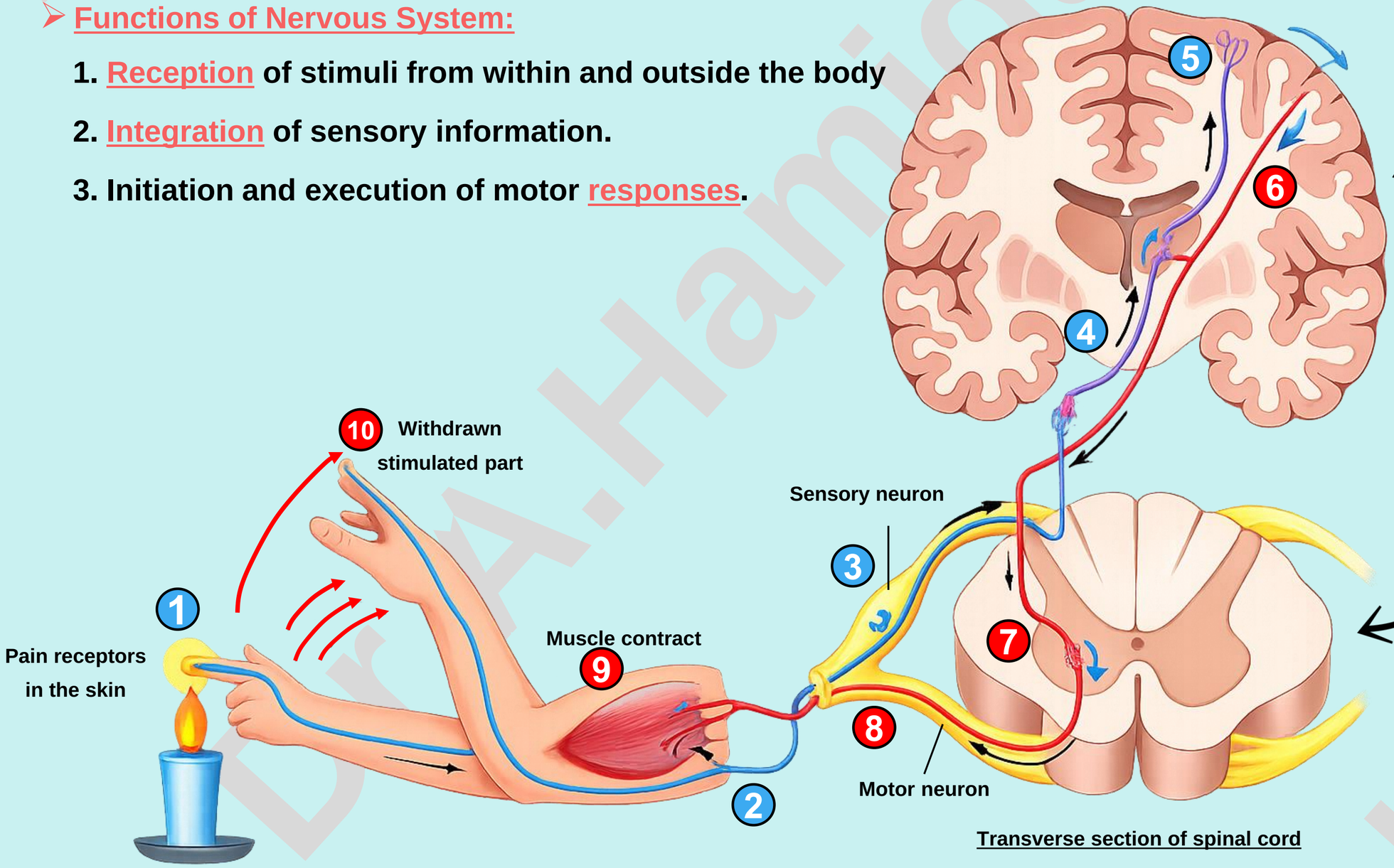


5 Nervous System

Gross lecture-7

Functions of Nervous System:

1. Reception of stimuli from within and outside the body
2. Integration of sensory information.
3. Initiation and execution of motor responses.



5 Nervous System

Gross lecture-7

➢ Functions of Nervous System:

1. Reception of stimuli from within and outside the body
   - Sensory receptors detect internal stimuli (such as increased blood pressure) or external stimuli (such as heat or burning of the skin).
   - This sensory information is carried to the brain and spinal cord through cranial and spinal nerves.

2. Integration of sensory information.
   - The nervous system processes sensory input by analyzing it and making decisions for appropriate responses, an activity known as integration.

3. Initiation and execution of motor responses.
   - After integration, the nervous system initiates a motor response by activating effectors (muscles or glands) via cranial and spinal nerves.
   - Stimulation of these effectors causes muscles to contract and glands to secrete.

5 Nervous System

Gross lecture-7

System Outline:

5.1 Nervous Tissue

5.2 Central Nervous System - Brain

5.3 Central Nervous System - Spinal Cord

5.4 Peripheral Nervous System

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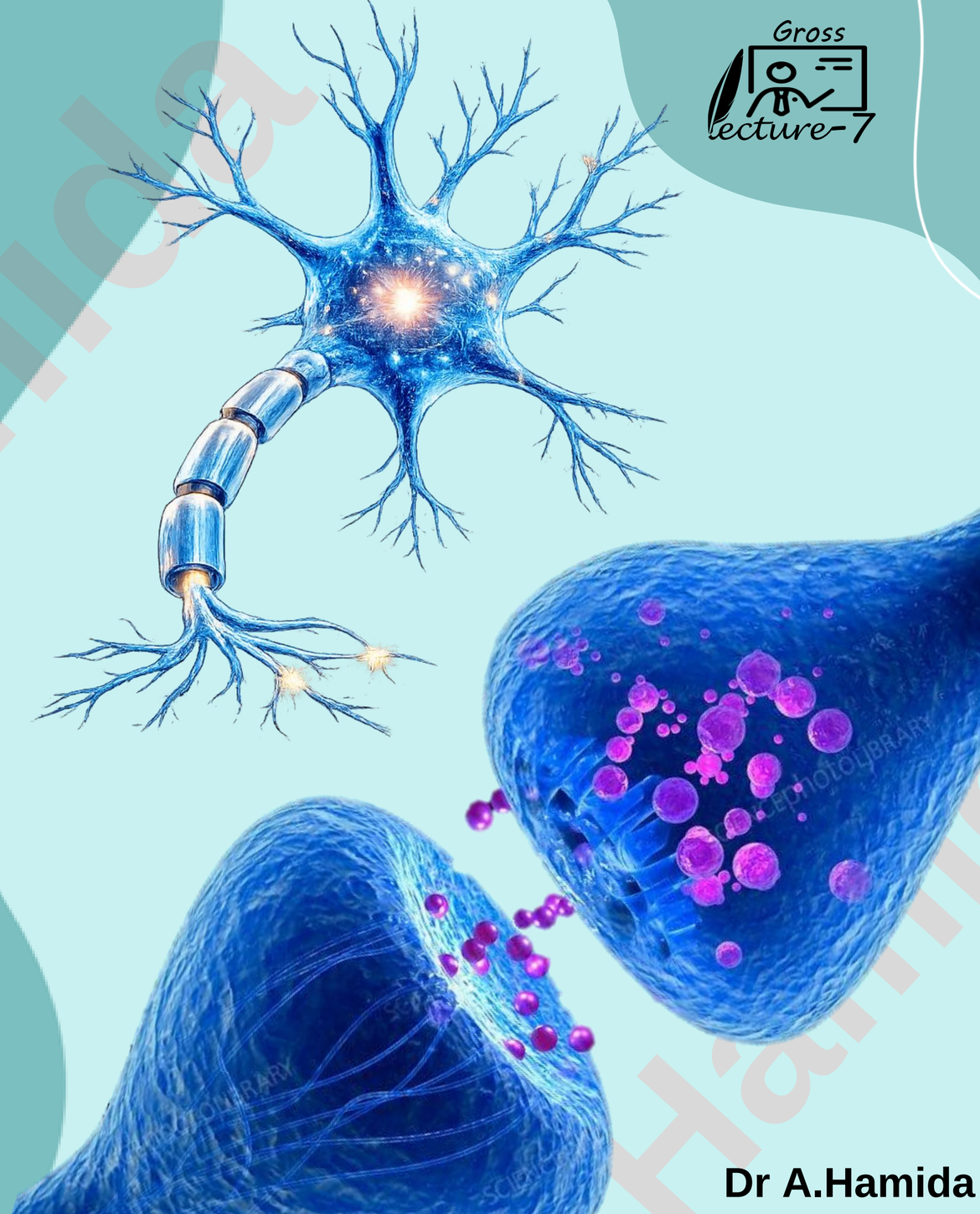
Gross lecture-7

Nervous System

1. Nervous Tissue



Dr A.Hamida

5.1 Nervous System– Nervous Tissue

Gross lecture-7

Lecture Outline:

- 5.1.1 Neurons (Nerve Cells)
- 5.1.2 Neuroglia (Glial Cells)
- 5.1.3 Nerve Fibers
- 5.1.4 Gray Matter
- 5.1.5 White Matter

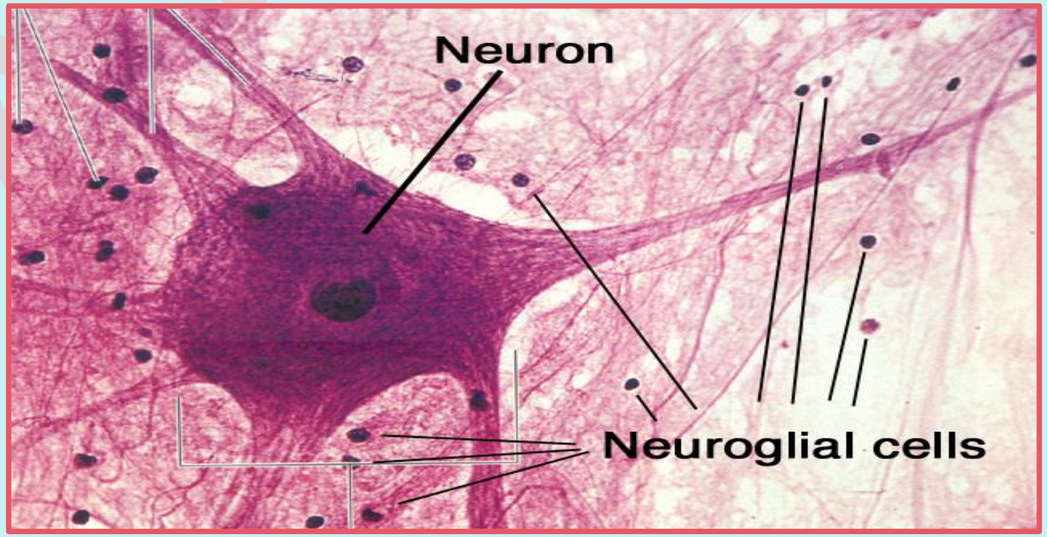
5.1 Nervous System– Nervous Tissue

Gross lecture-7

➢ The nervous system consists of two principal types of cells:

1. Neurons (Nerve Cells):
   - The structural and functional units of the nervous system.
   - The two main properties of neurons are excitability and conductivity.
   - Highly differentiated cells that have lost their ability to divide.

2. Neuroglia (Glial Cells):
   - Supportive cells that assist neurons both structurally and functionally.
   - Non-conducting cells located near neurons.
   - Unlike neurons, neuroglia retain the ability to divide throughout life.



5.1.1

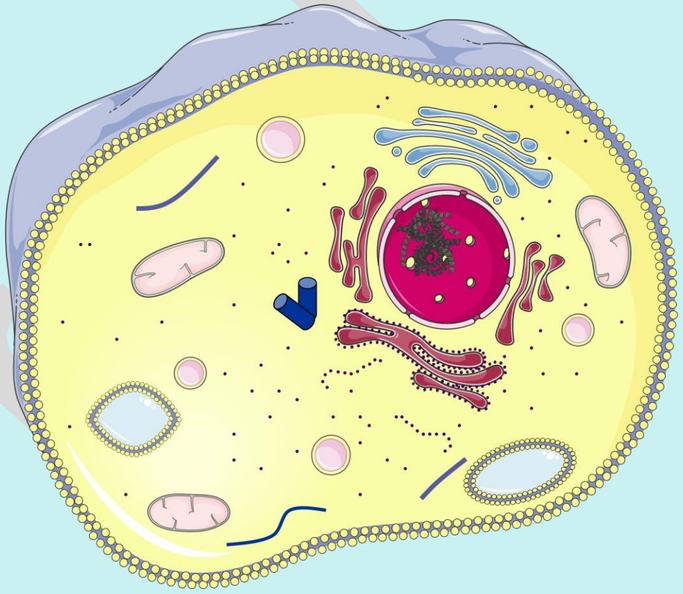
Neurons (Nerve Cells)

Gross lecture-7

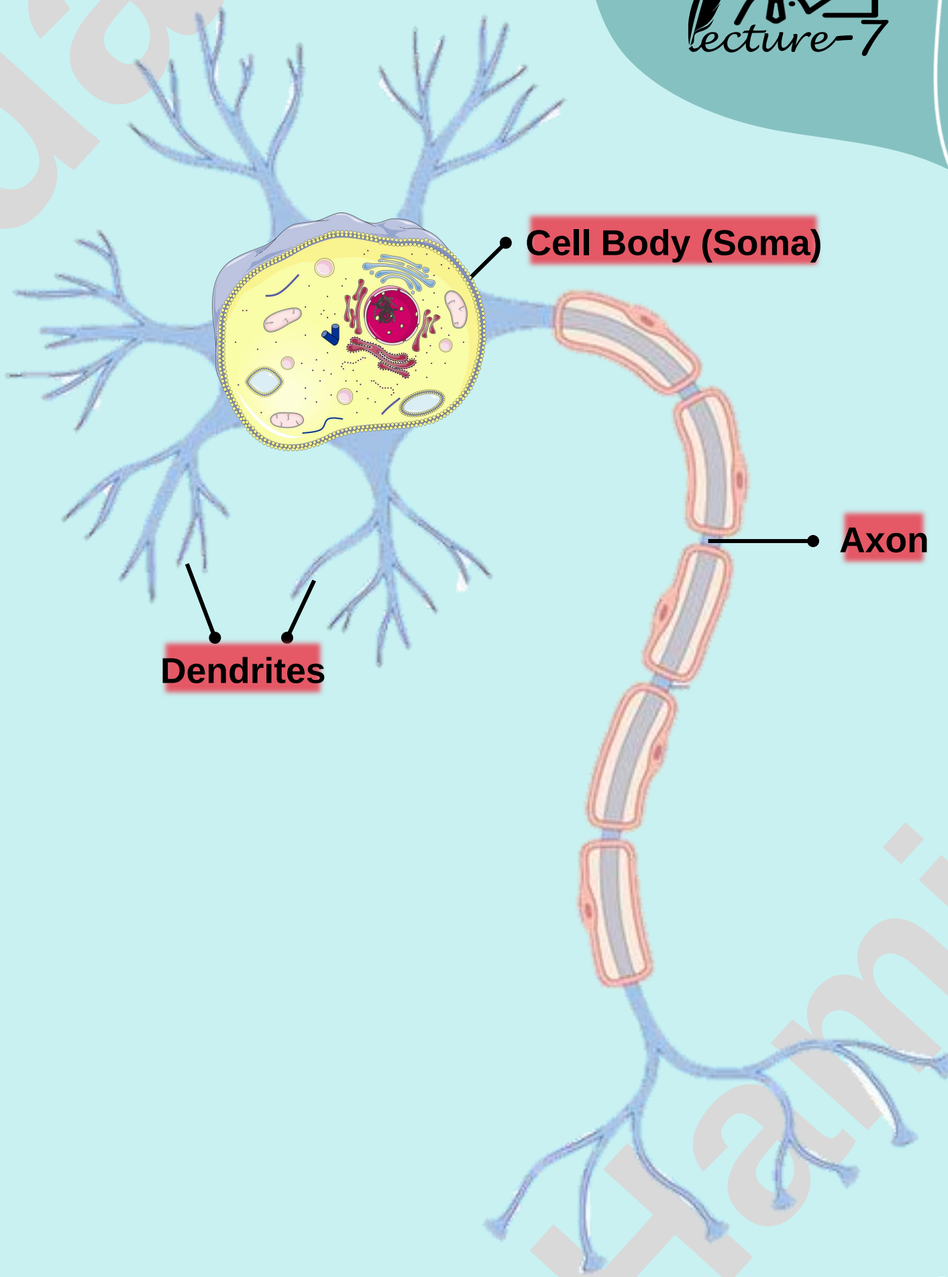
➢ **Each neuron consists of three parts:**

1. Cell Body (also called soma)
2. Dendrites
3. Axon

Typical Cell



Nerve Cells

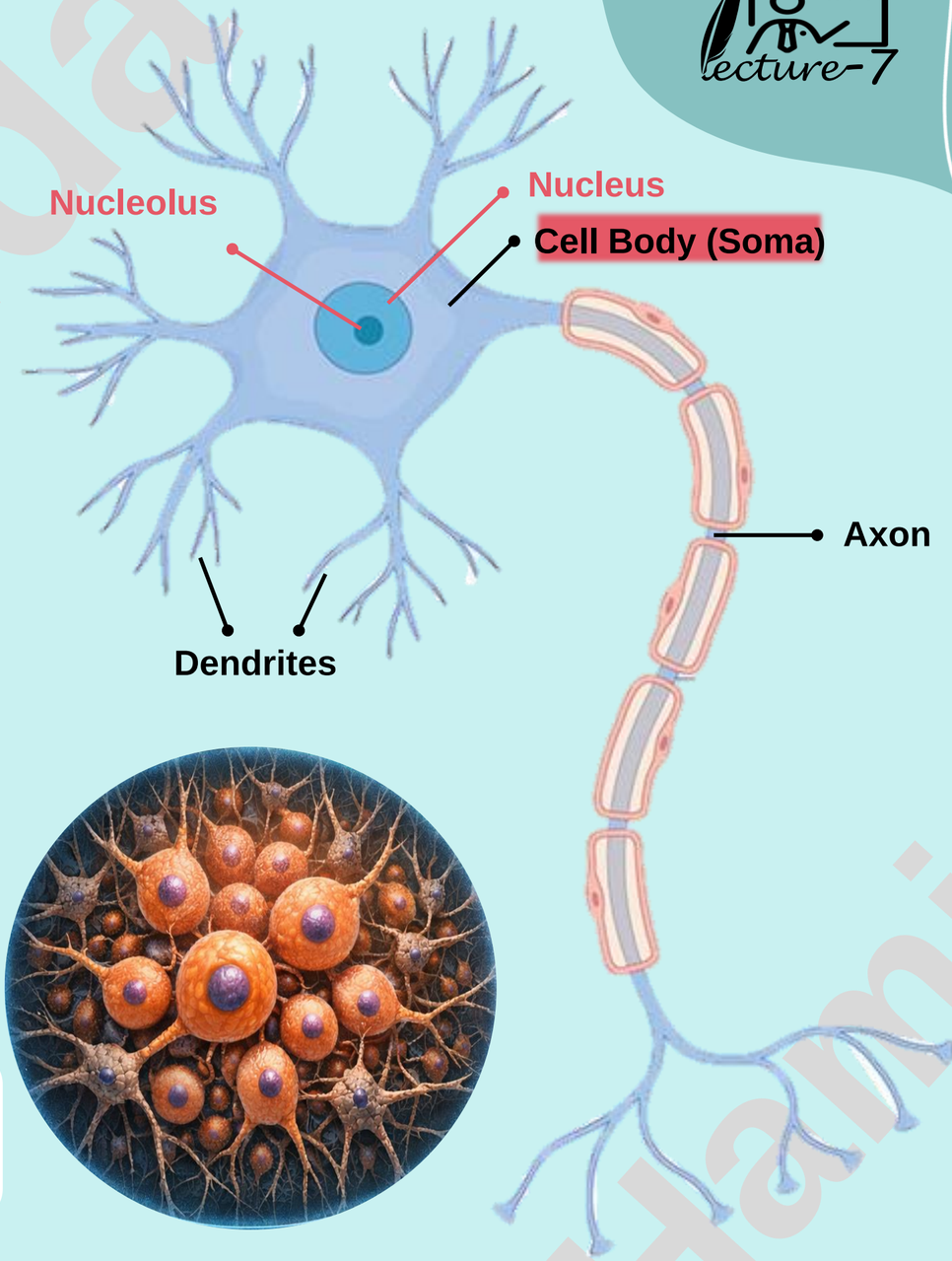


5.1.1

Neurons (Nerve Cells)

Gross lecture-7

1. Cell Body (soma)
   - Contains a large nucleus with a prominent nucleolus, surrounded by cytoplasm that includes organelles such as lysosomes, mitochondria, and a Golgi complex.
   - There are no centrioles and centrosome in the nerve cell body, which indicates that neurons cannot divide.

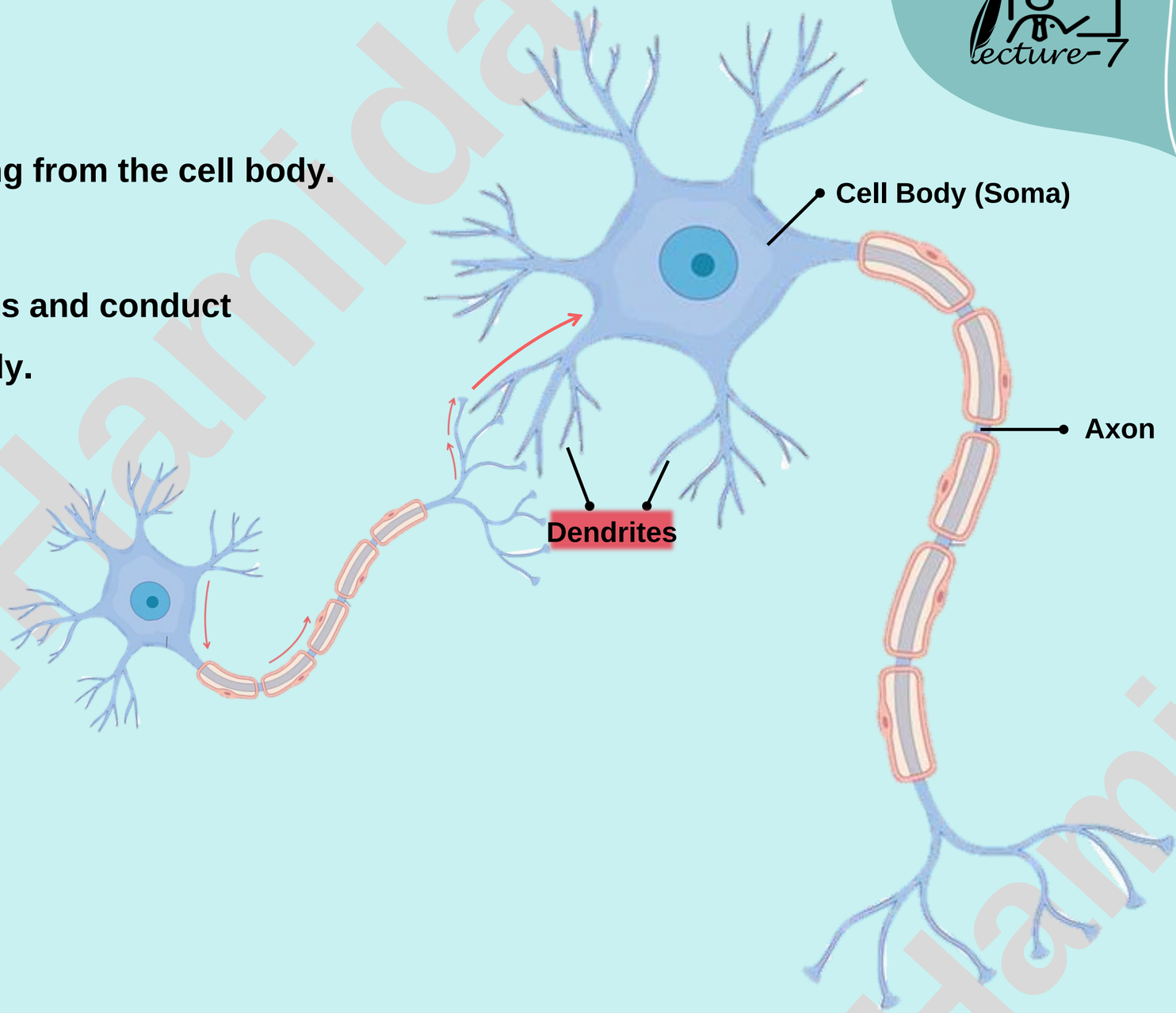


Clusters of cell bodies within the CNS are called Gray Matter

Clusters of cell bodies within the PNS are called Ganglion

5.1.1 Neurons (Nerve Cells)

2. Dendrites (dendron = tree):
   - Short, branched processes projecting from the cell body.
   - Receive impulses from other neurons and conduct electrical signals toward the cell body.



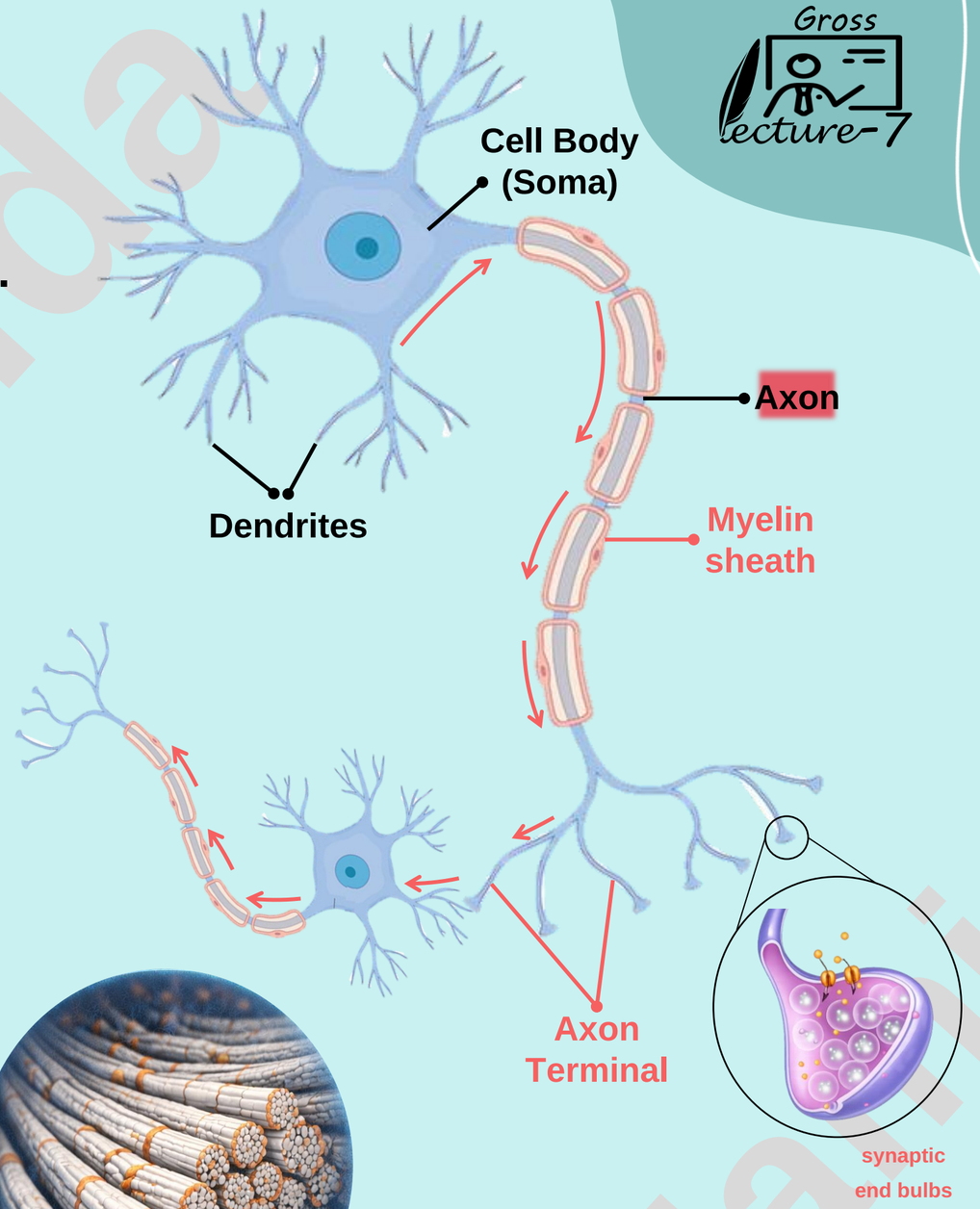
5.1.1

Neurons (Nerve Cells)

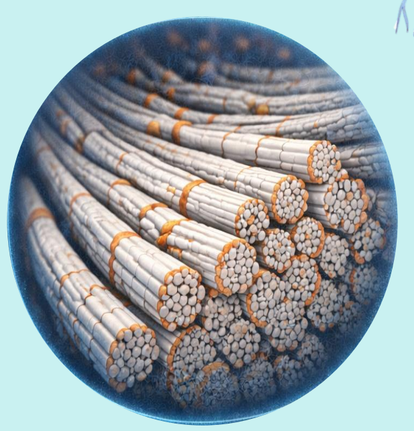
Gross lecture-7

3. Axon:

- A long, cable-like projection that extends from the cell body.
- An axon is also referred to as a nerve fiber.
- Axon could be myelinated or unmyelinated.
- The axon end dividing into many fine processes called axon terminals.
- The tips of some axon terminals expand into bulb-shaped structures called synaptic end bulbs.
- Axon conducts nerve impulses away from the cell body.



Bundle of axons within the CNS are called White Matter



Bundle of axons within the PNS are called Nerve

5.1.1

Neurons (Nerve Cells)

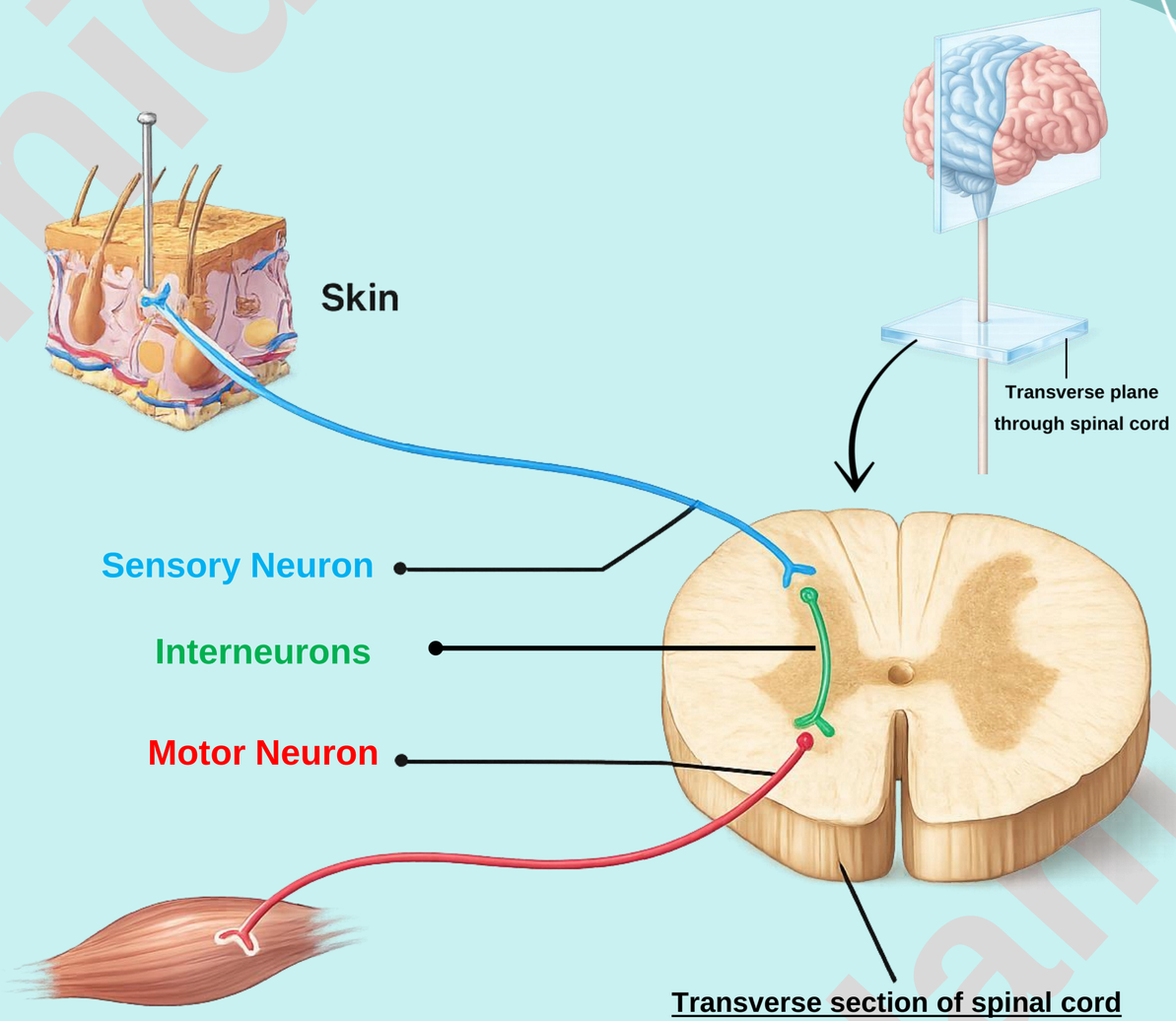
Gross lecture-7

➢ Functional classification of neurons:

1. **Sensory Neurons (Afferent):**
   - Carry sensory information from receptors throughout the body to the CNS.

2. **Motor Neurons (Efferent):**
   - Transmit impulses from the CNS to effector organs (muscles or glands) through cranial or spinal nerves.

3. **Interneurons**
   - Form communication and integration networks between sensory and motor neurons.
   - Mainly located within the CNS



5.1.1

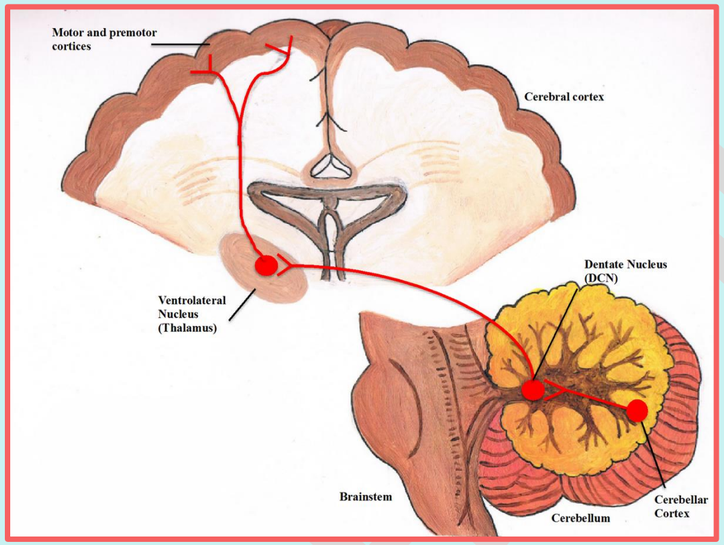
Neurons (Nerve Cells)

Gross lecture-7

➢ Classification of neurons according to the length of axons

1. Golgi type I
   - These neurons possess long axons that project to distant regions of the nervous system, sometimes reaching lengths of up to 1 meter.
   - Examples: Motor neurons whose axons extend from the spinal cord to the muscles of the foot (e.g., the big toe).

2. Golgi type II:
   - These neurons have short axons that terminate near the cell body.
   - Examples: Interneurons that connect nearby neurons within the brain.

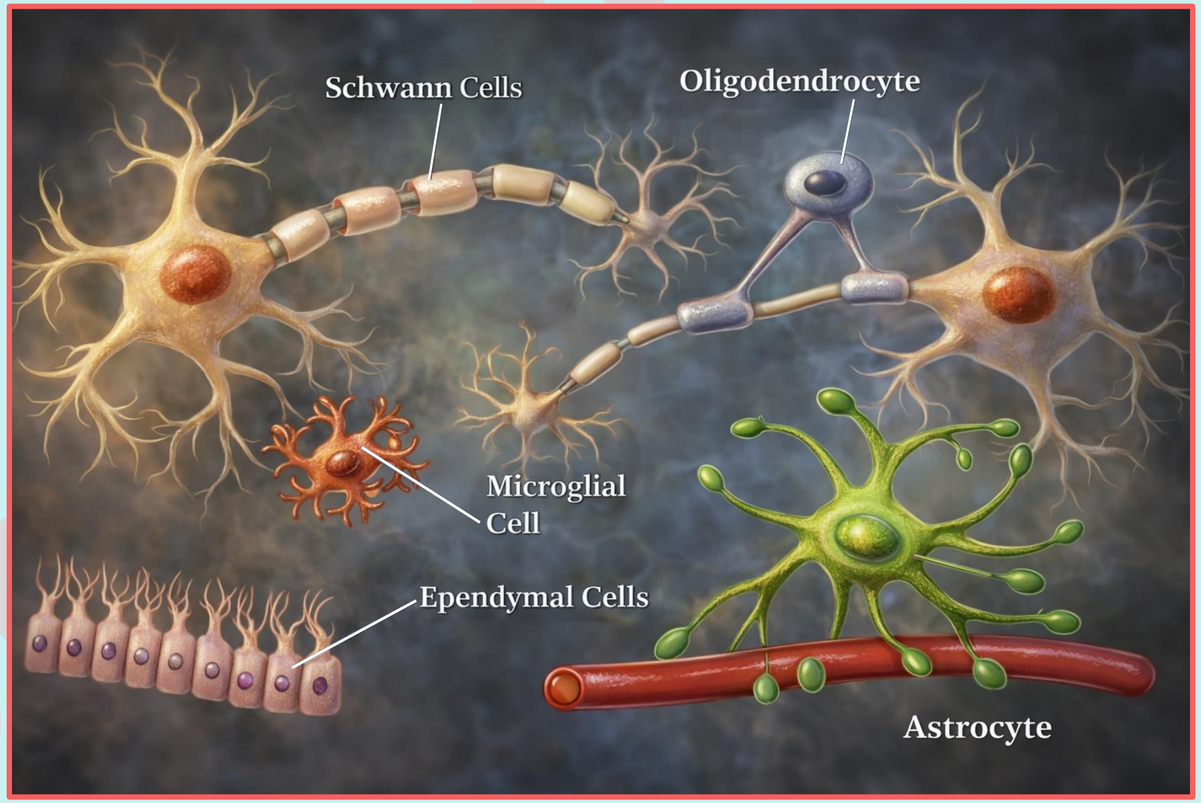


5.1.2

Neuroglia (Glial Cells)

Gross lecture-7

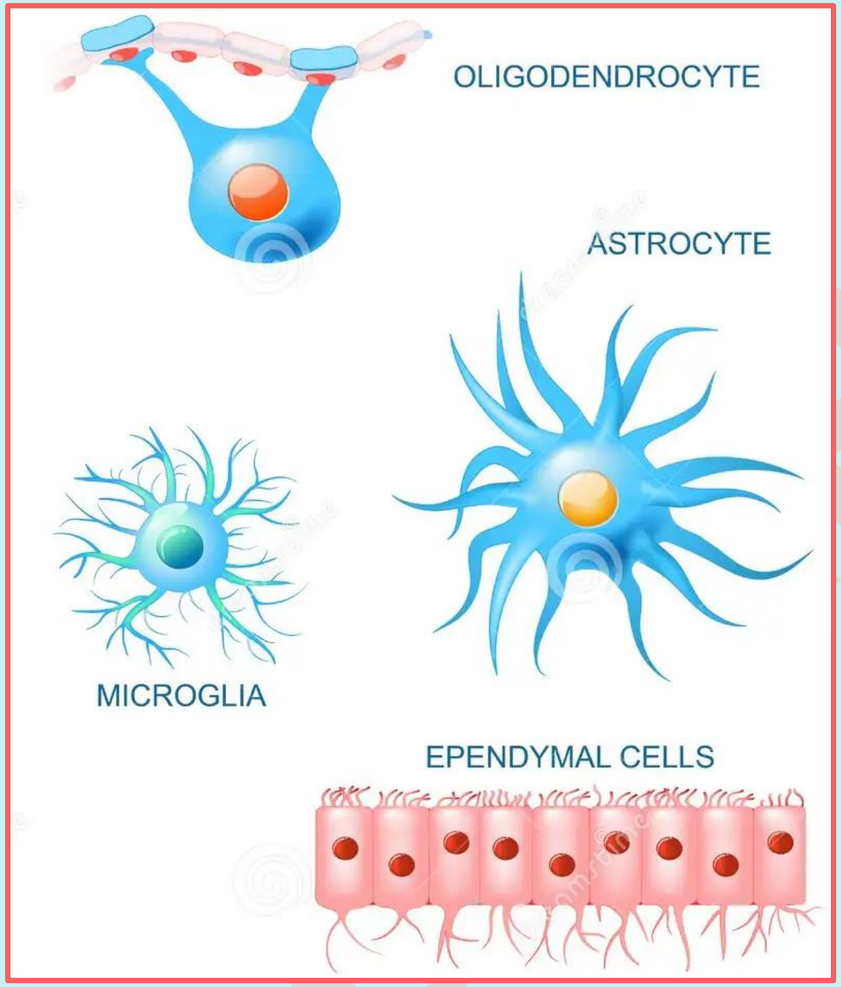
- Neuroglia are highly branched cells, smaller than neurons and are 5 to 25 times more numerous.
- They are the supporting cells of the nervous system.
- In contrast to neurons, glia do not generate or propagate action potentials, but they can multiply and divide in the mature nervous system.



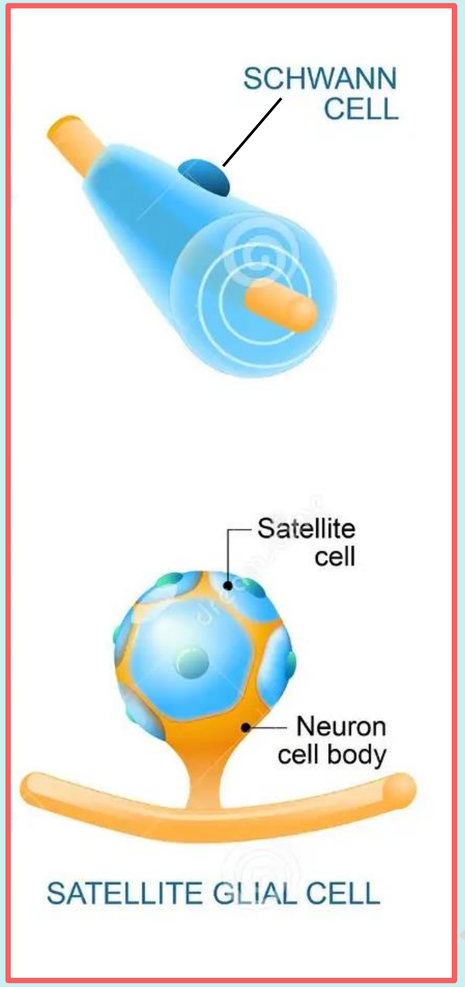
5.1.2 Neuroglia (Glial Cells)

Gross lecture-7

➢ **There are four types of neuroglia in the CNS:**



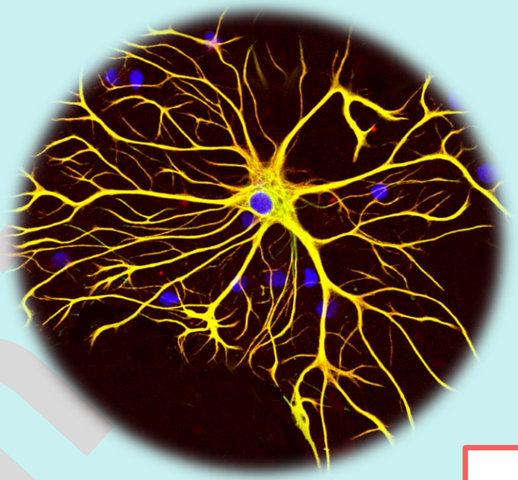
➢ **There are two types of neuroglia in the PNS:**



5.1.2

Neuroglia (Glial Cells)

Gross lecture-7

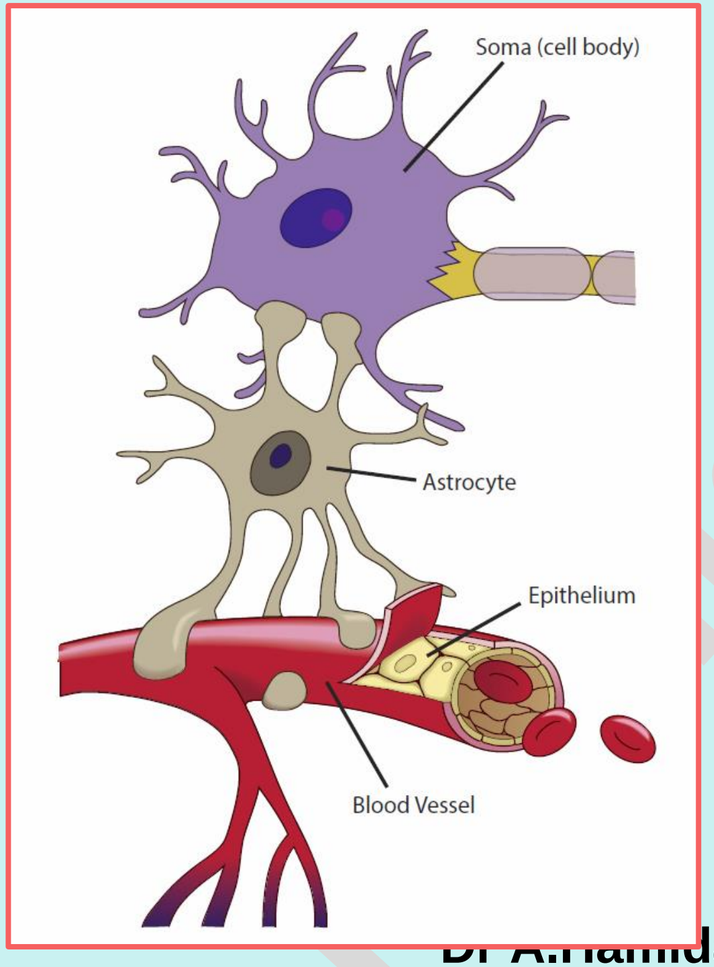


➢ Types of neuroglia in the CNS:

1. Astrocytes

- The largest and most numerous type of neuroglia.
- Star-shaped cells with many processes.

- Function:
  - Contain microfilaments that provide strength and support to neurons.
  - Processes of astrocytes wrap around blood capillaries, forming part of the blood–brain barrier (BBB).

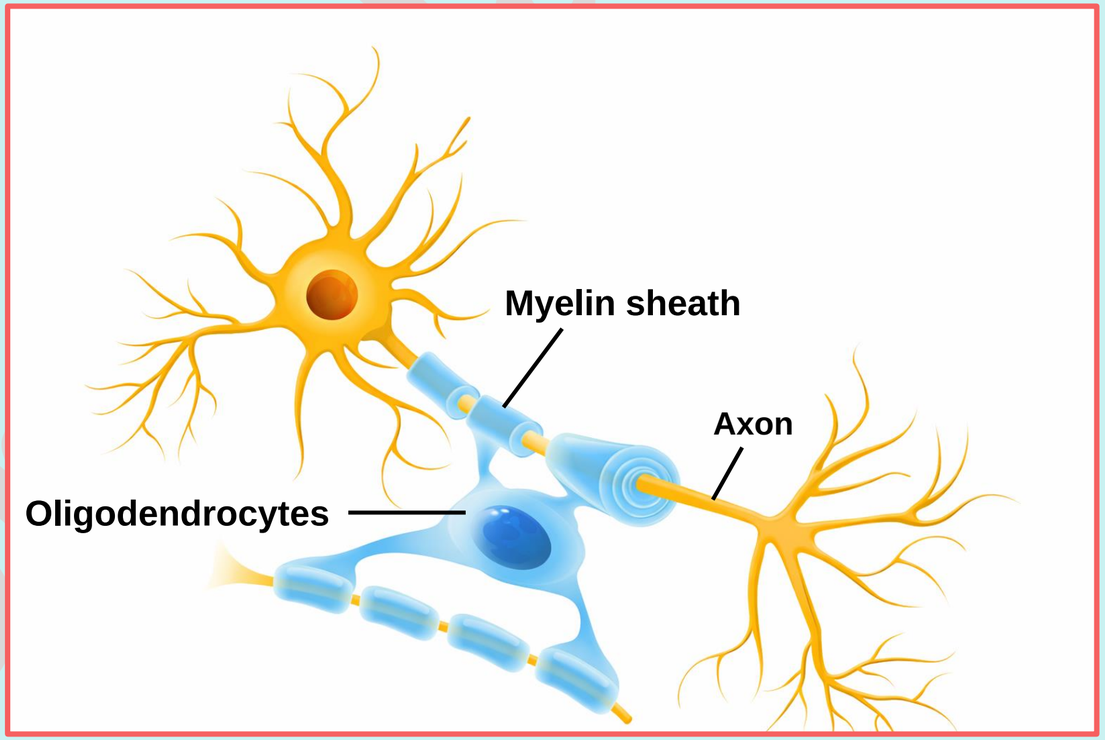


5.1.2 Neuroglia (Glial Cells)

➢ Types of neuroglia in the CNS:

2. Oligodendrocytes

- **Smaller than astrocytes and have fewer processes.**
- **Function:**
  - **Form and maintain the myelin sheath around CNS axons.**



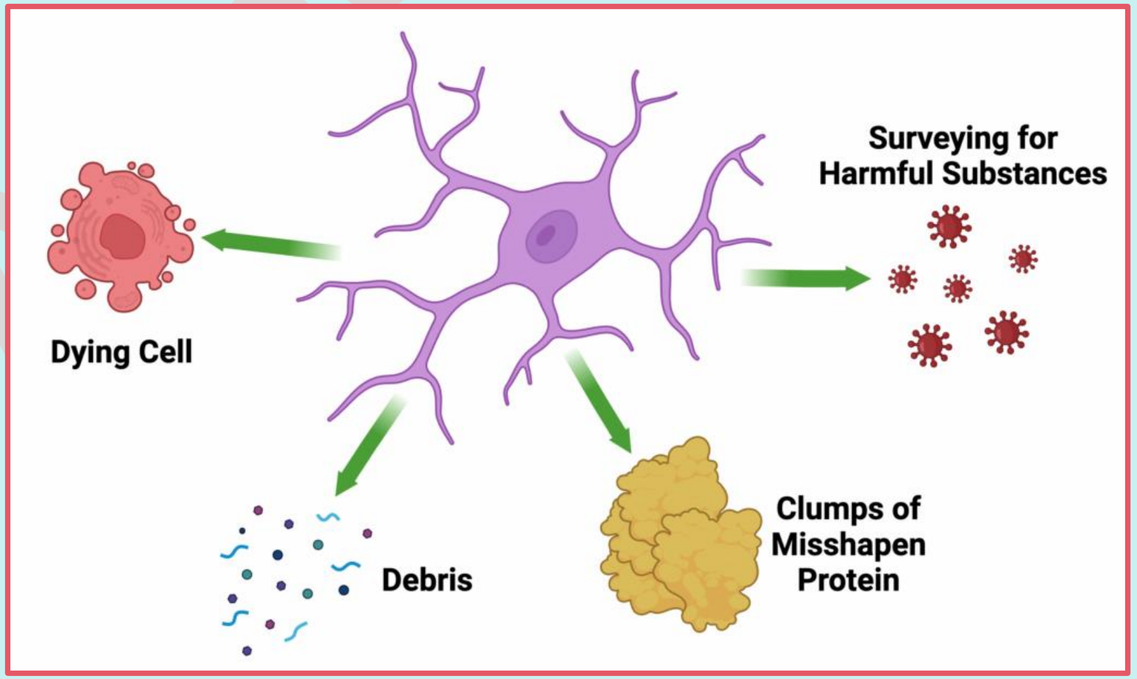
5.1.2 Neuroglia (Glial Cells)

Gross lecture-7

➢ **Types of neuroglia in the CNS:**

3. Microglia

- **The smallest of the glial cells and phagocytic in nature.**
- **Function:**
  - **Act as phagocytes similar to tissue macrophages.**
  - **Remove cellular debris formed during normal nervous system development and engulf microbes and damaged neural tissue.**

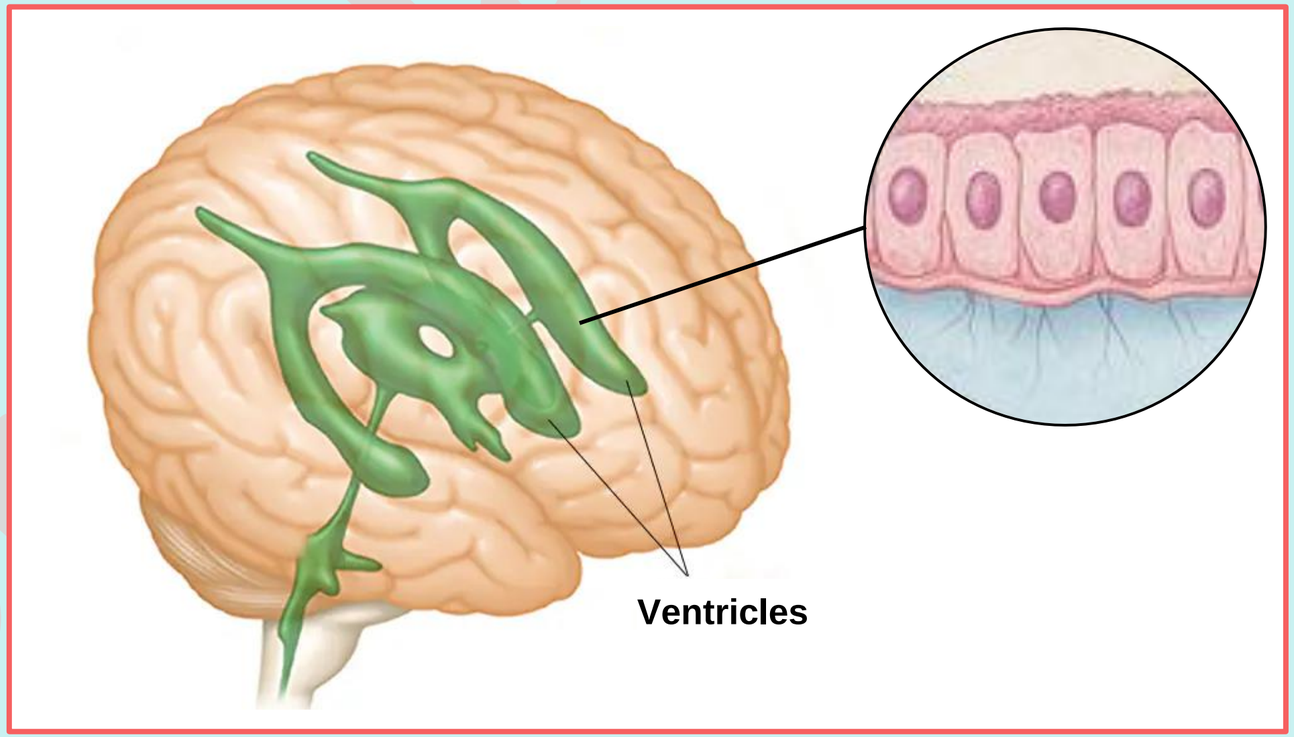


5.1.2 Neuroglia (Glial Cells)

➢ Types of neuroglia in the CNS:

4. Ependymal Cells

- Form a single layer of cuboidal or columnar cells with microvilli and cilia.
- Line the ventricles of the brain and the central canal of the spinal cord.
- Function:
  - Produce and assist in the circulation of cerebrospinal fluid (CSF).

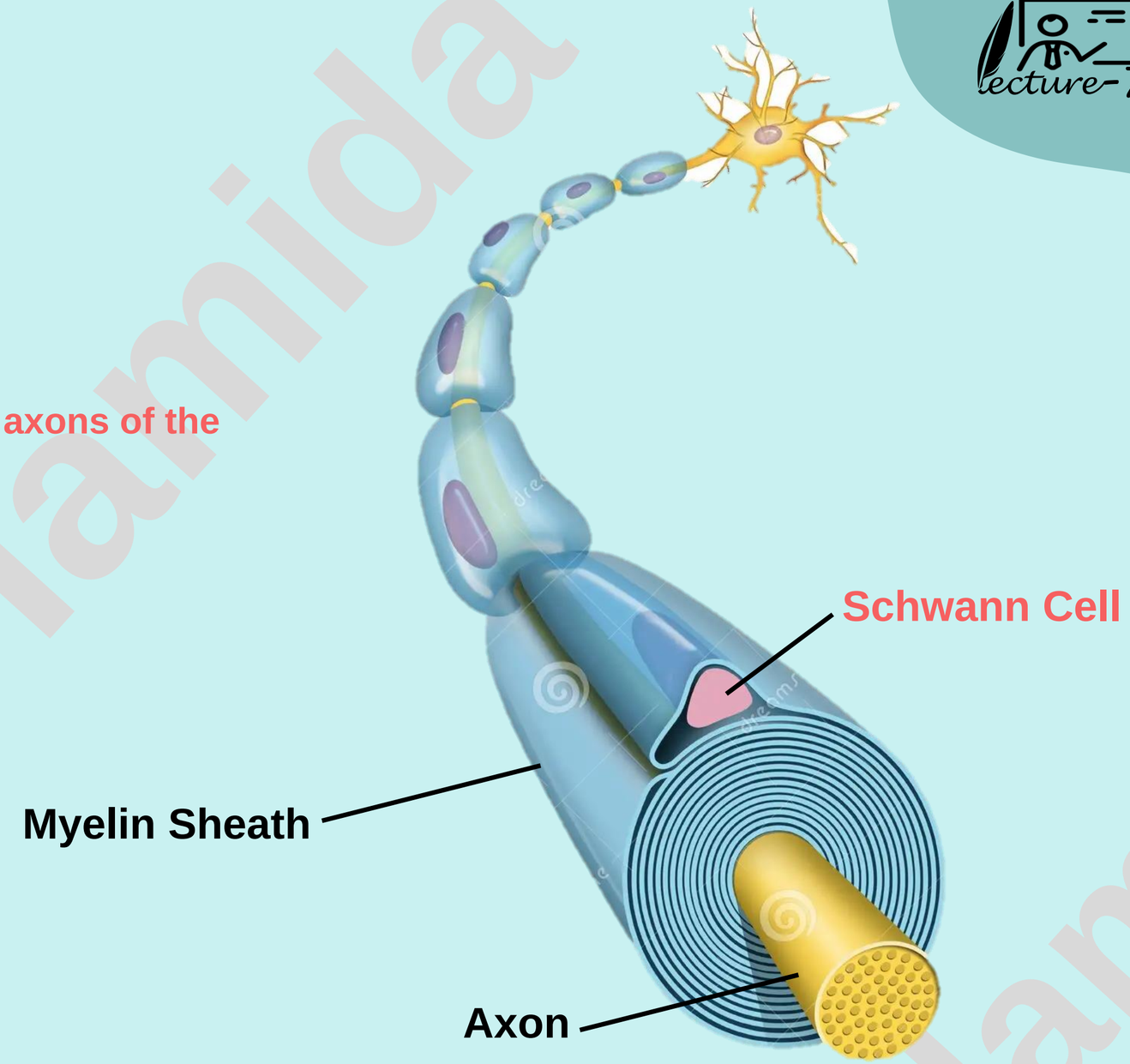


5.1.2 Neuroglia (Glial Cells)

➢ **Types of neuroglia in the PNS:**

1. Schwann cells

- **These cells encircle PNS axons.**
- **Function:**
  - **They form the myelin sheath around axons of the peripheral nervous system.**



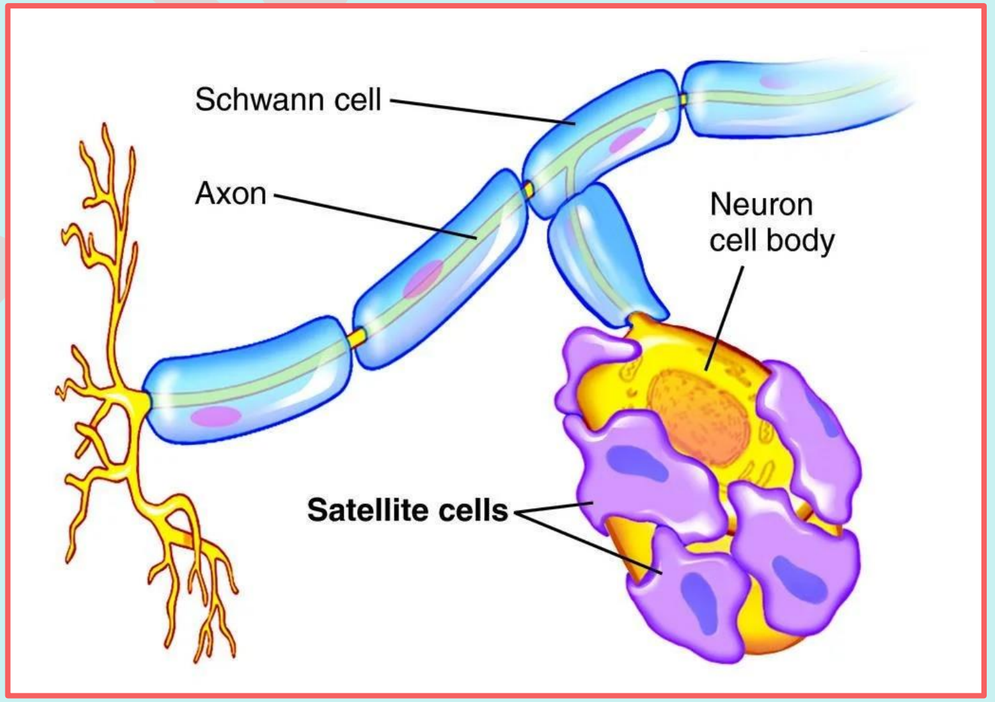
5.1.2 Neuroglia (Glial Cells)

Gross lecture-7

➢ **Types of neuroglia in the PNS:**

2. Satellite cells

- **Flat cells that surround the cell bodies of neurons within PNS ganglia.**
- **Function:**
  - **Provide structural support.**



5.1.3

Nerve Fibers

Gross lecture-7

❖ Myelin Sheath

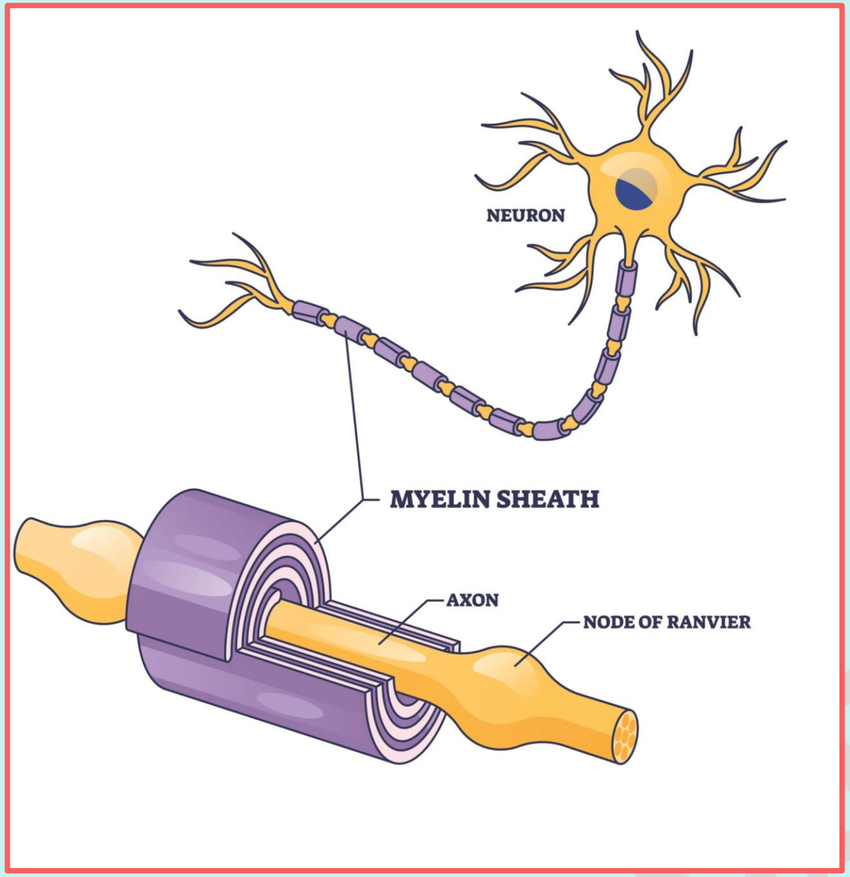
➢ The myelin sheath is an insulating layer composed of proteins and lipids that forms around the axon.

➢ In the CNS, it is formed by **oligodendrocytes**.

➢ In the PNS, it is formed by **Schwann cells**.

➢ Function:

- **Protects the axon.**
- **Enables rapid and efficient transmission of electrical impulses along nerve cells.**



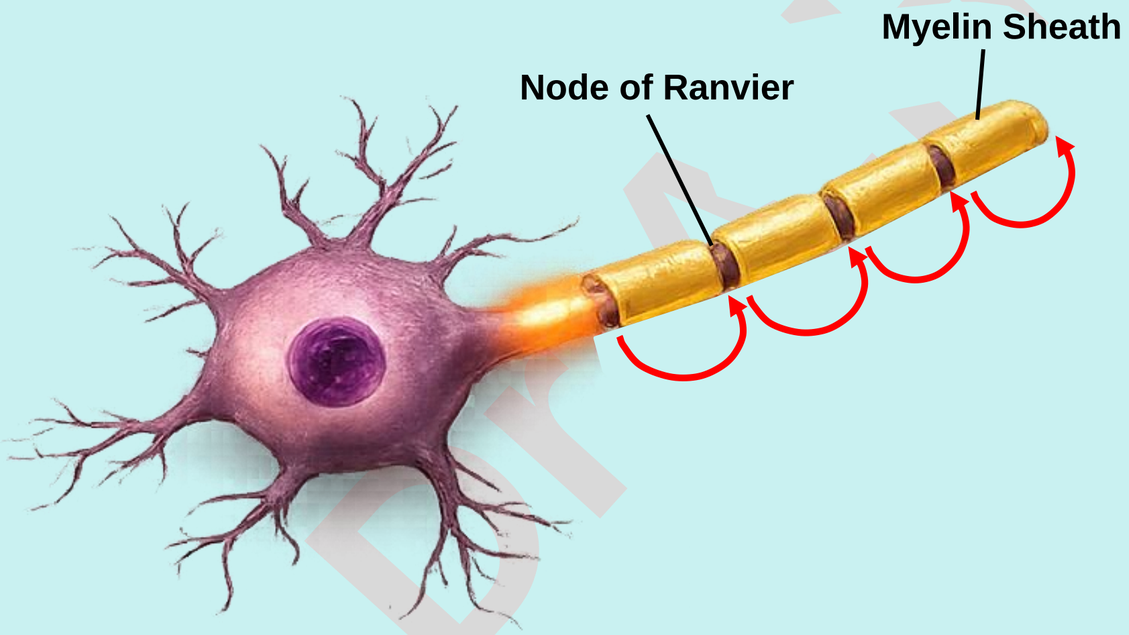
5.1.3 Nerve Fibers

Gross lecture-7

- The axon of nerve cell is called nerve fiber.
- There are two types of nerve fibers:

1. Myelinated Nerve Fibers

- Surrounded by a myelin sheath.
- The conduction of action potentials is faster, as impulses jump from one Node of Ranvier to the next.



2. Unmyelinated Nerve Fibers

- Lack a myelin sheath.
- Conduction of impulses is slower, as the action potential travels continuously along the fiber.

5.1.3

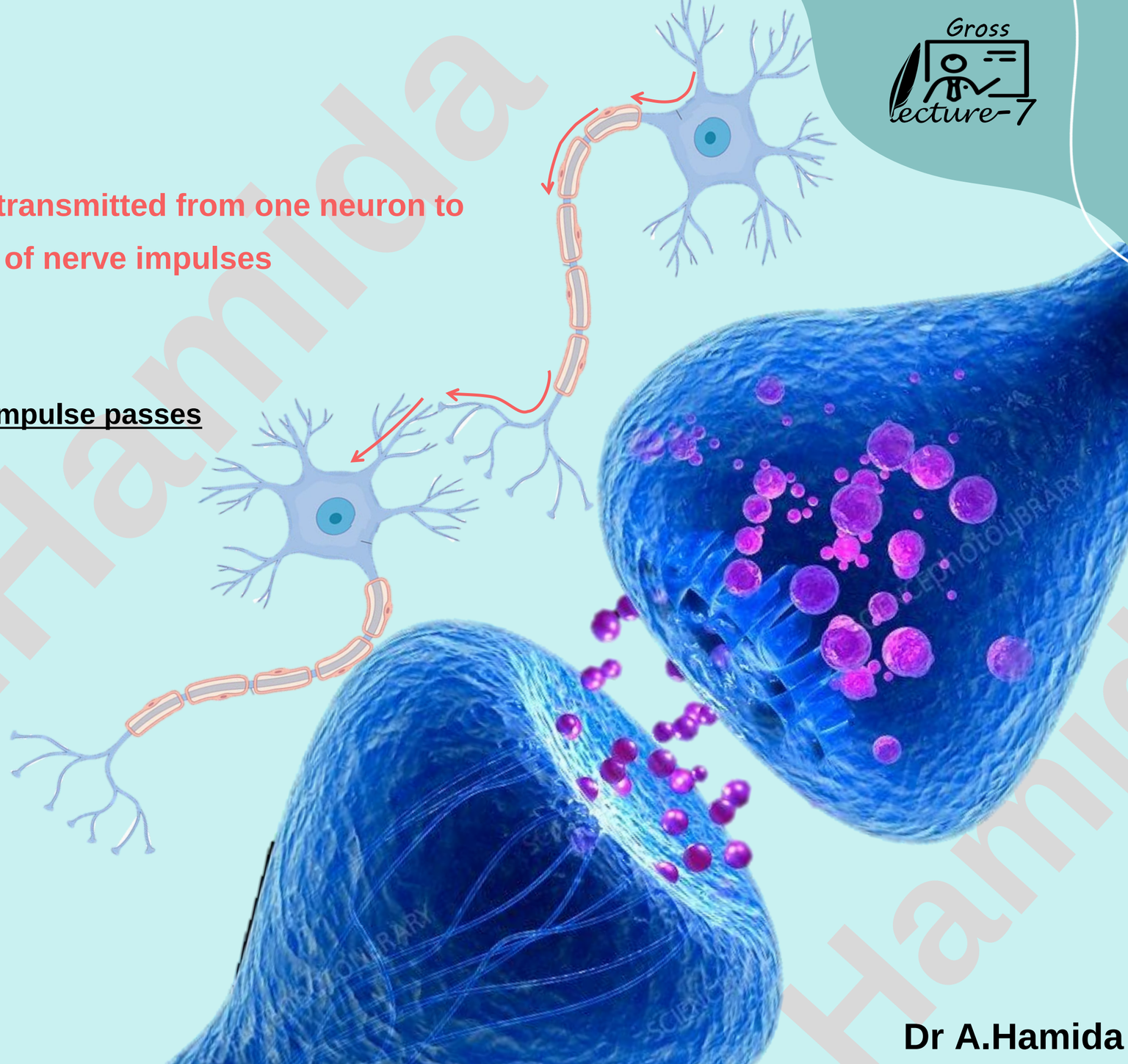
Nerve Fibers

Gross lecture-7

❖ Synapse

- In the nervous system, information is transmitted from one neuron to another through **synapses** in the form of nerve impulses (action potentials).

- A synapse is **the junction where a nerve impulse passes from one neuron to the next.**



5.1.3 Nerve Fibers

❖ Synapse

➢ Structure of Synapse

1. Presynaptic Neuron

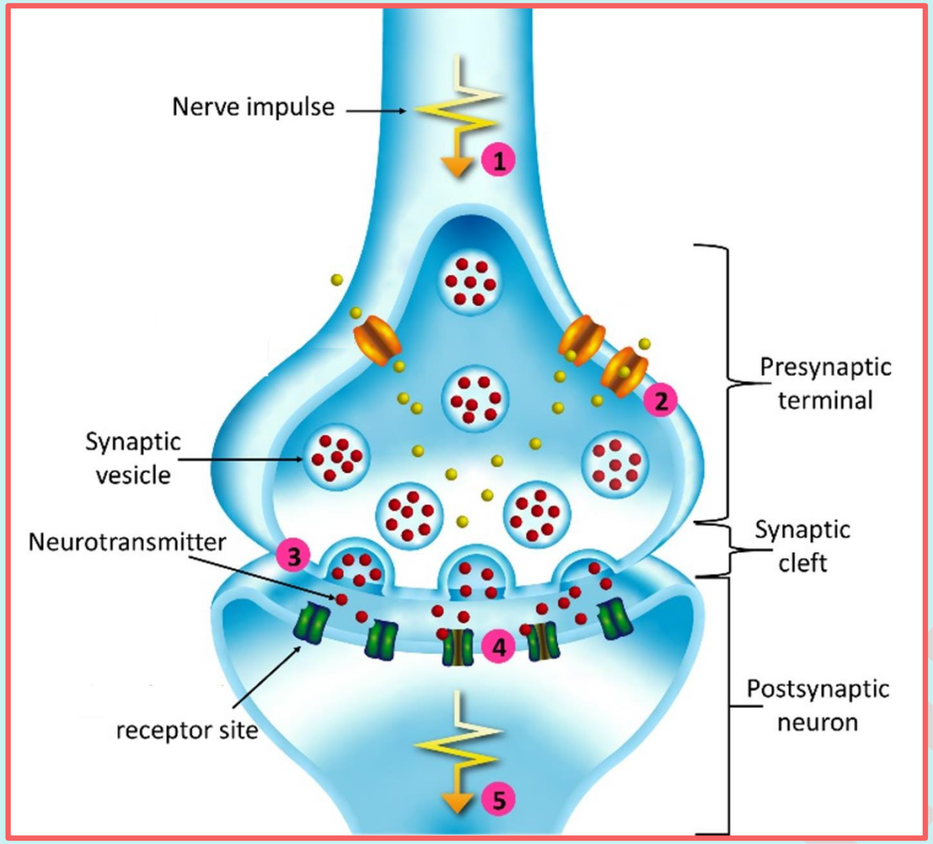
- Contains synaptic vesicles filled with neurotransmitters.
- The tips of its axon terminals form synaptic end bulbs containing these vesicles.

2. Postsynaptic Neuron

- Contains receptor sites on its membrane that bind neurotransmitters.

3. Synaptic Cleft

- A small gap separating the presynaptic and postsynaptic membranes.



Gross lecture-7

❖ Synapse

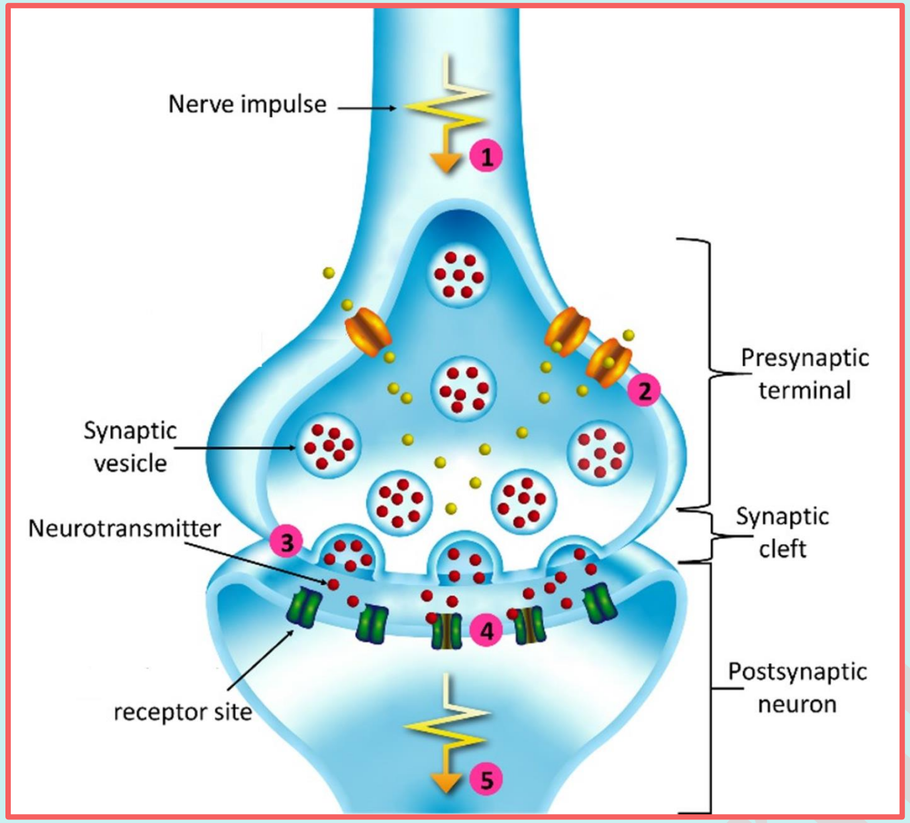
➢ Mechanism of Impulse Transmission Across a Synapse

1 2 3 When a nerve impulse reaches the presynaptic terminal, neurotransmitters are released into the synaptic cleft.

4 The neurotransmitters bind to receptors on the postsynaptic membrane.

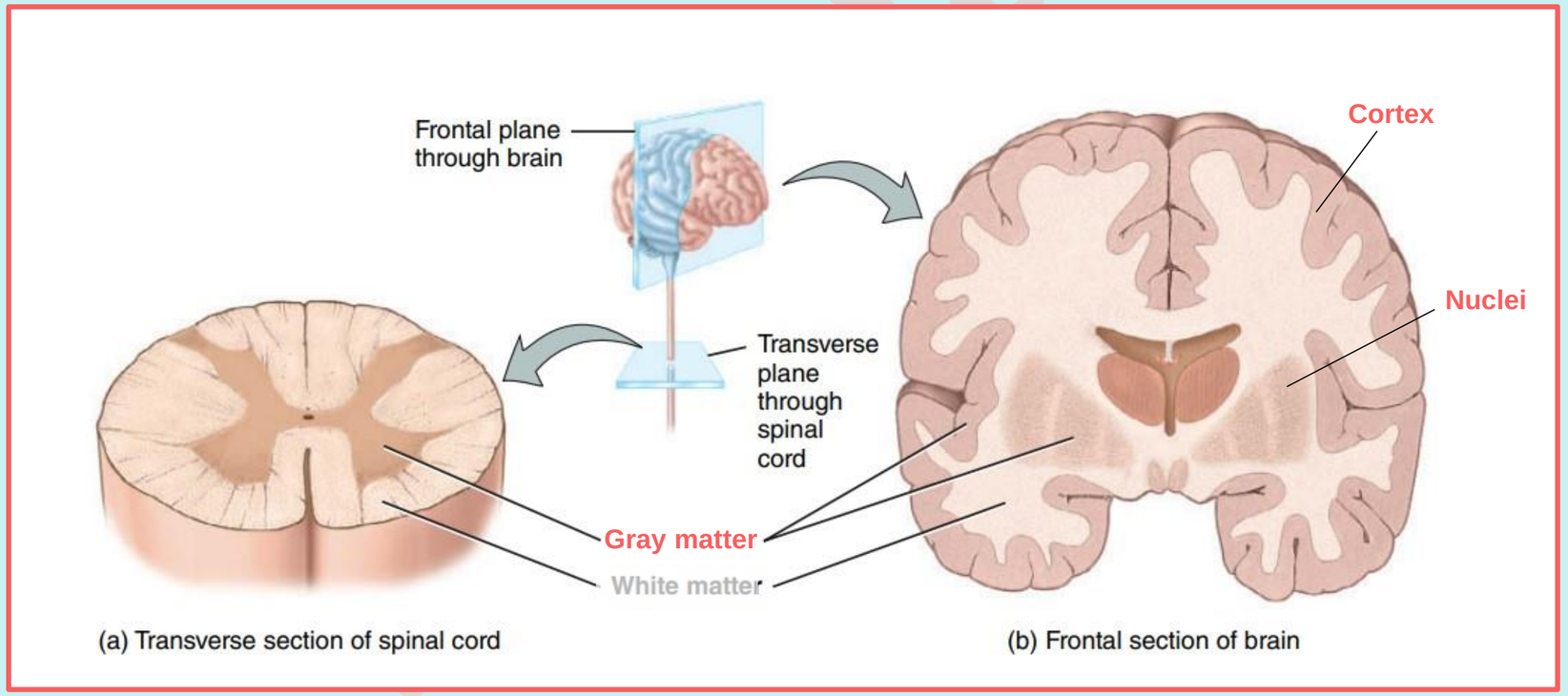
5 This binding causes depolarization of the postsynaptic membrane, generating a new nerve impulse.

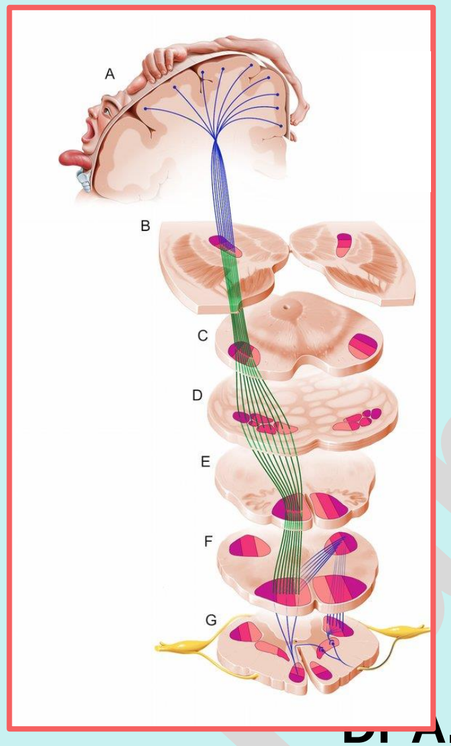
Thus, impulses are transmitted from one neuron to another.



5.1.4 Gray Matter

- It is a collection of neuron cells bodies in the CNS.
- It is called gray because the cell body contain **DNA/RNA which make the dark color.**
- In the brain, gray matter located on the outer surface is known as the **cortex**, while gray matter located deeper within the brain forms **nuclei**.
- In the spinal cord, gray matter is located centrally.





5.1.5 White Matter

Gross lecture-7

- It is a collection of myelinated axons in the CNS
- It is called white because the axons are **covered by myelin sheath which is white in color.**
- **In the brain**, white matter present in the **center**, whereas **in the spinal cord**, it lies at the **periphery**.
- Bundles of white matter fibers in the spinal cord are known as **tracts**.