NERVOUS SYSTEM

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Lec 1

- The CNS is a complex organ; it has been calculated that 40% of the human genes participate, at least to a degree, in its formation
- **The neurons** are the basic building blocks of the nervous system.
- The human central nervous system (CNS) contains about (100 billion) neurons.
- It also contains 10–50 times this number of glial cells.

- **Cellular elements of central nervous system:**
- **Glial cells**

The word glia is Greek for glue. It accounts for 90% of the cells in the nervous system.

Their main functions include providing structural integrity to the nervous system and chemical and anatomical support that permits neurons to carry out their functions.

However, glial cells may also play important roles in intercellular communication.

- **There are two major types of glial cells in the vertebrate nervous system:**

1. **Microglia**
2. **Macroglia**.

- **Microglia**, (the brain immune cells)
- Microglia is scavenger cells that resemble tissue macrophages and remove debris resulting from injury, infection, and disease (eg, Parkinson disease, and Alzheimer disease).
- Microglia arises from macrophages outside the nervous system and is physiologically and embryologically unrelated to other neural cell types.

Macroglia

- Consist of 4 types of cells:-

1. **Oligodendrocytes**
2. **Schwann cells.**
3. **Astrocytes.**
4. **Ependymal cell,**

- **1. Oligodendrocytes** are involved in myelin formation around axons in the CNS .
- **2. Schwann cells** are involved in myelin formation around axons in the peripheral nervous system.

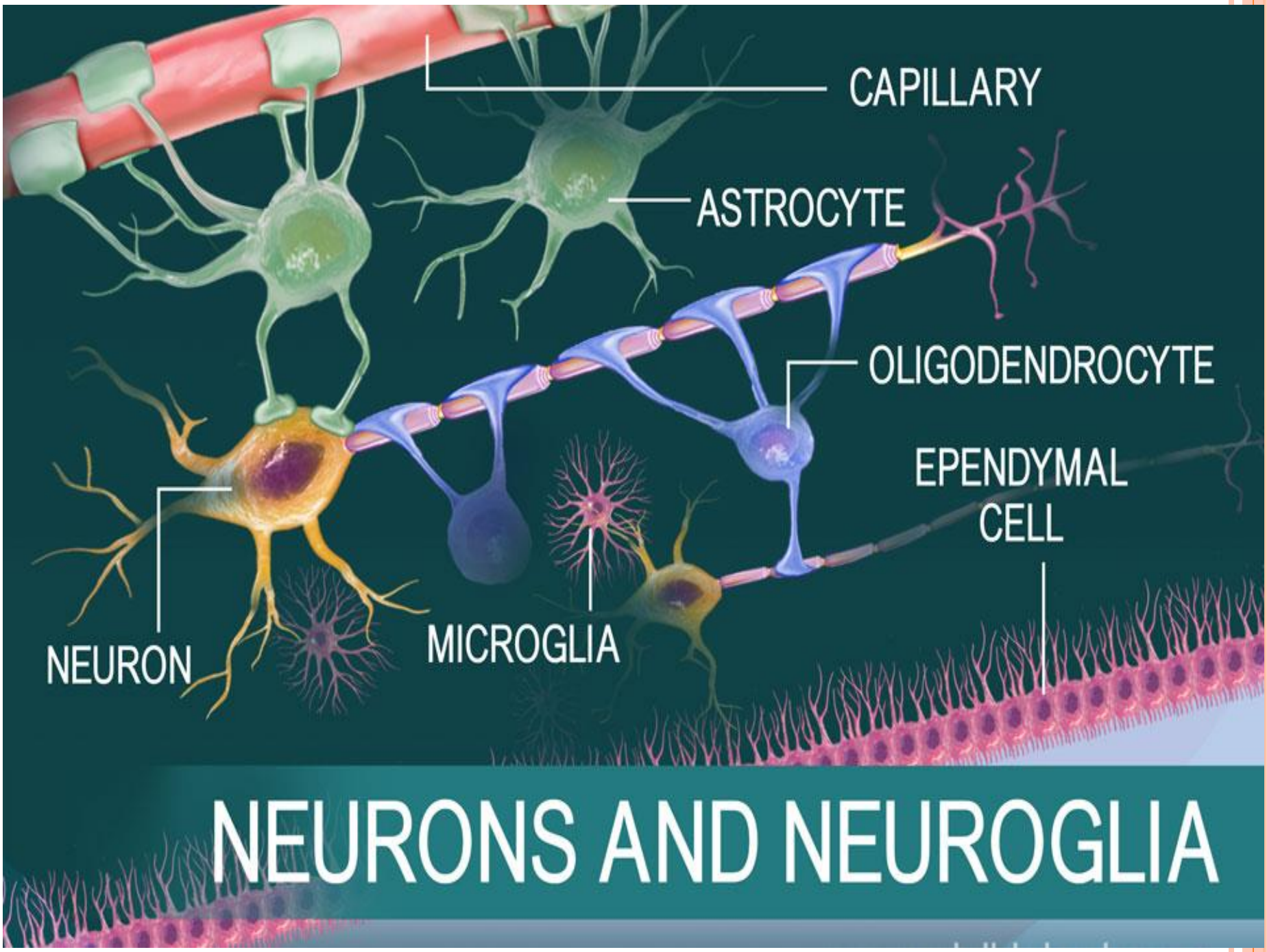
- Myelin sheaths act as insulators and help to speed up the electrical signals that travel down the axon.

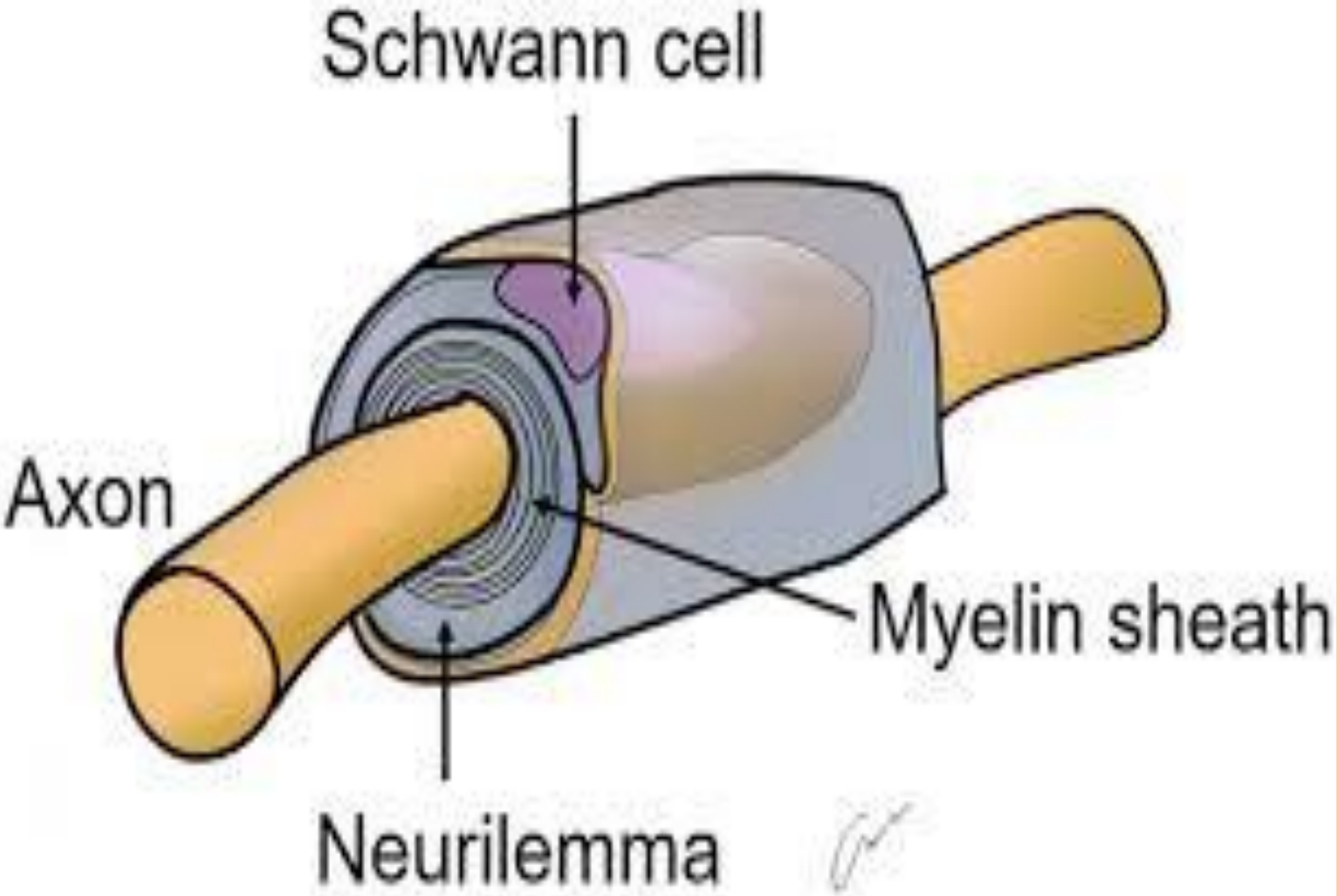
3. Astrocytes

- Which are found throughout the brain and are the most abundant of other glial cells. Astrocytes are essential for maintaining the blood-brain barrier's (BBB) integrity.
- The blood-brain barrier (BBB) is a selective semi-permeable membrane between the blood and the interstitium of the brain, allowing cerebral blood vessels to regulate molecule and ion movement between the blood and the brain

- Absence of BBB makes brain susceptible to injury by chemicals and toxins present in the blood and this is seen in newborn babies with physiological jaundice (elevation of bilirubin) in whom blood brain barrier is not yet developed resulting in permanent damage to the brain.

- **4. Ependymal cell:** type of neuroglia that forms the epithelial lining of the ventricles (cavities) in the brain and the central canal of the spinal cord.


CAPILLARY
ASTROCYTE
OLIGODENDROCYTE
EPENDYMAL CELL
NEURON
MICROGLIA
NEURONS AND NEUROGLIA


Schwann cell
Axon
Myelin sheath
Neurilemma

- **Structure of Nerve Cell**

The typical neuron consists of 3 parts:

1. Cell body (soma)
2. Receptor part (dendrite)
3. Affector part (axon).

1. The cell body (soma)

- It contains the cell nucleus, endoplasmic reticulum, Golgi apparatus, and most of the free ribosomes and Mitochondria
- The cell body carries out most of the functions such as protein synthesis and cellular metabolism Although mature neurons retain their nuclei, they lose the ability to undergo cell division.

2. Receptor part (Dendrites)

- Several processes that extend outward from the cell body and branch extensively where it receives action potential from neighboring neurons through specialized junctions called synapses.

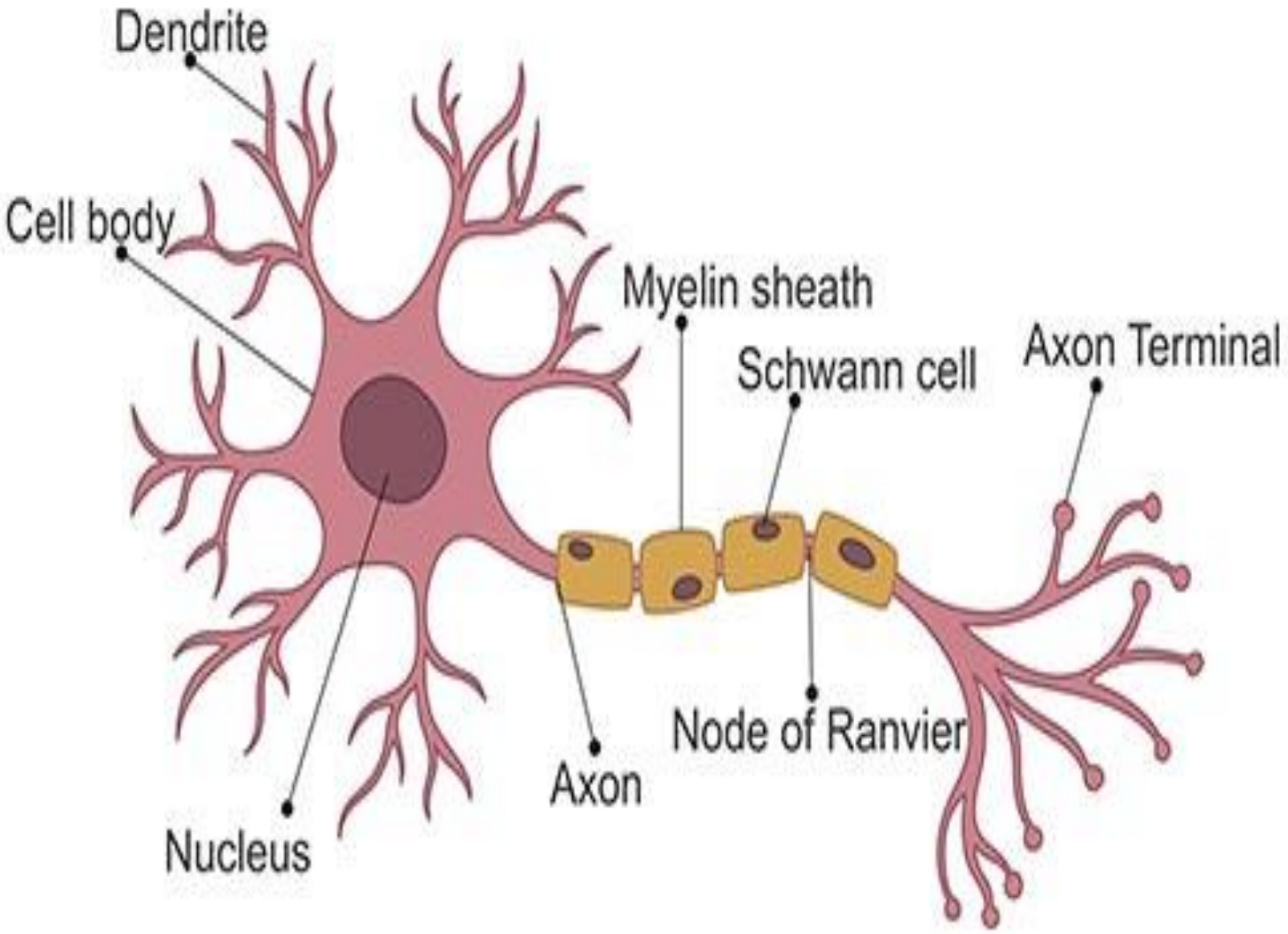
3. Affecter part (axon)

- Neuron has a long, fibrous axon that emerges from the axon hillock, a slightly thicker region of the cell body.

- The axon functions in the rapid transmission of information over relatively long distances in the form of electrical signals called action potentials.

- **Action Potentials:**

- which are quick, significant changes in membrane potential that cause the interior of the cell to become positively charged in relation to the outside, are the electrical signals.


Dendrite
Cell body
Myelin sheath
Schwann cell
Axon Terminal
Node of Ranvier
Axon
Nucleus

Structural Classification of Neurons

Neurons can be classified structurally according to the number of processes (axons and dendrites) that project from the cell body into:-

1. Bipolar neurons

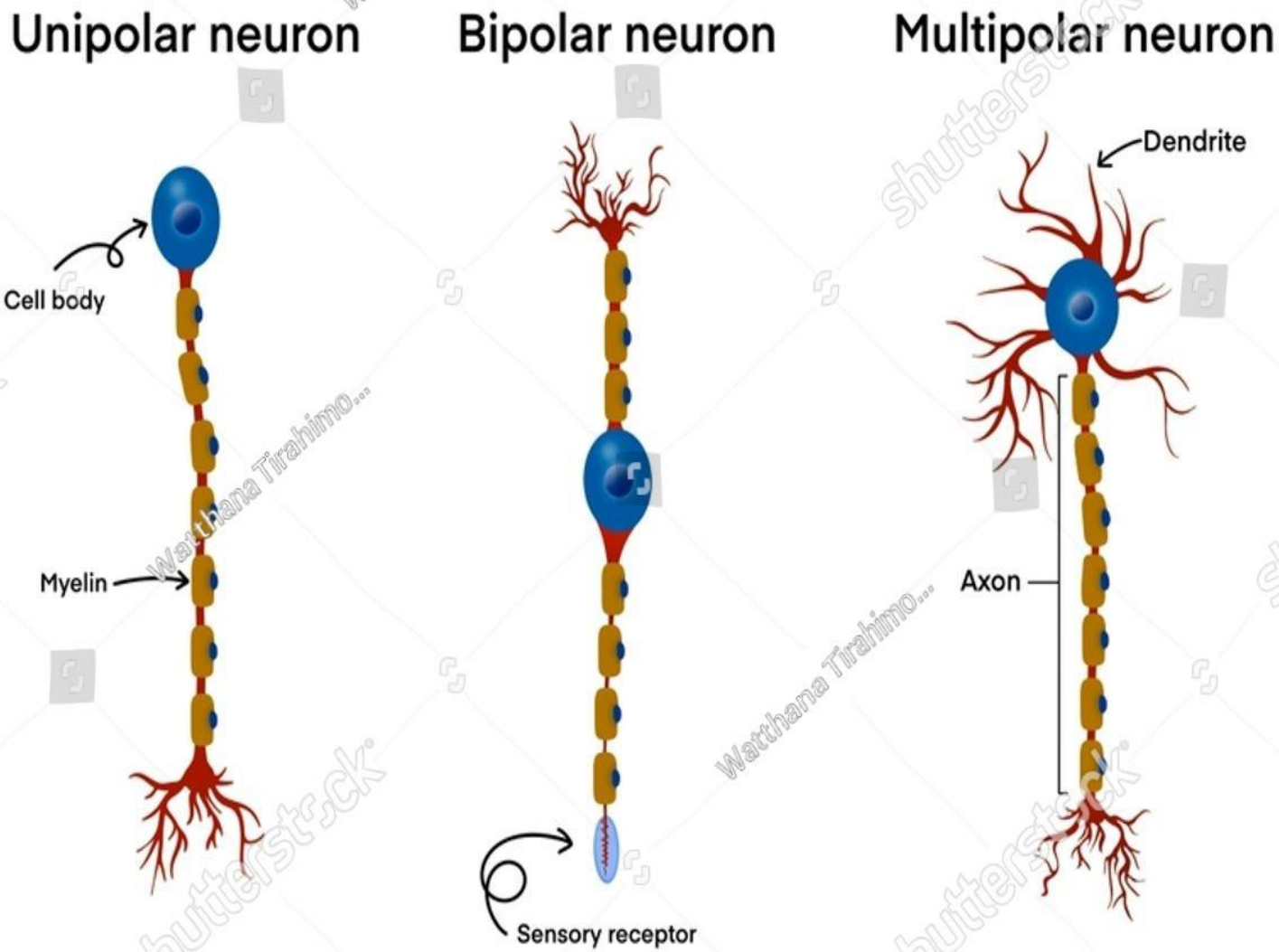
are generally sensory neurons with two projections, an axon, and a dendrite, coming off the cell body. typical bipolar neurons function in the senses of olfaction (smell) and vision.

2. Pseudo-uni-polar neurons

This name arises because the axon and dendrite projections appear as a single process that extends in two directions from the cell body.

3. Multipolar neurons

the most common neurons, have multiple projections from the cell body; one projection is an axon, all the others are dendrites


Unipolar neuron
Cell body
Myelin
Bipolar neuron
Sensory receptor
Multipolar neuron
Dendrite
Axon

Functional Classification of Neurons

Three functional classes of neurons exist: efferent neurons, afferent neurons, and interneurons.

1. Efferent neurons

transmit information from the central nervous system to effector organs & include the motor neurons that extend to skeletal muscle and the neurons of the autonomic nervous system

2. Afferent neurons

are responsible for sending information to the central nervous system from either sensory receptors, which recognize information about the external world, or visceral receptors, which recognize information about circumstances inside the body.

3. Interneurons

which account for 99% of all neurons in the body. They are located entirely in the central nervous system.

Interneurons perform all the functions of the central nervous system, including:

A. Processing

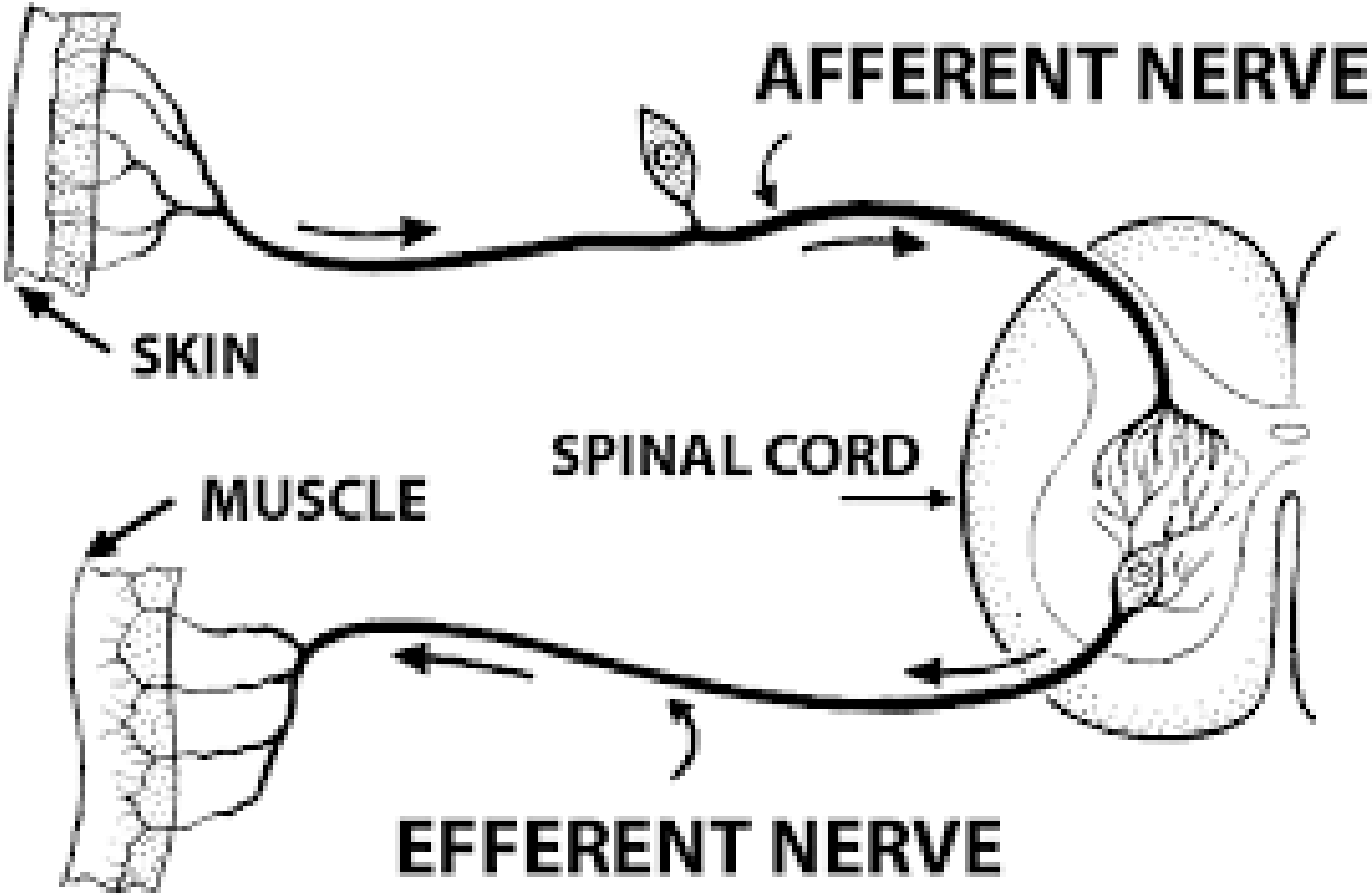
Sensory information from afferent neurons,

B. Creating

Sending out commands to effector organs through efferent neurons.

C. Carrying

out complex functions of the brain such as thought, memory, and emotions.


AFFERENT NERVE
SKIN
SPINAL CORD
MUSCLE
EFFERENT NERVE