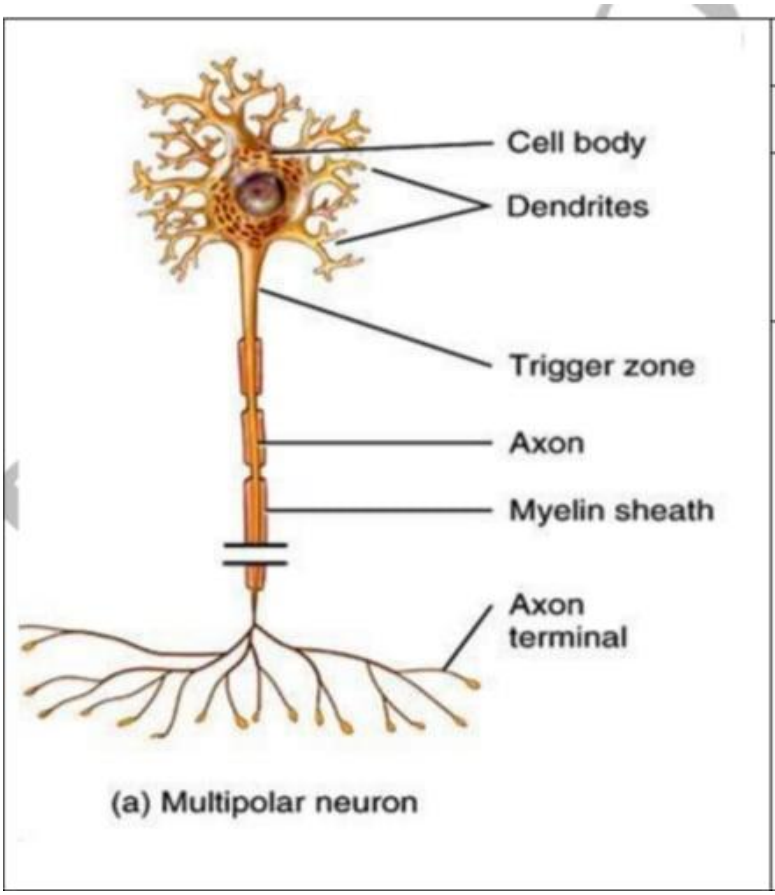
Lecture 2 / Nervous system

The nervous system is histologically composed of neurons which produce and contact electrochemical impulses and supporting cells, which assist the functions of neurons.

Neurons – are the basic structural and functional units of the nervous system. They are specialized to respond to physical and chemical stimuli, conduct impulses and release chemical regulators.

Neuron Structure:

In order to connect to other cells, receptors, and effectors, neurons have **cytoplasmic extensions** which attach to an enlarged area known as the **cell body or Cyton**. Within the cell body is the nucleus and the neuron's biosynthetic machinery, the rough endoplasmic reticulum and the Golgi bodies. These organelles are so highly concentrated they can be visualized with a light microscope when stained with a specific technique called Nissl bodies, they manufacture the Neurotransmitters., which transported to the axon terminus by microfilaments and microtubules. There are two basic types of cytoplasmic extensions: the dendrites and the axon. Dendrites are short branching processes which receive stimuli from receptors or other neurons



Axon	Dendrites
Longer process	Short processes
Single branch	Many thin branched processes (Tree branch)
Conduct impulses from cell body.	Provide a respective area that transmitelectrical impulse to cell body.

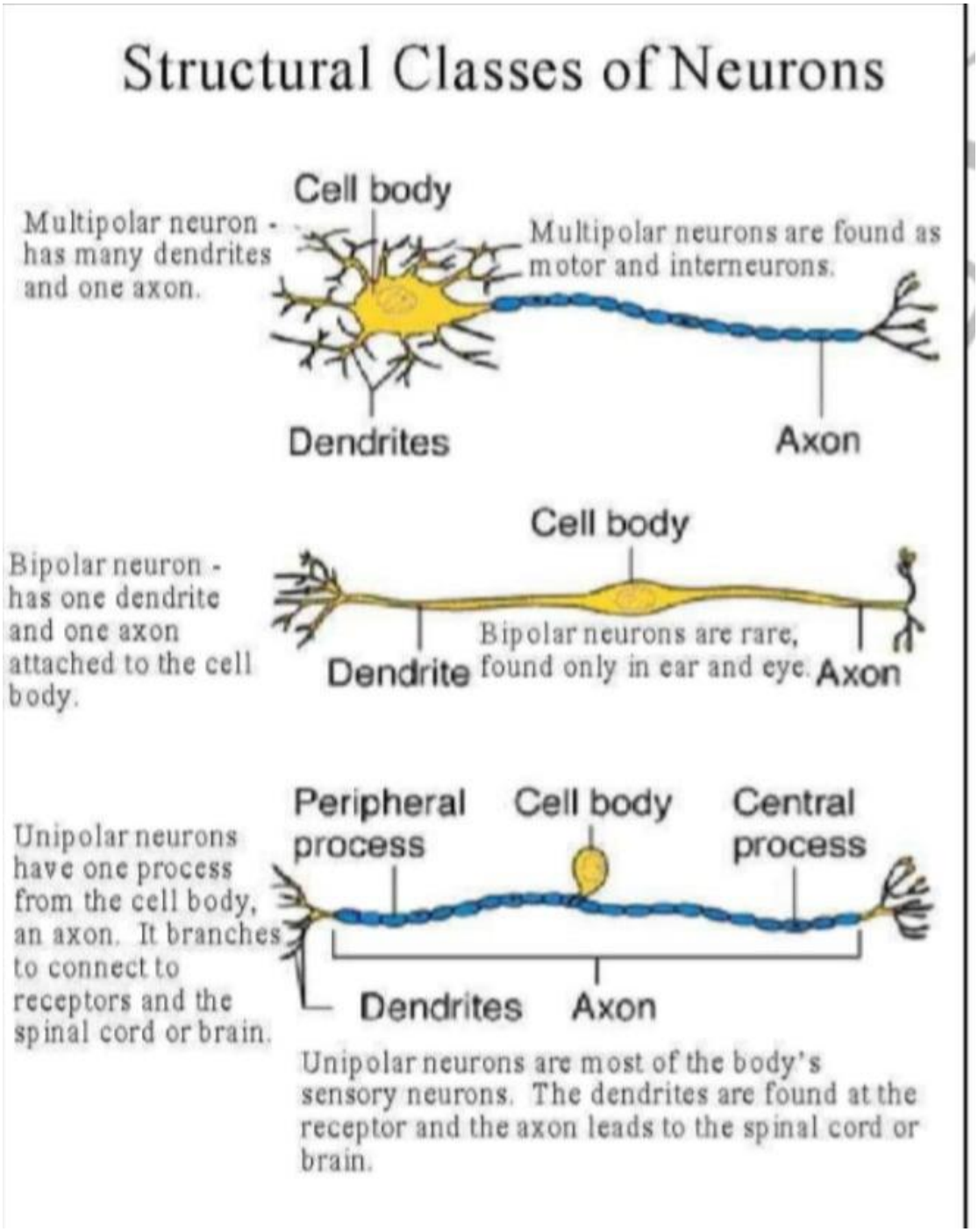
Figure 1 **Multipolar neuron**

Types of neurons based on structure:

1. Multipolar neuron: have many poles or processes, the dendrites and the axon. Multipolar neurons are found as Motor neurons and Inter neurons.

2. Bipolar neurons with two processes, a dendrite and an axon.

3. Unipolar neurons, which have only one process, classified as an axon. Found as sensory neurons. The axon carries the action potential to the central nervous system.


Structural Classes of Neurons
Cell body
Multipolar neuron - has many dendrites and one axon.
Multipolar neurons are found as motor and interneurons.
Dendrites
Axon
Cell body
Bipolar neuron - has one dendrite and one axon attached to the cell body.
Bipolar neurons are rare, found only in ear and eye.
Dendrite
Axon
Peripheral process
Cell body
Central process
Unipolar neurons have one process from the cell body, an axon. It branches to connect to receptors and the spinal cord or brain.
Dendrites
Axon
Unipolar neurons are most of the body's sensory neurons. The dendrites are found at the receptor and the axon leads to the spinal cord or brain.

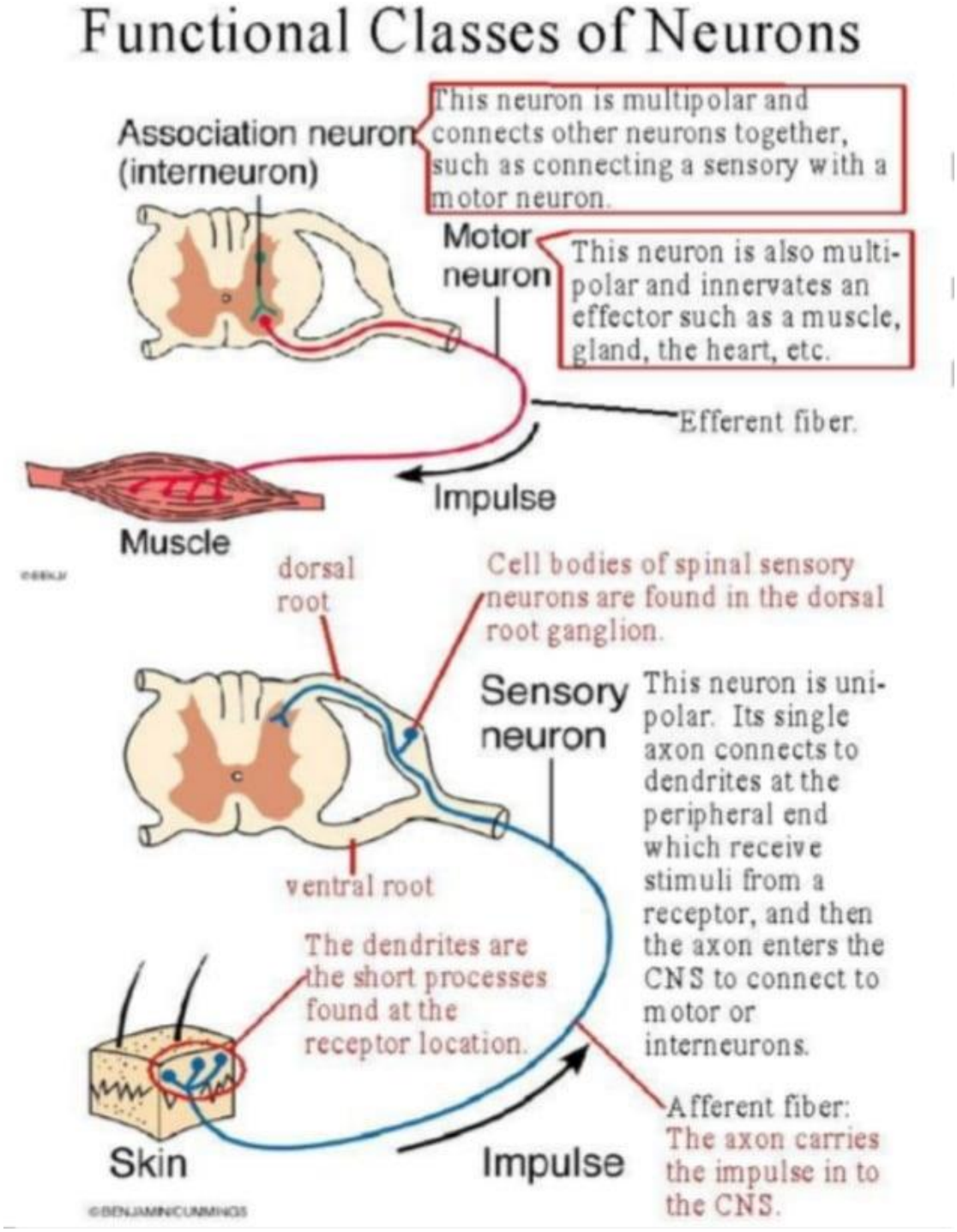
Types of neurons based on function: (based on the direction which they conduct impulses)

1. Motor neurons - these carry a message to a muscle, gland, or other effectors. They are said to be efferent, i.e. they carry the message away from the central nervous system. Include 2 types (Somatic neurons and Autonomic neurons , which include (sympathetic and parasympathetic neurons).

2. Sensory neurons - these carry a message in to the CNS. They are afferent, i.e. going toward the brain or spinal cord.

3. Interneuron (association neuron, connecting neuron) - these neurons connect one neuron with another. For example in many reflexes interneurons connect the sensory neurons with the motor neurons.

- The three functional types of neurons together composed the Reflex arc.


Functional Classes of Neurons
Association neuron (interneuron)
This neuron is multipolar and connects other neurons together, such as connecting a sensory with a motor neuron.
Motor neuron
This neuron is also multi-polar and innervates an effector such as a muscle, gland, the heart, etc.
Efferent fiber.
Impulse
Muscle
dorsal root
Cell bodies of spinal sensory neurons are found in the dorsal root ganglion.
Sensory neuron
This neuron is uni-polar. Its single axon connects to dendrites at the peripheral end which receive stimuli from a receptor, and then the axon enters the CNS to connect to motor or interneurons.
ventral root
The dendrites are the short processes found at the receptor location.
Afferent fiber: The axon carries the impulse in to the CNS.
Skin
Impulse
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Supporting cells

1. Schwann cells - produce the myelin sheath in the PNS. The myelin sheath protects and insulates axons, maintains their micro-environment, and enables them to regenerate and re-establish connection with receptors or effectors.

2. Oligodendrocyte- produces the myelin sheath in the CNS which insulates and protects axons.

3. Satellite cells- surround cell bodies of neurons in ganglia. Their role is to maintain the micro-environment and provide insulation for the ganglion cells.

4. Microglia - these cells are phagocytic to defend against pathogens. They may also monitor the condition of neurons.

5. Astrocytes- these cells anchor neurons to blood vessels, regulate the micro-environment of neurons in CNS, and regulate transport of nutrients and wastes to and from neurons.

6. Ependymal cells - these cells line the fluid-filled cavities of the brain and spinal cord. They play a role in production, transport, and circulation of the cerebrospinal fluid.

Myelin: is an insulating layering that forms around nerves, including those in the brain and spinal cord. It is made up of protein and fatty substances. The purpose of the myelin sheath is to allow rapid and efficient transmission of impulses along the nerve cells. If the myelin is damaged, the impulses slow down. This can cause diseases like multiple sclerosis.