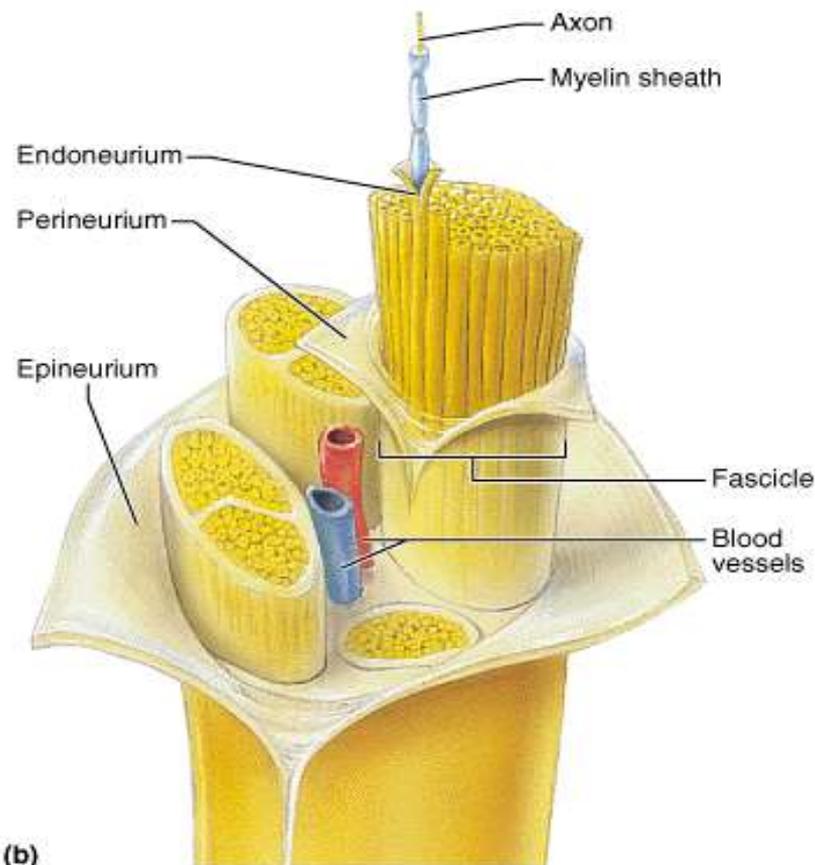


Histology of Nervous Tissue

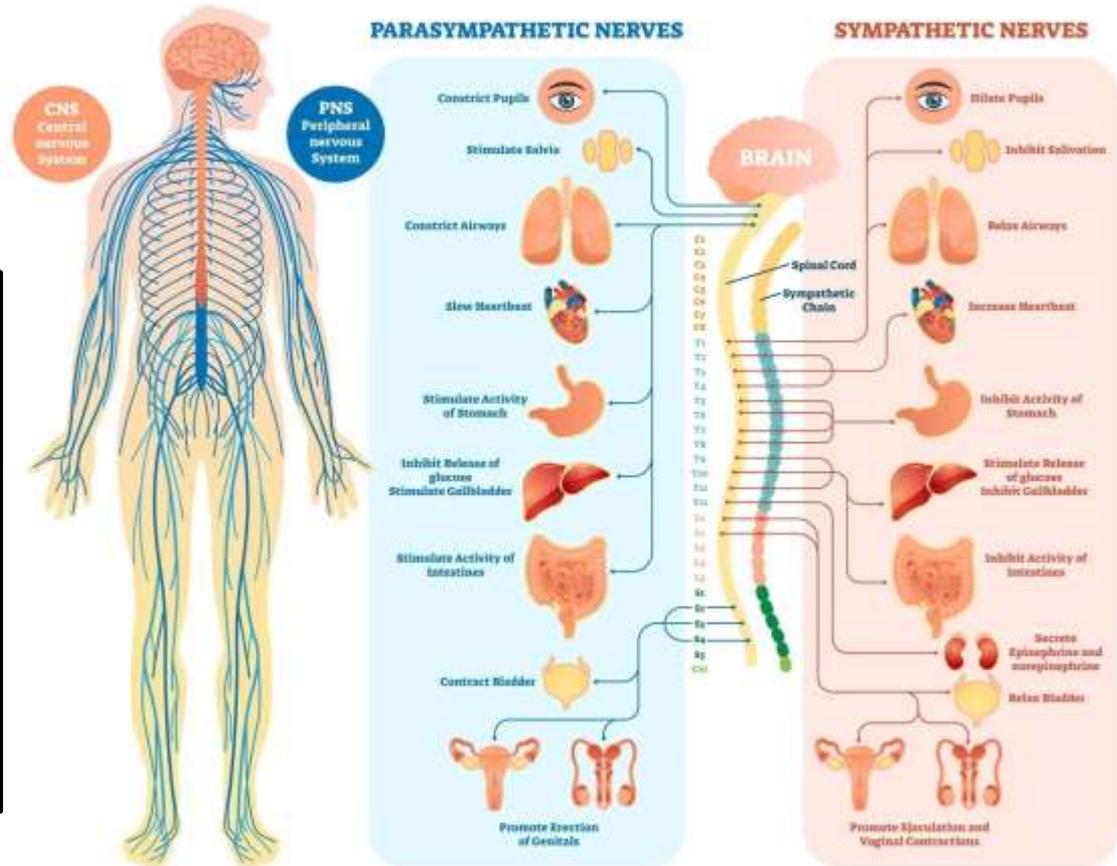
Nervous system

Dr Amal Albtoosh



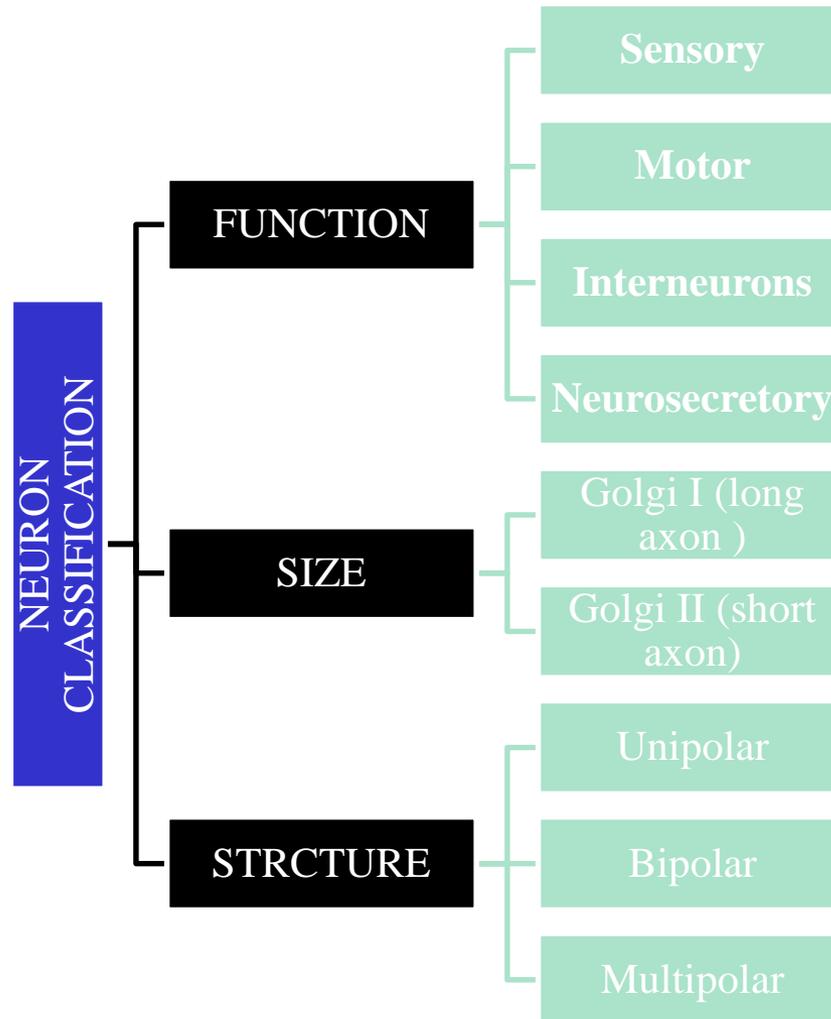
(b)

HUMAN NERVOUS SYSTEM



The Mammalian Nervous System

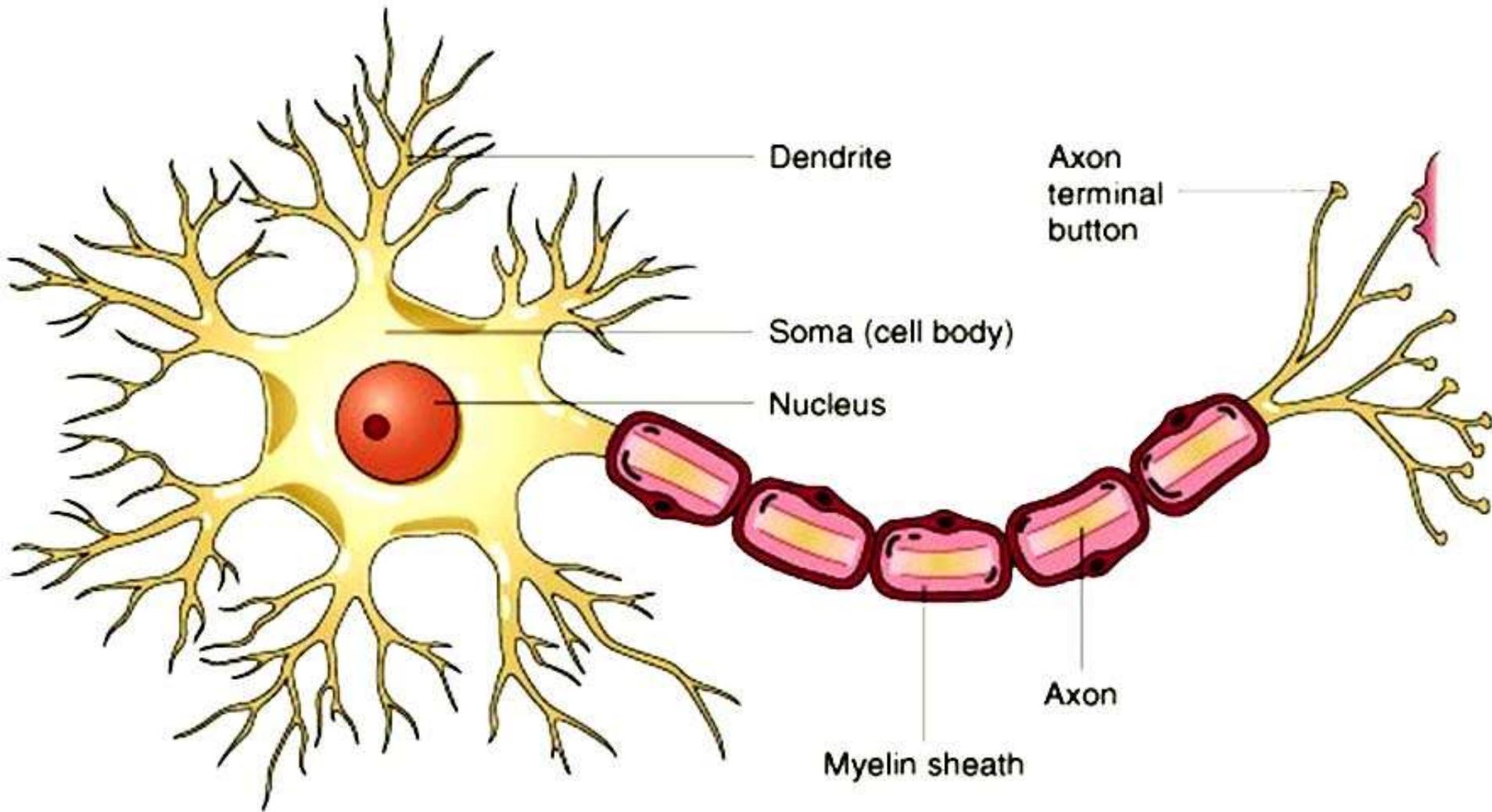
- Central nervous system (CNS) consists of the brain and spinal cord
- Peripheral nervous system



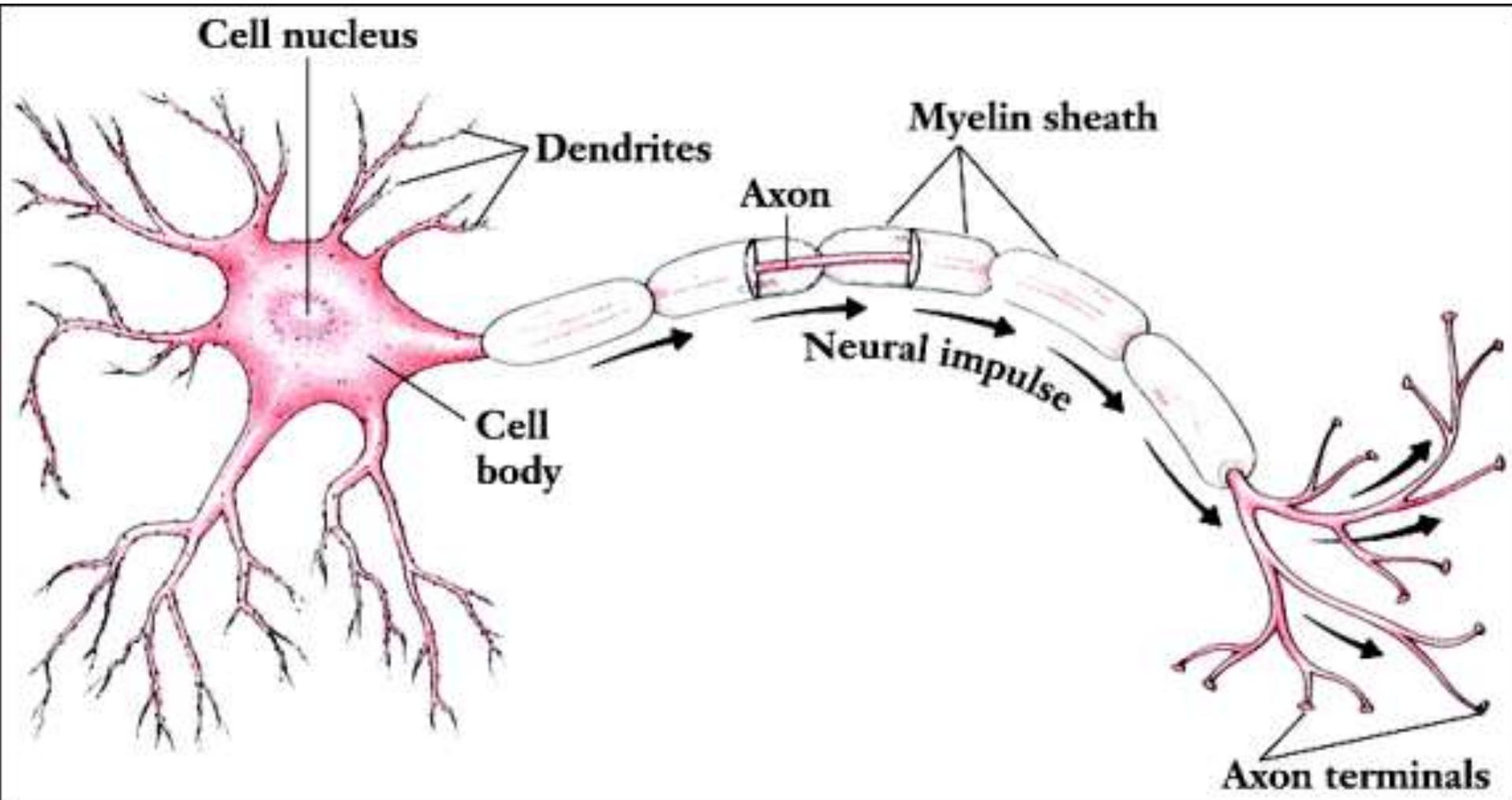
Nervous Tissue consists of 2 types of cells

- **1 - Neurons** – main cells, specialized to
 - perception of sensory stimuli,
 - processing received information and
 - transmission it further to other neurons in form of nerve impulses
- **2 - Neuroglia-**
 - they support,
 - nourish and
 - protect neurons

Neuron



Neuron

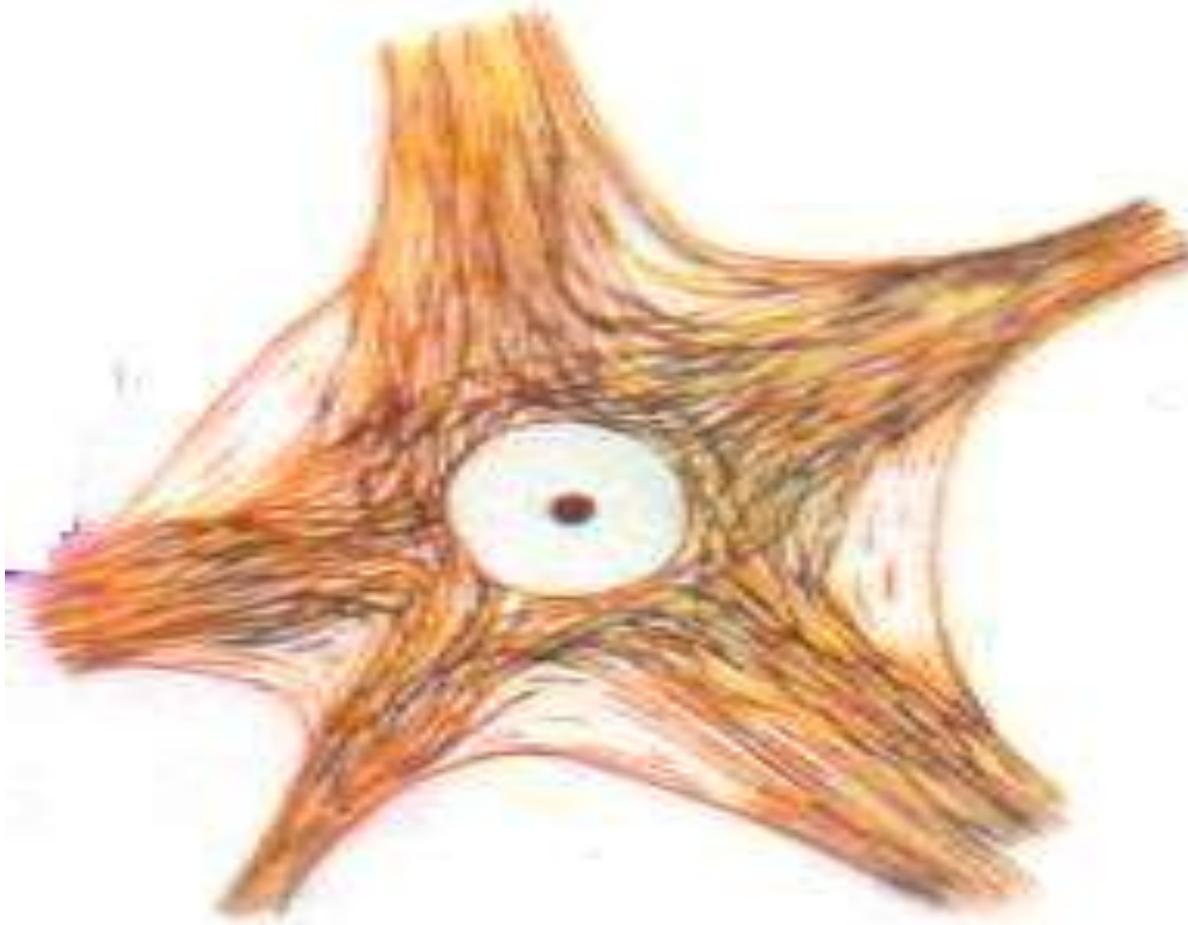


Neuron Structure

- 1. Cell body = perikaryon = contains nucleus and is the metabolic center of the cell
- 2. Processes – that extend from the cell body (dendrites and axon)
- 3. Nerve endings (synapses, special receptors)

- Cell body has:
- Nucleus with large nucleolus
 - Neurofibrils
 - “Nissl bodies” (chromophilic substance)

Neurofibrils are present in the perikaryon, dendrites and axon and are unique to neurons. = “Skeleton” of the neurons



Nissl bodies

- large clumps of basophilic material around the nucleus,

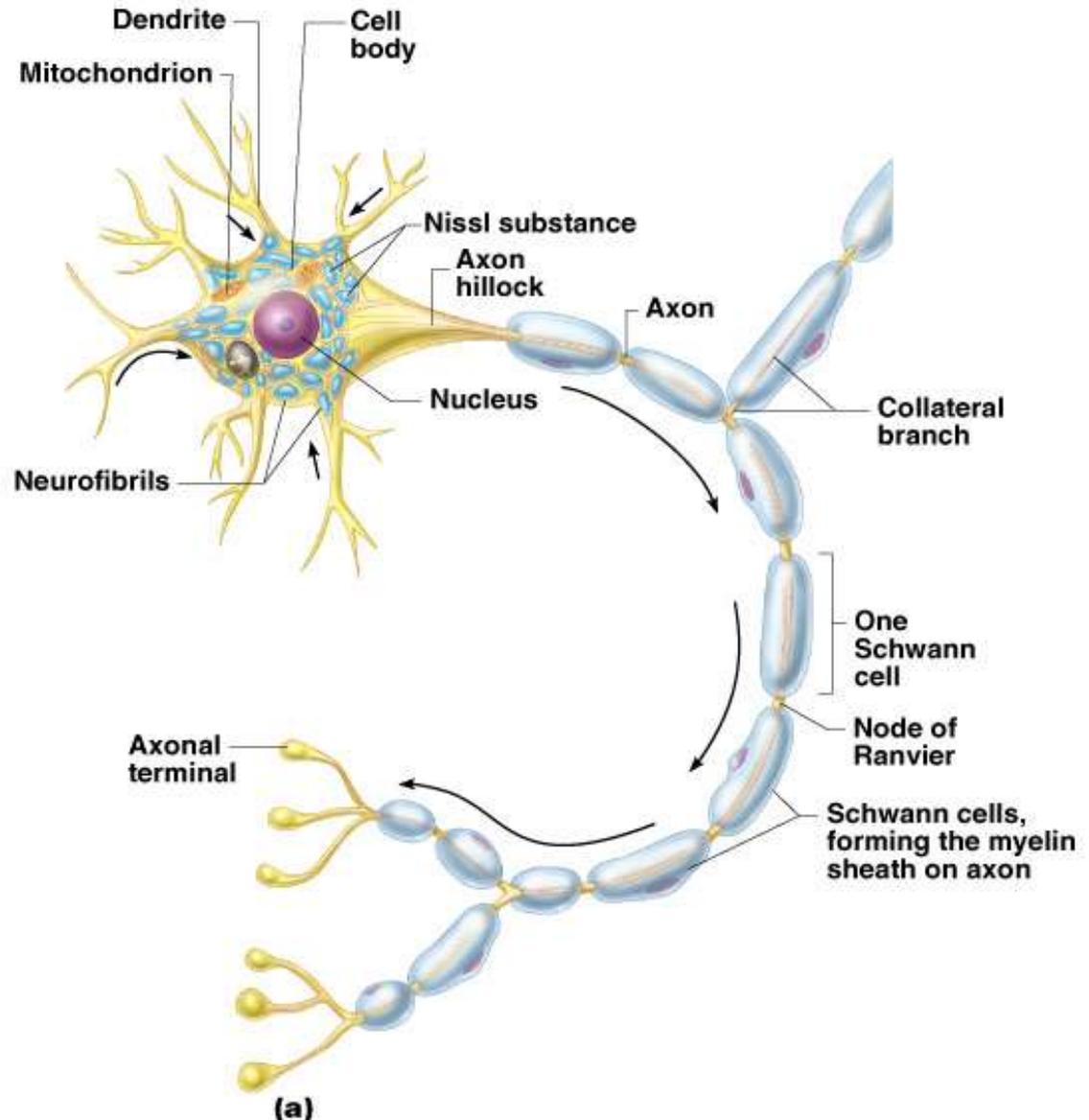
an aggregation of many parallel cisternae of the rough endoplasmic reticulum with the rosettes of free polisomal ribosomes

Function – protein synthesis
(neurotransmitters)



Neuron processes - Extensions outside the cell body

- **Dendrites** – conduct impulses **toward** the cell body
- **Axons** – conduct impulses **away** from the cell body (usually only 1!)
- All processes end with the nerve endings



(1) Structural Classification of Neurons - *According to amount of processes*

- 1. **Unipolar** neurons – are found during early embryogenesis. They have one axon



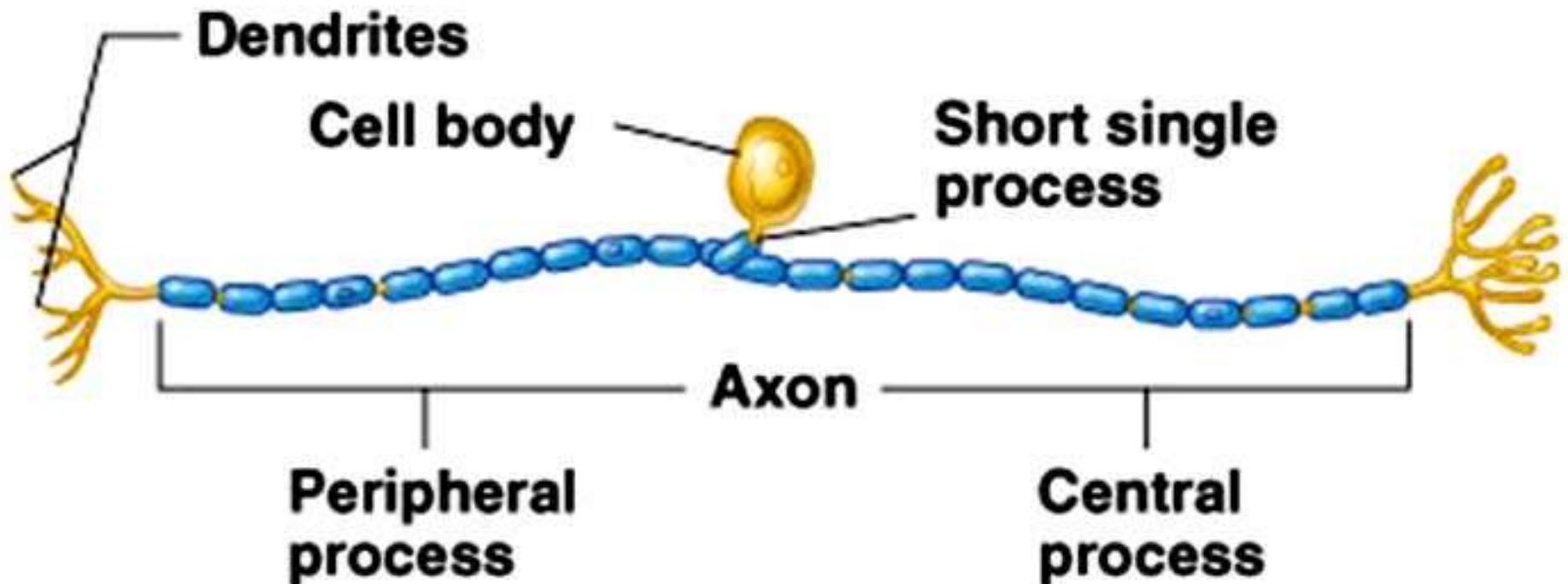
(1) Structural Classification of Neurons

- 2. **Bipolar** neurons – one axon and one dendrite



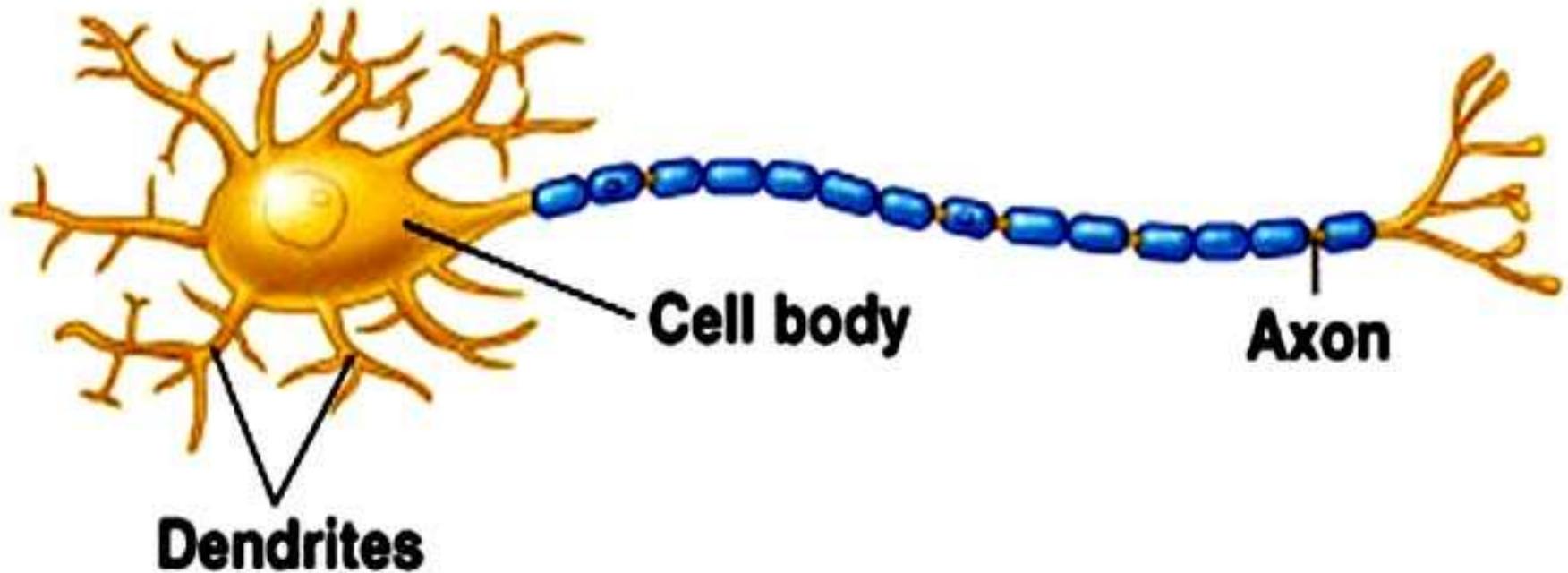
(1) Structural Classification of Neurons

- 3. **Pseudounipolar** neurons – have a short single process leaving the cell body



(1) Structural Classification of Neurons

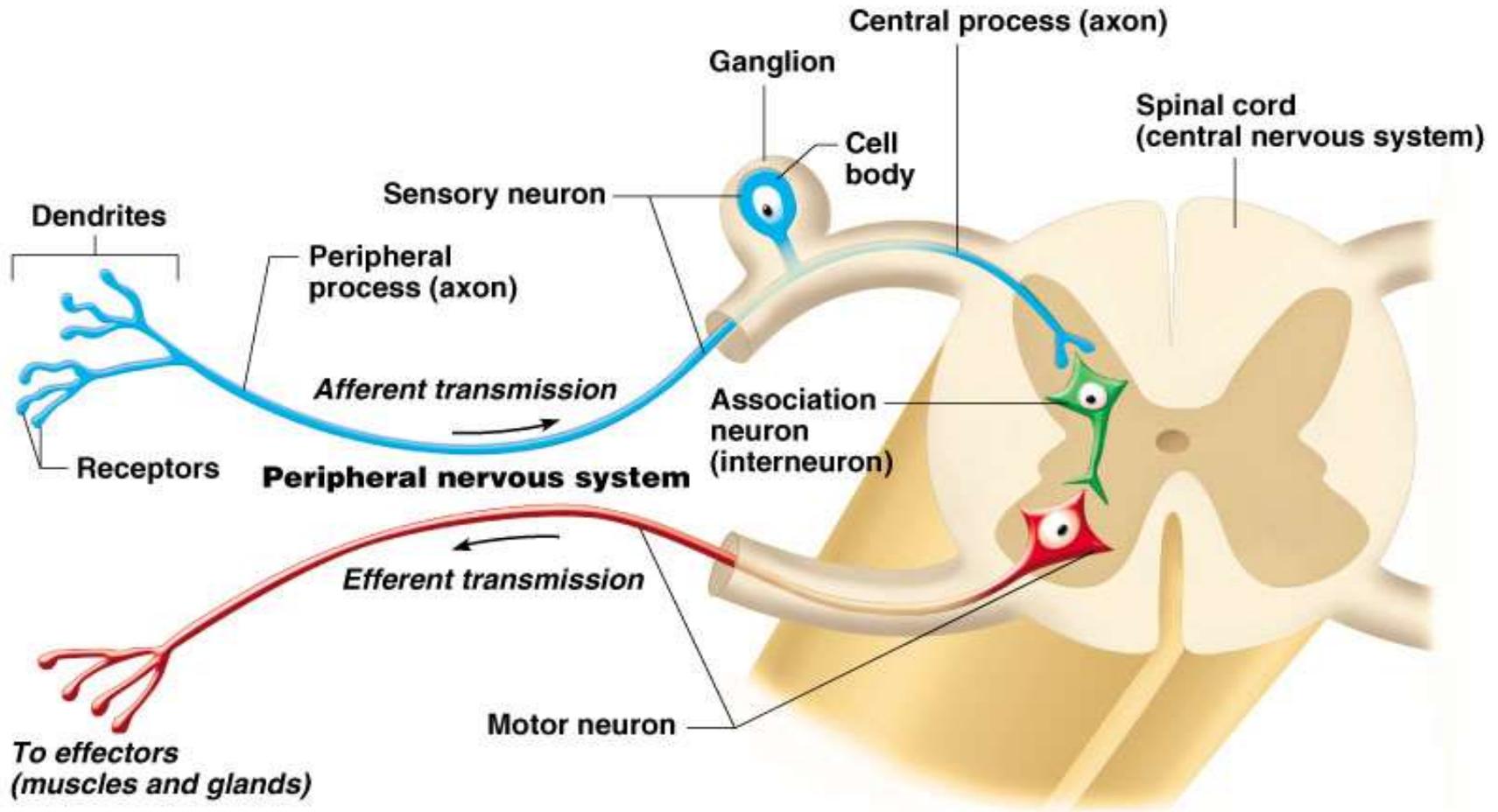
- 4. **Multipolar** neurons – many extensions from the cell body



(2) Functional Classification of Neurons

- 1. **Sensory** (afferent) neurons
Carry impulses from the sensory receptors to the cell body
- 2. **Motor** (efferent) neurons
Carry impulses from cell body which lie in the central nervous system to effector cells
- 3. **Interneurons** (=association neurons) -
99,9% in the central nervous system
Connect sensory and motor neurons

3. Neurons form reflex arc



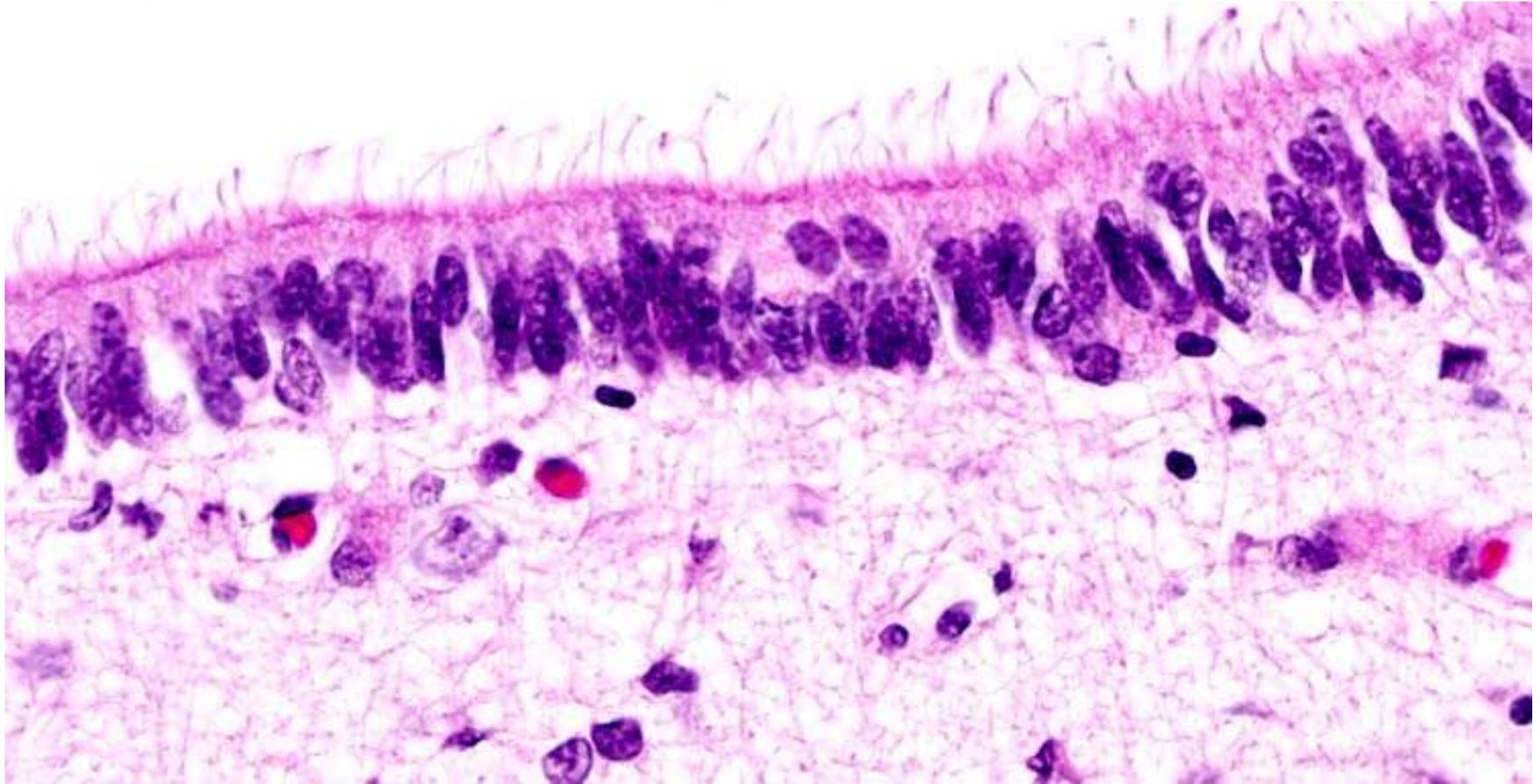
Supporting Cells
(Neuroglia or Glia) =

Macroglia + Microglia

Macroglia in the CNS

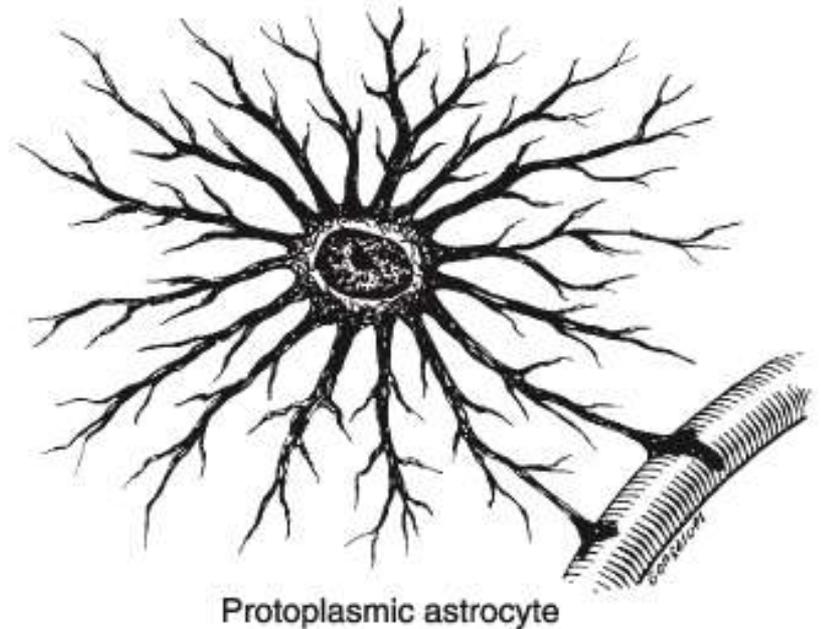
- 1. Ependymal cells

- Line cavities of the brain and spinal cord
Synthesize cerebrospinal fluid

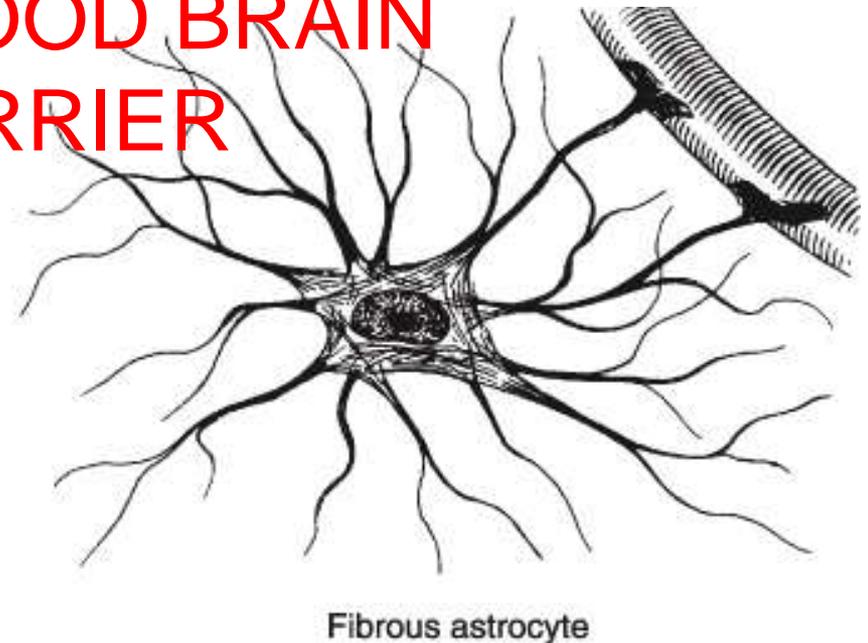


- **2. Astrocytes**

- Star-shaped cells
- Support neurons
- Form barrier between capillaries and neurons (BBB)
- Control the chemical environment of the brain (CNS)
- 2 types: Protoplasmic
- and Fibrous



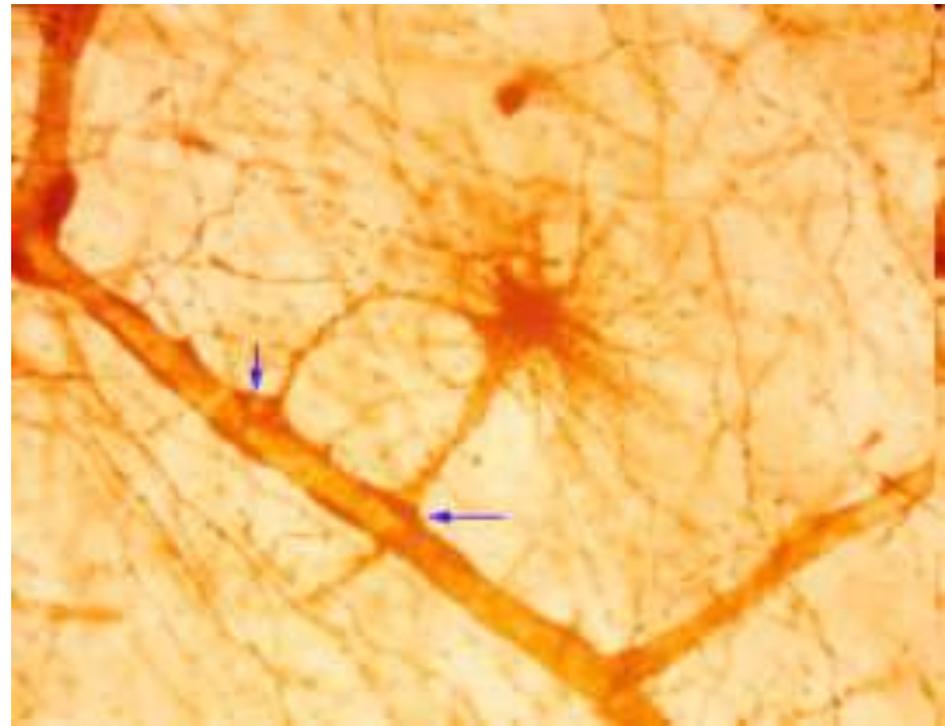
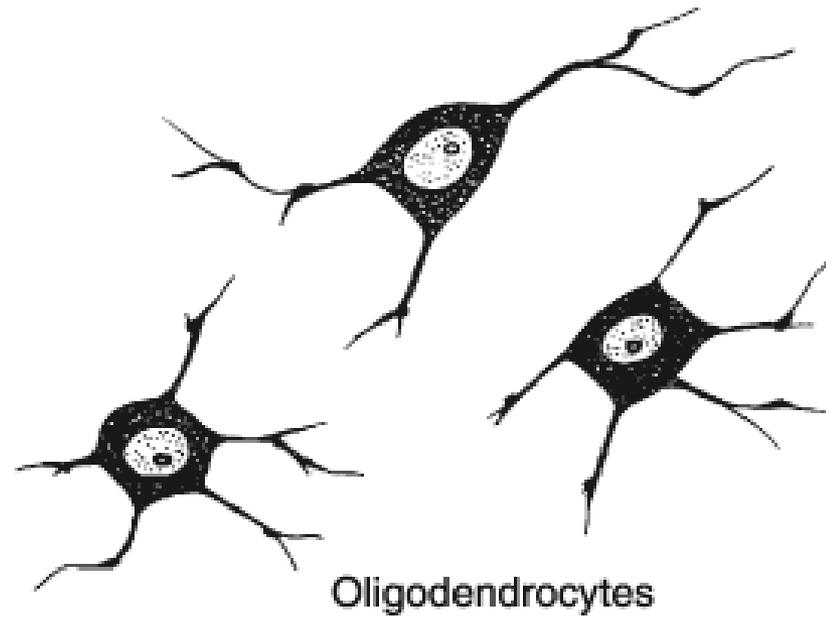
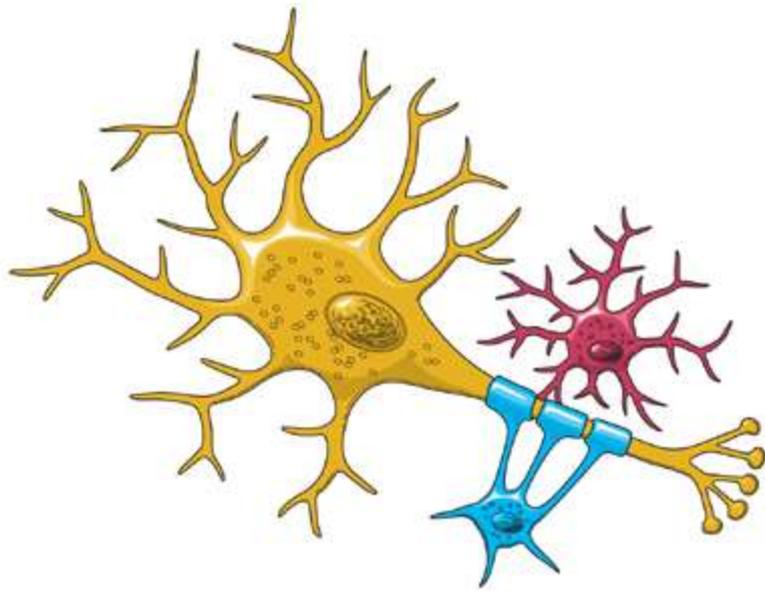
BLOOD BRAIN BARRIER



- 3. ***Oligodendrocytes***

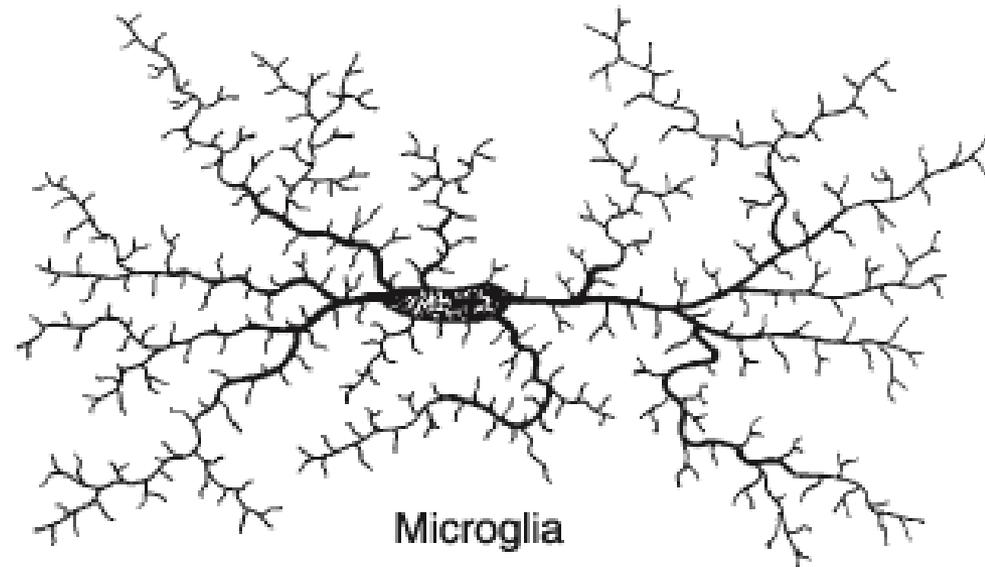
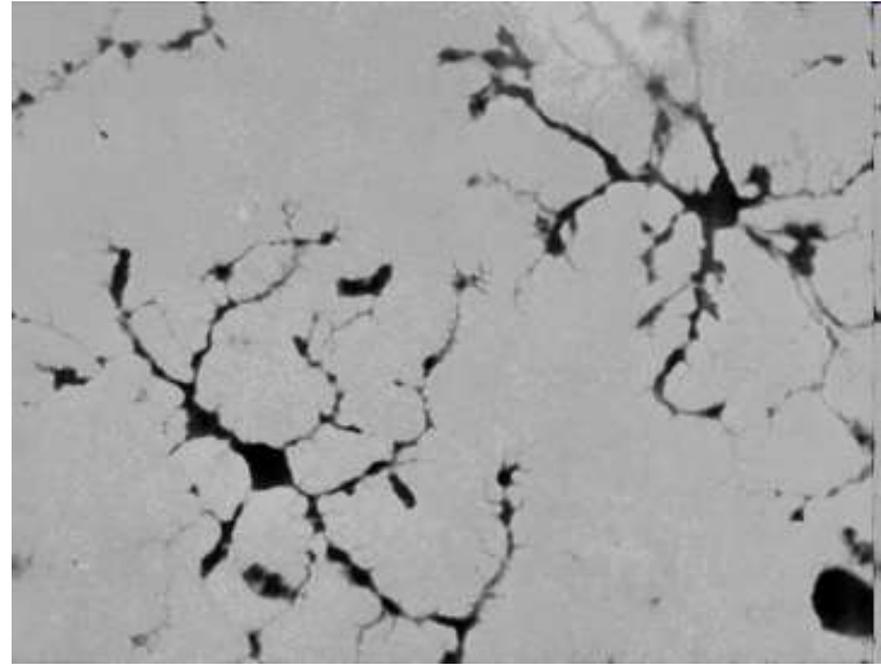
Produce myelin sheath around nerve fibers in the central nervous system

- Nourish neurons



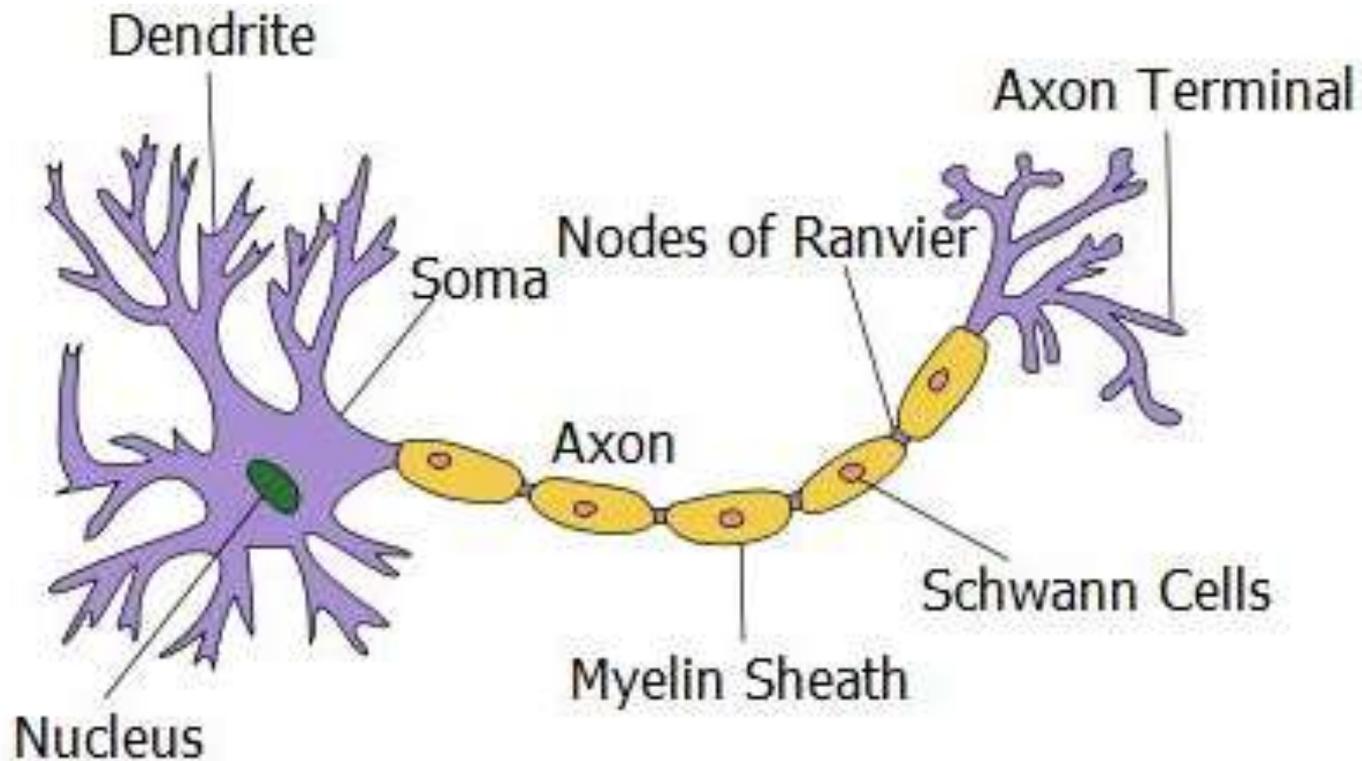
Microglia

- - arise from **monoblast** of the blood
- Spider-like
- phagocytes
- Dispose of debris



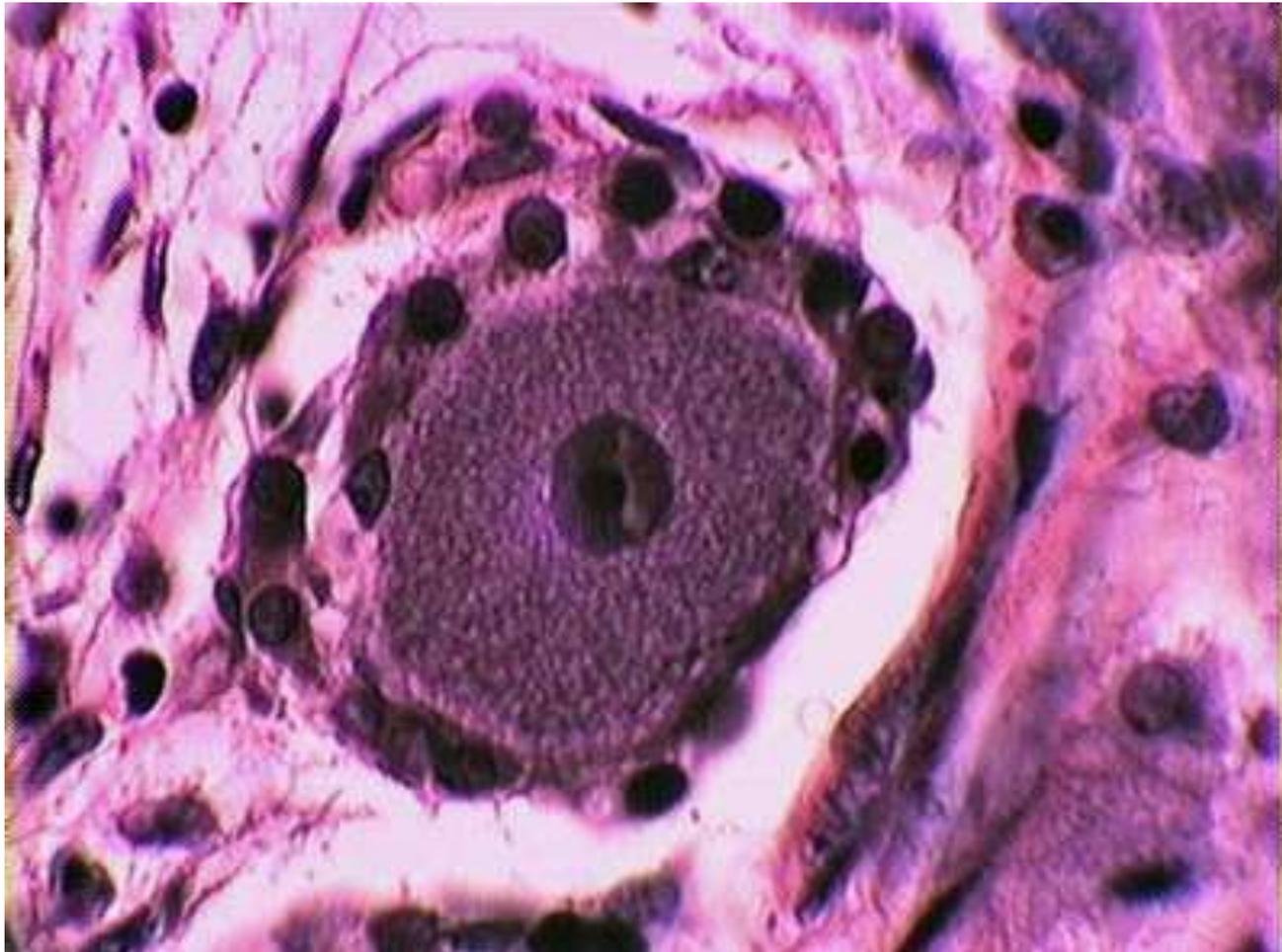
Supporting Cells of the PNS

- **Schwann cells** - form myelin sheath in the peripheral nervous system



Supporting Cells of the PNS

- **Satellite cells** – surround cell bodies of neurons in sensory ganglia



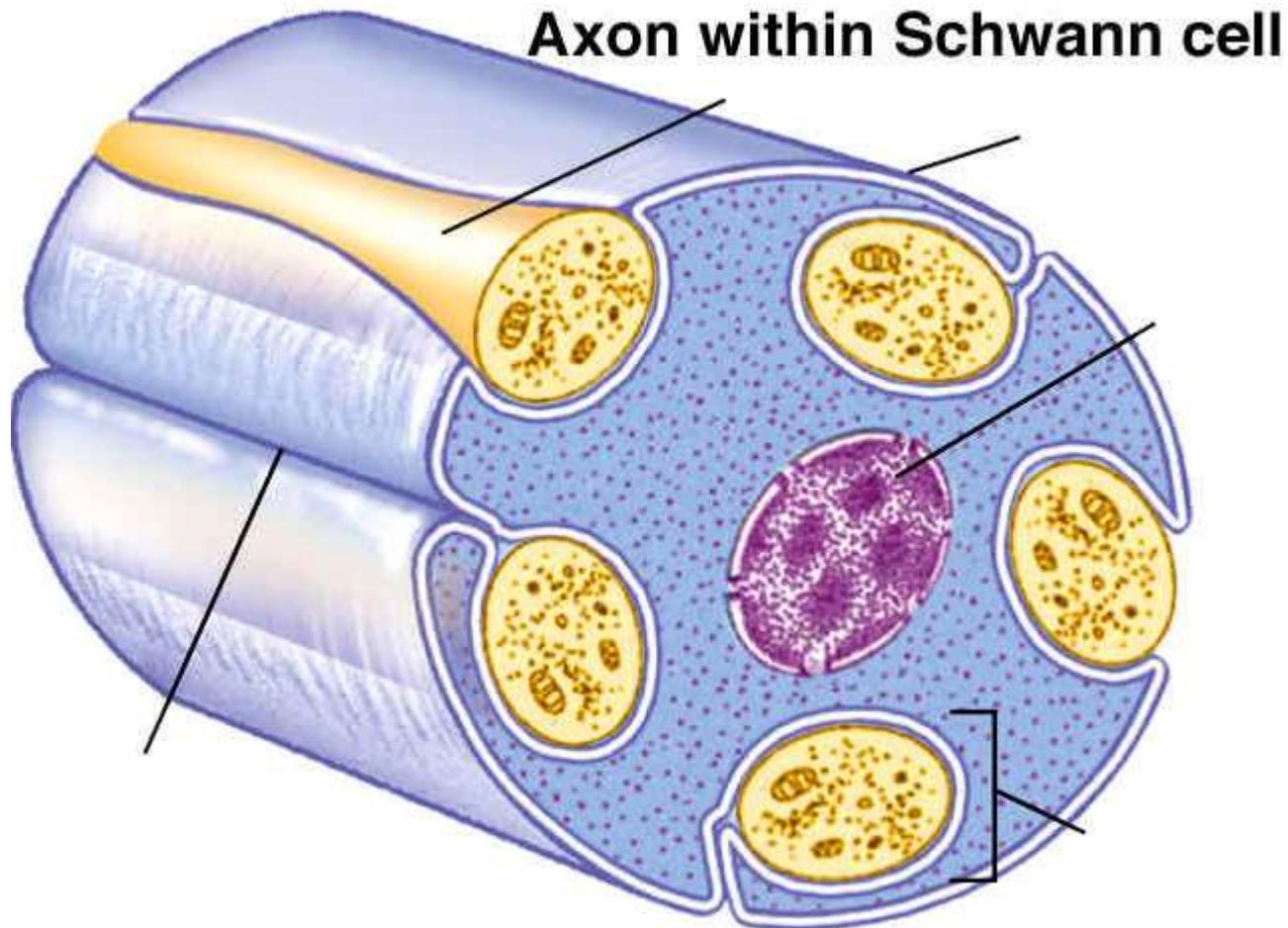
Nerve fibers

1. Unmyelinated

2. Myelinated

myelinated nerve fiber:

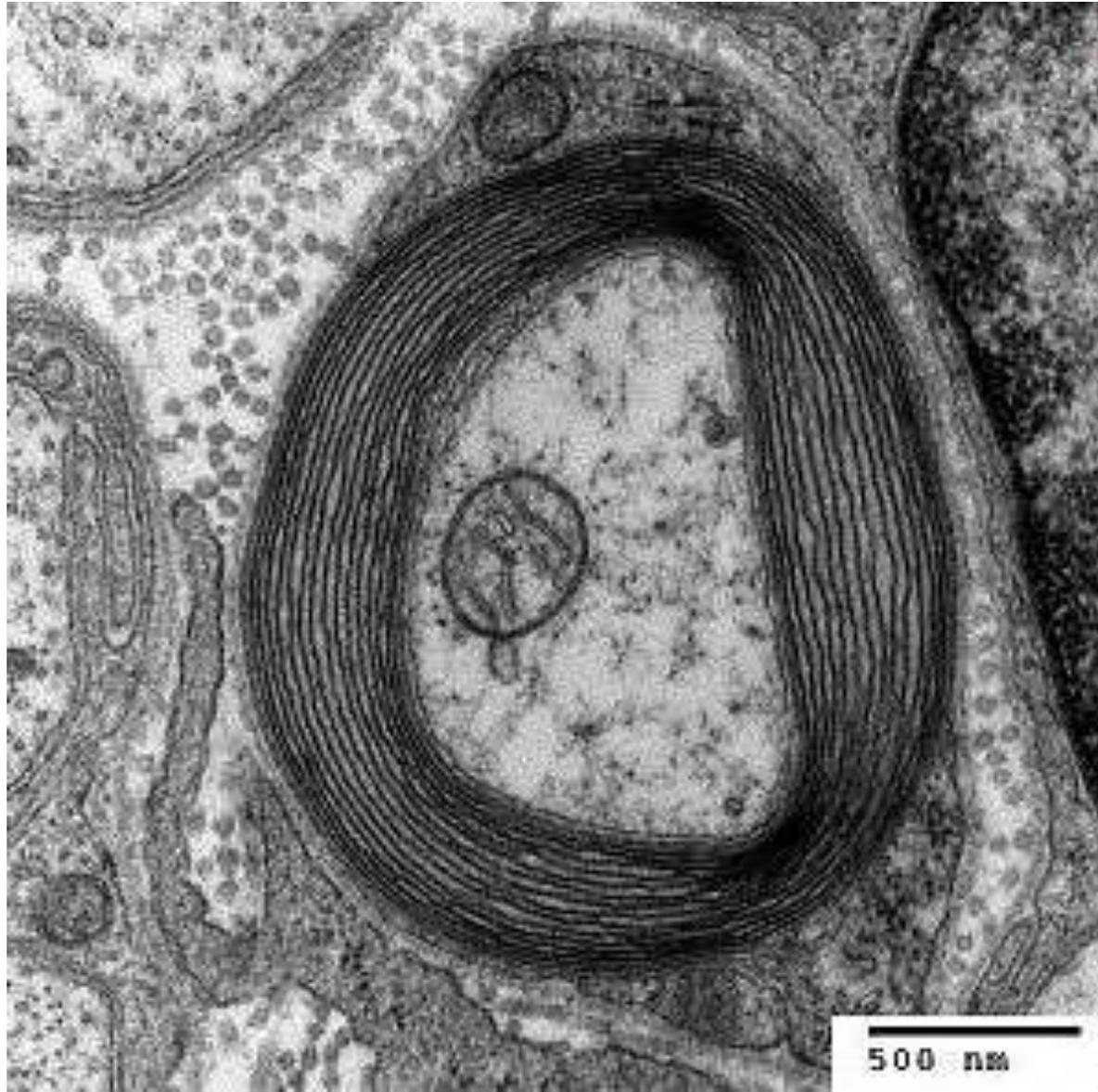
Axones and dendrites are invaginated in Schwann cell cytoplasm



Myelinated nerve fibers

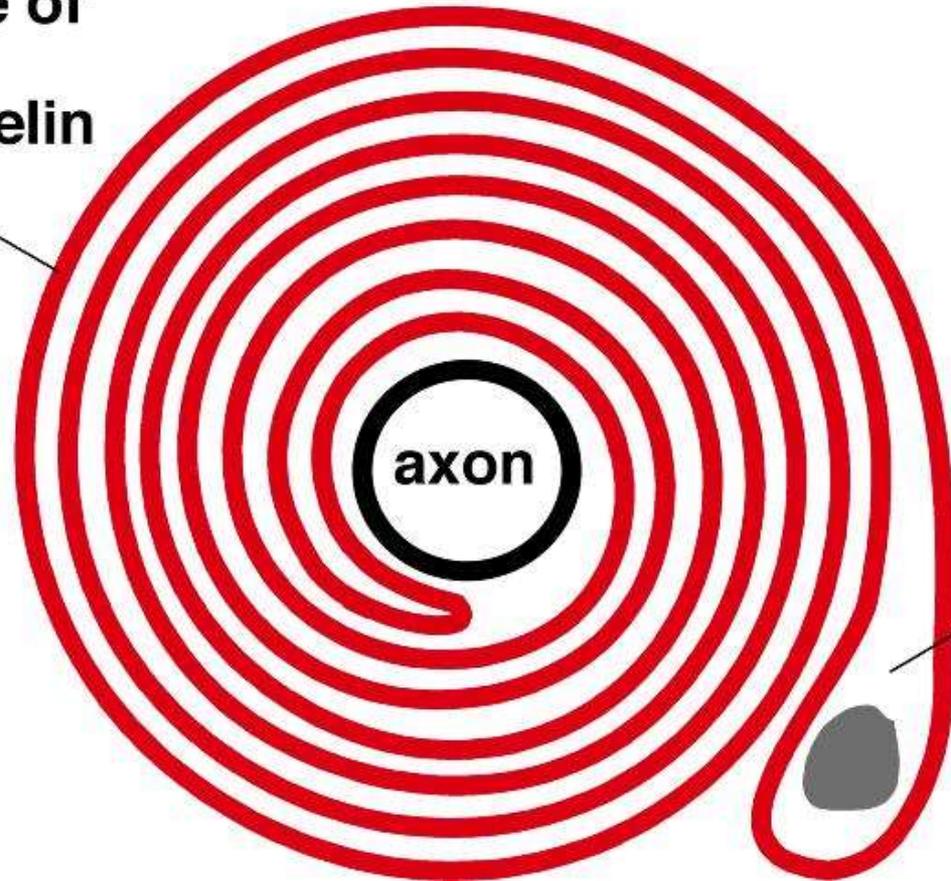


Myelinated nerve fibers



Myelinated nerve fibers

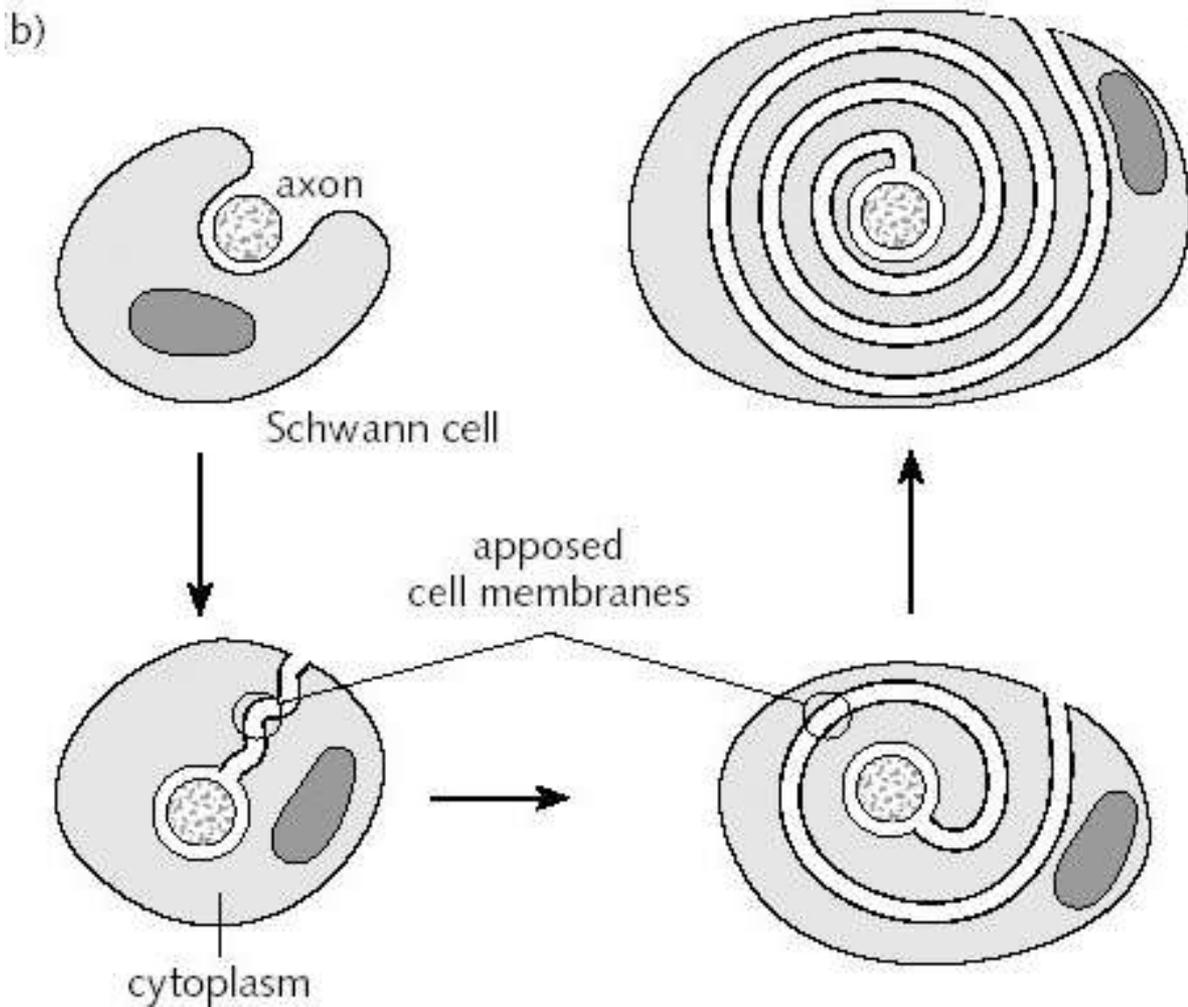
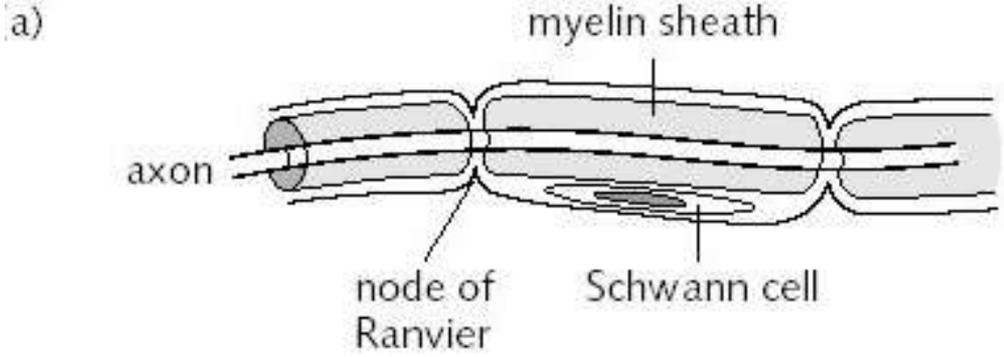
cell membrane of Schwann cell containing myelin



Schwann cell

Myelinated nerve fibers

- Schwann cells produce myelin sheath

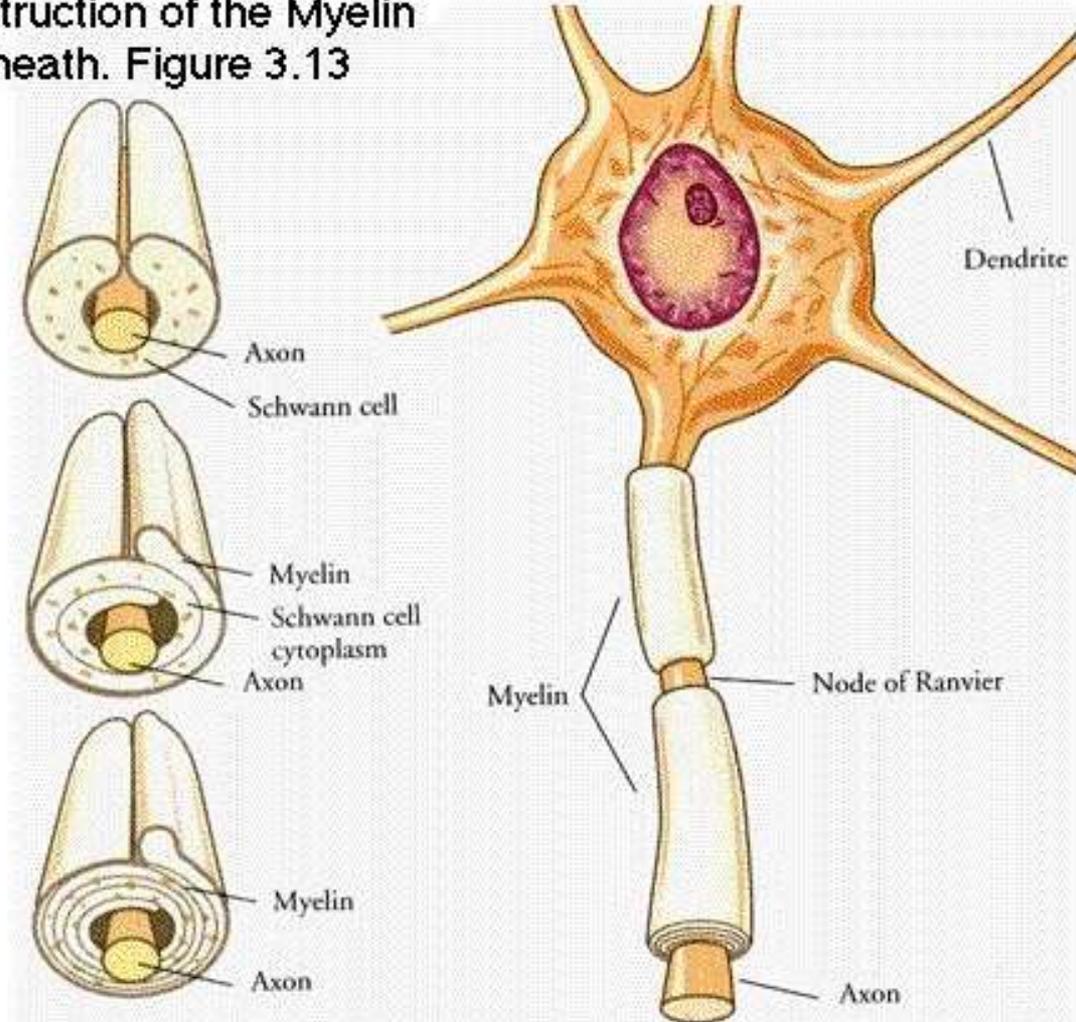


Myelinated nerve fiber structure

Nodes of Ranvier –
spaces between 2
Schwann cells –
free from myelin

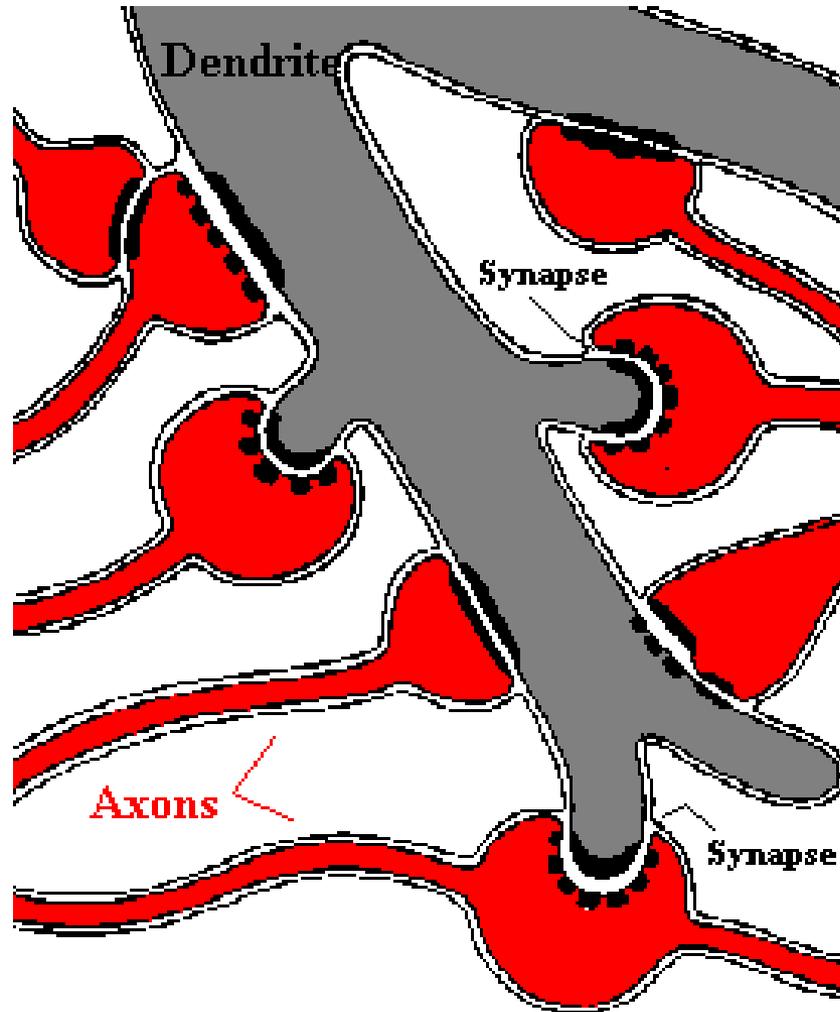
- Nodes of Ranvier provide saltatory conduction of nerve impulse

Construction of the Myelin Sheath. Figure 3.13



Synapse

The specialized region of contact between 2 neurons



Classification of synapses:

by nature:

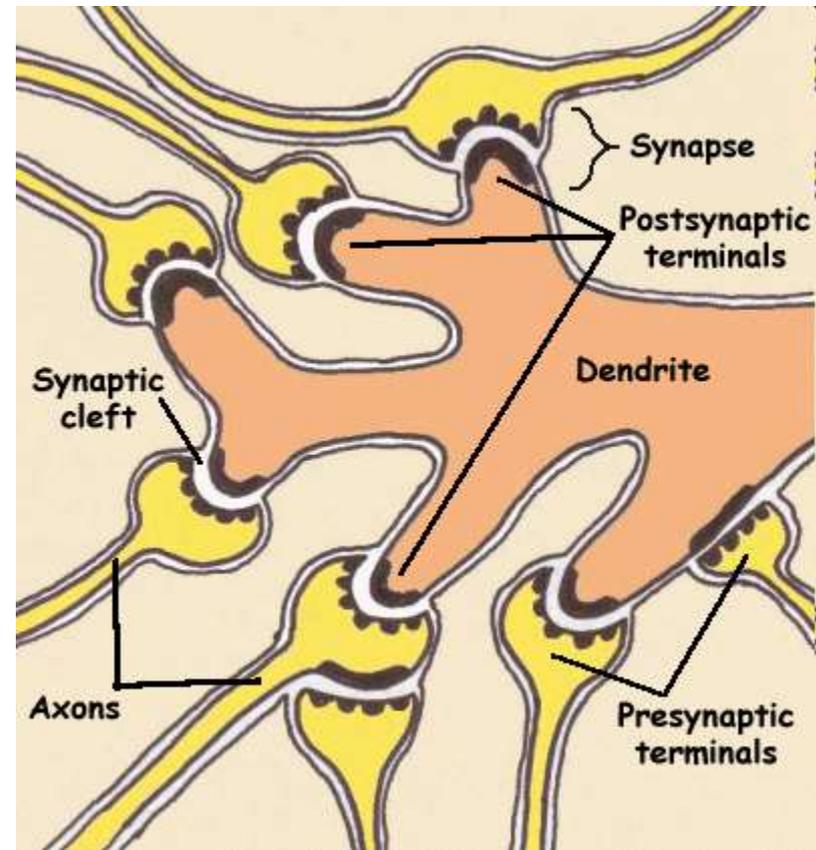
chemical synapse
electrical synapse

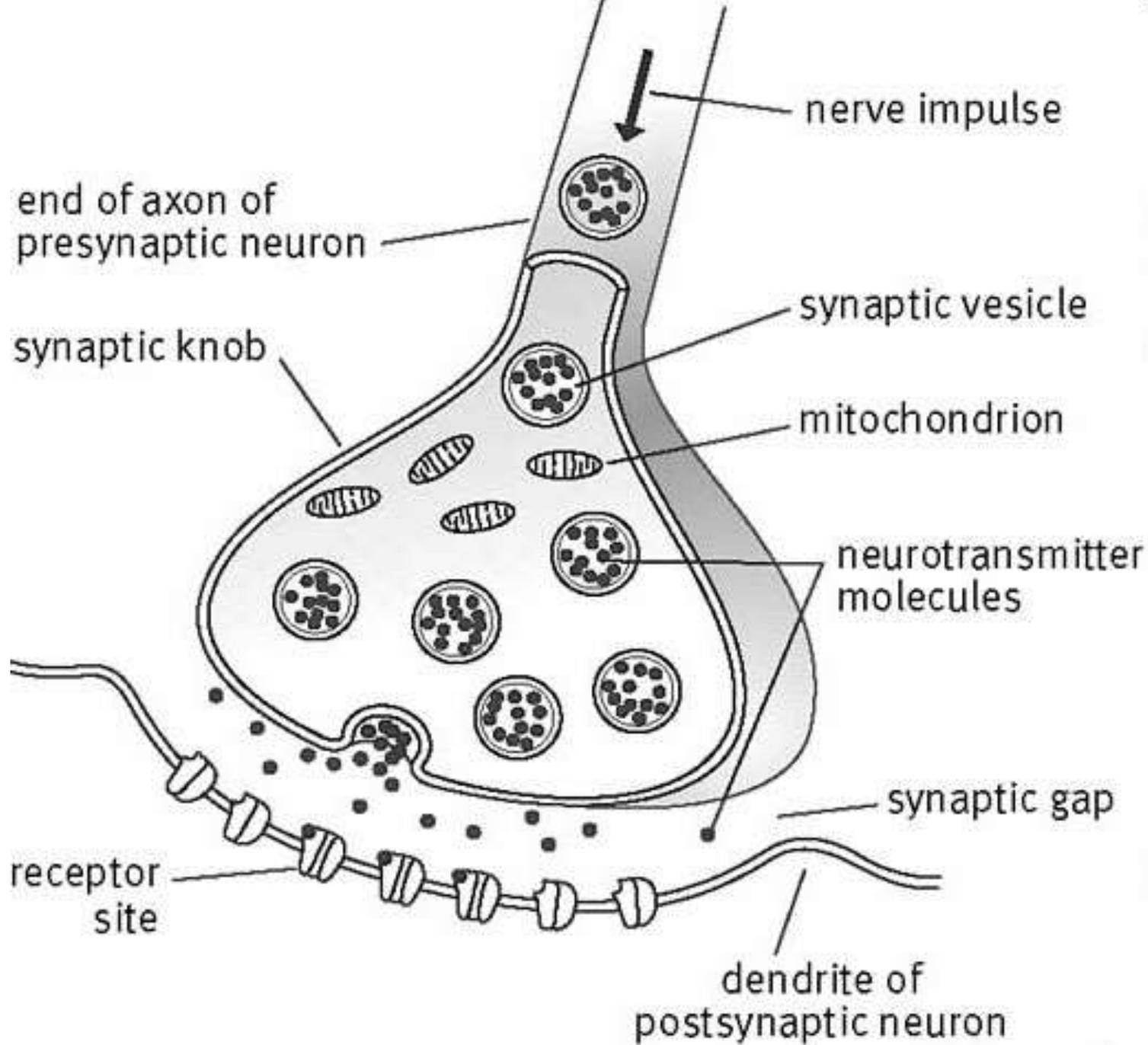
by localisation

axodendritic synapse
axosomatic synapse
axoaxonic synapse

By action:

excitatory synapse
inhibitory synapse





Sensory Nerve endings (afferent neurons receptors)

Classifications:

By location:

1. Exteroceptors,
2. Interoceptors,
3. Proprioceptors

By type of stimuli:

1. Chemoreceptors,
2. Mechanoreceptors,
3. Photoreceptors,
4. Thermoreceptors

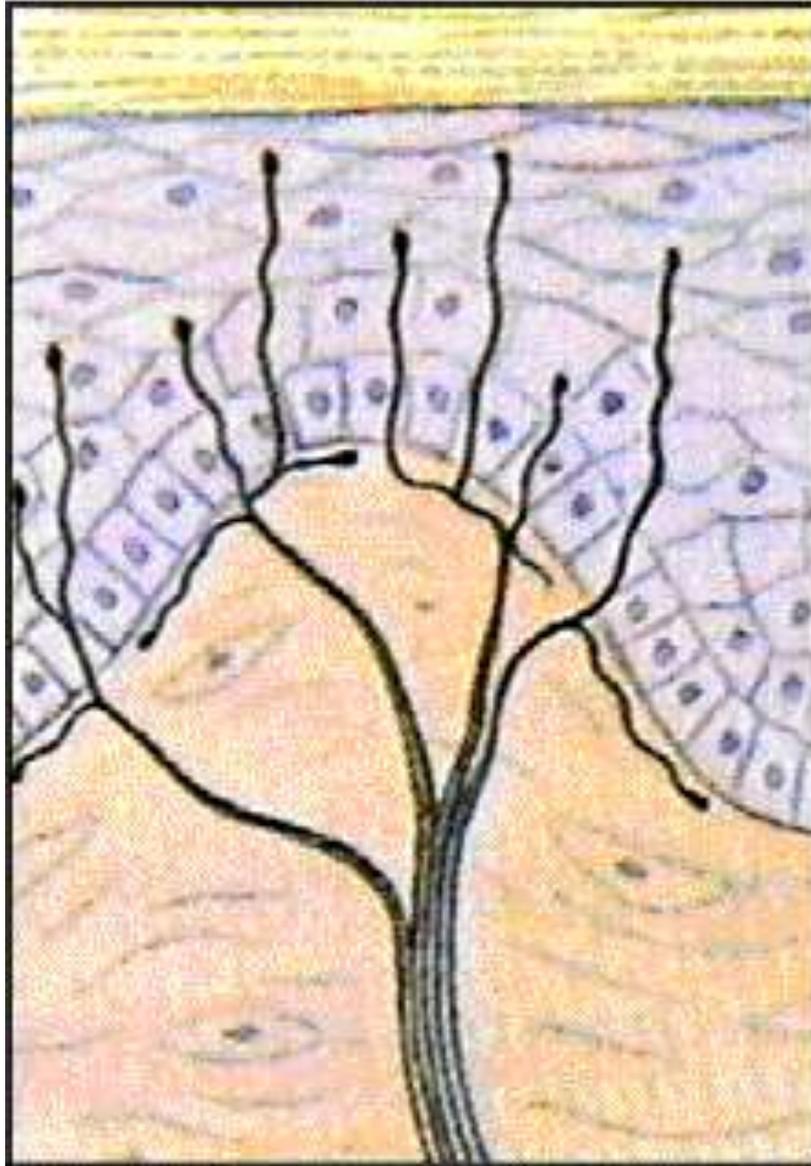
Sensory nerve endings (afferent neuron receptors)

Classification:

By type of the structure:

- 1. A. Free nerve endings**
 - B. Hair follicle nerve ending**
 - C. Merkel nerve endings (Merkel's disk)**
- 2. Encapsulated:**
 - Tactile corpuscle of Meissner**
 - Corpuscle of Pacini**
 - Ruffini endings**
- 3. Muscle spindle**

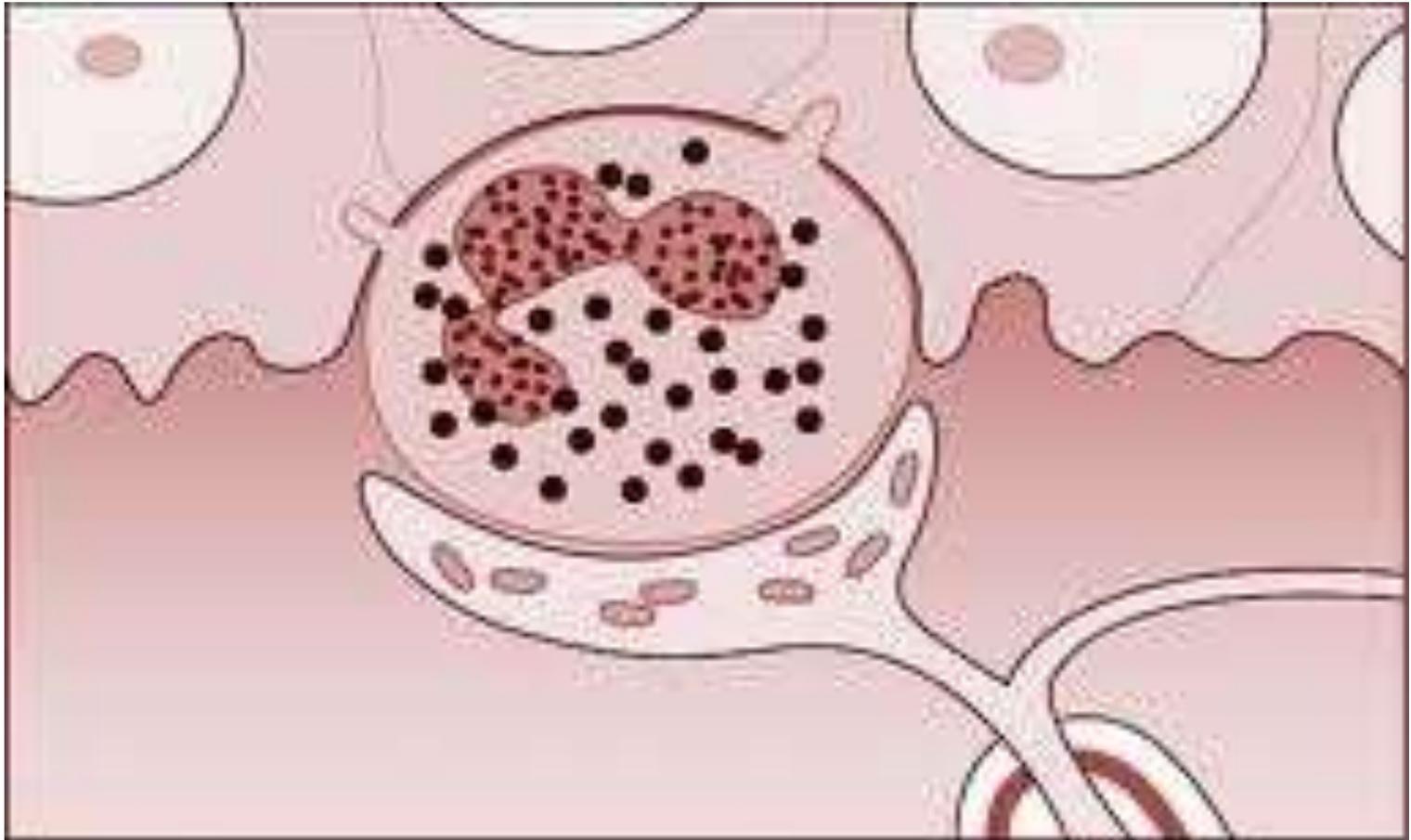
1. A. **Free nerve endings** – pain, thermal receptors



1. B. **Hair follicle nerve endings** – respond to very light touch

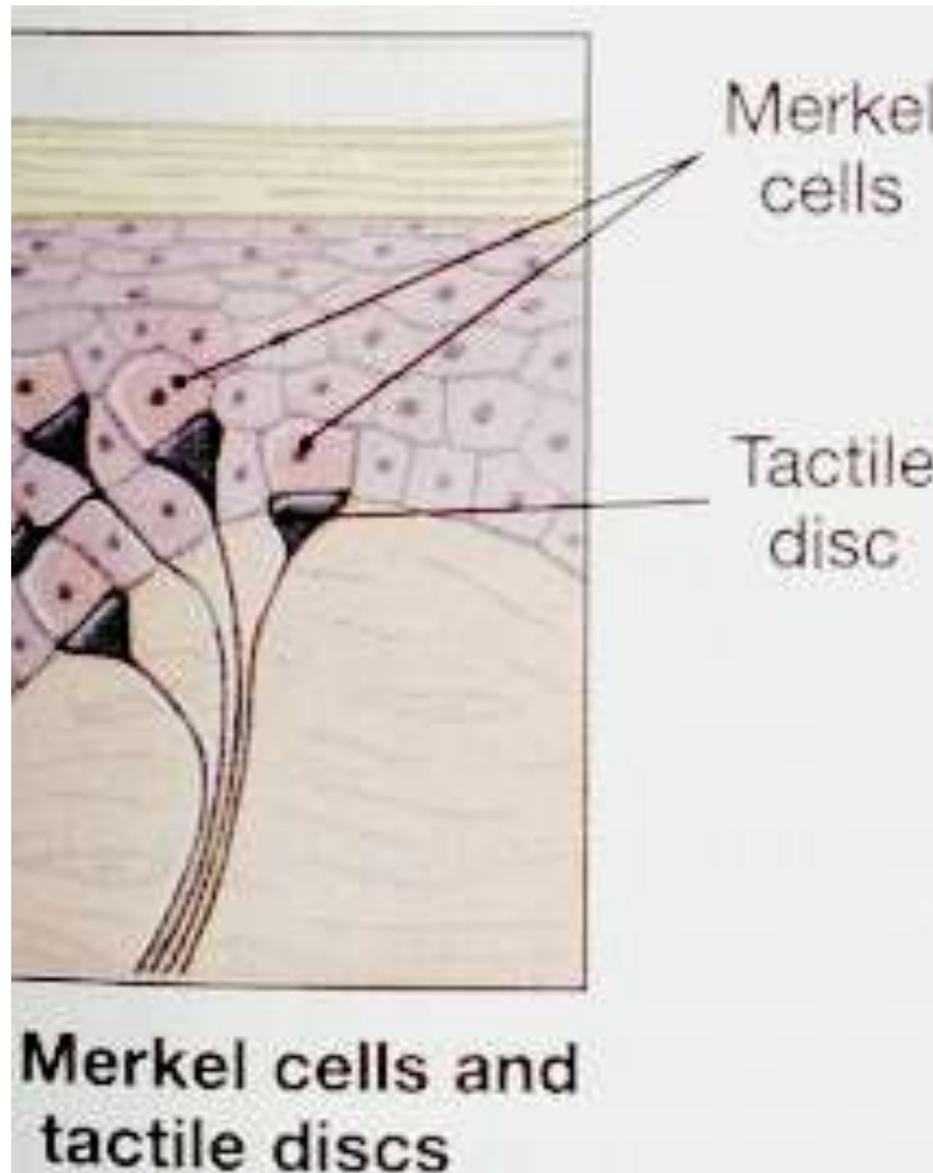


1. C. **Merkel nerve endings** – light touch receptors

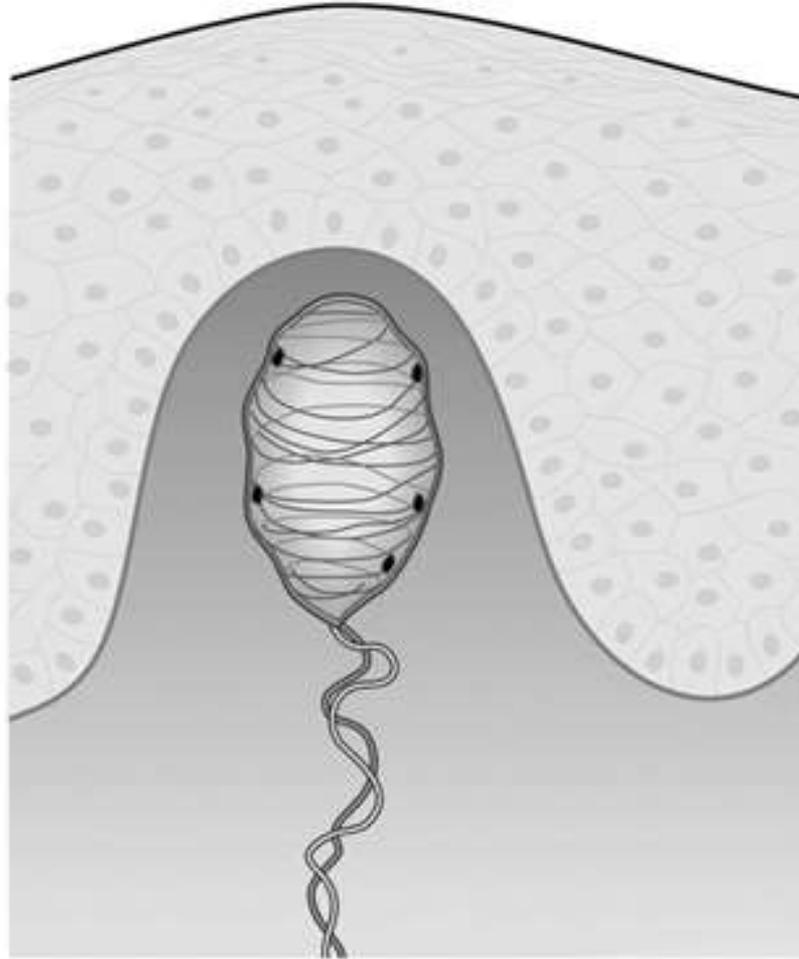


The nucleus of the cell is lobulated and the cytoplasm contains granules of unknown function similar to secretory granules. The axon terminal is filled with mitochondria and covered by a Schwann cell until it enters the Merkel cells.

1. C. **Merkel nerve endings** – light touch receptors



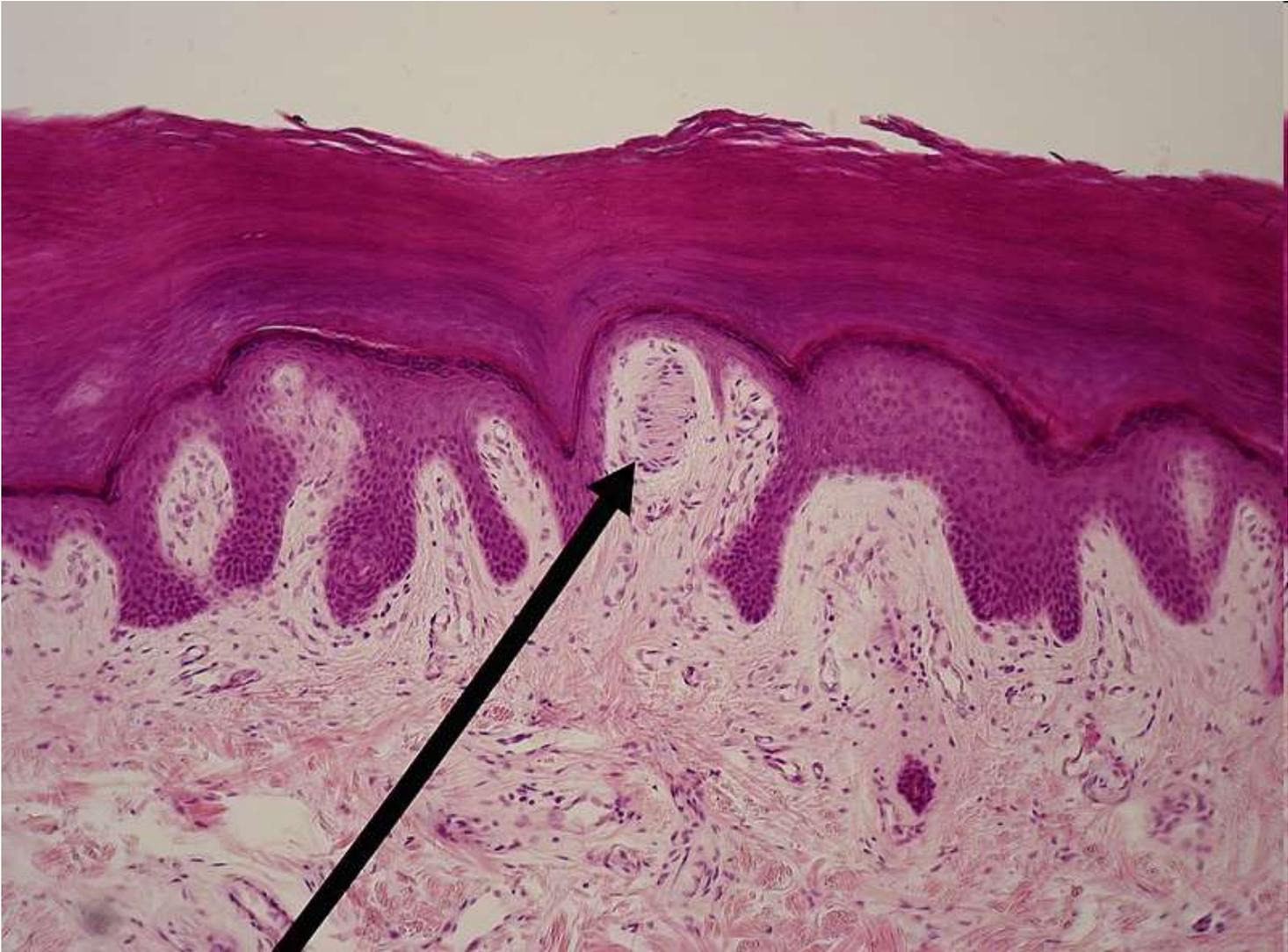
2. Encapsulated = Tactile corpuscle of Meissner



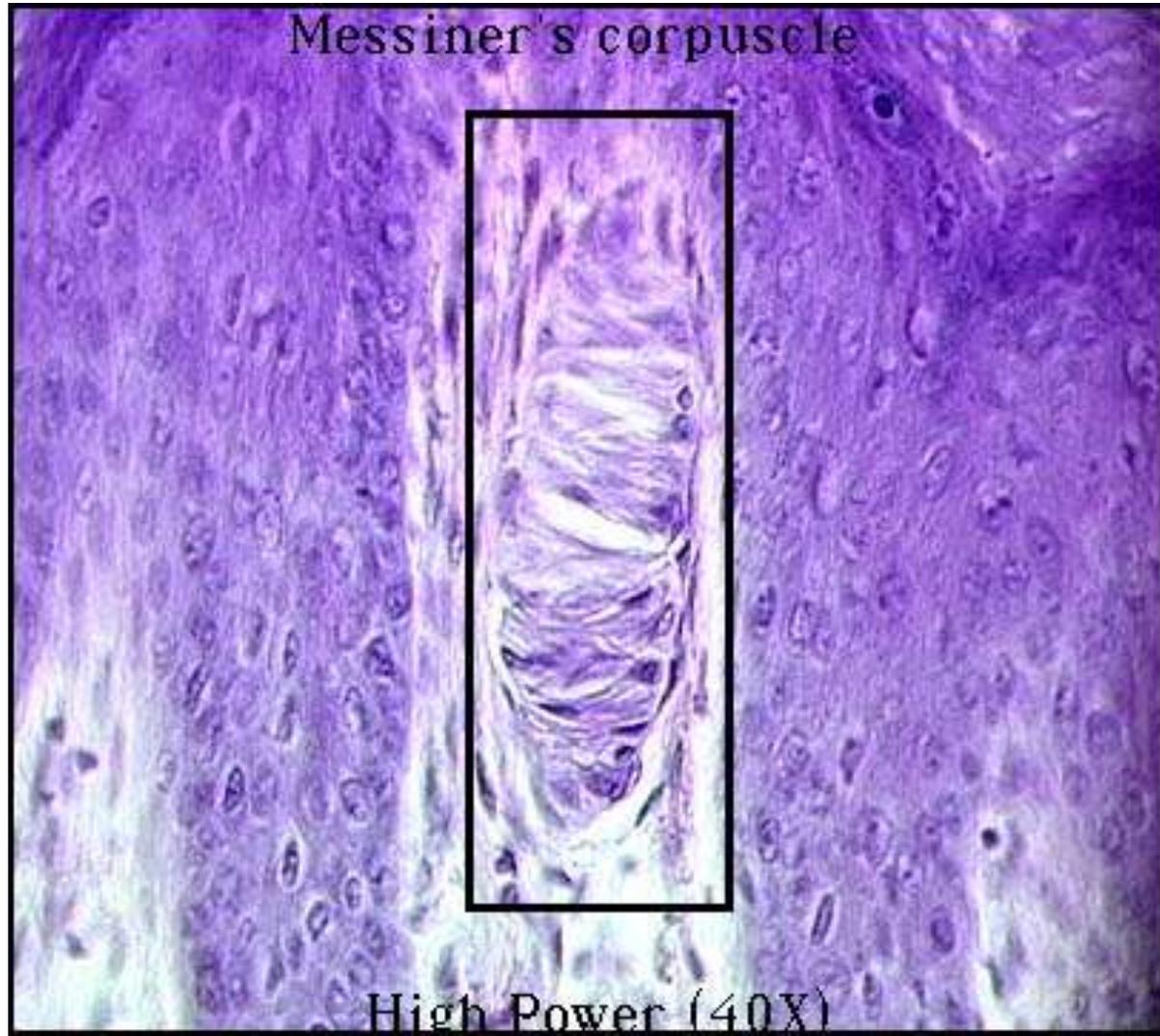
Non-neural corpuscular cells are wrapped around one or more branching nerve terminals. The structure is most sensitive to low-frequency vibrations.

Source: Dykes 1977.

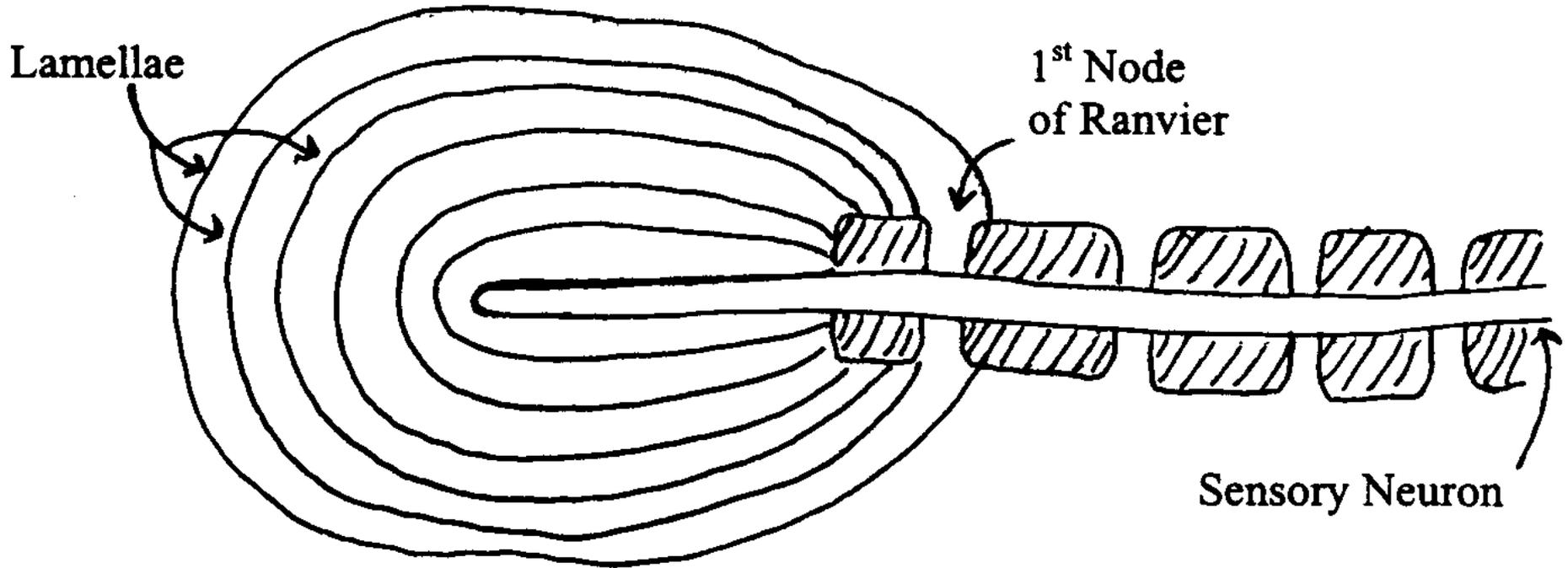
2. Encapsulated = Tactile corpuscle of Meissner



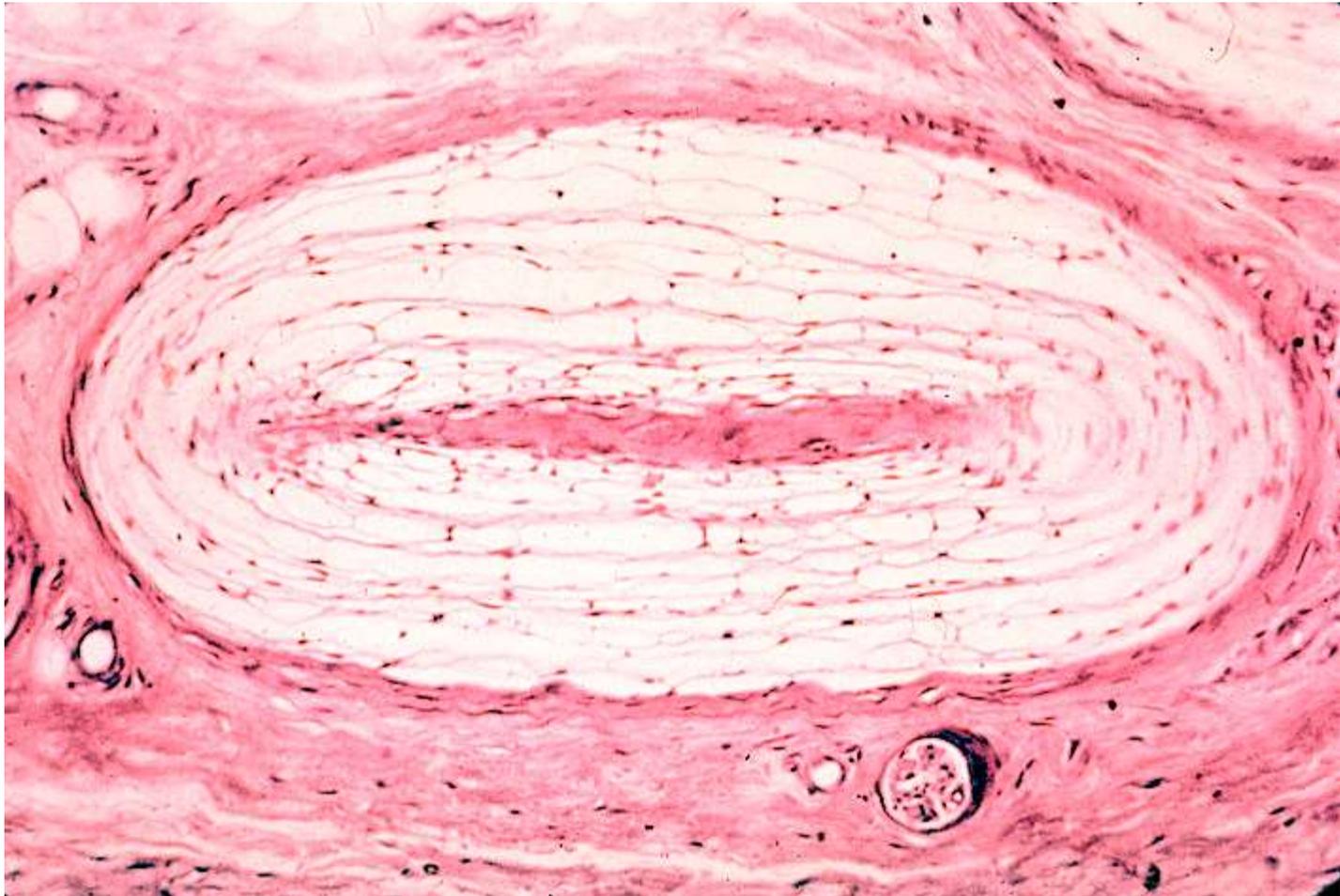
2. Encapsulated = Tactile corpuscle of Meissner



2. Encapsulated. Corpuscle of Pacini (lamellar body) is specialized to detect gross pressure changes and vibration

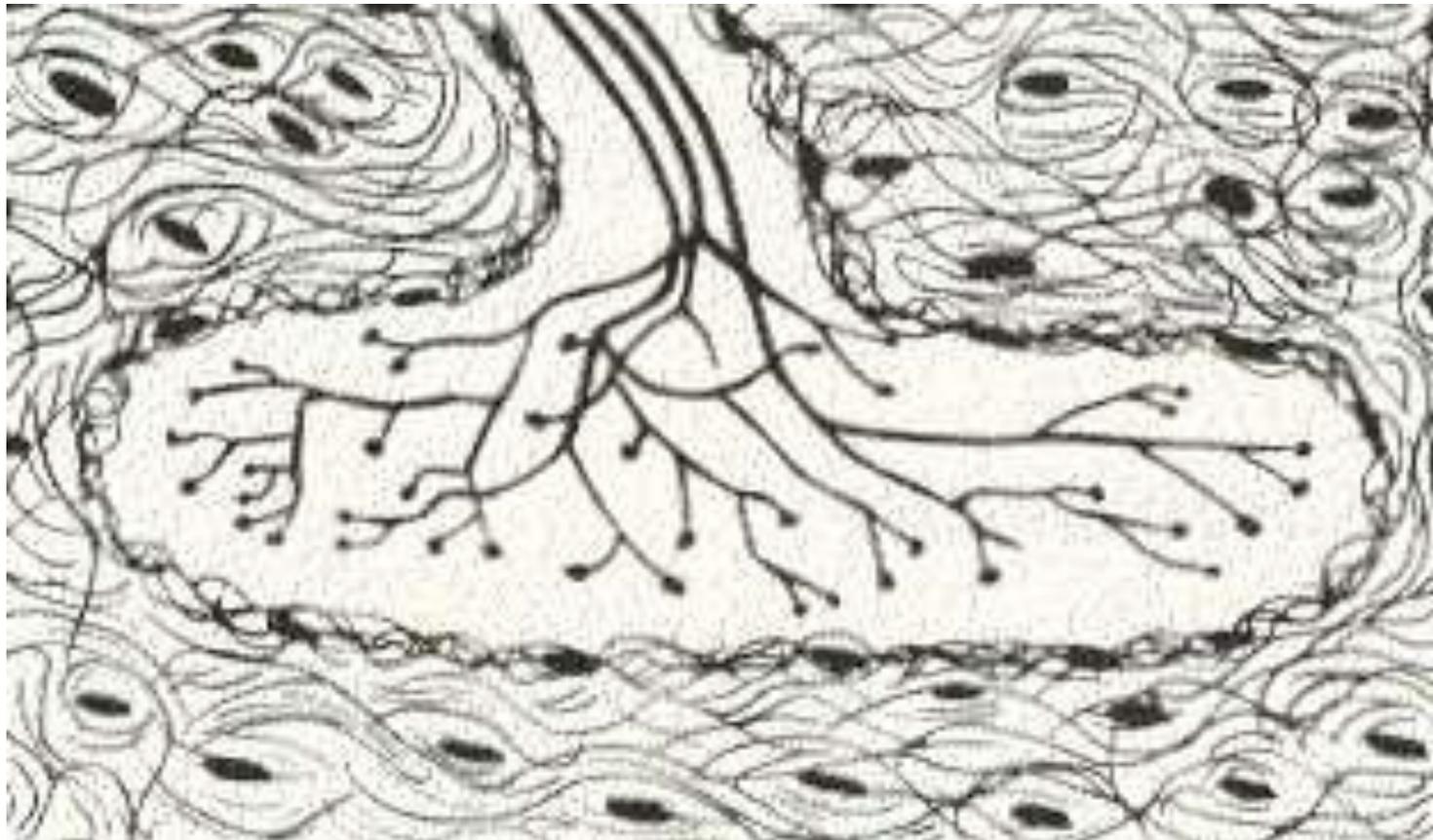


2. Encapsulated. Corpuscle of Pacini lamellar body are specialize to detect vibration



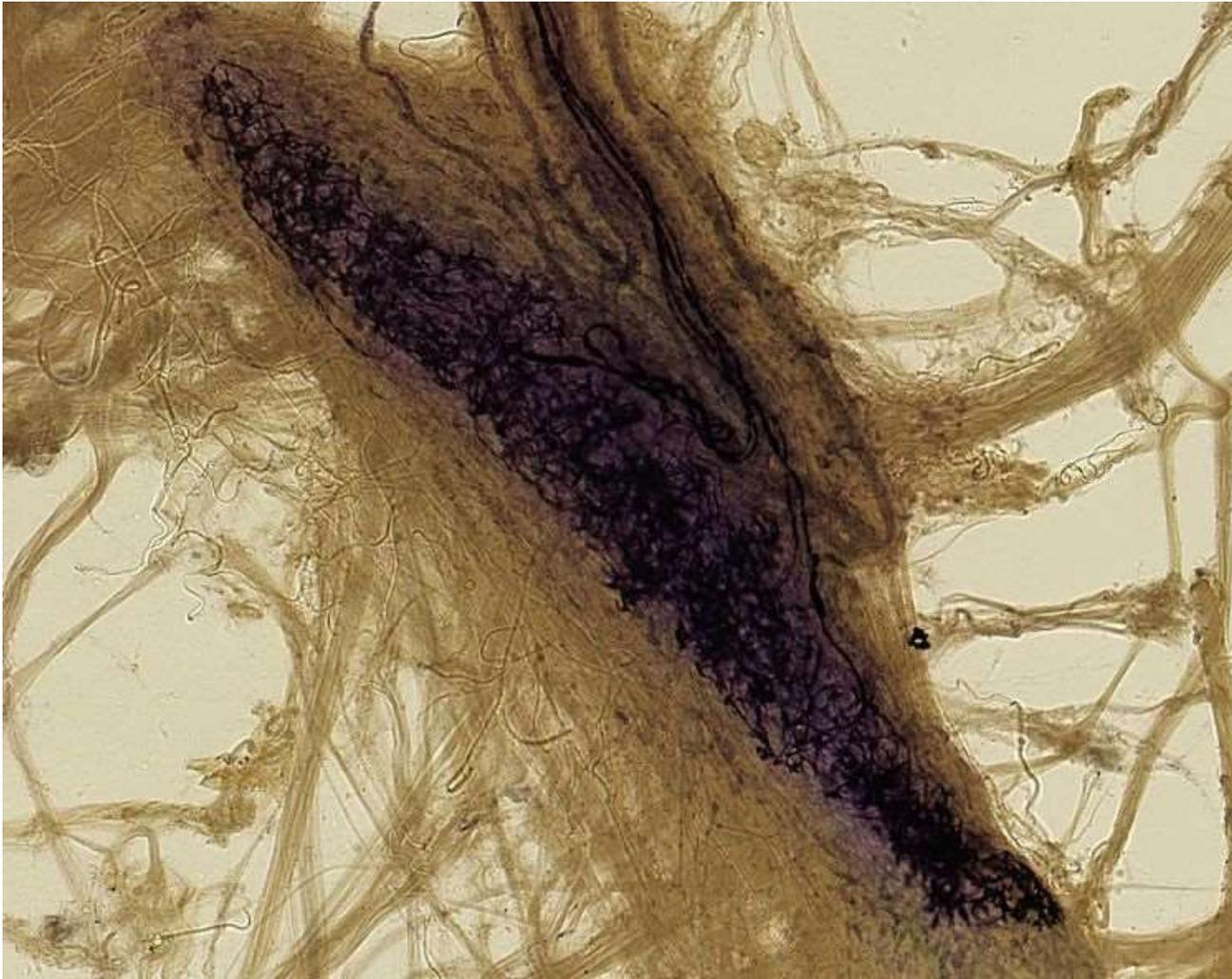
2. Encapsulated. Ruffini ending

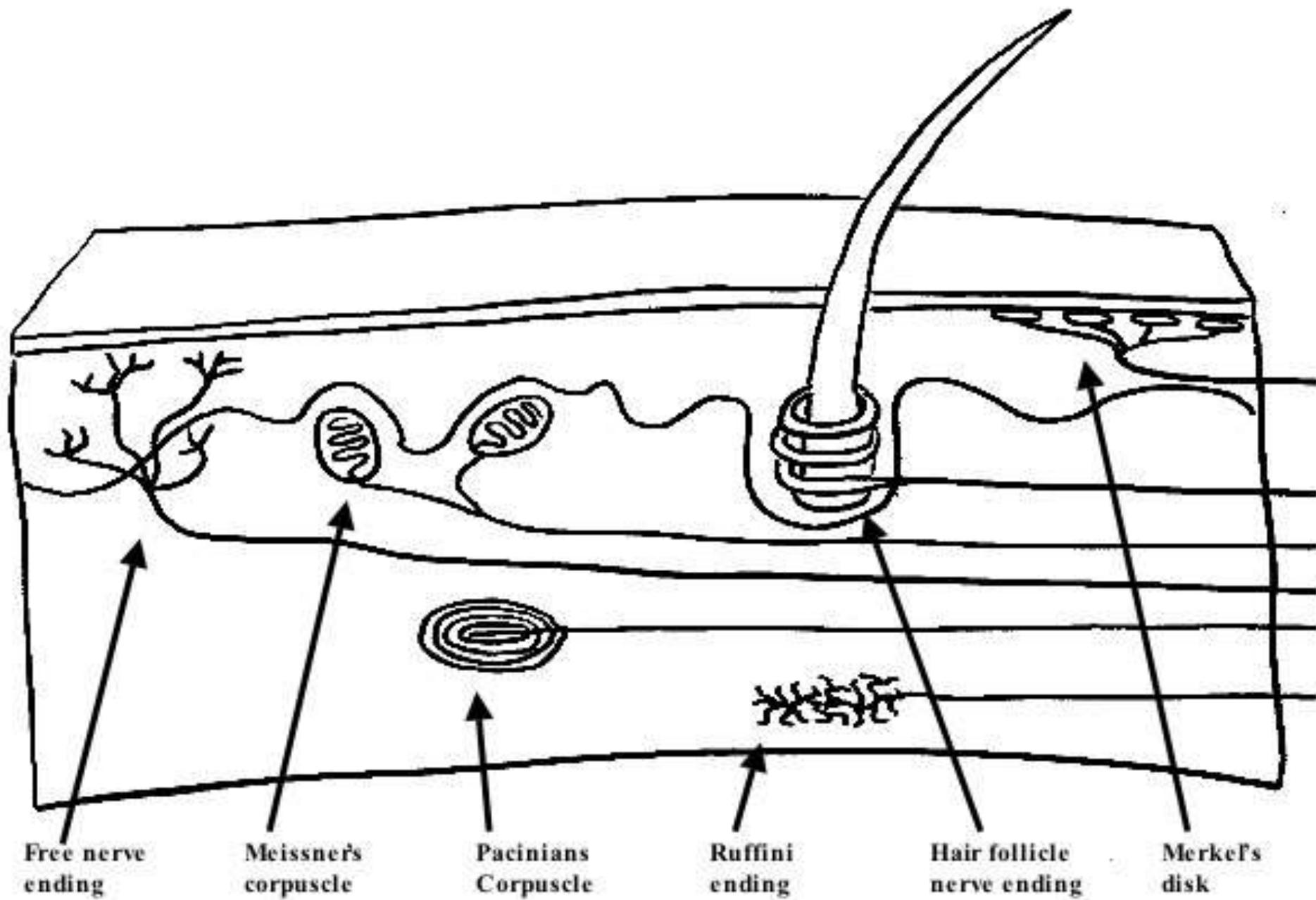
Dense branches of nerve-endings encapsulated in connective tissue. Is sensitive to skin stretch



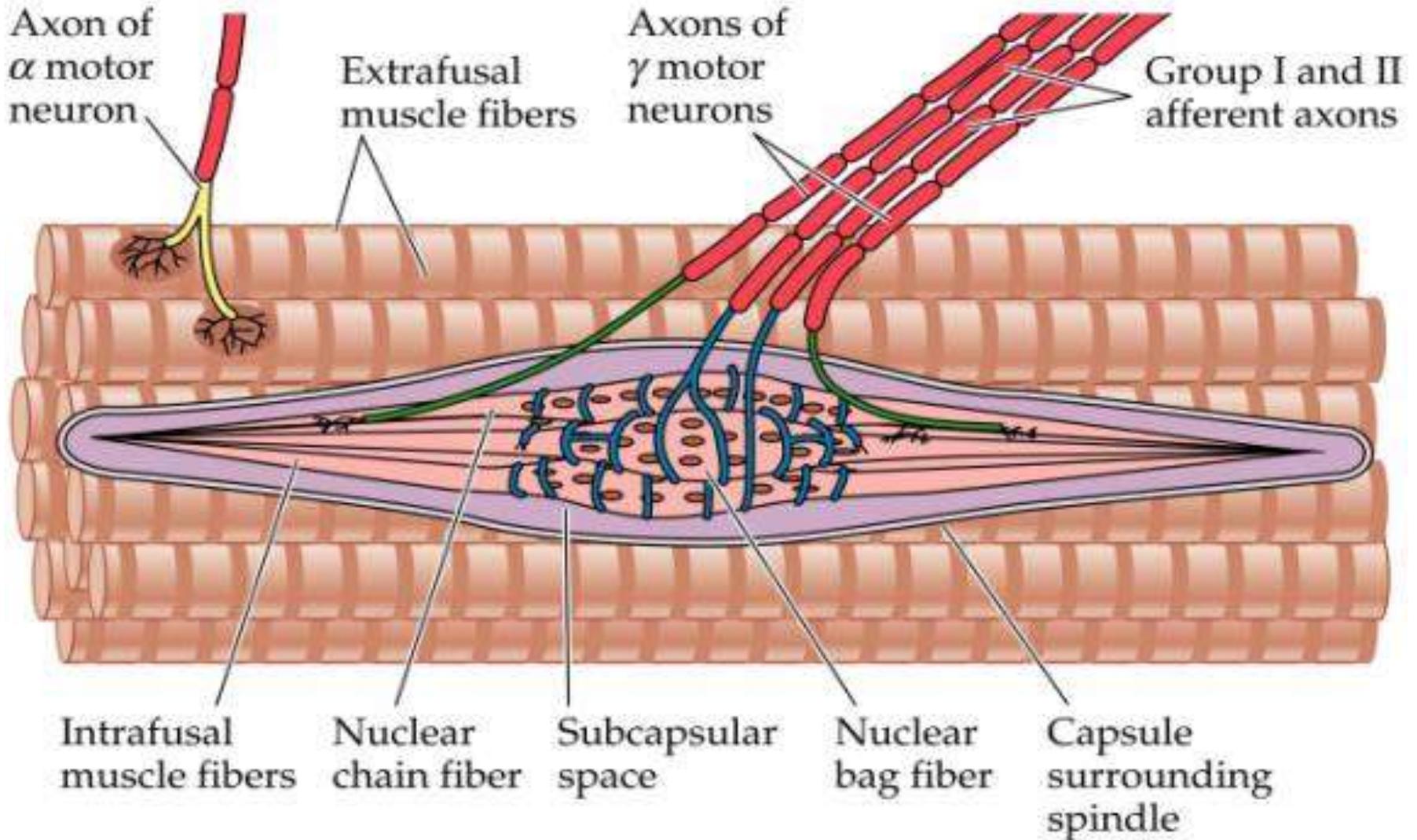
2. Encapsulated. Ruffini ending

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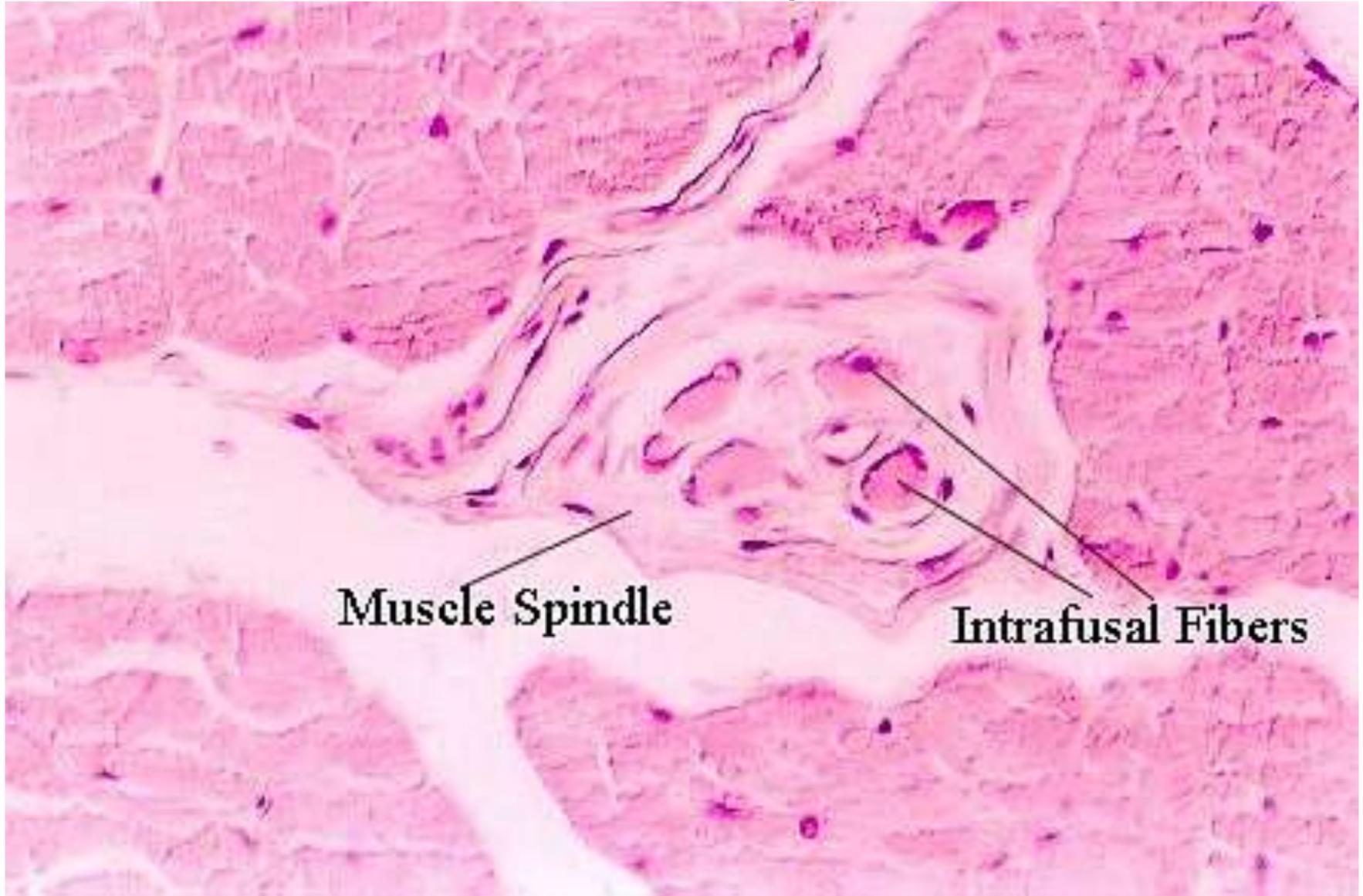




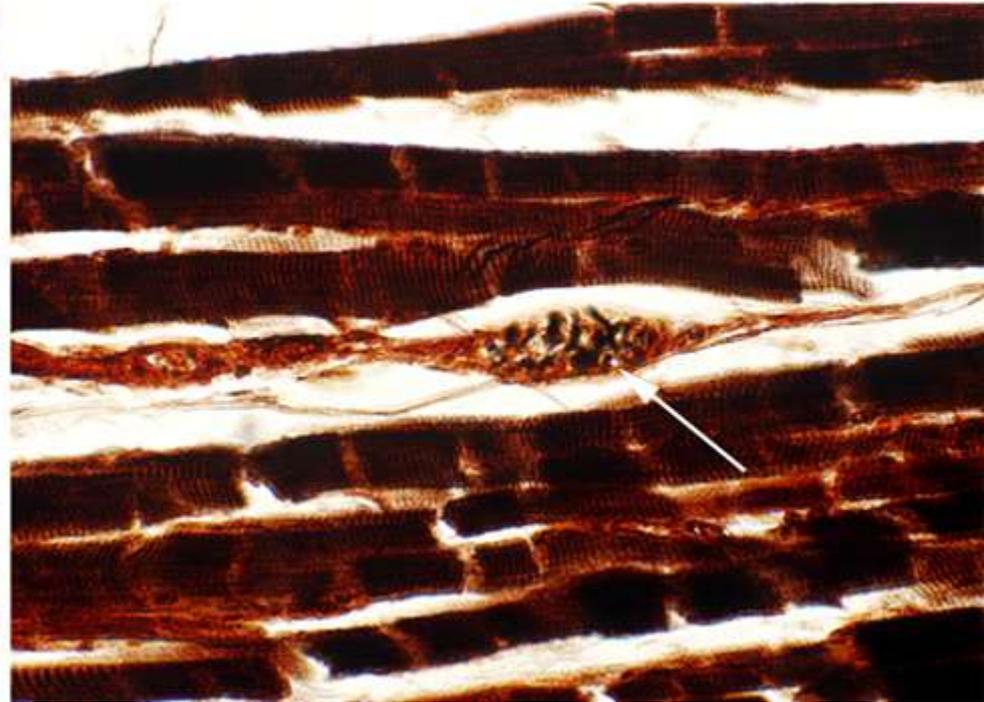
3. Muscle spindle (detects muscle stretch)



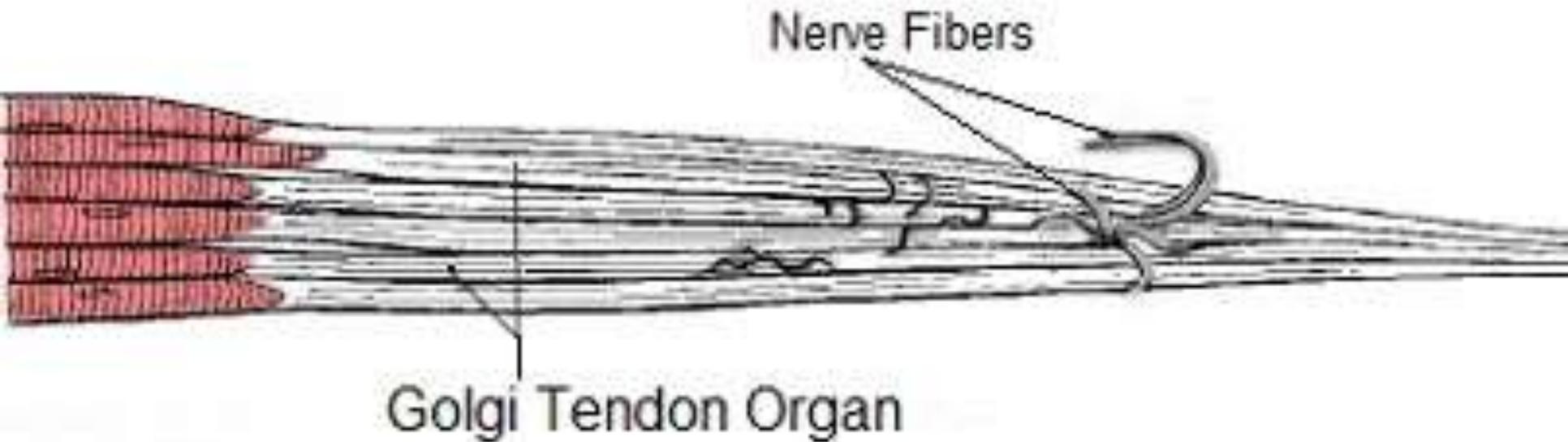
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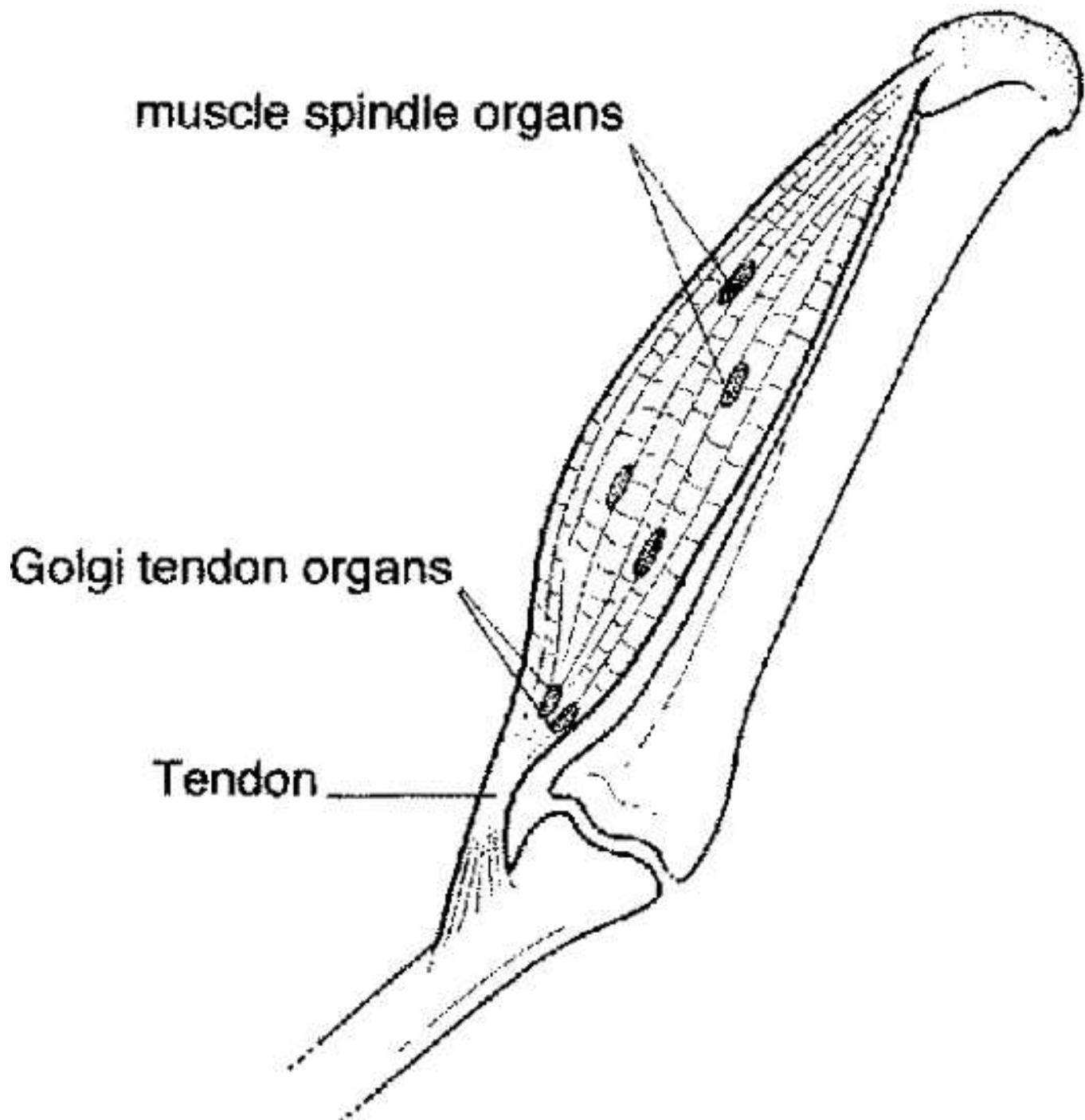


3. Muscle spindle (detects muscle stretch)



3. Golgi tendon organ (detects muscle tension)





muscle spindle organs

Golgi tendon organs

Tendon

Motor end plate

