

**SOME BASIC TERMINOLOGY**

**CNS:** Central Nervous System: Brain + Spinal Cord

**CEREBROSPINAL FLUID (CSF):** The fluid filling the ventricles, cerebral aqueduct, central canal, and subarachnoid space.

It is a filtrate of blood plasma produced primarily, but not entirely, by choroids plexuses (see below).

**CHOROID PLEXUSES:** Small masses of highly vascularized, delicate connective tissue covered with epithelial cells.

Located in the lateral, third, and fourth brain ventricles, but not in the cerebral aqueduct. Produce most, but not all, CSF.

**EPENDYMAL CELLS:** Columnar ciliated cells lining the cavities of the CNS and covering the choroid plexuses. One type of neuroglial cell.

**GANGLION** (plural: ganglia): Groups or clusters of neurons located outside the CNS.

**GREY MATTER:** Massed accumulations of nerve cell bodies. The grey color is due to the cells' cytoplasm.

**Cortex** (Adjective = *cortical*): Superficial grey matter, arranged in sheets covering parts of the brain surface.

**Cerebral cortex** covers the surfaces of the cerebral hemispheres.

**Cerebellar cortex** covers the surface of the cerebellum.

**Nucleus** (plural = nuclei): More or less discrete clusters of nerve cell bodies located within the brain or spinal cord.

**MENINGES (singular = meninx):** The three connective tissue envelopes enclosing the CNS.

**Dura (mater):** The outermost and toughest meninx, composed of dense irregular connective tissue.

**Epidural space:** A potential (normally closed) space between the dura and the periosteum of the cranial bones.

**Dural sinuses:** Venous blood channels located within the dura.

**Arachnoid (mater):** The middle meninx. Called "arachnoid" because of its resemblance to a cobweb.

**Subdural space:** A potential (normally closed) space between the dura and the arachnoid.

**Pia (mater):** The innermost and most delicate meninx. Adheres to and follows the contours of the cerebrum.

**Subarachnoid space:** A space between the arachnoid and pia filled with CSF (see below).

**NERVE:** A bundle of axons, wrapped in connective tissues, *outside* the CNS.

Connective tissue components:

**Endoneurium:** surrounds individual axons.

**Perineurium:** surrounds groups of axons.

**Epineurium:** surrounds entire nerve

**Cranial Nerves:** Twelve pairs of nerves connected to the brain.

**Spinal Nerves:** Thirty-one pairs of nerves connected to the spinal cord.

**NEUROGLIA:** Auxillary or Supporting cells of the CNS

**Astrocytes, Oligodendrocytes, Microglia, Schwann cells, Ependymal cells**

**TRACT:** A discrete bundle of nerve cell axons, usually having a common origin, destination, and function., *inside* the CNS.

**Association:** Relatively short tracts connecting areas on the same (*ipsilateral*) side of the brain or spinal cord.

**Commissural:** Tracts (*commissures*) that cross the midline to connect areas on opposite (*contralateral*) sides of the brain or spinal cord.

**Projection:** Tracts that run longitudinally through the CNS, connecting “higher” and “lower” areas.

**Ascending or Afferent:** Projection tracts carrying **sensory** information “up” through the CNS.

**Descending or Efferent:** Projection tracts carrying **motor** information “down” through the CNS.

**Crossed:** Any projection tract - ascending or descending - that crosses the midline to the opposite side of the CNS somewhere along its length. Most – but not all – tracts are crossed.

**VENTRICLES, AQUEDUCT, CANAL:** Interconnected cavities in the brain and spinal cord filled with CSF.

The brain contains five, the:

**Lateral ventricles** (Ventricles 1 and 2): one in each cerebral hemisphere.

**Third ventricle:** a slit-like cavity in the diencephalons.

**Cerebral aqueduct:** a tubular channel running through the midbrain or mesencephalon.

**Fourth ventricle:** a diamond-shaped cavity in the hindbrain or rhombencephalon.

The spinal cord contains one, the tubular:

**Central canal:** It may or may not be open its entire length.

**WHITE MATTER:** Masses of nerve cell processes, primarily axons. The white color is due to the myelination of many of the larger axons.

## **MAJOR DIVISIONS OF THE BRAIN**

### **1. PROSENCEPHALON or FOREBRAIN**

#### **A. Telencephalon (“end brain”): Cerebrum:**

- i. Right & Left Cerebral Hemispheres
- ii. Lateral ventricles

#### **B. Diencephalon (“between brain”)**

- i. Epithalamus (including pineal gland)
- ii. Thalamus
- iii. Hypothalamus
- iv. Third ventricle

### **2. MESENCEPHALON or MIDBRAIN**

#### **A. Tectum (“roof”)**

- i. corpora quadrigemina: superior and inferior colliculi

#### **B. Tegmentum (“floor”)**

- i. cerebral peduncles

#### **C. Cerebral aqueduct**

### **3. RHOMBENCEPHALON or HINDBRAIN**

#### **A. Metencephalon**

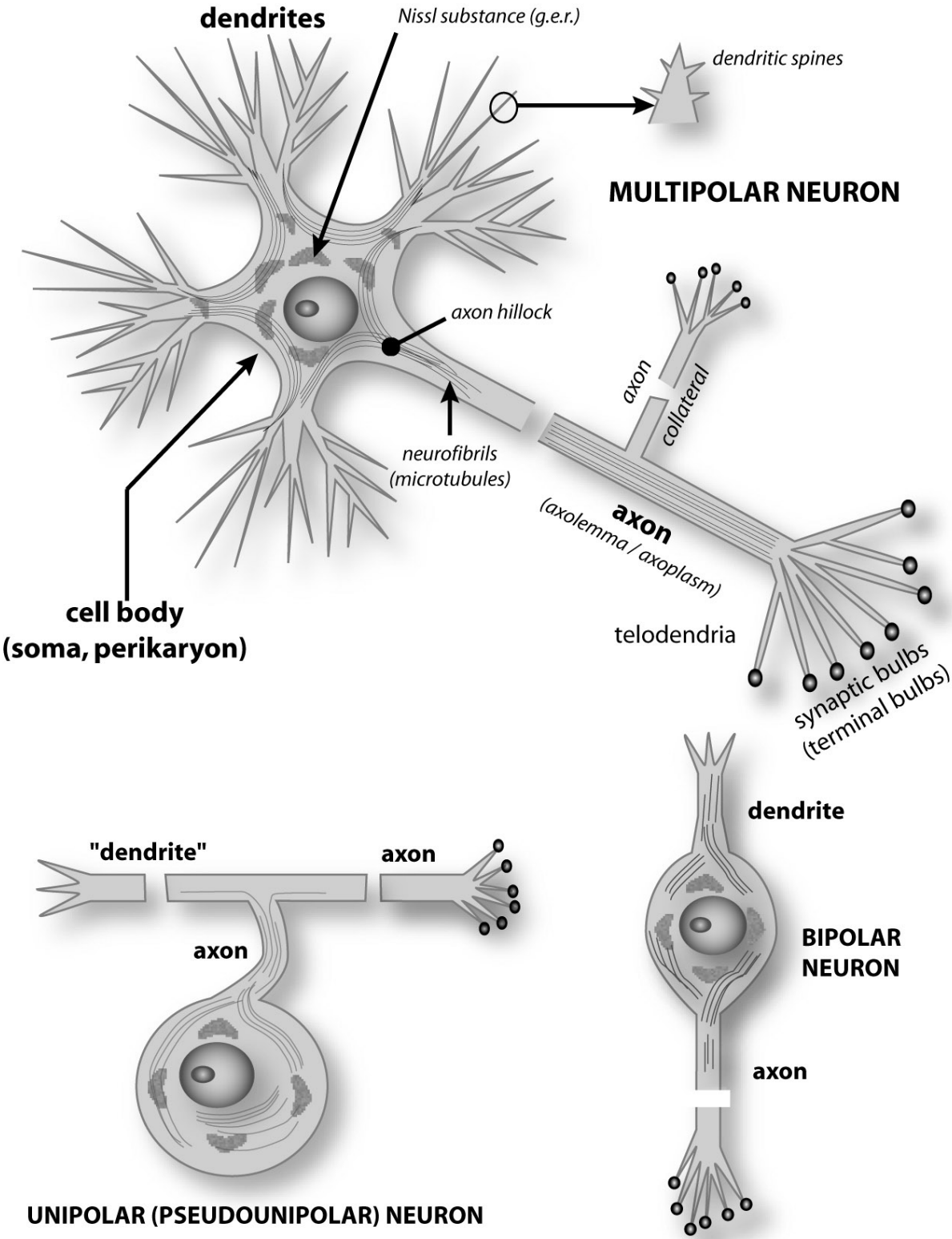
- i. Pons (“bridge”)
- ii. Cerebellum

#### **B. Myelencephalon**

- i. Medulla oblongata (“oblong core”)

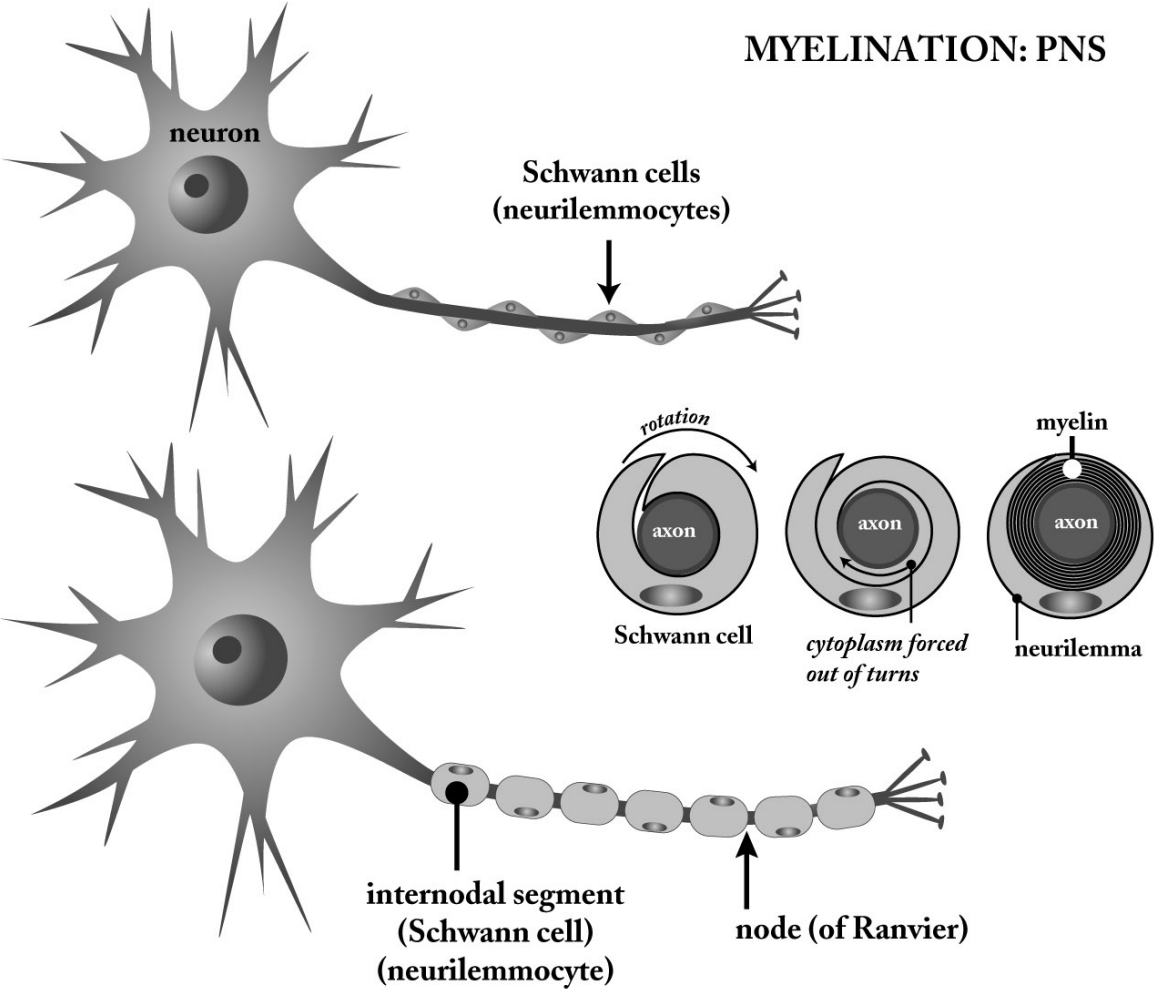
#### **C. Fourth ventricle**

NEURONS: BASIC STRUCTURE & TERMINOLOGY

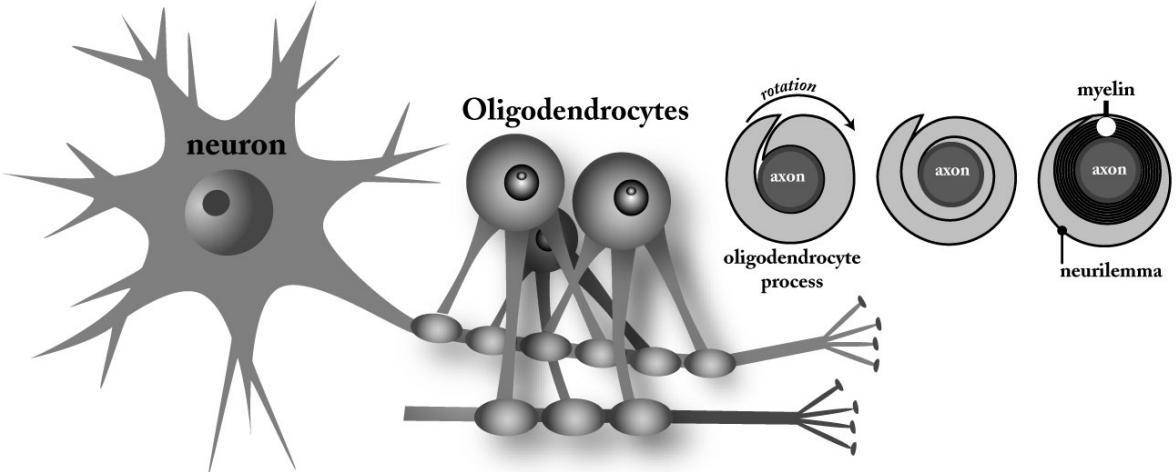


MYELINATED AXONS

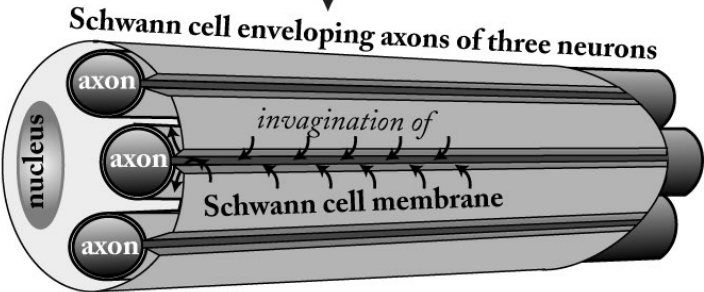
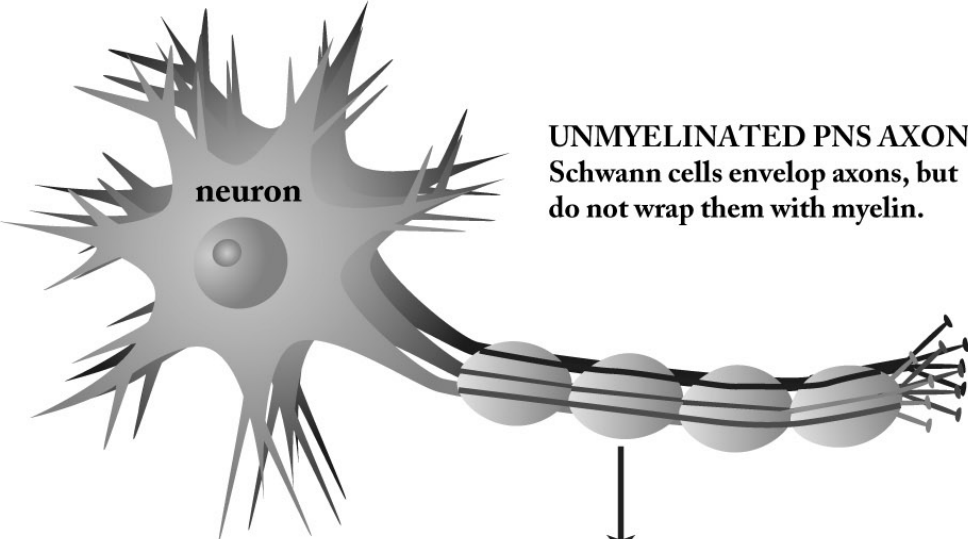
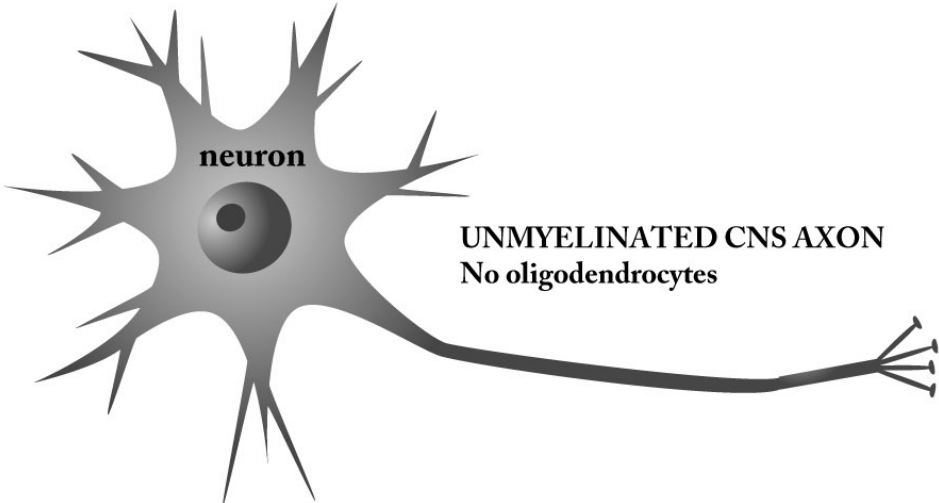
MYELINATION: PNS



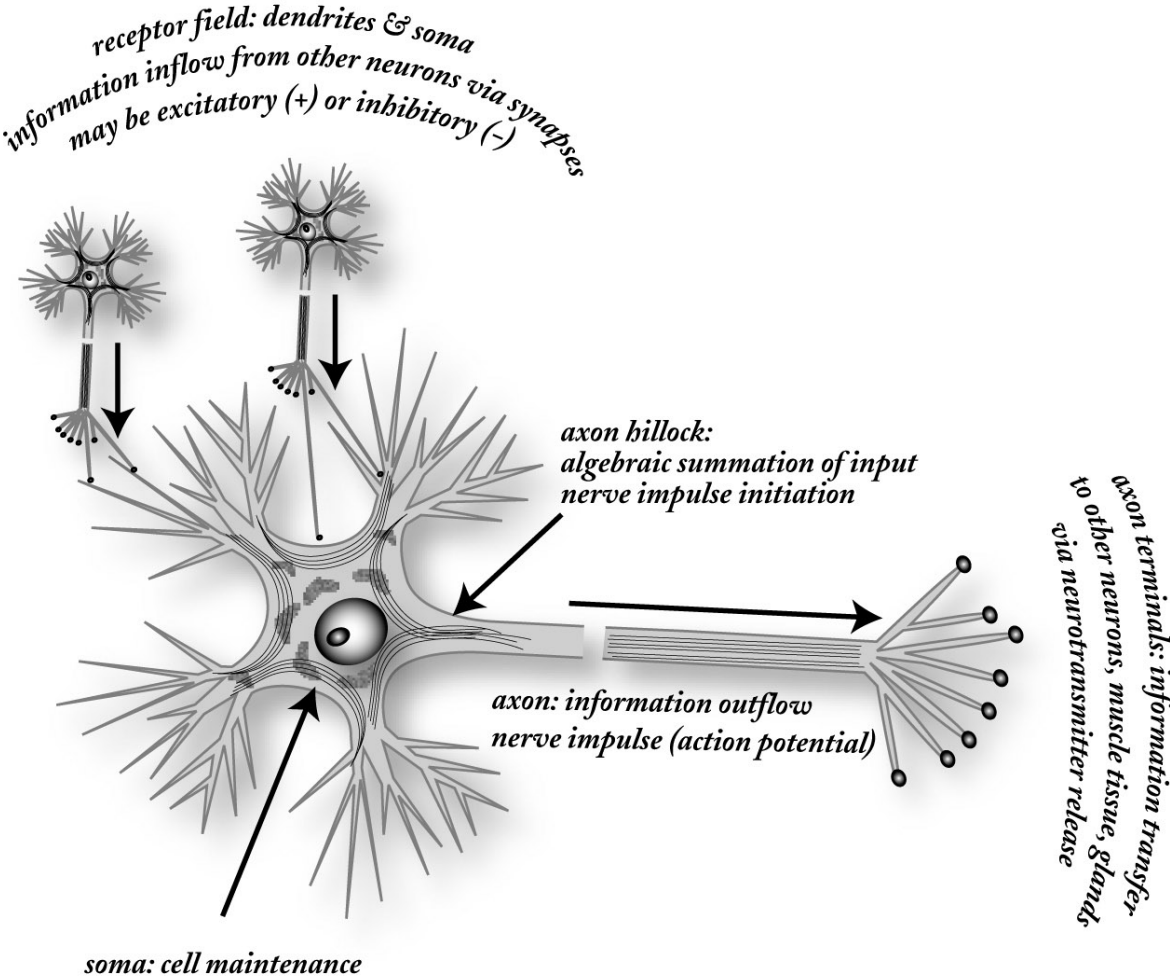
MYELINATION: CNS



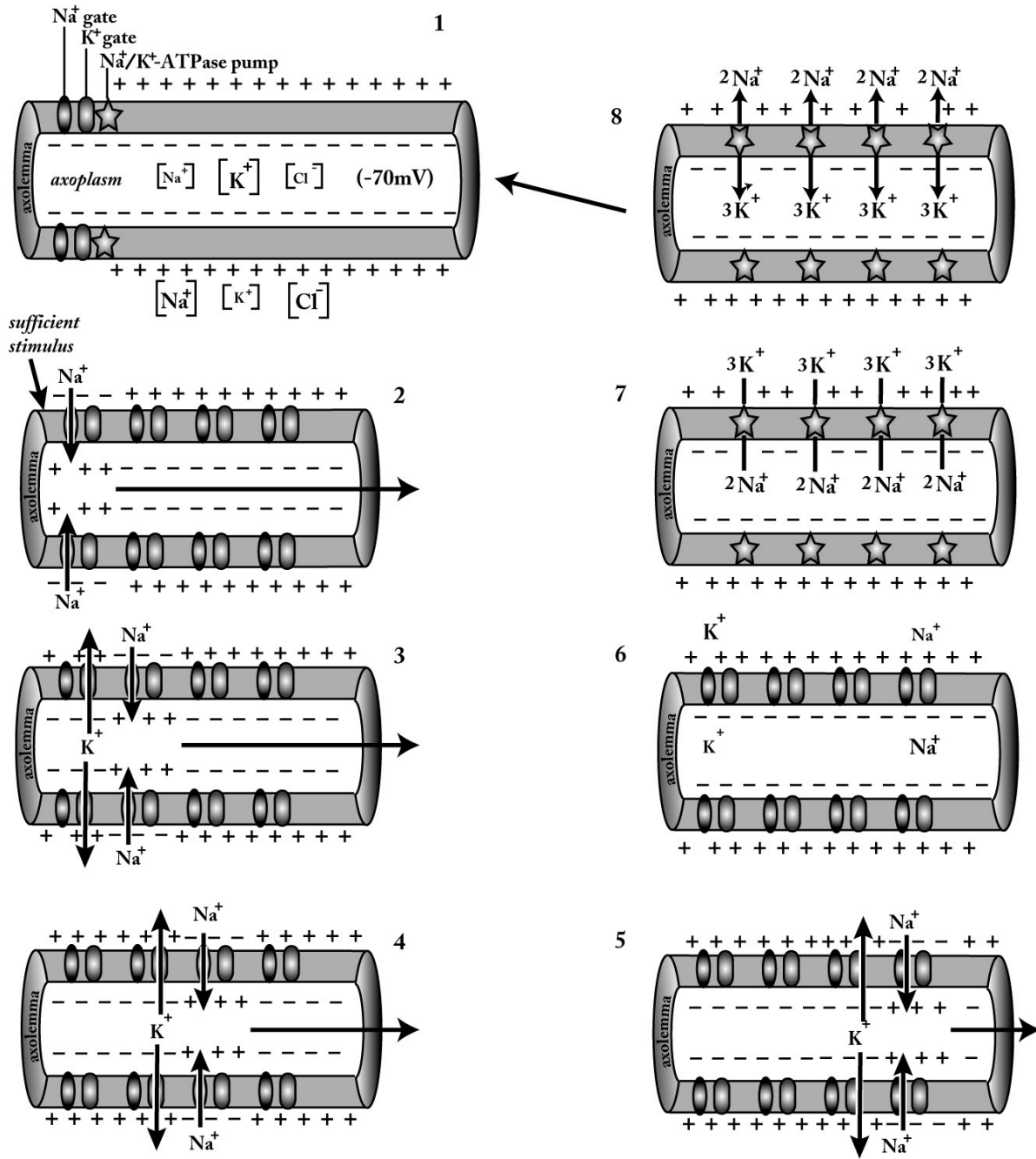
UNMYELINATED (AMYELINATED) AXONS



NEURON: FUNCTIONAL REGIONS

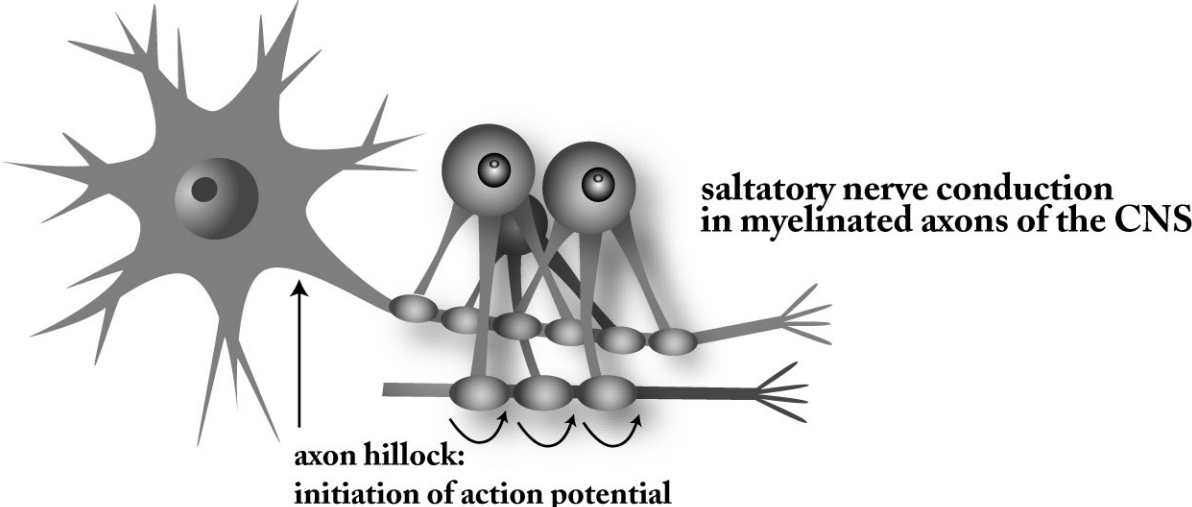
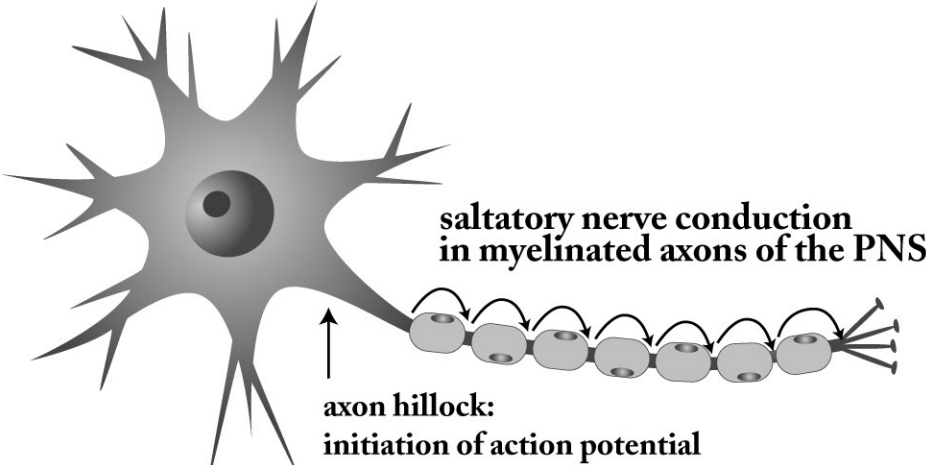
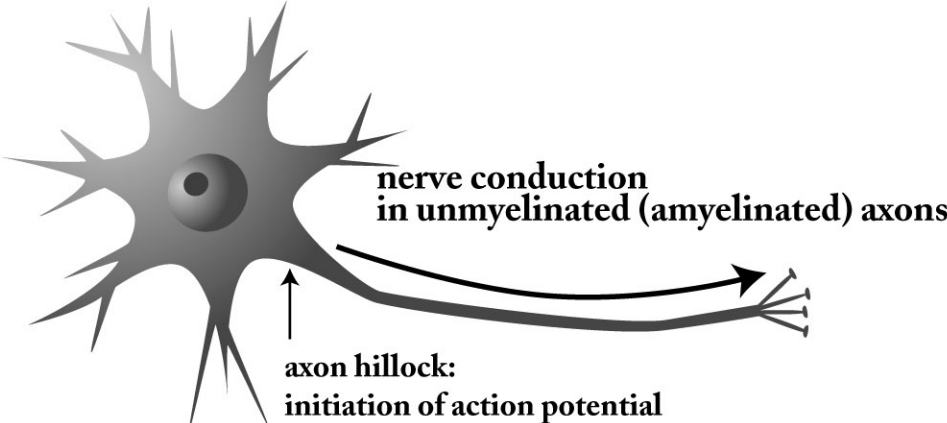


NERVE IMPULSE (ACTION POTENTIAL) PROPAGATION





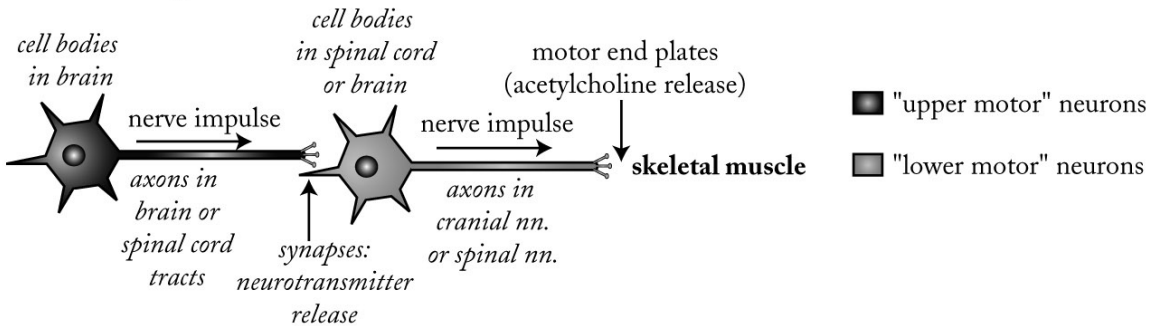
NERVE IMPULSE (ACTION POTENTIAL) PROPAGATION



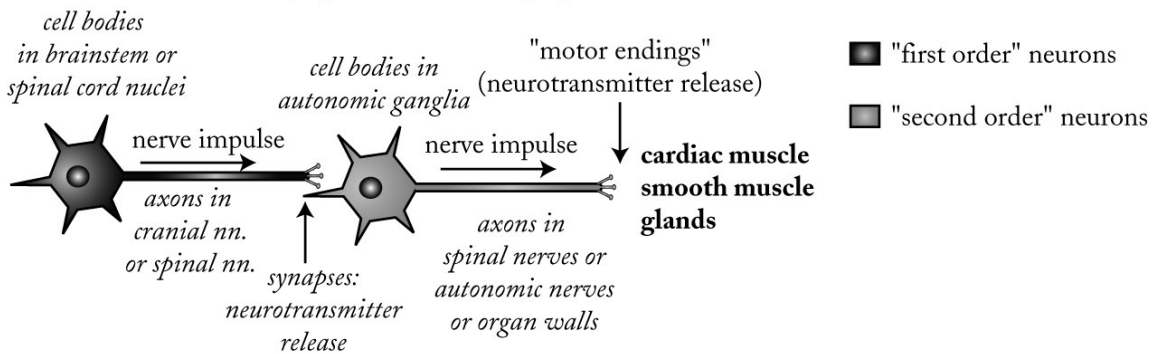
NEURONS: FUNCTIONAL CLASSES

1. Motor or Efferent Neurons Control Effectors

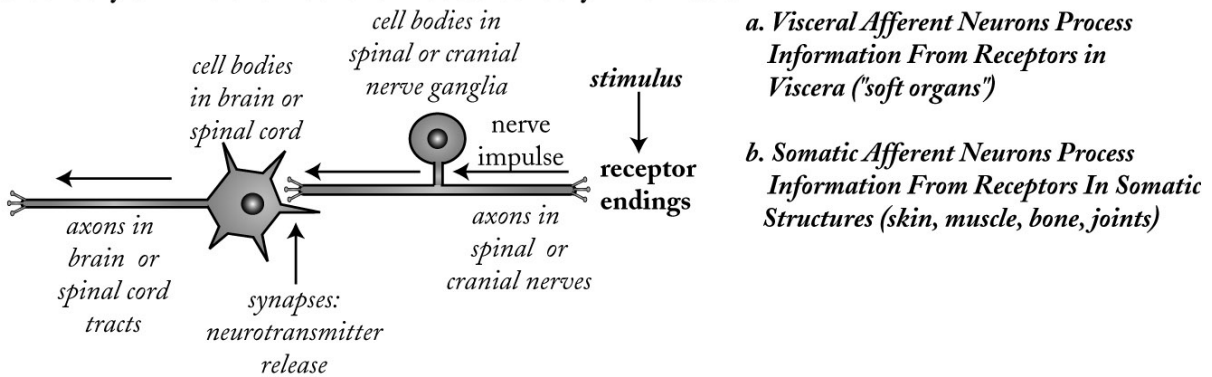
a. Somatic Efferent Neurons Control Skeletal Muscle



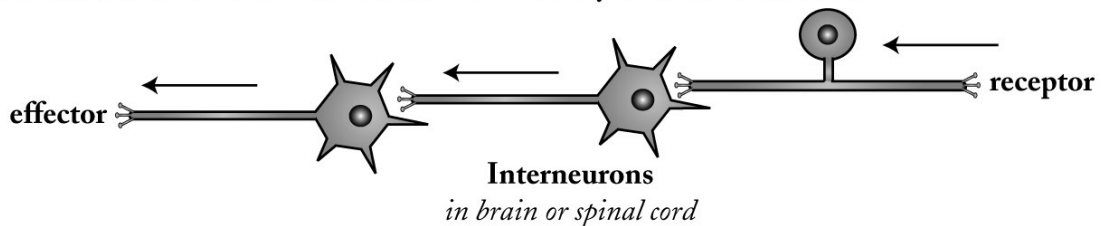
b. Visceral Efferent Neurons Control Cardiac Muscle, Smooth Muscles, and Glands (Autonomic Neurons, Sympathetic and Parasympathetic Neurons)



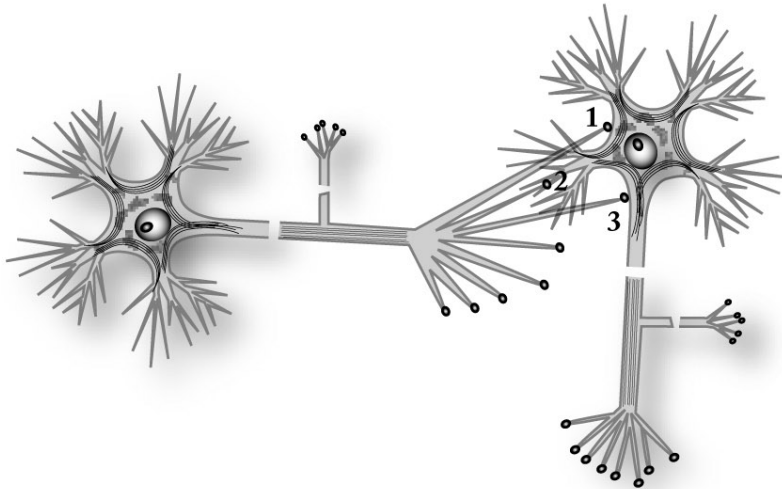
2. Sensory or Afferent Neurons Process Sensory Information



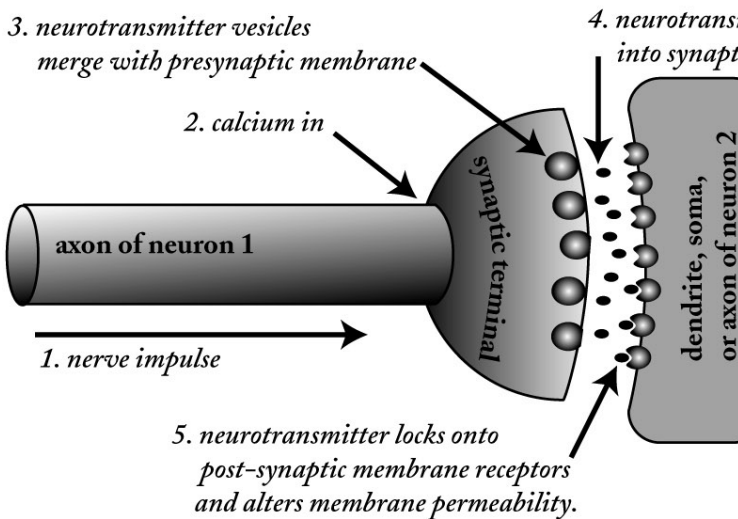
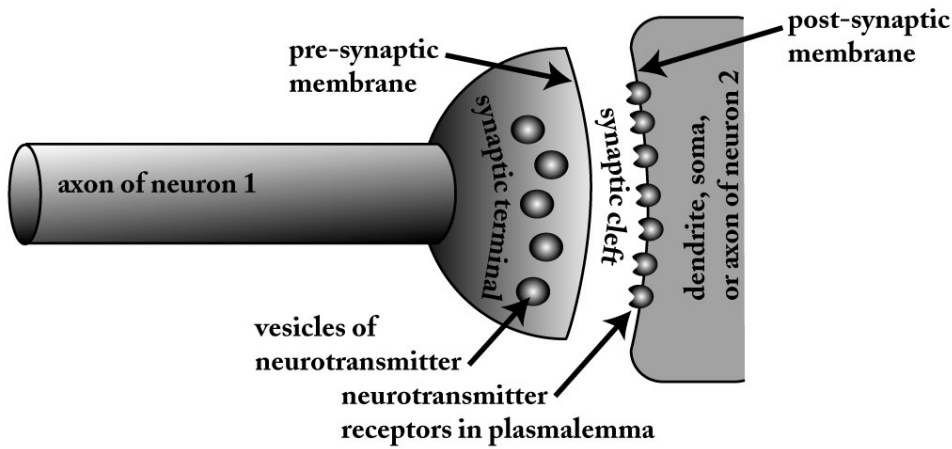
3. Association Neurons (Interneurons) Link Sensory and Motor Neurons



**SYNAPSES**



- 1. axosomatic
- 2. axodendritic
- 3. axoaxonic

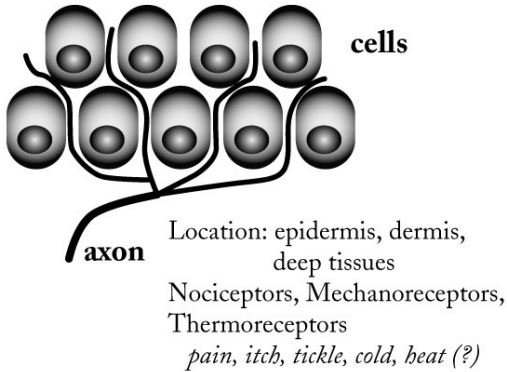


*Excitatory Synapse:  
Neuron 2 depolarized to threshold; action potential propagated.*

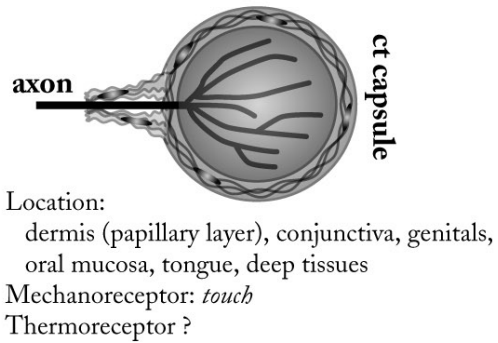
*Inhibitory Synapse:  
Neuron 2 hyperpolarized; no action potential propagated.*

RECEPTORS

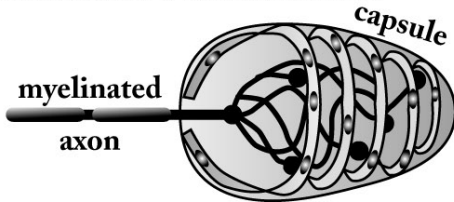
FREE ("NAKED") ENDINGS



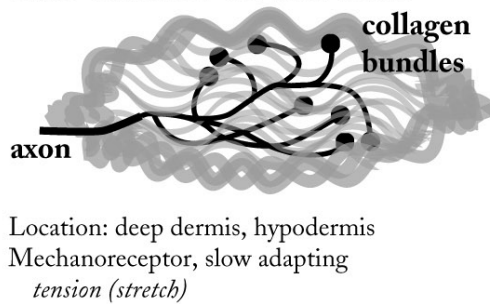
END BULB OF KRAUSE



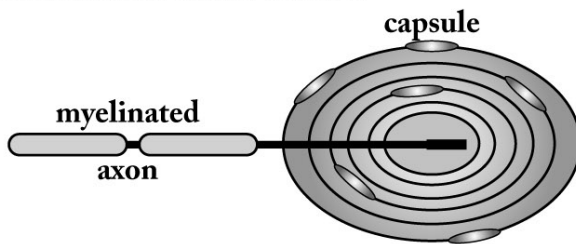
MEISSNER'S CORPUSCLE



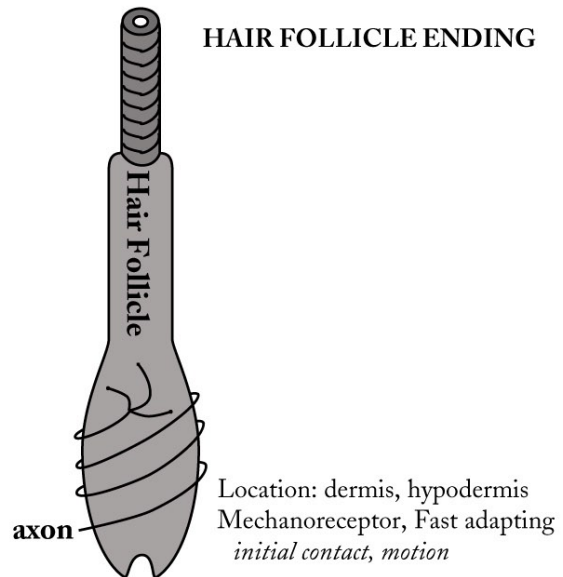
END ORGAN OF RUFFINI



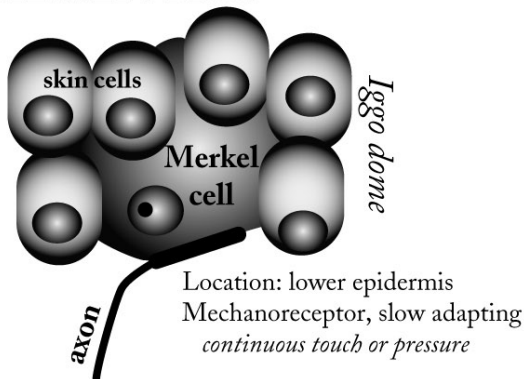
PACINIAN CORPUSCLE



HAIR FOLLICLE ENDING

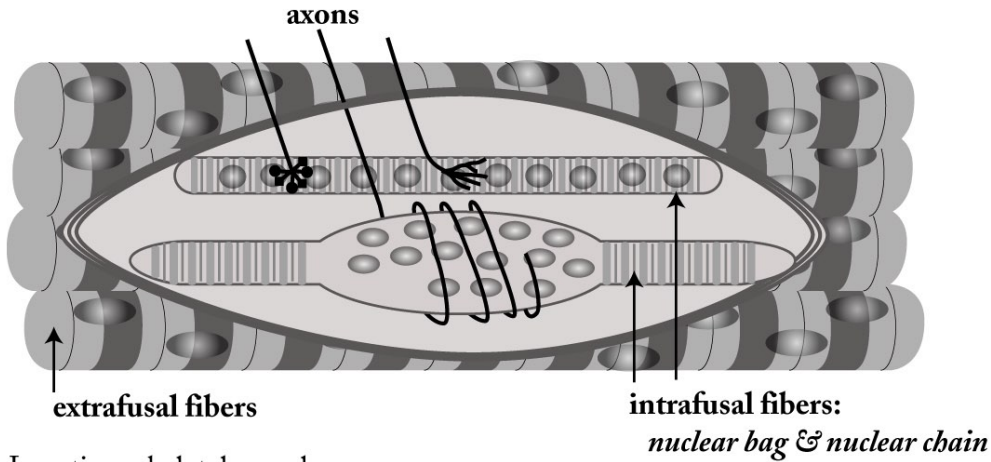


MERKEL'S DISCS



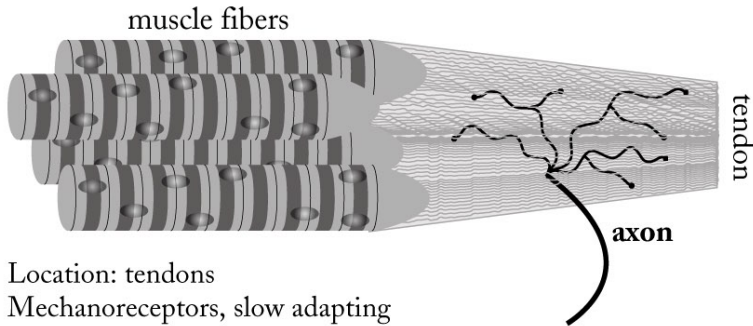
RECEPTORS

MUSCLE SPINDLE



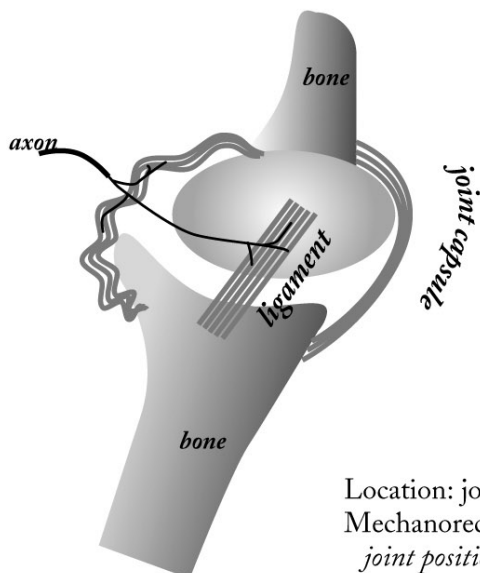
Location: skeletal muscles  
 Mechanoreceptors, slow & fast adapting  
*tension (stretch)*

GOLGI TENDON ORGAN



Location: tendons  
 Mechanoreceptors, slow adapting  
*tension (stretch)*

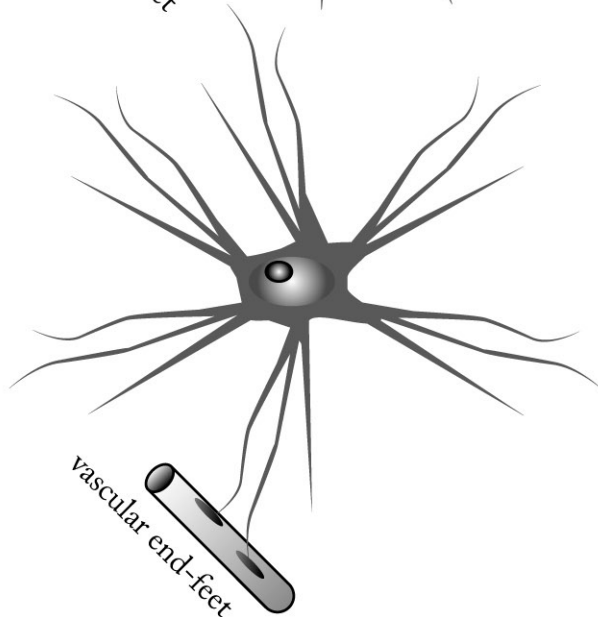
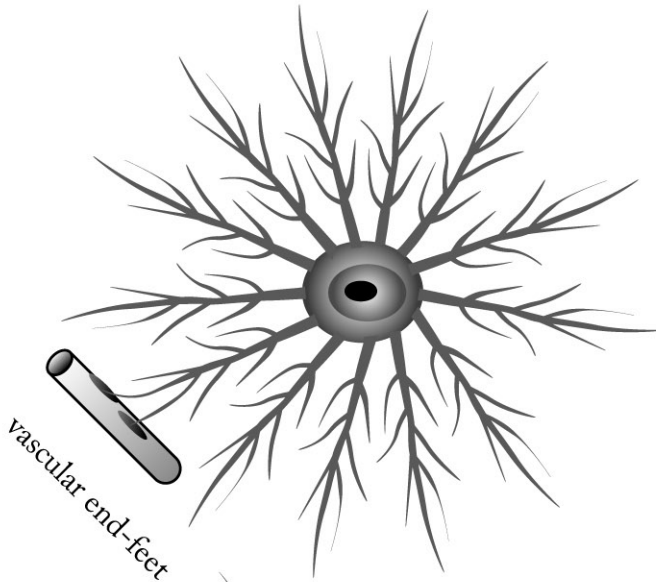
JOINT RECEPTORS



Location: joint tissues  
 Mechanoreceptors, rapid adapting  
*joint position*

## NEUROGLIA

*protoplasmic astrocyte*  
(located in grey matter)

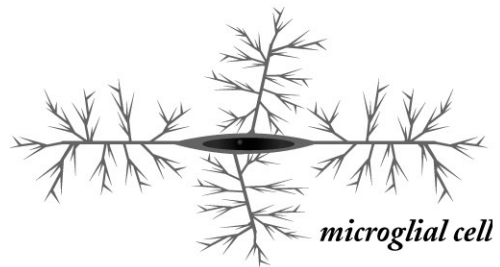


*fibrous astrocyte*  
(located in white matter)

**1. ASTROCYTES (ASTROGLIA)**

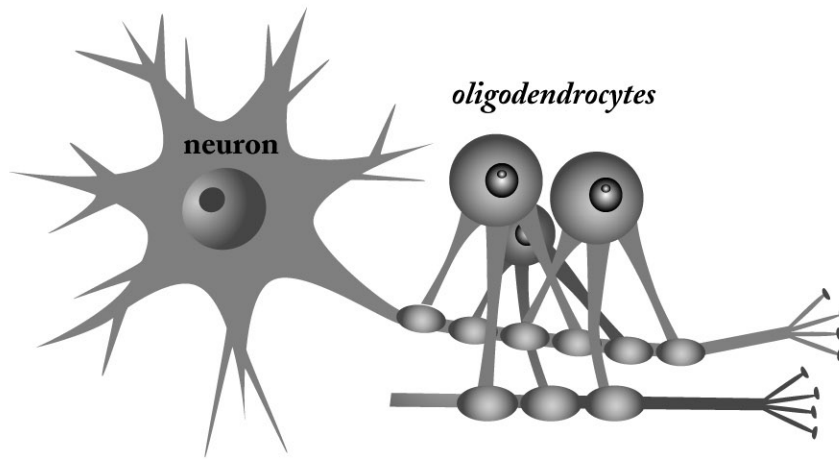
Surround nerve cell bodies and processes and:

- a. provide structural support for neurons and their processes
- b. regulate chemical environment around neurons
- c. facilitate metabolite exchange between bloodstream and neurons.
- d. absorb excess neurotransmitter substances
- e. repair damage by forming cellular scar tissue
- f. release cytokines affecting oligodendrocyte myelin-forming activity
- g. release neuroactive and vasoactive substances (e.g., angiotensinogen peptides, enkephalins, endothelins, etc.)
- h. communicate with each other via gap junctions
- i. part of blood-brain barrier

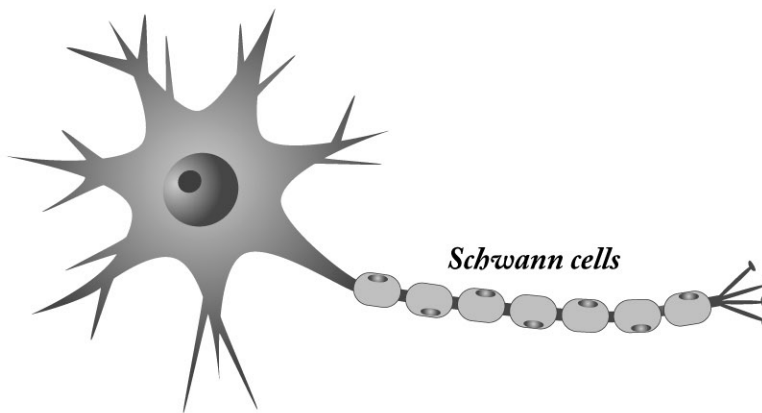
**2. MICROGLIA**

- a. part of MPS
- b. macrophage / APC activity

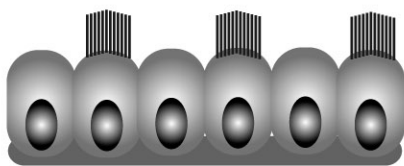
NEUROGLIA



3. *Oligodendrocytes*  
CNS myelination



4. *Schwann cells*  
PNS myelination



*ependymal cells*

5. *Ependymal cells (ependyma)*  
Line ventricles of brain and  
central canal of spinal cord.

## REVIEW QUESTIONS

*Match the term with its definition.*

- |  |              |
|--|--------------|
| 1. A group of neurons outside the CNS    | (a) cortex   |
| 2. A group of neurons inside the CNS     | (b) nucleus  |
| 3. A bundle of axons inside the CNS      | (c) nerve    |
| 4. A bundle of axons outside the CNS     | (d) ganglion |
| 5. A surface sheet of neurons in the CNS | (e) tract    |

*Match the neurons with the types of information they control.*

- |  |                               |
|--|-------------------------------|
| 6. Sensory information from skin, muscle, bone         | (a) somatic afferent neurons  |
| 7. Motor impulses to skeletal muscle                   | (b) visceral afferent neurons |
| 8. Motor impulses to cardiac and smooth muscle, glands | (c) somatic efferent neurons  |
| 9. Sensory information from soft organs                | (d) visceral efferent neurons |
| 10. Connect sensory and motor neurons                  | (e) association neurons       |

*Match the cells with their functions.*

- |   |                      |
|---|----------------------|
| 11. Myelination in the CNS                        | (a) microglia        |
| 12. Phagocytic cells of the CNS                   | (b) ependymal cells  |
| 13. Lining cells of the brain ventricles          | (c) Schwann cells    |
| 14. Myelination in the PNS                        | (d) astrocytes       |
| 15. Regulate composition of fluids around neurons | (e) oligodendrocytes |

*Match the term with its definition.*

- |   |                 |
|---|-----------------|
| 16. Connective tissue enveloping a nerve          | (a) perineurium |
| 17. Connective tissue enveloping a nerve fascicle | (b) epineurium  |
| 18. Connective tissue enveloping a nerve axon     | (c) endoneurium |

*Multiple Choice*

19. If a neuron has one axon and one dendrite leaving the cell body, then it is \_\_\_; if it has a single process that divides into an axon and a "dendrite," then it is \_\_\_; and if it has one axon and two or more dendrites, then it is \_\_\_. (a) unipolar, bipolar, multipolar (b) bipolar, unipolar, multipolar (c) multipolar, bipolar, unipolar (d) pseudounipolar, bipolar, multipolar (e) none of these
20. Telodendria are the end branches of a(n) \_\_\_. (a) axon (b) soma (c) dendrite (d) ganglion (e) none of these
21. Sensory neurons are also called \_\_\_ neurons and motor neurons are also called \_\_\_ neurons. (a) efferent, afferent (b) afferent, efferent (c) afferent, association (d) association, efferent (e) none of these
22. \_\_\_ connect sensory neurons to motor neurons. (a) interneurons (b) neurolemmocytes (c) afferent neurons (d) efferent neurons (e) astrocytes
23. Nissl substance in neurons consists of \_\_\_. (a) smooth endoplasmic reticulum (b) granular endoplasmic reticulum (c) microtubules (d) intermediate protein filaments (e) none of these
24. Which of the listed events occurs first in a nerve impulse? (a) potassium channels open (b) sodium channels open (c) sodium ions flow into the axoplasm (d) potassium ions flow out of the axoplasm (e) sodium channels close
25. At synapses, neurotransmitter is released from the \_\_\_. (a) axon terminals (b) synaptic cleft (c) dendritic spines (d) neuron soma (e) none of these



**NEUROHISTOLOGY**

**ANATOMY 25 - GUTHRIE**

26. Synapses may be \_\_?\_\_. (a) axoaxonic (b) axosomatic (c) axodendritic (d) excitatory or inhibitory (e) all of these
27. Nodes of Ranvier (neurofibril nodes) are \_\_?\_\_. (a) parts of axons insulated by Schwann cells or oligodendrocytes (b) present in the PNS but not in the CNS (c) sites of nerve impulse conduction (d) present on both axons and dendrites (e) none of these
28. The part of a Schwann cell that lies external to the myelin sheath is called the \_\_?\_\_. (a) neurilemma (b) axolemma (c) internodal segment (d) node of Ranvier (e) endoneurium

