Al-Mustaqbal University
College of Pharmacy
Second stage /2024
Physiology Lec1

Nervous system

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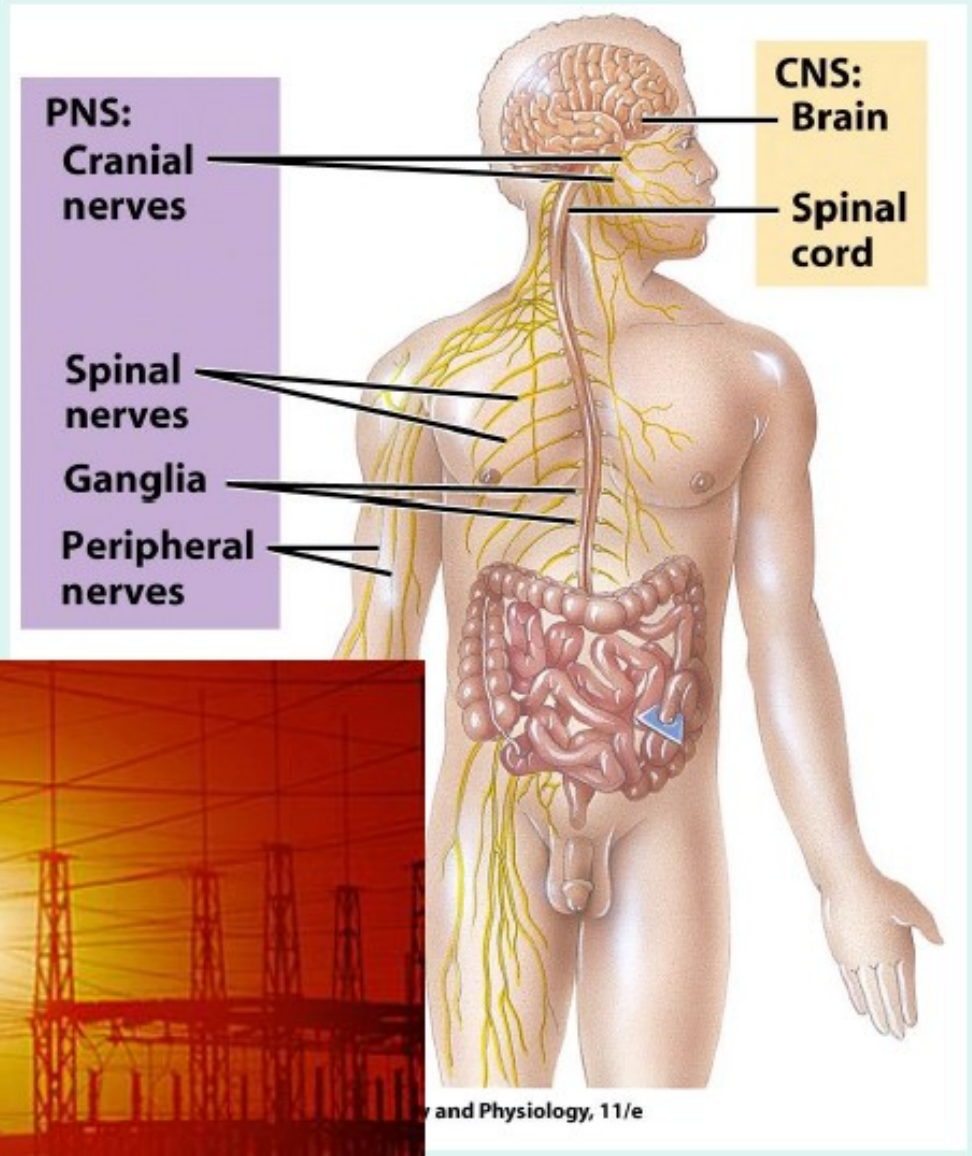
Outline

- **What is the Nervous System**
  - Complex system
- Neurons and glial cell
- Division of nervous system
- Myelin sheath
- **Neurons types**

The Nervous System

- The nervous system is the body's electrical system
- It is broadly divided into two parts:
  - Central nervous system = CNS (brain and spinal cord)
  - Peripheral nervous system = PNS (nerves and ganglia)
- The nervous system performs three important functions:
  - Sensory input
  - Integration
  - Motor output



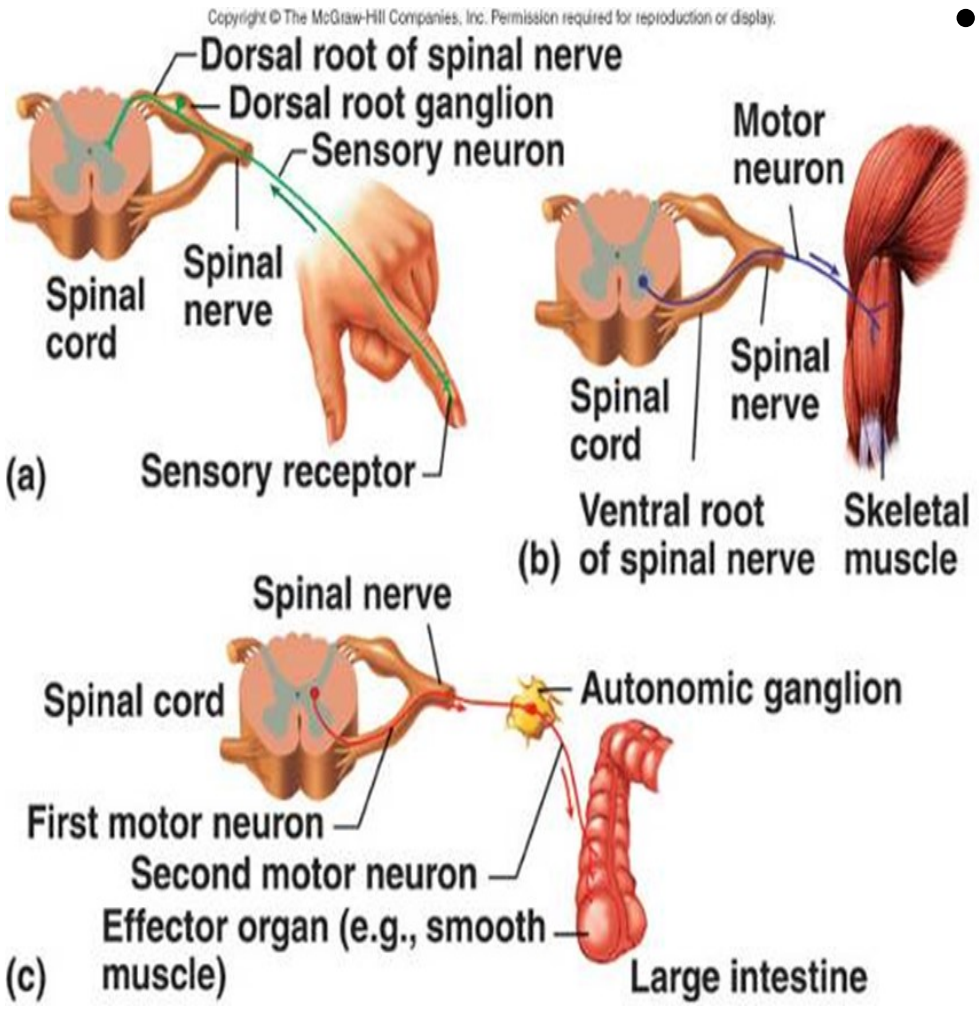
The Nervous System

- **I/ The Central Nervous System (CNS)** :

consists of the **brain and the spinal cord**,

- **II/ The Peripheral Nervous System (PNS) :** the peripheral nervous system consists of **All the neural tissue outside CNS** , this includes:
  - Afferent division (sensory input)
  - Efferent division (motor output)
- **PNS** can be divided into:
  - **Somatic nervous system,**
  - **Autonomic nervous system**

The Nervous System



- **Two subcategories**
  - Sensory or afferent
  - Motor or efferent
    - **Divisions**
      - **Somatic nervous system**
      - **Autonomic nervous system (ANS)**
        - » **Sympathetic**
        - » **Parasympathetic**
        - » **Enteric**

12 cranial nerves

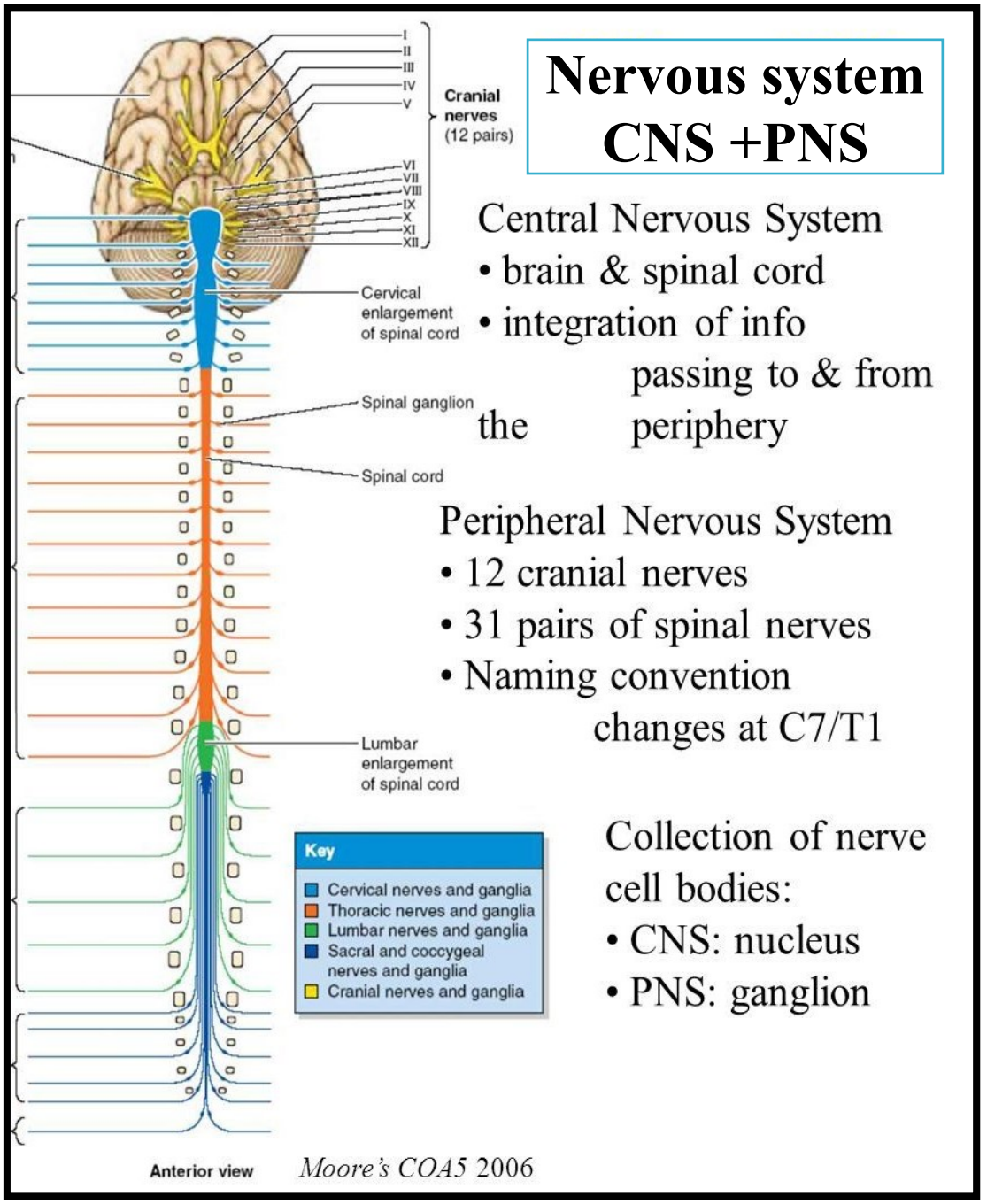
8 Cervical

12 thoracic

5 lumbar

5 sacral

1 coccygeal



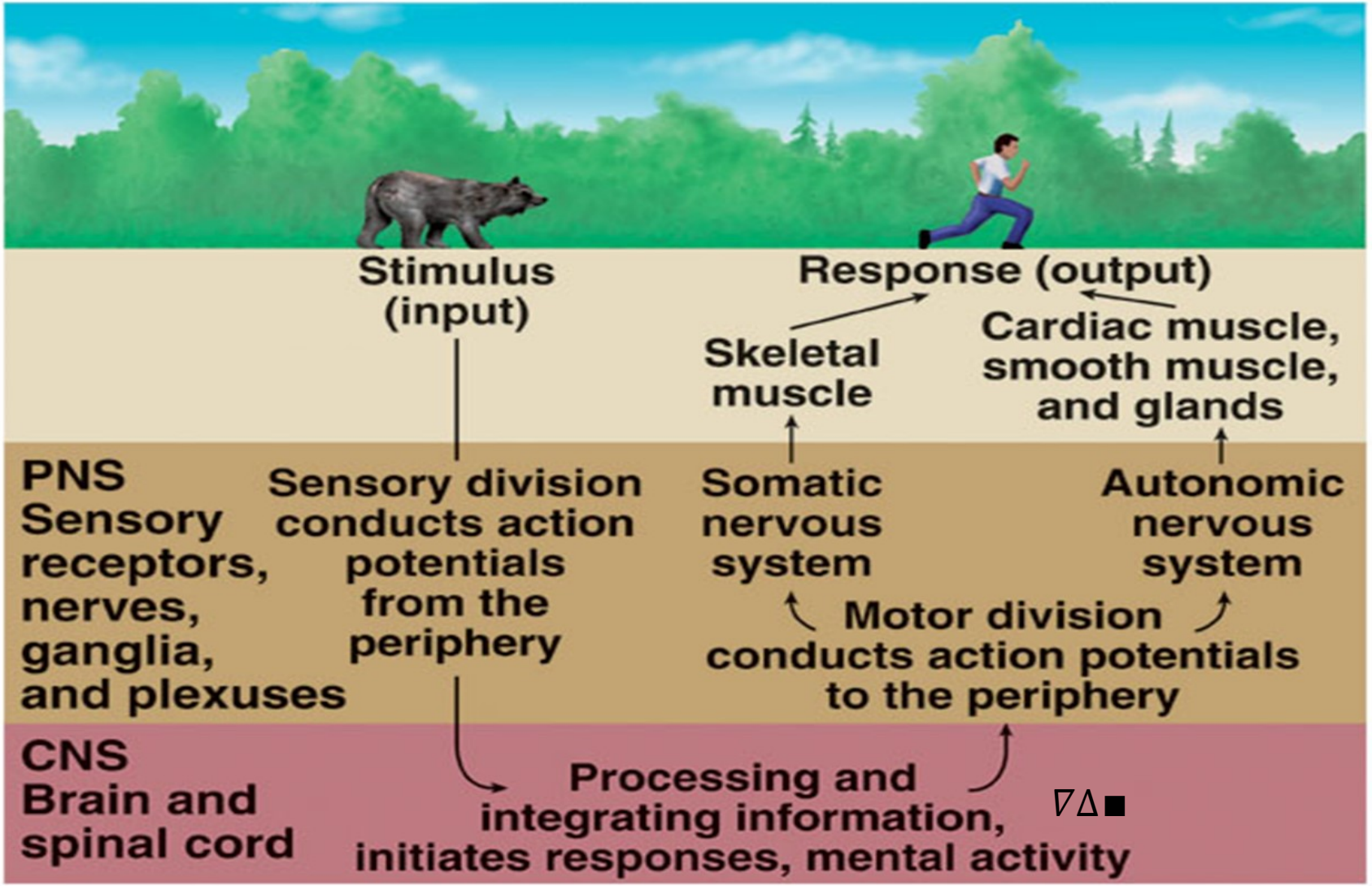
Nervous system CNS +PNS

Central Nervous System
- brain & spinal cord
- integration of info passing to & from the periphery

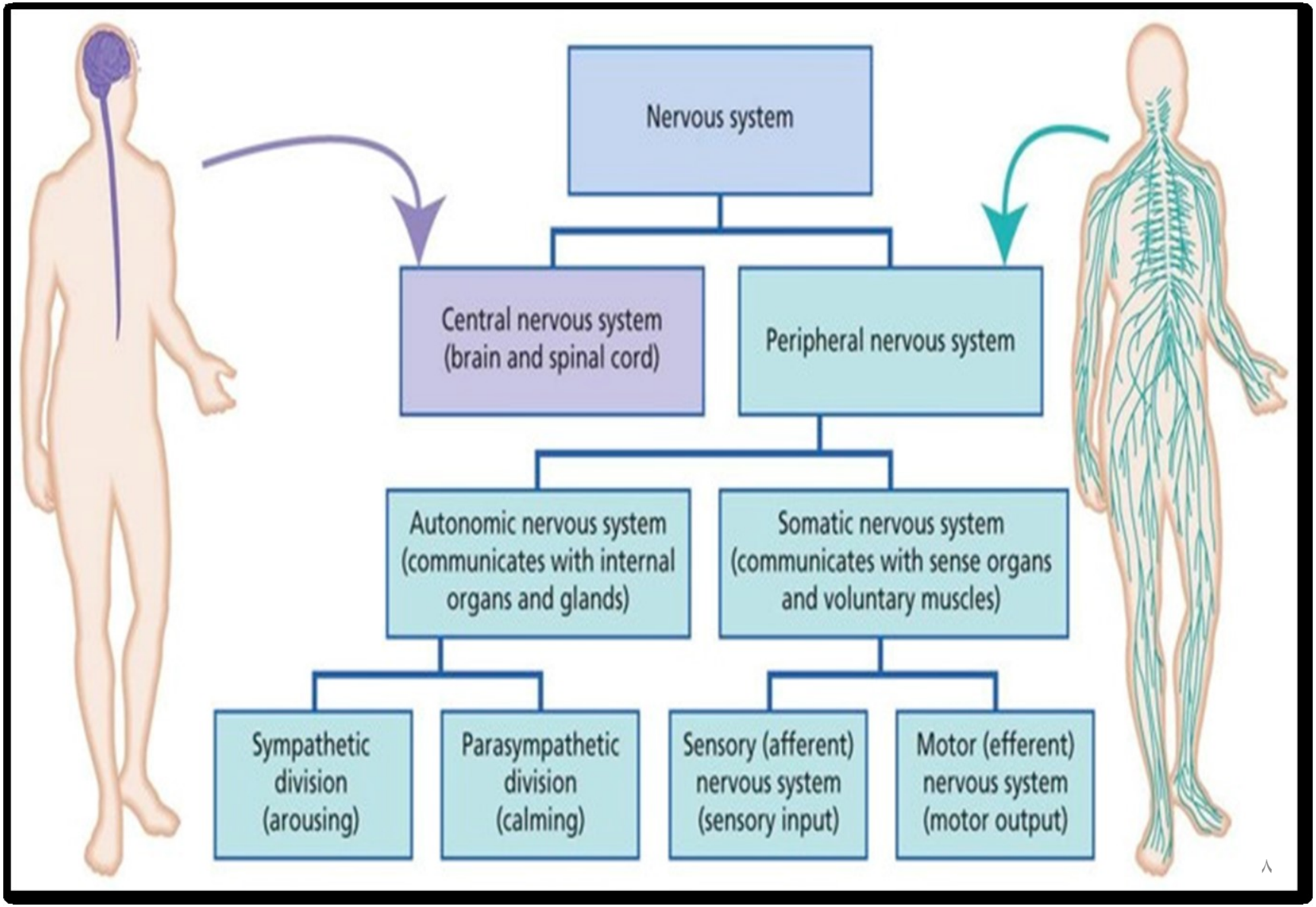
Peripheral Nervous System
- 12 cranial nerves
- 31 pairs of spinal nerves
- Naming convention changes at C7/T1

Collection of nerve cell bodies:
- CNS: nucleus
- PNS: ganglion

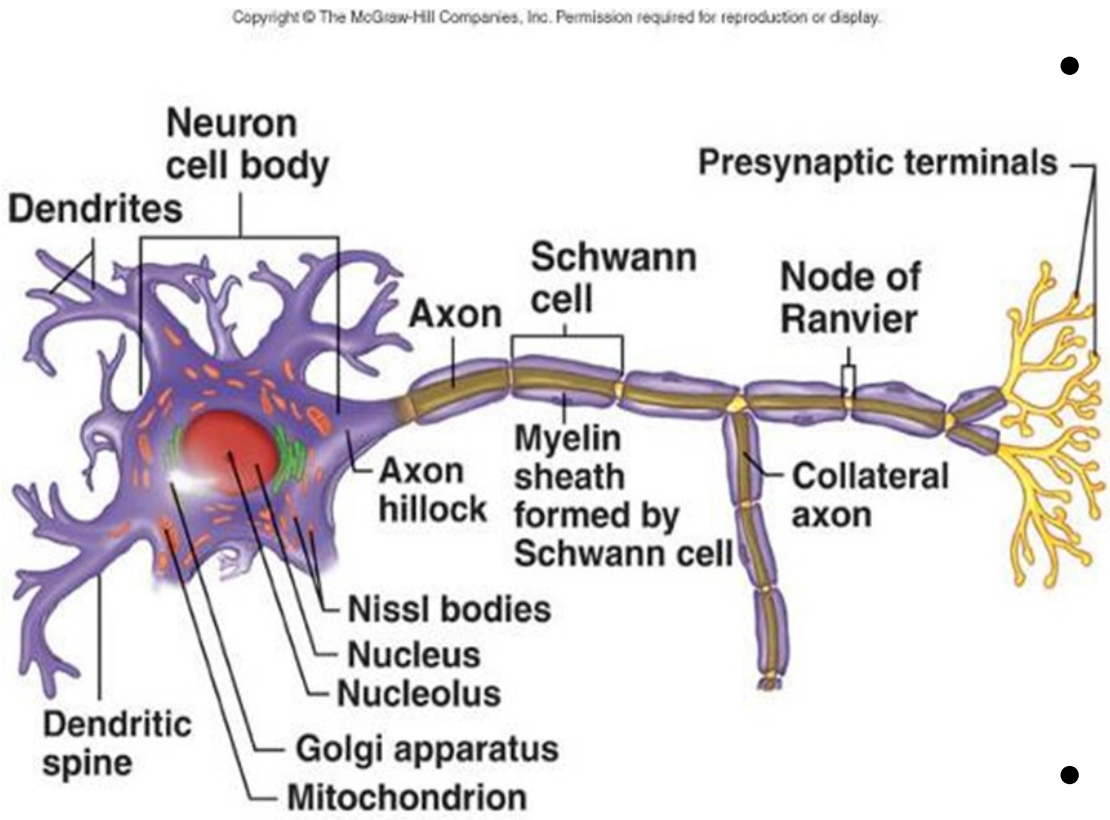
Nervous System organization



The Nervous System



Cells of Nervous System

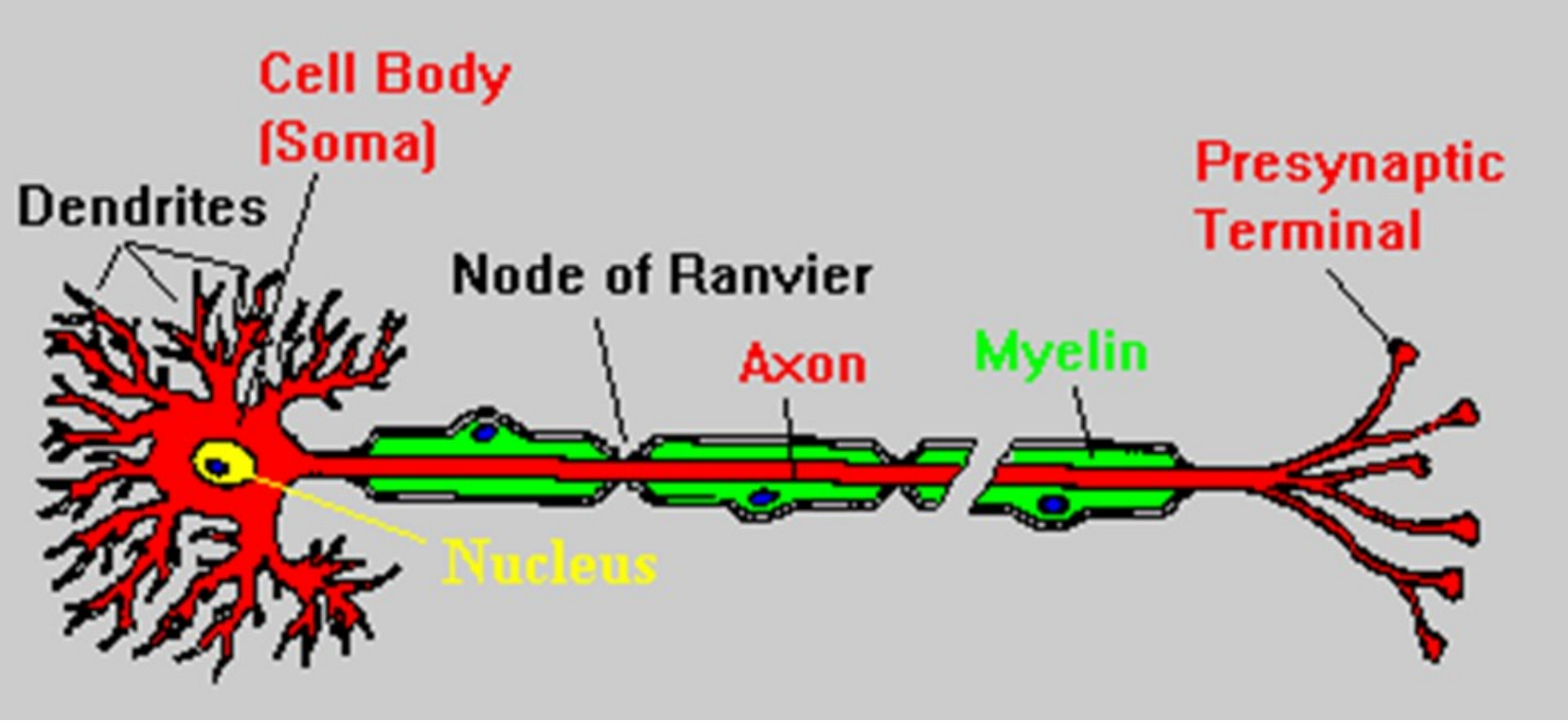


- **Neurons or nerve cells**
  - cellular connection Receive stimuli and transmit action potentials
  - Organization
    - **Cell body or soma**
    - **Dendrites**: Input
    - **Axons**: Output
- **Neuroglia or glial cells**
  - **Support and protect neurons**

Neuron Cell Body Location

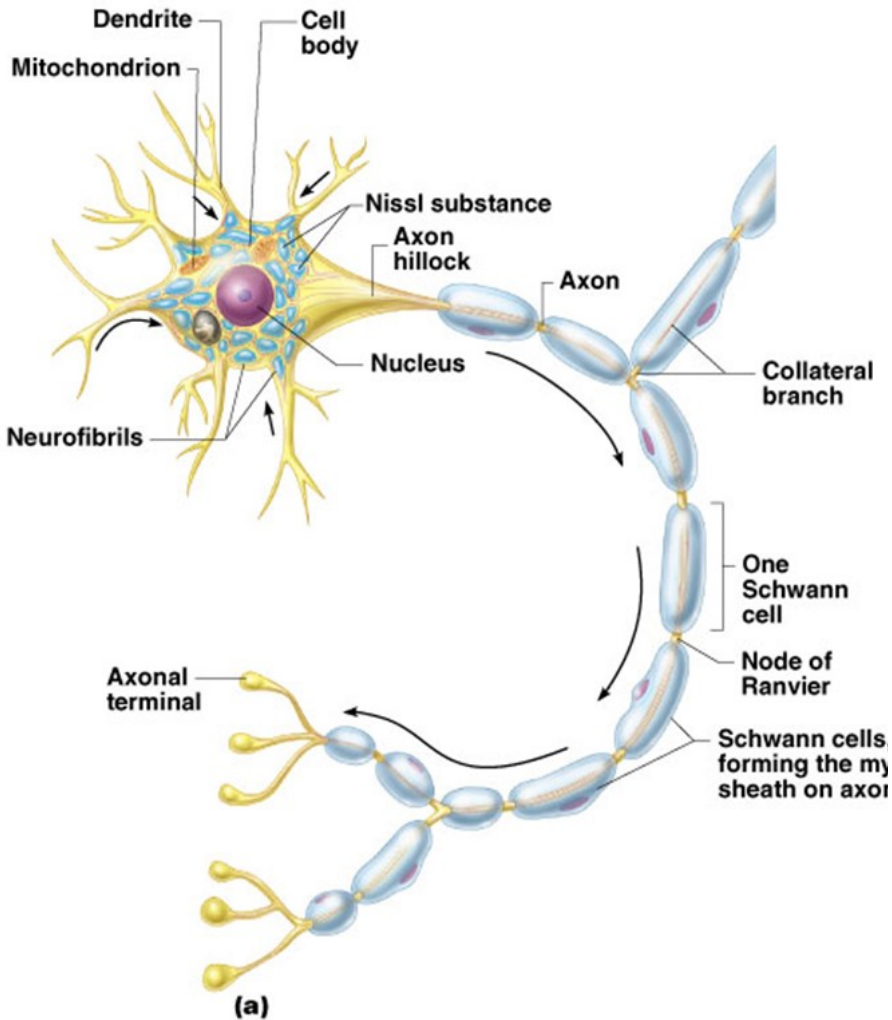
- Most are found in the central nervous system
  - **Gray matter** – cell bodies and unmylenated fibers
  - **Nuclei** – clusters of cell bodies within the white matter of the central nervous system
- **Ganglia** – collections of cell bodies outside the central nervous system

General Function of Neuron and Neuroglia



Structure and function

Typical Neuron has 4 Regions



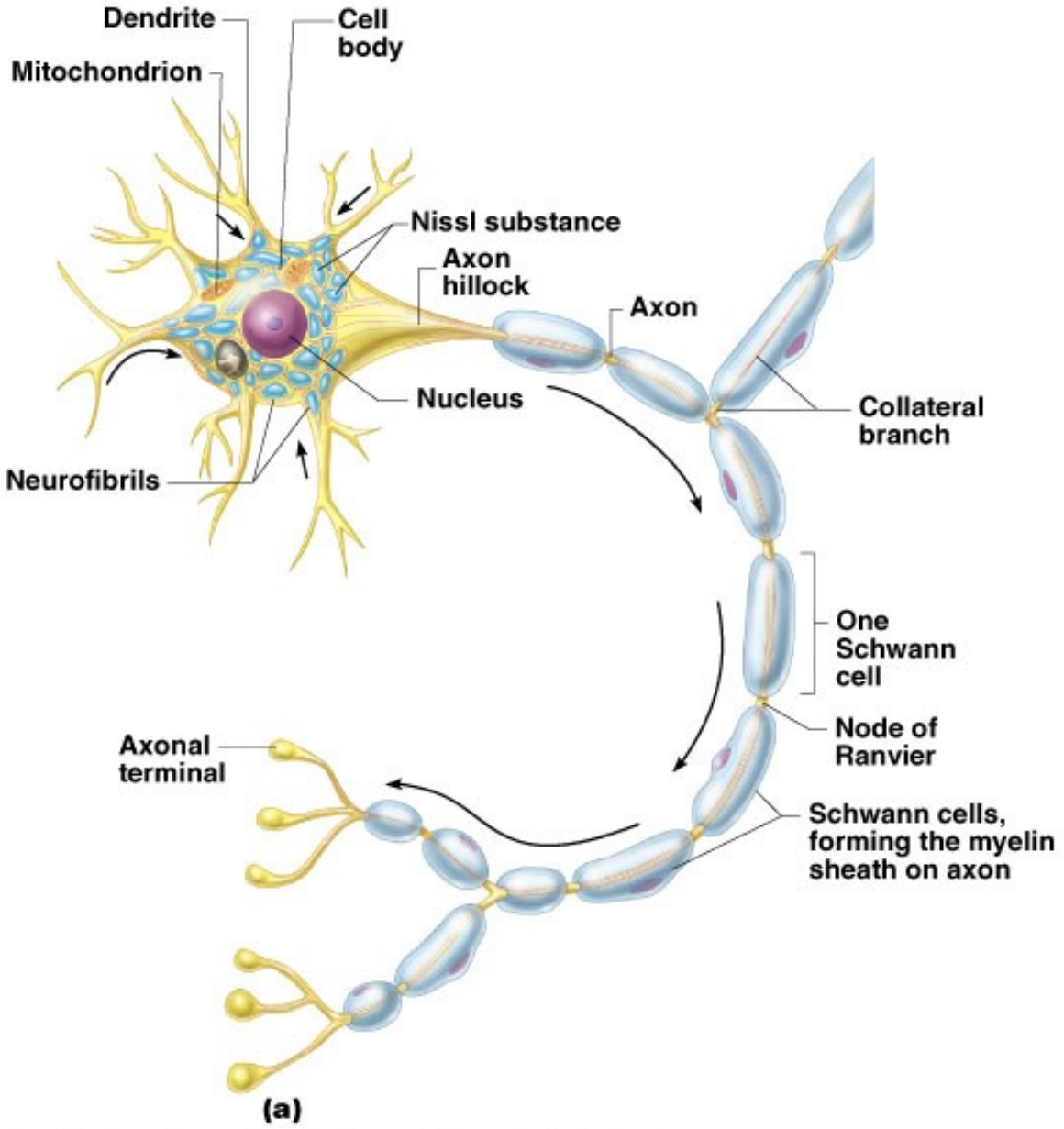
- Cell Body
- Dendrites
- Axon
- Presynaptic Terminals

Each region is specialized for its particular function

Information flows in a single direction

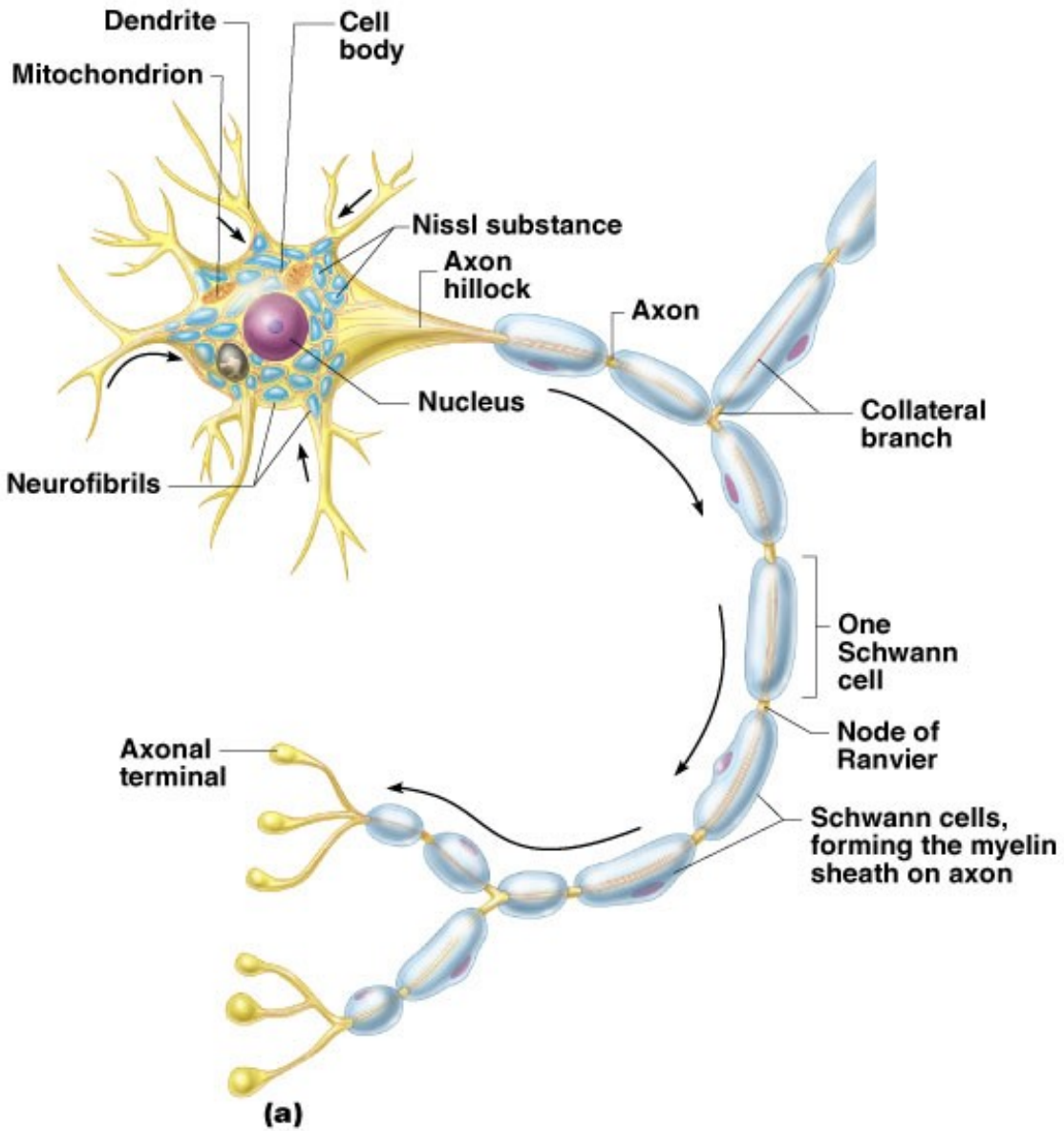
Sructure function

- Extensions outside the cell body
  - Dendrites – conduct impulses toward the cell body
  - Axons – conduc impulses away from the cell body (only 1!)



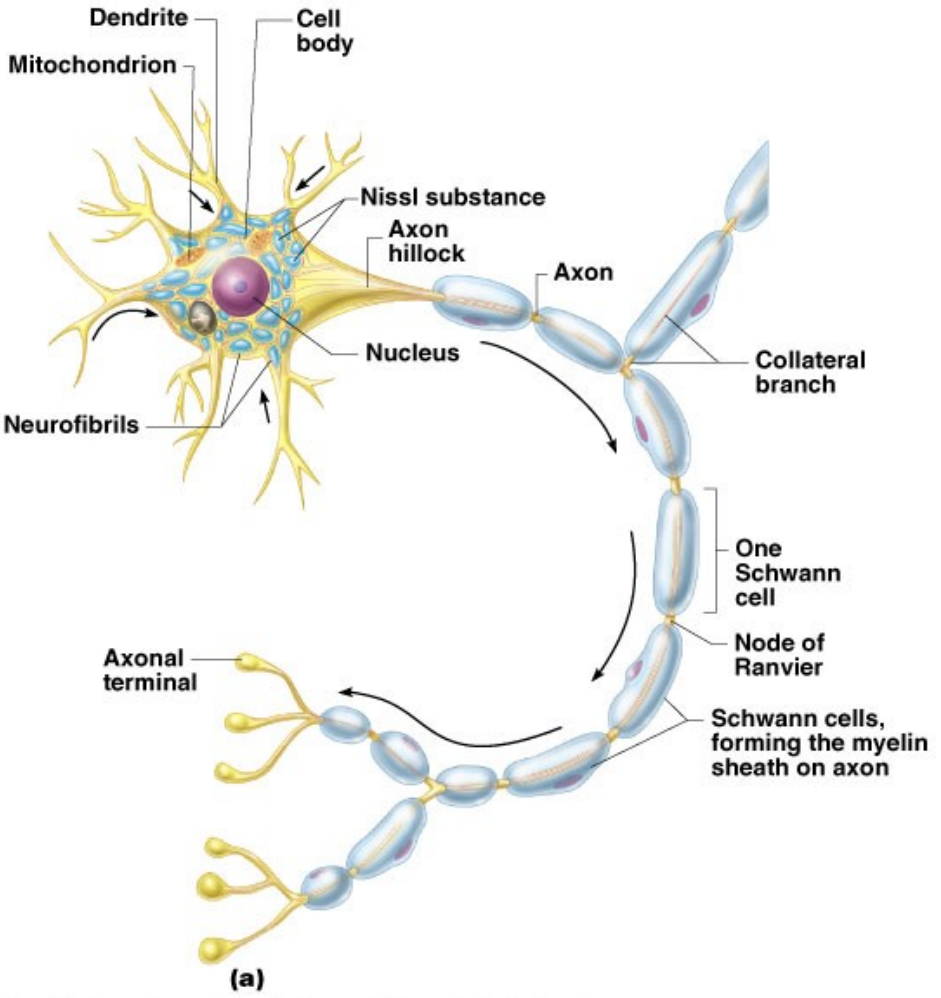
Dendrites of Motor Neurons

- Short, tapering, and diffusely branched processes
- They are the receptive, or input, regions of the neuron
- Electrical signals are conveyed (pass)as graded potentials (not action potentials)



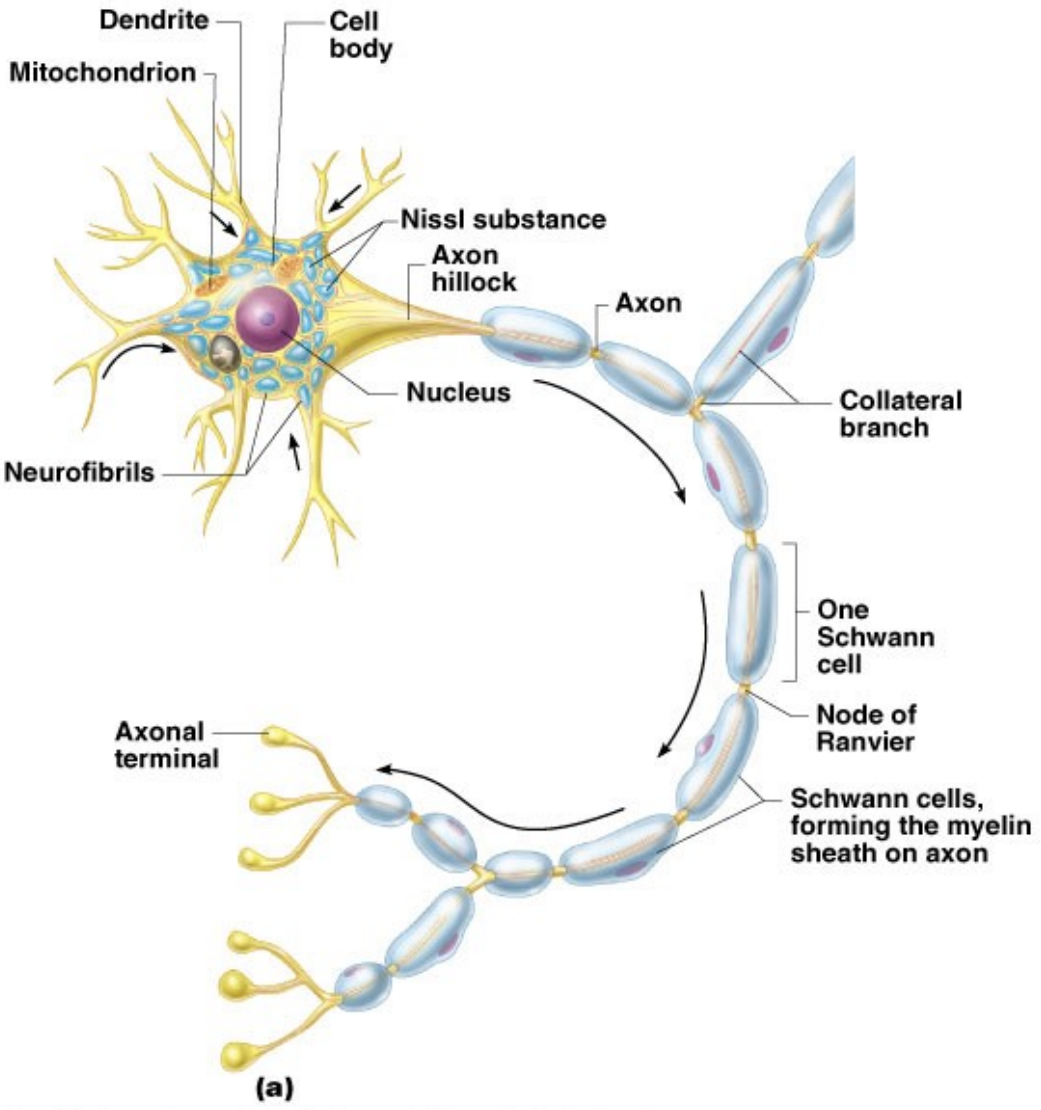
Axons: Structure

- Slender processes of uniform diameter arising from the hillock
- Long axons are called nerve fibers
- Usually there is only one unbranched axon per neuron
- Rare branches, if present, are called *axon collaterals*
- Axonal terminal – branched terminus of an axon

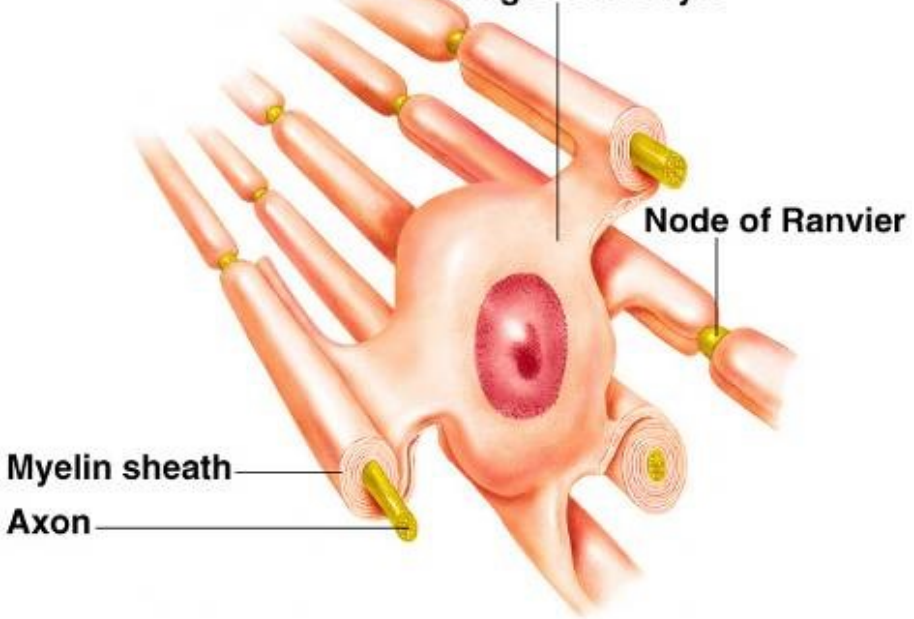


Axons: Function

- **Generate and transmit** action potentials
- **Secrete** neurotransmitters from the axonal terminals



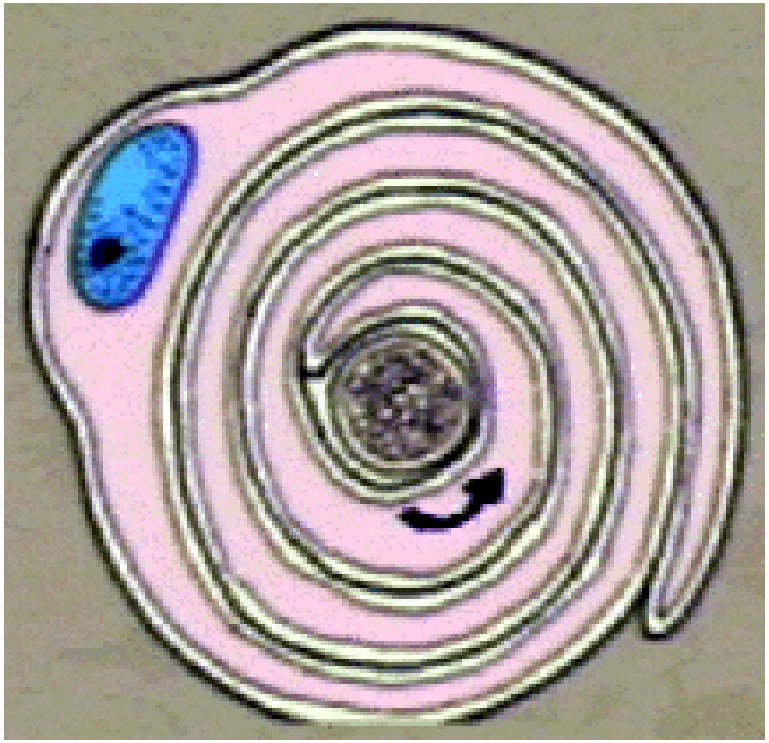
Myelin



- Myelin: Whitish, fatty (protein-lipid), segmented sheath around most long axons.
- **CNS: oligodendroglia**

  or oligodendrocytes

- **PNS: Schwann cells ~**



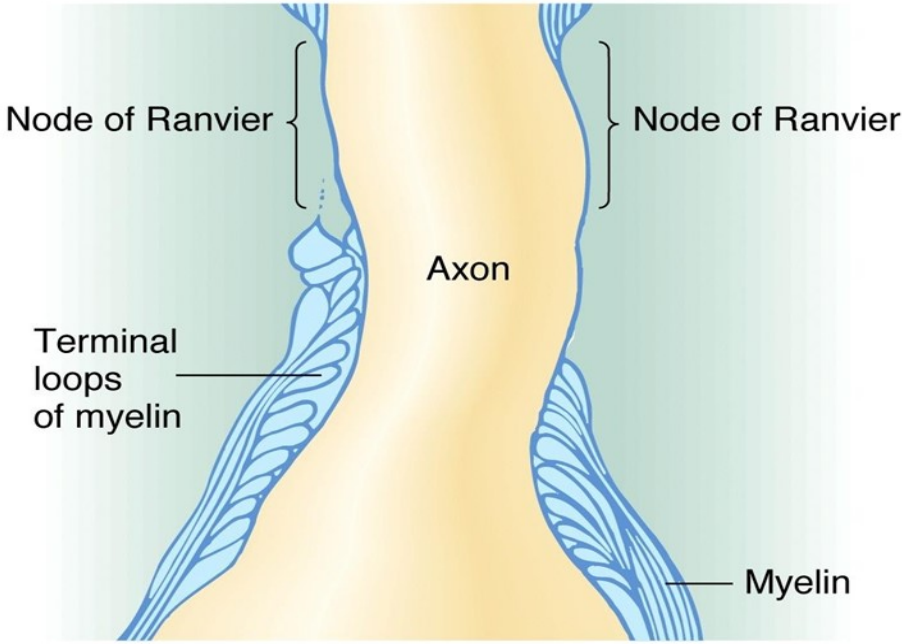
Myelin Sheath

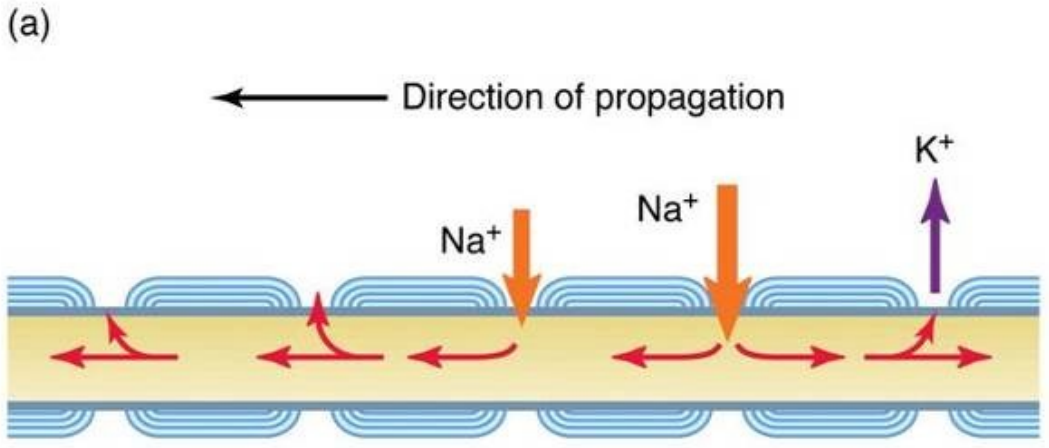
Myelin functions in :

- Protection of the axon
- Electrically insulating fibers from one another
- **It increases the excitability of the nerve fiber**
- Increasing the speed of nerve impulse transmission

Nodes of Ranvier

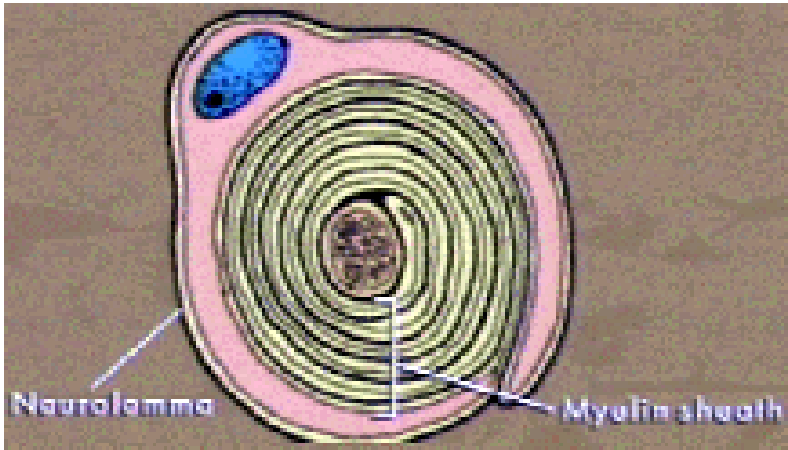
- Gaps in the myelin sheath between adjacent Schwann cells
- They are the sites where collaterals can emerge
- Salutatory (welcome) conduction



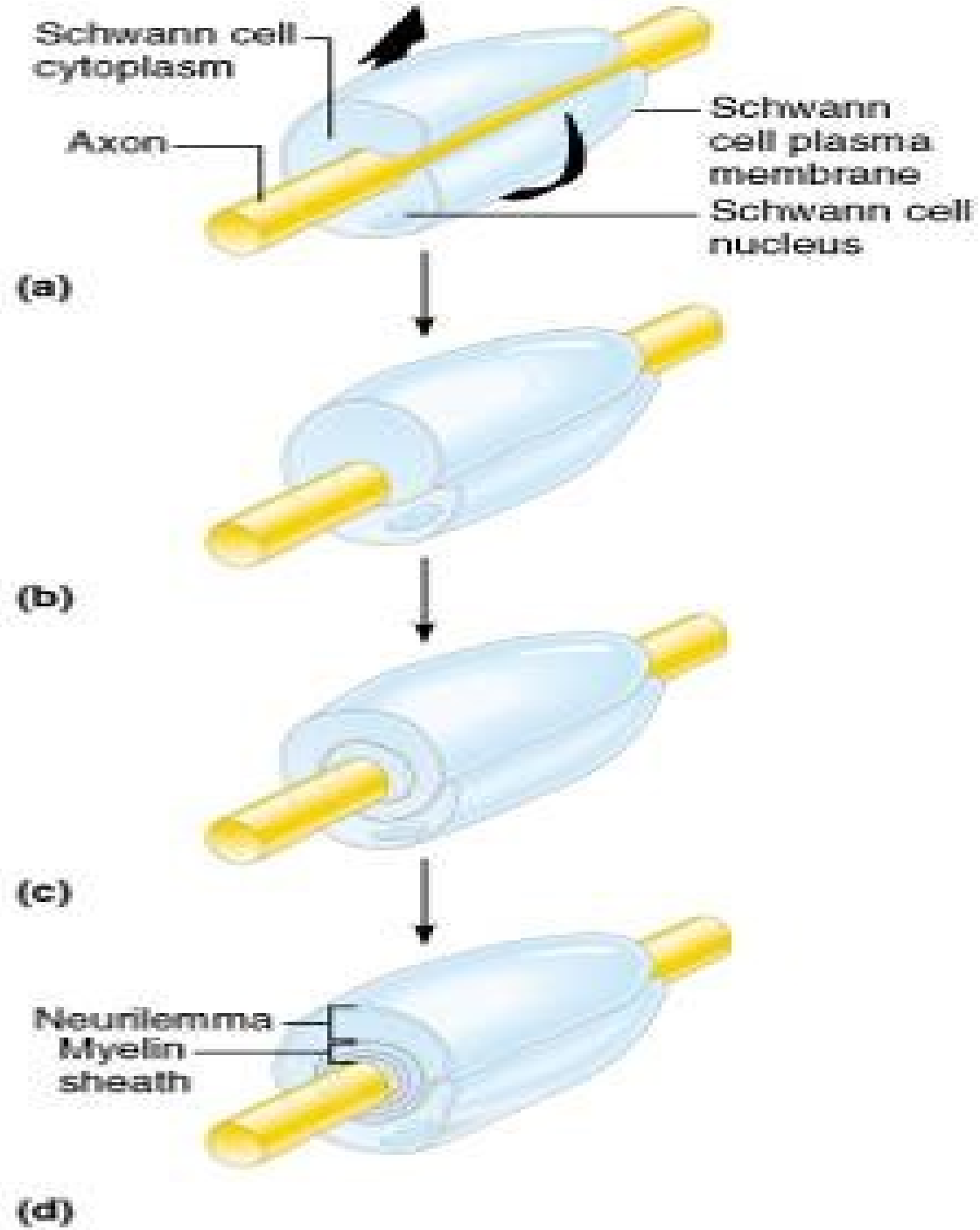


Myelin Sheath and Neurilemma: Formation

- Formed by Schwann cells in the PNS
- A Schwann cell:
  - Envelopes an axon in a trough
  - Encloses the axon with its plasma membrane
  - Concentric layers of membrane make up the myelin sheath
- Neurilemma – remaining nucleus and cytoplasm of a Schwann cell

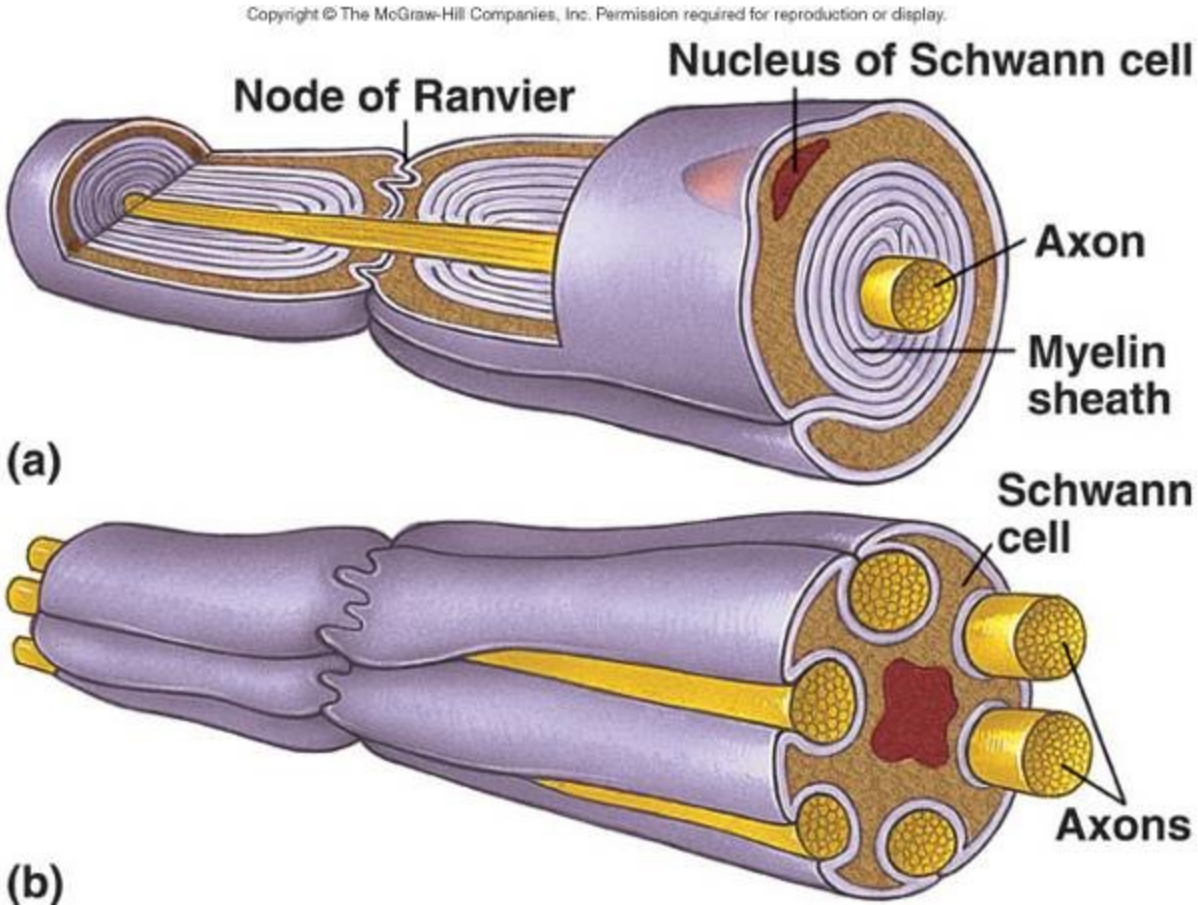


Myelin Sheath and Neurilemma: Formation



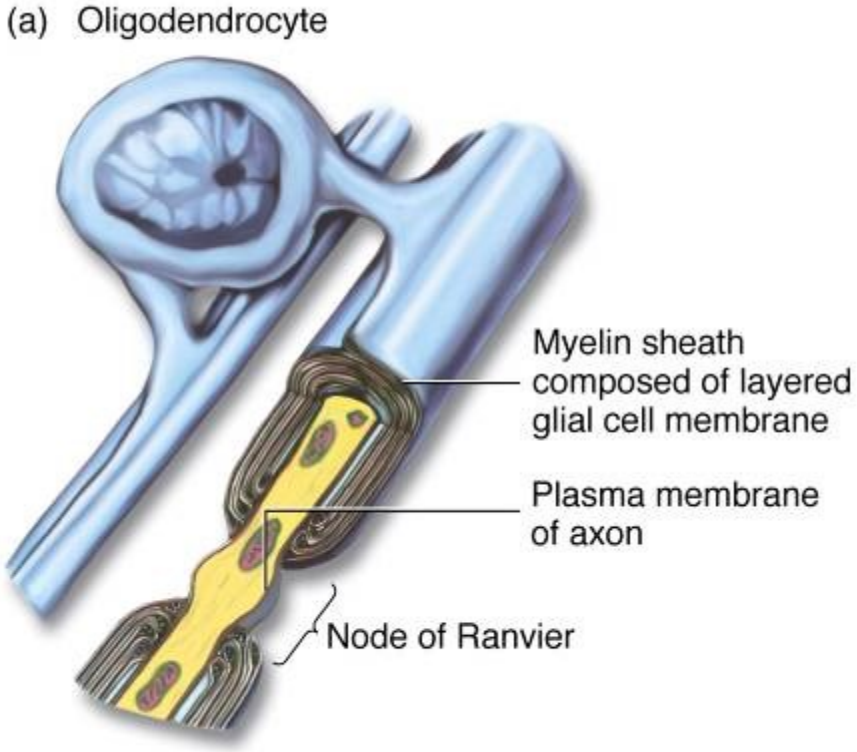
Unmyelinated Axons

- A Schwann cell surrounds nerve fibers but coiling does not take place
- Schwann cells partially enclose 15 or more axons



Axons of the CNS

- Both myelinated and unmyelinated fibers are present
- Myelin sheaths are formed by oligodendrocytes
- Nodes of Ranvier are widely spaced
- There is no neurilemma



Glia: other than Neuron cell in Nervous system

In the **peripheral nervous system** there are two types of glial cells:

a. **Schwann cells**.
b. **Satellite cells.**

Nervous System Tissue: Glial Cells

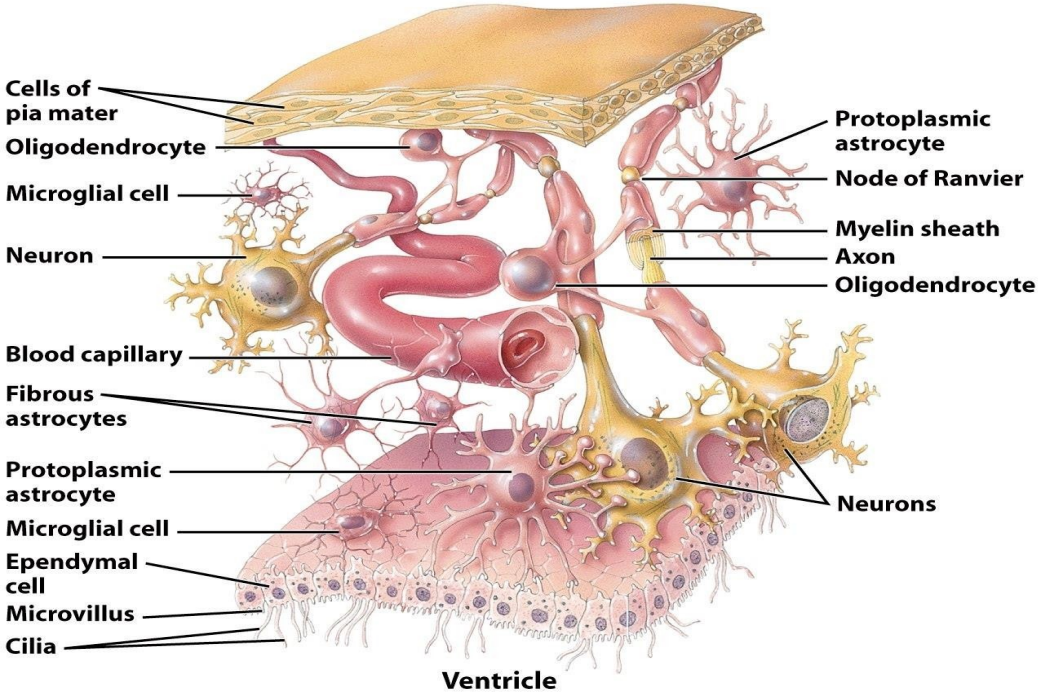


Figure 12-6 Principles of Anatomy and Physiology, 11/e
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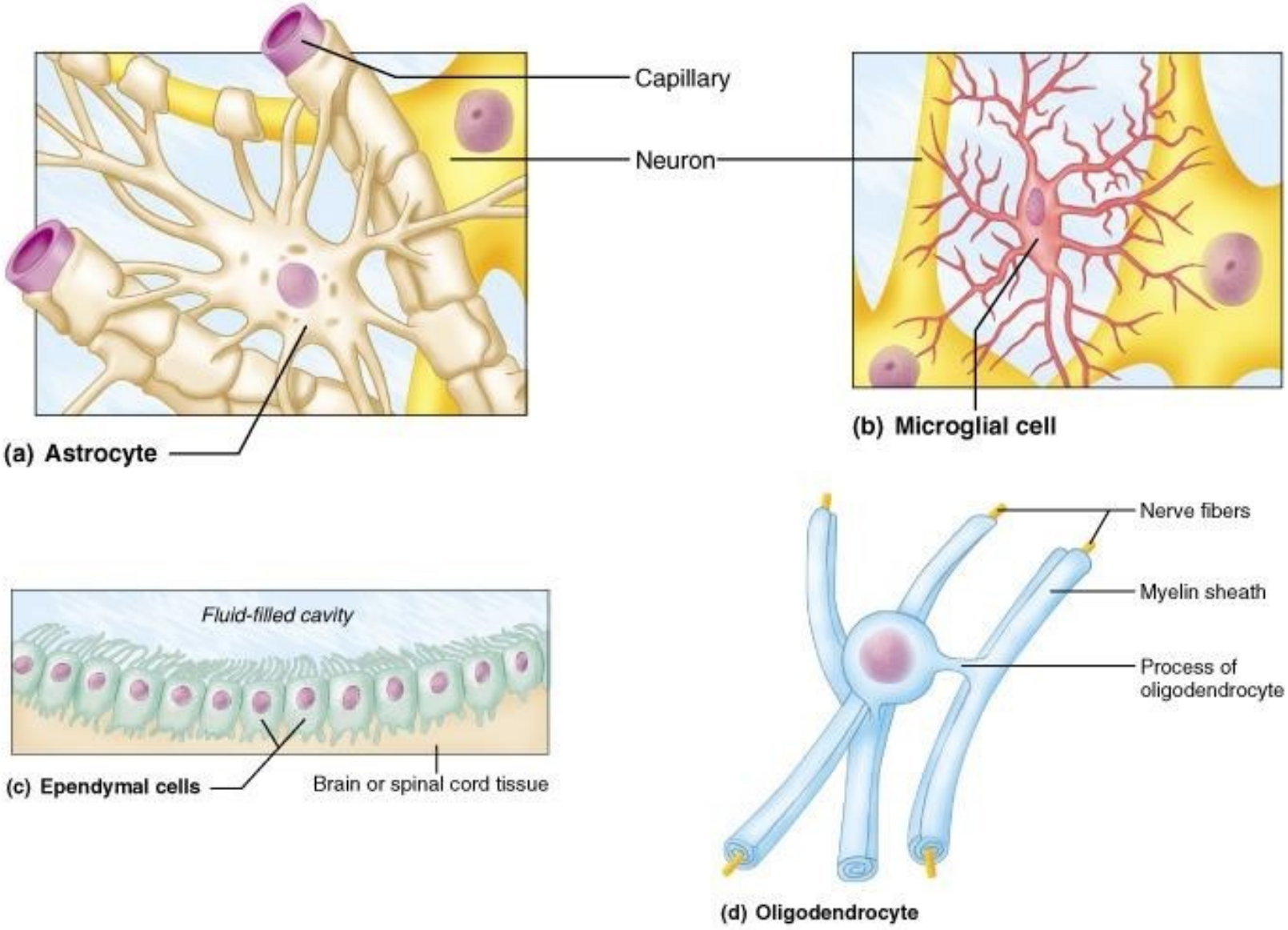
- Glial cells (neuroglia) are the "glue" of the NS
- They also perform many functions
- There are six basic types:
  - Astrocytes (CNS(
  - Microglia (CNS(
  - Oligodendrocytes (CNS(
  - Ependymal cells (CNS(
  - Schwann cells (PNS(
  - Satellite cells (PNS(
- Glial cells outnumber neurons about 10 to 1

- Astrocytes provide structural support, form the blood-brain barrier, and regulate ions
- Microglia function as phagocytes
- Ependymal cells line the ventricles and spinal canal, and produce cerebrospinal fluid
- Oligodendrocytes form the myelin sheaths around axons in the CNS



Nervous System Tissue: Gray & White Matter

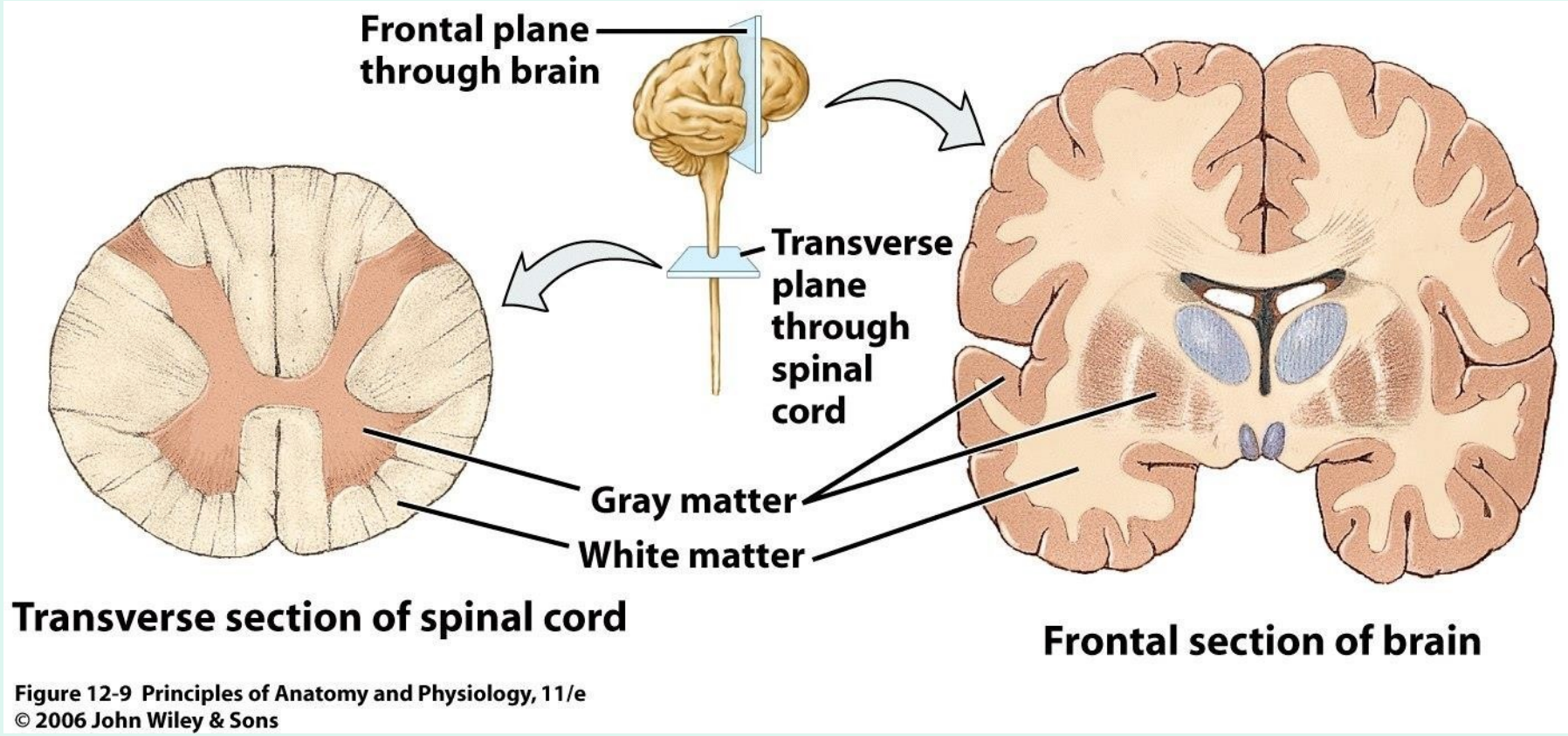
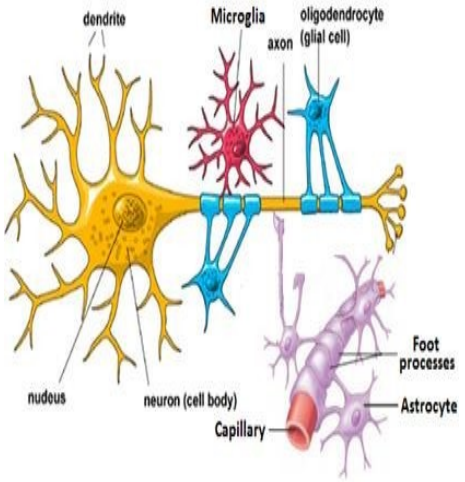


Figure 12-9 Principles of Anatomy and Physiology, 11/e

- Gray matter consists of cell bodies, unmyelinated axons, dendrites, and glial cells
- White matter consists of myelinated axons

Glia:

In the central nervous system there are four types of glial cells:



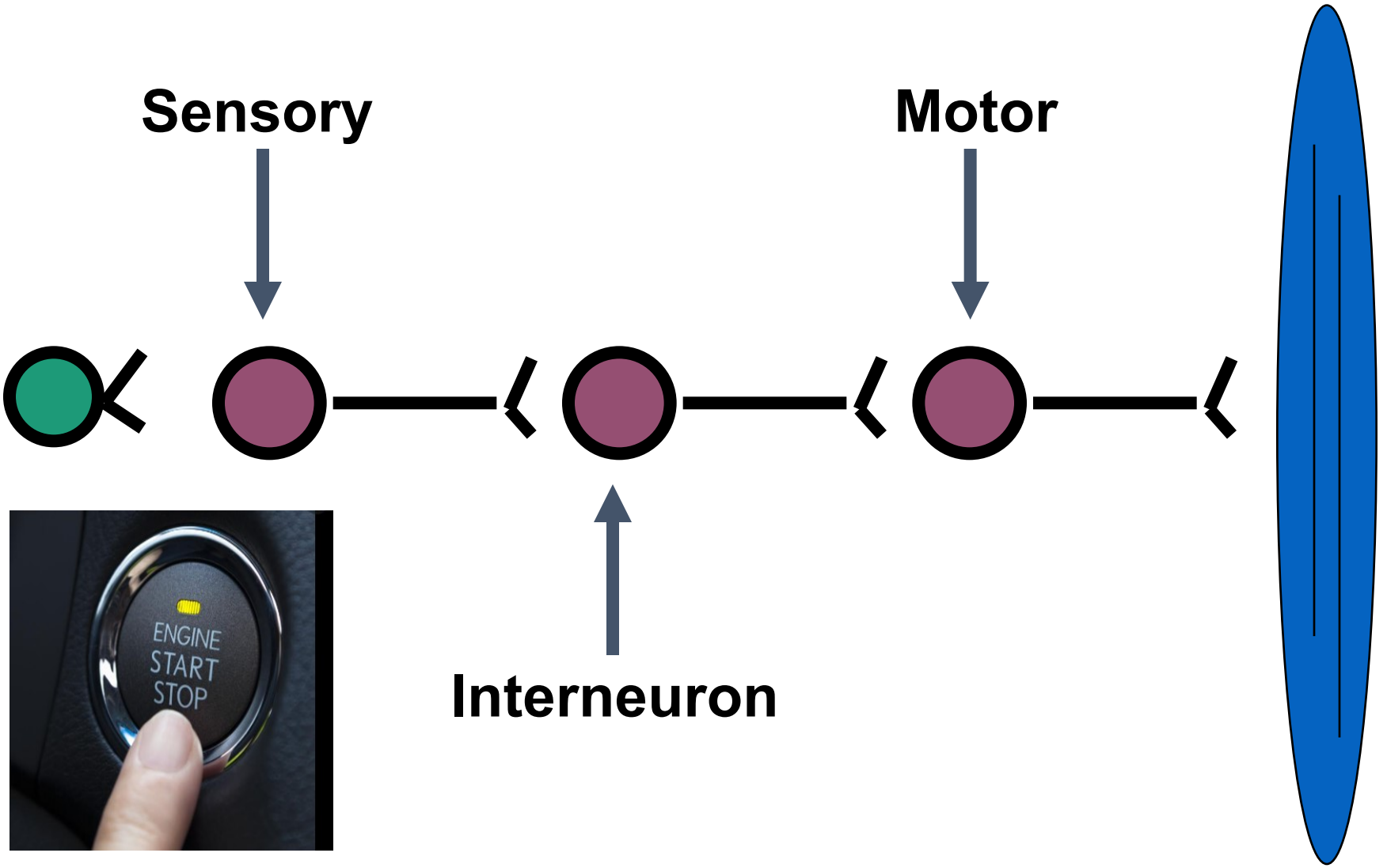
a. **Blood-brain barrier (BBB)**
b. **Envelop synapses and the surface of nerve cells.**

a. **They produce substances that are trophic to neurons.**
b. **Maintain the appropriate concentration of substances in the brain interstitial fluid.**
c. **Provide neurons with lactate as an energy source.**
d. **Synthesize neurotransmitter precursors for neurons.**

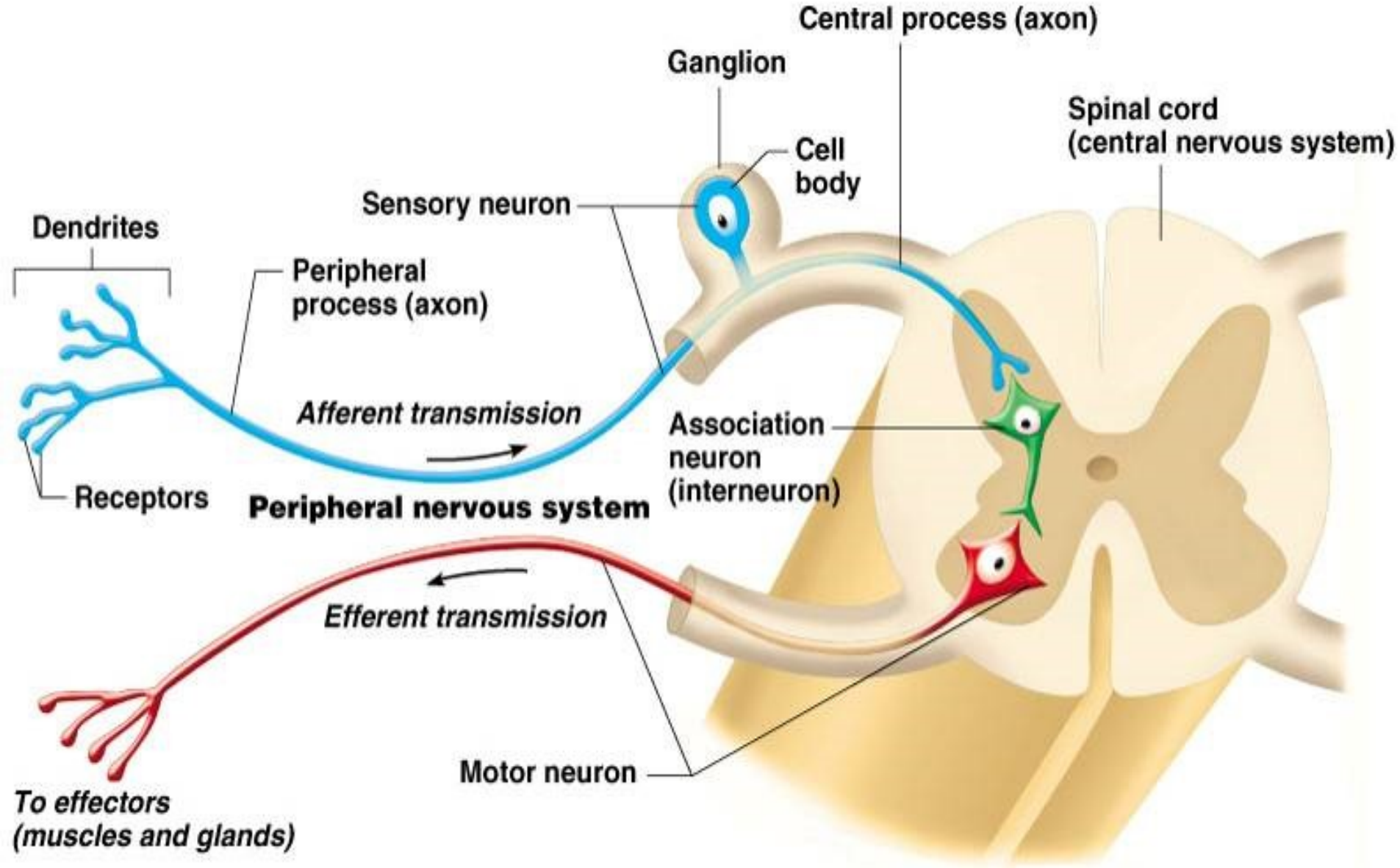
Classification of neuron according to function

- **Sensory (afferent) neurons**
  - Carry impulses from the sensory receptors
    - Cutaneous sense organs
    - Proprioceptors – detect stretch or tension
- **Motor (efferent) neurons**
  - Carry impulses from the central nervous system
- **Interneurons (association neurons)**
  - Found in neural pathways in the central nervous system
    - Connect sensory and motor neurons

By function (connections)



Neuron Classification



Classification of nerve fibers:

]A] The fibers can be classified **according to their conduction velocity** into the following general types:

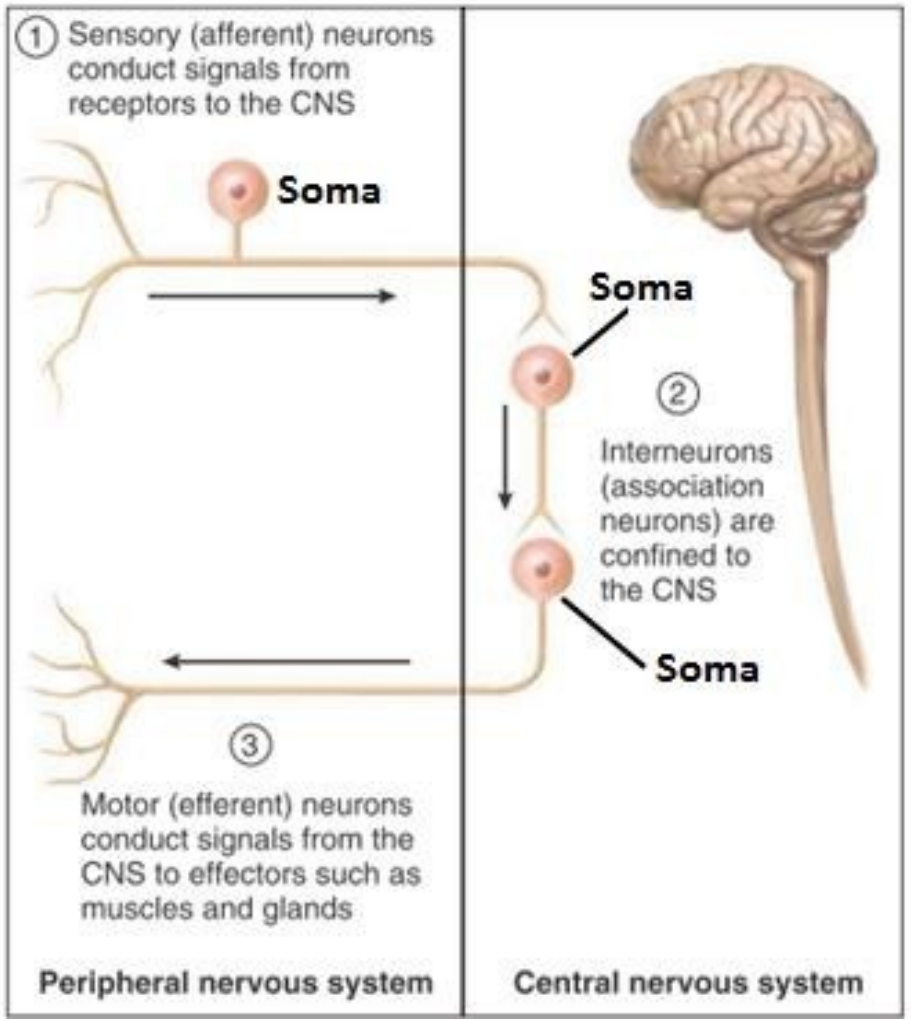
1. **Type A fibers: Myelinated**
   - **Alpha (α) fibers**
   - **Beta (β) fibers**
   - **Gamma (γ) fibers**
   - **Delta (δ) fibers**

2. **Type B fiber: Myelinated**

3- **Type C fibers: Unmyelinated**

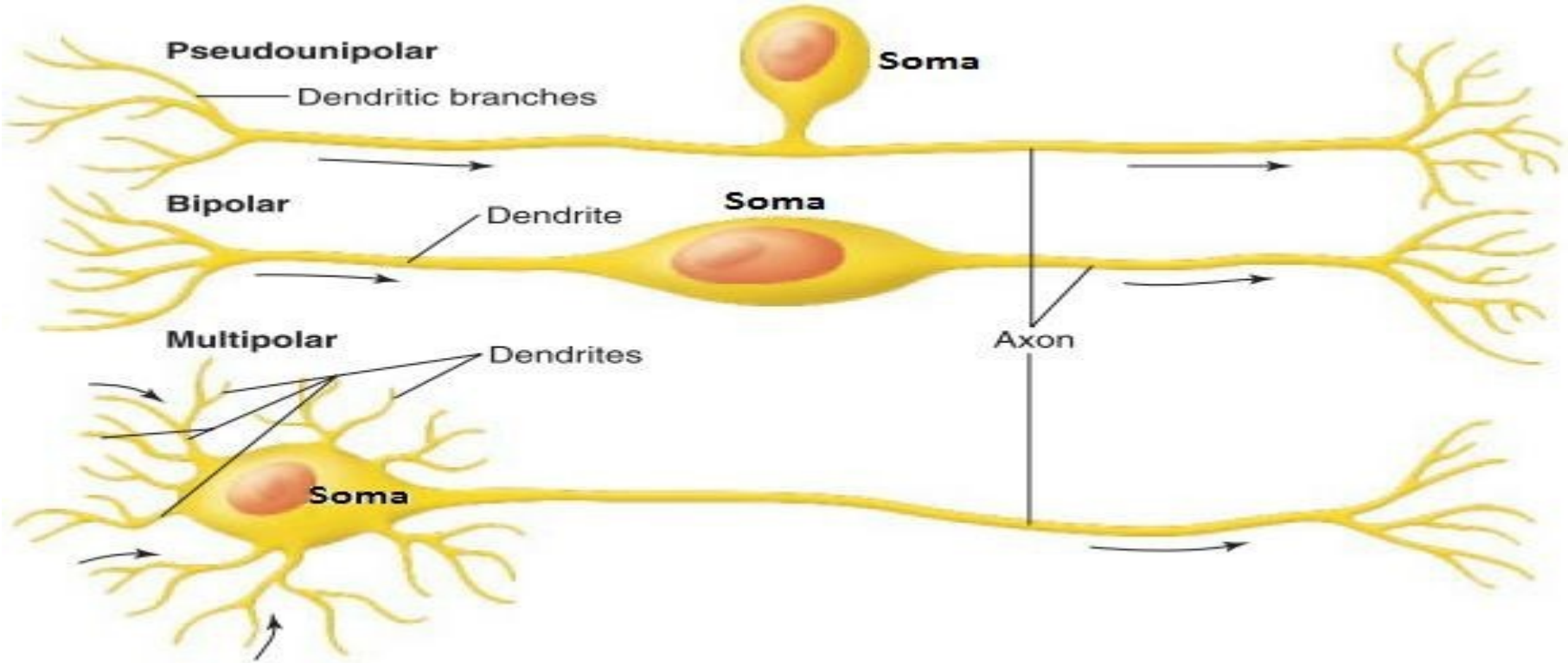
]B] The fibers can be classified **according to the direction in which they conduct impulses**.

- **Sensory,** or **Afferent‹**
- **Motor**, or **Efferent (somatic** and **autonomic‹(**
- **Interneurons**.



]C] The structural classification of neurons is based **according to the number of processes that extend from the cell body of the neuron**.

- **Unipolar neurons**
- **Bipolar neurons**
- **Multipolar neurons**

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