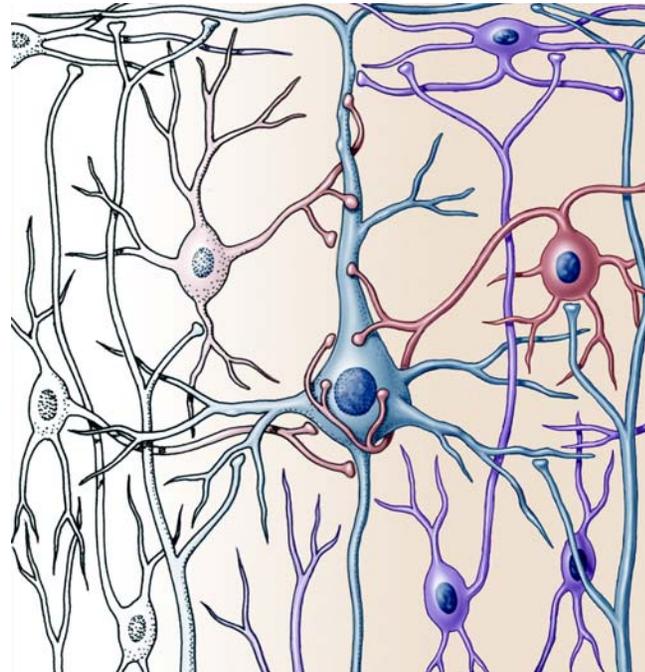


# HUMAN ANATOMY

Fifth Edition



## Chapter 13

### The Nervous System: Neural Tissue

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# Introduction

- Nervous and endocrine systems:
  - Control and adjust the activities of other systems.
- Shared characteristics:
  - Chemical communication with targeted tissues
  - Nervous system:
    - Relatively swift but brief responses
  - Endocrine:
    - Slower but they often last much longer

# An Overview of the Nervous System

- Two anatomical subdivisions:
  - *Central nervous system (CNS)*
    - Brain and spinal cord
    - Integrating, processing, and coordinating
    - Intelligence, memory, learning, and emotion
  - *Peripheral nervous system (PNS)*
    - Neural tissue outside the CNS
    - Provides sensory information to the CNS
    - Carries motor commands to peripheral tissues

# Subdivisions of the PNS

- The PNS is subdivided into two divisions.
  - The *afferent division* of the PNS brings sensory information to the CNS.
  - The *efferent division* carries motor commands to muscles and glands.
    - The efferent division is further divided into two divisions:
      - somatic nervous system (SNS)
      - autonomic nervous system (ANS)

# Subdivisions of the PNS

- Afferent division:
  - Receptors to the CNS
- The afferent division carries information from:
  - Somatic sensory receptors:
    - Skeletal muscles, joints, and the skin
  - Visceral sensory receptors:
    - Smooth muscle, cardiac muscle, and glands
  - Special sense organs:
    - Eye, nose, tongue, and ear

# Subdivisions of the PNS

- The efferent division begins inside the CNS and ends at an effector.
- The efferent division:
  - Somatic nervous system (SNS):
    - Controls skeletal muscle contractions.
    - May be voluntary or involuntary.
  - Autonomic nervous system (ANS):
    - Is also called visceral motor system.
    - Regulates smooth muscle, cardiac muscle, and glands.
    - Is involuntary.

# Nervous System Subdivisions Review

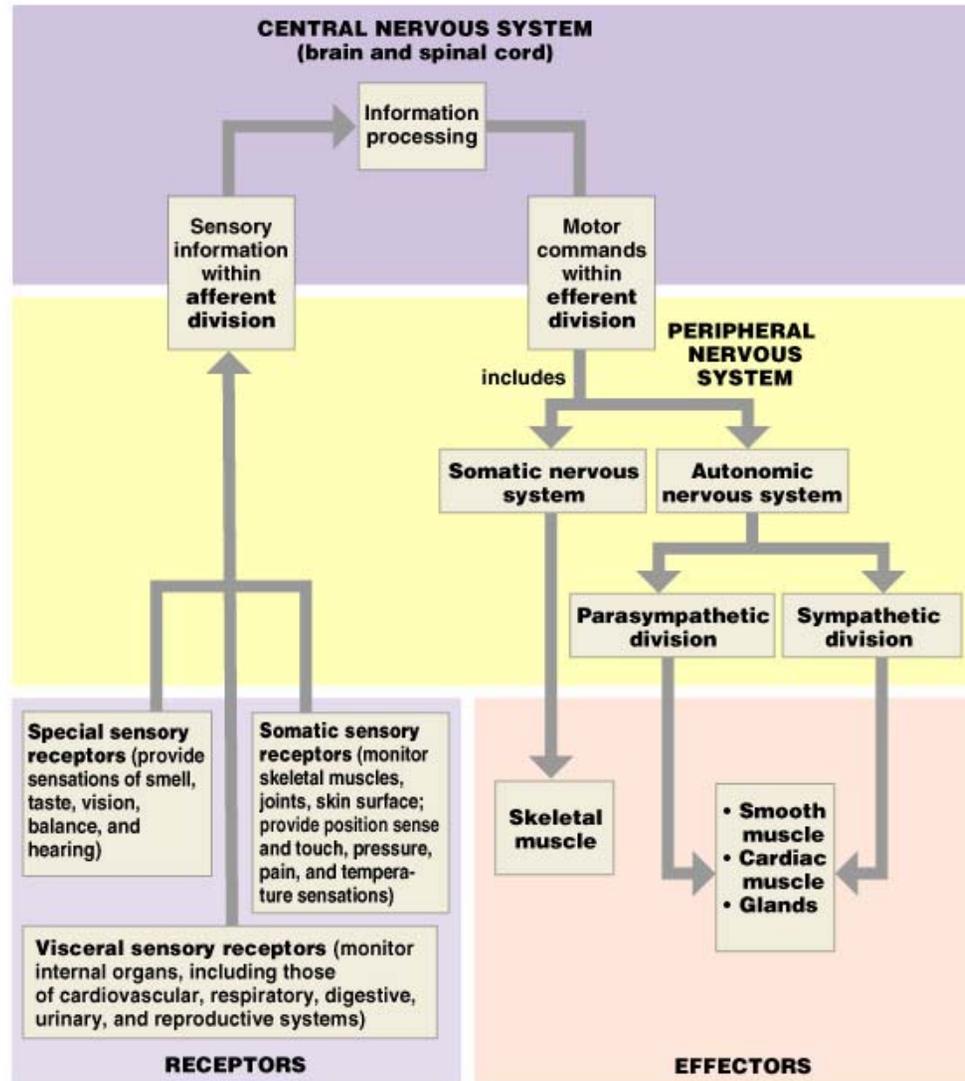


Figure 13.2 Nervous System

# Cellular Organization in Neural Tissue

- Neural tissue contains two distinct cell types:
  - Nerve cells, or neurons:
    - Are responsible for the transfer and processing of information in the nervous system.
  - Supporting cells, or neuroglia:
    - Isolate the neurons.

# Typical Neuron

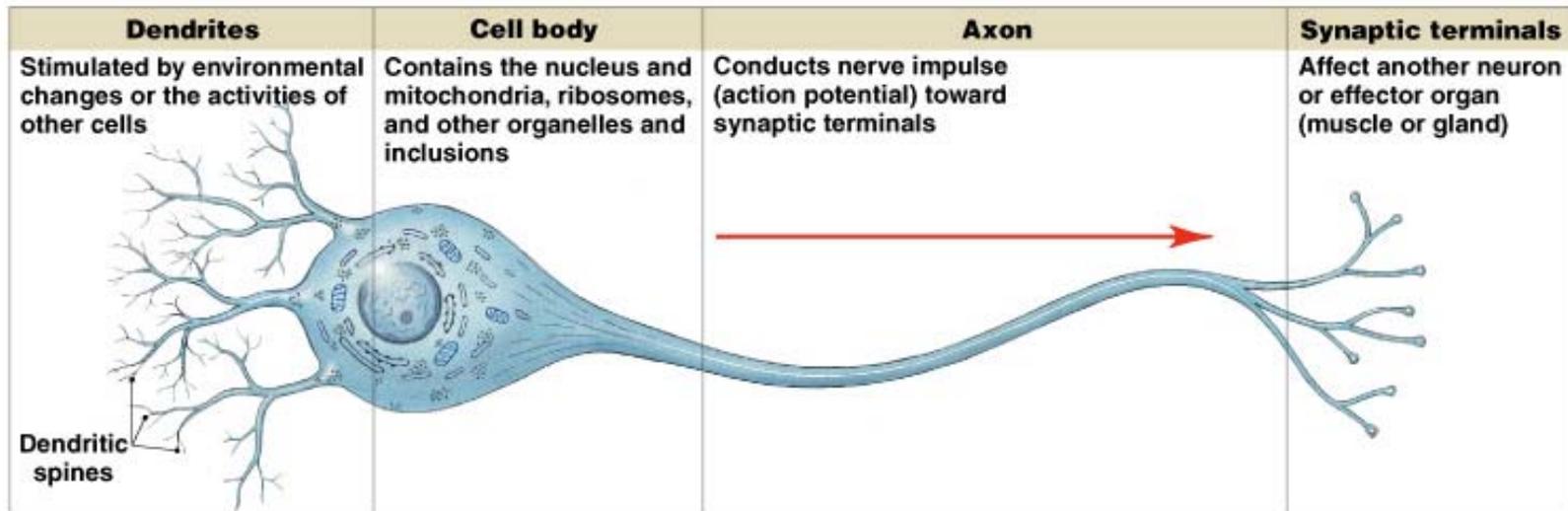


Figure 13.3 Neuron Structure

# Cellular Organization in Neural Tissue

- Neuroglia have many functions including:
  - Providing the framework for the neural tissue
  - Maintaining the intercellular environment
  - Acting as phagocytes
- 100 billion neuroglia, or glial cells
  - Roughly five times the number of neurons.

# Neuroglia

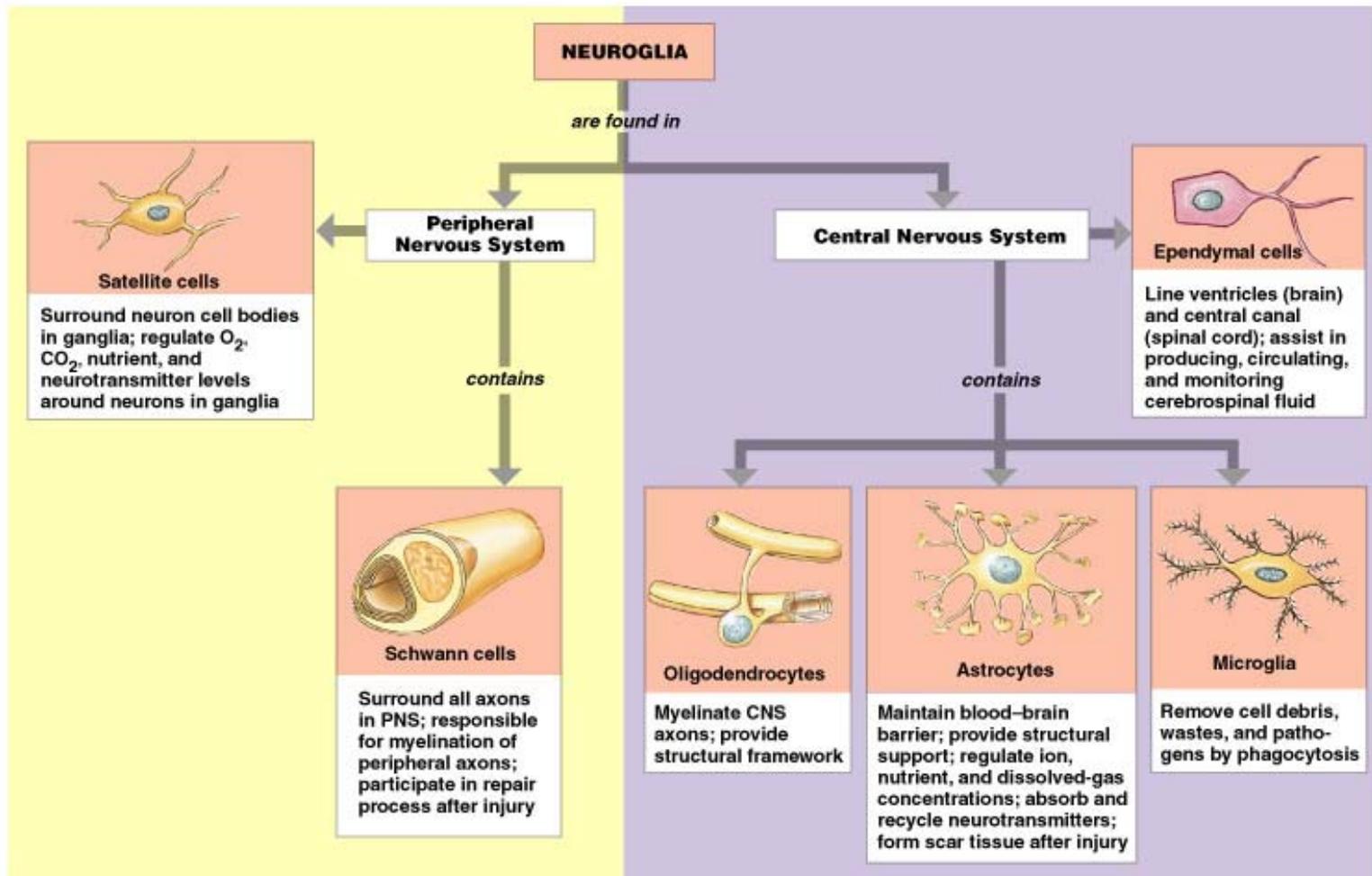


Figure 13.4 Classification of Neuroglia

# Neuroglia of the CNS

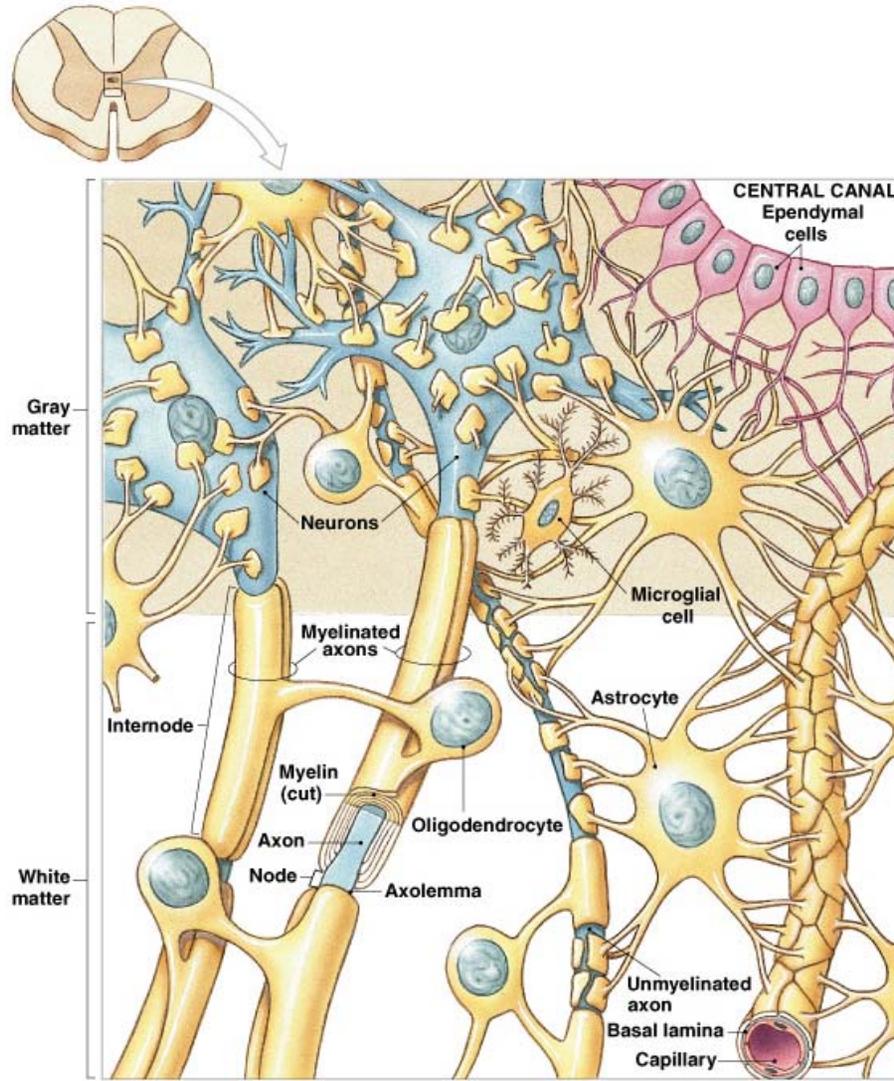


Figure 13.5 Histology of the CNS

# Astrocytes

- Are the largest and most numerous glial cells.
- Have a variety of functions:
  - Maintaining the blood–brain barrier.
  - Creating a three-dimensional framework for the CNS.
  - Performing repairs in damaged neural tissue.
  - Guiding neuron development.
  - Controlling the interstitial environment.

- Oligodendrocytes-myelinate axons in the CNS
  - Works like insulation making actions potentials travel down axons ~ 6 times faster
- Microglia-break down cellular waste and pathogens in the CNS
- Ependymal cells-with capillaries produce cerebral spinal fluid in the brain

# Neuroglia of the PNS: Satellite Cells

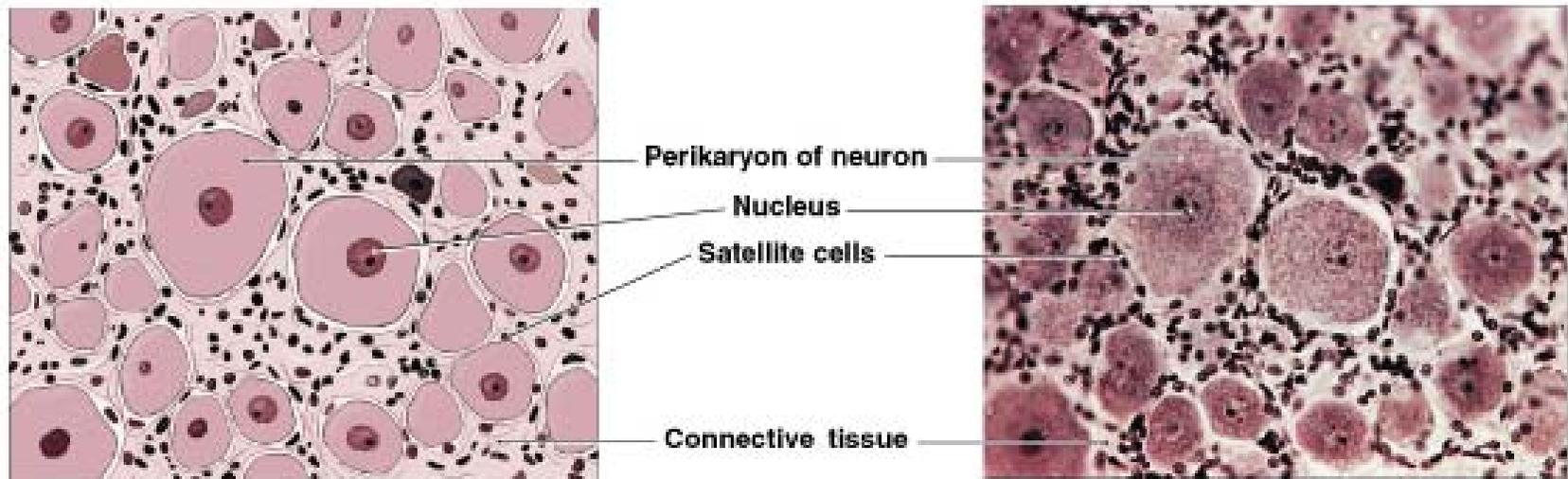


Figure 13.7 Satellite Cells and Peripheral Neurons

# PNS neuroglia

- Schwann cells-myelinate axons in the PNS
- Satellite cells-exchange waste/nutrients cell body & extracellular fluid

# Neuroglia of the PNS: Schwann Cells

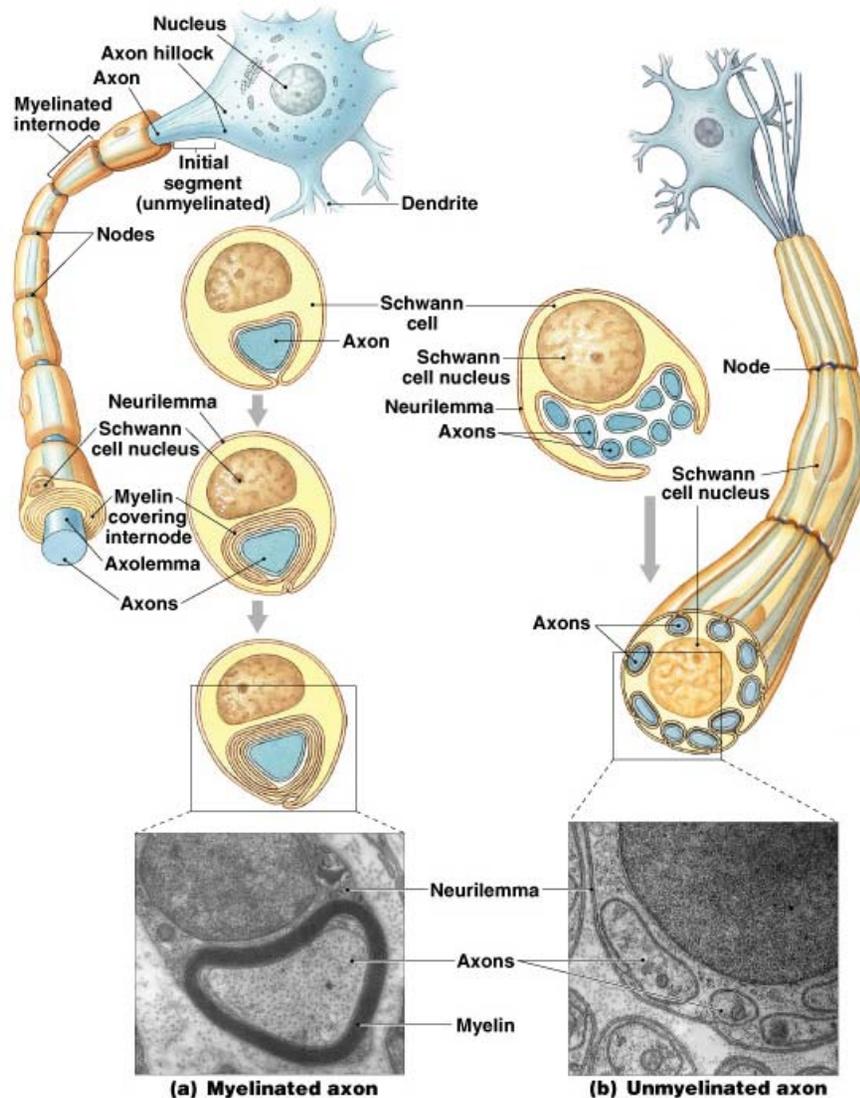


Figure 13.8 Schwann Cells and Peripheral Axons

# Neuron Structure

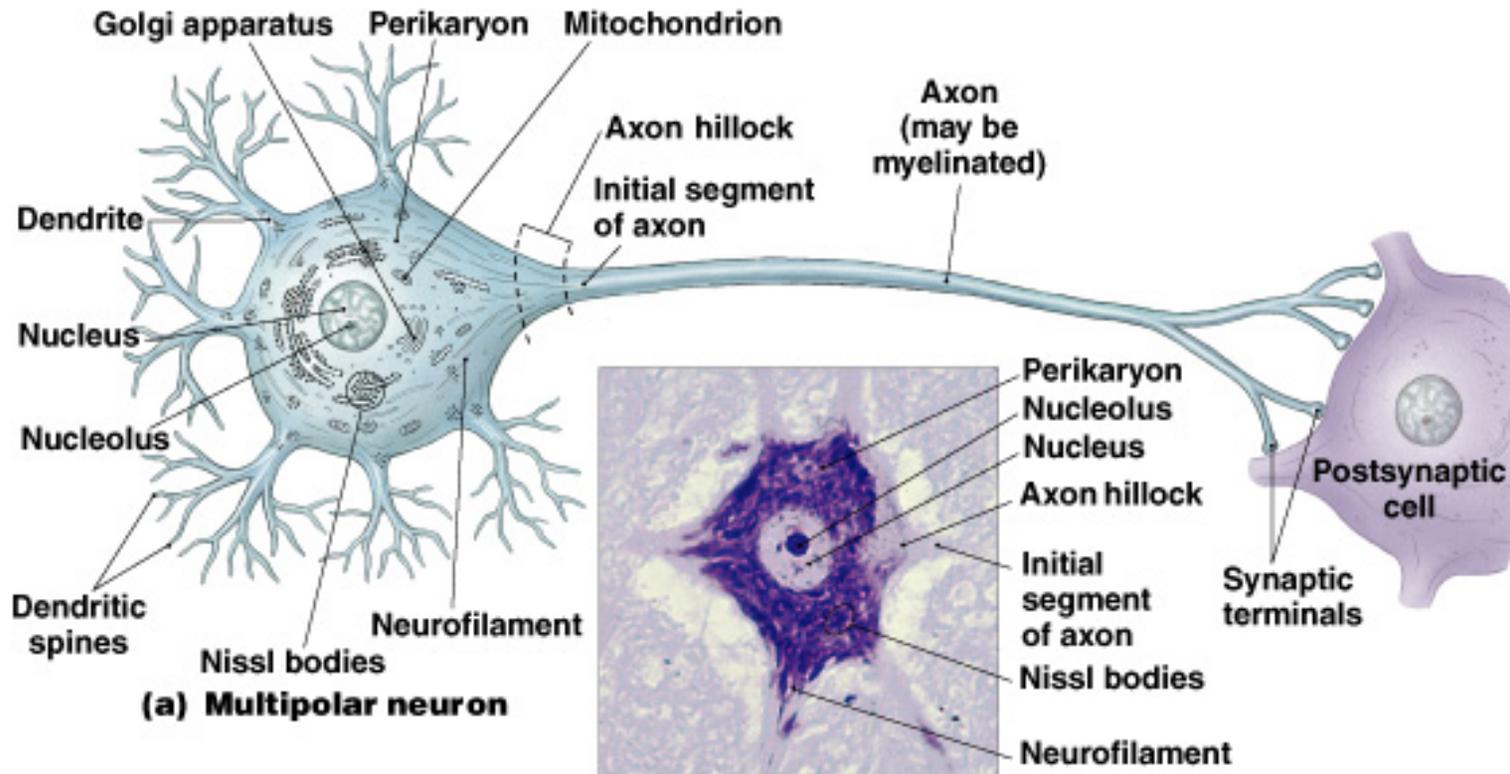
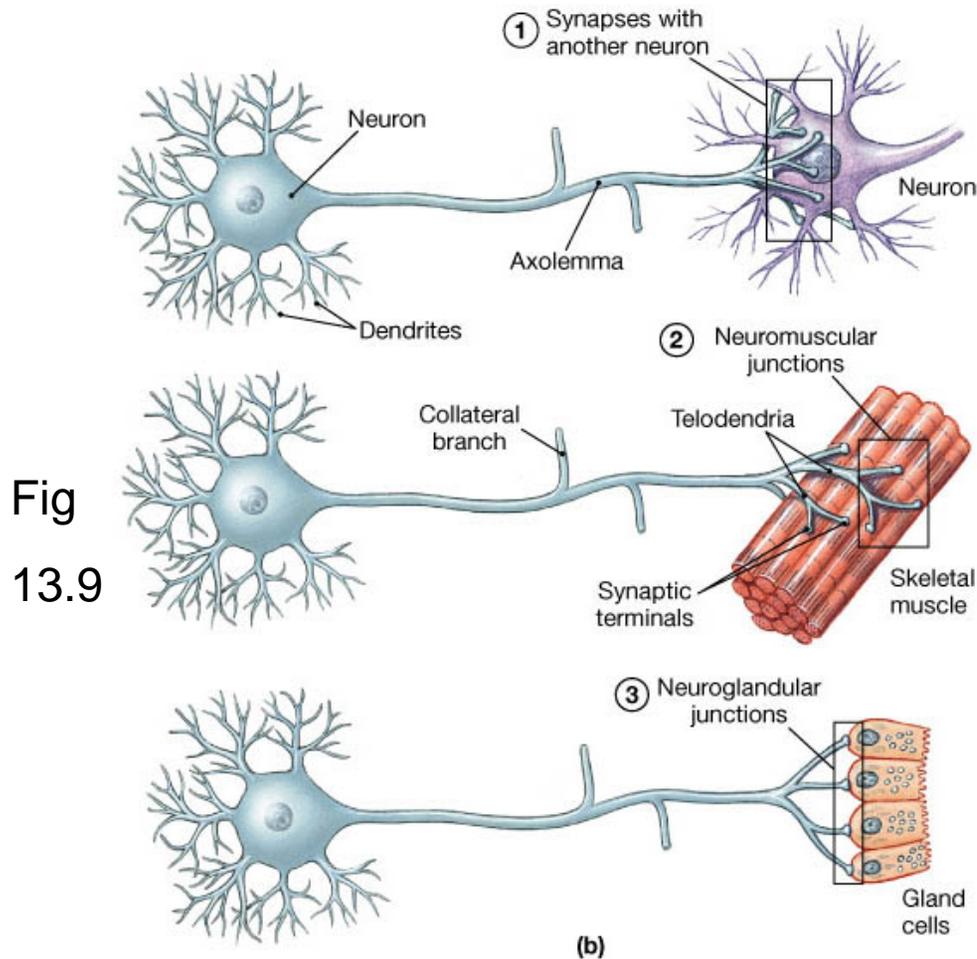


Figure 13.9a Anatomy of a Multipolar Neuron

- Neurons release neurotransmitters to signal other cells

Signaling within a neuron is electric



Signaling between a neuron & other cells is usually chemical

# Neuron Classification: Anatomical

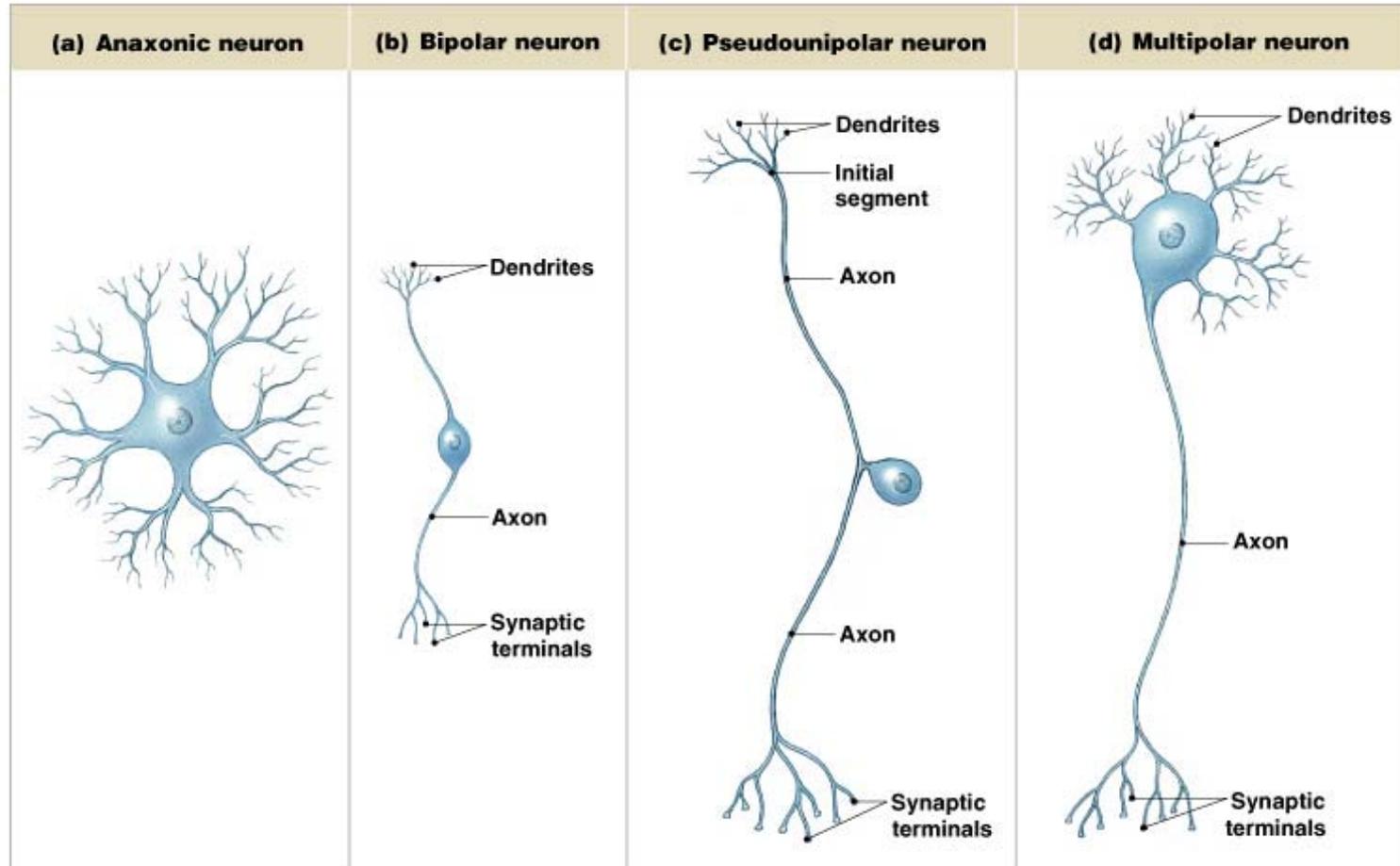


Figure 13.10 Structural Classification of Neurons

# Neuron Classification: Functional

- Neurons have three functional groups:
  - Sensory neurons:
    - Most are pseudounipolar neurons.
  - Motor neurons:
    - Most are multipolar neurons.
  - Interneurons or association neurons:
    - Most are multipolar neurons.

# Neuron Classification: Receptors

- Receptors are monitored by the sensory neurons:
  - Exteroceptors = external environment:
    - Touch, temperature, and pressure sensations
    - Special senses of sight, smell, and hearing
  - Proprioceptors = internal environment:
    - Position and movement of skeletal muscles and joints
  - Interoceptors = internal environment:
    - Digestive, respiratory, cardiovascular, urinary, and reproductive systems
    - Sensations of deep pressure and pain

# Neuron Classification: Functional

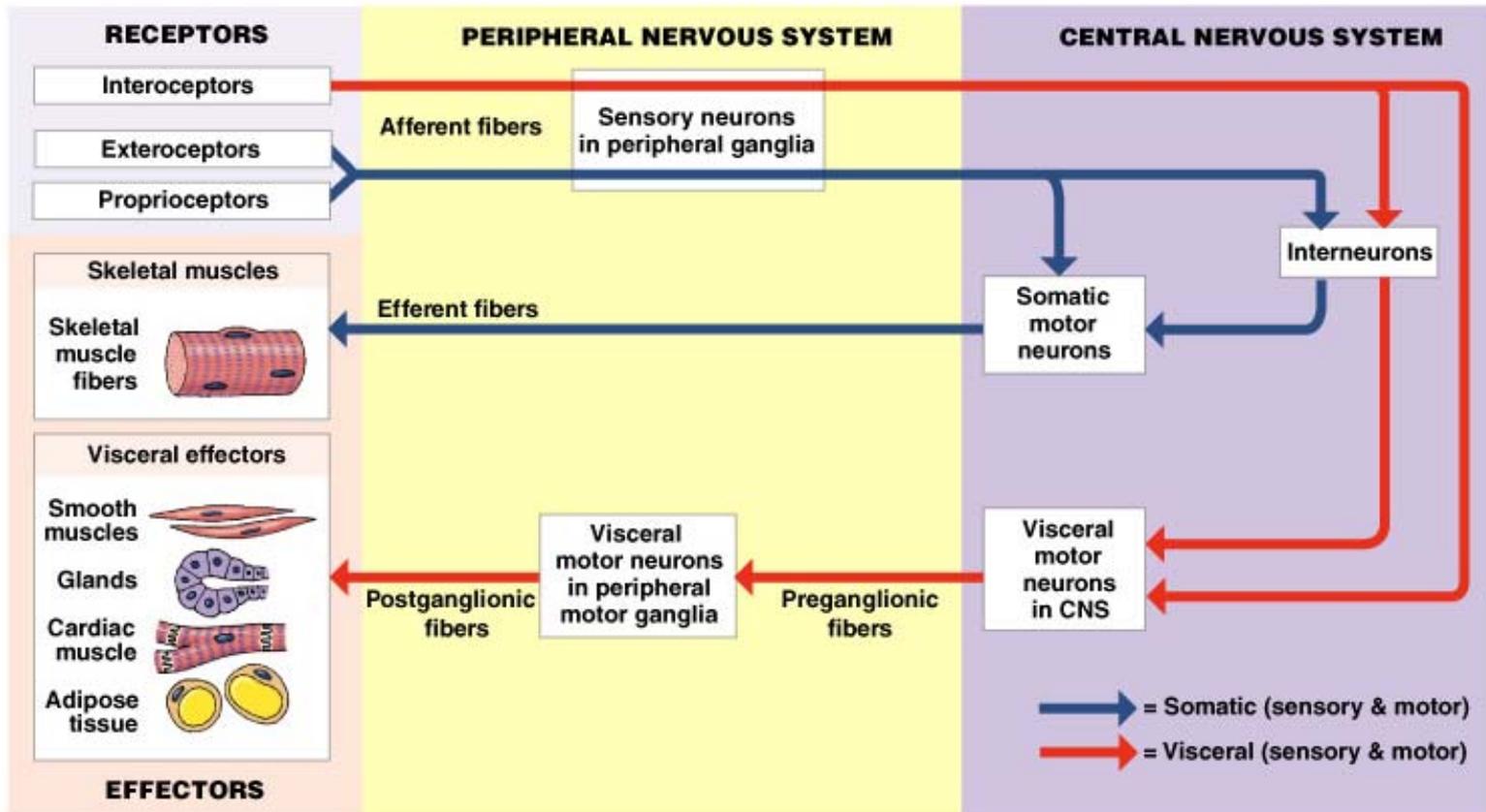


Figure 13.11 Functional Classification of Neurons

# Nerve impulse

- A neuron is electrically stimulated to threshold (summation @ axon hillock)
- At the threshold the cell membrane permeability to ions  $\text{Na}^+/\text{K}^+$  changes
- This creates an action potential
- Large myelinated axon sends signals at 300 mhp!

# The Chemical Synapse

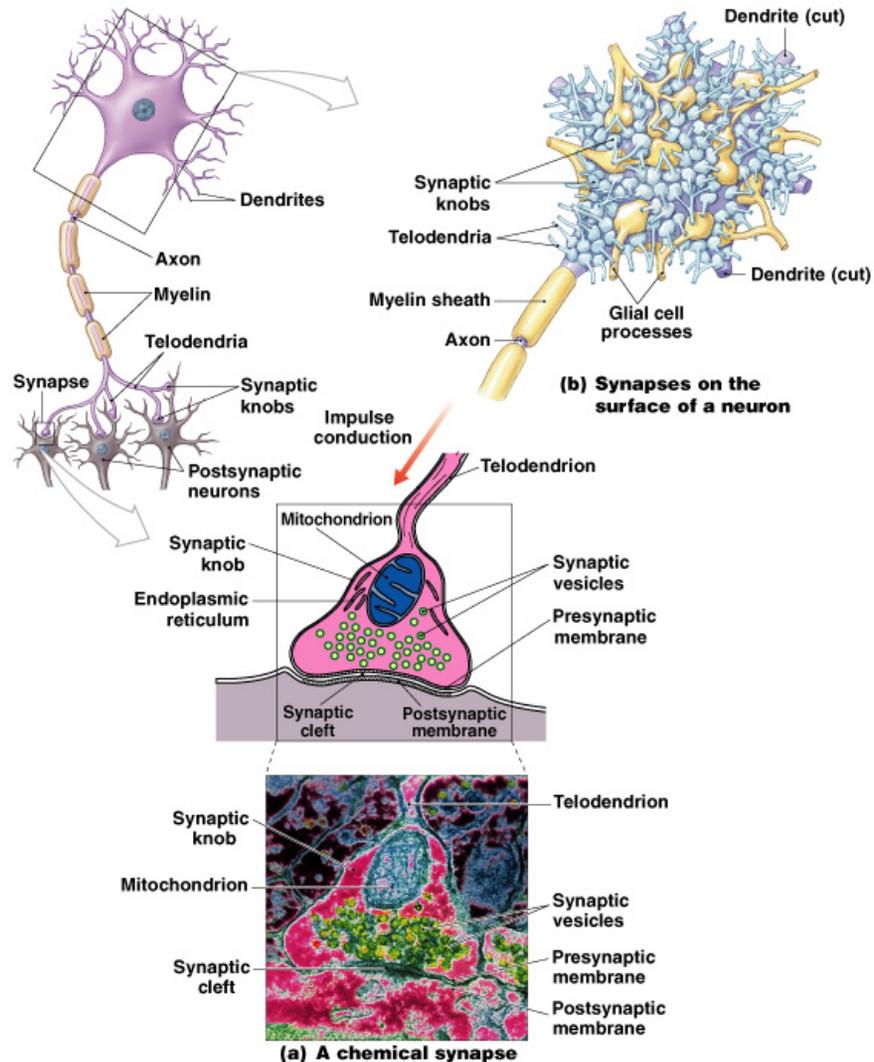


Figure 13.13a,b Structure of a Synapse

# Neuron Organization and Processing

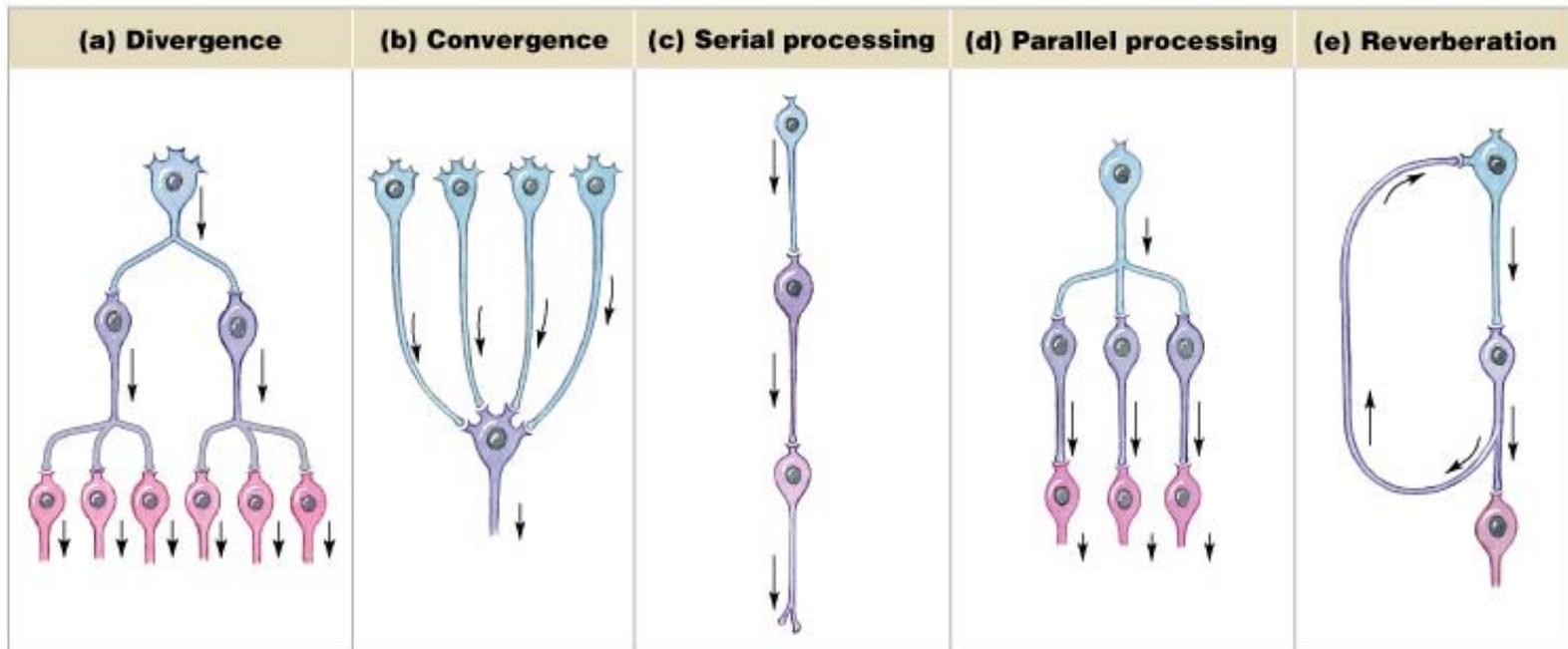


Figure 13.14 Types of Neuronal Circuits

# Anatomical Organization of the Nervous System

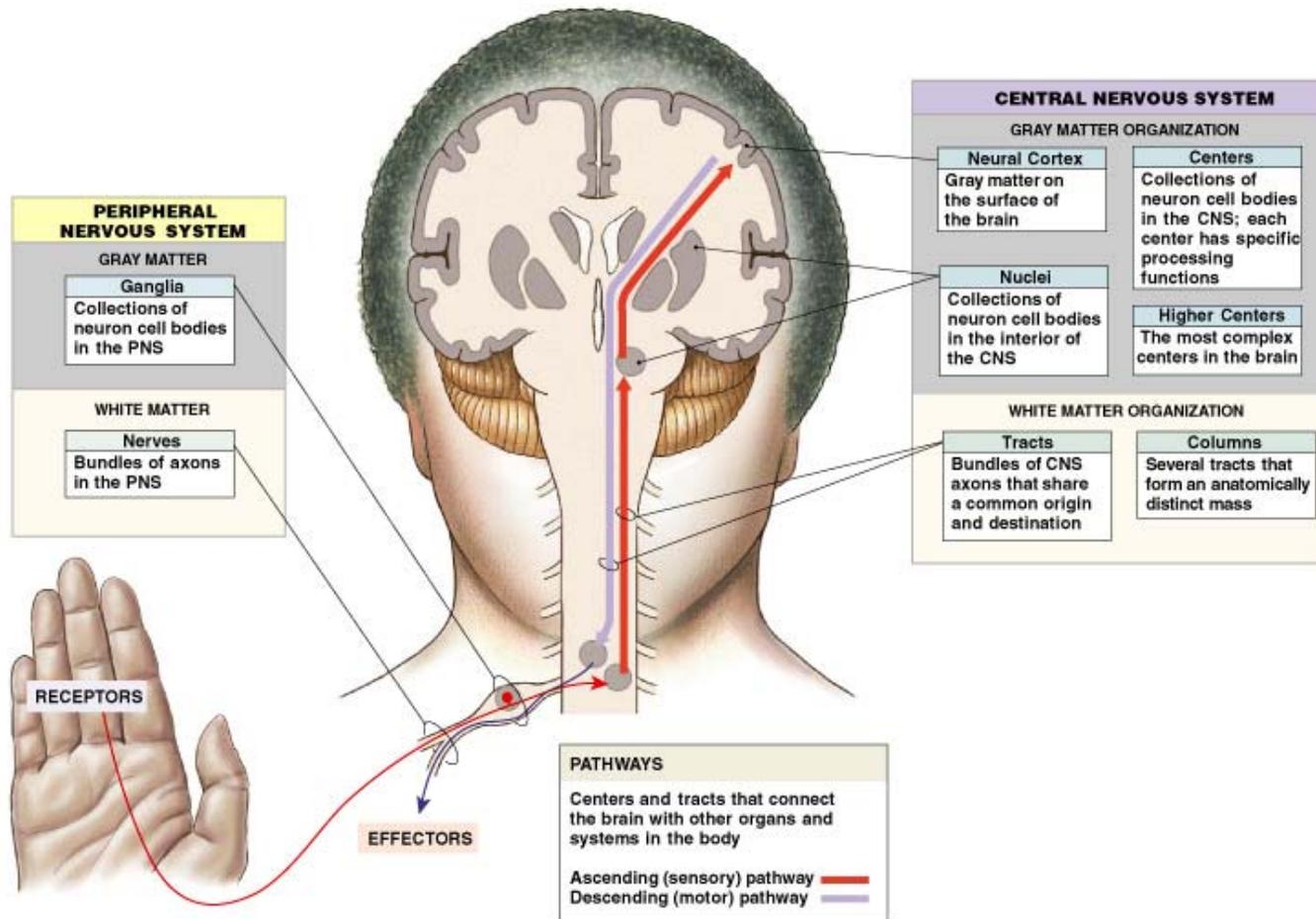


Figure 13.15 Anatomical Organization of the Nervous System