The Nervous System

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Organization

**CNS**
- Brain
- Spinal cord

**PNS**
- Cranial nerves
- Spinal nerves
- Ganglia
  ...everything else!

- Brain
- Spinal cord
- Peripheral nerve
Peripheral Nervous System

Central Nervous System

Sensory input

Motor neurons

Somatic

Autonomic

Sympathetic

Parasympathetic

Skeletal muscle

Smooth muscle, glands, cardiac muscle
Nervous system cells

- Neurons
- Neuroglia
Structure of a neuron

- cell body (soma)
- dendrites
- axon
- axon hillock
- myelin sheath
- nodes of Ranvier
- synapse
Parts of the neuron

- **Dendrites**
  - Processes
  - receive information
  - lose diameter with each branch

- **Soma**
  - the area of the neuron containing the nucleus

- **Nissl bodies**
  - polyribosomes surrounding the soma nucleus
Parts of neuron

- **Axon**
  - usually singular
  - Same diameter entire length
- **axon hillock**
  - transition from soma to axon
  - Site of synaptic integration
- **collaterol branches**
  - “right angle” branches off a main axon
  - maintain the same diameter
- **Myelin**
  - Sheath formed by fatty cells
Parts of neuron

- **Telodendria**
  - terminal branches on every axon
  - lead to individual target cells
  - never myelinated

- **Neurofibrils**
  - strands of protein used in “intra” axonal transport

- **Synaptic endbulbs**
  - enlargements at ends of telodendria
  - Contain vesicles with neurotransmitter
(a) Parts of a motor neuron

(b) Sections through a myelinated fiber

(c) Motor neuron
Classifications by structure

- **Multipolar**
  - Contain a single axon + 3 or more processes
  - Most common type
- **Unipolar** (pseudounipolar)
  - cell body sits on a stalk in the middle of one long axon
  - contains 2 parts
    - peripheral process with dendrites
    - central process
• **Bipolar**
  - one main dendrite + one main axon
Functional classification

• Sensory neurons (afferent)
  - Detect change in the environment
  - Send information to CNS

• Motor neurons (efferent)
  - Transmit information to muscles or glands from CNS

• Interneurons
  - Multipolar neurons located completely in CNS
  - Facilitate sensory and motor communication
  - Most numerous type of neuron = 99%
A Reflex Arc Shows How Neuron Types Work Together.

The afferent and efferent fibers often pass in the same nerve.
Neuroglia = “nerve glue”

- Astrocytes
- Ependymal cells
- Microglia
- Oligodendrocytes
- Schwann cells
Astrocytes

- Regulate microenvironment of neurons in CNS
  - Blood brain barrier
  - Buffer extracellular environment
    - Metabolize neurotransmitter substances and uptake K+
- Mechanical support for CNS tissues
Blood Brain Barrier

The blood–brain barrier (BBB)

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Ependymal cells

- Epithelium that lines CNS
- Specialized ependymal cells of choroid plexus secrete components of CSF
Microglia

- Phagocytes
- Remove cellular products when damage occurs
Myelin sheath

- Increases speed of conduction of action potential
  - Oligodendrocytes (CNS)
  - Schwann cells (PNS)
Oligodendrocytes
schwann cells
(neurolemmocytes)

- located in the PNS
- form myelin sheaths surrounding axons
- form "growth tube" for developing axons
Satellite cells (ganglionic gliocytes)

- located in the PNS
- insulate neuron cell bodies in ganglia
Terminology

- **Cluster of nerve cell bodies**
  - CNS = nucleus
  - PNS = ganglion

- **Bundle of axons**
  - CNS = tract
  - PNS = nerve
Terminology

- **Gray matter**
  - neuron cell bodies
  - dendrites
  - unmyelinated axons

- **White matter**
  - myelinated axons
  - neuroglia

In CNS