STRUCTURE OF NEURON AND NEUROGLIA

NERVOUS SYSTEM

• Has three overlapping functions
  – Sensory - receptors monitor changes (stimuli) and gathers information inside and outside the body
  – Integrative - processes and interprets sensory input, makes decisions
  – Motor - dictates a response by activating effector organs

NERVOUS TISSUE

• Nervous Tissue comprises of
  Neurons,
  Neuroglia,
  and blood vessels
• Neuron is the basic structural and functional unit of nervous tissue
• Neuroglia is the supporting or glial tissue that is 10-times more abundant in mammalian brain than neurons

NEURON

• Basic structural unit of the nervous system

• Specialized cells conduct electrical impulses along the plasma membrane

• Composed of:
  Body: Soma/Perikaryon
  Body Contains:
  Nucleus:
  Cytoplasmic organelles
  Inclusions
  Cytoskeletal components
  Processes:
  Axon and Dendrites
**Cytoplasmic Organelles**

- Nissel bodies
  - Polysomes and RER
  - More abundant in motor neurons
- Golgi complex (located near nucleus)
- Mitochondria (scattered diffusely cytoplasm)
- No centriole (non-capable of division)

**Inclusions**

- Melanin containing granule in CNS neuron and dorsal root sympathetic ganglia
- Lipofuscin granules in some neurons increase with age
- Lipid droplet present occasionally

**NUCLEUS**

- Diameter of nucleus varies from 3-18 um
- Proportional to the size of neuron
- Usually spherical
Cytoskeletal Components

- Neurofilaments
- Microtubules
- Microfilaments

Structure of Neuron and its organelles

**NUCLEUS**

- Diameter of nucleus varies from 3-18 um
- Proportional to the size of neuron
- Usually spherical
- Chromosomes are not compact
- Homogenous nucleoplasm
- Unable to divide
NISSL SUBSTANCE

- With basic aniline dyes
  - Cresyl violet & Toluidine blue
  - Chromophilic
- Present in soma
- Absent in axons
- Abundant in large cells
- Larger in motor than in sensory cells
- Electron microscope – Rough Endoplasmic Reticulum

NEURON PROCESSES - DENDRITES

- Extensively branching from the cell body
- Transmit electrical signals toward the cell body
- Function as receptive sites for receiving signals from other neurons
NEURON PROCESSES - AXONS

- Neuron has only one
- Impulse generator and conductor
- Transmits impulses away from the cell body
- No protein synthesis in axon

NEURON: MORPHOLOGICAL CLASSIFICATION

- **Unipolar**
- **Bipolar**
- **Multipolar**
  - Single axon & multiple dendrites
  - Most common type in men, e.g
  - Motor cortex, interneurons, …
- **Pseudounipolar**
  - Single process arises from body
  - Branches into an axon and dendrite, e.g
  - Present in spinal and cranial ganglia
NEUROGLIAL IN THE CNS

- Glial cells have branching processes and a central cell body
- Outnumber neurons 10 to 1
- Make up half the mass of the brain
- Can divide throughout life

Astrocytes (macroglia)
- Protoplasmic & fibrous
- Helps establish & maintain blood-brain barrier

Oligodendrocytes (macroglia)
- Produce myelin
  - a sheath that wraps axons of several cells

Microglia (phagocytic cells)
- Several cells with multiple branching processes

Ependyma (epithelial cells with cilia)
- Contributes for choroids plexus formation
Astrocytes (a) and Microglia (b)

(a) Astrocytes: processes extend between neurons and capillaries. Nourish neurons, maintain ionic concentration surrounding neurons; take up neurotransmitter; aid neuronal growth and synapse formation in developing neural tissue.

(b) Microglia: phagocytes that engulf and remove invading organisms and dead or damaged neural tissue.

Ependymal cells (c) and Oligodendrocytes (d)

(c) Ependymal cells: line the central hollow portions of the CNS; ventricles of the brain, central canal of spinal cord. Cells aid circulation of cerebral spinal fluid.

(d) Oligodendrocytes: form the myelin sheath surrounding neuronal processes in white matter of CNS.
PNS NEUROGLIA

- **Satellite Cells**
  - Found in ganglia, around nerve cell body
  - Functions as exchange of nutrients and waste

- **Schwann Cells (neurolemmocytes)**
  - Flattened cell produce myelin sheath in PNS
    - ... that surround axons
    - ... only associated with a single axon
  - Forms myelinated or unmyelinated coverings over neurons

NEURON SMEAR AT LOW POWER
NEURON SMEAR AT HIGH POWER

ELECTRON MICROGRAPH E: NEURON
NEURON

SATELLITE CELLS: SURROUNDING GANGLIA

SATELLITE CELLS: SURROUNDING GANGLIA

Satellite cell
Sensory neuron cell body

Satellite Cells (400x)
This neuron supports the neurons in a ganglion. This is a slice of the dorsal root ganglion.
OLIGODENDROGLIA