Nervous System 1

Learning Objectives
1. Understand the general organization of the nervous system.
2. Diagram the structure and major parts of a neuron.
3. Distinguish between different types of neurons.
4. Define and distinguish between terms for nervous system structures.
5. Learn the components of a basic neural pathway: the reflex arc.
6. Identify the types of glial cells found in the CNS and PNS.

Nervous System functions:
- communication
- information processing and integration
- control of body functions

A. Components of the Nervous System

<table>
<thead>
<tr>
<th>Central Nervous System (CNS)</th>
<th>Peripheral Nervous System (PNS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>brain</td>
<td>nerves</td>
</tr>
<tr>
<td>spinal cord</td>
<td>ganglia</td>
</tr>
<tr>
<td>neurons</td>
<td>sensory receptors</td>
</tr>
<tr>
<td>- functional cells of the nervous system</td>
<td></td>
</tr>
<tr>
<td>- excitable cells: produce action potentials</td>
<td></td>
</tr>
</tbody>
</table>

Neurons use electrical signals (action potentials) to transmit information within the cell and chemical signals (neurotransmitters) to transmit information between cells.

Functional types of neurons:
- sensory (afferent) neurons - input information to CNS from sensory receptors
- motor (efferent) neurons - output from CNS to effectors (e.g., muscle)
- interneurons - entirely within the CNS, information processing

B. Organization of the Nervous System

<table>
<thead>
<tr>
<th>CNS</th>
<th>PNS</th>
<th>Autonomic (ANS)</th>
<th>Enteric (ENS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>brain</td>
<td>Somatic (SNS)</td>
<td>sensory visceral</td>
<td></td>
</tr>
<tr>
<td>spinal cord</td>
<td>sensory</td>
<td>motor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>motor</td>
<td>sympathetic division</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>parasympathetic division</td>
<td></td>
</tr>
</tbody>
</table>

C. Nervous Tissue

1. Neuron Structure
   a. cell body
   b. dendrites
   c. axon
      - axon hillock
      - axon collaterals
      - axon terminals - form synapses with other neurons or effector cells
        - synaptic end bulbs
        - synaptic vesicles
        - contain neurotransmitter molecules (e.g., acetylcholine, ACh)

2. Structural Types of Neurons
   a. multipolar - motor neurons and interneurons
   b. bipolar - some special sensory neurons (e.g., retina)
   c. unipolar - most sensory neurons
3. Groupings of Neurons
- nerve - bundle of axons in the PNS
- tract - bundle of axons in the CNS
- ganglion - collection of neuron cell bodies in the PNS
- nucleus - collection of neuron cell bodies in the CNS
- plexus - nerve network in the PNS

D. Reflex Arc – a basic neural pathway
1. sensory receptor
2. sensory neuron
3. integrating center (CNS)
4. motor neuron
5. effector

E. Neuroglia (Glial cells)
- supporting cells of the nervous system
  - CNS
    1. astrocytes - supportive cells: structural, metabolic, blood-brain barrier
    2. oligodendrocytes - myelin sheath in CNS, no neurolemma
    3. microglia - phagocytes, immune function
    4. ependymal cells - cerebrospinal fluid (CSF) production
  - PNS
    5. Schwann cells - myelin sheath in PNS, neurolemma around PNS axons
    6. satellite cells - supportive cells in PNS ganglia

F. Gray Matter and White Matter in the CNS
- gray matter - contains cell bodies, dendrites, unmyelinated axons
  - central region of spinal cord
    cortex of cerebrum and cerebellum, deeper nuclei in the brain
    → functions to receive and process information, integration
- white matter - mostly myelinated axons
  - surrounds gray matter of the spinal cord
    tracts of axons in the brain
  → functions to transmit signals rapidly over longer distances in the CNS

Study Questions
1. Outline the major divisions and subdivisions of the nervous system.
2. What structures comprise the central nervous system (CNS)?
3. What structures are found in the peripheral nervous system (PNS)?
4. Distinguish between the following pairs of terms:
   - nerve / neuron
   - tract / nerve
   - sensory neuron / motor neuron
   - axon / dendrite
   - gray matter / white matter
   - somatic / autonomic
   - nucleus / ganglion
   - receptor / effector
   - sympathetic / parasympathetic
5. Diagram a simple reflex arc, label the five components of the reflex arc, and show the direction of information flow.
Nervous Tissue

6. Describe the general structure and components of a neuron including:
   • cell body  • dendrites  • axon  • axon terminals

7. What are Nissl bodies and where are they found?

8. Differentiate between the three major structural types of neurons (multipolar, bipolar, and unipolar) and give an example of where each type is found.

9. Describe the general structure and function of the six types of glial cells (neuroglia) and identify where they are found in the nervous system (CNS or PNS):
   • astrocytes  • microglia  • oligodendrocytes  • ependymal cells
   • Schwann cells  • satellite cells

10. What is the neurolemma and why is it important?

11. Describe the structure of the myelin sheath and explain its function.