Chapter 7: The Nervous System

I. Organization of the Nervous System

Objectives:
- List the general functions of the nervous system
- Explain the structural and functional classifications of the nervous system
- Define central nervous system and peripheral nervous system, and list the major parts of each.

A. Sensory input, integration and motor output

B. Structural classification
   1. Central nervous system (CNS)
   2. Peripheral nervous system (PNS)

C. Functional classification
   a. Sensory (afferent) division of the PNS
   b. Motor (efferent) division of the PNS
      i. Description
      ii. Somatic nervous system
      iii. Autonomic nervous system

II. Nervous Tissue: Structure and Function

Objectives:
- State the function of neurons and neuroglia.
- Describe the general structure of a neuron, and name its important anatomical regions.
- Describe the composition of gray matter and white matter.
- List the two major functional properties of neurons.
- Classify neurons according to structure and function.
- List the types of general sensory receptors, and describe their functions.
- Describe the events that lead to the generation of a nerve impulse and its conduction from one neuron to another.
- Define *reflex arc*, and list its elements.

A. Supporting cells
   1. Definition & functions of glia
   2. Types of glia
      a. Astrocytes
      b. Microglia
      c. Ependymal
      d. Oligodendrocytes
      e. Schwann cells

B. Neurons
   1. Anatomy
      a. Cell body & related structures
      b. Dendrites
      c. Axon & related structures
      d. Synapse
      e. Myelin
      f. White matter and gray matter
2. Classification

   a. Functional classification

      i. Sensory (afferent) neurons

         a) Function

         b) Receptors

         c) General senses (sensory receptors in the skin, muscles & tendons)

      ii. Motor (efferent) neurons

      iii. Interneurons (association neurons)

   b. Structural classification

3. Physiology

   a. Nerve impulse

      i. Irritability & conductivity

      ii. Ions that maintain the resting potential

      iii. How stimuli cause local depolarizations

      iv. Graded potentials and action potentials

      v. How repolarization occurs
vi. Saltatory conduction

vii. Synaptic communication

b. Reflexes

i. Definition of reflex and reflex arc

ii. Somatic reflex vs. autonomic reflex

iii. Elements of a reflex arc

iv. Patellar reflex

v. Two neuron vs. three neuron reflexes

III. Central Nervous System

Objectives:
- Identify and indicate the functions of the major regions of the cerebral hemispheres, diencephalon, brain stem, and cerebellum on a human brain model or diagram.
- Name the three meningeal layers, and state their functions.
- Discuss the formation and function of cerebrospinal fluid and the blood-brain barrier.
- Compare the signs of a CVA with those of Alzheimer’s disease; of a contusion with those of a concussion.
- Define EEG, and explain how it evaluates neural functioning.
- List two important functions of the spinal cord.
- Describe spinal cord structure.

A. Functional anatomy of the brain
   1. General features
2. Cerebral hemispheres
   a. Physical characteristics

   b. Some functions of the cerebral lobes
      i. Parietal lobe:
      ii. Occipital lobe:
      iii. Temporal lobe:
      iv. Frontal lobe:

   c. Speech centers
      i. Broca’s area
      ii. Speech area

   d. Arrangement of gray and white matter

3. Diencephalon
   a. General functions
   b. Thalamus
   c. Hypothalamus

   d. Epithalamus

4. Brain stem
   a. General functions
   b. Midbrain
c. Pons

d. Medulla oblongata

e. Reticular formation

5. Cerebellum
   a. Physical structure
   
   b. Functions

B. Protection of the central nervous system
   1. Meninges
      a. Dura mater
      
      b. Arachnoid mater
      
      c. Pia mater
   
   2. Cerebrospinal fluid
      a. Composition and formation of CSF
      
      b. Movement and pathway of CSF
   
   3. Blood-brain barrier
      a. Function & importance
C. Brain dysfunctions

1. Traumatic brain injuries
   a. Concussions vs. contusions
   b. Intracranial hemorrhage and cerebral edema

2. Cerebrovascular accidents
   a. Causes
   b. Aphasias
   c. Prognosis
   d. Transient ischemic attacks

D. Spinal cord

1. Physical structure

2. Spinal nerves

3. Gray matter of the spinal cord and spinal roots
   a. Dorsal horns and dorsal roots
   b. Dorsal root ganglia
   c. Ventral horns and ventral roots
4. White matter of the spinal cord

IV. Peripheral Nervous System

Objectives:
- Describe the general structure of a nerve.
- Identify the cranial nerves by number and name, and list the major functions of each.
- Describe the origin and fiber composition of (a) ventral and dorsal roots, (b) the spinal nerve proper, and (c) ventral and dorsal rami.
- Discuss the distribution of the dorsal and ventral rami of spinal nerves.
- Name the four major nerve plexuses, give the major nerves of each, and describe their distribution.
- Identify the site of origin, and explain the function of the sympathetic and parasympathetic divisions of the autonomic nervous system.
- Contrast the effect of the parasympathetic and sympathetic divisions on the following organs: heart, lungs, digestive system, blood vessels.

A. Structure of a nerve

B. Cranial nerves

1. Naming and numbering conventions

2. Mixed, sensory and motor cranial nerves

C. Spinal nerves and nerve plexuses

1. Rami

2. Ventral rami of thoracic spinal nerves

3. Ventral rami of cervical, lumbar and sacral spinal nerves

4. Plexuses
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a. Cervical plexus

b. Brachial plexus

c. Lumbar plexus

d. Sacral plexus

D. Autonomic nervous system

1. Function and importance

2. Somatic and autonomic nervous systems compared
   a. Location of cell bodies and numbers of neurons
   b. Sympathetic and parasympathetic divisions of the ANS

3. Anatomy of the parasympathetic division

4. Anatomy of the sympathetic division

5. Autonomic functioning
   a. Cholinergic (parasympathetic) vs. adrenergic (sympathetic) fibers
   b. Sympathetic division
      i. Physiological effects of sympathetic activation
      ii. Cause of sympathetic activation
iii. Importance of sympathetic activation

c. Parasympathetic division
   i. Physiological effects of parasympathetic activation
   ii. Importance of parasympathetic activation

V. Developmental Aspects of the Nervous System

Objectives:
- List several factors that may have harmful effects on brain development.
- Briefly describe the cause, signs, and consequences of the following congenital disorders: spina bifida, anencephaly, and cerebral palsy.
- Explain the decline in brain size and weight that occurs with age.
- Define senility, and list some possible causes.

A. Effects of maternal infection, drugs or radiation on fetal nervous development

B. Myelination in infants

C. Nervous system changes in the elderly
   1. Orthostatic hypotension
   2. Arteriosclerosis and senility
   3. Repeated head trauma (as in boxers)
   4. Effects of alcohol abuse