The Brain and Cranial Nerves
Student Objectives

Chapter 14 Textbook and Laboratory Manual

- Name the major regions of the brain and describe their functions
- Name the ventricles of the brain and describe their locations
- Name the connections between the ventricles
- List and describe the layers of protection and support for the brain
- Discuss formation, circulation and removal of cerebrospinal fluid
- Discuss the functions of cerebrospinal fluid
- Describe the anatomical differences between the medulla oblongata and the spinal cord
- Describe the location and functions of the medulla oblongata
- List the main components of the medulla oblongata and specify their functions
- Describe the location and functions of the pons
- List the main components of the pons and specify their functions
- Describe the location and functions of the cerebellum
- List the main components of the cerebellum and specify their functions
- Describe the location and functions of the mesencephalon
- List the main components of the mesencephalon and specify their functions
- Describe the location and functions of the diencephalon
- List the main components of the diencephalon and specify their functions
- Identify the major anatomical subdivisions of the cerebrum
- Specify the functions of the major anatomical subdivisions of the cerebrum
- Describe the locations and functions of the motor, sensory, and association areas of the cerebral cortex
- Discuss the relationship between the right and left cerebral hemispheres
- Explain the main functions of the limbic system
- List the main components of the limbic system and specify their functions
- Explain the primary functions of the cranial nerves
- Identify the 12 pairs of cranial nerves by name and roman numerals on models or diagrams
- State the function of each pair of cranial nerves

Terms for review:
- Recall the definitions of the following terms
  - Ganglia
  - Neurons
  - Nerves
  - Nerve fibers
  - Nerve tracts
  - Gray matter
  - White matter
  - Nuclei

Terms:
- Define the following terms
  - aphasia
  - cerebral lateralization
  - circadian rhythms

I. An introduction to the organization of the brain
   A. Functions of the brain
   B. Major regions of the brain
      1. brain stem
         a. medulla oblongata
         b. midbrain
         c. pons
      2. cerebellum
      3. diencephalon
         a. thalamus
b. hypothalamus
4. cerebrum

C. ventricles of the brain
1. lateral ventricles
   a. interventricular foramen (foramen of Monro)
   b. septum pellucidum
2. third ventricle
   a. cerebral aqueduct (mesencephalic aqueduct, aqueduct of the midbrain, aqueduct of Sylvius)
3. fourth ventricle
   a. central canal
   b. lateral apertures
   c. medial aperture

II. Protection and support of the brain
A. Cranial bones
B. Meninges
   1. dura mater
      a. endosteal layer (periosteal layer)
      b. dural sinuses
         i. superior sagittal sinus
      c. meningeal layer
   2. subdural space
   3. arachnoid mater
      a. subarachnoid space
      b. arachnoid villi
   4. pia mater
C. cerebral spinal fluid (CSF)
   1. functions
      a. differences between blood and CSF
   2. circulation
      a. choroid plexus
         i. ependymal cells
      b. arachnoid granulations
         i. arachnoid villi
D. blood supply to the brain
E. blood brain barrier
   1. astrocytes
   2. tight junctions
   3. areas where blood brain barrier not intact
      a. portions of hypothalamus
      b. posterior pituitary gland
      c. pineal gland
      d. choroid plexus

III. Anatomy of the Brain
A. Brain stem
   1. medulla oblongata
   2. pons
   3. midbrain
      a. superior colliculi
      b. inferior colliculi
B. Cerebellum (little brain)
   1. cerebellar hemispheres
   2. arbor vitae
3. cerebellar cortex

C. Diencephalon
1. thalamus
2. hypothalamus
   a. associated structures
      i. optic chiasm
      ii. pituitary gland
      iii. mammillary bodies
3. epithalamus
   a. pineal gland (body)

D. cerebrum
1. right and left cerebral hemispheres
2. Organization of cerebral gray and white matter
   a. cerebral cortex (cortical area)
   b. white matter
      i. mostly myelinated axons
         • association tracts – transmit in same hemisphere
         • commissures – transmit between the two hemispheres
         • projection tracts – ascending and descending tracts
      ii. corpus callosum
   c. nuclei
      i. basal ganglia
3. surface features of cerebrum
   a. lobes
      i. frontal lobe
      ii. parietal lobe
      iii. occipital lobe
      iv. temporal lobe
   b. gyrus
      i. precentral gyrus
      ii. postcentral gyrus
   c. sulcus
      i. central sulcus
      ii. lateral sulcus
   d. fissure
      i. longitudinal fissure
      ii. transverse fissure

IV. Physiology of the Brain
A. Brainstem
1. The medulla oblongata
2. The pons
3. The mesencephalon (midbrain)
   a. superior colliculi
   b. inferior colliculi
   c. red nucleus
   d. substantia nigra
4. Reticular formation
B. Cerebellum
C. The diencephalon
   1. Hypothalamus
      a. mammillary bodies
   2. Thalamus
      a. epithalamus
         i. pineal gland (pineal body)
D. The cerebrum
   1. basal nuclei (ganglia)
   2. functional areas of the cerebral cortex
      a. Motor and sensory areas of the cortex
         i. motor areas
            • primary motor cortex (primary motor area) – precentral gyrus
            • broca’s speech area (Broca area) – usually on left side only
         ii. sensory areas
            • primary somatosensory cortex – postcentral gyrus
            • primary auditory cortex
            • primary gustatory cortex
            • primary olfactory cortex - uncus
            • primary visual cortex
         iii. association areas
            • motor association area (premotor cortex)
            • somatosensory association area
            • visual association area
            • auditory association area
         iv. Integrative centers
            • General interpretive area (Wernicke’s area, agnostic area) – usually on left side only
               ◊ recognizes spoken words
               ◊ translates word into thoughts
            • Prefrontal cortex
            • Frontal eye field
V. Higher order functions
   A. The limbic system
      1. Functions
      2. Major structures
         a. Prefrontal cortex
         b. Hippocampus
         c. Hypothalamus
         d. Thalamus
         e. Amygdala
         f. Mammillary bodies
         g. Basal nuclei
   B. Memory
      1. Memories
      2. Memory trace (engram)
      3. Synaptic plasticity
      4. Types
         a. Fact (declarative) memory
         b. Skill (procedural) memory
      5. Classes
         a. Immediate memory
         b. Short term (primary) memory
i. Working memory
  c. Long term memory
6. Memory consolidation
7. Formation and storage
   a. Increased neurotransmitter release
   b. Facilitation / potentiation
   c. Formation of additional synaptic connections or neurotransmitter receptors
C. Consciousness and sleep
1. States of consciousness
   a. Conscious
   b. Unconscious
      i. Sleep
      ii. Coma
   c. Arousal
2. Brain waves: alpha, beta, theta, delta (slow) waves
3. Sleep
   a. Non-REM sleep: stages 1-4
   b. REM
VI. Cranial Nerves
A. Number and name of cranial nerves
   I. Olfactory: smell
   II. Optic
   III. Oculomotor: eye mover
   IV. Trochlear: pulley
   V. Trigeminal: three twins
   VI. Abducens: away
   VII. Facial
   VIII. Vestibulocochlear: vestibule of ear/equilibrium and cochlea of ear for hearing
   IX. Glossopharyngeal: tongue/throat
   X. Vagus: wanderer
   XI. Accessory
   XII. Hypoglossal: below the tongue
B. Ways to remember names
   1. On old Olympus towering top a friendly Viking grew vines and hops
   2. Oh, Oh, Oh, to touch and feel a good vein, ah heaven
   3. On occasion, our trusty truck acts funny – very good vehicle anyhow

OLD (OLfactory)
OPie (OPtic)
OCcasionally (OCulomotor)
TRies (TRochlear)
TRIGonometry (TRIGeminal)
And (Abducens)
Feels (Facial)
VEry (VEstibulocochlear)
GLoomy (GLOssopharyngeal)
VAGuE (VAGUs)
And (Accessory)
HYPOactive (HYPOglossal)
C. Sensory, motor, or mixed
   1. Some Say Marry Money, But My Brother Says Big Brains Matter More
D. Testing cranial nerve function
   1. DO NOT DO THE FOLLOWING TESTS
      a. V: touch cornea
      b. VII: taste
      c. IX, X
         i. Touch uvula
         ii. Taste

Clinical applications:
Agnosia
Alzheimer's disease
Amnesia (anterograde, retrograde)
Aphasia
Ataxia
Bell’s palsy
Cerebral palsy
Cerebrovascular diseases
Concussion
Contralateral neglect syndrome
Dyskinesias
Dyslexia
Encephalitis
Epilepsy
Huntington’s chorea
Hydrocephalus
Lobotomy
Meningitis
Migraine headache
Narcolepsy
Parkinson’s disease
Prospagnosia
Schizophrenia
Stroke (cerebrovascular accident)
Subdural hemorrhage