

CHAPTER 13

CENTRAL NERVOUS SYSTEM: Brain and Spinal Cord

CHAPTER OVERVIEW: This chapter provides an overview of the embryological development of the nervous system and detailed descriptions of the structure and function of the adult brain and spinal cord. Brain functions that are identified with a particular region of the brain are emphasized. Distinctions are drawn between gray and white matter and the specific functions of each in the production and coordination of whole brain activity. The meninges are described and their respective roles in the production and circulation of cerebrospinal fluid (CSF) are explained.

OUTLINE (three or four fifty-min. lectures):
Seeley, A&P, 5/e

Chapt. Object.	Topic Outline, Chapter 13	Figures & Tables	Transparency Acetates
1	I. Development, p. 383 <ol style="list-style-type: none"> 1. Neural Plate and Notochord 2. Forebrain (Prosencephalon) <ol style="list-style-type: none"> a. Telencephalon b. Diencephalon 3. Midbrain (Mesencephalon) 4. Hindbrain (Rhombencephalon) <ol style="list-style-type: none"> a. Metencephalon b. Myelencephalon 	Table 13.1, p.384 Fig. 13.1, p.383 Fig. 13.2, p.383 Fig. 13.3, p.384	TA-242 TA-243
2, 3	II. Brainstem, p. 385 <ol style="list-style-type: none"> A. Medulla Oblongata <ol style="list-style-type: none"> 1. Nuclei with Specialized Functions 2. Pyramids and Decussating Tracts 3. The Olives 4. Nuclei - Cranial Nerves IX, X, XI, and XII B. Pons <ol style="list-style-type: none"> 1. Ascending and Descending Tracts 2. Pontine Nuclei 3. Nuclei - Cranial Nerves V, VI, VII, and IX C. Midbrain (Mesencephalon) <ol style="list-style-type: none"> 1. Tectum = Corpora Quadragemini <ol style="list-style-type: none"> a. Superior Colliculi b. Inferior Colliculi 2. Tegmentum 	Fig. 13.4, p.386 Table 13.2, p.385 Fig. 13.5, p.387	TA-244 TA-245, 246, 247
		Fig. 13.6, p.388 Clinical Note, p.388	TA-248

	<ul style="list-style-type: none"> a. Ascending Tracts b. Red Nuclei 	
	<ul style="list-style-type: none"> 3. Cerebral Peduncles 4. Substantia Nigra 5. Nuclei - Cranial Nerves III, IV and V 	
4	D. Reticular Formation	Predict Quest. 1 Clinical Note, p. 388
2, 5	III. Diencephalon	Fig. 13.7a, p.389 TA-249
	A. Thalamus	Fig. 13.7b, p.389 TA-250
	<ul style="list-style-type: none"> 1. Intermediate Mass 2. Sensory Processing Nuclei <ul style="list-style-type: none"> a. Medial Geniculate Nucleus b. Lateral Geniculate Nucleus c. Ventral Posterior Nucleus d. Lateral Posterior Nucleus e. Pulvinar 3. Nuclei with Motor Involvement <ul style="list-style-type: none"> a. Ventral Anterior Nucleus b. Ventral Lateral Nucleus 4. Nuclei Associated with Limbic System and Emotions <ul style="list-style-type: none"> a. Anterior Nucleus b. Medial Nucleus c. Lateral Dorsal Nucleus 	
	B. Subthalamus	Fig. 13.7a, p.389 TA-249
	C. Epithalamus	Fig. 13.7a, p.389 TA-249 Clinical Note, p.390
	<ul style="list-style-type: none"> 1. Habenular Nuclei 2. Pineal Body (Epiphysis) 	
	D. Hypothalamus	Table 13.3, p.391 TA-249, 251 Fig. 13.7a,c, p.389
	<ul style="list-style-type: none"> 1. Mamillary Bodies 2. Infundibulum to Neurohypophysis 3. Major Integrating Center for "Mood" and Sense of Well-Being 	
2	IV. Cerebrum, p. 390	Fig. 13.8a, p.392 TA-252
	<ul style="list-style-type: none"> 1. Longitudinal Fissure 2. Central Sulcus <ul style="list-style-type: none"> a. Precentral Gyrus b. Postcentral Gyrus 3. Lateral Fissure 4. Lobes <ul style="list-style-type: none"> a. Frontal Lobe b. Parietal Lobe 	Fig. 13.8b, p.392 TA-252

- c. Occipital Lobe
- d. Temporal Lobe
- e. Insula
- 5. Nuclei and Cortical & Medullary Regions Fig. 13.9, p.393
- 6. Medullary Tracts
 - a. Association Fibers
 - b. Commissural Fibers
 - c. Projection Fibers
- 2, 6 A. Cerebral Cortex Fig. 13.10, p.393 TA-253
 - a. Primary Sensory Areas
 - 1). Primary Somatic Sensory Cortex or General Sensory Area = Postcentral Gyrus Fig. 13.11, p.394 TA-254
 - 2). Taste Area
 - 3). Olfactory Area
 - 4). Primary Auditory Cortex
 - 5). Visual cortex
 - b. Association Areas
 - 1). Somesthetic Association Area
 - 2). Visual Association Area Predict Quest. 2
 - c. Primary Motor Cortex = Precentral Gyrus
 - d. Premotor Area Clinical Note, p.395
 - e. Prefrontal Area Clinical Note, p.395
- 7 1. Speech Fig. 13.12, p.396 Clinical Note, p.396 Predict Quest. 3
 - d. Wernicke's Area
 - e. Broca's Area
- 8 2. Brain Waves Fig. 13.13, p.396 TA-255
 - a. Electroencephalogram (EEG)
 - b. Alpha Waves
 - c. Beta Waves
 - d. Theta Waves
 - e. Delta Waves
- 9 3. Memory Clinical Note, p.397
 - a. Sensory Memory
 - b. Short-Term Memory
 - c. Long-Term Memory
 - 1). Long-Term Potentiation

	2). Memory Engrams	
	3). Declarative Memory	
	a). Hippocampus	
	b). Amygdaloid Nucleus	
	4). Procedural or Reflexive Memory	
	4. Right and Left Cortex	
	a. Localization of Some Functions and Hemispheric Dominance	Clinical Note, p.398
	b. Communication Between Hemispheres	
	1). Commissures	
	2). Corpus Callosum	
10	B. Basal Ganglia - Functionally Related Nuclei	Fig. 13.14, p.398 TA-256-257 Clinical Focus, p.400
	1. Subthalamic Nucleus - Diencephalon	
	2. Substantia Nigra - Midbrain	
	3. Corpus Striatum - Cerebrum	
	a. Lentiform Nucleus	
	b. Caudate Nucleus	
11	C. Limbic System	Fig. 13.15, p.399 TA-258
	1. Cingulate Gyrus	
	2. Hippocampus	
	3. Habenular Nuclei	
	4. Parts of the Basal Ganglia	
	5. Mamillary Bodies	
	6. Olfactory Cortex	
	7. Association Tracts such as Fornix	
2, 12	V. Cerebellum, p. 400	Fig. 13.16, p.401 TA-259
	A. General Structure	
	1. Cerebellar Peduncles	
	2. Folia rather than Gyri	
	3. Sub-Parts	
	a. Flocculonodular Lobe	
	b. Vermis	
	c. Lateral Hemispheres	
	B. Cross Section	Clinical Note, p.401
	1. Fine Motor control	
	2. Cerebellar Comparator Function	Fig. 13.17, p.402 TA-260
	VI. Spinal Cord, p. 402	
	A. General Structure	Fig.13.18, p.403
	1. Cervical Enlargement	
	2. Lumbar Enlargement	Predict Quest. 4

	2. Inhibitory Association Neurons in Spinal Cord		
	C. Withdrawal Reflex	Fig. 13.20c, p.407	TA-264
	1. Reciprocal Innervation	Fig. 13.20d, p.407	TA-265
	2. Crossed-extensor Reflex	Fig. 13.20e, p.408 Predict Quest. 6	TA-266
	VIII. Spinal Pathways, p. 409	Fig. 13.21, p.409	TA-267
	A. Ascending Pathways	Table 13.4, pp.410-411	
	a. Primary Neurons from Periphery to Spinal Cord		
	1). Sensory Neurons		
	2). Cell Bodies in Dorsal Root Ganglion		
	b. Secondary Neurons from Spinal Cord to Thalamus		
	1). Cell Bodies in Spinal Gray Matter		
	2). Axons Cross-Over		
	c. Tertiary Neurons from Thalamus to Sensory Cortex		
15	1. Spinothalamic System	Fig. 13.22, p.412	
	a. Lateral Spinothalamic Tracts	Fig. 13.22a, p.412	TA-268
	1). Pain Information	Clinical Focus & Fig. 13A, pp.414-415	
	2). Temperature Information		
	b. Anterior Spinothalamic Tracts	Fig. 13.22b, p.412 Predict Quest. 7	TA-269
	1). Light Touch and Pressure Information		
	2). Tickle and Itch Sensation		
	c. Association Fibers Between Primary and Secondary Fibers		
	d. Pathway Joined by Fibers from Trigeminothalamic Tract in Brainstem - Collateral Branches to Reticular Formation		
15	2. Dorsal Column / Medial Lemniscal System	Fig. 13.23, p.413	TA-270

- a. Two-Point Discrimination and Proprioception Information Fig. 13.24, p.416
- b. Crossing-Over in Medulla Predict Quest. 8
- c. Fasciculus Gracilis
 - 1). From Nerve Endings Below Midthorax
 - 2). Cell Body of Secondary Neuron in Nucleus Gracilis
- d. Fasciculus Cuneatus
 - 1). From Nerve Endings Above Midthorax
 - 2). Cell Body of Secondary Neuron in Nucleus Cuneatus Predict Quest. 9
- 3. Spinocerebellar System & Other Tracts
 - a. Posterior Spinocerebellar Tracts Fig. 13.25, p.416 TA-271
 - 1). Uncrossed Proprioceptive Information
 - 2). From Thoracic and Upper Lumbar Regions
 - 3). Enter Cerebellum through Inferior Cerebellar Peduncles
 - b. Anterior Spinocerebellar Tracts
 - 1). Crossed and Uncrossed Proprioceptive Information
 - 2). From Lower Trunk and Lower Limbs Predict Quest. 10
 - 3). Enter Cerebellum through Superior Cerebellar Peduncles
 - 4). Crossed Fibers Recross in Cerebellum
 - c. Spino-Olivary Tracts
 - d. Spinotectal Tracts
 - e. Spinoreticular Tracts
- B. Descending Pathways Table 13.5, pp.410-411
Clinical Note, p.417
 - a. Upper Motor Neurons - Cell Bodies in Cortex, Cerebellum or Brainstem
 - b. Lower Motor Neurons - Cell Bodies in Anterior Horn of Spinal Cord or Cranial Nerve Nuclei
 - c. Direct Pathways and Pyramidal System Fig. 13.26, p.417 TA-272

- a. Median Foramen (of Magendie)
- b. Two Lateral Foramina (of Luschka)
- 3. Returned to Blood Across Arachnoid Granulations

X. Systems Pathology: Stroke

Clinical Focus,
pp.424-425
Systemic
Interactions,
p.428

IMPORTANT CONSIDERATIONS: This material logically splits into six basic topic areas, the organization of the brain, the functional relationships among the parts of the brain, the organization of the spinal cord, the functional relationships among the parts of the spinal cord, the functional relationships between the spinal cord and the brain (including the circulation of CSF), and the unifying concept of the role of the CNS in homeostasis. One or two lectures could easily be spent on each of the six topics, so the degree of detail for which students will be accountable needs to be set to determine the precise amount of lecture and lab time to be spent on each topic.

SEE INSTRUCTOR'S MANUAL AND COURSE SOLUTIONS MANUAL FOR ADDITIONAL RESOURCES.