

C O N T E N T S



	Preface	iii
	Acknowledgments	iv
	Color Atlas of Brain	xi
CHAPTER 1	Introduction and Organization of the Nervous System	1
	Chapter Objectives	2
	Central and Peripheral Nervous Systems	2
	Major Divisions of the Central Nervous System	2
	Major Divisions of the Peripheral Nervous System	10
	Early Development of the Nervous System	14
	Clinical Notes	17
	Clinical Problem Solving	28
	Answers and Explanations to Clinical Problem Solving	29
	Review Questions	30
	Answers and Explanations to Review Questions	31
	Additional Reading	32
CHAPTER 2	The Neurobiology of the Neuron and the Neuroglia	33
	Chapter Objectives	34
	Definition of a Neuron	34
	Varieties of Neurons	34
	Structure of the Neuron	34
	Definition of Neuroglia	53
	Astrocytes	53
	Oligodendrocytes	54
	Microglia	57
	Ependyma	58
	Extracellular Space	59
	Clinical Notes	61
	Clinical Problem Solving	63
	Answers and Explanations to Clinical Problem Solving	64
	Review Questions	65
	Answers and Explanations to Review Questions	67
	Additional Reading	69
CHAPTER 3	Nerve Fibers, Peripheral Nerves, Receptor and Effector Endings, Dermatomes, and Muscle Activity	70
	Chapter Objectives	71
	Nerve Fibers	71
	Peripheral Nerves	80
	Conduction in Peripheral Nerves	84
	Receptor Endings	86

Effector Endings	95
Segmental Innervation of Skin	100
Segmental Innervation of Muscles	100
Muscle Tone and Muscle Action	101
Summation of Motor Units	103
Muscle Fatigue	104
Posture	104
Clinical Notes	107
Clinical Problem Solving	120
Answers and Explanations to Clinical Problem Solving	123
Review Questions	126
Answers and Explanations to Review Questions	129
Additional Reading	131

CHAPTER 4 **The Spinal Cord and the Ascending and Descending Tracts** **132**

Chapter Objectives	133
A Brief Review of the Vertebral Column	133
Gross Appearance of the Spinal Cord	137
Structure of the Spinal Cord	138
The Ascending Tracts of the Spinal Cord	143
Anatomical Organization	143
Functions of the Ascending Tracts	144
The Descending Tracts of the Spinal Cord	153
Anatomical Organization	153
Functions of the Descending Tracts	154
Corticospinal Tracts	155
Reticulospinal Tracts	157
Tectospinal Tract	158
Rubrospinal Tract	159
Vestibulospinal Tract	159
Olivospinal Tract	160
Descending Autonomic Fibers	160
Intersegmental Tracts	161
Reflex Arc	162
Influence of Higher Neuronal Centers on the Activities of Spinal Reflexes	164
Renshaw Cells and Lower Motor Neuron Inhibition	164
Clinical Notes	165
Clinical Problem Solving	177
Answers and Explanations to Clinical Problem Solving	178
Review Questions	181
Answers and Explanations to Review Questions	183
Additional Reading	185

CHAPTER 5 **The Brainstem** **186**

Chapter Objectives	187
A Brief Review of the Skull	187
The Cranial Cavity	192
Introduction to the Brainstem	196
Gross Appearance of the Medulla Oblongata	197
Internal Structure	198
Gross Appearance of the Pons	206
Internal Structure of the Pons	208
Gross Appearance of the Midbrain	210
Internal Structure of the Midbrain	210
Clinical Notes	217
Clinical Problem Solving	221
Answers and Explanations to Clinical Problem Solving	222
Review Questions	224
Answers and Explanations to Review Questions	227
Additional Reading	229

CHAPTER 6	The Cerebellum and Its Connections	230
	Chapter Objective	231
	Gross Appearance of the Cerebellum	231
	Structure of the Cerebellum	231
	Cerebellar Cortical Mechanisms	236
	Cerebellar Afferent Fibers	237
	Cerebellar Efferent Fibers	240
	Functions of the Cerebellum	242
	Clinical Notes	243
	Clinical Problem Solving	245
	Answers and Explanations to Clinical Problem Solving	246
	Review Questions	247
	Answers and Explanations to Review Questions	249
	Additional Reading	250
CHAPTER 7	The Cerebrum	251
	Chapter Objectives	252
	Subdivisions of the Cerebrum	252
	Diencephalon	252
	General Appearance of the Cerebral Hemispheres	257
	Main Sulci	258
	Lobes of the Cerebral Hemisphere	260
	Internal Structure of the Cerebral Hemispheres	262
	Clinical Notes	271
	Clinical Problem Solving	277
	Answers and Explanations to Clinical Problem Solving	278
	Review Questions	279
	Answers and Explanations to Review Questions	281
	Additional Reading	283
CHAPTER 8	The Structure and Functional Localization of the Cerebral Cortex	284
	Chapter Objective	285
	Structure of the Cerebral Cortex	285
	Mechanisms of the Cerebral Cortex	287
	Cortical Areas	288
	Cerebral Dominance	295
	Clinical Notes	296
	Clinical Problem Solving	298
	Answers and Explanations to Clinical Problem Solving	299
	Review Questions	300
	Answers and Explanations to Review Questions	302
	Additional Reading	303
CHAPTER 9	The Reticular Formation and the Limbic System	304
	Chapter Objective	305
	Reticular Formation	305
	Limbic System	307
	Clinical Notes	312
	Clinical Problem Solving	312
	Answers and Explanations to Clinical Problem Solving	313
	Review Questions	313
	Answers and Explanations to Review Questions	314
	Additional Reading	315
CHAPTER 10	The Basal Nuclei (Basal Ganglia) and Their Connections	316
	Chapter Objective	317
	Terminology	317

Corpus Striatum	317
Amygdaloid Nucleus	319
Substantia Nigra and Subthalamic Nuclei	319
Clastrum	319
Connections of the Corpus Striatum and Globus Pallidus	319
Connections of the Corpus Striatum	319
Connections of the Globus Pallidus	319
Functions of the Basal Nuclei	320
Clinical Notes	322
Clinical Problem Solving	327
Answers and Explanations to Clinical Problem Solving	327
Review Questions	327
Answers and Explanations to Review Questions	329
Additional Reading	329

CHAPTER 11	The Cranial Nerve Nuclei and Their Central Connections and Distribution	331
	Chapter Objective	332
	The 12 Cranial Nerves	332
	Organization of the Cranial Nerves	332
	Olfactory Nerves (Cranial Nerve I)	335
	Optic Nerve (Cranial Nerve II)	336
	Oculomotor Nerve (Cranial Nerve III)	340
	Trochlear Nerve (Cranial Nerve IV)	340
	Trigeminal Nerve (Cranial Nerve V)	341
	Abducent Nerve (Cranial Nerve VI)	344
	Facial Nerve (Cranial Nerve VII)	346
	Vestibulocochlear Nerve (Cranial Nerve VIII)	348
	Glossopharyngeal Nerve (Cranial Nerve IX)	350
	Vagus Nerve (Cranial Nerve X)	352
	Accessory Nerve (Cranial Nerve XI)	354
	Hypoglossal Nerve (Cranial Nerve XII)	356
	Clinical Notes	358
	Clinical Problem Solving	363
	Answers and Explanations to Clinical Problem Solving	364
	Review Questions	365
	Answers and Explanations to Review Questions	368
	Additional Reading	369
CHAPTER 12	The Thalamus and Its Connections	371
	Chapter Objective	372
	General Appearances of the Thalamus	372
	Subdivisions of the Thalamus	372
	Connections of the Thalamus	375
	Function of the Thalamus	375
	Clinical Notes	378
	Clinical Problem Solving	378
	Answers and Explanations to Clinical Problem Solving	378
	Review Questions	379
	Answers and Explanations to Review Questions	380
	Additional Reading	381
CHAPTER 13	The Hypothalamus and Its Connections	382
	Chapter Objectives	383
	The Hypothalamus	383
	Hypothalamic Nuclei	383
	Afferent Nervous Connections of the Hypothalamus	385

	Efferent Nervous Connections of the Hypothalamus	387	
	Connections of the Hypothalamus With the Hypophysis Cerebri	388	
	Functions of the Hypothalamus	389	
	Clinical Notes	392	
	Clinical Problem Solving	392	
	Answers and Explanations to Clinical Problem Solving	393	
	Review Questions	393	
	Answers and Explanations to Review Questions	394	
	Additional Reading	395	
CHAPTER 14	The Autonomic Nervous System		396
	Chapter Objective	397	
	Organization of the Autonomic Nervous System	397	
	The Large Autonomic Plexuses	400	
	Autonomic Ganglia	400	
	Preganglionic Transmitters	400	
	Fast, Slow, and Inhibitory Synaptic Potentials	401	
	Ganglion-Stimulating Agents	402	
	Ganglion-Blocking Agents	402	
	Postganglionic Nerve Endings	402	
	Postganglionic Transmitters	402	
	Other Postganglionic Transmitters	403	
	Blocking of Cholinergic Receptors	403	
	Blocking of Adrenergic Receptors	403	
	Higher Control of the Autonomic Nervous System	404	
	The "Enteric Nervous System"	404	
	Functions of the Autonomic Nervous System	404	
	Important Anatomical, Physiologic, and Pharmacologic Differences Between the Sympathetic and Parasympathetic Parts of the Autonomic Nervous System	405	
	Some Important Autonomic Innervations	407	
	Some Important Physiological Reflexes Involving the Autonomic Nervous System	415	
	Clinical Notes	417	
	Clinical Problem Solving	420	
	Answers and Explanations to Clinical Problem Solving	421	
	Review Questions	422	
	Answers and Explanations to Review Questions	425	
	Additional Reading	426	
CHAPTER 15	The Meninges of the Brain and Spinal Cord		427
	Chapter Objectives	428	
	Meninges of the Brain	428	
	Meninges of the Spinal Cord	436	
	Clinical Notes	438	
	Clinical Problem Solving	441	
	Answers and Explanations to Clinical Problem Solving	442	
	Review Questions	443	
	Answers and Explanations to Review Questions	444	
	Additional Reading	444	
CHAPTER 16	The Ventricular System, the Cerebrospinal Fluid, and the Blood-Brain and Blood-Cerebrospinal Fluid Barriers		445
	Chapter Objectives	446	
	Ventricular System	446	
	Subarachnoid Space	457	
	Cerebrospinal Fluid	458	
	Blood-Brain and Blood-Cerebrospinal Fluid Barriers	462	
	Clinical Notes	466	

	Clinical Problem Solving	467	
	Answers and Explanations to Clinical Problem Solving	468	
	Review Questions	469	
	Answers and Explanations to Review Questions	472	
	Additional Reading	473	
CHAPTER 17	The Blood Supply of the Brain and Spinal Cord		474
	Chapter Objectives	475	
	Blood Supply of the Brain	475	
	Brain Capillaries	481	
	Cerebral Circulation	481	
	Blood Supply of the Spinal Cord	481	
	Clinical Notes	483	
	Clinical Problem Solving	493	
	Answers and Explanations to Clinical Problem Solving	495	
	Review Questions	497	
	Answers and Explanations to Review Questions	499	
	Additional Reading	500	
CHAPTER 18	The Development of the Nervous System		501
	Chapter Objectives	502	
	Spinal Cord	502	
	Brain	504	
	Clinical Notes	512	
	Clinical Problem Solving	516	
	Answers and Explanations to Clinical Problem Solving	516	
	Review Questions	516	
	Answers and Explanations to Review Questions	518	
	Additional Reading	519	
APPENDIX	Important Neuroanatomical Data of Clinical Significance		521
	Index		529