

Contents

1	Introduction to the Nervous System	1	
	The Nervous System Has Central and Peripheral Parts, 1		
	The Principal Cellular Elements of the Nervous System Are Neurons and Glial Cells, 2		
2	Development of the Nervous System	39	
	The Neural Tube Gives Rise to the Central Nervous System, 39		
	The Neural Crest and Cranial Placodes Give Rise to the Peripheral Nervous System, 48		
	Adverse Events During Development Can Cause Congenital Malformations of the Nervous System, 49		
3	Gross Anatomy and General Organization of the Central Nervous System	56	
	The Long Axis of the CNS Bends at the Cephalic Flexure, 57		
	Hemisecting a Brain Reveals Parts of the Diencephalon, Brainstem, and Ventricular System, 58		
	Humans, Relative to Other Animals, Have Large Brains and Many Neurons, 59		
	Named Sulci and Gyri Cover the Cerebral Surface, 59		
	The Diencephalon Includes the Thalamus and Hypothalamus, 66		
	Most Cranial Nerves Are Attached to the Brainstem, 68		
	The Cerebellum Includes a Vermis and Two Hemispheres, 70		
	Sections of the Forebrain Reveal the Basal Nuclei and Limbic Structures, 70		
	Parts of the Nervous System Are Interconnected in Systematic Ways (Generalizations), 72		
4	Meningeal Coverings of the Brain and Spinal Cord	84	
	There Are Three Meningeal Layers: The Dura Mater, Arachnoid, and Pia Mater, 84		
	The Dura Mater Provides Mechanical Strength, 86		
	The Arachnoid Mater, 90		
	Pia Mater Covers the Surface of the CNS, 93		
	The Vertebral Canal Contains a Spinal Epidural Space, 94		
	Bleeding Can Open Up Potential Meningeal Spaces, 96		
	Parts of the CNS Can Herniate from One Intracranial Compartment Into Another, 97		
5	Ventricles and Cerebrospinal Fluid	103	
	The Brain Contains Four Ventricles, 103		
	Choroid Plexus Is the Source of Most CSF, 107		
	Imaging Techniques Allow Noninvasive Visualization of the CNS, 111		
	Disruption of CSF Circulation Can Cause Hydrocephalus, 121		
6	Blood Supply of the Brain	126	
	The Internal Carotid Arteries and Vertebral Arteries Supply the Brain, 126		
	Imaging Techniques Allow Arteries and Veins to Be Visualized, 136		
	Blood Flow to the CNS Is Closely Controlled, 136		
	A System of Barriers Partially Separates the Nervous System From the Rest of the Body, 144		
	Superficial and Deep Veins Drain the Brain, 146		
7	Electrical Signaling by Neurons	154	
	A Lipid-Protein Membrane Separates Intracellular and Extracellular Fluids, 155		
	Inputs to Neurons Cause Slow, Local Potential Changes, 161		
	Action Potentials Convey Information Over Long Distances, 164		
	Resistors, Capacitors, and Neuronal Membranes, 177		
	Calculating the Membrane Potential, 179		

8	Synaptic Transmission Between Neurons 182 There Are Five Steps in Conventional Chemical Synaptic Transmission, 183 Synaptic Transmission Can Be Rapid and Point-to-Point, or Slow and Often Diffuse, 188 Synaptic Strength Can Be Facilitated or Depressed, 193 Most Neurotransmitters Are Small Amine Molecules, Amino Acids, or Neuropeptides, 196 Gap Junctions Mediate Direct Current Flow From One Neuron to Another, 201	
9	Sensory Receptors and the Peripheral Nervous System 207 Receptors Encode the Nature, Location, Intensity, and Duration of Stimuli, 208 Somatosensory Receptors Detect Mechanical, Chemical, or Thermal Changes, 212 Peripheral Nerves Convey Information To and From the CNS, 227	
10	Spinal Cord 233 The Spinal Cord Is Segmented, 234 All Levels of the Spinal Cord Have a Similar Cross-Sectional Structure, 238 The Spinal Cord Is Involved in Sensory Processing, Motor Outflow, and Reflexes, 239 Spinal Gray Matter Is Regionally Specialized, 240 Reflex Circuitry Is Built Into the Spinal Cord, 244 Ascending and Descending Pathways Have Defined Locations in the Spinal White Matter, 248 The Autonomic Nervous System Monitors and Controls Visceral Activity, 260 A Longitudinal Network of Arteries Supplies the Spinal Cord, 264 Spinal Cord Damage Causes Predictable Deficits, 267	
11	Organization of the Brainstem 272 The Brainstem Has Conduit, Cranial Nerve, and Integrative Functions, 273 The Medulla, Pons, and Midbrain Have Characteristic Gross Anatomical Features, 274 The Internal Structure of the Brainstem Reflects Surface Features and the Position of Long Tracts, 277	
	The Reticular Core of the Brainstem Is Involved in Multiple Functions, 286 Some Brainstem Nuclei Have Distinctive Neurochemical Signatures, 290 The Brainstem Is Supplied by the Vertebral-Basilar System, 295	
12	Cranial Nerves and Their Nuclei 301 Cranial Nerve Nuclei Have a Generally Predictable Arrangement, 301 Cranial Nerves III, IV, VI, XI, and XII Contain Somatic Motor Fibers, 305 Branchiomeric Nerves Contain Axons From Multiple Categories, 312 Brainstem Damage Commonly Causes Deficits on One Side of the Head and the Opposite Side of the Body, 325	
13	The Chemical Senses of Taste and Smell 329 The Perception of Flavor Involves Gustatory, Olfactory, Trigeminal, and Other Inputs, 330 Taste Is Mediated by Receptors in Taste Buds Innervated by Cranial Nerves VII, IX, and X, 330 Olfaction Is Mediated by Receptors That Project Directly to the Telencephalon, 336	
14	Hearing and Balance: The Eighth Cranial Nerve 348 Auditory and Vestibular Receptor Cells Are Located in the Walls of the Membranous Labyrinth, 349 The Cochlear Division of the Eighth Nerve Conveys Information About Sound, 354 The Vestibular Division of the Eighth Nerve Conveys Information About Linear and Angular Acceleration of the Head, 369	
15	Atlas of the Human Brainstem 383	
16	The Thalamus and Internal Capsule: Getting to and from the Cerebral Cortex 394 The Diencephalon Includes the Epithalamus, Subthalamus, Hypothalamus, and Thalamus, 395 The Thalamus Is the Gateway to the Cerebral Cortex, 398 Interconnections Between the Cerebral Cortex and Subcortical Structures Travel Through the Internal Capsule, 411	

