Contents

The Dura Mater Provides Mechanical

1	Introduction to the Nervous System The Nervous System Has Central and Peripheral Parts, 1 The Principal Cellular Elements of the Nervous System Are Neurons and Glial Cells, 2	1	,	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	
2	Development of the Nervous System 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	39	5	Bleeding Can Open Up Potential Meningeal Spaces, 96 Parts of the CNS Can Herniate from One Intracranial Compartment Into Another, 97 Ventricles and Cerebrospinal Fluid The Brain Contains Four Ventricles, 103 Choroid Plexus Is the Source of Most CSF, 107	103
3	Gross Anatomy and General Organization of the Central Nervous System The Long Axis of the CNS Bonds at the	56		Imaging Techniques Allow Noninvasive Visualization of the CNS, 111 Disruption of CSF Circulation Can Cause Hydrocephalus, 121	
	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			Blood Supply of the Brain 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	126
	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		7	Electrical Signaling by Neurons A Lipid-Protein Membrane Separates Intracellular and Extracellular Fluids, 155 Inputs to Neurons Cause Slow, Local Potential Changes, 161 Action Potentials Convey Information Over	154
4	Meningeal Coverings of the Brain and Spinal Cord There Are Three Meningeal Layers: The Dura Mater, Arachnoid, and Pia Mater, 84	84		Long Distances, 164 Resistors, Capacitors, and Neuronal Membranes, 177 Calculating the Membrane Potential, 179	

8	Synaptic Transmission Between Neurons	182		The Reticular Core of the Brainstem Is	
	There Are Five Steps in Conventional Chemical Synaptic Transmission, 183 Synaptic Transmission Can Be Rapid and			Involved in Multiple Functions, 286 Some Brainstem Nuclei Have Distinctive Neurochemical Signatures, 290 The Brainstem Is Supplied by the	
	Point-to-Point, or Slow and Often Diffuse, 188			Vertebral-Basilar System, 295	
	Synaptic Strength Can Be Facilitated or		12	Cranial Nerves and Their Nuclei	201
	Depressed, 193		14		301
	Most Neurotransmitters Are Small Amine Molecules, Amino Acids, or Neuropeptides, 196 Gap Junctions Mediate Direct Current Flow			Cranial Nerve Nuclei Have a Generally Predictable Arrangement, 301 Cranial Nerves III, IV, VI, XI, and XII Contain Somatic Motor Fibers, 305	
	From One Neuron to Another, 201			Branchiomeric Nerves Contain Axons From Multiple Categories, 312	
9	, ,			Brainstem Damage Commonly Causes	
	Nervous System	207		Deficits on One Side of the Head and the Opposite Side of the Body, 325	
	Receptors Encode the Nature, Location,			•	
	Intensity, and Duration of Stimuli, 208 Somatosensory Receptors Detect		13	The Chemical Senses of Taste and Smell	329
	Mechanical, Chemical, or Thermal			The Perception of Flavor Involves	
	Changes, 212			Gustatory, Olfactory, Trigeminal, and Other Inputs, 330	
	Peripheral Nerves Convey Information To and From the CNS, 227			Taste Is Mediated by Receptors in Taste Buds Innervated by Cranial Nerves	
10	Spinal Cord	233		VII, IX, and X, 330	
	The Spinal Cord Is Segmented, 234			Olfaction Is Mediated by Receptors That Project Directly to the	
	All Levels of the Spinal Cord Have a Similar Cross-Sectional Structure, 238			Telencephalon, 336	
	The Spinal Cord Is Involved in Sensory Processing, Motor Outflow, and		14	Hearing and Balance: The Eighth	
	Reflexes, 239			Cranial Nerve	348
	Spinal Gray Matter Is Regionally			Auditory and Vestibular Receptor Cells Are	
	Specialized, 240			Located in the Walls of the Membranous Labyrinth, 349	
	Reflex Circuitry Is Built Into the Spinal Cord, 244			The Cochlear Division of the Eighth	
	Ascending and Descending Pathways Have			Nerve Conveys Information About	
	Defined Locations in the Spinal White			Sound, 354 The Vestibular Division of the Eighth Nerve	
	Matter, 248 The Autonomic Nervous System			Conveys Information About Linear and	
	Monitors and Controls Visceral			Angular Acceleration of the Head, 369	
	Activity, 260		15	Atlas of the Human Brainstem	383
	A Longitudinal Network of Arteries			ridas of the Haman Brainstein	505
	Supplies the Spinal Cord, 264 Spinal Cord Damage Causes Predictable		16	The Thalamus and Internal Capsule:	
	Deficits, 267			Getting to and from the	
11		272		Cerebral Cortex	394
11	Organization of the Brainstem	272		The Diencephalon Includes the	
	The Brainstem Has Conduit, Cranial Nerve, and Integrative Functions, 273			Epithalamus, Subthalamus,	
	The Medulla, Pons, and Midbrain Have			Hypothalamus, and Thalamus, 395 The Thalamus Is the Gateway to the	
	Characteristic Gross Anatomical			Cerebral Cortex, 398	
	Features, 274			Interconnections Between the Cerebral	
	The Internal Structure of the Brainstem Reflects Surface Features and the			Cortex and Subcortical Structures	
	Position of Long Tracts, 277			Travel Through the Internal Capsule, 411	

17	The Visual System	419		Each Longitudinal Zone Has a Distinctive	
	The Eye Has Three Concentric Tissue Layers and a Lens, 420 The Retina Contains Five Major Neuronal			Output, 513 Clinical Syndromes Correspond to Functional Zones, 518	
	Cell Types, 424		21	Eye Movements	524
	Retinal Neurons Translate Patterns of Light Into Patterns of Contrast, 429 Half of the Visual Field of Each Eye Is Mapped Systematically in			Six Extraocular Muscles Move the Eye in the Orbit, 526 There Are Fast and Slow Conjugate Eye	
	the Contralateral Cerebral Hemisphere, 441			Movements, 529 Changes in Object Distance Require	
	Primary Visual Cortex Sorts Visual Information and Distributes It to Other Cortical Areas, 450 Early Experience Has Permanent Effects on the Visual System, 454 Reflex Circuits Adjust the Size of the Pupil and the Focal Length of the Lens, 454		Vergence Movements, 535 The Basal Nuclei and Cerebellum Participate in Eye Movement Control, 536		
			22	Cerebral Cortex	541
				Most Cerebral Cortex Is Neocortex, 542 Neocortical Areas Are Specialized for	
18	Overview of Motor Systems	459		Different Functions, 549 The Corpus Callosum Unites the Two	
	Each Lower Motor Neuron Innervates a Group of Muscle Fibers, Forming a Motor Unit, 459 Motor Control Systems Involve			Cerebral Hemispheres, 568 Consciousness and Sleep Are Active Processes, 570	
	Both Hierarchical and Parallel Connections, 463 The Corticospinal Tract Has Multiple Origins and Terminations, 465		23	Drives and Emotions: The	
				Hypothalamus and Limbic System	579
				The Hypothalamus Coordinates Drive- Related Behaviors, 580	
19	Basal Nuclei	475		Limbic Structures Are Interposed	
	The Basal Nuclei Include Five Major Nuclei, 476			Between the Hypothalamus and Neocortex, 593	
	Basal Nuclei Circuitry Involves Multiple Parallel Loops That Modulate Cortical Output, 480 Interconnections of the Basal Nuclei Determine the Pattern of Their Outputs, 481 Perforating Branches From the Cerebral Arterial Circle (of Willis) Supply the Basal Nuclei, 487 Many Basal Nuclei Disorders Result in Abnormalities of Movement, 488	2	24	Formation, Modification, and Repair of Neuronal Connections	605
				Both Neurons and Connections Are Produced in Excess During	
				Development, 606 Synaptic Connections Are Adjusted Throughout Life, 612 PNS Repair Is More Effective Than CNS	
			25	Repair, 625	
20	Cerebellum	495	25	Atlas of the Human Forebrain	632
	The Cerebellum Can Be Divided Into	100	Gle	ossary	652
	Both Transverse and Longitudinal Zones, 496 Cerebellar Cortex Receives Multiple Inputs, 507		Ind	dex	679