

Visual Anatomy and Physiology

THIRD EDITION

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- 15.10. The Neural Layer of the Retina Contains Multiple Layers of Specialized Photoreceptors, Neurons, and Supporting Cells
- 15.11. Photoreception Occurs in the Outer Segment of Rod and Cone Cells
- 15.12. Photoreception Involves Activation, Bleaching, and Reassembly of Visual Pigments
- 15.13. The Visual Pathways Distribute Visual Information from Each Eye to Both Cerebral Hemispheres
- 15.14. Clinical Module: Refractive Problems Result from Abnormalities in the Cornea or Lens or in the Shape of the Eye

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Section 3: Equilibrium and Hearing

- 15.15. Equilibrium and Hearing Involve the Internal Ear
- 15.16. The Ear is Divided into the External Ear, the Middle Ear, and the Internal Ear
- 15.17. in the Internal Ear, the Bony Labyrinth Protects the Membranous Labyrinth and Its Receptors



- 15.18. Hair Cells in the Semicircular Ducts Respond to Rotation; Hair Cells in the Utricle and Saccule Respond to Gravity and Linear Acceleration
- 15.19. The Cochlear Duct Contains the Hair Cells of the Spiral Organ that Function in Hearing
- 15.20. Sound Waves Lead to Movement of the Basilar Membrane in the Process of Hearing
- 15.21. The Vestibulocochlear Nerve Carries Equilibrium and Hearing Sensations to the Brainstem
- 15.22. Clinical Module: Aging is Associated with Many Disorders of the Special Senses; Trauma, Infection, and Abnormal Stimuli May Cause Problems at Any Age

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16. The Endocrine System

Section 1: Hormones and Intercellular Communication

- 16.1. The Nervous and Endocrine Systems Release Chemical Messengers that Bind to Target Cells
- 16.2. Hormones May be Amino Acid Derivatives, Peptides, or Lipid Derivatives
- 16.3. The Endocrine System Includes Organs and Tissues with Primary and Secondary Hormone-Secreting Roles
- 16.4. Hormones Affect Target Cells After Binding to Receptors in the Plasma Membrane, Cytoplasm, or Nucleus
- 16.5. The Hypothalamus Exerts Direct or Indirect Control Over the Activities of Many Endocrine Organs
- 16.6. The Anterior Lobe of the Pituitary Gland Produces and Releases 7 Tropic Hormones, While the Posterior Lobe Releases 2 Hormones
- 16.7. Negative Feedback Mechanisms Control the Secretion Rates of the Hypothalamus and the Pituitary Gland
- 16.8. The Thyroid Gland Contains Follicles and Requires Iodine to Produce Hormones that Stimulate Tissue Metabolism
- 16.9. Parathyroid Hormone, Produced by the Parathyroid Glands, is the Primary Regulator of Blood Calcium Ion Levels
- 16.10. The Adrenal Hormones are Involved in Metabolic Regulation, Electrolyte Balance, and Stress Responses
- 16.11. The Pancreatic Islets Secrete Insulin and Glucagon, Which Regulate Glucose Use by Most Cells

Smartart Video: The Pancreas and Regulation of Blood Glucose

16.12. The Pineal Gland of the Epithalamus Secretes Melatonin, Which Affects the Circadian Rhythm



16.13. Clinical Module: Diabetes Mellitus is an Endocrine Disorder Characterized by an Excessively High Blood Glucose Level

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Section 2: Hormones and System Integration

- 16.14. Hormones Interact to Produce Coordinated Physiological Responses
- 16.15. Regulation of Blood Pressure and Blood Volume Involves Hormones from Primary Endocrine Organs and from Endocrine Tissues in the Heart and Kidneys
- 16.16. Normal Growth Requires the Cooperation of Many Endocrine Organs
- 16.17. The Stress Response is a Predictable Response to Any Significant Threat to Homeostasis
- 16.18. Clinical Module: Overproduction or Underproduction of Hormones can Cause Endocrine Disorders

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17. Blood

Section 1: Plasma and Formed Elements

- 17.1. Blood is the Fluid Portion of the Cardiovascular System
- 17.2. Blood is a Fluid Connective Tissue Containing Plasma and Formed Elements
- 17.3. Formed Elements are Produced by Stem Cells in Red Bone Marrow

Section 1: Review

Section 2: Structure and Function of Formed Elements

- 17.4. Hematology is the Study of Blood and Blood-Forming Tissues
- 17.5. Red Blood Cells, the Most Common Formed Elements, Contain Hemoglobin that Transports Respiratory Gases
- 17.6. Red Blood Cells are Continually Produced and their Components Recycled or Eliminated
- 17.7. Blood Type is Determined by the Presence or Absence of Specific Surface Antigens on RBCs
- 17.8. Clinical Module: Hemolytic Disease of the Newborn is an Rbc-Related Disorder Caused by a Cross-Reaction Between Fetal and Maternal Blood Types
- 17.9. The Various Types of White Blood Cells Contribute to the Bodys Defenses
- 17.10. The Clotting Response is a Complex Cascade of Events that Reduces Blood Loss
- 17.11. Clinical Module: Blood Disorders can be Classified by their Origins and the Changes in Blood Characteristics

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18. The Heart and Cardiovascular Function

Section 1: Structure of the Heart

- 18.1. The Heart has Four Chambers that Pump and Circulate Blood Through the Pulmonary and Systemic Circuits
- 18.2. The Heart is Located in the Mediastinum and is Enclosed by the Pericardial Cavity
- 18.3. The Heart Wall Contains Concentric Layers of Cardiac Muscle Tissue
- 18.4. The Boundaries Between the Four Chambers of the Heart can be Identified on Its External Surface
- 18.5. The Heart has an Extensive Blood Supply
- 18.6. Internal Valves Control the Direction of Blood Flow Between the Heart Chambers and Great Vessels
- 18.7. when the Heart Beats, the AV Valves Close Before the Semilunar Valves Open, and the Semilunar Valves Close Before the AV Valves Open
- 18.8. Clinical Module: Arteriosclerosis can Lead to Coronary Artery Disease

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Section 2: Cardiac Cycle

- 18.9. The Cardiac Cycle is a Complete Round of Systole and Diastole
- 18.10. The Cardiac Cycle Creates Pressure Gradients that Maintain Blood Flow Smartart Video: The Cardiac Cycle
- 18.11. Cardiac Muscle Cell Contractions Last Longer than Skeletal Muscle Fiber Contractions Primarily Because of Differences in Calcium Ion Membrane Permeability

Smartart Video: The Conducting System of the Heart

- 18.12. Electrical Events of Pacemaker Cells and Conducting Cells Establish the Heart Rate
- 18.13. Clinical Module: Normal and Abnormal Cardiac Activity can be Detected in an Electrocardiogram
- 18.14. The Intrinsic Heart Rate can be Altered by Autonomic Activity
- 18.15. Stroke Volume Depends on the Relationship Between End-Diastolic Volume and End-Systolic Volume
- 18.16. Cardiac Output is Regulated by Adjustments in Heart Rate and Stroke Volume

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19. Blood Vessels and Circulation

- Section 1: Functional Anatomy of Blood Vessels
 - 19.1. The Heart Pumps Blood, in Sequence, Through the Arteries, Capillaries, and Veins of the Pulmonary and Systemic Circuits
 - 19.2. Arteries and Veins Differ in the Structure and Thickness of their Walls
 - 19.3. Capillary Structure and Capillary Blood Flow Affect the Rates of Exchange Between the Blood and Interstitial Fluid
 - 19.4. The Venous System has Low Pressures and Contains Almost Two-Thirds of the Bodys Blood Volume
- Section 1: Review
- Section 2: Coordination of Cardiac Output and Blood Flow
 - 19.5. Pressure, Resistance, and Venous Return Affect Cardiac Output
 - 19.6. Vessel Luminal Diameter is the Main Source of Resistance Within the Cardiovascular System
 - 19.7. Blood Flow is Determined by the Interplay Between Arterial Pressure and Peripheral Resistance
 - 19.8. Capillary Exchange is a Dynamic Process that Includes Diffusion, Filtration, and Reabsorption
 - 19.9. Cardiovascular Regulatory Mechanisms Respond to Changes in Blood Pressure or Blood Chemistry
 - 19.10. Endocrine Responses to Low Blood Pressure and Low Blood Volume are Very Different from Those to High Blood Pressure and High Blood Volume
 - 19.11. Chemoreceptors Monitor the Chemical Composition of the Blood and Cerebrospinal Fluid
 - 19.12. The Cardiovascular Center Makes Extensive Adjustments to Cardiac Output and Blood Distribution During Exercise
 - 19.13. Clinical Module: Short-Term and Long-Term Mechanisms Compensate for a Reduction in Blood Volume
- Section 2: Review
- Section 3: Patterns of Blood Flow
 - 19.14. New Blood Vessels Form Through Vasculogenesis and Angiogenesis
 - 19.15. The Pulmonary Circuit Carries Deoxygenated Blood from the Right Ventricle to the Lungs and Returns Oxygenated Blood to the Left Atrium
 - 19.16. The Arteries and Veins of the Systemic Circuit Operate in Parallel, and the Major Vessels Often have Similar Names
 - 19.17. The Branches of the Aortic Arch Supply Structures that are Drained by the Superior Vena Cava
 - 19.18. The External Carotid Arteries Supply the Neck, Lower Jaw, and Face, and the Internal Carotid and Vertebral Arteries Supply the Brain While the External Jugular Veins Drain the Regions Supplied by the External Carotid Arteries, and the Internal Jugula



- 19.19. The Internal Carotid Arteries and the Vertebral Arteries Supply the Brain Which is Drained by the Dural Sinuses and the Internal Jugular Veins
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- 19.23. The Arteries of the Systemic Circuit Deliver Oxygenated Blood Throughout the Body and the Veins of the Systemic Circuit Return Deoxygenated Blood Back to the Heart
- 19.24. Clinical Module: The Pattern of Blood Flow Through the Fetal Heart and the Systemic Circuit Must Change at Birth

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- 20.2. Interstitial Fluid Flows Continuously into Lymphatic Capillaries and Exits Tissues as Lymph in Lymphatic Vessels
- 20.3. Small Lymphatic Vessels Converge to Form Lymphatic Ducts that Empty into the Subclavian Veins
- 20.4. Lymphocytes are Responsible for the Immune Functions of the Lymphatic System
- 20.5. Lymphocytes Aggregate Within Lymphoid Tissues and Lymphoid Organs
- 20.6. The Thymus is a Lymphoid Organ that Produces Functional T Cells
- 20.7. The Spleen, the Largest Lymphoid Organ, Responds to Antigens in the Bloodstream

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- 20.8. Innate Immunity is Nonspecific and is not Stimulated by Specific Antigens
- 20.9. Physical Barriers Prevent Pathogens and Toxins from Entering Body Tissues
- 20.10. Phagocytes Respond to Pathogen Invasion
- 20.11. NK Cells Perform Immune Surveillance, Detecting and Destroying Abnormal Cells
- 20.12. Interferons and the Complement System are Distributed Widely in Body Fluids
- 20.13. Inflammation is a Localized Tissue Response to Injury; Fever is a Generalized Response to Tissue Damage and Infection



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Section 3: Adaptive Immunity

- 20.14. Adaptive Immunity Provides the Bodys Specific Defenses
- 20.15. Adaptive Immunity is Triggered by Exposure of T Cells and B Cells to Specific Antigens Smartart Video: The Immune Response
- 20.16. Infected Cells Stimulate the Formation and Division of Cytotoxic T Cells, Memory Tc Cells, and Regulatory T Cells
- 20.17. Antigen-Presenting Cells can Stimulate Activation of Cd4 T Cells, Producing Helper T Cells that Promote B Cell Activation and Antibody Production
- 20.18. Antibodies are Small Soluble Proteins that Bind to Specific Antigens and Whose Abundance Increases Upon Later Antigen Exposure
- 20.19. Antibodies Use Many Different Mechanisms to Destroy Target Antigens
- 20.20. Clinical Module: Hypersensitivities are Abnormal Reactions to Antigens
- 20.21. Innate Immunity and Adaptive Immunity Work Together to Defeat Pathogens
- 20.22. Clinical Module: Immune Disorders Involving Either Overactivity or Underactivity can be Harmful

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- 21.1. The Respiratory System has an Upper and Lower Respiratory Tract with Different Functions
- 21.2. The Respiratory Defense System Protects the Respiratory Mucosa
- 21.3. The Upper Respiratory System Includes the Nose, Nasal Cavity, Paranasal Sinuses, and Pharynx
- 21.4. The Larynx Protects the Glottis that Produces Sounds
- 21.5. The Trachea, Bronchi, and Bronchial Branches Convey Air to and from Lung Gas Exchange Surfaces
- 21.6. The Lungs have Lobes that are Subdivided into Bronchopulmonary Segments
- 21.7. Pulmonary Lobules Contain Alveoli, Where Gas Exchange Occurs

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- 21.8. Respiratory Physiology Involves External and Internal Respiration
- 21.9. Pulmonary Ventilation is Driven by Pressure Changes Within the Pleural Cavities
- 21.10. Respiratory Muscles are Involved with Breathing, and Pulmonary Function Tests



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- 21.11. Pulmonary Ventilation Must be Closely Regulated to Meet Tissue Oxygen Demands
- 21.12. Gas Diffusion Depends on the Partial Pressures and Solubilities of Gases

Smartart Video: Partial Pressures and Gas Diffusion

- 21.13. Almost All the Oxygen in Blood is Transported Bound to Hemoglobin Within Red Blood Cells
- 21.14. Carbon Dioxide is Transported Three Ways in the Bloodstream
- 21.15. Clinical Module: Pulmonary Disease can Affect Both Lung Elasticity and Airflow
- 21.16. Respiratory Control Mechanisms Involve Interacting Centers in the Brainstem
- 21.17. Respiratory Reflexes Provide Rapid Automatic Adustments in Pulmonary Ventilation
- 21.18. Clinical Module: Respiratory Function Decreases with Age; Smoking Makes Matters Worse

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- 22.2. The Digestive Tract is a Muscular Tube Lined by a Mucous Epithelium
- 22.3. Smooth Muscle Tissue is Found Throughout the Body, But It Plays a Particularly Prominent Role in the Digestive Tract
- 22.4. Smooth Muscle Contractions Produce Motility of the Digestive Tract and Local Factors
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- 22.5. The Digestive Tract Begins with the Mouth and Ends with the Anus
- 22.6. The Oral Cavity is a Space that Contains the Tongue, Teeth, and Gums
- 22.7. Teeth in Different Regions of the Jaws Vary in Size, Shape, and Function
- 22.8. The Muscular Walls of the Pharynx and Esophagus Play a Key Role in Swallowing
- 22.9. The Stomach and Most of the Intestinal Tract are Suspended by Mesenteries and Covered by the Peritoneum
- 22.10. The Stomach is a Muscular, Expandable, J-Shaped Organ with Three Layers in the Muscular Layer
- 22.11. The Stomach Receives Food and Liquids from the Esophagus and Aids in Mechanical and Chemical Digestion
- 22.12. The Intestinal Tract is Specialized to Absorb Nutrients



- 22.13. The Small Intestine is Divided into the Duodenum, Jejunum, and Ileum
- 22.14. Several Hormones Regulate Digestion
- 22.15. Central and Local Mechanisms Coordinate Gastric and Intestinal Activities
- 22.16. The Large Intestine Stores and Concentrates Fecal Material
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- Section 3: Accessory Digestive Organs
 - 22.18. Some Accessory Digestive Organs have Secretory Functions
 - 22.19. Saliva Lubricates, Moistens, and Protects the Mouth and Begins Carbohydrate Digestion
 - 22.20. The Liver, the Largest Visceral Organ, is Divided into Left, Right, Caudate, and Quadrate Lobes
 - 22.21. The Liver Tissues have an Extensive and Complex Blood Supply

Smartart Video: Structure and Function of the Liver Lobule

- 22.22. The Gallbladder Stores and Concentrates Bile
- 22.23. The Pancreas has Vital Endocrine and Exocrine Functions
- 22.24. Clinical Module: Disorders of the Digestive System are Diverse and Relatively Common
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 - 23.1. Metabolism is the Sum of Catabolic and Anabolic Reactions
 - 23.2. Cells Use Nutrients from the Nutrient Pool for Metabolism
 - 23.3. Glycolysis is the First Step in Glucose Catabolism
 - 23.4. The Citric Acid Cycle Transfers Hydrogen Atoms to Coenzymes
 - 23.5. The Electron Transport Chain Establishes a Proton Gradient Used to Make ATP
 - 23.6. Glucose Catabolism Yields 3032 ATP
 - 23.7. Nutrient Metabolism Follows Several Pathways
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 - 23.8. Digestion Involves a Series of Steps to Make Nutrients Available to the Body
 - 23.9. Carbohydrates are Usually the Preferred Substrates for Catabolism and ATP Production Under Resting Conditions
 - 23.10. Lipids Reach the Bloodstream in Chylomicrons; the Cholesterol is then Extracted and



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- 23.11. Fatty Acids can be Broken Down to Provide Energy or Converted to Other Lipids
- 23.12. An Amino Acid not Needed for Protein Synthesis May be Broken Down or Converted to a Different Amino Acid
- 23.13. There are Two General Patterns of Metabolic Activity: The Absorptive and Postabsorptive States
- 23.14. Vitamins are Essential to the Function of Many Metabolic Pathways
- 23.15. Proper Nutrition Depends on Eating a Balanced Diet
- 23.16. Clinical Module: Metabolic Disorders May Result from Nutritional or Biochemical Problems

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- 23.17. Energetics is the Study of Energy Changes, and Thermoregulation Involves Heat Balance
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- 23.19. to Maintain a Constant Body Temperature, Heat Gain and Heat Loss Must be in Balance
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- 24.5. The Kidneys are Highly Vascular, and the Circulation Patterns are Complex

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- 24.6. The Kidneys Maintain Homeostasis by Removing Wastes and Producing Urine
- 24.7. Filtration, Reabsorption, and Secretion Occur in Specific Segments of the Nephron and Collecting System
- 24.8. Filtration Occurs at the Renal Corpuscle
- 24.9. The Glomerular Filtration Rate is the Amount of Filtrate Produced Each Minute



- 24.10. Reabsorption Predominates Along the Proximal Convoluted Tubule, Whereas Reabsorption and Secretion are Often Linked Along the Distal Convoluted Tubule
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- 26.3. Spermatogenesis Occurs in the Testes and Produces Mature Sperm
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