

Sixth Edition

ANATOMY & PHYSIOLOGY



Thibodeau • Patton

MOSBY



Contents

UNIT 1 THE BODY AS A WHOLE, 1

Chapter 1 Organization of the Body, 5

- Science and Society, 6
- Anatomy and Physiology, 7
 - Anatomy, 7
 - Physiology, 7
- The Language of Science and Medicine, 7
- Characteristics of Life, 8
- Levels of Organization, 9
 - Chemical Level—Basis for Life, 9
 - Organelle Level, 9
 - Cellular Level, 9
 - Tissue Level, 9
 - Organ Level, 11
 - System Level, 11
 - Organism Level, 12
- Anatomical Position, 12
- Body Cavities, 13
- Body Regions, 14
 - Abdominal Regions, 15
 - Abdominopelvic Quadrants, 16
- Terms Used in Describing Body Structure, 16
 - Directional Terms, 16
 - Terms Related to Organs, 17
- Body Planes and Sections, 17
- Interaction of Structure and Function, 19
- Body Type and Disease, 20
- Homeostasis, 21
- Homeostatic Control Mechanisms, 22
 - Basic Components of Control Mechanisms, 24
 - Negative Feedback Control Systems, 25
 - Positive Feedback Control Systems, 26
 - Feed-Forward in Control Systems, 27
 - Levels of Control, 27

Clear View of the Human Body

Chapter 2 The Chemical Basis of Life, 37

- Basic Chemistry, 38
 - Elements and Compounds, 38
 - Atoms, 38
- Attractions Between Atoms—Chemical Bonds, 42
- Attractions Between Molecules, 44
- Chemical Reactions, 45
- Metabolism, 45
 - Catabolism, 46
 - Anabolism, 46
- Organic and Inorganic Compounds, 46

Inorganic Molecules, 47

- Water, 47
- Oxygen and Carbon Dioxide, 47
- Electrolytes, 48
- Organic Molecules, 51
 - Carbohydrates, 51
 - Proteins, 53
 - Lipids, 59
 - Nucleic Acids and Related Molecules, 66
- Combined Forms, 69

Chapter 3 Anatomy of Cells, 77

- Functional Anatomy of Cells, 81
 - The Typical Cell, 82
 - Cell Structures, 82
- Cell Membranes, 84
 - Membrane Structure, 84
 - Membrane Function, 84
- Cytoplasm and Organelles, 88
 - Endoplasmic Reticulum, 88
 - Ribosomes, 88
 - Golgi Apparatus, 89
 - Lysosomes, 91
 - Proteasomes, 91
 - Peroxisomes, 91
 - Mitochondria, 91
- Nucleus, 92
- Cytoskeleton, 93
 - Cell Fibers, 94
 - Centrosomes, 94
 - Cell Extensions, 95
- Cell Connections, 97

Chapter 4 Physiology of Cells, 103

- Movement of Substances Through Cell Membranes, 104
 - Passive Transport Processes, 104
 - Active Transport Processes, 110
- Cell Metabolism, 114
 - The Role of Enzymes, 114
 - Catabolism, 117
 - Anabolism, 120
- Growth and Reproduction of Cells, 126
 - Cell Growth, 128
 - Cell Reproduction, 130
 - Regulating the Cell Life Cycle, 134

Chapter 5 Tissues, 145

- Introduction to Tissues, 146
- Principal Types of Tissue, 146

Extracellular Matrix, 146

Embryonic Development of Tissues, 146

- Epithelial Tissue, 150
 - Types and Locations of Epithelial Tissue, 150
 - Functions of Epithelial Tissue, 150
 - Generalizations About Epithelial Tissue, 150
 - Classification of Epithelial Tissue, 150
- Connective Tissue, 160
 - Functions of Connective Tissue, 160
 - Characteristics of Connective Tissue, 160
 - Classification of Connective Tissue, 161
 - Fibrous Connective Tissue, 161
 - Bone Tissue, 170
 - Cartilage Tissue, 170
 - Blood Tissue, 172
- Muscle Tissue, 175
- Nervous Tissue, 177
- Tissue Repair, 178
- Body Membranes, 179
 - Epithelial Membranes, 179
 - Connective Tissue Membranes, 181

UNIT 2 SUPPORT AND MOVEMENT, 193

Chapter 6 Skin and Its Appendages, 195

- Structure of the Skin, 196
 - Thin and Thick Skin, 196
 - Epidermis, 197
 - Dermal-Epidermal Junction, 199
 - Dermis, 201
- Hypodermis, 204
- Skin Color, 204
 - Melanin, 204
 - Other Pigments, 205
- Functions of the Skin, 206
 - Protection, 207
 - Sensation, 208
 - Flexibility, 208
 - Excretion, 208
 - Hormone (Vitamin D) Production, 208
 - Immunity, 209
 - Homeostasis of Body Temperature, 209
- Appendages of the Skin, 210
 - Hair, 210
 - Nails, 213
 - Skin Glands, 214

Chapter 7 Skeletal Tissues, 229

- Types of Bones, 230
 - Parts of a Long Bone, 231
- Bone Tissue, 232
 - Composition of Bone Matrix, 232
- Microscopic Structure of Bone, 233
 - Compact Bone, 233
 - Cancellous Bone, 235
 - Types of Bone Cells, 236
- Bone Marrow, 237
- Functions of Bone, 237
- Regulation of Blood Calcium Levels, 237
 - Mechanisms of Calcium Homeostasis, 237
- Development of Bone, 238
 - Intramembranous Ossification, 238
 - Endochondral Ossification, 239
- Bone Growth and Resorption, 242
- Repair of Bone Fractures, 243
- Cartilage, 244
 - Types of Cartilage, 244
 - Histophysiology of Cartilage, 245
 - Growth of Cartilage, 246

Chapter 8 Skeletal System, 255

- Divisions of the Skeleton, 256
- Axial Skeleton, 256
 - Skull, 256
 - Hyoid Bone, 276
 - Vertebral Column, 277
 - Sternum, 284
 - Ribs, 284
- Appendicular Skeleton, 286
 - Upper Extremity, 286
 - Lower Extremity, 289
- Skeletal Differences in Men and Women, 296

Chapter 9 Articulations, 311

- Classification of Joints, 312
 - Fibrous Joints (Synarthroses), 312
 - Cartilaginous Joints (Amphiarthroses), 312
 - Synovial Joints (Diarthroses), 314
- Representative Synovial Joints, 317
 - Humeroscapular Joint, 317
 - Elbow Joint, 319
 - Forearm, Wrist, Hand, and Finger Joints, 320
 - Hip Joint, 322
 - Knee Joint, 324
 - Ankle Joint, 324
 - Vertebral Joints, 324
- Types and Range of Movement at Synovial Joints, 330
 - Measuring Range of Motion, 330
 - Angular Movements, 330
 - Circular Movements, 336
 - Gliding Movements, 336
 - Special Movements, 336

Chapter 10 Anatomy of the Muscular System, 347

- Skeletal Muscle Structure, 348
 - Connective Tissue Components, 348
 - Size, Shape, and Fiber Arrangement, 348
 - Attachment of Muscles, 350
 - Muscle Actions, 351
 - Lever Systems, 352

How Muscles Are Named, 352

- Hints on How To Deduce Muscle Actions, 357

Important Skeletal Muscles, 358

- Muscles of Facial Expression, 358
- Muscles of Mastication, 358
- Muscles That Move the Head, 362

Trunk Muscles, 363

- Muscles of the Thorax, 363
- Muscles of the Abdominal Wall, 363
- Muscles of the Back, 365
- Muscles of the Pelvic Floor, 369

Upper Limb Muscles, 369

- Muscles Acting on the Shoulder Girdle, 369
- Muscles That Move the Upper Arm, 370
- Muscles That Move the Forearm, 372
- Muscles That Move the Wrist, Hand, and Fingers, 372

Lower Limb Muscles, 374

- Muscles That Move the Thigh and Lower Leg, 374
- Muscles That Move the Ankle and Foot, 383

Posture, 386

- How Posture Is Maintained, 386

Chapter 11 Physiology of the Muscular System, 395

- General Functions, 396
- Function of Skeletal Muscle Tissue, 396
 - Overview of the Muscle Cell, 396
 - Myofilaments, 398
 - Mechanism of Contraction, 400
 - Energy Sources for Muscle Contraction, 404
- Function of Skeletal Muscle Organs, 408
 - Motor Unit, 408
 - Myography, 409
 - The Twitch Contraction, 409
 - Treppe: The Staircase Phenomenon, 409
 - Tetanus, 410
 - Muscle Tone, 411
- The Graded Strength Principle, 411
 - Isotonic and Isometric Contractions, 414
- Function of Cardiac and Smooth Muscle Tissue, 415
 - Cardiac Muscle, 415
 - Smooth Muscle, 417

UNIT 3 COMMUNICATION, CONTROL, AND INTEGRATION, 429**Chapter 12 Nervous System Cells, 431**

- Organization of the Nervous System, 432
 - Central and Peripheral Nervous Systems, 432
 - Afferent and Efferent Divisions, 432
 - Somatic and Autonomic Nervous Systems, 433
- Cells of the Nervous System, 433
 - Glia, 434
 - Neurons, 438
 - Classification of Neurons, 440
 - Reflex Arc, 440
- Nerves and Tracts, 443
- Repair of Nerve Fibers, 443
- Nerve Impulses, 444
 - Membrane Potentials, 444
 - Resting Membrane Potentials, 445
 - Local Potentials, 447

Action Potential, 447

- Refractory Period, 448
- Conduction of the Action Potential, 449

Synaptic Transmission, 450

- Structure of the Synapse, 450
- Types of Synapses, 450
- Mechanisms of Synaptic Transmission, 452
- Summation, 452

Neurotransmitters, 456

- Classification of Neurotransmitters, 456
- Acetylcholine, 457
- Amines, 457
- Amino Acids, 459
- Other Small-Molecule Transmitters, 460
- Neuropeptides, 460

Chapter 13 Central Nervous System, 471

- Coverings of the Brain and Spinal Cord, 472
- Cerebrospinal Fluid, 474
 - Fluid Spaces, 475
 - Formation and Circulation of Cerebrospinal Fluid, 475
- Spinal Cord, 478
 - Structure of the Spinal Cord, 478
 - Functions of the Spinal Cord, 479
- Brain, 482
 - Structure of the Brainstem, 483
 - Functions of the Brainstem, 484
 - Structure of the Cerebellum, 484
 - Functions of the Cerebellum, 486
 - Diencephalon, 487
 - Structure of the Cerebrum, 490
 - Functions of the Cerebral Cortex, 493
- Somatic Sensory Pathways in the Central Nervous System, 499
- Somatic Motor Pathways in the Central Nervous System, 502

Chapter 14 Peripheral Nervous System, 515

- Spinal Nerves, 516
 - Structure of Spinal Nerves, 516
 - Nerve Plexuses, 518
 - Dermatomes and Myotomes, 521
- Cranial Nerves, 523
 - Olfactory Nerve (I), 525
 - Optic Nerve (II), 525
 - Oculomotor Nerve (III), 525
 - Trochlear Nerve (IV), 525
 - Trigeminal Nerve (V), 525
 - Abducens Nerve (VI), 525
 - Facial Nerve (VII), 525
 - Vestibulocochlear Nerve (VIII), 530
 - Glossopharyngeal Nerve (IX), 530
 - Vagus Nerve (X), 532
 - Accessory Nerve (XI), 532
 - Hypoglossal Nerve (XII), 532
- Divisions of the Peripheral Nervous System, 533
 - Somatic Motor Nervous System, 533
 - Somatic Reflexes, 533
 - Autonomic Nervous System, 535

Chapter 15 Sense Organs, 553

- Sensory Receptors, 554
 - Receptor Response, 554
 - Distribution of Receptors, 554

Classification of Receptors, 554
 Classification by Location, 554
 Classification by Stimulus Detected, 555
 Classification by Structure, 555

Special Senses, 560

Sense of Smell, 560
 Olfactory Receptors, 560
 Olfactory Pathway, 561

Sense of Taste, 562
 Taste Buds, 562
 Neuronal Pathway for Taste, 563

Sense of Hearing and Balance: The Ear, 563
 External Ear, 563
 Middle Ear, 564
 Inner Ear, 565

Vision: The Eye, 571
 Structure of the Eye, 571
 The Process of Seeing, 576

Chapter 16 Endocrine System, 593
 Organization of the Endocrine System, 594
 Hormones, 595
 Classification of Hormones, 595
 How Hormones Work, 598
 Regulation of Hormone Secretion, 602
 Regulation of Target Cell Sensitivity, 603

Prostaglandins, 604

Pituitary Gland, 606
 Structure of the Pituitary Gland, 606
 Adenohypophysis (Anterior Lobe of Pituitary), 607
 Neurohypophysis (Posterior Lobe of Pituitary), 612

Pineal Gland, 613

Thyroid Gland, 614
 Structure of the Thyroid Gland, 614
 Thyroid Hormone, 614
 Calcitonin, 616

Parathyroid Glands, 617
 Structure of the Parathyroid Glands, 617
 Parathyroid Hormone, 617

Adrenal Glands, 619
 Structure of the Adrenal Glands, 619
 Adrenal Cortex, 619
 Adrenal Medulla, 623

Pancreatic Islets, 625
 Structure of the Pancreatic Islets, 625
 Pancreatic Hormones, 625

Gonads, 630
 Testes, 630
 Ovaries, 631

Placenta, 631

Thymus, 631

Gastric and Intestinal Mucosa, 631

Heart, 632

Other Endocrine Glands and Hormones, 632

UNIT 4 TRANSPORTATION AND DEFENSE, 645

Chapter 17 Blood, 647

Composition of Blood, 648
 Blood Volume, 648

Formed Elements of Blood, 649
 Red Blood Cells (Erythrocytes), 650
 White Blood Cells (Leukocytes), 655
 Platelets, 657

Blood Types (Blood Groups), 658
 The ABO System, 658
 The Rh System, 659

Blood Plasma, 660

Blood Clotting (Coagulation), 662
 Mechanism of Blood Clotting, 662
 Conditions That Oppose Clotting, 665
 Conditions That Hasten Clotting, 665
 Clot Dissolution, 665

Chapter 18 Anatomy of the Cardiovascular System, 677

Heart, 678
 Location of the Heart, 678
 Size and Shape of the Heart, 678
 Coverings of the Heart, 678
 Structure of the Heart, 682

Blood Vessels, 692
 Types of Blood Vessels, 692
 Structure of Blood Vessels, 694

Major Blood Vessels, 696
 Circulatory Routes, 696
 Systemic Circulation, 696

Chapter 19 Physiology of the Cardiovascular System, 733

Hemodynamics, 734

The Heart as a Pump, 734
 Conduction System of the Heart, 735
 Electrocardiogram (ECG), 737
 Cardiac Cycle, 742
 Heart Sounds, 744

Primary Principle of Circulation, 745

Arterial Blood Pressure, 746
 Cardiac Output, 746
 Peripheral Resistance, 751

Venous Return to the Heart, 755
 Venous Pumps, 757
 Total Blood Volume, 758

Measuring Blood Pressure, 762
 Arterial Blood Pressure, 762
 Blood Pressure and Bleeding, 764

Minute Volume of Blood, 764

Velocity of Blood Flow, 765

Pulse, 766
 Mechanism, 766
 Pulse Wave, 766
 Where Pulse Can Be Felt, 766
 Venous Pulse, 766

Chapter 20 Lymphatic System, 779

Overview of the Lymphatic System, 780
 Importance of the Lymphatic System, 780

Lymph and Interstitial Fluid, 781

Lymphatic Vessels, 781
 Distribution of Lymphatic Vessels, 781
 Structure of Lymphatic Vessels, 781
 Functions of Lymphatic Vessels, 782

Circulation of Lymph, 782
 The Lymphatic Pump, 782

Lymph Nodes, 785
 Structure of Lymph Nodes, 785
 Locations of Lymph Nodes, 785
 Functions of Lymph Nodes, 786

Lymphatic Drainage of the Breast, 788
 Distribution of Lymphatics in the Breast, 788
 Lymph Nodes Associated with the Breast, 789

Tonsils, 790

Thymus, 790

Location and Appearance of the Thymus, 790
 Structure of the Thymus, 791
 Function of the Thymus, 791

Spleen, 792
 Location of the Spleen, 792
 Structure of the Spleen, 792
 Functions of the Spleen, 793

Chapter 21 Immune System, 801

Organization of the Immune System, 802

Innate Immunity, 803
 Species Resistance, 803
 Mechanical and Chemical Barriers, 805
 Inflammation, 805
 Natural Killer Cells, 808
 Interferon, 810
 Complement, 810

Overview of Adaptive Immunity, 810

B Cells and Antibody-Mediated Immunity, 814
 Development and Activation of B Cells, 814
 Antibodies (Immunoglobulins), 814
 Clonal Selection Theory, 820

T Cells and Cell-Mediated Immunity, 820
 Development of T Cells, 820
 Activation and Functions of T Cells, 820

Types of Adaptive Immunity, 824
 Summary of Adaptive Immunity, 825

Chapter 22 Stress, 839

Selye's Concept of Stress, 840
 Development of the Stress Concept, 840
 Definitions, 840
 Stressors, 840
 General Adaptation Syndrome, 842
 Mechanism of Stress, 842

Some Current Concepts about Stress, 844
 Definitions, 844
 Stress Syndrome, 844
 Stress and Disease, 846
 Indicators of Stress, 846
 Corticoids and Resistance to Stress, 846
 Psychological Stress, 847
 Effects of Intrauterine Stress, 848

UNIT 5 RESPIRATION, NUTRITION, AND EXCRETION, 853

Chapter 23 Anatomy of the Respiratory System, 855

Overview of the Respiratory System, 856
 Functions of the Respiratory System, 856
 Structural Plan of the Respiratory System, 856

Upper Respiratory Tract, 857
 Nose, 857
 Pharynx, 859
 Larynx, 860

Lower Respiratory Tract, 862
 Trachea, 862
 Bronchi and Alveoli, 862
 Lungs, 869
 Thorax, 871

Chapter 24 Physiology of the Respiratory

- System, **883**
- Respiratory Physiology, **884**
- Pulmonary Ventilation, **884**
 - Mechanism of Pulmonary Ventilation, **884**
 - Pulmonary Volumes and Capacities, **894**
- Pulmonary Gas Exchange, **899**
 - Partial Pressure, **899**
 - Exchange of Gases in the Lungs, **899**
- How Blood Transports Gases, **903**
 - Hemoglobin, **903**
 - Transport of Oxygen, **903**
 - Transport of Carbon Dioxide, **904**
- Systemic Gas Exchange, **908**
- Regulation of Pulmonary Function, **911**
 - Respiratory Control Centers, **911**
 - Factors That Influence Breathing, **912**
 - Ventilation and Perfusion, **914**

Chapter 25 Anatomy of the Digestive

- System, **925**
- Overview of the Digestive System, **926**
 - Role of the Digestive System, **926**
 - Organization of the Digestive System, **926**
- Mouth, **929**
 - Structure of the Oral Cavity, **929**
 - Salivary Glands, **930**
 - Teeth, **932**
- Pharynx, **934**
- Esophagus, **934**
- Stomach, **935**
 - Size and Position of the Stomach, **935**
 - Divisions of the Stomach, **935**
 - Curves of the Stomach, **935**
 - Sphincter Muscles, **936**
 - Stomach Wall, **936**
 - Functions of the Stomach, **937**
- Small Intestine, **939**
 - Size and Position of the Small Intestine, **939**
 - Divisions of the Small Intestine, **939**
 - Wall of the Small Intestine, **939**
- Large Intestine, **940**
 - Size of the Large Intestine, **940**
 - Divisions of the Large Intestine, **940**
 - Wall of the Large Intestine, **942**
- Vermiform Appendix, **942**
- Peritoneum, **943**
- Liver, **944**
 - Location and Size of the Liver, **944**
 - Liver Lobes and Lobules, **944**
 - Bile Ducts, **946**
 - Functions of the Liver, **946**
- Gallbladder, **947**
 - Size and Location of the Gallbladder, **947**
 - Structure of the Gallbladder, **947**
 - Functions of the Gallbladder, **947**
- Pancreas, **947**
 - Size and Location of the Pancreas, **947**
 - Structure of the Pancreas, **949**
 - Functions of the Pancreas, **949**

Chapter 26 Physiology of the Digestive

- System, **961**
- Overview of Digestive Function, **962**
- Digestion, **962**
 - Mechanical Digestion, **962**
 - Chemical Digestion, **969**

Secretion, **973**

- Saliva, **974**
- Gastric Juice, **974**
- Pancreatic Juice, **975**
- Bile, **976**
- Intestinal Juice, **977**
- Control of Digestive Gland Secretion, **978**
 - Control of Salivary Secretion, **978**
 - Control of Gastric Secretion, **978**
 - Control of Pancreatic Secretion, **978**
 - Control of Bile Secretion, **980**
 - Control of Intestinal Secretion, **980**
- Absorption, **980**
 - Process of Absorption, **980**
 - Mechanisms of Absorption, **980**
- Elimination, **983**

Chapter 27 Nutrition and Metabolism, **993**

- Overview of Nutrition and Metabolism, **994**
- Carbohydrates, **996**
 - Dietary Sources of Carbohydrates, **996**
 - Carbohydrate Metabolism, **997**
- Lipids, **1008**
 - Dietary Sources of Lipids, **1008**
 - Transport of Lipids, **1008**
 - Lipid Metabolism, **1009**
- Proteins, **1011**
 - Sources of Proteins, **1011**
 - Protein Metabolism, **1011**
- Vitamins and Minerals, **1013**
 - Vitamins, **1013**
 - Minerals, **1015**
- Metabolic Rates, **1018**
 - Basal Metabolic Rate, **1018**
 - Total Metabolic Rate, **1020**
 - Energy Balance and Body Weight, **1020**
- Mechanisms for Regulating Food Intake, **1021**

Chapter 28 Urinary System, **1033**

- Overview of the Urinary System, **1034**
- Anatomy of the Urinary System, **1034**
 - Gross Structure, **1034**
 - Microscopic Structure of the Nephron, **1041**
- Physiology of the Urinary System, **1045**
 - Overview of Kidney Function, **1045**
 - Filtration, **1045**
 - Reabsorption, **1047**
 - Tubular Secretion, **1051**
 - Regulation of Urine Volume, **1051**
 - Urine Composition, **1054**

Chapter 29 Fluid and Electrolyte Balance, **1067**

- Interrelationship of Fluid and Electrolyte Balance, **1068**
- Total Body Water, **1068**
- Body Fluid Compartments, **1068**
- Chemical Content, Distribution, and Measurement of Electrolytes in Body Fluids, **1068**
 - Extracellular vs. Intracellular Fluids, **1069**
 - Measuring Electrolyte Reactivity, **1070**
- Avenues by Which Water Enters and Leaves the Body, **1072**
- Some General Principles About Fluid Balance, **1072**

Mechanisms That Maintain Homeostasis of Total Fluid Volume, **1072**

- Regulation of Fluid Intake, **1074**
- Regulation of Urine Volume, **1075**
- Factors That Alter Fluid Loss Under Abnormal Conditions, **1075**
- Regulation of Water and Electrolyte Levels in Plasma and Interstitial Fluid (ECF), **1076**
 - Edema, **1078**
- Regulation of Water and Electrolyte Levels in ICF, **1080**
- Regulation of Sodium and Potassium Levels in Body Fluids, **1080**

Chapter 30 Acid-Base Balance, **1089**

- Mechanisms That Control pH of Body Fluids, **1090**
 - Meaning of Term pH, **1090**
 - Sources of pH-Influencing Elements, **1090**
 - Types of pH Control Mechanisms, **1091**
 - Effectiveness of pH Control Mechanisms—Range of pH, **1092**
- Buffer Mechanisms for Controlling pH of Body Fluids, **1092**
 - Buffers Defined, **1092**
 - Buffer Pairs Present in Body Fluids, **1092**
 - Action of Buffers to Prevent Marked Changes in pH of Body Fluids, **1092**
 - Evaluation of the Role of Buffers in pH Control, **1095**
- Respiratory Mechanisms of pH Control, **1095**
 - Explanation of Mechanisms, **1095**
 - Adjustment of Respirations to pH of Arterial Blood, **1096**
 - Some Principles Relating Respirations and pH of Body Fluids, **1097**
- Urinary Mechanisms of pH Control, **1097**
 - General Principles About Mechanism, **1097**
 - Mechanisms That Control Urine pH, **1097**

UNIT 6 REPRODUCTION AND DEVELOPMENT, 1107**Chapter 31** Male Reproductive System, **1109**

- Male Reproductive Organs, **1110**
 - Perineum, **1110**
- Testes, **1110**
 - Structure and Location, **1110**
 - Microscopic Anatomy of the Testis, **1111**
 - Testes Functions, **1112**
 - Structure of Spermatozoa, **1113**
- Reproductive (Genital) Ducts, **1116**
 - Epididymis, **1116**
 - Vas Deferens (Ductus Deferens), **1116**
 - Ejaculatory Duct, **1116**
 - Urethra, **1117**
- Accessory Reproductive Glands, **1117**
 - Seminal Vesicles, **1117**
 - Prostate Gland, **1118**
 - Bulbourethral Glands, **1118**
- Supporting Structures, **1120**
 - Scrotum, **1120**
 - Penis (External), **1120**
 - Spermatic Cords (Internal), **1120**

Composition and Course of Seminal Fluid, **1120**
Male Fertility, **1121**

Chapter 32 Female Reproductive System, 1129

Overview of the Female Reproductive System, **1130**
Function of the Female Reproductive System, **1130**
Structural Plan of the Female Reproductive System, **1130**
Perineum, **1131**

Ovaries, **1131**

Location of the Ovaries, **1131**
Microscopic Structure of the Ovaries, **1132**
Functions of the Ovaries, **1133**

Uterus, **1134**

Structure of the Uterus, **1134**
Location of the Uterus, **1134**
Position of the Uterus, **1134**
Functions of the Uterus, **1135**

Uterine Tubes, **1135**

Location of the Uterine Tubes, **1135**
Structure of the Uterine Tubes, **1135**
Function of the Uterine Tubes, **1136**

Vagina, **1136**

Location of the Vagina, **1136**
Structure of the Vagina, **1137**
Functions of the Vagina, **1138**

Vulva, **1138**

Structure of the Vulva, **1138**
Functions of the Vulva, **1138**

Breasts, **1139**

Location and Size of the Breasts, **1139**

Structure of the Breasts, **1139**

Function of the Breasts, **1140**

Female Reproductive Cycles, **1141**

Recurring Cycles, **1141**

Control of Female Reproductive Cycles, **1143**

Importance of Female Reproductive Cycles, **1144**

Infertility and Use of Fertility

Drugs, **1144**

Menarche and Menopause, **1147**

Chapter 33 Growth and Development, 1161

A New Human Life, **1162**

Production of Sex Cells, **1162**

Ovulation and Insemination, **1164**

Fertilization, **1167**

Prenatal Period, **1169**

Cleavage and Implantation, **1169**

Placenta, **1171**

Periods of Development, **1173**

Formation of the Primary Germ Layers, **1173**

Histogenesis and Organogenesis, **1176**

Birth, or Parturition, **1181**

Stages of Labor, **1181**

Multiple Births, **1182**

Postnatal Period, **1183**

Infancy, **1184**

Childhood, **1184**

Adolescence and Adulthood, **1184**

Older Adulthood and Senescence, **1185**

Effects of Aging, **1187**

Skeletal System, **1187**

Muscular System, **1187**

Integumentary System (Skin), **1187**

Urinary System, **1187**

Respiratory System, **1187**

Cardiovascular System, **1187**

Special Senses, **1187**

Reproductive Systems, **1189**

Causes of Death, **1190**

Chapter 34 Genetics and Heredity, 1199

The Science of Genetics, **1200**

Chromosomes and Genes, **1200**

Mechanism of Gene Function, **1200**

The Human Genome, **1200**

Distribution of Chromosomes to Offspring, **1203**

Gene Expression, **1204**

Hereditary Traits, **1204**

Sex-Linked Traits, **1207**

Genetic Mutations, **1209**

Medical Genetics, **1209**

Mechanisms of Genetic Diseases, **1209**

Single-Gene Diseases, **1210**

Chromosomal Diseases, **1212**

Genetic Basis of Cancer, **1213**

Prevention and Treatment of Genetic Diseases, **1216**

Genetic Counseling, **1216**

Treating Genetic Diseases, **1220**

GLOSSARY, G-1