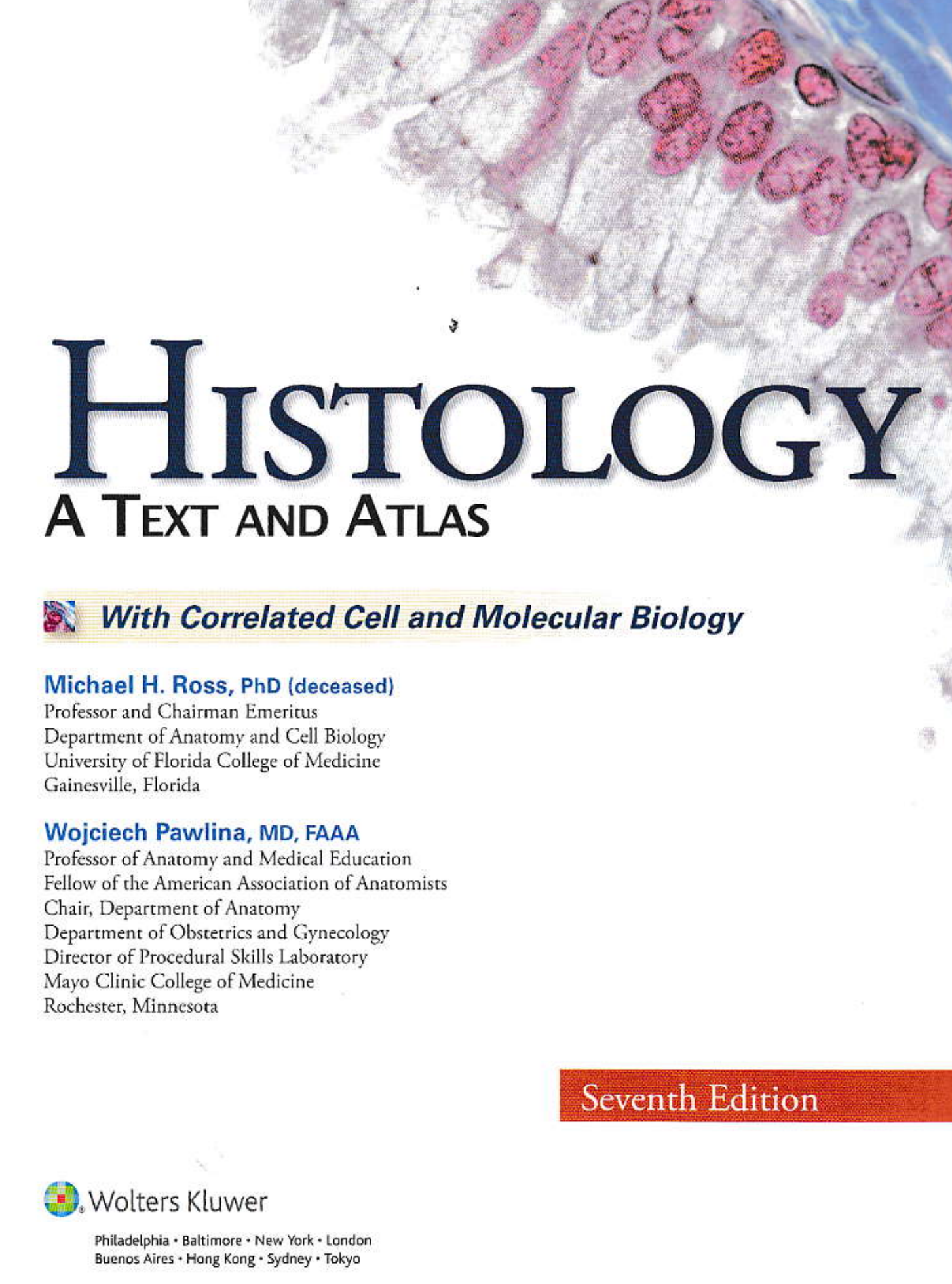




HISTOLOGY

A TEXT AND ATLAS

 ***With Correlated Cell and Molecular Biology***

Michael H. Ross, PhD (deceased)

Professor and Chairman Emeritus
Department of Anatomy and Cell Biology
University of Florida College of Medicine
Gainesville, Florida

Wojciech Pawlina, MD, FAAA

Professor of Anatomy and Medical Education
Fellow of the American Association of Anatomists
Chair, Department of Anatomy
Department of Obstetrics and Gynecology
Director of Procedural Skills Laboratory
Mayo Clinic College of Medicine
Rochester, Minnesota

Seventh Edition

 **Wolters Kluwer**

Philadelphia • Baltimore • New York • London
Buenos Aires • Hong Kong • Sydney • Tokyo

Contents

Preface vi

Acknowledgments vii

1 Methods 1

OVERVIEW OF METHODS USED IN HISTOLOGY / 1

TISSUE PREPARATION / 2

HISTOCHEMISTRY AND CYTOCHEMISTRY / 3

MICROSCOPY / 11

Folder 1.1 Clinical Correlation: Frozen Sections / 4

Folder 1.2 Functional Considerations: Feulgen

Microspectrophotometry / 7

Folder 1.3 Clinical Correlation: Monoclonal Antibodies in Medicine / 9

Folder 1.4 Functional Considerations: Proper Use of the Light Microscope / 15

HISTOLOGY 101 / 22

2 Cell Cytoplasm 23

OVERVIEW OF THE CELL AND CYTOPLASM / 23

MEMBRANOUS ORGANELLES / 26

NONMEMBRANOUS ORGANELLES / 55

INCLUSIONS / 70

CYTOPLASMIC MATRIX / 71

Folder 2.1 Clinical Correlation: Lysosomal Storage Diseases / 42

Folder 2.2 Clinical Correlation: Abnormalities in Microtubules and Filaments / 65

Folder 2.3 Clinical Correlation: Abnormal Duplication of Centrioles and Cancer / 71

HISTOLOGY 101 / 72

3 The Cell Nucleus 74

OVERVIEW OF THE NUCLEUS / 74

NUCLEAR COMPONENTS / 74

CELL RENEWAL / 84

CELL CYCLE / 84

CELL DEATH / 90

Folder 3.1 Clinical Correlation: Cytogenetic Testing / 79

Folder 3.2 Clinical Correlation: Regulation of Cell Cycle and Cancer Treatment / 80

HISTOLOGY 101 / 95

4 Tissues: Concept and Classification 97

OVERVIEW OF TISSUES / 97

EPITHELIUM / 98

CONNECTIVE TISSUE / 98

MUSCLE TISSUE / 99

NERVE TISSUE / 99

HISTOGENESIS OF TISSUES / 100

IDENTIFYING TISSUES / 101

Folder 4.1 Clinical Correlation: Ovarian Teratomas / 102

HISTOLOGY 101 / 104

5 Epithelial Tissue 105

OVERVIEW OF EPITHELIAL STRUCTURE AND FUNCTION / 105

CLASSIFICATION OF EPITHELIUM / 106

CELL POLARITY / 107

THE APICAL DOMAIN AND ITS MODIFICATIONS / 107

THE LATERAL DOMAIN AND ITS SPECIALIZATIONS IN CELL-TO-CELL ADHESION / 120

THE BASAL DOMAIN AND ITS SPECIALIZATIONS IN CELL-TO-EXTRACELLULAR MATRIX ADHESION / 133

GLANDS / 143

EPITHELIAL CELL RENEWAL / 146

Folder 5.1 Clinical Correlation: Epithelial Metaplasia / 109

Folder 5.2 Clinical Correlation: Primary Ciliary Dyskinesia (Immotile Cilia Syndrome) / 118

Folder 5.3 Clinical Correlation: Junctional Complexes as a Target of Pathogenic Agents / 126

Folder 5.4 Functional Considerations: Basement Membrane and Basal Lamina Terminology / 135

Folder 5.5 Functional Considerations: Mucous and Serous Membranes / 147

HISTOLOGY 101 / 148

Atlas Plates

PLATE 1 Simple Squamous and Cuboidal Epithelia / 150

PLATE 2 Simple and Stratified Epithelia / 152

PLATE 3 Stratified Epithelia and Epithelioid Tissues / 154

6 Connective Tissue 156

OVERVIEW OF CONNECTIVE TISSUE / 156

EMBRYONIC CONNECTIVE TISSUE / 156

CONNECTIVE TISSUE PROPER / 158

CONNECTIVE TISSUE FIBERS / 160

EXTRACELLULAR MATRIX / 171

CONNECTIVE TISSUE CELLS / 174

Folder 6.1 Clinical Correlation: Collagenopathies / 167

Folder 6.2 Clinical Correlation: Sun Exposure and Molecular Changes in Photoaged Skin / 171

Folder 6.3 Clinical Correlation: Role of Myofibroblasts in Wound Repair / 180

Folder 6.4 Functional Considerations: The Mononuclear Phagocyte System / 181

Folder 6.5 Clinical Correlation: The Role of Mast Cells and Basophils in Allergic Reactions / 183

HISTOLOGY 101 / 186

Atlas Plates

PLATE 4 Loose and Dense Irregular Connective Tissue / 188

PLATE 5 Dense Regular Connective Tissue, Tendons, and Ligaments / 190

PLATE 6 Elastic Fibers and Elastic Lamellae / 192

7 Cartilage 194

OVERVIEW OF CARTILAGE / 194

HYALINE CARTILAGE / 194

ELASTIC CARTILAGE / 200

FIBROCARILAGE / 200

CHONDROGENESIS AND CARTILAGE GROWTH / 201

REPAIR OF HYALINE CARTILAGE / 203

Folder 7.1 Clinical Correlation: Osteoarthritis / 195

Folder 7.2 Clinical Correlation: Malignant Tumors of the Cartilage; Chondrosarcomas / 203

HISTOLOGY 101 / 205

Atlas Plates

PLATE 7 Hyaline Cartilage / 206

PLATE 8 Hyaline Cartilage and the Developing Skeleton / 208

PLATE 9 Elastic Cartilage / 210

PLATE 10 Fibrocartilage / 212

8 Bone 214

OVERVIEW OF BONE / 214

GENERAL STRUCTURE OF BONES / 215

TYPES OF BONE TISSUE / 217

CELLS OF BONE TISSUE / 219

BONE FORMATION / 228

BIOLOGIC MINERALIZATION AND MATRIX VESICLES / 235

PHYSIOLOGIC ASPECTS OF BONE / 236

BIOLOGY OF BONE REPAIR / 239

Folder 8.1 Clinical Correlation: Joint Diseases / 217

Folder 8.2 Clinical Correlation: Osteoporosis / 237

Folder 8.3 Clinical Correlation: Nutritional Factors in Bone Formation / 239

Folder 8.4 Functional Considerations: Hormonal Regulation of Bone Growth / 239

HISTOLOGY 101 / 242

Atlas Plates

PLATE 11 Bone, Ground Section / 244

PLATE 12 Bone and Bone Tissue / 246

PLATE 13 Endochondral Bone Formation I / 248

PLATE 14 Endochondral Bone Formation II / 250

PLATE 15 Intramembranous Bone Formation / 252

9 Adipose Tissue 254

OVERVIEW OF ADIPOSE TISSUE / 254

WHITE ADIPOSE TISSUE / 254

BROWN ADIPOSE TISSUE / 259

TRANSDIFFERENTIATION OF ADIPOSE TISSUE / 266

Folder 9.1 Clinical Correlation: Obesity / 261

Folder 9.2 Clinical Correlation: Adipose Tissue Tumors / 263

Folder 9.3 Clinical Correlation: PET Scanning and Brown Adipose Tissue Interference / 264

HISTOLOGY 101 / 267

Atlas Plate

PLATE 16 Adipose Tissue / 268

10 Blood 270

OVERVIEW OF BLOOD / 270

PLASMA / 271

ERYTHROCYTES / 273

LEUKOCYTES / 277

THROMBOCYTES / 288

COMPLETE BLOOD COUNT / 291

FORMATION OF BLOOD CELLS (HEMOPOIESIS) / 292

BONE MARROW / 301

Folder 10.1 Clinical Correlation: ABO and Rh Blood Group Systems / 275

Folder 10.2 Clinical Correlation: Hemoglobin in Patients with Diabetes / 277

Folder 10.3 Clinical Correlation: Hemoglobin Disorders / 278

Folder 10.4 Clinical Correlation: Inherited Disorders of Neutrophils; Chronic Granulomatous Disease / 283

Folder 10.5 Clinical Correlation: Hemoglobin Breakdown and Jaundice / 284

Folder 10.6 Clinical Correlation: Cellularity of the Bone Marrow / 303

HISTOLOGY 101 / 304

Atlas Plates

PLATE 17 Erythrocytes and Granulocytes / 306

PLATE 18 Agranulocytes and Red Marrow / 308

PLATE 19 Erythropoiesis / 310

PLATE 20 Granulopoiesis / 312

11 Muscle Tissue 314

OVERVIEW AND CLASSIFICATION OF MUSCLE / 314

SKELETAL MUSCLE / 315

CARDIAC MUSCLE / 331

SMOOTH MUSCLE / 335

Folder 11.1 Functional Considerations: Muscle Metabolism and Ischemia / 320

Folder 11.2 Clinical Correlation: Muscular Dystrophies—Dystrophin and Dystrophin-Associated Proteins / 323

Folder 11.3 Clinical Correlation: Myasthenia Gravis / 328

Folder 11.4 Functional Considerations: Comparison of the Three Muscle Types / 340

HISTOLOGY 101 / 342

Atlas Plates

PLATE 21 Skeletal Muscle I / 344

PLATE 22 Skeletal Muscle II and Electron Microscopy / 346

PLATE 23 Myotendinous Junction / 348

PLATE 24 Cardiac Muscle / 350

PLATE 25 Cardiac Muscle, Purkinje Fibers / 352

PLATE 26 Smooth Muscle / 354

12 Nerve Tissue 356

OVERVIEW OF THE NERVOUS SYSTEM / 356

COMPOSITION OF NERVE TISSUE / 357

THE NEURON / 357

SUPPORTING CELLS OF THE NERVOUS SYSTEM:

THE NEUROGLIA / 368

ORIGIN OF NERVE TISSUE CELLS / 378

ORGANIZATION OF THE PERIPHERAL NERVOUS SYSTEM / 379

ORGANIZATION OF THE AUTONOMIC NERVOUS SYSTEM / 381

ORGANIZATION OF THE CENTRAL NERVOUS SYSTEM / 385

RESPONSE OF NEURONS TO INJURY / 389

Folder 12.1 Clinical Correlation: Parkinson's Disease / 362

Folder 12.2 Clinical Correlation: Demyelinating Diseases / 370

Folder 12.3 Clinical Correlation: Reactive Gliosis: Scar Formation in the Central Nervous System / 391

HISTOLOGY 101 / 392

- PLATE 27 Sympathetic and Dorsal Root Ganglia / 394
 PLATE 28 Peripheral Nerve / 396
 PLATE 29 Cerebrum / 398
 PLATE 30 Cerebellum / 400
 PLATE 31 Spinal Cord / 402

13 Cardiovascular System 404

OVERVIEW OF THE CARDIOVASCULAR SYSTEM / 404

HEART / 405

GENERAL FEATURES OF ARTERIES AND VEINS / 411

ARTERIES / 416

CAPILLARIES / 423

ARTERIOVENOUS SHUNTS / 425

VEINS / 425

ATYPICAL BLOOD VESSELS / 427

LYMPHATIC VESSELS / 429

Folder 13.1 Clinical Correlation: Atherosclerosis / 413

Folder 13.2 Clinical Correlation: Hypertension / 419

Folder 13.3 Clinical Correlation: Ischemic Heart Disease / 430

HISTOLOGY 101 / 432

Atlas Plates

- PLATE 32 Heart / 434
 PLATE 33 Aorta / 436
 PLATE 34 Muscular Arteries and Medium Veins / 438
 PLATE 35 Arterioles, Venules, and Lymphatic Vessels / 440

14 Lymphatic System 442

OVERVIEW OF THE LYMPHATIC SYSTEM / 442

CELLS OF THE LYMPHATIC SYSTEM / 443

LYMPHATIC TISSUES AND ORGANS / 455

Folder 14.1 Functional Considerations: Origin of the Names *T Lymphocyte* and *B Lymphocyte* / 448

Folder 14.2 Clinical Correlation: Hypersensitivity Reactions / 449

Folder 14.3 Clinical Correlation: Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) / 456

Folder 14.4 Clinical Correlation: Reactive (Inflammatory) Lymphadenitis / 470

HISTOLOGY 101 / 474

Atlas Plates

- PLATE 36 Palatine Tonsil / 476
 PLATE 37 Lymph Node I / 478
 PLATE 38 Lymph Node II / 480
 PLATE 39 Spleen I / 482
 PLATE 40 Spleen II / 484
 PLATE 41 Thymus / 486

15 Integumentary System 488

OVERVIEW OF THE INTEGUMENTARY SYSTEM / 488

LAYERS OF THE SKIN / 489

CELLS OF THE EPIDERMIS / 493

STRUCTURES OF SKIN / 500

Folder 15.1 Clinical Correlation: Cancers of Epidermal Origin / 491

Folder 15.2 Functional Considerations: Skin Color / 500

Folder 15.3 Functional Considerations: Hair Growth and Hair Characteristics / 504

Folder 15.4 Functional Considerations: The Role of Sebum / 505

Folder 15.5 Clinical Correlation: Sweating and Disease / 505

Folder 15.6 Clinical Correlation: Skin Repair / 511

HISTOLOGY 101 / 512

- PLATE 42 Skin I / 514
 PLATE 43 Skin II / 516
 PLATE 44 Apocrine and Eccrine Sweat Glands / 518
 PLATE 45 Sweat and Sebaceous Glands / 520
 PLATE 46 Integument and Sensory Organs / 522
 PLATE 47 Hair Follicle and Nail / 524

16 Digestive System I: Oral Cavity and Associated Structures 526

OVERVIEW OF THE DIGESTIVE SYSTEM / 526

ORAL CAVITY / 527

TONGUE / 529

TEETH AND SUPPORTING TISSUES / 533

SALIVARY GLANDS / 545

Folder 16.1 Clinical Correlation: The Genetic Basis of Taste / 535

Folder 16.2 Clinical Correlation: Classification of Permanent (Secondary) and Deciduous (Primary) Dentition / 538

Folder 16.3 Clinical Correlation: Dental Caries / 546

Folder 16.4 Clinical Correlation: Salivary Gland Tumors / 553

HISTOLOGY 101 / 554

Atlas Plates

- PLATE 48 Lip and Mucocutaneous Junction / 556
 PLATE 49 Tongue I / 558
 PLATE 50 Tongue II—Foliate Papillae and Taste Buds / 560
 PLATE 51 Submandibular Gland / 562
 PLATE 52 Parotid Gland / 564
 PLATE 53 Sublingual Gland / 566

17 Digestive System II: Esophagus and Gastrointestinal Tract 568

OVERVIEW OF THE ESOPHAGUS AND GASTROINTESTINAL TRACT / 568

ESOPHAGUS / 571

STOMACH / 572

SMALL INTESTINE / 584

LARGE INTESTINE / 594

Folder 17.1 Clinical Correlation: Pernicious Anemia and Peptic Ulcer Disease / 576

Folder 17.2 Clinical Correlation: Zollinger-Ellison Syndrome / 577

Folder 17.3 Functional Considerations: The Gastrointestinal Endocrine System / 578

Folder 17.4 Functional Considerations: Digestive and Absorptive Functions of Enterocytes / 585

Folder 17.5 Functional Considerations: Immune Functions of the Alimentary Canal / 592

Folder 17.6 Clinical Correlation: The Pattern of Lymph Vessel Distribution and Diseases of the Large Intestine / 598

Folder 17.7 Clinical Correlation: Colorectal Cancer / 600

HISTOLOGY 101 / 602

Atlas Plates

- PLATE 54 Esophagus / 604
 PLATE 55 Esophagus and Stomach, Cardiac Region / 606
 PLATE 56 Stomach I / 608
 PLATE 57 Stomach II / 610
 PLATE 58 Gastroduodenal Junction / 612
 PLATE 59 Duodenum / 614
 PLATE 60 Jejunum / 616
 PLATE 61 Ileum / 618
 PLATE 62 Colon / 620
 PLATE 63 Appendix / 622
 PLATE 64 Anal Canal / 624

18 Digestive System III: Liver, Gallbladder, and Pancreas 626

LIVER / 626

GALLBLADDER / 640

PANCREAS / 643

Folder 18.1 Clinical Correlation: Lipoproteins / 628

Folder 18.2 Clinical Correlation: Congestive Heart Failure and Liver Necrosis / 634

Folder 18.3 Clinical Correlation: Insulin Production and Alzheimer's Disease / 650

Folder 18.4 Functional Considerations: Insulin Synthesis, an Example of Posttranslational Processing / 651

HISTOLOGY 101 / 652

Atlas Plates

PLATE 65 Liver I / 654

PLATE 66 Liver II / 656

PLATE 67 Gallbladder / 658

PLATE 68 Pancreas / 660

19 Respiratory System 662

OVERVIEW OF THE RESPIRATORY SYSTEM / 662

NASAL CAVITIES / 663

PHARYNX / 668

LARYNX / 668

TRACHEA / 669

BRONCHI / 673

BRONCHIOLES / 674

ALVEOLI / 676

BLOOD SUPPLY / 679

LYMPHATIC VESSELS / 682

NERVES / 682

Folder 19.1 Clinical Correlation: Squamous Metaplasia in the Respiratory Tract / 669

Folder 19.2 Clinical Correlation: Asthma / 676

Folder 19.3 Clinical Correlation: Cystic Fibrosis / 683

Folder 19.4 Clinical Correlation: Emphysema and Pneumonia / 684

HISTOLOGY 101 / 686

Atlas Plates

PLATE 69 Olfactory Mucosa / 688

PLATE 70 Larynx / 690

PLATE 71 Trachea / 692

PLATE 72 Bronchioles and End Respiratory Passages / 694

PLATE 73 Terminal Bronchiole, Respiratory Bronchiole, and Alveolus / 696

20 Urinary System 698

OVERVIEW OF THE URINARY SYSTEM / 698

GENERAL STRUCTURE OF THE KIDNEY / 699

KIDNEY TUBULE FUNCTION / 714

INTERSTITIAL CELLS / 720

HISTOPHYSIOLOGY OF THE KIDNEY / 720

BLOOD SUPPLY / 722

LYMPHATIC VESSELS / 724

NERVE SUPPLY / 724

URETER, URINARY BLADDER, AND URETHRA / 724

Folder 20.1 Functional Considerations: Kidney and Vitamin D / 699

Folder 20.2 Clinical Correlation: Antiglomerular Basement Membrane Antibody-Induced Glomerulonephritis; Goodpasture Syndrome / 706

Folder 20.3 Clinical Correlation: Renin-Angiotensin-Aldosterone System and Hypertension / 713

Folder 20.4 Clinical Correlation: Examination of the Urine—Urinalysis / 714

Folder 20.5 Functional Considerations: Structure and Function of Aquaporin Water Channels / 720

Folder 20.6 Functional Considerations: Antidiuretic Hormone Regulation of Collecting Duct Function / 721

HISTOLOGY 101 / 728

Atlas Plates

PLATE 74 Kidney I / 730

PLATE 75 Kidney II / 732

PLATE 76 Kidney III / 734

PLATE 77 Kidney IV / 736

PLATE 78 Ureter / 738

PLATE 79 Urinary Bladder / 740

21 Endocrine Organs 742

OVERVIEW OF THE ENDOCRINE SYSTEM / 742

PITUITARY GLAND (HYPOPHYSIS) / 745

HYPOTHALAMUS / 755

PINEAL GLAND / 756

THYROID GLAND / 757

PARATHYROID GLANDS / 764

ADRENAL GLANDS / 766

Folder 21.1 Functional Considerations: Regulation of Pituitary Gland Secretion / 746

Folder 21.2 Clinical Correlation: Principles of Endocrine Diseases / 754

Folder 21.3 Clinical Correlation: Pathologies Associated with ADH Secretion / 754

Folder 21.4 Clinical Correlation: Abnormal Thyroid Function / 763

Folder 21.5 Clinical Correlation: Chromaffin Cells and Pheochromocytoma / 772

Folder 21.6 Functional Considerations: Biosynthesis of Adrenal Hormones / 774

HISTOLOGY 101 / 776

Atlas Plates

PLATE 80 Pituitary I / 778

PLATE 81 Pituitary II / 780

PLATE 82 Pineal Gland / 782

PLATE 83 Parathyroid and Thyroid Glands / 784

PLATE 84 Adrenal Gland I / 786

PLATE 85 Adrenal Gland II / 788

22 Male Reproductive System 790

OVERVIEW OF THE MALE REPRODUCTIVE SYSTEM / 790

TESTIS / 790

SPERMATOGENESIS / 797

SEMINIFEROUS TUBULES / 803

INTRATESTICULAR DUCTS / 808

EXCURRENT DUCT SYSTEM / 808

ACCESSORY SEX GLANDS / 812

PROSTATE GLAND / 813

SEMEN / 817

PENIS / 818

Folder 22.1 Functional Considerations: Hormonal Regulation of Spermatogenesis / 797

Folder 22.2 Clinical Correlation: Factors Affecting Spermatogenesis / 798

Folder 22.3 Clinical Correlation: Sperm-Specific Antigens and the Immune Response / 807

Folder 22.4 Clinical Correlation: Benign Prostatic Hypertrophy and Cancer of the Prostate / 815

Folder 22.5 Clinical Correlation: Mechanism of Erection and Erectile Dysfunction / 818

HISTOLOGY 101 / 820

Atlas Plates

PLATE 86 Testis I / 822

PLATE 87 Testis II / 824

PLATE 88 Efferent Ductules and Epididymis / 826

PLATE 89 Spermatid Cord and Ductus Deferens / 828

PLATE 90 Prostate Gland / 830

PLATE 91 Seminal Vesicle / 832

23 Female Reproductive System 834

OVERVIEW OF THE FEMALE REPRODUCTIVE SYSTEM / 834

OVARY / 835

UTERINE TUBES / 848

UTERUS / 850

PLACENTA / 858

VAGINA / 863

EXTERNAL GENITALIA / 864

MAMMARY GLANDS / 866

Folder 23.1 Clinical Correlation: Polycystic Ovarian Disease / 841

Folder 23.2 Clinical Correlation: In Vitro Fertilization / 847

Folder 23.3 Functional Considerations: Summary of Hormonal Regulation of the Ovarian Cycle / 851

Folder 23.4 Clinical Correlation: Fate of the Mature Placenta at Birth / 862

Folder 23.5 Clinical Correlation: Cytologic Pap Smears / 865

Folder 23.6 Clinical Correlation: Cervix and Human Papillomavirus Infections / 871

Folder 23.7 Functional Considerations: Lactation and Infertility / 872

HISTOLOGY 101 / 873

Atlas Plates

PLATE 92 Ovary I / 876

PLATE 93 Ovary II / 878

PLATE 94 Corpus Luteum / 880

PLATE 95 Uterine Tube / 882

PLATE 96 Uterus I / 884

PLATE 97 Uterus II / 886

PLATE 98 Cervix / 888

PLATE 99 Placenta I / 890

PLATE 100 Placenta II / 892

PLATE 101 Vagina / 894

PLATE 102 Mammary Gland Inactive Stage / 896

PLATE 103 Mammary Gland, Late Proliferative and Lactating Stages / 898

24 Eye 900

OVERVIEW OF THE EYE / 900

GENERAL STRUCTURE OF THE EYE / 900

MICROSCOPIC STRUCTURE OF THE EYE / 903

Folder 24.1 Clinical Correlation: Glaucoma / 910

Folder 24.2 Clinical Correlation: Retinal Detachment / 911

Folder 24.3 Clinical Correlation: Age-Related Macular Degeneration / 912

Folder 24.4 Clinical Correlation: Color Blindness / 917

Folder 24.5 Clinical Correlation: Conjunctivitis / 922

HISTOLOGY 101 / 926

Atlas Plates

PLATE 104 Eye I / 928

PLATE 105 Eye II: Retina / 930

PLATE 106 Eye III: Anterior Segment / 932

PLATE 107 Eye IV: Sclera, Cornea, and Lens / 934

25 Ear 936

OVERVIEW OF THE EAR / 936

EXTERNAL EAR / 936

MIDDLE EAR / 937

INTERNAL EAR / 941

Folder 25.1 Clinical Correlation: Otosclerosis / 942

Folder 25.2 Clinical Correlation: Hearing Loss—Vestibular Dysfunction / 950

Folder 25.3 Clinical Correlation: Vertigo / 955

HISTOLOGY 101 / 956

Atlas Plates

PLATE 108 Ear / 958

PLATE 109 Cochlear Canal and Organ of Corti / 960

Index 962