

# Contents

PREFACE VII | ACKNOWLEDGMENTS IX

## 1 Histology & Its Methods of Study 1

Preparation of Tissues for Study 1  
Light Microscopy 4  
Electron Microscopy 8  
Autoradiography 9  
Cell & Tissue Culture 10  
Enzyme Histochemistry 10  
Visualizing Specific Molecules 10  
Interpretation of Structures in Tissue Sections 14  
Summary of Key Points 15  
Assess Your Knowledge 16

## 2 The Cytoplasm 17

Cell Differentiation 17  
The Plasma Membrane 17  
Cytoplasmic Organelles 27  
The Cytoskeleton 42  
Inclusions 47  
Summary of Key Points 51  
Assess Your Knowledge 52

## 3 The Nucleus 53

Components of the Nucleus 53  
The Cell Cycle 58  
Mitosis 61  
Stem Cells & Tissue Renewal 65  
Meiosis 65  
Apoptosis 67  
Summary of Key Points 69  
Assess Your Knowledge 70

## 4 Epithelial Tissue 71

Characteristic Features of Epithelial Cells 72  
Specializations of the Apical Cell Surface 77  
Types of Epithelia 80  
Transport Across Epithelia 88  
Renewal of Epithelial Cells 88  
Summary of Key Points 90  
Assess Your Knowledge 93

## 5 Connective Tissue 96

Cells of Connective Tissue 96  
Fibers 103  
Ground Substance 111  
Types of Connective Tissue 114  
Summary of Key Points 119  
Assess Your Knowledge 120

## 6 Adipose Tissue 122

White Adipose Tissue 122  
Brown Adipose Tissue 126  
Summary of Key Points 127  
Assess Your Knowledge 128

## 7 Cartilage 129

Hyaline Cartilage 129  
Elastic Cartilage 133  
Fibrocartilage 134  
Cartilage Formation, Growth, & Repair 134  
Summary of Key Points 136  
Assess Your Knowledge 136

## 8 Bone 138

Bone Cells 138  
Bone Matrix 143  
Periosteum & Endosteum 143  
Types of Bone 143  
Osteogenesis 148  
Bone Remodeling & Repair 152  
Metabolic Role of Bone 153  
Joints 155  
Summary of Key Points 158  
Assess Your Knowledge 159

## 9 Nerve Tissue & the Nervous System 161

Development of Nerve Tissue 161  
Neurons 163  
Glial Cells & Neuronal Activity 168  
Central Nervous System 175  
Peripheral Nervous System 182

Neural Plasticity & Regeneration 187  
Summary of Key Points 190  
Assess Your Knowledge 191

## **10 Muscle Tissue 193**

Skeletal Muscle 193  
Cardiac Muscle 207  
Smooth Muscle 208  
Regeneration of Muscle Tissue 213  
Summary of Key Points 213  
Assess Your Knowledge 214

## **11 The Circulatory System 215**

Heart 215  
Tissues of the Vascular Wall 219  
Vasculature 220  
Lymphatic Vascular System 231  
Summary of Key Points 235  
Assess Your Knowledge 235

## **12 Blood 237**

Composition of Plasma 237  
Blood Cells 239  
Summary of Key Points 250  
Assess Your Knowledge 252

## **13 Hemopoiesis 254**

Stem Cells, Growth Factors, & Differentiation 254  
Bone Marrow 255  
Maturation of Erythrocytes 258  
Maturation of Granulocytes 260  
Maturation of Agranulocytes 263  
Origin of Platelets 263  
Summary of Key Points 265  
Assess Your Knowledge 265

## **14 The Immune System & Lymphoid Organs 267**

Innate & Adaptive Immunity 267  
Cytokines 269  
Antigens & Antibodies 270  
Antigen Presentation 271  
Cells of Adaptive Immunity 273  
Thymus 276  
Mucosa-Associated Lymphoid Tissue 281  
Lymph Nodes 282  
Spleen 286  
Summary of Key Points 293  
Assess Your Knowledge 294

## **15 Digestive Tract 295**

General Structure of the Digestive Tract 295  
Oral Cavity 298  
Esophagus 305  
Stomach 307  
Small Intestine 314  
Large Intestine 318  
Summary of Key Points 326  
Assess Your Knowledge 327

## **16 Organs Associated with the Digestive Tract 329**

Salivary Glands 329  
Pancreas 332  
Liver 335  
Biliary Tract & Gallbladder 345  
Summary of Key Points 346  
Assess Your Knowledge 348

## **17 The Respiratory System 349**

Nasal Cavities 349  
Pharynx 352  
Larynx 352  
Trachea 354  
Bronchial Tree & Lung 354  
Lung Vasculature & Nerves 366  
Pleural Membranes 368  
Respiratory Movements 368  
Summary of Key Points 369  
Assess Your Knowledge 369

## **18 Skin 371**

Epidermis 372  
Dermis 378  
Subcutaneous Tissue 381  
Sensory Receptors 381  
Hair 383  
Nails 384  
Skin Glands 385  
Skin Repair 388  
Summary of Key Points 391  
Assess Your Knowledge 391

## **19 The Urinary System 393**

Kidneys 393  
Blood Circulation 394  
Renal Function: Filtration, Secretion, & Reabsorption 395  
Ureters, Bladder, & Urethra 406

Summary of Key Points 411  
Assess Your Knowledge 412

## **20 Endocrine Glands 413**

Pituitary Gland (Hypophysis) 413  
Adrenal Glands 423  
Pancreatic Islets 427  
Diffuse Neuroendocrine System 429  
Thyroid Gland 429  
Parathyroid Glands 432  
Pineal Gland 434  
Summary of Key Points 437  
Assess Your Knowledge 437

## **21 The Male Reproductive System 439**

Testes 439  
Intratesticular Ducts 449  
Excretory Genital Ducts 450  
Accessory Glands 451  
Penis 456  
Summary of Key Points 457  
Assess Your Knowledge 459

## **22 The Female Reproductive System 460**

Ovaries 460  
Uterine Tubes 470  
Major Events of Fertilization 471  
Uterus 471  
Embryonic Implantation, Decidua, & the Placenta 478  
Cervix 482  
Vagina 483  
External Genitalia 483  
Mammary Glands 483  
Summary of Key Points 488  
Assess Your Knowledge 489

## **23 The Eye & Ear: Special Sense Organs 490**

Eyes: The Photoreceptor System 490  
Ears: The Vestibuloauditory System 509  
Summary of Key Points 522  
Assess Your Knowledge 522

## **APPENDIX 525**

### **FIGURE CREDITS 527**

### **INDEX 529**