

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 48
 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 71
 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 154
 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 206

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 232

Summary of Key Points 235

Assess Your Knowledge 235

12 Blood 237

Composition of Plasma 237

Blood Cells 239

Summary of Key Points 252

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 269

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 320

Summary of Key Points 326

Assess Your Knowledge 328

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 355

Lung Vasculature & Nerves 367

Pleural Membranes 368

Respiratory Movements 369

Summary of Key Points 369

Assess Your Knowledge 370

18 Skin 371

Epidermis 372

Dermis 380

Subcutaneous Tissue 381

Sensory Receptors 382

Hair 383

Nails 384

Skin Glands 385

Skin Repair 388

Summary of Key Points 391

Assess Your Knowledge 392

19 The Urinary System 393

Kidneys 393

Blood Circulation 394

Renal Function: Filtration, Secretion,
& Reabsorption 395

Ureters, Bladder, & Urethra 407

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 430
Parathyroid Glands 432
Pineal Gland 435
Summary of Key Points 437
Assess Your Knowledge 437

21 The Male Reproductive System 439

Testes 439
Intratesticular Ducts 449
Excretory Genital Ducts 449
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 473
Embryonic Implantation, Decidua, & the Placenta 478
Cervix 480
Vagina 483
External Genitalia 484
Mammary Glands 484
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