

076-051  
V 25

# GOULD'S Pathophysiology *for the* Health Professions

SEVENTH EDITION



Karin C. VanMeter  
Robert J. Hubert



Evolve®

Student Resources on Evolve  
Access Code Inside



# GOULD'S

# Pathophysiology *for the*

# Health Professions

SEVENTH EDITION

## Karin C. VanMeter, PhD

Lecturer

Austrian Biotech University of Applied Sciences, Tulln, Austria

University of Applied Sciences Upper Austria, Hagenberg, Austria

Lecturer (retired)

Iowa State University

College of Veterinary Medicine

Department of Biomedical Sciences

Ames, Iowa

## Robert J. Hubert, BS

Laboratory Coordinator (retired)

Iowa State University

Department of Animal Sciences

Ames, Iowa

772527



SL3



ELSEVIER

# Contents

## SECTION I Pathophysiology: Background and Overview, 1

### CHAPTER 1 Introduction to Pathophysiology, 1

- What Is Pathophysiology and Why Study It?, 1
  - Understanding Health and Disease, 2*
  - Concept and Scope of Pathophysiology, 2*
  - Beginning the Process: A Medical History, 4*
  - New Developments and Trends, 4*
  - Basic Terminology of Pathophysiology, 5*
- Introduction to Cellular Changes, 8
  - Terms Used for Common Cellular Adaptations, 8*
  - Cell Damage and Necrosis, 9*
- Case Study, 12
- Chapter Summary, 12
- Study Questions, 13

### CHAPTER 2 Fluid, Electrolyte, and Acid-Base Imbalances, 14

- Fluid Imbalance, 15
  - Review of Concepts and Processes, 15*
  - Fluid Excess: Edema, 16*
  - Fluid Deficit: Dehydration, 20*
  - Third-Spacing: Fluid Deficit and Fluid Excess, 21*
- Electrolyte Imbalances, 21
  - Sodium Imbalance, 21*
  - Potassium Imbalance, 24*
  - Calcium Imbalance, 26*
  - Other Electrolytes, 28*
- Acid-Base Imbalance, 30
  - Review of Concepts and Processes, 30*
  - Control of Serum pH, 30*
  - Acid-Base Imbalance, 32*
- Treatment of Imbalances, 36
- Case Studies, 36
- Chapter Summary, 37
- Study Questions, 38

### CHAPTER 3 Introduction to Basic Pharmacology and Other Common Therapies, 39

- Pharmacology, 39
  - Basic Principles, 39*
  - Drug Effects, 40*
  - Administration and Distribution of Drugs, 41*
  - Drug Mechanisms and Receptors, 45*
  - Responses, 45*

- Drug Classifications, Prescriptions, and Development, 46*
- Traditional Forms of Therapy, 47
  - Physiotherapy, 47*
  - Occupational Therapy, 47*
  - Speech/Language Therapy, 48*
  - Nutrition/Diet, 48*
  - Registered Massage Therapy, 48*
  - Osteopathy, 48*
  - Chiropractic, 48*
- Complementary or Alternative Therapies, 48
  - Noncontact Therapeutic Touch, 48*
  - Naturopathy, 48*
  - Homeopathy, 49*
  - Herbal Medicine, 49*
  - Aromatherapy, 49*
  - Asian Concepts of Disease and Healing, 49*
- Case Study, 50
- Chapter Summary, 51
- Study Questions, 51

### CHAPTER 4 Pain, 52

- Etiology and Sources of Pain, 52
- Structures and Pain Pathways, 53
- Physiology of Pain and Pain Control, 54
- Characteristics of Pain, 56
  - Signs and Symptoms, 56*
  - Young Children and Pain, 56*
  - Referred Pain, 56*
  - Phantom Pain, 56*
  - Pain Perception and Response, 57*
- Basic Classifications of Pain, 58
  - Acute Pain, 58*
  - Chronic Pain, 58*
  - Headache, 58*
  - Central Pain, 60*
  - Neuropathic Pain, 60*
  - Ischemic Pain, 60*
  - Cancer-Related Pain, 60*
- Pain Control, 60
  - Methods of Managing Pain, 60*
  - Anesthesia, 62*
- Case Studies, 63
- Chapter Summary, 63
- Study Questions, 64



**SECTION II Defense/Protective Mechanisms, 65****CHAPTER 5 Inflammation and Healing, 65**

- Review of Body Defenses, 66
- Review of Normal Capillary Exchange, 67
- Physiology of Inflammation, 67
  - Definition, 67
  - Causes, 67
  - Steps of Inflammation, 67
- Acute Inflammation, 69
  - Pathophysiology and General Characteristics, 69
  - Local Effects, 70
  - Systemic Effects, 70
  - Diagnostic Tests, 72
  - Potential Complications, 72
- Chronic Inflammation, 72
  - Pathophysiology and General Characteristics, 72
  - Potential Complications, 73
- Treatment of Inflammation, 73
  - Drugs, 73
  - Antiinflammatory Herbs and Spices, 75
  - First Aid Measures, 76
  - Other Therapies, 76
- Healing, 76
  - Types of Healing, 76
  - Healing Process, 76
  - Factors Affecting Healing, 78
  - Complications Owing to Scar Formation, 78
- Example of Inflammation and Healing, 79
  - Burns, 79
  - Classifications of Burns, 80
- Case Studies, 86
- Chapter Summary, 86
- Study Questions, 87
- Inflammation, 87
  - Healing, 87
  - Burns, 87

**CHAPTER 6 Infection, 88**

- Review of Microbiology, 89
  - Microorganisms, 89
  - Types of Microorganisms, 89
  - Other Agents of Disease, 99
  - Resident Flora (Indigenous Normal Flora, Resident Microbiota), 99
- Principles of Infection, 100
  - Transmission of Infectious Agents, 100
  - Host Resistance, 101
  - Virulence and Pathogenicity of Microorganisms, 102
  - New Issues Affecting Infections and Transmission, 102
  - Control of Transmission and Infection, 103
- Physiology of Infection, 105
  - Onset and Development, 105
  - Patterns of Infection, 105
  - Signs and Symptoms of Infection, 106
  - Methods of Diagnosis, 107
  - Treatment and Antimicrobial Drugs, 108
  - Example of Infection: Influenza (Flu), 110
- Case Studies, 112

Chapter Summary, 113

Study Questions, 113

**CHAPTER 7 Immunity, 114**

- Review of the Immune System, 115
  - Components of the Immune System, 115
  - Elements of the Immune System, 115
  - Immune Response, 118
  - Diagnostic Tests, 120
  - Process of Acquiring Immunity, 120
  - Outcome of Infectious Disease, 121
  - Emerging and Reemerging Infectious Diseases and Immunity, 121
  - Bioterrorism, 121
- Tissue and Organ Transplant Rejection, 122
  - Rejection Process, 122
  - Treatment and Prevention, 122
- Hypersensitivity Reactions, 123
  - Type I: Allergic Reactions, 123
  - Type II: Cytotoxic Hypersensitivity, 126
  - Type III: Immune Complex Hypersensitivity, 127
  - Type IV: Cell-Mediated or Delayed Hypersensitivity, 127
- Autoimmune Disorders, 128
  - Mechanism, 128
  - Example: Systemic Lupus Erythematosus, 129
- Immunodeficiency, 131
  - Causes of Immunodeficiency, 131
  - Effects of Immunodeficiency, 132
  - Acquired Immunodeficiency Syndrome, 132
- Case Studies, 139
- Chapter Summary, 140
- Study Questions, 141

**SECTION III Pathophysiology of Body Systems, 142****CHAPTER 8 Skin Disorders, 142**

- Review of the Skin, 143
- Resident Microbial Flora, 144
- Skin Lesions, 145
- Skin Inflammatory Disorders, 146
  - Contact Dermatitis, 146
  - Urticaria (Hives), 147
  - Atopic Dermatitis (Eczema), 147
  - Psoriasis, 148
  - Pemphigus, 149
  - Scleroderma, 150
  - Dupuytren's Contracture, 150
- Skin Infections, 151
  - Bacterial Infections, 151
  - Viral Infections, 153
  - Fungal Infections, 155
  - Other Infections, 156
- Skin Tumors, 157
  - Keratoses, 157
  - Squamous Cell Carcinoma, 158
  - Malignant Melanoma, 158
  - Kaposi Sarcoma, 159
- Case Studies, 160
- Chapter Summary, 160
- Study Questions, 160

**CHAPTER 9 Musculoskeletal System Disorders, 162**

Review of the Musculoskeletal System, 163

*Bone*, 163*Skeletal Muscle*, 165*Joints*, 167*Diagnostic Tests*, 168

Trauma, 168

*Fractures*, 168*Dislocations*, 171*Sprains and Strains*, 172*Other Injuries*, 172*Muscle Tears*, 172*Repetitive Strain Injury*, 172

Bone Disorders, 173

*Osteoporosis*, 173*Rickets and Osteomalacia*, 174*Paget Disease (Osteitis Deformans)*, 174*Osteomyelitis*, 174*Abnormal Curvatures of the Spine*, 174*Bone Tumors*, 175

Disorders of Muscle, Tendons, and

*Ligaments*, 176*Muscular Dystrophy*, 176*Primary Fibromyalgia Syndrome*, 177*Myositis*, 177

Joint Disorders, 178

*Osteoarthritis*, 178*Rheumatoid Arthritis*, 179*Juvenile Rheumatoid Arthritis*, 182*Infectious (Septic) Arthritis*, 182*Psoriatic Arthritis*, 182*Gout (Gouty Arthritis)*, 182*Ankylosing Spondylitis*, 183*Other Inflammatory Joint Disorders*, 184

Case Studies, 184

Chapter Summary, 184

Study Questions, 185

**CHAPTER 10 Blood and Circulatory System Disorders, 186**

Review of the Circulatory System and Blood, 187

*Anatomy, Structures, and Components*, 187*Blood Vessels*, 187*Blood*, 189

Blood Dyscrasias, 197

*Anemias*, 197*Blood-Clotting Disorders*, 205*Myelodysplastic Syndrome*, 210

Neoplastic Blood Disorders, 210

*Polycythemia*, 210*Leukemias*, 211

Vascular Disorders, 213

*Arterial Disorders*, 213*Peripheral Vascular Disease and Atherosclerosis*, 213*Aortic Aneurysms*, 217

Venous Disorders, 218

*Varicose Veins*, 218*Thrombophlebitis and Phlebothrombosis*, 219

Case Study, 219

Chapter Summary, 220

Study Questions, 220

**CHAPTER 11 Lymphatic System Disorders, 221**

Review of the Lymphatic System, 221

*Structures and Function*, 221*Composition and Production of Lymph*, 223

Lymphatic Disorders, 225

*Lymphadenopathy*, 225*Lymphomas*, 225*Multiple Myeloma or Plasma Cell Myeloma*, 228*Lymphedema*, 229*Elephantiasis (Filariasis)*, 229*Castleman Disease*, 229

Case Study, 230

Chapter Summary, 230

Study Questions, 231

**CHAPTER 12 Cardiovascular System Disorders, 232**

Review of the Cardiovascular System, 233

*Heart*, 233*Blood Pressure*, 238

Heart Disorders, 239

*Diagnostic Tests for Cardiovascular**Function*, 239*General Treatment Measures for Cardiac**Disorders*, 240*Coronary Artery Disease, Ischemic Heart**Disease, or Acute Coronary Syndrome*, 242*Cardiac Dysrhythmias (Arrhythmias)*, 247*Congestive Heart Failure*, 250*Young Children With Congestive Heart**Failure*, 253*Congenital Heart Defects*, 254*Inflammation and Infection in the Heart*, 259

Vascular Disorders, 263

*Arterial Disorders*, 263

Shock, 266

Case Studies, 269

Chapter Summary, 270

Study Questions, 271

**CHAPTER 13 Respiratory System Disorders, 272**

Review of Structures of the Respiratory System, 273

*Purpose and General Organization*, 273*Structures in the Respiratory System*, 273*Ventilation*, 275*Gas Exchange*, 278*Diagnostic Tests*, 281

General Manifestations of Respiratory Disease, 281

Common Treatment Measures for Respiratory

*Disorders*, 283

Infectious Diseases, 284

*Upper Respiratory Tract Infections*, 284*Lower Respiratory Tract Infections*, 286

Obstructive Lung Diseases, 295

*Cystic Fibrosis*, 295*Lung Cancer*, 297*Aspiration*, 299*Obstructive Sleep Apnea*, 301*Asthma*, 301

Chronic Obstructive Pulmonary Disease, 304

*Emphysema*, 305*Chronic Bronchitis*, 308*Bronchiectasis*, 309

Restrictive Lung Disorders, 310

Pneumoconioses, 310

*Vascular Disorders*, 310*Pulmonary Edema*, 310*Pulmonary Embolus*, 312



- Expansion Disorders, 313
  - Atelectasis*, 313
  - Pleural Effusion*, 315
  - Pneumothorax*, 316
  - Flail Chest*, 317
  - Infant Respiratory Distress Syndrome*, 319
  - Adult or Acute Respiratory Distress Syndrome*, 321
  - Acute Respiratory Failure*, 321
- Case Studies, 322
- Chapter Summary, 323
- Study Questions, 324

#### CHAPTER 14 Nervous System Disorders, 326

- Review of Nervous System Anatomy and Physiology, 327
  - Brain*, 327
  - Spinal Cord*, 333
  - Neurons and Conduction of Impulses*, 335
  - Autonomic Nervous System*, 336
- General Effects of Neurologic Dysfunction, 339
  - Local (Focal) Effects*, 339
  - Supratentorial and Infratentorial Lesions*, 339
  - Left and Right Hemispheres*, 339
  - Level of Consciousness*, 339
  - Motor Dysfunction*, 340
  - Sensory Deficits*, 341
  - Visual Loss: Hemianopia*, 341
  - Language Disorders*, 341
  - Seizures*, 343
  - Movement Disorder: Tardive Dyskinesia*, 343
  - Increased Intracranial Pressure*, 343
  - Herniation*, 345
  - Diagnostic Tests*, 346
- Acute Neurologic Problems, 346
  - Brain Tumors*, 346
  - Vascular Disorders*, 347
  - Infections*, 351
  - Brain Injuries*, 356
  - Spinal Cord Injury*, 360
- Congenital Neurologic Disorders, 365
  - Hydrocephalus*, 365
  - Spina Bifida*, 366
  - Cerebral Palsy*, 367
- Seizure Disorders, 369
- Chronic Degenerative Disorders, 371
  - Multiple Sclerosis*, 371
  - Parkinson Disease (Paralysis Agitans)*, 373
  - Amyotrophic Lateral Sclerosis*, 375
  - Myasthenia Gravis*, 375
  - Huntington Disease*, 376
- Dementia, 377
  - Alzheimer Disease*, 377
  - Other Forms of Dementia*, 378
- Mental Disorders, 379
  - Schizophrenia*, 379
  - Depression*, 380
  - Panic Disorders*, 381
- Spinal Cord Disorder, 381
  - Herniated Intervertebral Disc*, 381
- Case Studies, 382
- Chapter Summary, 384
- Study Questions, 385

#### CHAPTER 15 Disorders of the Eyes, Ears, and Other Sensory Organs, 387

- Sensory Receptors, 387
- The Eye, 388
  - Review of Structure and Function*, 388
  - Diagnostic Tests*, 390
  - Structural Defects*, 390
  - Infections and Trauma*, 391
  - Glaucoma*, 393
  - Cataracts*, 394
  - Detached Retina*, 395
  - Macular Degeneration*, 395
- The Ear, 396
  - Review of Structure and Function*, 396
  - Hearing Loss*, 397
  - Ear Infections*, 398
  - Chronic Disorders of the Ear*, 400
- Case Studies, 401
- Chapter Summary, 401
- Study Questions, 402

#### CHAPTER 16 Endocrine System Disorders, 403

- Review of the Endocrine System, 403
- Endocrine Disorders, 406
  - Diagnostic Tests*, 407
  - Treatment*, 407
- Insulin and Diabetes Mellitus, 407
  - Type 1 and Type 2 Diabetes Mellitus*, 407
- Parathyroid Hormone and Calcium, 414
- Pituitary Hormones, 416
  - Growth Hormone*, 418
  - Antidiuretic Hormone (Vasopressin)*, 419
  - Inappropriate Antidiuretic Hormone Syndrome*, 420
- Thyroid Disorders, 420
  - Goiter*, 421
  - Hyperthyroidism (Graves Disease)*, 423
  - Hypothyroidism*, 423
  - Diagnostic Tests*, 424
- Adrenal Glands, 424
  - Adrenal Medulla*, 424
  - Adrenal Cortex*, 424
- Multiple Endocrine Neoplasia Type I, 427
- Case Studies, 427
- Chapter Summary, 429
- Study Questions, 429

#### CHAPTER 17 Digestive System Disorders, 430

- Review of the Digestive System, 431
  - Structures and Their Functions*, 431
  - Neural and Hormonal Controls*, 436
  - Digestion and Absorption*, 437
- Common Manifestations of Digestive System Disorders, 438
  - Anorexia, Vomiting, and Bulimia*, 438
  - Diarrhea*, 439
  - Constipation*, 440
  - Fluid and Electrolyte Imbalances*, 440
  - Pain*, 441
  - Malnutrition*, 441
- Basic Diagnostic Tests, 442
- Common Therapies and Prevention, 442
- Upper Gastrointestinal Tract Disorders, 444
  - Disorders of the Oral Cavity*, 444

*Dysphagia*, 449  
*Esophageal Cancer*, 451  
*Hiatal Hernia*, 451  
*Gastroesophageal Reflux Disease*, 452  
*Gastritis*, 452  
*Peptic Ulcer*, 454  
*Gastric Cancer*, 457  
*Dumping Syndrome*, 459  
*Pyloric Stenosis*, 459

Disorders of the Liver and Pancreas, 459

*Gallbladder Disorders*, 459  
*Jaundice*, 461  
*Hepatitis*, 461  
*Cirrhosis*, 466  
*Liver Cancer*, 470  
*Acute Pancreatitis*, 471  
*Pancreatic Cancer*, 472

Lower Gastrointestinal Tract Disorders, 472

*Celiac Disease*, 472  
*Chronic Inflammatory Bowel Disease*, 473  
*Irritable Bowel Syndrome*, 476  
*Appendicitis*, 477  
*Diverticular Disease*, 478  
*Colorectal Cancer*, 479  
*Intestinal Obstruction*, 482  
*Peritonitis*, 486

Case Studies, 487

Chapter Summary, 489

Study Questions, 489

**CHAPTER 18 Urinary System Disorders, 491**

Review of the Urinary System, 491

Structures and Anatomy, 492

*Kidneys*, 492

*Renal Arteries and Veins*, 493

Incontinence and Retention, 497

Diagnostic Tests, 498

*Urinalysis*, 498

*Blood Tests*, 499

*Other Tests*, 499

Diuretic Drugs, 499

Dialysis, 500

Disorders of the Urinary System, 501

*Urinary Tract Infections*, 501

*Inflammatory Disorders*, 504

Urinary Tract Obstructions, 506

*Urolithiasis (Calculi, or Kidney Stones)*, 506

*Hydronephrosis*, 508

*Tumors*, 508

Vascular Disorders, 509

*Nephrosclerosis*, 509

Congenital Disorders, 510

*Adult Polycystic Kidney*, 510

*Wilms Tumor (Nephroblastoma)*, 511

Renal Failure, 511

*Acute Renal Failure*, 511

*Chronic Renal Failure*, 513

Case Studies, 515

Chapter Summary, 515

Study Questions, 516

**CHAPTER 19 Reproductive System Disorders, 517**

Disorders of the Male Reproductive System, 517

*Review of the Male Reproductive System*, 517

*Congenital Abnormalities of the Penis and*

*Trauma*, 519

*Disorders of the Testes and Scrotum*, 520

*Inflammation and Infections*, 521

*Tumors*, 522

Disorders of the Female Reproductive System, 525

*Review of the Female Reproductive System*, 525

*Structural Abnormalities*, 529

*Menstrual Disorders*, 530

*Infections and Inflammation*, 532

*Benign Tumors*, 534

*Malignant Tumors*, 536

Infertility, 541

Sexually Transmitted Diseases, 542

*Bacterial Infections*, 542

*Viral Infections*, 545

*Protozoan Infection*, 546

Case Studies, 547

Chapter Summary, 547

Study Questions, 548

**SECTION IV Factors Contributing to Pathophysiology, 549**

**CHAPTER 20 Neoplasms and Cancer, 549**

Review of Normal Cells, 549

Benign and Malignant Tumors, 550

*Nomenclature*, 551

*Characteristics of Benign and Malignant*

*Tumors*, 551

Malignant Tumors: Cancer, 552

*Pathophysiology*, 552

*Etiology*, 557

*Treatment*, 560

*Prognosis*, 565

Examples of Malignant Tumors, 565

*Skin Cancer*, 565

*Ovarian Cancer*, 566

*Brain Cancer*, 566

*Cancer Incidences*, 567

Case Studies, 567

Chapter Summary, 567

Study Questions, 568

**CHAPTER 21 Congenital and Genetic Disorders, 569**

Review of Genetic Control, 569

Congenital Anomalies, 571

Genetic Disorders, 574

*Single-Gene Disorders*, 574

*Chromosomal Disorders*, 576

*Multifactorial Disorders*, 576

Developmental Disorders, 577

Diagnostic Tools, 577

Genetic Technology, 579

*Genetic Engineering and Gene Therapy*, 579

*Genetic Diagnosis and DNA Testing*, 579

*Proteomic Research and Designer Drugs*, 579

Down Syndrome, 580

Case Study, 580

Chapter Summary, 581

Study Questions, 582

**CHAPTER 22 Complications of Pregnancy, 583**

Embryonic and Fetal Development, 583

Physiologic Changes During Pregnancy, 584



