

# **TABLE OF CONTENTS**

## **Animal Physiology, 4th Edition**

### **Part I. Fundamentals of Physiology**

#### **Chapter 1 Animals and Environments: Function on the Ecological Stage**

The Importance of Physiology Mechanism and Origin

Environments

Evolutionary Processes

#### **Chapter 2 Molecules and Cells in Animal Physiology**

Cell Membranes and Intracellular Membranes

Epithelia

Elements of Metabolism

Enzyme Fundamentals

Regulation of Cell Function by Enzymes

Evolution of Enzymes

Enzymes Are Instruments of Change in All Time Frames

The Life and Death of Proteins

Cell Signaling: Signal Reception and Cell Signal Transduction

#### **Chapter 3 Genomics, Proteomics, and Related Approaches to Physiology**

Genomics

Top-down versus Bottom-up Approaches to the Study of Physiology

Screening or Profiling as a Research Strategy

The Study of Gene Expression: Transcriptomics

Proteomics

Metabolomics

## **Chapter 4 Transport of Solutes and Water**

Passive Solute Transport by Simple Diffusion

Passive Solute Transport by Facilitated Diffusion

Active Transport

Modulation of Channels and Transporters

Osmotic Pressure and Other Colligative Properties of Aqueous Solutions

Osmosis

Looking Forward

## **Part II. Food, Energy, and Temperature**

### **Chapter 5 Nutrition, Feeding, and Digestion**

Nutrition

Feeding

Digestion and Absorption

Responses to Eating

Nutritional Physiology in Additional Time Frames; Interactions between Nutritional  
Physiology and Environment

### **Chapter 6 Energy Metabolism**

Why Animals Need Energy: The Second Law of Thermodynamics

Fundamentals of Animal Energetics

Metabolic Rate: Meaning and Measurement

Factors That Affect Metabolic Rates

Basal Metabolic Rate and Standard Metabolic Rate

The Relation between Metabolic Rate and Body Size

Energetics of Food and Growth

Conclusion: Energy as the Common Currency of Life

POSTSCRIPT: The Energy Cost of Mental Effort

## **Chapter 7 Aerobic and Anaerobic Forms of Metabolism**

Mechanisms of ATP Production and Their Implications

Comparative Properties of Mechanisms of ATP Production

Two Themes in Exercise Physiology: Fatigue and Muscle Fiber Types

The Interplay of Aerobic and Anaerobic Catabolism during Exercise

Responses to Impaired O<sub>2</sub> Influx from the Environment

## **Chapter 8 The Energetics of Aerobic Activity**

How Active Animals Are Studied

The Energy Costs of Defined Exercise

The most advantageous speed depends on the function of exercise

The minimal cost of transport depends in regular ways on mode of locomotion and body size

The Maximal Rate of Oxygen Consumption

The Energetics of Routine and Extreme Daily Life

Ecological Energetics

## **Chapter 9 Thermal Relations**

Temperature and Heat

Heat Transfer between Animals and Their Environments

Poikilothermy (Ectothermy)

Homeothermy in Mammals and Birds

Warm-Bodied Fish

Endothermy and Homeothermy in Insects

## **Chapter 10 Food, Energy, and Temperature at Work: The Lives of Mammals in Frigid Places**

Food, Nutrition, Energy Metabolism, and Thermoregulation in the Lives of Adult

Reindeer

Newborn Reindeer

Lifetime Patterns of Thermoregulation and Thermogenesis in Small Mammals

The Effect of Body Size on Mammals - Lives in Cold Environments  
Hibernation as a Winter Strategy: New Directions and Discoveries

## **Part III. Integrating Systems**

### **Chapter 11 Neurons**

The Physiology of Control: Neurons and Endocrine Cells Compared

Neurons are organized into functional circuits in nervous systems

The Cellular Organization of Neural Tissue

The Ionic Basis of Membrane Potentials

The Action Potential

Propagation of Action Potentials

### **Chapter 12 Synapses**

Synaptic Transmission Is Usually Chemical but Can Be Electrical

Synaptic Potentials Control Neuronal Excitability

Fast Chemical Synaptic Actions Depend on Increases in Permeability to Ions

Presynaptic Neurons Release Neurotransmitter Molecules in Quantal Packets

Neurotransmitters Are of Two General Kinds

Postsynaptic Receptors for Fast Ionotropic Actions: Ligand-Gated Channels

Postsynaptic Receptors for Slow, Metabotropic Actions: G Protein-Coupled Receptors

Synaptic Plasticity: Synapses Change Properties with Time and Activity

### **Chapter 13 Sensory Processes**

Organization of Sensory Systems

Mechanoreception and touch

Vestibular Organs and Hearing

Chemoreception and Taste

Olfaction

Photoreception

Visual Sensory Processing

## **Chapter 14 Nervous System Organization and Biological Clocks**

The Organization and Evolution of Nervous Systems

The Vertebrate Nervous System: A Guide to the General Organizational Features of Nervous Systems

Biological Clocks

## **Chapter 15 Endocrine and Neuroendocrine Physiology**

Introduction to Endocrine Principles

Synthesis, Storage, and Release of Hormones

Types of Endocrine Glands and Cells

Control of Endocrine Systems: The Vertebrate Pituitary Gland

The Mammalian Stress Response

Endocrine Control of Nutrient Metabolism in Mammals

Endocrine Control of Salt and Water Balance in Vertebrates

Hormones and Other Chemical Signals

Insect Metamorphosis

## **Chapter 16 Reproduction**

What Aspects of Reproduction Do Physiologists Study?

Reproduce Once or More Than Once - Semelparity versus Iteroparity

Eggs, Provisioning, and Parental Care

External or Internal Fertilization?

The Environment as a Player in Reproduction

The Timing of Reproductive Cycles

Sex Change

Reproductive Endocrinology of Placental Mammals

## **Chapter 17 Integrating Systems at Work: Animal Navigation**

The Adaptive Significance of Animal Navigation

Navigational Strategies

Innate and Learned Components of Navigation

## **Part IV. Movement and Muscle**

### **Chapter 18 Control of Movement: The Motor Bases of Animal Behavior**

Neural Control of Skeletal Muscle is the Basis of Animal Behavior

Neural Generation of Rhythmic Behavior

Control and Coordination of Vertebrate Movement

### **Chapter 19 Muscle**

Vertebrate Skeletal Muscle Cells

Excitation - Contraction Coupling

Whole Skeletal Muscles

Muscle Energetics

Neural Control of Skeletal Muscle

Vertebrate Smooth Muscle

Vertebrate Cardiac Muscle

### **Chapter 20 Movement and Muscle at Work: Muscle in Human Health and Disease**

Muscle phenotypes

Atrophy

Regulating muscle mass

Summary

## **Part V. Oxygen, Carbon Dioxide, and Internal Transport**

### **Chapter 21 Introduction to Oxygen and Carbon Dioxide Physiology**

The Properties of Gases in Gas Mixtures and Aqueous Solutions

Diffusion of Gases

Convective Transport of Gases: Bulk Flow

The Oxygen Cascade

Expressing the Amounts and Partial Pressures of Gases in Other Units

The Contrasting Physical Properties of Air and Water

Respiratory Environments

## **Chapter 22 External Respiration: The Physiology of Breathing**

Fundamental Concepts of External Respiration

Principles of Gas Exchange by Active Ventilation

Introduction to Vertebrate Breathing

Breathing by Fish

Breathing by Amphibians

Breathing by Nonavian Reptiles

Breathing by Mammals

Breathing by Birds

Breathing by Aquatic Invertebrates and Allied Groups

Breathing by Insects and Other Tracheate Arthropods

## **Chapter 23 Transport of Oxygen and Carbon Dioxide in Body Fluids**

The Chemical Properties and Distributions of the Respiratory Pigments

The O<sub>2</sub>-Binding Characteristics of Respiratory Pigments

The Functions of Respiratory Pigments in Animals

Carbon Dioxide Transport

Acid-Base Physiology

## **Chapter 24 Circulation**

Hearts

Principles of Pressure, Resistance, and Flow in Vascular Systems

Circulation in Mammals and Birds

Circulation in Fish

Circulation in Amphibians and Nonavian Reptiles

Concluding Comments on Vertebrates

Invertebrates with Closed Circulatory Systems

Invertebrates with Open Circulatory Systems

## **Chapter 25 Oxygen, Carbon Dioxide, and Internal Transport at Work: Diving by Marine Animals**

Diving Feats and Behavior

Types of Dives and the Importance of Method

Physiology: The Big Picture

The Oxygen Stores of Divers

Circulatory Adjustments during Dives

Metabolism during Dives

The Aerobic Dive Limit: Physiology's Benchmark for Understanding Diving Behavior

Decompression Sickness

A Possible Advantage for Pulmonary O<sub>2</sub> Sequestration in Deep Dives

## **Part VI. Water, Salts, and Excretion**

### **Chapter 26 Water and Salt Physiology: Introduction and Mechanisms**

The Importance of Animal Body Fluids

The Relations among Body Fluids

Types of Regulation and Conformity

Natural Aquatic Environments

Natural Terrestrial Environments

Organs of Blood Regulation

Food and Drinking Water

Metabolic Water

Cell Volume Regulation

From Osmolytes to Compatible Solutes: Terms and Concepts

### **Chapter 27 Water and Salt Physiology of Animals in Their Environments**

Animals in Freshwater

Animals in the Ocean

Animals that Face Changes in Salinity

Responses to Drying of the Habitat in Aquatic Animals



Animals on Land: Fundamental Physiological Principles

Animals on Land: Case Studies

Control of Water and Salt Balance in Terrestrial Animals

### **Chapter 28 Kidneys and Excretion**

Basic Mechanisms of Kidney Function

Urine Formation in Amphibians

Urine Formation in Mammals

Urine Formation in Other Vertebrates

Urine Formation in Decapod Crustaceans

Urine Formation in Molluscs

Urine Formation in Insects

Nitrogen Disposition and Excretion

### **Chapter 29 Water, Salts, and Excretion at Work: Mammals of Deserts and Dry Savannas**

Desert and Dry-Savanna Environments

The Relations of Animals to Water

The Dramatic Adaptations of Particular Species.