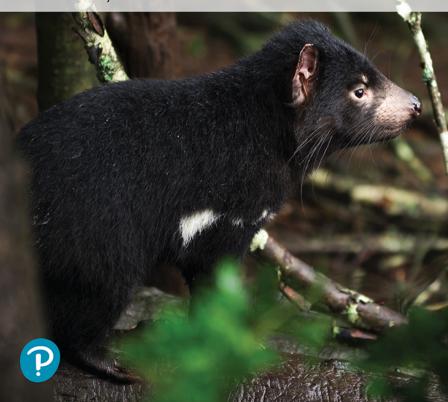


Campbell Essential Biology

SEVENTH EDITION

Simon • Dickey • Reece



Brief Contents

1 Learning About Life 36

Unit 1 Cells 55

- Essential Chemistry for Biology 56
- 3 The Molecules of Life 70
- 4 A Tour of the Cell 88
- 5 The Working Cell 108
- 6 Cellular Respiration: Obtaining Energy from Food 124
- 7 Photosynthesis: Using Light to Make Food 140

Unit 2 Genetics 153

- 8 Cellular Reproduction: Cells from Cells 154
- 9 Patterns of Inheritance 178
- 10 The Structure and Function of DNA 204
- 11 How Genes Are Controlled 230
- 12 DNA Technology 250

Unit 3 Evolution and Diversity 275

- **13** How Populations Evolve 276
- **14** How Biological Diversity Evolves 302
- **15** The Evolution of Microbial Life 326
- 16 The Evolution of Plants and Fungi 348
- **17** The Evolution of Animals 370

Unit 4 Ecology 405

- 18 An Introduction to Ecology and the Biosphere 406
- **19** Population Ecology 436
- **20** Communities and Ecosystems 458

Campbell Essential Biology, Global Edition

Table of Contents

Front Cover

Title Page

Copyright Page

About the Authors

Preface

Acknowledgments

Detailed Contents

Chapter 1 Learning About Life

Chapter Thread Swimming with the Turtles

Biology and Society A Passion for Life

The Scientific Study of Life

An Overview of the Process of Science

Hypotheses, Theories, and Facts

Controlled Experiments

The Process of Science Do Baby Turtles Swim?

Evaluating Scientific Claims

The Properties of Life

Major Themes in Biology

The Relationship of Structure to Function

Information Flow

Pathways That Transform Energy and Matter

Interactions within Biological Systems

Evolution

Evolution Connection Turtles in the Tree of Life

Unit 1 Cells

Chapter 2 Essential Chemistry for Biology

Chapter Thread Helpful Radiation

Biology and Society Nuclear Medicine

Some Basic Chemistry

Matter: Elements and Compounds



Atoms

The process of science How Effective Is Radiation in Treating Prostate Cancer?

Chemical Bonding and Molecules

Chemical Reactions

Water and Life

Water

Acids, Bases, and pH

Evolution Connection Radioactivity as an Evolutionary Clock

Chapter 3 The Molecules of Life

Chapter Thread Lactose Intolerance

Biology and Society Got Lactose?

Organic Compounds

Carbon Chemistry

Giant Molecules from Smaller Building Blocks

Large Biological Molecules

Carbohydrates

Lipids

Proteins

Nucleic Acids

The Process of Science Does Lactose Intolerance Have a Genetic Basis?

Evolution Connection The Evolution of Lactose Intolerance in Humans

Chapter 4 A Tour of the Cell

Chapter Thread Humans Versus Bacteria

Biology and Society Antibiotics: Drugs That Target Bacterial Cells

The Microscopic World of Cells

The Two Major Categories of Cells

An Overview of Eukaryotic Cells

Membrane Structure

The Plasma Membrane

Cell Surfaces

The Process of Science How Was the First 21st-Century Antibiotic Discovered?

The Nucleus and Ribosomes:Genetic Control of the Cell

The Nucleus

Ribosomes

How DNA Directs Protein Production

The Endomembrane System: Manufacturing and Distributing Cellular Products

The Endoplasmic Reticulum

The Golgi Apparatus

Lysosomes



Vacuoles

Chloroplasts and Mitochondria: Providing Cellular Energy

Chloroplasts

Mitochondria

The Cytoskeleton: Cell Shape and Movement

Maintaining Cell Shape

Flagella and Cilia

Evolution Connection The Evolution of Bacterial Resistance in Humans

Chapter 5 The Working Cell

Chapter Thread Nanotechnology

Biology and Society Harnessing Cellular Structures

Some Basic Energy Concepts

Conservation of Energy

Heat

Chemical Energy

Food Calories

ATP and Cellular Work

The Structure of ATP

Phosphate Transfer

The ATP Cycle

Enzymes

Activation Energy

The Process of Science Can Enzymes Be Engineered?

Enzyme Activity

Enzyme Inhibitors

Membrane Function

Passive Transport: Diffusion across Membranes

Osmosis and Water Balance

Active Transport: The Pumping of Molecules across Membranes

Exocytosis and Endocytosis: Traffic of Large Molecules

Evolution Connection The Origin of Membranes

Chapter 6 Cellular Respiration: Obtaining Energy from Food

Chapter Thread Exercise Science

Biology and Society Getting the Most Out of Your Muscles

Energy Flow and Chemical Cyclingin the Biosphere

Producers and Consumers

Chemical Cycling between Photosynthesis and Cellular Respiration

Cellular Respiration: Aerobic Harvest of Food Energy

An Overview of Cellular Respiration



The Three Stages of Cellular Respiration

The Results of Cellular Respiration

Fermentation: Anaerobic Harvest of Food Energy

Fermentation in Human Muscle Cells

The Process of Science What Causes Muscle Burn?

Fermentation in Microorganisms

Evolution Connection The Importance of Oxygen

Chapter 7 Photosynthesis: Using Light to make Food

Chapter Thread Solar Energy

Biology and Society A Solar Revolution

The Basics of Photosynthesis

Chloroplasts: Sites of Photosynthesis

An Overview of Photosynthesis

The Light Reactions: Converting Solar Energy to Chemical Energy

The Nature of Sunlight

The Process of Science What Colors of Light Drive Photosynthesis?

Chloroplast Pigments

How Photosystems Harvest Light Energy

How the Light Reactions Generate ATP and NADPH

The Calvin Cycle: Making Sugar from Carbon Dioxide

Evolution Connection Creating a Better Biofuel Factory

Unit 2 Genetics

Chapter 8 Cellular Reproduction: Cells from Cells

Chapter Thread Life with and without Sex

Biology and Society Virgin Birth of a Shark

What Cell Reproduction Accomplishes

The Cell Cycle and Mitosis

Eukaryotic Chromosomes

Duplicating Chromosomes

The Cell Cycle

Mitosis and Cytokinesis

Cancer Cells: Dividing Out of Control

Meiosis, the Basis of Sexual Reproduction

Homologous Chromosomes

Gametes and the Life Cycle of a Sexual Organism

The Process of Meiosis

Review: Comparing Mitosis and Meiosis

The Origins of Genetic Variation

The process of Science Do All Animals Have Sex?



When Meiosis Goes Wrong

Evolution Connection The Advantages of Sex

Chapter 9 Patterns of Inheritance

Chapter Thread Dog Breeding

Biology and Society Darwins Dogs

Genetics and Heredity

In an Abbey Garden

Mendels Law of Segregation

Mendels Law of Independent Assortment

Using a Testcross to Determine an Unknown Genotype

The Rules of Probability

Family Pedigrees

Human Traits Controlled by a Single Gene

The Process of Science What Is the Genetic Basis of Short Legs in Dogs?

Variations on Mendels Laws

Incomplete Dominance in Plants and People

ABO Blood Groups: An Example of Multiple Alleles and Codominance

Pleiotropy and Sickle-Cell Disease

Polygenic Inheritance

Epigenetics and the Role of Environment

The Chromosomal Basis of Inheritance

Linked Genes

Sex Determination in Humans

Sex-Linked Genes

Evolution Connection Barking Up the Evolutionary Tree

Chapter 10 The Structure and Function of DNA

Chapter Thread Deadly Viruses

Biology and Society The Global Threat of Zika Virus

DNA: Structure and Replication

DNA and RNA Structure

Watson and Cricks Discovery of the Double Helix

DNA Replication

From DNA to RNA to Protein

How an Organisms Genotype Determines Its Phenotype

From Nucleotides to Amino Acids: An Overview

The Genetic Code

Transcription: From DNA to RNA

Translation: The Players

The Processing of Eukaryotic RNA

Translation: The Process



Review: DNA S RNA S Protein

Mutations

Viruses and Other NoncellularInfectious Agents

Bacteriophages

Plant Viruses

Animal Viruses

The Process of Science Can DNA and RNA Vaccines Protect Against Viruses?

HIV, the AIDS Virus

Prions

Evolution Connection Emerging Viruses

Chapter 11 How Genes Are Controlled

Chapter Thread Cancer

Biology and Society Breast Cancer and Chemotherapy

How and Why Genes Are Regulated

Gene Regulation in Bacteria

Gene Regulation in Eukaryotic Cells

Cell Signaling

Homeotic Genes

Visualizing Gene Expression

Cloning Plants and Animals

The Genetic Potential of Cells

Reproductive Cloning of Animals

Therapeutic Cloning and Stem Cells

The Genetic Basis of Cancer

Genes That Cause Cancer

The Process of Science Can Avatars Improve Cancer Treatment?

Cancer Risk and Prevention

Evolution Connection The Evolution of Cancer in the Body

Chapter 12 DNA Technology

Chapter Thread DNA Profiling

Biology and Society Using DNA to Establish Guilt and Innocence

Genetic Engineering

Recombinant DNA Techniques

Gene Editing

Medical Applications

Genetically Modified Organisms in Agriculture

Human Gene Therapy

DNA Profiling and Forensic Science

DNA Profiling Techniques

Investigating Murder, Paternity, and Ancient DNA



Bioinformatics

DNA Sequencing

Genomics

Genome-Mapping Techniques

The Human Genome

The Process of Science Did Nic Have a Deadly Gene?

Applied Genomics

Systems Biology

Safety and Ethical Issues

The Controversy over Genetically Modified Foods

Ethical Questions Raised by Human DNA Technologies

Evolution Connection The Y Chromosome as a Window on History

Unit 3 Evolution and Diversity

Chapter 13 How Populations Evolve

Chapter Thread Evolution in Action

Biology and Society Mosquitoes and Evolution

The Diversity of Life

Naming and Classifying the Diversity of Life

Explaining the Diversity of Life

Charles Darwin and The Origin of Species

Darwins Journey

Darwins Theory

Evidence of Evolution

Evidence from Fossils

Evidence from Homologies

Evolutionary Trees

Natural Selection as the Mechanism for Evolution

Natural Selection in Action

Key Points about Natural Selection

The Evolution of Populations

Sources of Genetic Variation

Populations as the Units of Evolution

Analyzing Gene Pools

Population Genetics and Health Science

Microevolution as Change in a Gene Pool

Mechanisms of Evolution

Natural Selection

Genetic Drift

Gene Flow

Natural Selection: A Closer Look



The Process of Science Did Natural Selection Shape the Beaks of Darwins Finches?

Evolution Connection The Rising Threat of Antibiotic Resistance

Chapter 14 How Biological Diversity Evolves

Chapter Thread Evolution in the Human-Dominated World

Biology and Society Humanitys Footprint

The Origin of Species

What is a Species?

Reproductive Barriers between Species

Mechanisms of Speciation

The Process of Science Do Human Activities Facilitate Speciation?

Earth History and Macroevolution

The Fossil Record

Plate Tectonics and Biogeography

Mass Extinctions and Explosive Diversifications of Life

Mechanisms of Macroevolution

Large Effects from Small Genetic Changes

The Evolution of Biological Novelty

Classifying the Diversity of Life

Classification and Phylogeny

Classification: A Work in Progress

Evolution Connection Evolution in the Anthropocene

Chapter 15 The Evolution of Microbial Life

Chapter Thread Human Microbiota

Biology and Society Our Invisible Inhabitants

Major Episodes in the History of Life

The Origin of Life

A Four-Stage Hypothesis for the Origin of Life

From Chemical Evolution to Darwinian Evolution

Prokaryotes

Theyre Everywhere!

The Structure and Function of Prokaryotes

The Ecological Impact of Prokaryotes

The Two Main Branches of Prokaryotic Evolution: Bacteria and Archaea

The Process of Science Are Intestinal Microbiota to Blame for Obesity?

Protists

Protozoans

Slime Molds

Unicellular and Colonial Algae

Seaweeds

Evolution Connection The Sweet Life of Streptococcus mutans



Chapter 16 The Evolution of Plants and Fungi

Chapter Thread Plant-Fungus Interactions

Biology and Society The Diamond of the Kitchen

Colonizing Land

Terrestrial Adaptations of Plants

The Origin of Plants from Green Algae

Plant Diversity

Highlights of Plant Evolution

Bryophytes

Ferns

Gymnosperms

Angiosperms

Plant Diversity as a Nonrenewable Resource

Fungi

Characteristics of Fungi

The Process of Science What Killed the Pines?

The Ecological Impact of Fungi

Commercial Uses of Fungi

Evolution Connection A Pioneering Partnership

Chapter 17 The Evolution of Animals

Chapter Thread Human Evolution

Biology and Society Evolving Adaptability

The Origins of Animal Diversity

What is an Animal?

Early Animals and the Cambrian Explosion

Animal Phylogeny

Major Invertebrate Phyla

Sponges

Cnidarians

Molluscs

Flatworms

Annelids

Roundworms

Arthropods

Echinoderms

Vertebrate Evolution and Diversity

Characteristics of Chordates

Fishes

Amphibians

Reptiles



Mammals

The Human Ancestry

The Evolution of Primates

The Emergence of Humankind

The Process of Science What Can Lice Tell Us About Ancient Humans?

Evolution Connection Are We Still Evolving?

Unit 4 Ecology

Chapter 18 An Introduction to Ecology and the Biosphere

Chapter Thread Climate Change

Biology and Society Penguins, Polar Bears, and People in Peril

An Overview of Ecology

Ecology and Environmentalism

A Hierarchy of Interactions

Living in Earths Diverse Environments

Abiotic Factors of the Biosphere

The Evolutionary Adaptations of Organisms

Adjusting to Environmental Variability

Biomes

Freshwater Biomes

Marine Biomes

How Climate Affects Terrestrial Biome Distribution

Terrestrial Biomes

The Water Cycle

Human Impact on Biomes

Climate Change

The Greenhouse Effect and Global Warming

The Accumulation of Greenhouse Gases

Effects of Climate Change on Ecosystems

The Process of Science How Does Climate Change Affect Species Distribution?

Looking to Our Future

Evolution Connection Climate Change as an Agent of Natural Selection

Chapter 19 Population Ecology

Chapter Thread Biological Invasions

Biology and Society Invasion of the Lionfish

An Overview of Population Ecology

Population Density

Population Age Structure

Life Tables and Survivorship Curves

Life History Traits as Adaptations

Population Growth Models



The Exponential Population Growth Model: The Ideal of an Unlimited Environment

The Logistic Population Growth Model: The Reality of a Limited Environment

Regulation of Population Growth

Applications of Population Ecology

Conservation of Endangered Species

Sustainable Resource Management

Invasive Species

Biological Control of Pests

The Process of Science Can Fences Stop Cane Toads?

Integrated Pest Management

Human Population Growth

The History of Human Population Growth

Age Structures

Our Ecological Footprint

Evolution Connection Humans as an Invasive Species

Chapter 20 Communities and Ecosystems

Chapter Thread Importance of Biodiversity

Biology and Society Why Biodiversity Matters

Biodiversity

Genetic Diversity

Species Diversity

Ecosystem Diversity

Causes of Declining Biodiversity

Community Ecology

Interspecific Interactions

Trophic Structure

Species Diversity in Communities

Disturbances and Succession in Communities

Ecological Succession

Ecosystem Ecology

Energy Flow in Ecosystems

Chemical Cycling in Ecosystems

Conservation and Restoration Biology

Biodiversity Hot Spots

Conservation at the Ecosystem Level

The Process of Science Does Biodiversity Protect Human Health?

Restoring Ecosystems

The Goal of Sustainable Development

Evloution Connection Saving the Hot Spots

Appendix

A Metric Conversion Table

B The Periodic Table



C Credits

D Selected Answers

Glossary

Index

Back Cover