

Brief Contents

- 1 Can Science Cure the Common Cold? Introduction to the Scientific Method 1

Unit One Chemistry and Cells

- 2 Are We Alone in the Universe? Water, Biochemistry, and Cells 22
- 3 The Only Diet You Will Ever Need Nutrients, Enzymes and Metabolism, and Transport Across Membranes 44
- 4 Is the Earth Warming? The Greenhouse Effect, Cellular Respiration, and Photosynthesis 70

Unit Two Genetics

- 5 Cancer DNA Synthesis, Mitosis, and Meiosis 100
- 6 Are You Only as Smart as Your Genes? Mendelian and Quantitative Genetics 136
- 7 DNA Detective Extensions of Mendelism, Sex Linkage, Pedigree Analysis, and DNA Fingerprinting 166
- 8 Genetic Engineering Transcription, Translation, and Genetically Modified Organisms 192

Unit Three Evolution

- 9 Where Did We Come From? The Evidence for Evolution 224
- 10 An Evolving Enemy Natural Selection 256
- 11 Who Am I? Species and Races 282
- 12 Prospecting for Biological Gold Biodiversity and Classification 316

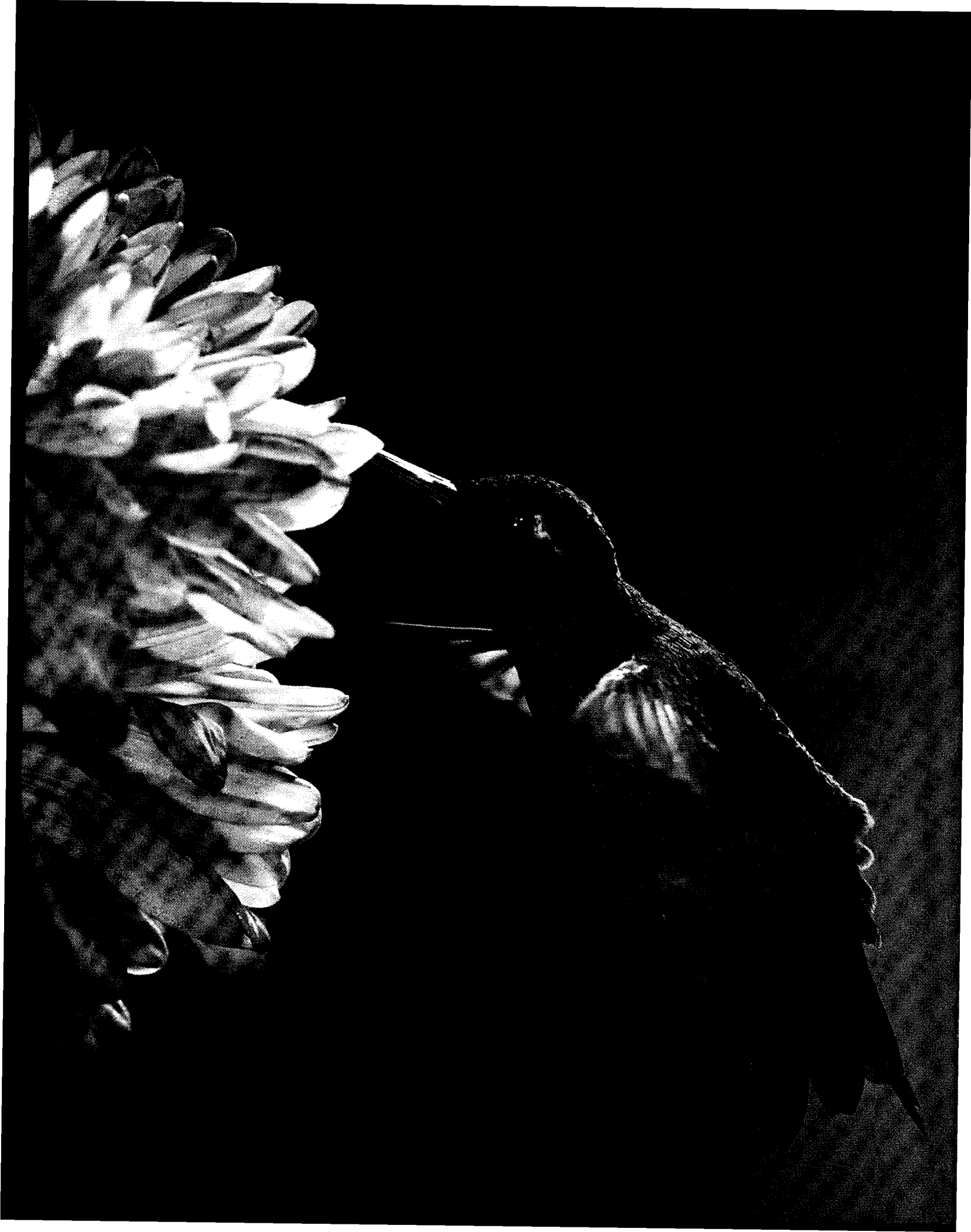
Unit Four Ecology

- 13 Is the Human Population Too Large? Population Ecology 344
- 14 Is Earth Experiencing a Biodiversity Crisis? Community Ecology, Ecosystem Ecology, and Conservation Biology 358
- 15 Where Do You Live? Climate and Biomes 390

This textbook is available in two versions:

Biology: Science for Life, Second Edition (0-13-148969-0) consists of **Chapters 1-15**, which provide non-majors biology students with a thorough overview of the foundations of modern biological science: cell biology, genetics, evolution, and ecology.

Biology: Science for Life with Physiology, Second Edition (0-13-225770-X), an expanded version of the text, contains **Chapters 1-23**: the fifteen chapters noted above, plus eight chapters on animal and plant anatomy and physiology.



BIOLOGY

Science for Life

SECOND EDITION

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Preface

To the Student

As you worked your way through high school, or otherwise worked to prepare yourself for college, you were probably unaware that an information explosion was taking place in the field of biology. This explosion, brought on by advances in biotechnology and communicated by faster, more powerful computers, has allowed scientists to gather data more quickly and disseminate data to colleagues in the global scientific community with the click of a mouse. Every discipline of biology has benefited from these advances, and today's scientists collectively know more than any individual could ever hope to understand.

Paradoxically, as it becomes more and more difficult to synthesize huge amounts of information from disparate disciplines within the broad field of biology, it becomes more vital that we do so. The very same technologies that led to the information boom, coupled with expanding human populations, present us with complex ethical questions. These questions include whether or not it is acceptable to clone humans, when human life begins and ends, who owns living organisms, what our responsibilities toward endangered species are, and many more. No amount of knowledge alone will provide satisfactory answers to these questions. Addressing these kinds of questions requires the development of a scientific literacy that surpasses the rote memorization of facts. To make decisions that are individually, socially, and ecologically responsible, you must not only understand some fundamental principles of biology but also be able to use this knowledge as a tool to help you analyze ethical and moral issues involving biology.

To help you understand biology and apply your knowledge to an ever-expanding suite of issues, we have structured each chapter of *Biology: Science for Life* around a compelling story in which biology plays an integral role. Through the story you will not only learn the relevant biological principles, but you will also see how science can be used to help answer complex questions. As you learn to apply the strategies modeled by the text, you will begin developing your critical thinking skills.

By the time you finish this book, you should have a clear understanding of many important biological principles. You will also be able to critically evaluate which information is most reliable instead of simply accepting all the information you hear or read about. Even though you may not be planning to be a practicing biologist, well-developed critical thinking skills will enable you to make decisions that affect your own life, such as whether or not to take nutritional supplements, and decisions that affect the lives of others, such as whether or not to believe the DNA evidence presented to you as a juror in a criminal case.

It is our sincere hope that understanding how biology applies to important personal, social, and ecological issues will convince you to stay informed about such issues. On the job, in your community, at the doctor's office, in the voting booth, and at home reading the paper or surfing the web, your knowledge of the basic biology underlying so many of the challenges that we as individuals and as a society face will enable you to make well-informed decisions for your home, your nation, and your world.

To the Instructor



Virginia Borden and **Colleen Belk** have collaborated on teaching the nonmajors biology course at the University of Minnesota–Duluth for over a decade. This collaboration has been enhanced by their differing but complementary areas of expertise. In addition to the nonmajors course, Colleen Belk teaches General Biology for majors, Genetics, Cell Biology, and Molecular Biology courses. Virginia Borden teaches General Biology for majors, Evolutionary Biology, Plant Biology, Ecology, and Conservation Biology courses.

After several somewhat painful attempts at teaching all of biology in a single semester, the two authors came to the conclusion that they needed to find a better way. They realized that their students were more engaged when they understood how biology directly affected their lives. Colleen and Virginia began to structure their lectures around stories they knew would interest students. When they began letting the story drive the science, they immediately noticed a difference in student interest, energy, and willingness to work harder at learning biology. Not only has this approach increased student understanding, it has increased the authors' enjoyment in teaching the course—presenting students with fascinating stories infused with biological concepts is simply a lot more fun. This approach served to invigorate their teaching. Knowing that their students are learning the biology that they will need now and in the future gives the authors a deep and abiding satisfaction.

By now you are probably all too aware that teaching nonmajor students is very different from teaching biology majors. You know that most of these students will never take another formal biology course; therefore your course may be the last chance for these students to see the relevance of science in their everyday lives and the last chance to appreciate how biology is woven throughout the fabric of their lives. You recognize the importance of engaging these students because you know that these students will one day be voting on issues of scientific importance, holding positions of power in the community, serving on juries, and making healthcare decisions for

themselves and their families. You know that your students' lives will be enhanced if they have a thorough grounding in basic biological principles and scientific literacy.

Themes Throughout *Biology: Science for Life*

Helping nonmajors to appreciate the importance of learning biology can be a tremendously rewarding job—and a challenging one as well. We sometimes struggled to actively engage students in lectures and to raise their scientific literacy and critical thinking skills, and we knew we were not alone. In fact, when we asked instructors from around the country what challenges they faced while teaching the nonmajors introductory biology course, these dedicated teachers echoed our concerns. This book was written to help biology instructors meet these challenges.

The Story Drives the Science. We have found that students are much more likely to be engaged in the learning process when the textbook and lectures capitalize on their natural curiosity. This text accomplishes this by using a story to drive the science in every chapter. Students get caught up in the story and become interested in learning the biology so they can see how the story is resolved. This approach allows us to cover the key areas of biology, including basic chemistry, the unity and diversity of life, cell structure and function, classical and molecular genetics, evolution, and ecology, in a manner that makes students want to learn. Not only do students want to learn, this approach allows students to both connect the science to their everyday lives and integrate the principles and concepts for later application to other situations. This approach will give you flexibility in teaching and will support you in developing students' critical thinking skills.

The Process of Science. This book also uses another novel approach in the way that the process of science is modeled. The first chapter is dedicated to the scientific method and hypothesis testing, and each subsequent chapter weaves the scientific method and hypothesis testing throughout the story. The development of students' critical thinking skills is thus reinforced for the duration of the course. Students will see that the application of the scientific method is often the best way to answer questions raised in the story. This practice not only allows students to develop their critical thinking skills but, as they begin to think like scientists, helps them understand why and how scientists do what they do.

Integration of Evolution. Another aspect of *Biology: Science for Life* that sets it apart from many other texts is the manner in which evolutionary principles are integrated throughout the text. The role of evolutionary processes is highlighted in every chapter, even when the chapter is not specifically focused on an evolutionary question. For example, when discussing infectious diseases, the evolution of antibiotic-resistant strains of bacteria is addressed. The physiology unit includes an essay on evolution in each chapter. These essays illustrate the importance of natural selection in the development of various organs and organ systems across a wide range of organisms. With evolution serving as an overarching theme, students are better able to see that all of life is connected through this process.

Pedagogical Elements

Open the book and flip through a few pages and you will see some of the most inviting, lively, and informative illustrations you have ever seen in a biology text. The illustrations are inviting because they have a warm, hand-drawn quality that is clean and uncluttered. Most importantly, the illustrations are informative, not only because they were carefully crafted to enhance concepts in the text but

also because they employ techniques like the “pointer” that help draw the students’ attention to the important part of the figure (see page 50). Likewise, tables are more than just tools for organizing information; they are illustrated to provide attractive, easy references for the student. We hope that the welcoming nature of the art and tables in this text will encourage nonmajors to explore ideas and concepts instead of being overwhelmed before they even get started.

In addition to lively illustrations, this text also strives to engage the nonmajor student through the use of analogies. For example, the process of translation is likened to baking a cake, and the heterozygote advantage is likened to the advantage conferred by having more than one type of jacket (see page 144 and pages 201–202). These clever illustrations are peppered throughout the text.

Students can reinforce and assess what they are learning in the classroom by reading the chapter, studying the figures, and answering the end-of-chapter questions. We have written these questions in every format likely to be used by an instructor during an exam so that students have practice in answering many different types of questions. We have also included “Connecting the Science” questions that would be appropriate for essay exams, class discussions, or use as topics for term papers.

Improvements in the Second Edition

Bringing the first edition of *Biology: Science for Life* to instructors around the country was extremely gratifying to us. The success of the first edition and the positive feedback that it garnered assured us that this approach works for students and instructors alike. We also received feedback from users and reviewers on how to enhance the second edition to most closely meet the needs of biology instructors in diverse settings.

- To make your transition to teaching from this text as simple as possible, we have reorganized the sequence of topics to more closely resemble the traditional topical order found in most biology courses.
- To better meet the needs of instructors teaching a wide diversity of nonmajors biology courses who employed the first edition of *Biology: Science for Life*, we have created two versions of the book. The shorter version provides a thorough overview of the four pillars of modern biological science: cell biology, genetics, evolution, and ecology. We have increased coverage of basic chemistry and metabolism so that students develop a more solid understanding of the basic process that support and constrain much of life on Earth. The longer version includes an expanded animal physiology section, including coverage of all major animal organ systems, as well as additional chapters on plant structure and function.
- We have increased coverage of non-human biology, often providing examples of how the biology of other organisms differs from that of humans. For example, while the storyline of the natural selection chapter is the evolution and control of the HIV virus in an infected person, the chapter is peppered with non-human examples of the effects of natural selection—from the evolution of bill size in Galapagos finches to the adaptations for wind pollination in grasses. Likewise, we have included additional photos to provide more vivid illustrations of the wonderful variety of life on Earth, from amoebas reproducing asexually (Chapter 5) to peacocks demonstrating the effects of sexual selection (Chapter 11).
- The overall goal of the text remains providing a thorough overview of the essentials of biological science while trying to avoid overloading students with information. We worked closely with instructors using the first edition, as well as other reviewers, to pinpoint essential content to include in the second edition. When necessary, we judiciously added more detailed content where the students’ understanding of the material would be enhanced by additional information. Chapter 2: Are We Alone

in the Universe? and Chapter 4: Is the Earth Warming? provide examples of where coverage was expanded (in this case, of chemistry and metabolism), while staying true to the book's philosophy of teaching essential information in a story format.

The development of the second edition has truly been a collaborative process among ourselves, the students and instructors who used the first edition, and the many thoughtful reviewers of these chapters. We look forward to learning about your experience with *Biology: Science for Life, 2e*.

Supplements

A group of talented and dedicated biology educators teamed up with us to build a set of resources that equip nonmajors with the tools to achieve scientific literacy that will allow them to make informed decisions about the biological issues that affect them daily. The student resources offer several ways of reviewing and reinforcing the concepts and facts covered in this textbook. The instructor resources provide a thoroughly revised collection of test questions, an updated and expanded suite of lecture presentation materials, and a valuable source of ideas for educators to enrich their instruction efforts. Available in print and media formats, the *Biology: Science for Life* resources are easy to navigate and support a variety of learning and teaching styles.

We believe you will find that the design and format of this text and its supplements will help you meet the challenge of helping students both succeed in your course and develop science skills—for life.

Acknowledgments

Reviewers

Each chapter of this book was thoroughly reviewed several times as it moved through the development process. Reviewers were chosen on the basis of their demonstrated talent and dedication in the classroom. Many of these reviewers were already trying various approaches to actively engage students in lectures, and to raise the scientific literacy and critical thinking skills among their students. Their passion for teaching and commitment to their students was evident throughout this process. These devoted individuals scrupulously checked each chapter for scientific accuracy, readability, and coverage level. In addition to general reviewers, we also had a team of expert reviewers evaluate individual chapters to ensure that the content was accurate and that all the necessary concepts were included.

All of these reviewers provided thoughtful, insightful feedback, which improved the text significantly. Their efforts reflect their deep commitment to teaching nonmajors and improving the scientific literacy of all students. We are very thankful for their contributions.

We express sincere gratitude to the expert reviewers who worked so carefully with the author in reviewing manuscript to ensure the scientific accuracy of the text and art.

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Print and media supplements were prepared by a very creative, energetic, and fun team of nonmajors biology instructors from colleges and universities across the country. As a result, students will see dynamic animations of many complex processes and will have the opportunity to practice newly learned skills. The work of these instructors helped ensure that the supplements were reinforcing the chapter content. We cannot thank them enough.

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The Book Team

When we set out to write this book, we would not have predicted that we would so thoroughly enjoy the experience. Our enjoyment stems directly from the enthusiasm and talent of the Prentice Hall team. It has been an honor to work with all of these talented, dedicated people.

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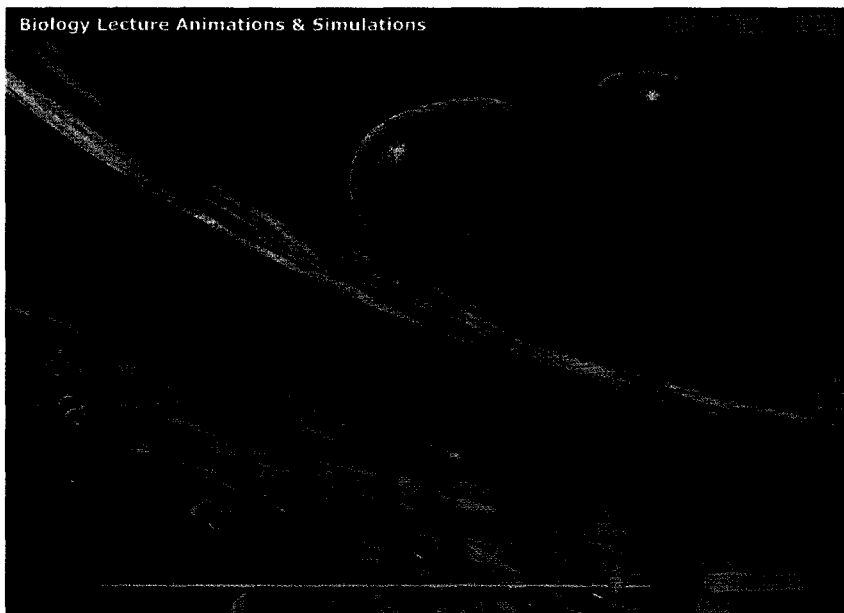
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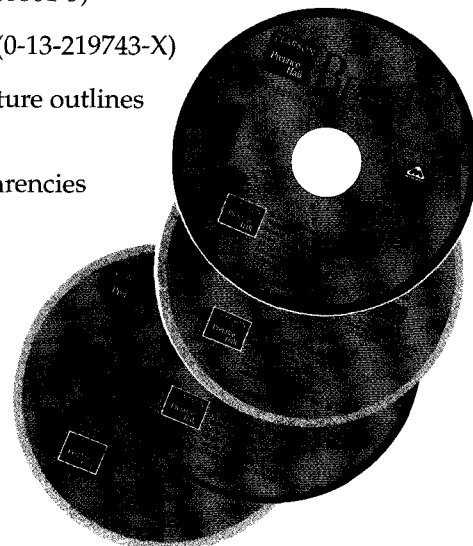
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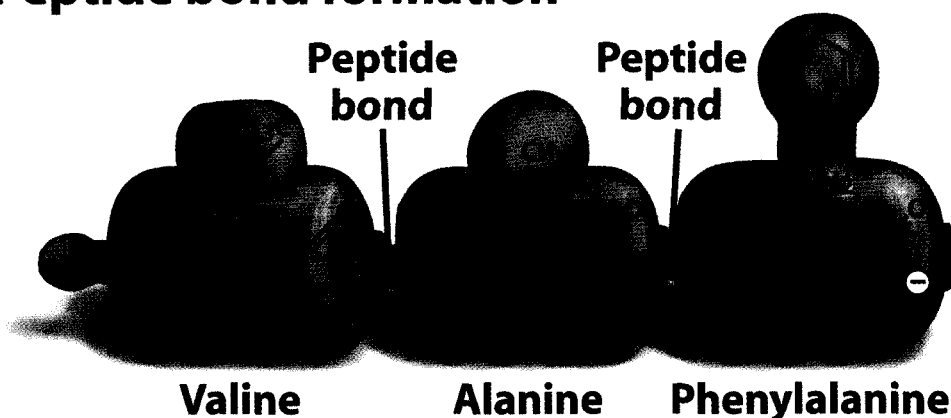
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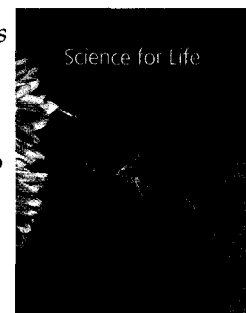
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Contents

Preface **v**

Chapter 1

Can Science Cure the Common Cold? Introduction to the Scientific Method **1**

1.1 The Process of Science 2

The Logic of Hypothesis Testing 3

The Experimental Method 5

Using Correlation to Test Hypotheses 10

Understanding Statistics 12

1.2 Evaluating Scientific Information 15

Information from Anecdotes 16

Science in the News 16

Understanding Science from Secondary Sources 17

1.3 Is There a Cure for The Common Cold? 19

Chapter Review 19

Unit One

Chemistry and Cells

Chapter 2

Are We Alone in the Universe?

Water, Biochemistry, and Cells **22**

2.1 What Does Life Require? 24

A Definition of Life 24

The Properties of Water 25

Organic Chemistry 27

Structure and Function of Macromolecules 29

2.2 Life on Earth 35

Prokaryotic and Eukaryotic Cells 35

Cell Structure 35

The Tree of Life and Evolutionary Theory 40

Chapter Review 41

Chapter 3

The Only Diet You Will Ever Need Nutrients, Enzymes and Metabolism, and Transport Across Membranes **44**



- 3.1 Nutrients 46**
 Macronutrients 46
 Micronutrients 50
 Processed Versus Whole Foods 52
- 3.2 Enzymes and Metabolism 54**
 Enzymes 54
 Calories and Metabolic Rate 56
- 3.3 Transport Across Membranes 58**
 Passive Transport: Diffusion, Facilitated Diffusion,
 and Osmosis 58
 Active Transport: Pumping Substances Across
 the Membrane 59
 Exocytosis and Endocytosis: Movement of Large Molecules
 Across the Membrane 60
- 3.4 Body Fat and Health 60**
 Evaluating How Much Body Fat Is Healthful 62
 Obesity 62
 Anorexia and Bulimia 66
- Chapter Review 67**

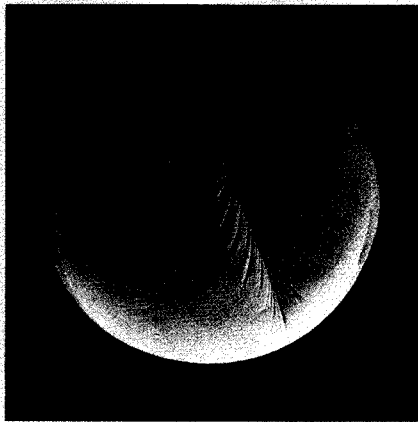
Chapter 4

Is the Earth Warming? The Greenhouse Effect, Cellular Respiration, and Photosynthesis 70

- 4.1 The Greenhouse Effect 72**
 Water, Heat, and Temperature 72
 Carbon Dioxide 73
 The Greenhouse Effect, Organisms, and
 Their Environments 75
- 4.2 Cellular Respiration 77**
 Structure and Function of ATP 77
 A General Overview of Cellular Respiration 79
 Glycolysis, the Krebs Cycle, and Electron
 Transport 80
 Global Warming and Cellular Respiration 87
- 4.3 Photosynthesis 88**
 A General Overview of Photosynthesis 88
 The Light Reactions and the Calvin Cycle 89
 Global Warming and Photosynthesis 92
- 4.4 Decreasing the Effects of Global Warming 95**
Essay 4.1 Metabolism Without Oxygen: Anaerobic Respiration
 and Fermentation 82
- Chapter Review 98**



Unit Two



Genetics

Chapter 5

Cancer DNA Synthesis, Mitosis, and Meiosis 100

5.1 What Is Cancer? 103

5.2 Cell Division Overview 105

DNA Replication 106

5.3 The Cell Cycle and Mitosis 108

Interphase 108

Mitosis 109

Cytokinesis 111

5.4 Cell Cycle Control and Mutation 112

Controls in the Cell Cycle 112

Mutations to Cell-Cycle Control Genes 113

5.5 Cancer Detection and Treatment 117

Detection Methods: Biopsy 117

Treatment Methods: Chemotherapy and Radiation 121

5.6 Meiosis 123

Interphase 127

Meiosis I 127

Meiosis II 127

Crossing Over and Random Alignment 130

Essay 5.1 Cancer Risk Factors 118

Chapter Review 133

Chapter 6

Are You Only as Smart as Your Genes? Mendelian and Quantitative Genetics 136

6.1 The Inheritance of Traits 138

Genes and Chromosomes 139

Diversity in Offspring: Segregation, Independent Assortment, Crossing Over, and Random Fertilization 142

6.2 Mendelian Genetics: When the Role of Genes Is Clear 146

Genotype and Phenotype 148

Genetic Diseases in Humans 149

Using Punnett Squares to Predict Offspring Genotypes 150

6.3 Quantitative Genetics: When Genes and Environment Interact 153

Quantitative Traits 153

Why Traits Are Quantitative 154

Using Heritability to Analyze Inheritance 156

Calculating Heritability in Human Populations 157

6.4 Genes, Environment, and the Individual 159

The Use and Misuse of Heritability 160

How Do Genes Matter? 162

Essay 6.1 Gregor Mendel 147**Chapter Review 163****Chapter 7****DNA Detective** Extensions of Mendelism,
Sex Linkage, Pedigree Analysis, and DNA
Fingerprinting **166****7.1 Extensions of Mendelian Genetics 168****7.2 Sex Determination and Sex Linkage 172**

Sex Determination 172

Meiosis and Sex Chromosomes 174

Sex Linkage 176

7.3 Pedigrees 178**7.4 DNA Fingerprinting 181**

Polymerase Chain Reaction (PCR) 182

Restriction Fragment Length Polymorphism
(RFLP) Analysis 183

Gel Electrophoresis 183

Meiosis and DNA Fingerprinting 185

Essay 7.1 Blood Group Genetics 171**Essay 7.2** Chromosomal Anomalies 174**Essay 7.3** X Inactivation 178**Chapter Review 190****Chapter 8****Genetic Engineering** Transcription, Translation, and
Genetically Modified Organisms **192****8.1 Genetic Engineers 194****8.2 Protein Synthesis and Gene Expression 194**

From Gene to Protein 195

Transcription 197

Translation 197

Mutations 200

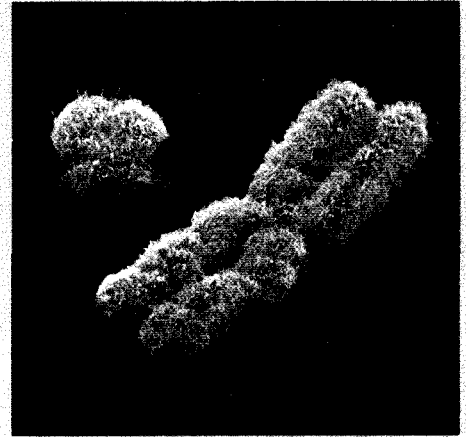
Regulating Gene Expression 202

8.3 Producing Recombinant Proteins 204

Cloning a Gene Using Bacteria 204

FDA Regulations 207

Basic Versus Applied Research 207



- 8.4 Genetic Engineers Can Modify Foods 208**
 Why Genetically Modify Crop Plants? 208
 Modifying Crop Plants with the Ti Plasmid and Gene Gun 210
 Effect of GMOs on Health 210
 GM Crops and the Environment 213
- 8.5 Genetic Engineers Can Modify Humans 215**
 The Human Genome Project 215
 Gene Therapy 216
 Cloning Humans 218
- Essay 8.1 Stem Cells 220**
Chapter Review 221

Unit Three

Evolution



Chapter 9

Where Did We Come From? The Evidence for Evolution 224

- 9.1 What Is Evolution? 226**
 The Process of Evolution 226
 The Theory of Evolution 227
- 9.2 Charles Darwin and the Theory of Evolution 229**
 Early Views of Evolution 229
 The Voyage of the *Beagle* 229
 Developing the Hypothesis of Common Descent 230
- 9.3 Evaluating the Evidence for Common Descent 231**
 Biological Classification Suggests Evolutionary Relationships 234
 Evidence of Homology 237
 Evidence from Biogeography 242
 Evidence from the Fossil Record 244
- 9.4 Are Alternatives to the Theory of Evolution Equally Valid? 250**
 The Static Model and Transformation Hypotheses 250
 The Separate Types and Common Descent Hypotheses 250
 The Best Scientific Explanation for the Diversity of Life 251
- Essay 9.1** Argument from Design 232
Essay 9.2 The Origin of Life 252
Chapter Review 253

Chapter 10

An Evolving Enemy Natural Selection 256

- 10.1 AIDS and HIV 258**
 AIDS Is a Disease of the Immune System 258
 HIV Causes AIDS 259
 The Course of HIV Infection 261

10.2 The Theory of Natural Selection 262

- Four Observations and an Inference 263
- Testing Natural Selection 266
- The Modern Understanding of Natural Selection 267
- Subtleties of Natural Selection 268

10.3 Natural Selection and HIV 272

- HIV Fits Darwin's Observations 272
- The Evolutionary Arms Race 272

10.4 How Understanding Evolution Can Help Prevent AIDS 273

- Single Drug Therapy Selects for Drug Resistance 273
- Combination Drug Therapy Can Slow HIV Evolution 275
- Problems with Combination Drug Therapy 276
- Preventing AIDS 277

Essay 10.1 The Evidence Linking HIV to AIDS 259**Chapter Review 279****Chapter 11****Who Am I? Species and Races 282****11.1 What Is a Species? 284**

- The Biological Species Concept 284
- The Process of Speciation 288

11.2 The Race Concept in Biology 293**11.3 Humans and the Race Concept 295**

- The Morphological Species Concept 296
- Modern Humans: A History 297
- Genetic Evidence of Divergence 298
- Human Races Are Not Biological Groups 300
- Human Races Have Never Been Truly Isolated 303

11.4 Why Human Groups Differ 306

- Natural Selection 306
- Convergent Evolution 308
- Genetic Drift 309
- Sexual Selection 312
- Assortative Mating 312

11.5 Race in Human Society 313**Essay 11.1 The Hardy-Weinberg Theorem 304****Chapter Review 314****Chapter 12****Prospecting for Biological Gold Biodiversity and Classification 316****12.1 Biological Classification 318**

- How Many Species Exist? 318
- Kingdoms and Domains 320



12.2 The Diversity of Life 323

- Bacteria and Archaea 323
- Protista 325
- Animalia 328
- Fungi 331
- Plantae 332

12.3 Learning About Species 336

- Fishing for Useful Products 337
- Understanding Ecology 337
- Reconstructing Evolutionary History 338
- Learning from the Shamans 340

Essay 12.1 Diversity's Rocky Road 334

Chapter Review 342

Unit Four

Ecology

Chapter 13

Is the Human Population Too Large?

Population Ecology 344

13.1 A Growing Human Population 346

- Population Structure 346
- Population Growth 347
- The Demographic Transition 349

13.2 Limits to Population Growth 350

- Carrying Capacity and Logistic Growth 350
- Earth's Carrying Capacity for Humans 351

13.3 The Future of the Human Population 353

- A Possible Population Crash? 353
- Avoiding Disaster 355

Chapter Review 356

Chapter 14

Is Earth Experiencing a Biodiversity Crisis?

Community Ecology, Ecosystem Ecology, and Conservation Biology 358

14.1 The Sixth Extinction 360

- Measuring Extinction Rates 361
- Habitat Loss and Food Chains 363
- Other Human Causes of Extinction 367

14.2 The Consequences of Extinction 368

- Loss of Resources 368
- Disruption of Ecological Communities 370



Changed Ecosystems 376

Psychological Effects 378

14.3 Saving Species 379

Protecting Habitat 379

Protection from Environmental Disasters 381

Protection from Loss of Genetic Diversity 382

14.5 Protecting Biodiversity Versus Meeting Human Needs 386

Chapter Review 388

Chapter 15

Where Do You Live? Climate and Biomes 390

15.1 Global and Regional Climate 392

Temperature 393

Precipitation 398

15.2 Terrestrial Biomes 400

Forests and Shrublands 400

Grasslands 405

Desert 406

Tundra 408

15.3 Aquatic Biomes 409

Freshwater 409

Saltwater 411

15.5 Human Habitats 414

Energy and Natural Resources 414

Waste Production 415

Essay 15.1 Wildfire! 405

Chapter Review 418

Appendix: Metric System Conversions A-1

Answers to Learning the Basics ANS-1

Glossary G-1

Credits CR-1

Index I-1

