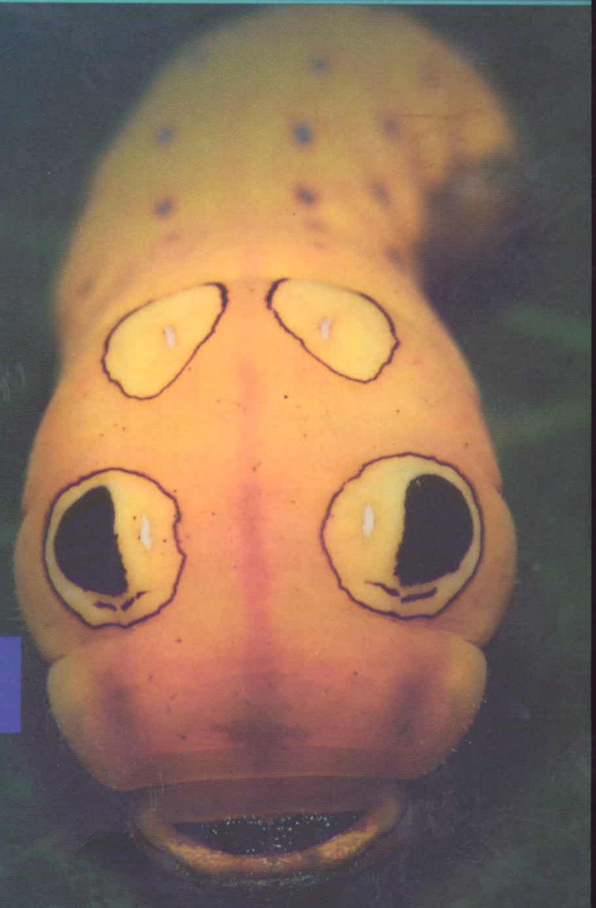
教育部高等教育司推荐
国外优秀生命科学教学用书

Essential Biology

生物学导论

影印版



• Neil A. Campbell

• Jane B. Reece

高等教育出版社
Higher Education Press

Prentice Hall
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By Neil A. Campbell and Jane B. Reece

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出版前言

随着克隆羊的问世和人类基因组计划的完成，生命科学成为21世纪名副其实的领头学科，生物高新技术产业逐步成为高科技产业的核心。生物科技和生物产业的发展对世界科技、经济、政治和社会发展等方面产生着深刻的影响，这也是我国赶超世界发达国家生产力水平最有前途和希望的领域。生命科学与技术全方位的发展呼唤高等教育培养更多高水平的复合型科技人才。

为此，教育部在《关于加强高等学校本科教学工作 提高教学质量的若干意见》[教高（2001）4号文件]中提出，高等学校要大力提倡编写、引进和使用先进教材，其中信息科学、生命科学等发展迅速、国际通用性强、可比性强的学科和专业可以直接引进先进的、能反映学科发展前沿的原版教材。教育部高等教育司还于2001年11月向全国主要大学和出版社下发了“关于开展‘国外生命科学类优秀教学用书’推荐工作的通知”，有力推动了生命科学类教材的引进工作。

高等教育出版社对国外生命科学教材进行了充分的调研，并委托教育部高等学校生物科学与工程教学指导委员会的专家教授开展了“引进国外优秀生命科学教材及其教学辅助材料专项研究”，并就国内外同类教材进行了比较，提出了具体的引进教材书目。经过版权谈判，目前我社已经购买了Pearson Education, McGraw-Hill, John Wiley & Sons, Blackwell Science, Thomson Learning, Cambridge University Press, Lippincott Williams & Wilkins等出版的13种教材的影印权，学科领域涉及生物化学、细胞生物学、遗传学、微生物学、生态学、免疫学、神经科学、发育生物学、解剖学与生理学、分子生物学、普通生物学等。这些教材具有以下特点：（1）所选教材基本是近2年出版的，及时反映了学科发展的最新进展，在国际上使用广泛，具有权威性和时代感；（2）内容简明，篇幅适中，结构合理，兼具一定的深度和广度，适用范围广；（3）插图精美、丰富，既有很强的艺术性，又不失严谨的科学性，图文并茂，与正文相辅相成；（4）语言简练、流畅，十分适合非英语国家的学生阅读。其中9种已入选教育部高等教育司推荐“国外优秀生命科学教学用书”。

引进国外优秀生命科学教学用书是我社一项长期的重点工作，因此，我们衷心希望广大专家教授和同学提出宝贵的意见和建议，如有更好的教材值得引进，请与高等教育出版社生命科学分社联系，联系电话：010-58581665，E-mail 地址：lifesciences-hep@x263.net。

高等教育出版社

2003年3月

国外优秀生命科学教学用书

（影印教材）

Biochemistry (2nd ed.)	生物化学
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Essentials of Genetics (4th ed.)	遗传学基础
Microbiology (5th ed.)	微生物学
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Roitt's Essential Immunology (10th ed.)	Roitt 免疫学基础
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Gene Cloning and DNA Analysis (4th ed.)	基因克隆和DNA分析
Principles of Gene Manipulation (6th ed.)	基因操作原理
An Introduction to Genetic Engineering (2nd ed.)	遗传工程导论
Essential Biology	生物学导论

Preface

A decade ago in his popular book, *Megatrends 2000*, futurist John Naisbitt predicted the coming of the Age of Biology. It was a safe forecast. Biology was already emerging as the new millennium's central science—the concourse where all the natural sciences meet and intersect with the humanities and social sciences. But the *scale* of biology's impact is probably more surprising to most scientists. In addition to illuminating life more brightly than ever, modern biology is remodeling medicine, agriculture, forensics, conservation science, anthropology, psychology, sociology, and almost every other "-ology" that's paying attention. This is the best time ever to take a biology course!

It is a privilege for us to be able to help instructors share the story of life with students during this golden age of biology. We see our responsibility as science educators to be especially important in communicating with students who are *not* biology majors, because their attitudes about science and scientists are likely to be shaped by a single, required science course—*this* course. And because biology and society are so interwoven today, we believe that non-majors courses are the most important classes biology departments teach. Many of our colleagues around the country apparently agree, for the most enthusiastic and innovative among them are drawn to the adventure of teaching non-majors. It's among the liveliest and most creative communities in all of science education.

As important and inspirational as modern biology is, these are also the most challenging times to teach and learn the subject. The same discovery explosion that makes biology exhilarating today also threatens to suffocate our students under an avalanche of information. With each of its many subfields bustling in research activity, biology grows larger every year, while the academic semester stays the same size. Something has to give.

In this era of ever-expanding biology, we have no choice but to make our courses less encyclopedic. Leading the way in this movement are the many thoughtful instructors who have opted to cover fewer main biology topics rather than compromise depth in the most important areas. To support this trend, we have created this new biology textbook, which we call *Essential Biology.* Yes, it is a shorter biology text than most, but we did not achieve this brevity by trying to fit all of biology into less space. Instead, we focused on just four core topics: cells, genes, evolution, and ecology. By exploring these four areas and fitting them together, students can synthesize a coherent view of life. In the context of these four main topics, students will encounter diverse organisms and their evolutionary adaptations. However, we have not included separate units on the anatomy and physiology of plants, animals, and other organisms. This enabled us to keep *Essential Biology* manageable in size—and, well, *essential*—without being superficial in the areas we chose to cover. We take the "less is more" mantra in education today to mean fewer topics, not more dilute explanations.

Even with a decision to cover fewer major topics, there is still the potential for biology to collapse into a formless pile of terms and factoids. An integrated view of life depends on a theme that cuts across all topics, and that theme is evolution. Understanding how evolution accounts for both the unity and diversity of life makes biology whole. Evolution will continue to provide this form no matter how big and complex biology becomes. Every chapter of *Essential Biology* connects to this evolutionary theme of life.

We named our new book *Essential Biology* partly because this look at life is relatively brief, selective, and integrated. But the title has a second meaning. It announces an emphasis on concepts and applications that are *essential* for students to make biologically informed decisions throughout their lives—to evaluate certain health and environmental issues, for example. From ethical and safety concerns surrounding genomics to debates about global warming, students will find biology in the news every day. Biology *is* more essential than ever in a general education, and we've tried to spotlight this central place of biology in modern culture.

Long after students have forgotten most of the specific content of their college courses, they will be left with general impressions that will influence their interests, opinions, values, and actions. We hope this textbook, and its supporting media, will help students fold biological perspectives into their personal worldviews. Please let us know how we are doing and how we can improve the next edition of *Essential Biology*.

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Acknowledgments

As the authors of *Essential Biology*, we're spoiled! We've managed to surround ourselves with the very best publishing professionals and biology colleagues. Though we must take sole responsibility for any of the textbook's shortcomings, its merits reflect the contributions of many associates who helped us build a new kind of textbook and who created integral media activities that complement the lessons.

First, we thank senior editor Beth Wilbur. When the going got tough—and it always does at some point during the development of a textbook—Beth joined the team. She brought a fresh and objective perspective, a collaborative nature, adaptability and humor, and a rational sense of priorities. Her follow-through and confidence-building leadership were reassuring. And speaking of leadership, it was executive editor Erin Mulligan who enlisted us to write *Essential Biology* and who recruited Beth Wilbur as our editor. We appreciate Erin's confidence in us and value her brand of publishing partnership with authors. Of course, publishing excellence flows from the top, and we are grateful to Linda Davis, president of Benjamin Cummings, for the example she provides to her entire company. Benjamin Cummings authors are very fortunate.

Especially important in the creation of *Essential Biology* were three team members: Pat Burner, Shelley Parlante, and Russell Chun. Senior developmental editors Pat and Shelley worked with us and the production team to make *every* paragraph and *every* illustration work better for students. Their commitment to quality and clarity shows on every page. Shelley was responsible for the excellent developmental work on the genetics chapters and helped us refine our vision for the whole book. Russell, as multimedia developmental editor, is a gifted artist and animator. He shaped the book's art program and brought to life the concepts on the *Essential Biology Place* Website and CD-ROM. Pat, in addition to the extensive and topnotch development she did on three-fourths of the book, was also Russell's partner in developing the media. The commitment that Pat, Shelley, and Russell made to *Essential Biology* inspired the whole team.

Several others played key roles in developing and refining the text, graphics, and media of this project. Associate multimedia producer Maureen Kennedy had a big impact on the planning of the CD-ROM and website. Senior art supervisor Donna Kalal not only kept the book's illustrations and photos moving through the pipeline, but her keen eye also helped assure the quality of the art program. Photo researcher Stephen Forsling worked very hard to find just the right pictures to fit each topic and make the book look great. Copy editor Janet Greenblatt provided excellent editorial counsel and proofreader Martha Ghent was vigilant, assuring quality on every page. Project editor Evelyn Dahlgren managed the editorial schedules, coordinated development of the supplements package, monitored the entire project's budget, and helped out in many ways with the media. Katherine Pitcoff created the book's very functional index. And publishing assistant Aaron Gass tirelessly supported the whole team and played an especially important role in coordinating the media initiatives.

The production team transformed our manuscripts and drawings into a real book. Wendy Earl, the managing editor for production, was heroic in mobilizing the entire production effort throughout our very tight schedule. Production editor Leslie Austin managed the book schedules and the production team with expertise and good humor. Art and design manager Bradley Burch and text and cover designer Carolyn Deacy made *Essential Biology* beautiful as well as functional. Finally, manufacturing supervisor Vivian McDougal worked miracles to manage the printing of the bound book you now hold.

"Marketing" is an alien concept to most of us in the biology community. But for what we try to do as authors, "market" translates as "the students and instructors we are trying to serve." Marketing manager Josh Frost and senior project editor for market development Kirsten Watrud kept us focused on the needs of students and instructors. Kirsten initiated valuable contacts with biology instructors and students, and coordinated class testing of our material. We also thank the Addison Wesley field staff for representing *Essential Biology* on campuses. These representatives will also tell us what you like (and don't like) about this book and media, which will help us improve the next edition.

Numerous colleagues in the biology community also contributed to *Essential Biology.* For Units One, Three, and Four, Ed Zalisko of Blackburn College synthesized the lists of intriguing facts that introduce the chapters and wrote many of the summaries. Arlene Larson of the University of Colorado, Denver, read the entire book to help assure biological accuracy. Although Larry Mitchell did not work directly on this textbook, his past collaboration with us on our other books is certainly reflected in *Essential Biology.* At the end of these acknowledgments you'll find a list of the many instructors who provided valuable information about their courses, reviewed chapters, and/or conducted class tests of *Essential Biology* with their students. We thank them for their efforts and support.

Most of all, we thank our families and friends who continue to tolerate our obsession with doing our best for science education. We two have worked together on various projects for more than 20 years. It's still as much fun as ever!

Neil Campbell
Jane Reece

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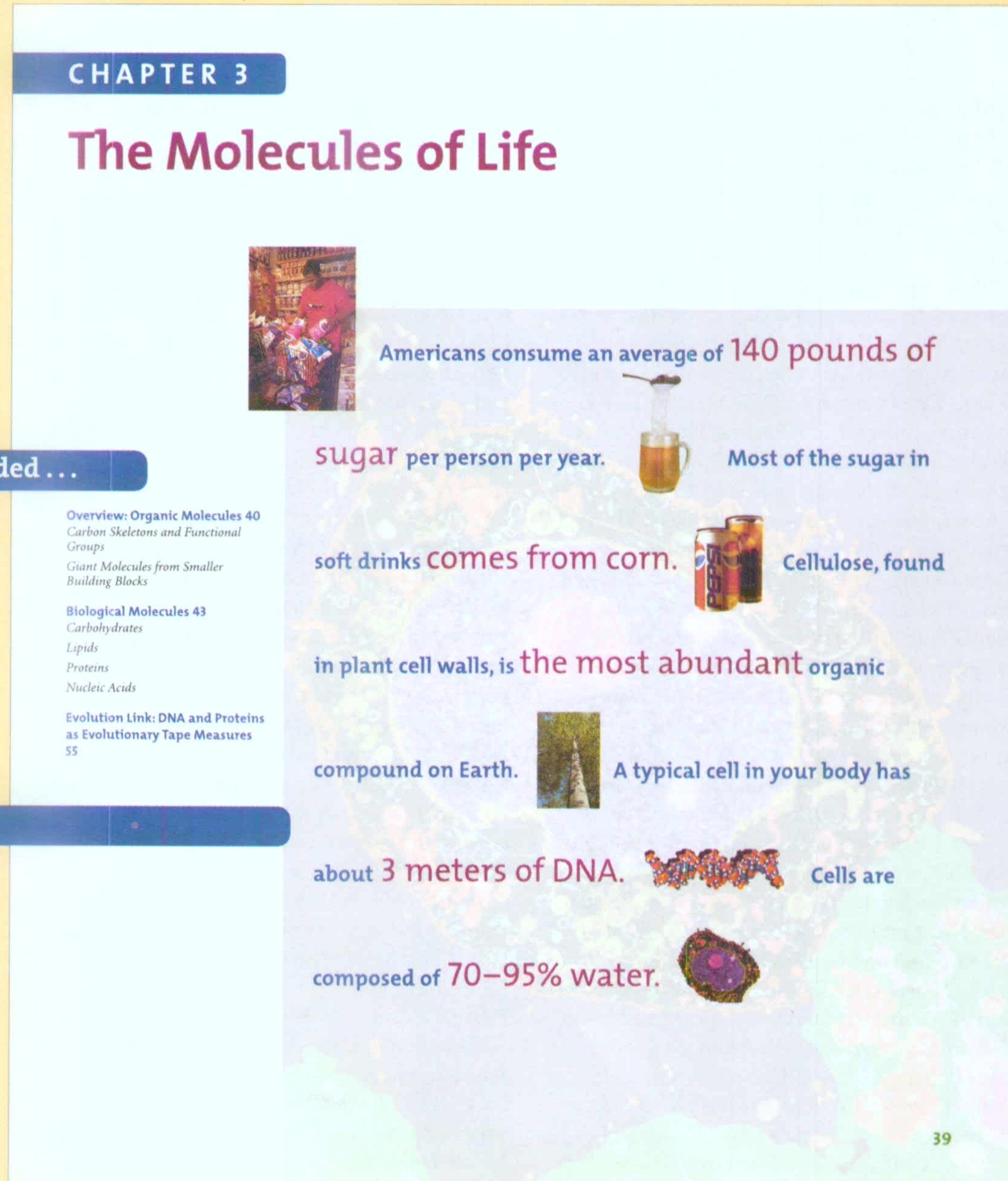
How to Use *Essential Biology*

Know where you're headed . . .

Chapter outline. Use the chapter outline as your road map.

. . . and why.

Opening "snapshots." Get a feel for what you'll learn from the intriguing facts at the start of each chapter.



CHAPTER 3

The Molecules of Life

Americans consume an average of 140 pounds of sugar per person per year. Most of the sugar in soft drinks comes from corn. Cellulose, found in plant cell walls, is the most abundant organic compound on Earth. A typical cell in your body has about 3 meters of DNA. Cells are composed of 70–95% water.

39

Overview: Our Dependence on Plants

Plants and other photosynthetic organisms convert the energy of sunlight to the chemical energy of sugar and other organic compounds. It is the source of all our food. And we depend on plants for more than our food. You are probably wearing underwear, jeans, or other clothing made of another product of photosynthesis, cotton. Most of our homes are framed with lumber, which is wood produced by photosynthetic trees. Even the text you are now reading is printed on paper, still another material that can be traced to photosynthesis in plants. But mostly, photosynthesis is all about feeding the biosphere.

Discover more ways we are linked to plants in Web/CD Activity 6A.

Plants are **autotrophs,** which means "self-feeders" in Greek. The term is a bit misleading in its implication that plants do not require nutrients—they do. But those nutrients are entirely inorganic: carbon dioxide from the air, and water and minerals from the soil. From that inorganic diet, plants can make all their own organic molecules, including carbohydrates, lipids, proteins, and nucleic acids. That is the definition of an autotroph: an organism that makes all its own organic matter from inorganic nutrients. In contrast, humans and other animals are **heterotrophs,** meaning "other-feeders." We heterotrophs cannot make organic molecules from inorganic ones. That is why we must eat. Heterotrophs depend on autotrophs for their organic fuel and material for growth and repair.

The most common form of autotrophic nutrition is photosynthesis, which uses light energy to drive the synthesis of organic molecules. Almost all plants are photosynthetic, and so are certain groups of protists and bacteria (Figure 6.2).

Start with the big picture . . .

Overview. Each chapter starts with an overview that gives you a context for the details to come.

take it one step at a time,

Numbered steps. Follow biological processes easily using numbered steps in art, text, and legends.

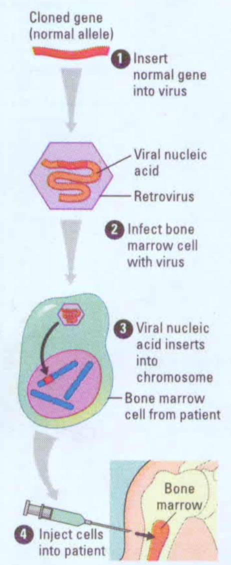


Figure 11.30 One type of gene therapy procedure. ❶ The normal gene is cloned by recombinant DNA techniques. It is then converted into RNA and inserted into the RNA genome of a retrovirus vector that has been rendered harmless. ❷ Bone marrow cells are taken from the patient and infected with the virus. ❸ The virus inserts a DNA copy of its genome, including the human gene, into the cells' DNA. ❹ The engineered cells are then injected back into the patient, where they colonize the bone marrow.

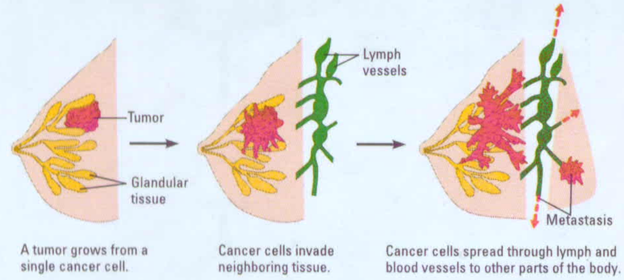


Figure 7.9 Growth and metastasis of a malignant (cancerous) tumor o

ell division by interfering
vinblastine, prevents the

and see how biology applies to your life.

Health and environmental applications. In every chapter, *Essential Biology* makes connections to topics that will be meaningful to you and your family long after this course is done.

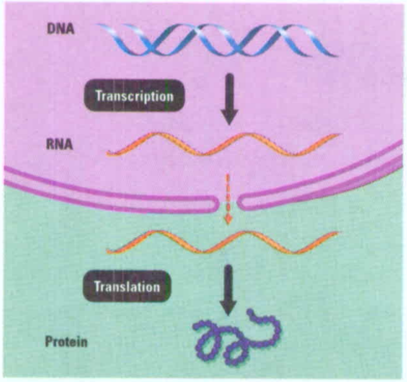


Figure 9.14 The flow of genetic information in a eukaryotic cell: a review. A sequence of nucleotides in the DNA is transcribed into a molecule of RNA in the cell's nucleus (purple area). The RNA travels to the cytoplasm (blue-green area), where it is translated into the specific amino acid sequence of a protein.

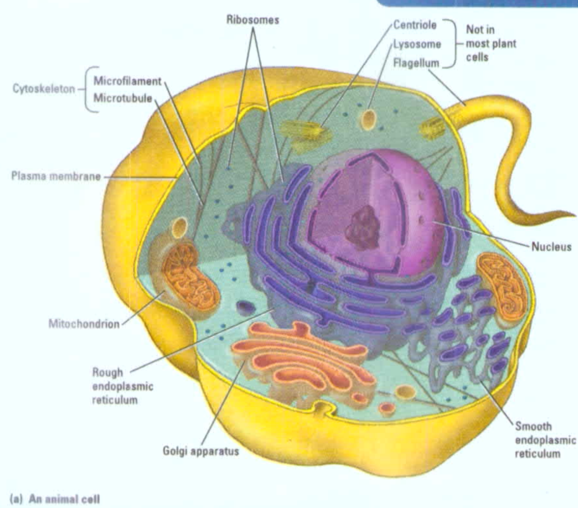


Figure 4.6 Panoramic view of idealized animal cell and plant cell. For now, the labels are just words, but these organelles will come to life as we take a closer look at how each of these parts works. To keep from getting lost on our tour of cells, we'll carry miniature versions of these overview diagrams as our road maps, with "you are here" highlighted.

Get to know the cast of characters,

Consistent colors and symbols. Consistent colors and symbols—the aqua cell interior with purple nucleus, the blue DNA helix, the red RNA ribbon, the purple protein, and many others—help you recognize biological players that appear throughout *Essential Biology*.

visualize the processes of life,

Art that explains main ideas. Use the illustrations to reinforce what you read in the text. Photos, illustrations, and captions combine to explain key ideas.

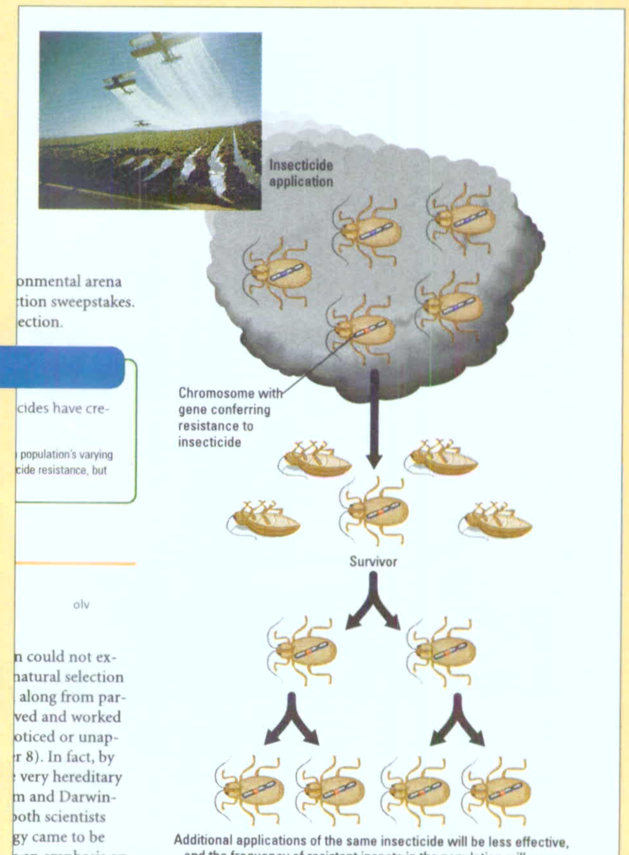
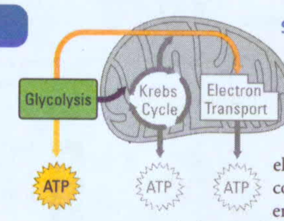


Figure 12.14 Evolution of pesticide resistance in insect populations. By spraying crops with poisons to kill insect pests, humans have unwittingly favored the reproductive success of insects with inherent resistance to the poisons.

and know where you are.

Orientation diagrams. Orientation diagrams show you where you are in a complex process, and where this topic fits into the bigger picture.



Stage 1: Glycolysis The word *glycolysis* means "splitting of sugar." That is exactly what happens (Figure 5.14). Glycolysis breaks the six-carbon glucose in half, forming two three-carbon molecules. These molecules then donate high-energy electrons to NAD^+, the electron carrier. Glycolysis also makes some ATP directly when enzymes transfer phosphate groups from fuel molecules to ADP (Figure 5.15). What remains of the fractured glucose at the end of glycolysis are two molecules of pyruvic acid. The pyruvic acid still holds most of the energy of glucose, and that energy is harvested in the Krebs cycle.

Watch the process of glycolysis in Web/CD Activity 5E.

Natural Selection in Action: The Evolution of Pesticide-Resistant Insects

Natural selection and the adaptive evolution it causes are observable phenomena. A classic and unsettling example is the evolution of pesticide resistance in hundreds of insect species.

Pesticides are poisons used to kill insects that are pests in crops, swamps, backyards, and homes. Examples are DDT, now banned in many countries, and malathion. These chemical weapons against insects have proved to be double-edged swords. We have used pesticides to control insects that eat our crops, transmit diseases such as malaria, or just annoy us around the house or campground. But widespread use of these poisons, which are not specific for the intended targets, has also produced some colossal environmental problems, which we'll examine in Chapter 17. Our focus here is the evolutionary outcome of introducing these chemicals into the environments of insects.

Whenever a new type of
the story is usually the same
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But subsequent sprayings ar
increasing the amount of th
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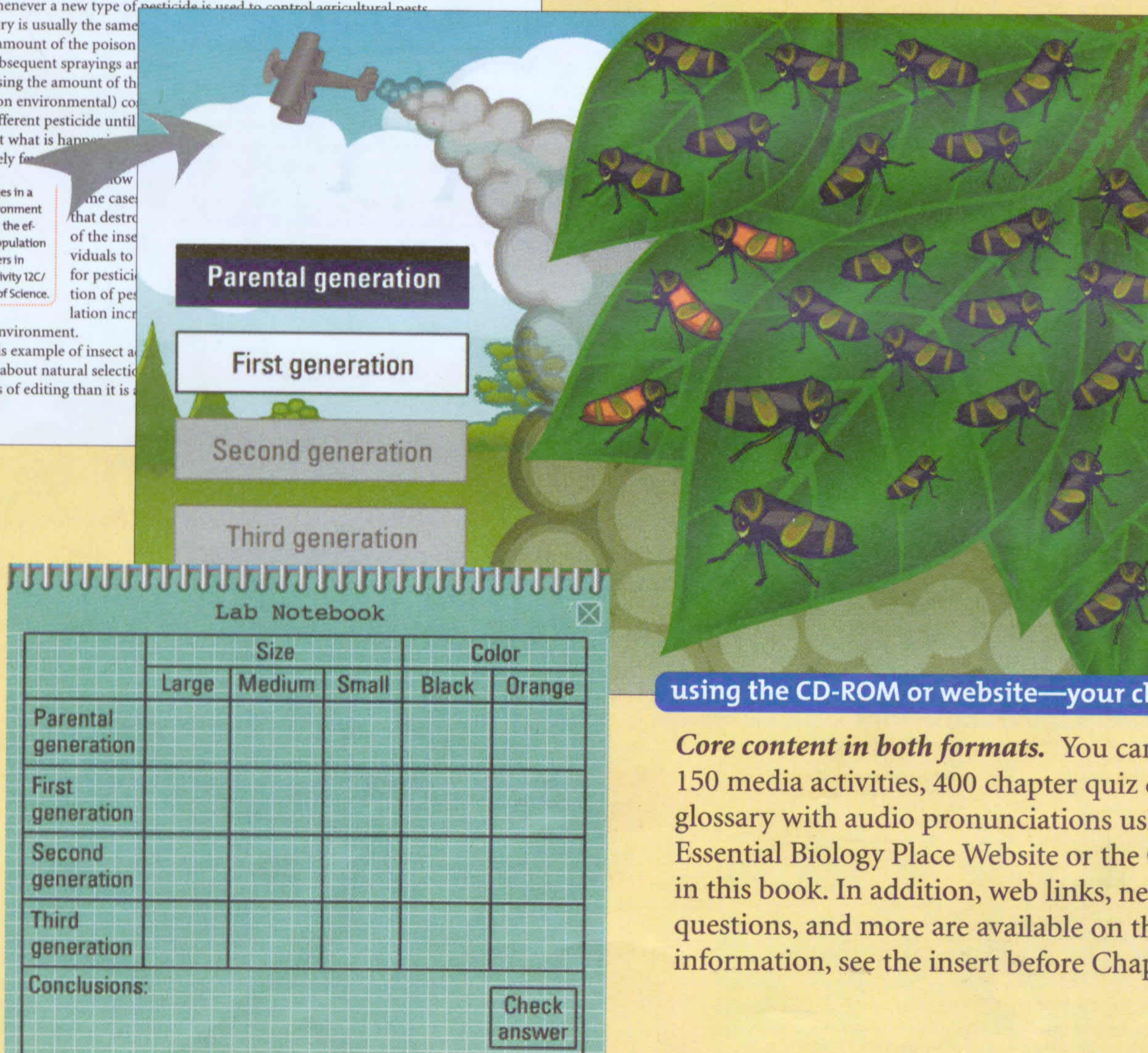
lation incr
in its environment.

Make changes in a virtual environment and observe the effects on a population of leafhoppers in Web/CD Activity 12C/ The Process of Science.

This example of insect a
points about natural selectic
process of editing than it is

Watch, practice, and learn with multimedia,

Multimedia for every topic. Media flags in the text guide you to media activities—at least one for every main topic—that let you see animations, perform virtual experiments, and more.



using the CD-ROM or website—your choice.

Core content in both formats. You can access more than 150 media activities, 400 chapter quiz questions, and a glossary with audio pronunciations using either the Essential Biology Place Website or the CD-ROM included in this book. In addition, web links, news, practice test questions, and more are available on the website. For more information, see the insert before Chapter 1.

Did you get it? Receive immediate feedback.

***CheckPoint* with every topic.** A CheckPoint at the end of each main section of the chapter lets you assess your understanding.

X allele. In contrast to the Hardy-Weinberg equilibrium of a nonevolving population, we now have the changing gene pool of an evolving population.

One of the products of the modern synthesis was a definition of evolution that is based on population genetics: *Evolution is a generation-to-generation change in a population's frequencies of alleles.* Because this describes evolution on the smallest scale, it is sometimes referred to more specifically as **microevolution.**

CheckPoint

1. What is the smallest biological unit that can evolve?
2. Define microevolution.
3. Which term in the Hardy-Weinberg formula ($p^2 + 2pq + q^2 = 1$) corresponds to the frequency of individuals who have no alleles for the disease PKU?
4. Which of the following variations in a human population is the best example of polymorphism: height, ABO blood group, number of fingers, or math proficiency?
5. Which process, mutation or sexual recombination, results in most of the generation-to-generation variability in human populations?

Answers: **1.** A population **2.** Microevolution is a change in a population's frequencies of alleles. **3.** p^2 **4.** Blood group **5.** Sexual recombination

Connect with biology's key theme.

Evolution Link. As the capstone of each chapter, an Evolution Link helps you connect the chapter's subject to the overarching theme of evolution.

red eyes; all male offspring will be white-eyed (X^rY). **4.** $\frac{1}{4}$ ($\frac{1}{2}$ chance the child will be male × $\frac{1}{2}$ chance that he will inherit the X carrying the disease allele)

Evolution Link: The Telltale Y Chromosome

The Y chromosome of human males is only about one-third the size of the X chromosome and carries only $\frac{1}{100}$ as many genes. As mentioned earlier, most of the Y genes seem to function in maleness and male fertility and are not present on the X. In prophase I of meiosis, only two tiny regions of the X and Y chromosomes can cross over (recombine). Crossing over requires that the DNA in the recombining regions line up and match very closely, and for the human X and Y chromosomes, this can only happen at their tips.

Nevertheless, biologists believe that X and Y were once a fully homologous pair, having evolved from a pair of autosomes about 300 million years ago. Since that time, four major episodes of change, the most recent about 40 million years ago, have rearranged pieces of the Y chromosome in a way that prevents the matching required for recombination with the X. Much of the reshuffling seems to have resulted from inversions (see Figure 7.24c).

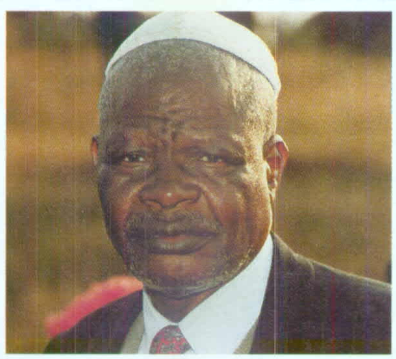


Figure 8.35 A Lemba tribesman. DNA sequences from the Y chromosomes of Lemba men suggest that the Lemba are descended from ancient Jews.

Review the main points.

Chapter Review. The summary gives you a quick review of the chapter along with a guide to the resources on the website and CD-ROM.

Chapter Review

Summary of Key Concepts

Overview: Why and How Genes Are Regulated

- Gene expression—the flow of information from genes to proteins—is subject to control, mainly by the turning on and off of genes. Cells become specialized in structure and function because only certain genes of the genome are expressed. In eukaryotic cells, there are multiple possible control points in the pathway of gene expression. However, the most important control point in both eukaryotic cells and prokaryotes is at gene transcription.
  - Web/CD Activity 10A *Control of Gene Expression Overview*

Gene Regulation in Bacteria

- **The *lac* Operon** In prokaryotes, genes for enzymes with related functions are often controlled together by being grouped into regulatory units called operons. Regulatory proteins bind to control sequences in the DNA and turn operons on or off in response to environmental changes. The *lac* operon, for example, produces enzymes that break down lactose only when lactose is present.
  - Web/CD Activity 10B *The* lac *Operon in* E. Coli
- **Other Kinds of Operons** While the repressor for the *lac* operon is innately active, some operons, such as those that affect the synthesis of certain amino acids, have repressors that are innately *inactive*. The activation of still other operons depends on activator proteins.

Self-Quiz

1. Which of the following shows the effects of a density-dependent limiting factor?
   a. A forest fire kills all the pine trees in a patch of forest.
   b. Early rainfall triggers the explosion of a locust population.
   c. Drought decimates a wheat crop.
   d. Silt from logging kills half the young salmon in a stream.
   e. Rabbits multiply, and their food supply begins to dwindle.

2. With regard to its percent increase, a population that is growing logistically
   a. grows fastest when density is lowest.
   b. has a high intrinsic rate of increase.
   c. grows fastest at an intermediate population density.
   d. grows fastest as it approaches carrying capacity.
   e. is always slowed by density-independent factors.

3. ...

Prepare for the test,

Self-Quiz in book and media. Try the self-quiz questions at the end of each chapter, and go to the website or CD-ROM for twenty additional questions on each chapter. Test Flight on the website lets you prepare for a test on multiple chapters by building a practice test from a database of hundreds of questions.

QUIZ Chapter 7

1. Which statement regarding meiosis is correct?

- Crossing over occurs during prophase II.
- DNA is duplicated once and centromeres are split once
- Haploid cells become diploid during this process.
- Centromeres are split and sister chromatids separate during anaphase I.
- DNA is duplicated twice and cytokinesis occurs once.

2. Which of the following is a function of meiosis?

- asexual reproduction
- reduction of the chromosome number of daughter cells to half that of the parent cell
- Production of a mature organism from a zygote
- replacement of dead or dying cells
- growth and development of an individual organism

The Process of Science

1. A population of snails has recently become established in a new region. The snails are preyed on by birds that break the snails open on rocks, eat the soft bodies, and leave the shells. The snails occur in both striped and unstriped forms. In one area, researchers counted both live snails and broken shells. Their data are summarized here:

	Striped	Unstriped
Living	264	296
Broken	486	377

Based on these data, which snail form is more subject to predation by birds? Predict how the frequencies of striped and unstriped individuals might change over the generations.

2. Explore the Galápagos Islands and other places Darwin visited in *The Voyage of the Beagle*. Conduct virtual experiments on an evolving population of leafhoppers in *Effects of Environmental Changes on a Population*. Both activities are available in The Process of Science section of Chapter 1? on the website and CD-ROM.

Biology and Society

To what extent are humans in a technological society exempt from natural selection? Explain your answer.

practice science,

Process of Science questions. The Process of Science questions challenge you to think scientifically about the questions of biology.

and finally, what's your opinion?

Biology and Society questions. Biology and Society questions invite you to apply the biology you've learned to evaluate ethical or policy-related issues you're likely to read about or vote on at the polls.

To Rochelle and Allison, with love

N. A. C.

To Paul, with love

J. B. R.

About the Authors

Neil A. Campbell has taught general biology for 30 years and is a coauthor, with Jane Reece and Larry Mitchell, of *Biology*, Fifth Edition, and *Biology: Concepts and Connections*, Third Edition. His enthusiasm for sharing the fun of science with students stems from his own undergraduate experience. He began at Long Beach State College as a history major, but switched to zoology after general education requirements "forced" him to take a science course. Following a B.S. from Long Beach, he earned an M.A. in Zoology from UCLA and a Ph.D. in Plant Biology from the University of California, Riverside. He has published numerous articles on how certain desert plants survive in salty soil and how the sensitive plant (Mimosa) and other legumes move their leaves. His diverse teaching experiences include courses for non-biology majors at Cornell University, Pomona College, and San Bernardino Valley College, where he received the college's first Outstanding Professor Award in 1986. Dr. Campbell is currently a visiting scholar in the Department of Botany and Plant Sciences at UC Riverside.

Jane B. Reece has worked in biology publishing since 1978, when she joined the editorial staff of Benjamin Cummings. She is a coauthor, with Neil Campbell and Larry Mitchell, of *Biology*, Fifth Edition, and *Biology: Concepts and Connections*, Third Edition. Her education includes an A.B. in Biology from Harvard University, an M.S. in Microbiology from Rutgers University, and a Ph.D. in Bacteriology from the University of California at Berkeley. At UC Berkeley, and later as a postdoctoral fellow in genetics at Stanford University, her research focused on genetic recombination in bacteria. She taught biology at Middlesex County College (New Jersey) and Queensborough Community College (New York). During her 12 years as an editor at Benjamin Cummings, Dr. Reece played major roles in a number of successful textbooks including *Microbiology: An Introduction*, by G. J. Tortora, B. R. Funke, and C. L. Case, and *Molecular Biology of the Gene*, Fourth Edition, by J. D. Watson et al. She was also a coauthor of *The World of the Cell*, Third Edition, with W. M. Becker and M. F. Poenie.

Brief Contents

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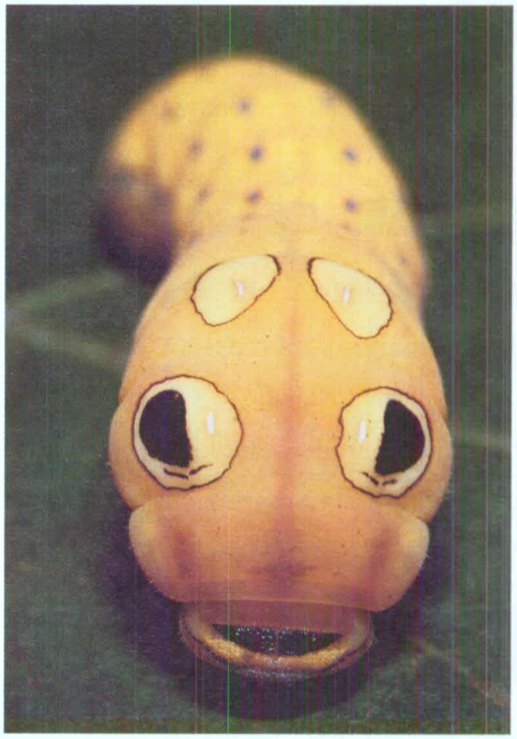

CHAPTER 1