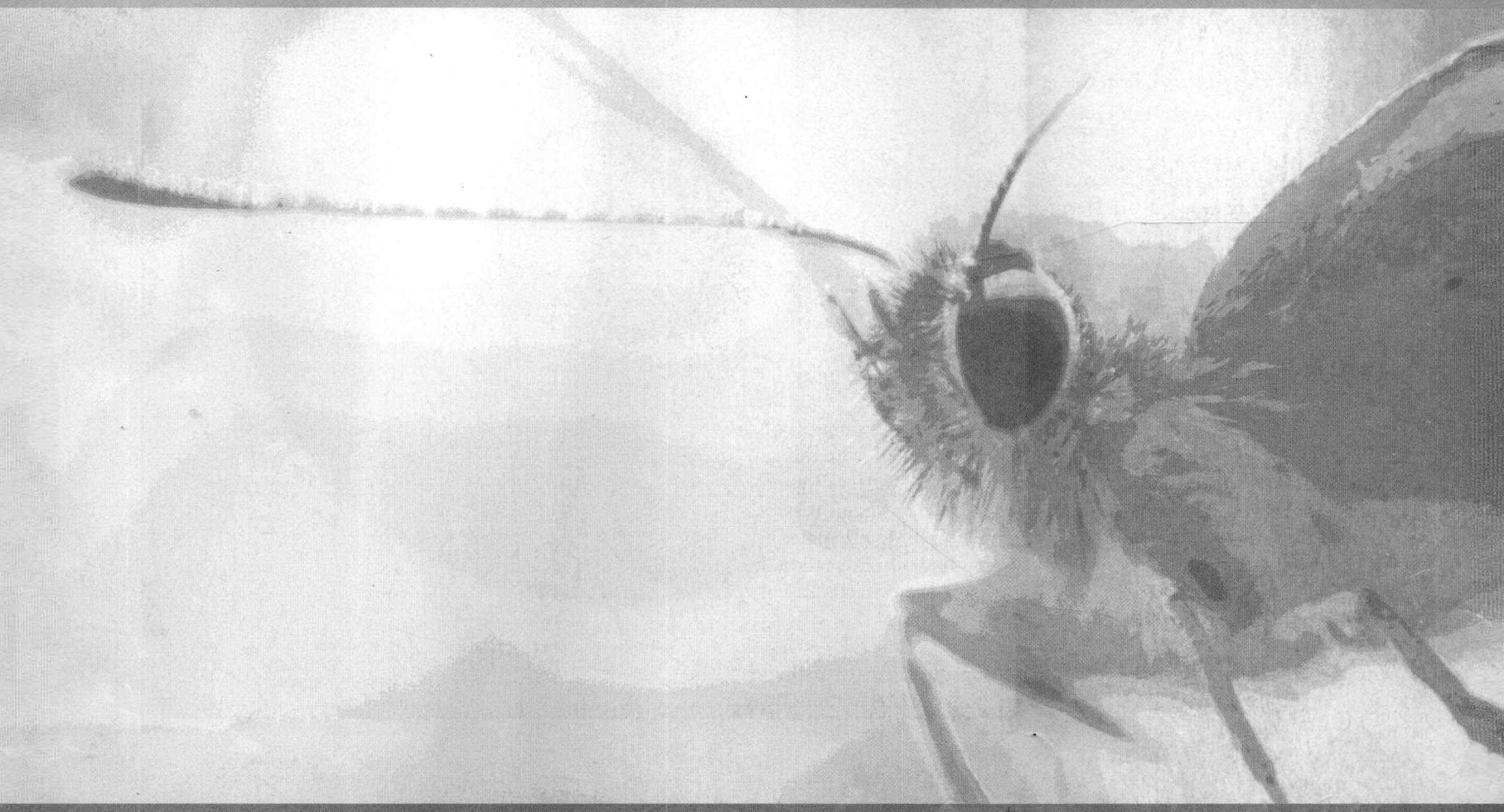
INTERNATIONAL EDITION

SECOND EDITION

ESSENTIAL BIOLOGY

CAMPBELL | REECE | SIMON

ESSENTIAL BIOLOGY



SECOND EDITION

Neil A. Campbell
University of California, Riverside

Jane B. Reece
Palo Alto, California

Eric J. Simon
New England College

PEARSON
Benjamin Cummings

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Cover Printer: Phoenix Color
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On the cover: Photograph of a scarce copper butterfly (*Heodes virgaureae*). © Getty Images/Pam Hermansen

Credits continue in Appendix C

ISBN 0-321-20462-X

Benjamin Cummings
1301 Sansome Street
San Francisco, CA 94111
.www.aw.com/bc

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ABOUT THE AUTHORS

Neil A. Campbell has taught general biology for 30 years, and with Dr. Reece, has coauthored *Biology*, Sixth Edition, the most widely used text for biology majors. 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 thrive in salty soil and how a 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 first Outstanding Professor Award in 1986. Dr. Campbell is currently a visiting scholar in the Department of Botany and Plant Sciences at UC Riverside, which recognized him as the university's Distinguished Alumnus for 2001. In addition to *Biology*, Sixth Edition, he is coauthor of *Biology: Concepts and Connections*, Fourth Edition.

Eric J. Simon is an Assistant Professor of Biology at New England College in Henniker, New Hampshire. He teaches introductory biology to both biology majors and non-biology majors, as well as upper-level biology courses in genetics, microbiology, and molecular biology. Dr. Simon received a B.A. in Biology and Computer Science and an M.A. in Biology from Wesleyan University, and a Ph.D. in Biochemistry at Harvard University. Currently, he is working toward an M.S.Ed. in Educational Psychology. Dr. Simon's diverse classroom experience includes teaching both biology majors and non-biology majors at numerous institutions, including St. John's University (Minnesota), Minneapolis Community and Technical College—where he earned an Outstanding Teacher Award—and Fordham College at Lincoln Center in New York City. Dr. Simon's research focuses on innovative ways for using technology to improve teaching and learning in the science classroom, particularly among non-biology major students.

Jane B. Reece has worked in biology publishing since 1978, when she joined the editorial staff of Benjamin Cummings. 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, Berkeley. At UC Berkeley and later as a post-doctoral fellow in genetics at Stanford University, her research focused on genetic recombination in bacteria. Dr. Reece taught biology at Middlesex County College (New Jersey) and Queensborough Community College (New York). During her 12 years as an editor at Benjamin Cummings, she played major roles in a number of successful textbooks. Subsequently, she was a coauthor of *The World of the Cell*, Third Edition, with W. M. Becker and M. F. Poenie. Dr. Reece also coauthored *Biology*, Sixth Edition, and *Biology: Concepts and Connections*, Fourth Edition.

ESSENTIAL BIOLOGY

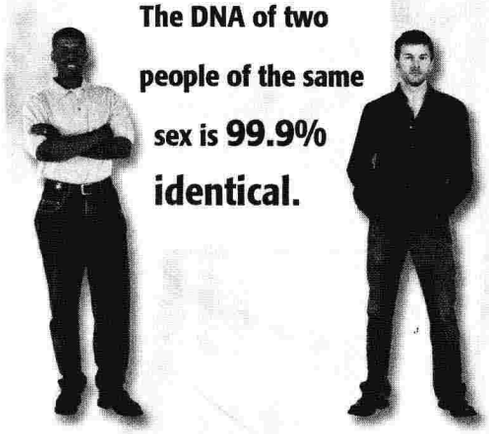
To the student: How to use this book

Neil Campbell, Jane Reece, and Eric Simon bring biology to life in ***Essential Biology,* Second Edition,** a brief non-majors text that focuses on four core biological topics: cells, genetics, evolution, and ecology. This manageable text combines clear writing with real-world applications and powerful media. The following walk-through of Chapter 12, DNA Technology, highlights key features of this innovative text.

CHAPTER 12

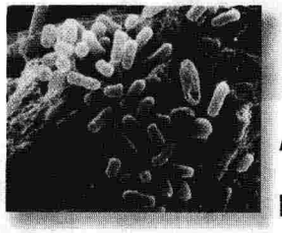
DNA Technology

Intriguing facts at the beginning of every chapter pique your interest.



The DNA of two people of the same sex is 99.9% identical.

The first use of DNA fingerprinting in a murder case proved one man innocent and another guilty.



Animals, plants, and even bacteria can be genetically modified to produce human proteins.

Genetically modified strains account for half of the U.S. corn crop.

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Human applications reveal the world of biology

Biology and Society chapter-opening essays focus on topics of human interest and show you how biology affects your life and the world around you.

New! To reinforce the connection between biology and society, you can access the **Biology and Society web link** and essay questions from the Essential Biology Website (www.essentialbiology.com)

Biology and Society

Hunting for Genes

DNA technology, a set of methods for studying and manipulating genetic material, has brought about some of the most remarkable scientific advances in recent years: Corn has been genetically modified to produce its own insecticide; DNA fingerprints have been used to solve crimes and study the origins of ancient peoples; and significant advances have been made toward curing fatal genetic diseases. Perhaps the most exciting use of DNA technology in basic biological research began in 1990 with the launch of the Human Genome Project. The goal of the Human Genome Project is to determine the nucleotide sequence of all DNA in the human genome and to identify the location and function of every gene. A rough draft of the human genome sequence has already been completed. This ambitious project is revealing the genetic basis of what it means to be human.

Biology and Society on the Web
Learn more about the Human Genome Project.

...tial benefits of ... ...te map of the hu...

Figure 12.7 Genetically modified sheep.
These transgenic sheep carr... they secrete in their milk. Thi... to lung dame...

Farm Animals and "Pharm" Animals While transgenic plants are used today as commercial products, transgenic whole animals are currently only in the testing phase. **Figure 12.7** shows a herd of transgenic sheep that carry a gene for a human blood protein. The human protein can be harvested from the sheep's milk and is being tested as a treatment for cystic fibrosis. Because transgenic animals are difficult to produce, researchers may produce a single transgenic animal and then clone it. The resulting herd of genetically identical transgenic animals, all carrying a recombinant human gene, could then serve as a grazing pharmaceutical factory—"pharm" animals.

While transgenic animals are currently used to produce potentially useful proteins, none are yet found in our food supply. It is possible that DNA technology will eventually replace traditional animal breeding—for instance, to make a pig with leaner meat or a cow that will mature in less time. Someday soon, scientists might, for example, identify a gene that causes the development of larger muscles (which make up most of the meat we eat) in one variety of cattle and transfer it to other cattle or even to sheep.

Recombinant DNA technology serves many roles today and will certainly play an even larger part in our future. In the next section, you'll learn more about the methods that scientists use to create and manipulate recombinant DNA.

Recombinant DNA Techniques

...n use cells from yeasts, plants, ... modern biotechnology. To ma...

***Essential Biology* integrates human applications** into the narrative throughout the book. Here, the text discusses the genetic engineering of animals for pharmaceutical uses.

Evolution Connection

Genomes Hold Clues to Evolution

The DNA sequences determined to date confirm the evolutionary connections between even distantly related organisms and the relevance of research on simpler organisms to understanding human biology. Yeast, for example, has a number of genes close enough to the human versions that they can substitute for them in a human cell. In fact, researchers can sometimes work out what a human disease gene does by studying its counterpart in yeast. Many genes of disparate organisms are turning out to be astonishingly similar, to the point that one researcher has joked that he now views fruit flies as "little people with wings." On a grander scale, comparisons of the completed genome sequences of bacteria, archaea, and eukaryotes strongly support the theory that these are the three fundamental domains of life—a topic we discuss further in the next unit, "Evolution and Diversity."

Evolution Connection on the Web
Investigate relationships among different life forms by examining genes.

As the capstone of each chapter, the **Evolution Connection** helps you connect every field of biology to *Essential Biology*'s overarching theme of evolution.

The website also has an **Evolution Connection web link** and essay questions. Responses to essay questions can be printed or e-mailed to instructors.

The integration of text, art, and media makes biology come alive

Text, art, and photographs work together to teach core concepts. Numbered steps in the text and art guide you through complex processes. The accompanying media activity allows you to see the process in motion.

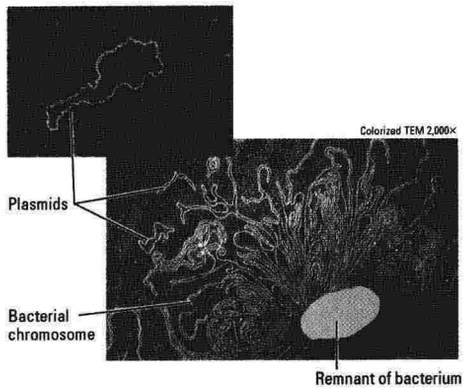


Figure 12.8 Bacterial plasmids.
The large, light blue oval shape is the remnant of a bacterium that has ruptured and released all of its DNA. Most of the DNA is the bacterial chromosome, which extends in loops from the cell. Two plasmids are also present. The inset shows an enlarged view of a single plasmid.

Making recombinant DNA in large enough quantities to be useful requires several steps. Consider a typical genetic engineering challenge: A molecular biologist at a pharmaceutical company has identified a human gene *V* that codes for a valuable product—a hypothetical substance called protein V that kills certain human viruses. The biologist wants to set up a system for manufacturing the protein on a large scale. **Figure 12.9** illustrates a way to accomplish this using recombinant DNA techniques.

❶ First, the biologist isolates two kinds of DNA: many copies of a bacterial plasmid (to serve as a vector) and human DNA containing many genes, including gene *V*, the gene of interest. ❷ The researcher cuts both the plasmids and the human DNA. The human DNA is cut into many fragments, one of which carries gene *V*. The figure shows the processing of just three human DNA fragments and three plasmids, but actually millions of plasmids and human DNA fragments (most of which do not contain gene *V*) are treated simultaneously. ❸ Next, the human DNA fragments are mixed with the cut plasmids. The plasmid and human DNA join together, resulting in recombinant DNA plasmids, some of which contain gene *V*. ❹ The recombinant plasmids are then mixed with bacteria. Under the right conditions, the bacteria take up the recombinant plasmids. ❺ Each bacterium, with its recombinant plasmid, is allowed to reproduce. This step is the actual **gene cloning,** the production of multiple copies of the gene. As the bacterium forms a clone (a group of identical cells descended from a single ancestral cell), any genes carried by the recombinant plasmid are also cloned (copied). ❻ The molecular biologist finds those bacterial clones that contain gene *V*. ❼ The transgenic bacteria with gene *V* can then be grown in large tanks, producing protein V in marketable quantities.

Media References guide you through a wealth of media activities. Activities Quizzes on the website and CD-ROM can be assigned to encourage students to use the Activities.

Activity 12C on the Web & CD
View an animation that will help you further understand gene cloning.

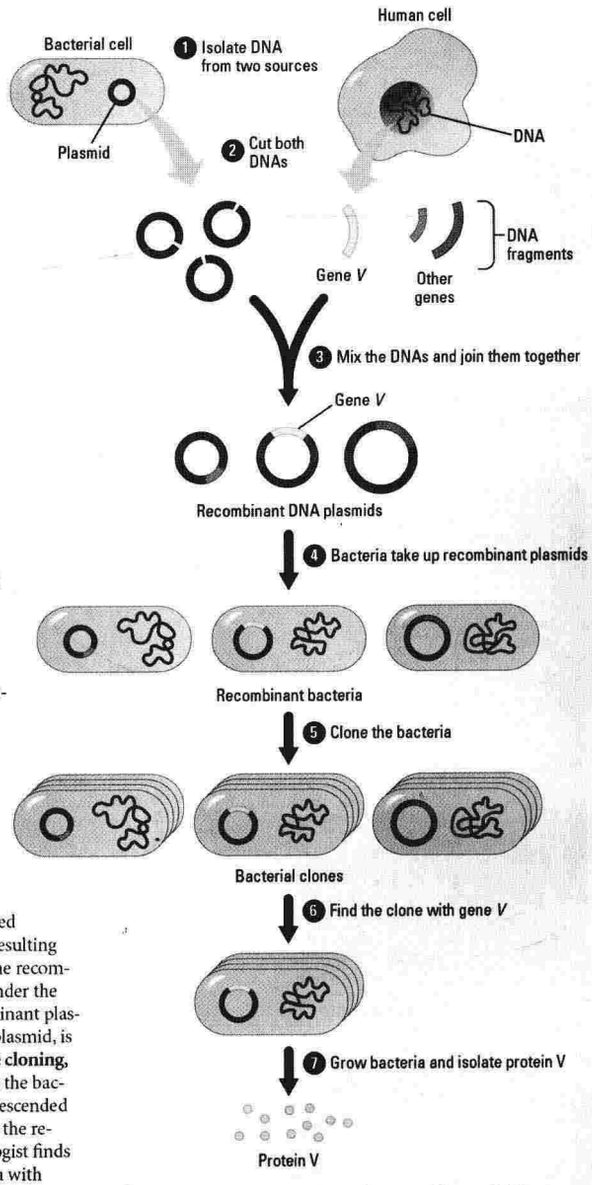


Figure 12.9 An overview of recombinant DNA techniques.

Visual Summaries reinforce key concepts

***New!* End-of-Chapter Visual Summaries** use art to visually reinforce important concepts. The chapter summaries also refer you to media Activities and Case Studies in the Process of Science.

Chapter Review

Summary of Key Concepts

For study help, go to the Essential Biology Web site (www.essentialbiology.com) or CD-ROM to explore the Activities and Case Studies in the Process of Science.

Recombinant DNA Technology

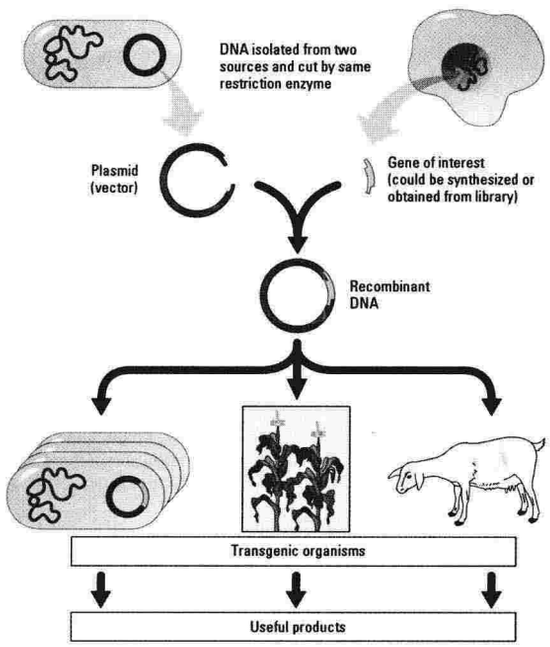
- Recombinant DNA technology is a set of laboratory procedures for combining DNA from different sources—even different species—into a single DNA molecule.

Activity 12A *Applications of DNA Technology*

- **From Humulin to Genetically Modified Foods** Recombinant DNA techniques have been used to create non-human cells that produce human proteins, genetically modified (GM) food crops, and transgenic farm animals.

Activity 12B *DNA Technology and Golden Rice*

- **Recombinant DNA Techniques** Review the steps of recombinant DNA technology in the following diagram.



Case Study in the Process of Science *How Are Plasmids Introduced Into Bacterial Cells?*

Activity 12C *Cloning a Gene in Bacteria*

Activity 12D *Restriction Enzymes*

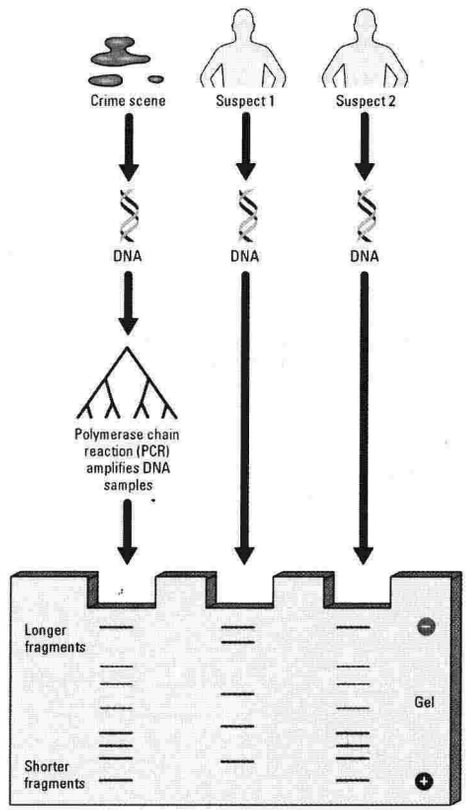
DNA Fingerprinting and Forensic Science

- DNA fingerprinting is used to determine whether two DNA samples come from the same individual.

Activity 12E *DNA Fingerprinting*

- **Murder, Paternity, and Ancient DNA** DNA fingerprinting can be used to establish innocence or guilt of a criminal suspect, identify victims, determine paternity, and contribute to basic research.

- **DNA Fingerprinting Techniques** Restriction fragment length polymorphism (RFLP) analysis compares DNA fragments using restriction enzymes and gel electorophesis.



Activity 12F *Gel Electrophoresis of DNA*

Activity 12G *Analyzing DNA Fragments Using Gel Electrophoresis*

Case Study in the Process of Science *How Can Gel Electrophoresis Be Used to Analyze DNA?*

Questions that encourage self-assessment and help you think like a scientist

Case Studies in the Process of Science on the website and CD-ROM ask you to make observations, analyze data, and draw conclusions. Lab Report questions can be answered electronically.

DNA fingerprints from an actual murder case are shown on a gel in **Figure 12.19**. The restriction fragments from the victim's DNA clearly match the fragments from the blood on the defendant's clothes. Furthermore, the markers from the defendant's DNA are clearly different. Thus, electrophoresis allows us to see similarities as well as differences between mixtures of restriction fragments, reflecting similarities as well as differences between the nucleotide sequences from two DNA samples.

Case Study in the Process of Science on the Web & CD
Conduct virtual gel electrophoresis.

Self-Quiz questions provide a variety of formats for your self-assessment at the end of each chapter. The CD-ROM and website also include approximately 70 multiple-choice quiz questions for each chapter.

CheckPoint questions within the chapter help you to assess your understanding of key concepts.

CHECKPOINT

1. Why is only the slightest trace of DNA at a crime scene often sufficient for forensic analysis?
2. You use a restriction enzyme to cut a DNA molecule. The base sequence of this DNA is known, and the molecule has a total of three restriction sites clustered close together near one end. When you separate the restriction fragments by electrophoresis, how do you expect the bands to be distributed in the electrophoresis lane?
3. Put these three techniques in the order that would allow you to create a DNA fingerprint from a minuscule crime scene sample: gel electrophoresis, PCR, treatment with restriction enzymes.

Answers: 1. Because PCR can be used to produce enough molecules for analysis **2.** Three bands near the positive pole at the bottom of the gel (small fragments) and one band near the negative pole at the top of the gel (large fragment) **3.** PCR, treatment with restriction enzymes, gel electrophoresis

Self-Quiz

1. Suppose you wish to create a large batch of the protein lactase using recombinant DNA. Place the following steps in the order you would have to perform them.
   a. Find the clone with the gene for lactase.
   b. Insert the plasmids into bacteria and grow the bacteria into clones.
   c. Isolate the gene for lactase.
   d. Create recombinant plasmids, including one that carries the gene for lactase.
2. Why is an artificial gene made using reverse transcriptase often shorter than the natural form of the gene?
3. A carrier that moves DNA from one cell to another, such as a plasmid, is called a _____.
4. In making recombinant DNA, what is the benefit of using a restriction enzyme that cuts DNA in a staggered fashion?
5. A paleontologist has recovered a bit of organic material from the 400-year-old preserved skin of an extinct [illegible]. She would like to compare [illegible] with DNA [illegible]

The Process of Science questions encourage you to think like a scientist by analyzing data, posing hypotheses and designing experiments. **Case Studies in the Process of Science** on the CD-ROM and website also reinforce these skills.

The Process of Science

1. A biochemist hopes to find a gene in human liver cells that codes for an important blood-clotting protein. She knows that the nucleotide sequence of a small part of the gene is CTGGACTGACA. Briefly explain how to obtain the desired gene.
2. Some scientists have joked that once the Human Genome Project is complete, "we can all go home" because there will be nothing left for genetic researchers to discover. Do you agree? Why or why not?

Case Study in the Process of Science on the Web & CD *Learn how plasmids are introduced into bacterial cells.*

Biology and Society questions ask you to apply biological concepts to environmental problems, public policies, health concerns, and other social issues. The **Biology and Society web link** includes essay questions that encourage you to explore current issues and write about them. Responses can be printed or e-mailed to instructors.

Biology and Society

1. In the not-too-distant future, gene therapy may be an option for the treatment and cure of many inherited disorders. What do you think are the most serious ethical issues that must be dealt with before human gene therapy is used on a large scale? Why do you think these issues are important?
2. Today, it is fairly easy to make transgenic plants and animals. What are some important safety and ethical issues raised by this use of recombinant DNA technology? What are some of the possible dangers of introducing genetically engineered organisms into the environment? What are some reasons for and against leaving decisions in these areas to scientists? Who do you think should make these decisions?

Biology and Society on the Web *Learn more about the Human Genome Project.*

PREFACE

We are privileged to help instructors share the story of life with students during this golden age of biology. It is an era of breathtaking progress in our understanding of life and a time when biology weaves into the fabric of our society as never before. Modern biology is remodeling medicine, agriculture, forensics, conservation science, anthropology, psychology, sociology, and even philosophy, including ethics. This is the best time ever to take a biology course!

This is also the most challenging time to teach and learn biology. The same discovery explosion that makes biology so much fun also threatens to suffocate 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, many instructors are opting to cover fewer main topics rather than compromise depth in the most important areas. We created *Essential Biology* to support this trend. 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. 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 without being superficial in developing the concepts that are most fundamental to understanding life. We take the "less is more" mantra in education today to mean fewer topics, not more diluted explanations.

The book's title, *Essential Biology*, partly reflects this look at life that 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 various 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 *Essential Biology* spotlights this central place of biology in modern culture.

The success of the first edition of *Essential Biology* validated the book's counter-encyclopedic, culturally-connected approach. And with the help of reviewers and many other instructors and students who contributed suggestions, we found ways to make this second edition work even better. Here are just a few of the improvements you'll find in *Essential Biology,* Second Edition:

- ***"Biology and Society" Sections:*** Each chapter now begins with a human-interest story that engages students in the chapter topic.
- ***Visual Summaries:*** We have replaced the traditional all-text chapter summary with a review that includes diagrams to help students synthesize relationships among the key concepts. Student focus groups were particularly helpful in helping us refine our idea for this new kind of chapter summary.
- ***Campbell Image Presentation Library:*** The breakthrough package of *Essential Biology* supplements is now even more robust with the addition of an extensive archive of digital content for lecture presentations. This image library gives instructors easy access to over 1,000 photos, all text art with and without labels, selected figures layered for step-by-step presentation, all text tables, 110 animations, and 85 video clips.
- ***New Coauthor Eric Simon:*** Bringing his award-winning gift for teaching non-majors, Eric played an especially important role in strengthening *Essential Biology*'s connections to the social and personal issues that concern students.

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. 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 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*.

Neil Campbell
Dept. of Botany and
Plant Sciences
University of California
Riverside, CA 92521

Jane Reece
Benjamin Cummings
1301 Sansome St.
San Francisco, CA 94111

Eric J. Simon
Dept. of Biology
New England College
Henniker, NH 03242

ACKNOWLEDGMENTS

As authors, we feel incredibly privileged to have worked with the very best publishing professionals and biology colleagues. Though the responsibility for any shortcomings of this book lies solely with us, its merits reflect the contributions of many associates who helped us with the textbook, supplements, and the integral media activities that complement the lessons.

First, we'd like to thank the *Essential Biology* team at Benjamin Cummings. Beth Wilbur oversaw the project as Executive Editor. Beth's talents as a consensus builder and team leader helped to move the book along at several critical junctures. Acquisitions Editor Chalon Bridges brought unending enthusiasm and positive energy to the book; her bright nature inspired us, especially during the most difficult stages of writing. 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. Further guidance and inspiration was provided by Frank Ruggirello, Vice President and Editorial Director, and Kay Ueno, Director of Development. Benjamin Cummings authors are very fortunate to have such supportive leadership.

Developmental Editor Evelyn Dahlgren helped to craft every chapter of this book. Her handiwork can be found on every page and the final book is much the better for it. Editorial Project Manager Ginnie Simione Jutson guided the many facets of the project with just the right combination of firmness and compassion. Developmental Manager Pat Burner applied her broad knowledge of biology to help ensure the clarity and accuracy of our words.

If you find yourself admiring a wonderful piece of art in this book, you can thank the gifted Russell Chun, Senior Producer, Art and Media. Photo Image Editor Donna Kalal used her keen eye and discerning taste to provide the wealth of photographs used in the book and the supplements. Freelance developmental editors Betsy Dilernia and Robin Fox maintained their high standards despite the challenging schedule. Publishing Assistants Trinh Bui, Krystina Sibley, and the always cheerful Nora Lally-Graves (who also contributed significantly to the supplements) smoothed out the day-to-day operations of the whole team. The dedication to perfection shown by the entire editorial team inspired the authors to do our very best.

After our words and drawings were committed to paper, the production team transformed them into the book you hold in your hands. Erin Gregg, Managing Editor, Production, rose to the challenge of our very tight schedule with aplomb. For the production and composition of the book, we thank Jonathan Peck and Joan Keyes of Dovetail Publishing Services, whose professionalism and commitment to the quality of the finished product eased our authorial burdens tremendously. The authors owe much to the copyeditor, Janet Greenblatt, and proofreaders, Pete Shanks and Roberta Watkinson, for polishing our words. We thank Charlotte Shane for compiling the index. If you like the look of the book, it is thanks to text designer Gary Hespenheide and cover designer Yvo Riezebos. We thank Precision Graphics for creating the illustrations. In the final stages of production, the talents of manufacturing buyer Pam Augspurger shone.

More and more, the success of a textbook depends upon the quality of its supplements. Luckily, the *Essential Biology* supplements team is as committed to the core goals of accuracy and readability as the authors and editorial team. The multitalented Aaron Gass produced the website and student CD that accompany every copy of *Essential Biology*. The stylish and informative website is also the product of web developers Steve Wright and Marie-Beth Millares. Corinne Benson expertly coordinated the production of the supplements, a difficult task given their number and variety. We owe particular gratitude to two supplement authors: Ed Zalisko of Blackburn College wrote the Student Study Guide and Instructor's Guide, while Gene Fenster of Longview Community College wrote most of the questions found in the Test Bank. Additionally, Brian Shmaefsky contributed many valuable media teaching tips to the Instructor's Guide. As teachers, we know the value of well crafted PowerPoint lectures, so we thank Chris Romero and John Hammett for writing and editing those that accompany this book. Karl Miyajima ably oversaw the production of all of the visual supplements.

As educators and writers, we rarely think about marketing. But for what we try to do as authors, "market" translates as "the students and instructors we are trying to serve." Senior Marketing Manager Josh Frost and Marketing Development Manager Susan Winslow helped us achieve our authorial goals by keeping us constantly focused on the needs of students and instructors. For their amazing efforts in marketing, we also thank Director of Marketing Stacy Treco, Creative Director Lillian Carr, Marketing Specialist David Good, and Marketing Coordinator Ben Russo. We also thank the Benjamin Cummings field staff for representing *Essential Biology* on campuses. These representatives are our lifeline to the greater educational community, telling us what you like (and don't like) about this book and media. Their enthusiasm for sharing our words buoyed us during the writing process. In particular, we'd like to thank Science Project Specialists Scott Davidson, Kathryn Speers, and Melissa Young, and Field Market Specialist Jeff Howard for their dedication to presenting *Essential Biology* to instructors all over the country.

Numerous colleagues in the biology community also contributed to *Essential Biology*. In particular, Jennifer Warner of University of North Carolina at Charlotte wrote many of the critical thinking questions found at the end of the textbook chapters and in the Instructor's Guide. Amanda Marsh Simon provided nearly superhuman support to the project, as an incomparable research specialist and in other ways too numerous to mention. Furthermore, 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, friends, and colleagues who continue to tolerate our obsession with doing our best for science education.

Neil A. Campbell
Jane B. Reece
Eric J. Simon

Reviewers

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Felix O. Akojie, *Paducah Community College*
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Greg Jones, *Santa Fe Community College*
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Bonnie Wood, *University of Maine at Presque Isle*
Mark L. Wygoda, *McNeese State University*
Samuel J. Zeakes, *Radford University*
Uko Zylstra, *Calvin College*

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Suchi Bhardwaj, *Winthrop University*
Donna H. Bivans, *East Carolina University*
Steve Browder, *Franklin College*
Reggie Cobb, *Nash Community College*
Pat Cox, *University of Tennessee, Knoxville*
Ade Ejire, *Johnston Community College*
Carl Estrella, *Merced College*
Dianne M. Fair, *Florida Community College at Jacksonville*
Lynn Fireston, *Ricks College*
Patricia Glas, *The Citadel*
Consetta Helmick, *University of Idaho*
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Katrina McCrae, *Abraham Baldwin Agricultural College*
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Jon R. Nickles, *University of Alaska, Anchorage*
Jennifer Penrod, *Lincoln University*
Laurel Roberts, *University of Pittsburgh*
April Rottman, *Rock Valley College*
Mike Runyan, *Lander University*
Travis Ryan, *Furman University*
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Sandra Slivka, *Miramar College*
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Paula Thompson, *Florida Community College*
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Virginia Vandergon, *California State University, Northridge*
Lisa Volk, *Fayetteville Technical Community College*
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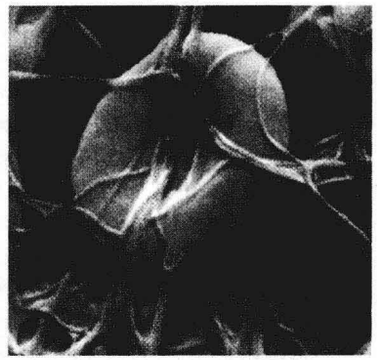
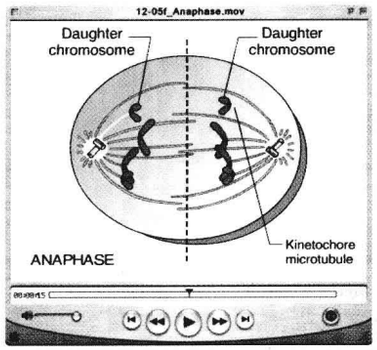
Michael Womack, *Macon State College*

New! Campbell Image Presentation Library with Visual Guide (0-8053-7498-1)

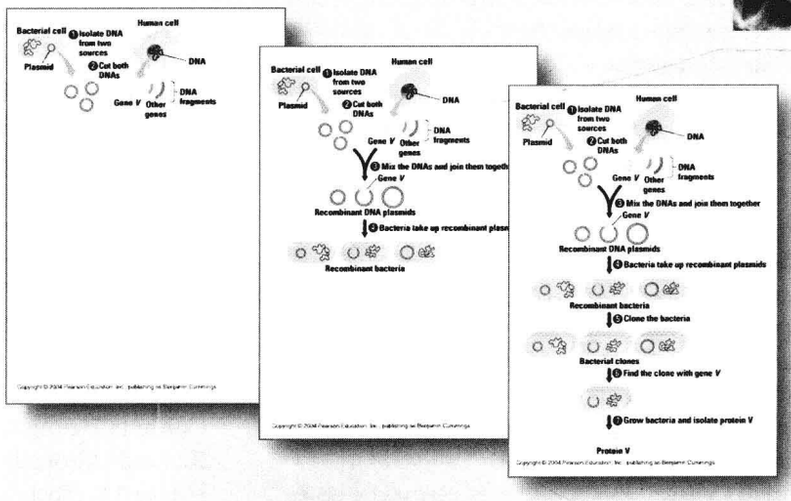
The new Campbell Image Presentation Library is a chapter-by-chapter visual archive that includes more than 1,000 photos from the text plus additional sources, all text art with and without labels, selected figures layered for step-by-step presentation, all text tables, 110 animations, and 85 video clips. Thumbnail-sized images in the printed Visual Guide provide easy viewing of all resources in the Campbell Image Presentation Library.



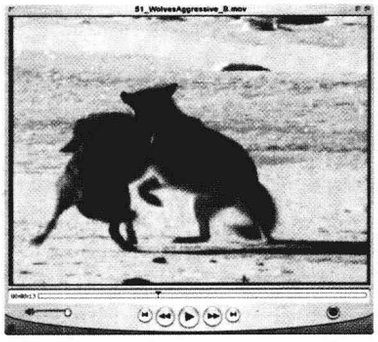
More than 1,000 photos



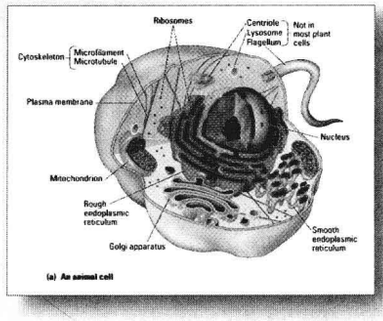
110 animations

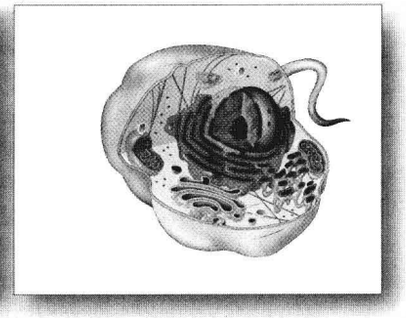


Selected figures layered for step-by-step presentation



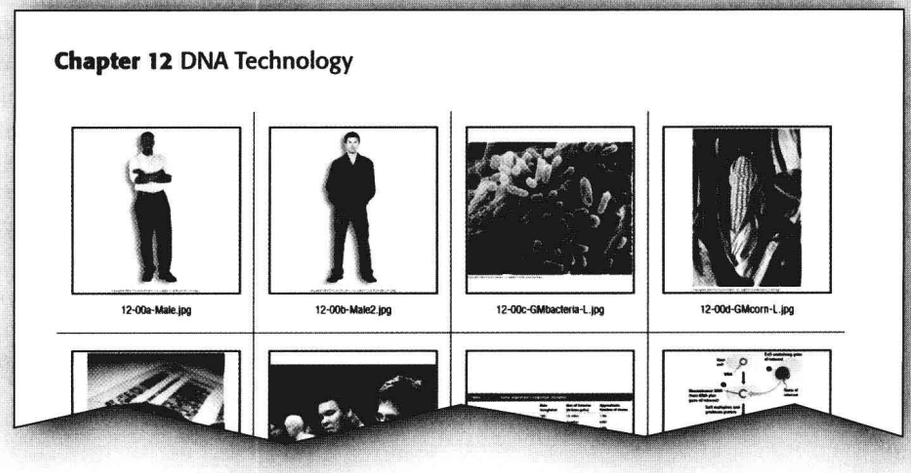
85 video clips

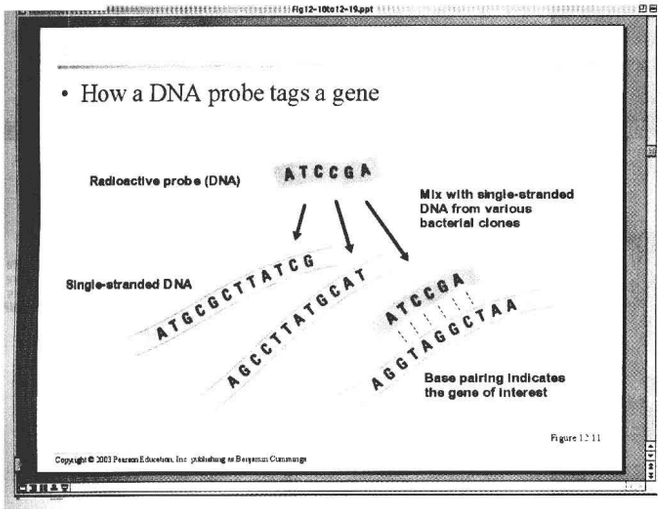




All the art from the text with and without labels

Visual guide to all resources





PowerPoint® lectures include art, photos, tables, and lecture outlines

New! PowerPoint® Lectures (0-8053-7474-4)

Chris Romero, *Front Range Community College, Larimer Campus*

Prepared PowerPoint® Lectures integrate the art, photos, tables, and lecture outlines for each chapter. Art labels can be edited in PowerPoint®, and selected figures are layered for step-by-step presentation. These PowerPoint® Lectures can be used as is, edited, or customized for your course with your own images and text. Videos and animations can be added from the Campbell Image Presentation Library.

New! Essential Biology Website Instructor Resources www.essentialbiology.com

The Instructor Resources section of the *Essential Biology* Website provides one convenient location for adopters to download materials they need to teach their course: the Campbell Image Presentation Library, the PowerPoint® Lectures, the Instructor's Guide to Text and Media (in Word), the Test Bank (in Word), and additional critical thinking questions (in Word). The Instructor Resources section also includes Lab Report worksheets (in Word) from the Case Studies in the Process of Science media investigations, which can be printed and given to students as assignments; suggested answers for the Lab Report worksheets; links to additional photo resources; and the Forum for Great Teaching Ideas, where professors can share ideas with their colleagues.

Instructor's Guide to Text and Media (0-8053-7475-2)

Edward J. Zalisko, *Blackburn College*

This comprehensive guide provides chapter-by-chapter references to all the media resources available to instructors and students plus a list of Transparency Acetates. The guide also includes objectives, additional critical thinking questions, lecture outlines, teaching tips, media tips, key terms, and word roots. A separate chapter offers suggestions for effective uses of technology in teaching introductory biology. The Instructor's Guide is available in print and in Word.

Transparency Acetates (0-8053-7484-1)

Over 650 full-color acetates include all illustrations and tables from the text, many of which incorporate photographs. New to this edition are selected figures illustrating key concepts broken down into layers for step-by-step lecture presentation.

Printed Test Bank (0-8053-7482-5)
Computerized Test Bank (0-8053-7477-9)

Eugene J. Fenster, *Longview Community College*

Thoroughly revised and updated, the test bank now includes more questions that emphasize critical thinking and an optional section with questions that test students on the Web/CD Activities. The Test Bank is available in print, on a cross-platform CD-ROM, and in the instructor section of CourseCompass™, Blackboard, and WebCT.

Annotated Instructor's Edition for Laboratory Investigations for Biology, Second Edition

(0-8053-6792-6)

Jean Dickey, *Clemson University*

The instructor's version of the lab manual includes the complete student version plus margin notes with instructor overviews, time requirements, helpful hints, and suggestions for extending or supplementing labs; answers to questions in the Student Edition; and suggestions for adapting the labs to a two-hour period.

Preparation Guide for Laboratory Investigations for Biology, Second Edition (0-8053-6771-3)

New! Course Management Systems

The content from the Essential Biology Website and Computerized Test Bank is available in these popular course management systems: CourseCompass™, Blackboard, and WebCT. Visit http://cms.aw.com for more information.

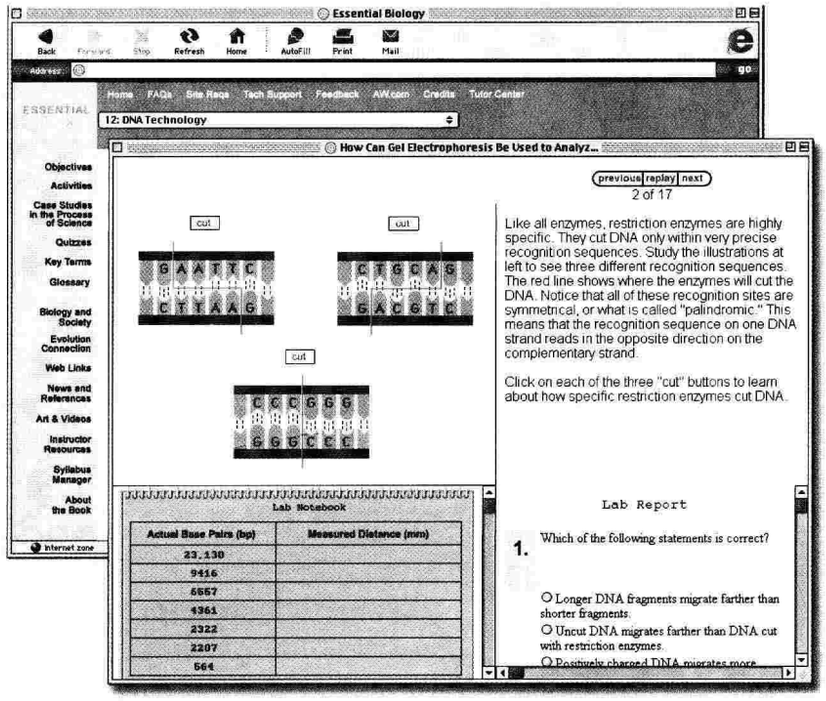
Supplements for the student

New! Essential Biology CD-ROM and Website

www.essentialbiology.com

The CD-ROM and Website included with the book contain:

- **200 Activities,** including animations, interactive review exercises, and videos. Activity Quizzes test students on the Activities.
- **56 Case Studies in the Process of Science** involve students in the process of science by asking them to make observations, analyze data, and draw conclusions. Lab Report questions can be answered electronically or on printable worksheets.
- **Over 2,000 quiz questions.** Each chapter includes a Pre-Test, an Activities Quiz, and a comprehensive Chapter Quiz. Each quiz has hints, immediate feedback, grading, and e-mailable results.
- **Glossary** with pronunciations
- **Flashcards** test knowledge of key terms.
- **Word Roots**
- **Key Terms**
- In addition, the Website provides access to **Biology and Society Web links** with questions, **Evolution Connection Web links** with questions, all the **art** from the book (with and without labels), **85 Videos, Web Links, News Links, News Archives, Further Readings,** and the **Syllabus Manager.**



Addison Wesley Tutor Center

www.aw.com/tutorcenter

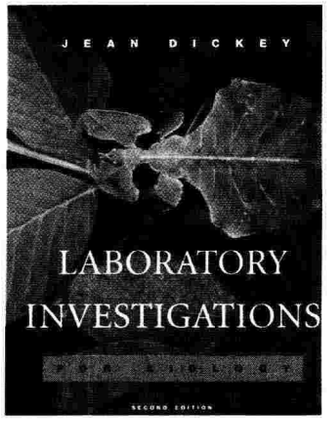
This center provides one-to-one tutoring in four different ways—phone, fax, email, and the Internet—during evening hours and on weekends. Qualified college instructors are available to answer questions and provide instruction regarding self-quizzes and other content found in *Essential Biology*.

Student Study Guide (0-8053-7479-5)

Edward J. Zalisko, *Blackburn College*

Students can master key concepts and earn a better grade with the thought-provoking exercises found in this study guide. Study advice, tables, quizzes, and crossword puzzles help students test their understanding of biology. The Student Study Guide also includes references to student media activities on the *Essential Biology* CD-ROM and Website.

Flexible options for the lab



Laboratory Investigations for Biology, Second Edition

(0-8053-6789-6)

Jean Dickey, *Clemson University*

An investigative approach actively involves students in the process of scientific discovery by allowing them to make observations, devise techniques, and draw conclusions. Twenty carefully chosen laboratory topics encourage students to use their critical thinking skills and the scientific method to solve problems.

New! Symbiosis Lab Authoring Kit—Customized Lab Manuals (0-321-10049-2)

Instructors can build a customized lab manual, choosing the labs they want, importing artwork from our graphics library, and even adding their own notes, syllabi, or other material. For more information visit http://www.pearsoncustom.com/database/symbiosis.html.

Biology Labs On-Line

www.biologylabsonline.com

These 12 virtual lab exercises enable students to perform potentially dangerous, lengthy, or expensive experiments in a safe electronic environment. The labs are available for purchase individually or in a 12-pack with the printed Student Lab Manual.