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Cecie Starr | Christine A. Evers | Lisa Starr

# Biology

**A Human Emphasis**

SEVENTH EDITION

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Cecie Starr, Christine A. Evers, Lisa Starr

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Managing Development Editor: Peggy Williams

Assistant Editor: Jessica Kuhn

Editorial Assistant: Rose Barlow

Technology Project Manager: Kristina Razmara

Marketing Manager: Kara Kindstrom

Marketing Communications Manager:  
Stacy Pratt

Project Manager, Editorial Production:  
Andy Marinkovich

Creative Director: Rob Hugel

Art Director: John Walker

Print Buyer: Karen Hunt

Permissions Editor: Bob Kauser

Production Service:  
Grace Davidson & Associates

Text Designers:  
Chris Keeney, Yvo Riezebos, John Walker

Photo Researcher:  
Myrna Engler Photo Research Inc.

Copy Editor: Anita Wagner

Illustrators:  
Gary Head, ScEYEnce Studios, Lisa Starr  
Cover Designers: Dare Porter, John Walker

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# Preface

In preparation for this revision, we invited instructors who teach introductory biology for non-majors students to meet with us and discuss the goals of their course. Nearly always, their goal was something like this: “To familiarize students with the way that science works and provide them with the tools they need to make well-informed choices as consumers and as voters.” This makes sense. Most students who use this book will not be biologists, and many will never take another science course. Yet they certainly need to make decisions that require an understanding of the process of science and of basic biological principles.

We provide these future decision-makers with an accessible introduction to science. Throughout this edition, we emphasize that biology is not a body of facts, but rather an ongoing endeavor carried out by a diverse community of people. We underscore this point by describing current research and providing photos and videos of the scientists who do it. We explain not only what is known, but also how it was discovered, and how our understanding has changed over time. At the same time, we highlight the role of longstanding scientific theories, most notably the theory of evolution, which is a unifying theme in this book.

We revised every page of text to make it as straightforward and clear as possible, keeping in mind that English is a second language for many students. We added new tables to summarize important points and streamlined figures to eliminate unnecessary complexity.

## CHANGES FOR THIS EDITION

**Links to Key Concepts** New to this edition are tools that link concepts within and between chapters. These tools reinforce the concept that each new idea in science rests on a foundation of other ideas.

Every chapter introduction has a section-by-section list of *Key Concepts*, each with a simple title. We repeat the titles at the top of appropriate text pages as ongoing reminders of the chapter’s conceptual organization. A brief list of *Links to Earlier Concepts* helps remind students of relevant concepts that they encountered in previous chapters. For instance, students are advised that before reading about neural function, they may wish to scan an earlier chapter section on active transport. Icons are repeated in text page margins.

**Media-Integrated Summaries** We have always offered a wealth of online media for students. With this edition, we have made it easier for students to determine which online material supports each section. We have integrated information about the relevant animations, tutorials, and videos into the section summaries.

**Chapter-Specific Changes** Every chapter was extensively revised for clarity; this edition has 350 new photos and almost 170 new or updated figures. A page-by-page guide to new content and figures is available upon request, but we summarize the highlights here.

- *Chapter 1, Invitation to Biology* New essay about discovery of new species. Greatly expanded coverage of critical thinking and the process of science.
- *Chapter 2, Life’s Chemical Basis* Chemistry of bonding revised to include electronegativity; new pH art.
- *Chapter 3, Molecules of Life* New art demonstrating protein structural organization; other art reorganized.
- *Chapter 4, Cell Structure and Function* Microscopy section updated; plasma membrane art simplified; new focus section on biofilms; cytoskeleton section reworked.
- *Chapter 5, Ground Rules of Metabolism* Energy and metabolism sections reorganized and rewritten; much new art, including molecular model of active site.
- *Chapter 6, Where It Starts—Photosynthesis* New essay on global warming emphasizes role of photosynthesis in the cycling of atmospheric carbon dioxide.
- *Chapter 7, How Cells Release Chemical Energy* All art showing metabolic pathways revised and simplified.
- *Chapter 8, How Cells Reproduce* Updated micrographs of mitosis; cancer section updated.
- *Chapter 9, Meiosis and Sexual Reproduction* Opener revised to include Red Queen hypothesis; new essay on evolutionary connection between mitosis and meiosis.
- *Chapter 10, Observing Patterns in Inherited Traits* Updated essay on cystic fibrosis; new figures for coat color genetics in dogs, and environmental effects on *Daphnia* phenotype.
- *Chapter 11, Chromosomes and Human Inheritance* Chapter reorganized; expanded discussion and new figure on the evolution of chromosome structure.
- *Chapter 12, DNA Structure and Function* New opener essay on pet cloning; adult cloning section updated.
- *Chapter 13, From DNA to Protein* New, simplified figures for transcription and translation.
- *Chapter 14, Controls Over Genes* Chapter reorganized; eukaryotic gene control section rewritten; updated X chromosome inactivation photos; new lac operon art.
- *Chapter 15, Studying and Manipulating Genomes* Chapter reorganized; gene library and PCR section rewritten; genetic engineering sections updated and expanded.
- *Chapter 16, Evidence of Evolution* Heavily revised; reorganized with Chapter 17 to emphasize evidence-based thinking. Revised opener essay on evidence leading to inference; updated geologic time scale; comparative morphology section rewritten with new figure; comparative embryology photo series added; cladistics section rewritten; new, updated tree of life.
- *Chapter 17, Processes of Evolution* Heavily revised; reorganized with chapter 16 to emphasize evolution as a process. Revised rats/warfarin essay; sections on sexual selection, reproductive isolation, sympatric speciation, and macroevolution rewritten; examples added: directional selection in the peppered moth, reproductive isolation in stalk-eyed flies, genetic drift in flour beetles, mechanical isolation in sage, sympatric speciation in palms, and ring species.
- *Chapter 18, Life’s Origin and Early Evolution* Information about origin of agents of metabolism updated. New discussion of ribozymes as evidence for RNA world.



- *Chapter 19, Prokaryotes and Viruses* New art of viral structure. Herpes virus replication added. New section on discovery of viroids and prions.
- *Chapter 20, Protists—The Simplest Eukaryotes* Figure showing different protist life cycles added. New section about amoebozoans. Fungi now in separate chapter.
- *Chapter 21, Plant Evolution* Plant life cycle diagram added. Whisk fern coverage added. More about ferns. New section about quinoa, the most nutritious plant.
- *Chapter 22, Fungi* New chapter devoted to the fungi. Includes information on chytrids and microsporidians, a separate section for each major fungal group.
- *Chapter 23, Animal Evolution—the Invertebrates* Improved coverage of animal origins and of crustacean diversity. New section about invertebrate pests and parasites.
- *Chapter 24, Animal Evolution—the Vertebrates* Updated figure for fish-to-tetrapod limb evolution. Sections on primate and human evolution revised and updated.
- *Chapter 25, Plants and Animals—Common Challenges* More information about plant defensive mechanisms.
- *Chapter 26, Plant Tissues* Primary structure of roots reorganized; new section on tree rings and past climate.
- *Chapter 27, Plant Nutrition and Transport* New essay on effects of ozone on plants.
- *Chapter 28, Plant Reproduction and Development* New section on plant responses to seasonal changes.
- *Chapter 29, Animal Tissues and Organ Systems* Opener about stem cells updated. Improved coverage of embryonic tissues, development of body cavities.
- *Chapter 30, Neural Control* Chapter reorganized to begin with overview of nervous systems. New sections cover neurotransmitters and the role of neuroglia.
- *Chapter 31, Sensory Perception* New art of vestibular apparatus, image formation in eyes, and accommodation.
- *Chapter 32, Endocrine Control* Chapter reorganized into smaller sections focused on specific glands. New graphic for insulin/glucagon effects. More on diabetes.
- *Chapter 33, Structural Support and Movement* Improved coverage of joints, clarified discussion of sliding-filament model.
- *Chapter 34, Circulation* Clearer discussion of Rh factor and risks with pregnancy. New art of cardiac muscle.
- *Chapter 35, Immunity* Heavily reorganized, updated to reflect current paradigms, and rewritten to emphasize integrated actions of the immune system. Opener essay updated to include vaccine development; new, simplified art of adaptive immune responses; AIDS section updated.
- *Chapter 36, Respiration* New section about respiration in extreme habitats (high altitude and deep dives).
- *Chapter 37, Digestion and Human Nutrition* Nutritional information and obesity research sections updated.
- *Chapter 38, The Internal Environment* New figure of fluid distribution in the body. Coverage of nephron anatomy and urine formation completely revised.
- *Chapter 39, Animal Reproduction and Development* The chapter has been shortened by tightening sections about classical embryology and birth defects. New section about female reproductive disorders.

- *Chapter 40, Population Ecology* Exponential and logistic growth clarified. Effect of fishing on Atlantic cod added.
- *Chapter 41, Community Structure and Biodiversity* Whirling disease in trout, salamander competition study added. Updated coverage of succession and stability.
- *Chapter 42, Ecosystems* New figures for food chain and food webs. Updated greenhouse gas coverage.
- *Chapter 43, The Biosphere* New section about soils and desertification. New section about rain forests. More on coral reefs and threats to them. More on ocean life.
- *Chapter 44, Behavioral Ecology* Chapter reorganized and shortened.

*Appendix V, Molecular Models* New art and text explain why we use different types of molecular models.

*Appendix VI, Closer Look at Some Major Metabolic Pathways* New art shows details of electron transport chains in thylakoid membranes.

*Appendix VIII, Restless Earth—Life's Changing Geologic Stage* A new map from NASA summarizes Earth's tectonic and volcanic activity.

*Appendix X, A Comparative View of Mitosis in Plant and Animal Cells* A new figure shows the stages of plant and animal mitosis side-by-side for easy comparison.

## ACKNOWLEDGMENTS

Thanks to our advisors for their ongoing impact on the book's content. John Jackson, Jean deSaix, David Rintoul, and Michael Plotkin all deserve recognition for their deep commitment to excellence in education. This edition also reflects many influential contributions of the instructors, listed on the following page, who helped shape our thinking. *Impacts/Issues* essays, *Key Concepts*, custom videos—such features are direct responses to their insights from the classroom.

Cengage Learning continues to prove why it is one of the world's foremost publishers; Michelle Julet, thank you again for supporting our ideals and our creativity. Keli Amann and Kristina Razmara created a world-class technology package for both students and instructors. Peggy Williams, with her clarity, humor, intelligence, and patience, has been truly inspiring. Grace Davidson calmly kept us on track and put all of the pieces together, and Andy Marinkovich made sure that production went smoothly. Thanks also to our marketing manager Kara Kindstrom, Paul Forkner in photo research, and Jessica Kuhn and Rose Barlow, our tireless editorial assistants.

It takes a dedicated group of publishing professionals to produce a textbook, yet no listing conveys how this team interacted to create something extraordinary. And thank you, Jack Carey, for being the first to identify the need for features, including student voting, that can further biology education.

CECIE STARR, CHRIS EVERS, AND LISA STARR July 2007



# CONTRIBUTORS TO THIS EDITION: INFLUENTIAL CLASS TESTS AND REVIEWS

- BRENDA ALSTON-MILLS  
*North Carolina State University*
- NORRIS ARMSTRONG  
*University of Georgia*
- DAVE BACHOON  
*Georgia College & State University*
- ANDREW BALDWIN  
*Mesa Community College*
- LISA LYNN BOGGS  
*Southwestern Oklahoma State University*
- GAIL BREEN  
*University of Texas at Dallas*
- MARGUERITE "PEGGY" BRICKMAN  
*University of Georgia*
- DAVID WILLIAM BRYAN  
*Cincinnati State College*
- URIEL BUITRAGO-SUAREZ  
*Harper College*
- SHARON KING BULLOCK  
*Virginia Commonwealth University*
- JOHN CAPEHART  
*University of Houston - Downtown*
- DANIEL CECCOLI  
*American InterContinental University*
- TOM CLARK  
*Indiana University South Bend*
- HEATHER COLLINS  
*Greenville Technical College*
- CYNTHIA LYNN DASSLER  
*Ohio State University*
- CAROLE DAVIS  
*Kellogg Community College*
- LEWIS E. DEATON  
*University of Louisiana - Lafayette*
- JEAN SWAIM DESAIX  
*University of North Carolina - Chapel Hill*
- (JOAN) LEE EDWARDS  
*Greenville Technical College*
- HAMID M. ELHAG  
*Clayton State University*
- PATRICK ENDERLE  
*East Carolina University*
- DANIEL J. FAIRBANKS  
*Brigham Young University*
- AMY FENSTER  
*Virginia Western Community College*
- KATHY E. FERRELL  
*Greenville Technical College*
- ROSA GAMBIR  
*Suffolk Community College - Ammerman*
- TIM D. GASKIN  
*Cuyahoga Community College - Metropolitan*
- STEPHEN J. GOULD  
*Johns Hopkins University*
- MARCELLA HACKNEY  
*Baton Rouge Community College*
- GALE R. HAIGH  
*McNeese State University*
- JOHN HAMILTON  
*Gainesville State*
- RICHARD HANKE  
*Rose State Community College*
- CHRIS HAYNES  
*Shelton St. Community College*
- KENDRA M. HILL  
*South Dakota State University*
- JULIANA GUILLORY HINTON  
*McNeese State University*
- KELLY HOGAN  
*University of North Carolina*
- ROBERT HUNTER  
*Trident Technical College*
- JOHN IRELAND  
*Jackson Community College*
- THOMAS M. JUSTICE  
*McLennan College*
- TIMOTHY OWEN KONEVAL  
*Laredo Community College*
- SHERRY KRAYESKY  
*University of Louisiana - Lafayette*
- DUBEAR KROENING  
*University of Wisconsin - Fox Valley*
- JEROME KRUEGER  
*South Dakota State University*
- JIM KRUPA  
*University of Kentucky*
- MARY LYNN LAMANTIA  
*Golden West College*
- KEVIN T. LAMPE  
*Bucks County Community College*
- SUSANNE W. LINDGREN  
*Sacramento State University*
- MADLINE LOVE  
*New River Community College*
- DR. KEVIN C. MCGARRY  
*Kaiser College - Melbourne*
- JEANNE MITCHELL  
*Truman State University*
- ALICE J. MONROE  
*St. Petersburg College - Clearwater*
- BRENDA MOORE  
*Truman State University*
- RAJKUMAR "RAJ" NATHANIEL  
*Nicholls State University*
- FRANCINE NATALIE NORFLUS  
*Clayton State University*
- ALEXANDER E. OLVIDO  
*Virginia State University*
- BOB PATTERSON  
*North Carolina State University*
- SHELLEY PENROD  
*North Harris College*
- MARY A. (MOLLY) PERRY  
*Kaiser College - Corporate*
- JOHN S. PETERS  
*College of Charleston*
- MICHAEL PLOTKIN  
*Mt. San Jacinto College*
- RON PORTER  
*Penn State University*
- KAREN RAINES  
*Colorado State University*
- LARRY A. REICHARD  
*Metropolitan Community College - Maplewood*
- JILL D. REID  
*Virginia Commonwealth University*
- ROBERT REINSWOLD  
*University of Northern Colorado*
- DAVID RINTOUL  
*Kansas State University*
- DARRYL RITTER  
*Okaloosa Walton Junior College*
- AMY WOLF ROLLINS  
*Clayton State University*
- ROBIN SEARLES-ADENEGAN  
*Morgan State University*
- JULIE SHEPKER  
*Kaiser College - Melbourne*
- RAINY SHOREY  
*Illinois Central College*
- ERIC SIKORSKI  
*University of South Florida*
- ROBERT (BOB) SPEED  
*Wallace Junior College*
- TONY STANCAMPANO  
*Oklahoma City Community College*
- JON R. STOLTZFUS  
*Michigan State University*
- PETER SVENSSON  
*West Valley College*
- JEFFREY L. TRAVIS  
*University at Albany*
- NELS H. TROELSTRUP, JR.  
*South Dakota State University*
- ALLEN ADAIR TUBBS  
*Troy University*
- WILL UNSELL  
*University of Central Oklahoma*
- RANI VAJRAVELU  
*University of Central Florida*
- JACK WABER  
*West Chester University of Pennsylvania*
- KATHY WEBB  
*Bucks County Community College*
- VIRGINIA WHITE  
*Riverside Community College*
- KATHLEEN LUCY WILSENN  
*University of Northern Colorado*
- PENNI JO WILSO  
*Cleveland State Community College*
- MICHAEL L. WOMACK  
*Macon State College*
- MARK L. WYGODA  
*McNeese State University*
- LAN XU  
*South Dakota State University*
- POKSYN ("GRACE") YOON  
*Johnson and Wales University*

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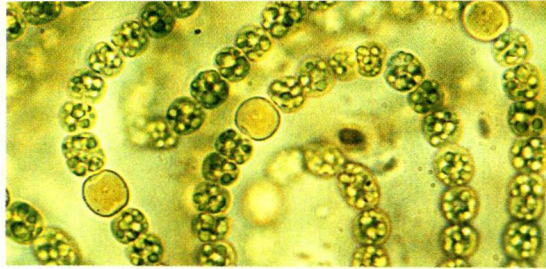


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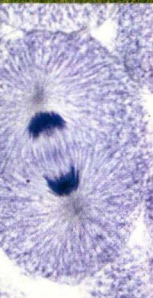
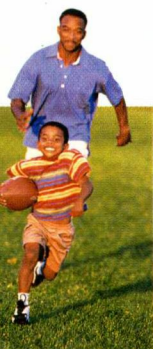
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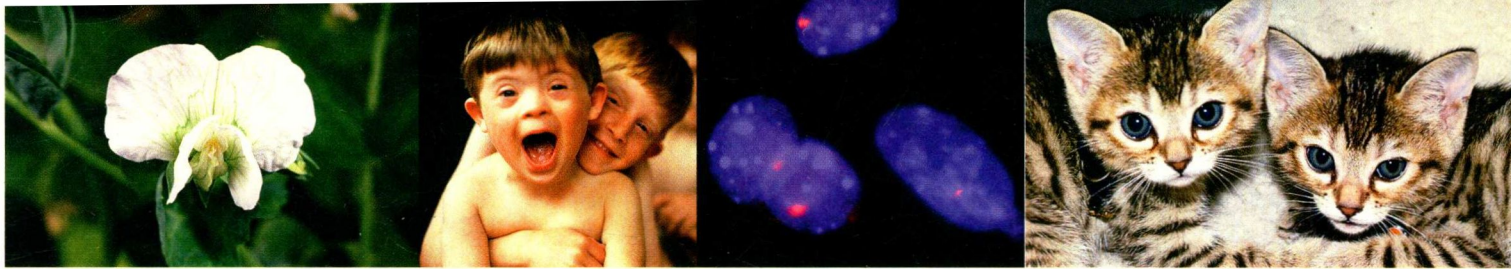
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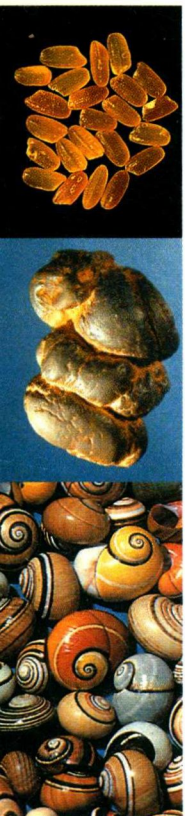
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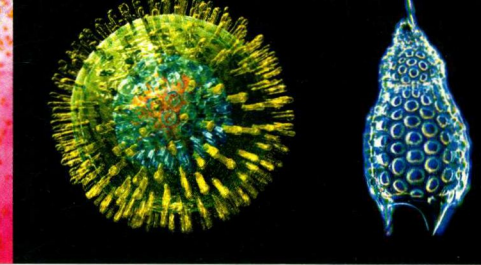
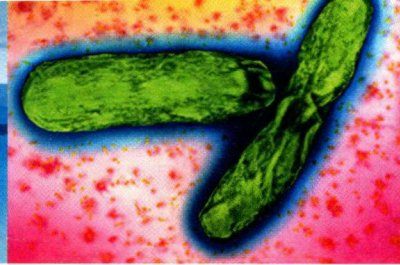
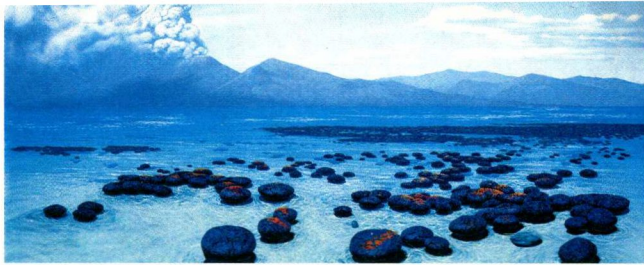
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