

# Preface

**W**e first began work on this text in 1982, over twenty years ago. We set out to write a text that explained biology the way we taught it in the classroom—as the product of evolution. Most texts in 1982 relegated evolution to a few chapters in the diversity section. But evolution pervades biology, and is just as evident in the bacterial character of the mitochondria within your cells, in the biochemical similarities of photosynthesis and glycolysis, in the evolution of genes that control development—everywhere you look in biology, you see Darwin staring back at you. This evolutionary approach has proven popular among our nation's biology faculty, and most texts to greater or lesser degrees now adopt it.

Our text has changed a lot over twenty years, reflecting great changes in biology. The book has become more molecular, as biology has. In particular, a lot more is said about cell biology and development, areas where biology has made enormous strides. But our text remains fundamentally an evolutionary explanation of biology. In this edition, for example, while there is a new chapter on genomes, there is also a new “evo-devo” chapter that examines how genomes and developmental control mechanisms have evolved. This is just one example of our efforts to integrate biological questions and approaches at multiple levels of organization throughout the text, as we strive to guide students toward a connected understanding of biology.

This new seventh edition marks perhaps the greatest change in our text: the addition of two new biologists to the author team, Jonathan Losos, also at Washington University, and Susan Singer of Carleton College. Both made major contributions to the previous edition—Jonathan to the chapter on evolution and ecology, and Susan to the chapters on plant biology—and we are delighted to welcome them as full-fledged authors. In this edition their responsibilities have broadened to include the revolution that is ongoing in our understanding of systematics and evolution at the DNA level, matters that affect many chapters of this book.

Text development today involves an even greater number of people, as instructors from across the country are continually invited to share their knowledge and experience with us through reviews and focus groups. All of the feedback we have received has shaped this edition, resulting in new chapters, reorganization of the table of contents, and expanded coverage in key areas. This edition also incorporated the expertise of three consultants: Randy Di Domenico, University of Colorado—Boulder; Kenneth Mason, Purdue University; and Randall Phillis, University of Massachusetts—Amherst, who provided detailed suggestions for improving the clarity, flow and accuracy of large portions of the text.

## How We Have Responded to You

Perhaps more than any other text on the market, this text has continued to evolve as a result of feedback from instructors teaching majors' biology. Overwhelmingly, they have told us that up-to-date content, a clear writing style, quality illustrations and dynamic presentation materials are the most important factors they consider when evaluating textbooks. We have let those values guide our revision of the text, as McGraw-Hill Education worked with those same instructors to create supplements that will help them in the classroom.

## Up-to-date Treatment

The core of any majors' biology course is the exploration of cells and genetics, always covered in the first half of any majors' text. This book has been particularly aggressive in keeping its treatment of cell biology and genetics comprehensive and up-to-date. It was the first to present a chapter on cell communication, for example (other books soon followed). We are continuing in that tradition by incorporating such cutting edge topics as the structure of ATP synthetase, small RNAs and RNA editing. This edition also includes a new chapter 17 that explores what we can learn about genomes, covering topics ranging from human health issues and concerns about privacy, agricultural applications, and the potential of genomics in minimizing bioterrorism.

We did not contain this revision to a few select chapters in the first half of the text, however, and it's possible to point to many areas where treatment of recent breakthroughs has been integrated. By concluding our evolution section with a comparative approach to genomes and evolution of development, we were able to connect new breakthroughs in these areas and provide a springboard into the diversity section. Major changes in our understanding of phylogenetic relationships among land plants, protists, and fungi along with other major groups, are reflected in the extensive revision of the diversity chapters. Rapid advances in our knowledge of plant defense responses led to a new chapter on this topic.

## Writing Style

Students of biology are responsible for an ever-growing volume of information, and that amount of detail is reflected in today's textbooks, which are increasingly becoming encyclopedic references as opposed to teaching texts.

But students are more likely to succeed with a text that they enjoy reading, that gives them a sense of the wonderment that inspired their own instructors to study biology. For this reason, we have endeavored to strike a balance; an inviting and accessible writing style with the level of authority and rigor expected of a majors' level text.

To further aid the student, every page or two-page spread in this book functions as a semi-independent learning module, organized under its own heading at the top of the left-hand page, with its own summary at the bottom of the right-hand page. This modular presentation makes the conceptual organization of the chapter clear, greatly enhancing student learning.

## Illustrations

This book is set apart from others in that its artists, William Ober, M.D. and Claire Garrison, R.N., are part of the author team. Their respective backgrounds as a practicing physician and pediatric registered nurse, and their experience creating art for highly successful anatomy and physiology, zoology and marine biology textbooks, bring an invaluable contribution to the text. The close collaboration between text and illustration authors results in dynamic, accurate figures that aid student understanding and instructor presentation.

- **Combination Figures** These pieces combine a photo or micrograph with a line drawing, to make the connection between conceptual figures and what the student may encounter in lab (Figure 5.10, page 88).
- **Biochemistry Pathway Icons** Found in the discussion of metabolism, these icons help students follow complex processes by highlighting the step currently under discussion (Figure 9.15, page 174).
- **Phylogeny Guideposts** This icon is presented as each group is introduced, to remind students of relationships among diverse organisms (TA 32.1, page 636).
- **Process Boxes** These figures include step-by-step descriptions to walk the student through a compact summary of important concepts (Figure 6.18, page 121)

We have also been fortunate in that this collaboration has allowed us to carefully integrate explanatory text into the figures. The end results are uncluttered, easy to follow illustrations that guide a student through a concept. They also benefit the instructor, as figures without distracting captions can be used for presentation while still allowing instructors to tell their own story.

## What Sets this Book Apart

Those who have not used or reviewed previous editions will want to know how this book differs from others.

## Evolutionary Focus

The treatment of evolution in this book differs from others in a simple but very important way: Evolution is the organizing principle guiding the teaching of each chapter. Instead of leaping from chemistry directly to cell structure as in other books, this book uses the chemistry of the first chapters to examine the origin of life and the evolution of cells; the cell chapters that follow can then be seen in a broader evolutionary context. Similarly, the treatment of animal anatomy and physiology in other books is largely limited to structure and function—this is the organ and this is how it functions. This book examines each animal body system in terms of how it has evolved. Every section of this book, whether it is genetics or plant biology, presents biology from an evolutionary perspective.

## Chemistry in a Biological Context

In talking to students over 30 years of teaching freshman biology, a consistent student complaint has been that the introductory biology course begins with a heavy jolt of chemistry. In other books, only after as many as 100 pages of chemistry do students encounter any biology. This is very off-putting for many students, and gets the course off to a rocky start. This book, by contrast, integrates the chemistry of the first section with biological themes. The treatment of macromolecules in Chapter 3 starts with proteins, which can be easily understood without detailed knowledge of carbohydrates. This arrangement has the distinct advantage of starting the student off with material of obvious relevance to biology.

## A Modern Approach

Some of the most obvious differences between this book and others can be seen in the second half of the book, that part devoted to coverage of evolution, diversity, plant biology, anatomy and physiology, and ecology.

*Evolution.* Our approach to evolutionary biology is unique in two respects. First, we strongly emphasize the role of experiments in studying evolution. Although much of evolutionary biology concerns the study of what happened in the past, that does not mean that experimental approaches are impossible. We emphasize the role that experiments play in studying evolutionary phenomena. More generally, like any detective story, we point out how various approaches must be integrated to fully understand evolutionary diversity.

Second, our book devotes an entire chapter to the evidentiary basis for evolutionary biology. Unlike other aspects of biology, or science in general, the factual basis of evolutionary biology is disputed by some segments of society. Thus, we feel that it is important to clearly present the

diversity and depth of evolution that leads almost all biologists to conclude that evolution has occurred. We feel that it is essential for all college biology students—regardless of their own opinions—to understand the scientific basis for this view.

**Diversity.** Our text has been organized so the diversity section is framed by a discussion of the revolution in taxonomy and phylogenetics (Chapter 25). Complete with vivid examples of dramatic changes in our understanding of relationships among organisms, this chapter can be used alone as an abbreviated approach to diversity or as a foundation for a more comprehensive evolutionary investigation of the diversity of life in the chapters that follow.

The book also differs from other majors' biology textbooks in that its coverage of diversity is more extensive. Consider for example the invertebrates. Other books devote as few as 30 pages to the invertebrates, presenting only the briefest of sketches of what used to be the core of traditional biology courses. This book devotes more than twice as many pages to the invertebrates, followed by a more comprehensive chapter on the vertebrates than is found in other books. Why is this more extensive treatment of diversity important? Even in courses that don't cover diversity in detail, it is important that students be able to uncover for themselves the relations among animal groups.

**Plant Biology.** The plant biology chapters have undergone extensive revision, and are now organized to lead the student through the plant life cycle. In addition, we have carefully integrated both developmental and genetic perspectives, a fusion not found in other texts. For example, Chapter 36, Vegetative Plant Development, explores root formation in the context of the *monopterous* mutant of *Arabidopsis* that fails to make a root. The shift from its developmental role to its functional role as an auxin receptor begins to move students toward a physiological understanding of plant function.

**Anatomy and Physiology.** Most books devote nearly the same amount of space to anatomy and physiology, about 250 pages. The differences lie primarily in approach, this book having a more evolutionary focus than others, and in its emphasis on fundamentals.

**Ecology and Behavior.** We take an integrative view to understanding how the environment functions and how organisms interact with it. This section is broken into different chapters, such as behavioral ecology, population ecology, and community ecology, but the topics are carefully integrated. Moreover, we apply this information extensively in Chapters 56 and 57 (The Biosphere and Conservation Biology) to address the environmental issues facing our planet. We believe it is of the utmost importance that students understand the scientific bases to current problems so they can evaluate efforts to solve them.

## Changes to the Seventh Edition

The seventh edition of *Biology* is the result of extensive analysis of the text and evaluation of input from biology instructors who conscientiously reviewed chapters during various stages of this revision. We have utilized the constructive comments provided by these professionals in our continuing efforts to enhance the strengths of the text. Listed first are general changes that have been made to the entire text, which is then followed by specific changes for each part.

### End-of-chapter Pedagogy

The end-of-chapter student review has been greatly expanded, offering students a full-page chapter review and three assessment tools: Self Test, multiple choice questions; Test Your Visual Understanding, questions based on a figure from the chapter; and Apply Your Knowledge, critical thinking questions. The assessment doesn't end there, however. These tools are carried over to the web where the student can take an interactive version of the test and receive instructional feedback.

### Inquiry Questions

In this edition we have developed Inquiry Questions, which follow the legend in figures presenting graphed data. These questions require the student to think about the information contained in the graph in even greater depth, increasing their understanding of, and facility with, the material.

Answers to both end of chapter questions and Inquiry Questions are found on the Online Learning Center at [www.mhhe.com/raven7](http://www.mhhe.com/raven7).

### Volumes

We recognize that instructors don't always use the entire text, so we now offer *Biology* in the following volumes:

**Volume 1 Chapters 1–20** Chemistry, Cell and Genetics

**Volume 2 Chapters 35–51** Plant Biology and Animal Biology

**Volume 3 Chapters 21–34, 52–57** Evolution, Diversity and Ecology

## Content Changes by Part

### Part I The Origin of Living Things

Part I was revised with the intention of creating a more solid foundation of key concepts in biology, which students can then build on in later chapters. Discussions are now clearer and better supported with illustrations.

### New Topics and Revised Treatments

- Chapter 1** Properties of life, hierarchical organization *Revised*; Additional topics in evolution *New*
- Chapter 2** The Nature of Molecules *Entire chapter revised*
- Chapter 3** Figures on chaperons and protein denaturing *New*; Protein folding, lipids *Revised*
- Chapter 4** Figures on endosymbiosis, Domains/ Kingdoms, phylogenetic tree of life *New*; Bacteria and archaeobacteria, microfossils *Revised*

## Part II Biology of the Cell

Randall Phillis assisted in the revision of Part II by directing the authors to concepts that needed additional detail, and by providing suggestions for improving the accuracy and parsimony of the narrative. Concepts that were covered too briefly in previous editions are now supported with more extensive discussion and new illustrations.

### New Topics and Revised Treatments

- Chapter 6** Membrane microdomains *New*; Osmosis; coupled transport *Revised*
- Chapter 7** Signal amplification, expression of cellular identification *Revised*
- Chapter 8** Redox reactions, ATP functioning *Revised*
- Chapter 9** ATP synthetase *New*; Electron transport; reducing power; chemiosmosis *Revised*
- Chapter 10** The Calvin cycle *Revised*
- Chapter 11** Cell cycle control *New*; Chromosome structure *Revised*

## Part III Genetic and Molecular Biology

With the help of Kenneth Mason, Part III was carefully updated to incorporate the most current research. Chapter 13, Patterns of Inheritance, was rewritten for better organization and clearer presentation. Two new chapters provide expanded discussion in fields where our knowledge has grown exponentially.

**Chapter 17, "Genomes"** integrates plant and animal genomics, functional genomics and proteomics in a chapter that is inquiry driven rather than a discussion of techniques.

**Chapter 20, "Cancer Biology and Cell Technology"** explores two areas where recent advances in cell and molecular biology have the potential of revolutionizing medicine. The first is cancer, where research into the molecular events leading to cancer is beginning to suggest effective therapies. The second is cell technology, including cloning, embryonic stem cells, and the exciting and controversial proposal of therapeutic cloning.

### New Topics and Revised Treatments

- Chapter 12** Meiotic prophase *Revised*
- Chapter 13** Patterns of inheritance *Entire chapter revised*
- Chapter 14** Eukaryotic DNA replication *Revised*
- Chapter 15** Eukaryotic transcription *New*
- Chapter 16** The tools of genetic engineering *New*
- Chapter 18** Small RNAs, iRNA, RNA editing *New*; Transcriptional control in prokaryotes *Revised*
- Chapter 19** Vertebrate embryonic axis formation, evolution of homeotic genes *New*; Cell movement; cell induction; embryonic determination; pattern formation *Revised*

## Part IV Evolution

The Evolution section has been revised to bring more experimental data and analysis into the discussions. Because presentation of the experimental data used to derive conclusions and concepts is key to understanding how the concepts arose from the research, you will see that graphs and charts have become more plentiful in these chapters. The evolution of many groups is reassessed in light of new molecular data.

**Chapter 24, "Evolution of Genomes and Developmental Mechanisms"** is a new comparative genomics chapter that addresses our emerging understanding of the evolution of development, and helps to provide a conceptual framework for the diversity chapters that follow. The chapter was developed in conjunction with Chapter 17, Genomes, to first provide students with an understanding of what we can learn about genomes, and then having learned about evolution, delve into a deeper discussion of how development has evolved to yield novel phenotypes.

### New Topics and Revised Treatments

- Chapter 21** Measuring fitness, components of fitness, role of selection in maintaining variation *New*; Hardy-Weinberg *Revised*
- Chapter 22** Darwin's finches, industrial melanism *New*; Evidence from developmental biology for evolution *Revised*
- Chapter 23** Plant speciation by chromosomal change, the future of evolution *New*

## Part V Diversity of Life on Earth

The fungi chapter has been moved to the phylogenetically appropriate place in the diversity section following plant diversity. Where appropriate, chapters in the diversity unit have been updated to reflect phylogenetic changes. The thoroughly revised and rewritten **Chapter 25, "Systematics and the Phylogenetic Revolution"** addresses the current tension between taxonomy and systematics. The chap-

ter can be used alone, to teach the basic concepts of diversity, or can be used as a starting place for a more in-depth study of this area of biology.

#### **New Topics and Revised Treatments**

- Chapter 25** Phylogenetics and classification *Entire chapter revised*
- Chapter 26** Virus genomes *New*; Viral diseases and HIV *Revised*
- Chapter 27** Term “eubacteria” replaced with “bacteria,” figures of cell structure and clades *New*
- Chapter 28** Phylogenetic approach *New*; Protist disease in South, Central and North America, relationships between algae and land plants *Revised*
- Chapter 29** Fossil evidence of ancient angiosperm Archaeofructacea, evolution of triploid endosperm *New*  
Monophyletic relationships between ferns and horsetails *Revised*
- Chapter 30** Fungi *Entire chapter revised*
- Chapter 31** Protostomes and deuterostomes *New and expanded*  
Classification *Revised*
- Chapter 32** Protostome phylogeny, rotifers and cyclophora *Revised*
- Chapter 33** Mollusks, annelids, arthropods, and echinoderms combined into one chapter *New*
- Chapter 34** Characteristics and phylogeny illustration, primate evolution *New*

#### **Part VI Plant Form and Function**

The plant biology chapters have been revised so that the traditional discussion of evolutionary influences on plant form and function are brought into a developmental context. Evolution is still presented as the underlying explanation for the character of vascular tissues, seeds, flowers, and fruits, however the developmental processes that produce these organs are now given more emphasis. Two previously combined topics, transport and nutrition, have been split into separate chapters allowing for more in-depth discussion of both topics.

**Chapter 39, “Plant Defense Responses”** is a new chapter that provides a thorough discussion of secondary compounds and their roles in both plant defense and human applications. Wound responses and R gene mediated responses are explored in depth with an emphasis on signaling pathways.

#### **New Topics and Revised Treatments**

- Chapter 35** Updated photographs, discussion of genetic regulation of trichomes *Revised*

- Chapter 36** Discussion of signal transduction in germination, comparison of roles of *Hox* genes in plant and animal development *Revised*
- Chapter 37** Water relations problems, mRNA transport in phloem *New*
- Chapter 38** Newly expanded chapter on plant nutrition. Effects of global change on photosynthesis and balance of plant nutrients, phytoremediation *New*  
Nutritional symbioses *Revised and expanded*
- Chapter 40** Signal transduction mediated by light including phot1 *New*  
Light responses *Revised*
- Chapter 41** Plant reproduction *Entire chapter revised and reorganized*

#### **Part VII Animal Form and Function**

With the assistance of Randy DiDomenico, many discussions were rewritten for better organization and clarity. Previous chapters on circulation and respiration were combined into one chapter, as were chapters on body organization and locomotion.

#### **New Topics and Revised Treatments**

- Chapter 42** Combined organization of the animal body and locomotion into one chapter, coordination of organ systems *New*
- Chapter 43** Neural, hormonal and accessory organ regulation *New*  
Small intestine discussion reorganized to group all functions together *Revised*
- Chapter 44** Maximizing rate of gas diffusion *New*  
Integration of circulation and respiration chapter *Revised*
- Chapter 45** Graded potentials *New*; Membrane and action potentials, synapses and drug addiction *Revised*
- Chapter 46** Sensory transduction *Revised*
- Chapter 47** The Endocrine System *Entire chapter revised*
- Chapter 48** Immunoglobulins, illustrated table *New*  
AIDS *Revised*
- Chapter 49** Discussion of ammonia, urea and uric acid reorganized, nephron *Revised*
- Chapter 50** Sex determination, reptiles and birds *Revised*  
Human intercourse *Omitted*
- Chapter 51** Combined discussion of chick and mammalian extraembryonic membranes, neurulation *Revised*

instructors can take complete control over their course content. These course cartridges also provide online testing and powerful student tracking features. The *Biology Online Learning Center* is available within all of these platforms.

## For the Student:

### Online Learning Center

[www.mhhe.com/raven7](http://www.mhhe.com/raven7)

The site includes quizzes for each chapter, interactive activities, and answers to questions from the text. Turn to the inside cover of the text to learn more about the exciting features provided for students through the enhanced *Biology Online Learning Center*.

### Student Study Guide

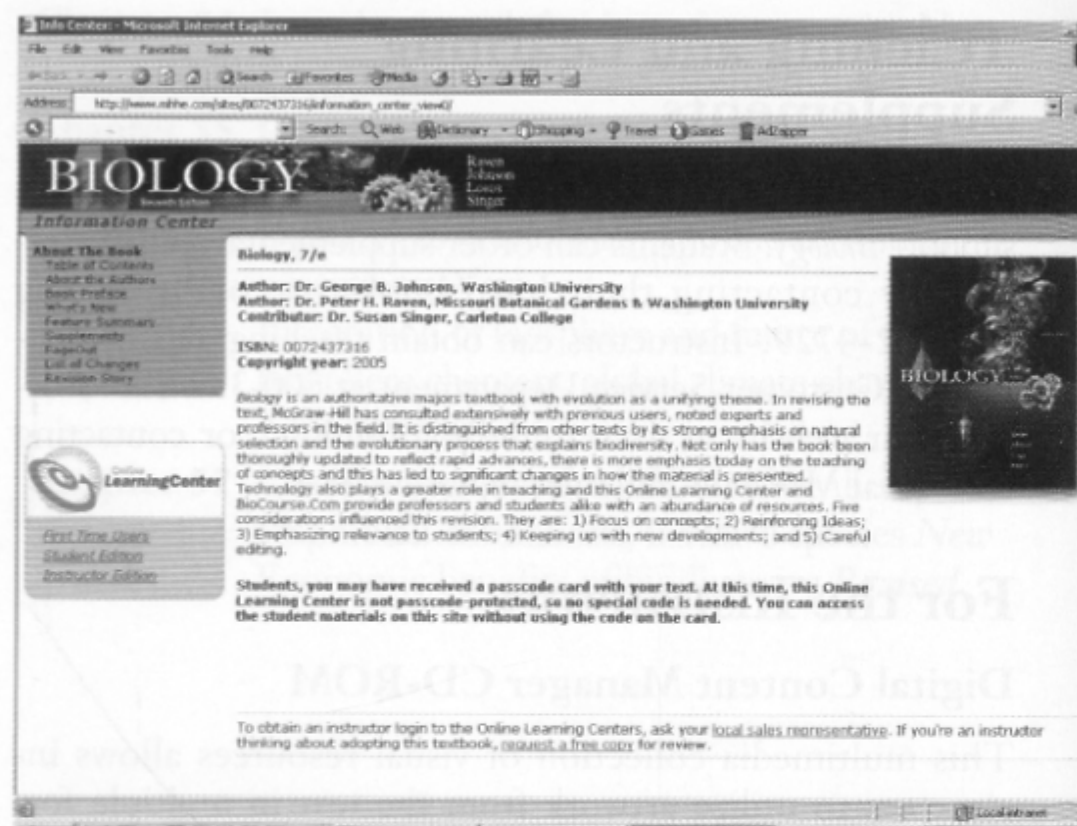
This student resource contains activities and questions to help reinforce chapter concepts. The guide provides students with tips and strategies for mastering the chapter content, concept outlines, concept maps, key terms and sample quizzes.

## Acknowledgements

Our goal for *Biology* has always been to present the science in an interesting and engaging way while maintaining a comprehensive and authoritative text. This is a lofty goal considering the mountain of information and research we must go through just to update the text from one edition to the next. This seventh edition would not have been possible without the contributions of many. We are indebted to our colleagues across the country and around the globe that provided numerous suggestions on how to improve on the sixth edition. We wish particularly to thank Kenneth Mason of Purdue University, Randy DiDomenico of the University of Colorado, Boulder, and Randall Phyllis of the University of Massachusetts, Amherst for very detailed advice on how to improve large sections of the text.

As any author knows, a textbook is made not only by an author team aided by their colleagues, but also by a publishing team, a group of people that guide the raw book written by the authors through a yearlong process of reviewing, editing, fine-tuning and production. This edition was particularly fortunate in its book team, led by Patrick Reidy, sponsoring editor; Anne Winch, developmental editor; Tami Petsche, marketing manager; Peggy Selle, project manager; Michelle Whitaker, designer; Megan Jackman and Elizabeth Sievers, off-site editors; Kennie Harris, copy editor, and many more people behind the scenes.

The illustrations are critically important to a biology text, and ours continue to be superbly conceived and rendered by Bill Ober and Claire Garrison.



As always, we have had the support of spouses and children, who have seen less of us than they might have liked because of the pressures of getting this revision completed. They have adapted to the many hours this book draws us away from them and, even more than us, look forward to its completion.

As with every edition, acknowledgements would not be complete without thanking the generations of students who have used the many editions of this text. They have taught us as least as much as we have taught them, and, thanks to e-mail, are an increasing part of our lives.

Finally, we need to thank our reviewers. Every text owes a great deal to those instructors across the country who review it. Serving as sensitive antennae for errors and omissions, and as sounding boards for new approaches, reviewers are among the most valuable tools at an author's disposal. Many improvements in this edition are the direct result of their suggestions. Every one of them has our heartfelt thanks.

### Reviewers of the Seventh Edition

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## General Biology Symposium

Each year McGraw-Hill holds a General Biology Symposium, which is attended by instructors from across the country. These events are an opportunity for editors from McGraw-Hill to gather information about the needs and challenges of instructors teaching the major's biology course, however it also offers professors a forum for exchanging ideas and experiences with colleagues they might not have otherwise met. The feedback we have received has been invaluable, and has contributed to the success of *Biology* and its supplements.

## 2003

Marc Ammerlaan *University of Michigan–Ann Arbor*  
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 Ellen Baker *Santa Monica College*  
 Stephen W. Banks *Louisiana State University–Shreveport*  
 Ruth Beattie *University of Kentucky*  
 Samuel N. Beshers *University of Illinois*  
 Christine Konicki Bieszczad *Saint Joseph College*  
 John Birdsell *University of Arizona*  
 Brenda C. Blackwelder *Central Piedmont Community College*

Sandra Bobrick *Community College of Allegheny County  
Allegheny Campus*  
 Randall Breitwisch *University of Dayton*  
 Mark Browning *Purdue University*  
 Roger Buckanan *Arkansas State University*  
 Theodore Burk *Creighton University*  
 John S. Campbell *Northwest College*  
 John R. Capeheart *University of Houston–Downtown*  
 Michael S. Capp *Carlow College*  
 Jeff Carmichael *University of North Dakota*  
 George P. Chamuris *Bloomsburg University*  
 Susan Cockayne *Brigham Young University*  
 William Cohen *University of Kentucky*  
 W. Wade Cooper *Shelton State Community College*  
 Lisa M. Coussens *University of California–San Francisco,  
Cancer Research Institute*  
 Wilson Crone *Hudson Valley Community College*  
 Paul V. Cupp Jr. *Eastern Kentucky University*  
 Richard Cyr *The Pennsylvania State University*  
 Grayson Davis *Trinity University*  
 Mark A. DeCrosta *University of Tampa*  
 David L. Denlinger *Ohio State University*  
 C. Lynn Dorn *Valencia Community College*  
 Charles D. Drewes *Iowa State University*  
 Sondra Dubowsky *Allen County Community College*  
 Peter I. Ekechukwu *Horry-Georgetown Technical College*  
 Dennis Emery *Iowa State University*  
 Frederick B. Essig *University of South Florida*  
 Bruce Evans *Huntington College*  
 Deborah Fahey *Wheaton College*  
 Linda E. Fisher *University of Michigan–Dearborn*  
 Rob Fitch *Wenatchee Valley College*  
 Robert Fogel *University of Michigan*  
 James Franzen *University of Pittsburgh–Pittsburgh Campus*  
 William Friedman *University of Colorado*  
 Lawrence Fritz *Northern Arizona University*  
 Bernard Frye *University of Texas at Arlington*  
 Robert J. Full *University of California–Berkeley*  
 Warren Gallin *University of Alberta*  
 Darrell Galloway *The Ohio State University*  
 Ted Gish *St. Mary's College*  
 Donald Glassman *Des Moines Area Community College*  
 Jim Glenn *Red Deer College*  
 Jim R. Goetze *Laredo Community College*  
 Jack M. Goldberg *University of California–Davis*  
 Elizabeth Godrick *Boston University*  
 Dalton Gossett *Louisiana State University–Shreveport*  
 John Griffis *Joliet Junior College*  
 Kathryn Gronlund *New Mexico State University–Carlsbad*  
 Elizabeth L. Gross *The Ohio State University*  
 Patricia A. Grove *College of Mount St. Vincent*  
 Randolph Hampton *University of California–San Diego*  
 Sehoya E. Harris *The Pennsylvania State University*  
 Carla Ann Hass *The Pennsylvania State University*  
 Chris Haynes *Shelton State Community College*  
 Albert A. Herrera *University of Southern California*  
 Pamela Higgins *Allentown College of St. Francis DeSales*  
 Richard Hill *Michigan State University*  
 Phyllis Hirsch *East Los Angeles College*  
 Victoria Hittinger *Rhode Island College*  
 Nan Ho *Las Positas College*

Leland N. Holland, Jr. *Pasco-Hernando Community College-West Campus*  
 Elisabeth A. Hooper *Truman State University*  
 Terry L. Hufford *The George Washington University*  
 Allen Hunt *Elizabethtown Community College*  
 Sobrasua E. M. Ibin *Morris Brown College*  
 Louis Irwin *University of Texas at El Paso*  
 Laurie E. Iten *Purdue University*  
 Jeffrey Jack *College of Arts & Sciences*  
 James B. Jensen *Brigham Young University*  
 Judy Jernstedt *University of California - Davis*  
 George P. Johnson *Arkansas Tech University*  
 Kenneth V. Kardong *Washington State University*  
 Cheryl Kerfeld *University of California-Los Angeles*  
 Joanne M. Kilpatrick *Auburn University at Montgomery*  
 Peter King *Francis Marion University*  
 Edward C. Kisailus *Canisius College*  
 Robert M. Kitchin *University of Wyoming*  
 Will Kleinelp *Middlesex County College*  
 Kenton Ko *Queen's University*  
 Ross E. Koning *Eastern Connecticut State University*  
 Karen L. Koster *University of South Dakota*  
 V.A. Langman *Louisiana State University-Shreveport*  
 Simon Lawrance *Otterbein College*  
 Jeffrey N. Lee *Essex County College*  
 Laura G. Leff *Kent State University*  
 Mary E. Lehman *Longwood College*  
 Niles Lehman *University at Albany SUNY*  
 Michael Lema *Midlands Technical College*  
 Charles Kingsley Levy *Boston University*  
 Leslie Lichtenstein *Massasoit Community College*  
 Harvey Liftin *Broward Community College*  
 Richard Londraville *University of Akron*  
 Sonja L. Maki *Clemson University*  
 Bradford D. Martin *La Sierra University*  
 Barbara Maynard *Colorado State University*  
 Deanna McCullough *University of Houston Downtown*  
 L. R. McEdward *University of Florida*  
 Michael Ray Meighan *University of California-Berkeley*  
 John Merrill *Michigan State University*  
 Harry A. Meyer *McNeese State University*  
 Dennis J. Minchella *Purdue University*  
 Jonathan D. Monroe *James Madison University*  
 David L. Moore *Utica College of Syracuse University*  
 Tony E. Morris *Fairmont State College*  
 Roger N. Morrisette *Framingham State College*  
 Richard Mortensen *Albion College*  
 William H. Nelson *Morgan State University*  
 Peter H. Niewiarowski *University of Akron*  
 Colleen J. Nolan *St. Mary's University*  
 John C. Osterman *University of Nebraska-Lincoln*  
 Thomas G. Owens *Cornell University*  
 Bruce Parker *Utah Valley State University*  
 Dustin Penn *University of Utah*  
 Stacia Pieffer-Schneider *Marquette University*  
 Carl S. Pike *Franklin and Marshall College*  
 Nancy A. Perigo *Willamette University*  
 Greg Phillips *Blinn College-Brenham Campus*  
 Jon Pigage *University of Colorado at Colorado Springs*  
 Barbara Pleasants *Iowa State University*  
 John Pleasants *Iowa State University*

Peggy Pollack *Northern Arizona University*  
 Mitch Price *The Pennsylvania State University*  
 Margene Ranieri *Bob Jones University*  
 Arthur Raske *Northland Baptist Bible College*  
 Keith Redetzke *University of Texas at El Paso*  
 Peter J. Rizzo *Texas A&M University*  
 Ellison Robinson *Midlands Technical College*  
 Lyndell P. Robinson *Lincoln Land Community College*  
 Angel M. Rodriguez *Broward Community College*  
 June R. P. Ross *Western Washington University*  
 Patricia Rugaber *Coastal Georgia Community College*  
 Connie Rye *Bevill State Community College*  
 Nancy K. Sanders *Truman State University*  
 Robert B. Sanders *University of Kansas-Main Campus*  
 Lisa M. Sardinia *Pacific University*  
 Brian W. Schwartz *Columbus State University*  
 Bruce S. Serlin *DePauw University*  
 Mark A. Sheridan *North Dakota State University*  
 Janet Anne Sherman *Penn College of Technology*  
 Louis Sherman *Purdue University*  
 Jim Shinkle *Trinity University*  
 Richard Shippee *Vincennes University*  
 Brian Shmaefsky *Kingwood College*  
 Michele Shuster *University of Pittsburgh*  
 Robert C. Sizemore *Alcorn State University*  
 Mark Smith *Victor Valley College*  
 Nancy Solomon *Miami University*  
 Norm Stacey *University of Alberta*  
 Ruth Stutts-Moseley *Bishop State Community College*  
 Kathy Sympton *Florida Keys Community College*  
 Stan Szarek *Arizona State University*  
 Robert H. Tamarin *University of Massachusetts Lowell*  
 Michael Tenneson *Evangel University*  
 Sharon Thoma *Edgewood College*  
 Joanne Kivela Tillotson *Purchase College State University of New York*  
 Maurice Thomas *Palm Beach Atlantic College*  
 Thomas Tomasi *Southwest Missouri State University*  
 Leslie Towill *Arizona State University*  
 Akif Uzman *University of Houston-Downtown*  
 Thomas J. Volk *University of Wisconsin-La Crosse*  
 Keith D. Waddington *University of Miami*  
 D. Alexander Wait *Southwest Missouri State University*  
 Timothy S. Wakefield *Auburn University*  
 Charles Walcott *Cornell University*  
 Eileen Walsh *Westchester Community College*  
 Frederick Wasserman *Boston University*  
 Steven A. Wasserman *University of California-San Diego*  
 Robert F. Weaver *University of Kansas*  
 Andrew N. Webber *Arizona State University*  
 Harold J. Webster *Penn State DuBois*  
 Mark Wheelis *University of California-Davis*  
 Lynn D. Wike *University of South Carolina at Aiken*  
 William Williams *Saint Mary's College of Maryland*  
 Mary L. Wilson *Gordon College*  
 Kevin Winterling *Emory & Henry College*  
 E. William Wischusen *Louisiana State University and Agricultural and Mechanical College*  
 Kenneth Wunch *Tulane University*  
 Mark L. Wygoda *McNeese State University*  
 Roger Young *Drury College*