preface

Everywhere you look in this edition you will see a new Raven & Johnson's *Biology*. From the new author team, to the new design and art program and the completely revised content, *Biology* has undergone a transformation. This "new" text maintains the clear, accessible, and engaging writing style of past editions and the pervasive emphasis on evolution and scientific inquiry that have made this a leading textbook for students majoring in biology. Now we have coupled this approach to a modern integration of the exciting new research in molecular biology and genomics to offer our readers the most significant and important revision of our text since the first edition.

Our New Author Team

Perhaps the greatest change to this edition is the change in authoring responsibilities. Two of us, Jonathan Losos (Harvard University) and Susan Singer (Carleton College), became new co-authors in the seventh edition, and now we've taken on full authoring responsibilities for the eighth edition as we welcome Kenneth Mason of Purdue University to our team. Ken served as a key contributor in the genetics unit for the seventh edition. The quality of the work he provided, his expertise in genetics, and his experience in teaching majors in biology at the university level made him a natural choice to join our new author team.

We're excited about the opportunity to take what was already a high-quality textbook and move it forward in a significant way for a new generation of students. All of us have extensive experience teaching undergraduate biology and we've used this knowledge as a guide in producing a text that is up-to-date, beautifully illustrated, and pedagogically sound for the student. We've also worked to make it even easier to use and more closely integrated with its media support materials to provide instructors with an excellent complement to their teaching.

Our New Visual Program

Even a casual look through the pages of the eighth edition will show the care that went into developing the art and photo program and the related page design. A brand new visual program is rare in a revision, and our team found the opportunity to reevaluate the effectiveness of the artwork and photos to be an exciting challenge. Our goal has been to provide a clear, consistent, accurate art program that is easy-to-follow and beautifully three-dimensional.

To prepare for the revision, a variety of specialists reviewed the seventh edition art and photo program to assess its instructional effectiveness and presentational value. We worked closely with the artists and medical illustrators to produce sketches that effectively convey the chapter's most important concepts or that provide students with a particularly thought-provoking or dynamic example. A separate panel of reviewers then evaluated each newly rendered figure for pedagogical value and accuracy.

Our text-paging team then worked in conjunction with the artists to create innovative page spreads where the visuals and textual content function together in a well-coordinated and closely integrated manner. For complex processes, figures use numbered text boxes to lead the student step-by-step through the figure. For others, where the whole is more important than the pieces, the figure is not interrupted by text but explained thoroughly in the legend. Multilevel figures take students from a macro to micro view using "blow-out" arrows. Where figures can be put "inline" within the text this has been done to intimately connect the art with the text narrative and to allow the artwork to visually enliven the page.

Our Modern Content and Approach

One goal that unites our author team is the attempt to bring students an exciting and up-to-date view of modern biology. The extensive nature of this revision has produced exceptionally current content throughout. Likewise, rather than pasting paragraphs of new material into selected chapters, we have carefully worked together to reconsider our text's outline and coverage to provide a more consistent approach to concepts so that the reader is not buried in detail in one chapter and left wondering how something works in another.

Two new chapters in the evolution unit perfectly illustrate the importance of this goal. Chapter 24: *Genome Evolution* describes comparative genomics and explains how exciting new discoveries resulting from the genome sequencing of so many different species is revolutionizing our understanding of evolution. Chapter 25: *Evolution of Development* follows with a discussion of how changes in genes can produce changes in development patterns, which result in new characteristics and sometimes in speciation.

We've expanded our coverage of patterns of inheritance into chapter 12 on heredity and Mendelian principles and chapter 13 on chromosomal theory of inheritance. We've created a new chapter 23: *Systematics and the Phylogenetic Revolution* and we now provide chapter 26: *The Tree of Life* to offer a broad overview as a way of introduction to the unit.

Another individual example of the current content is the coverage of the newly discovered fossil that is transitional between fish and amphibians, *Tiktaalik*, which was announced in mid-2006 (see figure 35.14b). Similarly, our discussion of the

state of the environment is based on up-to-the-moment data on population trends, global temperatures, and CO_2 levels.

The physiology unit has been reorganized and includes a new introductory chapter 43: *The Animal Body and Principles of Regulation.* This is designed to introduce the tissues and organ systems covered in later chapters and provide an understanding of control systems and their associated feedback mechanisms.

Our Consistent Themes

It is important to have consistent themes that organize and unify a text. We met extensively to discuss our approaches to teaching biology and to design the most effective text possible. A number of themes are used throughout the book to unify the broad-ranging material that makes up modern biology. This begins with the primary goal of this textbook to provide a comprehensive understanding of evolutionary theory and the scientific basis for this view. We use an experimental framework combining both historical and contemporary research examples to help students appreciate the progressive and integrated nature of science.

Biology Is Based Upon an Understanding of Evolution

When Peter Raven and George Johnson began work on *Biology* in 1982 they set out to write a text that presented biology the way they taught in their classrooms: as the product of evolution. Much as all biology "only makes sense in the light of evolution," this text is enhanced by a consistent evolutionary theme that is woven throughout the text, and we have enhanced this theme in the eighth edition.

The enhanced evolutionary thread can be found in obvious examples such as the two new chapters on molecular evolution, but can also be found throughout the text. As each section considers the current state of knowledge, the "what" of biological phenomenon, they also consider how each system may have arisen by evolution, the "where it came from" of biological phenomenon.

Our approach allows evolution to be dealt with in the context in which it is relevant. The material throughout this book is considered not only in terms of present structure and function, but how that structure and function may have arisen via evolution by natural selection.

Biology Uses the Methods of Scientific Inquiry

Another unifying theme within the text is that knowledge arises from experimental work that moves us progressively forward. The use of historical and experimental approaches throughout allow the student to not only see where the field is now, but more importantly, how we arrived here. The incredible expansion of knowledge in biology has created challenges for authors to decide what content to keep, and to what level an introductory text should strive. We have tried to keep as much historical context as possible and to provide this within an experimental framework consistently throughout the text.

Rather than interrupting the text with an experimental box, we describe experiments in the context of the concepts being provided. This keeps experimental approaches relevant to the story being told. Data are provided throughout the text and figures to illustrate how we have arrived at our present view of the various topics that make up the different sections of the book. Students are also provided with "Inquiry Questions" to stimulate thought about the material throughout the book. The questions often involve data that are presented in figures, but are not limited to this approach, also leading the student to question the material in the text as well.

Biology Is an Integrative Science

The explosion of molecular information has reverberated throughout all areas of biological study. Scientists are increasingly able to describe complicated processes in terms of the interaction of specific molecules, and this knowledge of life at the molecular level has illuminated relationships that were previously unknown. Using this cutting-edge information, we have made great strides to more strongly connect the different areas of biology in this edition.

One example of this integration concerns the structure and function of biological molecules, an emphasis of modern biology. This revision brings that focus to the entire book using this as a theme to weave together the different aspects of content material with a modern perspective. Given the enormous amount of information that has accumulated in recent years, this provides a necessary thread that integrates these new perspectives into the fabric of the traditional biology text.

Likewise, all current biology texts have added a genomics chapter, and our text was one of the first to do this. This chapter has been updated, but, more importantly, the results from the analysis of genomes and the proteomes that they encode have been added throughout the book wherever this information is relevant. This allows a more modern perspective throughout the book rather than limiting it to a few chapters. Examples, for instance, can be found in the diversity chapters, where classification of some organisms were updated based on new findings revealed by molecular techniques.

This systems approach to biology also shows up at the level of chapter organization. We introduce genomes in the genetics section in the context of learning about DNA and genomics. We then come back to this topic with an entire chapter at the end of the evolution unit where we look at the evolution of genomes, followed by a chapter on the evolution of development, which leads into our unit on the diversity of organisms.

Similarly, we introduce the topic of development with a chapter in the genetics section, return to it in the evolution unit, and have dedicated chapters in both the plant and animal units. This layering of concepts is important as we believe that students best understand evolution, development, physiology, and ecology when they can reflect on the connections between the microscopic and macroscopic levels of organization.

Our Enhanced Readability and Learning System

Biology has always been considered a user-friendly text, but the sheer volume of information in a major's biology text demands that authors do everything possible to make the content clear

and well-organized to aid the student. In this eighth edition we have taken steps to help our readers through careful scrutiny of the narrative and thorough redesign of our pedagogical learning system.

Telling the Story of Biology

We had the benefit of an excellent developmental copyeditor who worked with us on each revised chapter prior to turning the manuscript over to production. The copyeditor focused on improving the use of headings to organize the content, improving the clarity of the writing, making the writing consistent between chapters, consistently identifying and defining the key terms, and eliminating redundant material within and among chapters. This process removed the clutter that can accumulate over several editions and ensured that each chapter reads smoothly from start to finish.

Providing a Learning System

Part of what makes *Biology* such an easy book to learn from is its consistent pedagogical framework, and we have strengthened this learning system in the eighth edition. Each chapter opens with an outline consisting of the numbered headings and the supporting headings. Throughout the chapter the interior design works with the content to remind the students of where they are in the chapter.

Each concept within a chapter is clearly demarcated at beginning and end. The declarative main headings and sentence-style supporting headings provide an excellent overview of each concept to be covered. Short interim summaries following each main concept within the narrative remind students of the most critical information they need to take away from that reading.

Extensive figure legends in conjunction with the new visual program provide a "visual outline" of all major ideas in every chapter. Great care was taken during the paging process to ensure that with few exceptions figures are displayed on the same pages where the narrative detail supporting those figures is provided.

We've also created an extensive set of summary tables throughout the text to make study and review as easy and efficient as possible. Content reviews at the end of the chapter recapitulate important content within the same conceptual framework provided in the opening outline. We've also developed new Challenge Questions to promote active learning and higher level critical thinking.

Our Commitment to You

We are united in our excitement about this opportunity to take a textbook that was already accurate and innovative and move it forward in a meaningful way. We believe our research and teaching experience provides us with the tools to couple the most significant modern research findings and scientific approach to an engaging pedagogical presentation.

In working with reviewers, contributors, focus group participants, students, and our colleagues around the globe, we have been impressed with the level of energy, thoughtfulness, and dedication faculty and students bring to the study of biology. It is a privilege to serve you through the pages of this textbook and its media support program.

Please let us know how we can serve you better by writing us at ravenbiology@mcgraw-hill.com. Best wishes to you in your own classroom. We look forward to hearing from you.

Jonathan Losos
Ken Mason
Susan Singer

ACKNOWLEDGMENTS

A revision of this scope relies on the talents and efforts of many people working behind the scenes and we have benefited greatly from their assistance.

Jody Larson was our developmental copyeditor who labored many hours and provided countless suggestions for improving the organization and clarity of the text. Her contributions had a tremendous impact on the quality of the final product.

We were fortunate to have Electronic Publishing Services on our side for the overhaul of the *Biology* art program. Kim Moss, Jen Christiansen, Martin Huber, Eliza Jewett, Patty O'Connell, and the rest of the team did a fantastic job in developing art and photo concepts and page spreads based on our manuscript and the ideas exchanged in our development meetings. Our close collaboration resulted in a text that is pedagogically effective as well as more beautiful than any biology text on the market. This was a giant undertaking and the staff at EPS handled it all with professionalism, skill, and good humor.

We were fortunate in our McGraw-Hill book team led by Patrick Reidy, executive editor, Anne Winch, senior developmental editor, Chad Grall, marketing director for life sciences, Peggy Selle, lead project manager, Michelle Whitaker, senior freelance design coordinator, Linda Davoli, production copyeditor, and many more people behind the scenes.

During this revision 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, acknowledgments 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 their questions and suggestions continue to improve the text and supplementary materials.

Finally, we need to thank our reviewers and contributors. Instructors from across the country are continually invited to share their knowledge and experience with us through reviews and focus groups. The feedback we received shaped this edition, resulting in new chapters, reorganization of the table of contents, and expanded coverage in key areas. Several faculty members were asked to provide preliminary drafts of chapters to ensure that the content was as up to date and accurate as possible, and still others were asked to provide chapter outlines and assessment questions. All of these people took time out of their already busy lives to help us build a better edition of *Biology* for the next generation of introductory biology students, and they have our heartfelt thanks.

Preliminary Draft Revision Contributors

Brian Bagatto
University of Akron
Nancy Maroushek Boury
Iowa State University
Julia Emerson
Amherst College
T. H. Frazzetta
University of Illinois, Urbana-Champaign
Douglas Gaffin
University of Oklahoma
Gonzalo Giribet
Harvard University
Richard Hill
Michigan State University
Duncan S. MacKenzie
Texas A&M University
Elizabeth A. Weiss
University of Texas, Austin

End-of-Chapter Pedagogy and Inquiry Contributors

Arthur Buikema
Virginia Polytechnic Institute
Merri Lynn Casem
California State University-Fullerton
Mark Lyford
University of Wyoming
Peter Niewiarowski
University of Akron
Thomas Pitzer
Florida International University
Laurel Roberts
University of Pittsburgh
Michael Windelspecht
Appalachian State University

Reviewers and Accuracy Checkers

Barbara J. Abraham
Hampton University
Richard Adler
University of Michigan, Dearborn
Sylvester Allred
Northern Arizona University
Steven M. Aquilani
Delaware County Community College
Jonathan W. Armbruster
Auburn University
Gregory A. Armstrong
The Ohio State University
Jorge E. Arriagada
St. Cloud State University
David K. Asch
Youngstown State University
Brian Bagatto
University of Akron
Garen Baghdasarian
Santa Monica College
Anita Davelos Baines
The University of Texas, Pan American
Ronald A. Balsamo Jr.
Villanova University
Michael Bartlett
Portland State University
Vernon W. Bauer
Francis Marion University
James E. Baxter
Ohlone College
George W. Benz
Middle Tennessee State University
Gerald K. Bergtrom
University of Wisconsin, Milwaukee
Arlene G. Billock
University of Louisiana, Lafayette
Catherine S. Black
Idaho State University
Michael W. Black
California Polytechnic State University
Robert O. Blanchard
University of New Hampshire

Andrew R. Blaustein
Oregon State University
Mary A. Bober
Santa Monica College
Nancy Maroushek Boury
Iowa State University
M. Deane Bowers
University of Colorado
Scott A. Bowling
Auburn University
Benita A. Brink
Adams State College
Anne Bullerjahn
Owens Community College
Ray D. Burkett
Southwest Tennessee Community College
Helaine Burstein
Ohio University
Scott Burt
Truman State University
Carol T. Burton
Bellevue Community College
Jennifer Carr Burtwistle
Northeast Community College
Jorge Busciglio
University of California, Irvine
Pat Calie
Eastern Kentucky University
Christy A. Carello
The Metropolitan State College of Denver
Michael Carey
University of Scranton
Jeff Carmichael
University of North Dakota
Michael J. Carlisle
Trinity Valley Community College
John H. Caruso
University of New Orleans
Thomas T. Chen
University of Connecticut
Cynthia Church
The Metropolitan State College of Denver
Linda T. Collins
University of Tennessee, Chattanooga
Scott T. Cooper
University of Wisconsin, La Crosse
Joe R. Cowles
Virginia Tech
Nigel M. Crawford
University of California, San Diego
James Crowder
Brookdale Community College
Karen A. Curto
University of Pittsburgh
Bela Dadhich
Delaware County Community College
Lydia B. Daniels
University of Pittsburgh
Terry Davin
Penn Valley Community College
Joseph S. Davis
University of Florida
Neta Dean
Stony Brook University
Kevin W. Dees
Wharton County Junior College
D. Michael Denbow
Virginia Tech
Donald Deters
Bowling Green State University
Hudson DeYoe
University of Texas, Pan American
Randy DiDomenico
University of Colorado
Nd Dikeocha
College of the Mainland
Robert S. Dill
Bergen Community College
Diane M. Dixon
Southeastern Oklahoma State University
Kevin Dixon
University of Illinois
John S. Doctor
Duquesne University
Ernest F. DuBrul
University of Toledo
Charles Duggins Jr.
University of South Carolina
Richard P. Elinson
Duquesne University
Johnny El-Rady
University of South Florida
Frederick B. Essig
University of South Florida
David H. Evans
University of Florida
Guy E. Farish
Adams State College
Daphne G. Fautin
University of Kansas
Bruce E. Felgenhauer
University of Louisiana, Lafayette
Carolyn J. Ferguson
Kansas State University
Teresa G. Fischer
Indian River Community College
Irwin Forseth
University of Maryland
Gail Fraizer
Kent State University
Barbara A. Frase
Bradley University
Sylvia Fromherz
University of Northern Colorado
Phillip E. Funk
DePaul University
Caitlin R. Gabor
Texas State University, San Marcos
Purti P. Gadkari
Wharton County Junior College
John R. Geiser
Western Michigan University
Frank S. Gilliam
Marshall University
Miriam S. Golbert
College of the Canyons
Scott A. Gordon
University of Southern Indiana
John S. Graham
Bowling Green State University
David A. Gray
California State University, Northridge
William F. Hanna
Massasoit Community College
Kyle E. Harms
Louisiana State University
Kerry D. Heafner
University of Louisiana, Monroe
Susan E. Hengeveld
Indiana University
Charles Henry
University of Connecticut, Storrs
Peter Heywood
Brown University
Juliana G. Hinton
McNeese State University
Margaret L. Horton
University of North Carolina, Greensboro
James Horwitz
Palm Beach Community College
Laura A. Houston
Montgomery College
Feng Sheng Hu
University of Illinois
Allen N. Hunt
Elizabethtown Community and Technical College
David C. Jarrell
University of Mary Washington
Jennifer L. Jeffery
Wharton County Junior College
William Jeffery
University of Maryland, College Park
Lee Johnson
The Ohio State University
Craig T. Jordan
The University of Texas, San Antonio
Ronald L. Jones
Eastern Kentucky University
Robyn Jordan
University of Louisiana, Monroe
Walter S. Judd
University of Florida
David Julian
University of Florida
Daniel Kainer
Montgomery College
Ronald C. Kaltreider
York College of Pennsylvania
Thomas C. Kane
University of Cincinnati
Donald A. Kangas
Truman State University
William J. Katembe
Delta State University
Steven J. Kaye
Red Rocks Community College
Stephen R. Kelso
University of Illinois, Chicago
Nancy S. Kirkpatrick
Lake Superior State University

John Z. Kiss
Miami University
John C. Krenetsky
The Metropolitan State College of Denver
Karin E. Krieger
University of Wisconsin, Green Bay
David T. Kurjiaka
University of Arizona
Arlene T. Larson
University of Colorado, Denver
Peter Lavrentyev
University of Akron
Laura G. Leff
Kent State University
Michael R. Lentz
University of North Florida
Harvey Liftin
Broward Community College
Yue J. Lin
St. John's University
Amy Litt
New York Botanical Garden
Christopher R. Little
The University of Texas, Pan American
James Long
Boise State University
James O. Luken
Coastal Carolina University
Dennis J. Lye
Northern Kentucky University
P. T. Magee
University of Minnesota, Minneapolis
Richard Malkin
University of California, Berkeley
Mark D. Mamrack
Wright State University
Kathleen A. Marrs
Indiana University Purdue University, Indianapolis
Diane L. Marshall
University of New Mexico
Paul B. Martin
St. Philip's College
Peter J. Martinat
Xavier University, Los Angeles
Joel Maruniak
University of Missouri
Patricia Matthews
Grand Valley State University
Robin G. Maxwell
The University of North Carolina, Greensboro
Brenda S. McAdory
Tennessee State University
Nael A. McCarty
Georgia Institute of Technology
Brock R. McMillan
Minnesota State University, Mankato
Kay McMurry
The University of Texas, Austin
Elizabeth McPartlan
De Anza College
Brad Mehrtens
University of Illinois, Urbana-Champaign
Michael Meighan
University of California, Berkeley
Douglas Meikle
Miami University
Allen F. Mensinger
University of Minnesota, Duluth
Wayne B. Merkley
Drake University
Catherine E. Merovich
West Virginia University
Frank J. Messina
Utah State University
Brian T. Miller
Middle Tennessee State University
Sarah L. Milton
Florida Atlantic University
Subhash Minocha
University of New Hampshire
Hector C. Miranda Jr.
Texas Southern University
Patricia Mire
University of Louisiana, Lafayette
Robert W. Morris
Widener University
Satyanarayana Swamy Mruthinti
State University of West Georgia
Richard L. Myers
Southwest Missouri State University
Monica Marquez Nelson
Joliet Junior College
Jacalyn S. Newman
University of Pittsburgh
Harry Nickla
Creighton University
Richard A. Niesenbaum
Muhlenberg College
Kris M. Norenberg
Xavier University, Louisiana
Deborah A. O'Dell
University of Mary Washington
Sharman D. O'Neill
University of California, Davis
Cynthia P. Paul
University of Michigan, Dearborn
John S. Peters
College of Charleston
Jay Phelan
University of California, Los Angeles
Gregory W. Phillips
Blinn College
Thomas R. Pitzer
Florida International University
Gregory J. Podgorski
Utah State University
Alan Prather
Michigan State University
Mitch Price
The Pennsylvania State University
Carl Quertermus
State University of West Georgia
Shana Rapoport
California State University, Northridge
Kim Raun
Wharton County Junior College
Robert S. Rawding
Gannon University
Jill D. Reid
Virginia Commonwealth University
Linda R. Richardson
Blinn College
Robin K. Richardson
Winona State University
Carolyn Roberson
Roane State Community College
Kenneth R. Robinson
Purdue University
Kenneth H. Roux
Florida State University
Charles L. Rutherford
Virginia Tech University
Margaret Saha
College of William and Mary
Thomas Sasek
University of Louisiana, Monroe
Bruce M. Saul
Augusta State University
Deemah N. Schirf
The University of Texas, San Antonio
Christopher J. Schneider
Boston University
Timothy E. Shannon
Francis Marion University
Rebecca Sheller
Southwestern University
Mark A. Sheridan
North Dakota State University
Richard Showman
University of South Carolina
Michéle Shuster
New Mexico State University
William Simcik
Tomball College, a North Harris Community College
Rebecca B. Simmons
University of North Dakota
Phillip Snider Jr.
Gadsden State Community College
Thomas E. Snowden
Florida Memorial College
Dianne Snyder
Augusta State University
Farah Sogo
Orange Coast College
Nancy G. Solomon
Miami University
Kathryn H. Sorensen
American River College
Kevin N. Sorensen
Snow College
Bruce Stallsmith
University of Alabama, Huntsville
Patricia Steinke
San Jacinto College
Jacqueline J. Stevens
Jackson State University
John W. Stiller
East Carolina University

Antony Stretton
University of Wisconsin, Madison
Brett W. Strong
Palm Beach Community College
Gregory W. Stunz
Texas A&M University, Corpus Christi
Cynthia A. Surmacz
Bloomsburg University
Yves S. H. Tan
Cabrillo College
Sharon Thoma
University of Wisconsin, Madison
Anne M. S. Tokazewski
Burlington County College
Marty Tracey
Florida International University
Terry M. Trier
Grand Valley State University
Marsha R. Turell
Houston Community College
Linda Tyson
Santa Fe Community College
Rani Vajravelu
University of Central Florida
Jim Van Brunt
Rogue Community College
Judith B. Varelas
University of Northern Colorado
Neal J. Voelz
St. Cloud State University
Janice Voltzow
University of Scranton
Jyoti R. Wagle
Houston Community College System, Central
Charles Walcott
Cornell University
Randall Walikonis
University of Connecticut
Eileen Walsh
Westchester Community College
Steven A. Wasserman
University of California, San Diego
R. Douglas Watson
University of Alabama, Birmingham
Cindy Martinez Wedig
University of Texas, Pan American
Richard Weinstein
Southern New Hampshire University
Elizabeth A. Weiss
University of Texas, Austin
William R. Wellnitz
Augusta State University
Jonathan F. Wendel
Iowa State University
Sue Simon Westendorf
Ohio University
Vernon Lee Wiersema
Houston Community College, Southwest
Judy Williams
Southeastern Oklahoma State University
Lawrence R. Williams
University of Houston
Robert Winning
Eastern Michigan University
C. B. Wolfe
The University of North Carolina, Charlotte
Clarence C. Wolfe
Northern Virginia Community College
Eric Vivien Wong
University of Louisville
Gene K. Wong
Quinnipiac University
Denise Woodward
The Pennsylvania State University
Richard P. Wunderlin
University of South Florida
Douglas A. Wymer
The University of West Alabama
Lan Xu
South Dakota State University
H. Randall Yoder
Lamar University
Kathryn G. Zeiler
Red Rocks Community College
Scott D. Zimmerman
Missouri State University
Henry G. Zot
University of West Georgia

International Reviewers

Mari L. Acevedo
University of Puerto Rico, Arecibo
Heather Addy
University of Calgary
Heather E. Allison
University of Liverpool
David Backhouse
University of New England
Andrew Bendall
University of Guelph
Tony Bradshaw
Oxford Brookes University
D. Bruce Campbell
Okanagan College
Clara E. Carrasco
University of Puerto Rico, Ponce
Ian Cock
Griffith University
Margaret Cooley
University of New South Wales
R. S. Currah
University of Alberta
Logan Donaldson
York University
Theo Elzenga
University of Groningen
Neil Haave
University of Alberta, Augustana
Louise M. Hafner
QUT
Clare Hasenkampf
University of Toronto, Scarborough
Annika F. M. Haywood
Memorial University of Newfoundland
Rong-Nan Huang
National Central University
William Huddleston
University of Calgary
Wendy J. Keenleyside
University of Guelph
Chris Kennedy
Simon Fraser University
Alex Law
Nanyang Technical University, Singapore
Richard C. Leegood
University of Sheffield
R. W. Longair
University of Calgary
Thomas H. MacRae
Dalhousie University
Rolf W. Matthewes
Simon Fraser University
R. Ian Menz
Flinders University
Todd C. Nickle
Mount Royal College
Kirsten Poling
University of Windsor
Jim Provan
Queen's University Belfast
Roberto Quinlan
York University
Elsa I. Colón Reyes
University of Puerto Rico, Aguadilla Campus
Richard Roy
McGill University
Liliane Schoofs
Katholicke Universiteit Leuren
Joan Sharp
Simon Fraser University
Julie Smit
University of Windsor
Nguan Soon Tan
Nanyang Technological University
Fleur Tiver
University of South Australia
Llinil Torres-Ojeda
University of Puerto Rico, Aguadilla Campus
Han A. B. Wösten
University of Utrecht
H. H. Yeoh
National University of Singapore

Art Review Panel

David K. Asch
Youngstown State University
Karl J. Aufderheide
Texas A&M University
Brian Bagatto
University of Akron
Andrew R. Blaustein
Oregon State University
Mark Browning
Purdue University
Jeff Carmichael
University of North Dakota
Wes Colgan III
Pikes Peak Community College
Karen A. Curto
University of Pittsburgh
Donald Deters
Bowling Green State University
Ernest F. DuBrul
University of Toledo
Ralph P. Eckerlin
Northern Virginia Community College
Frederick B. Essig
University of South Florida
Sharon Eversman
Montana State University, Bozeman
Barbara A. Frase
Bradley University
John R. Geiser
Western Michigan University
John Graham
Bowling Green State University
Susan E. Hengeveld
Indiana University
David Julian
University of Florida
Pamela J. Lanford
University of Maryland, College Park
James B. Ludden
College of DuPage
Patricia Mire
University of Louisiana, Lafayette
Janice Moore
Colorado State University
Jacalyn S. Newman
University of Pittsburgh
Robert Newman
University of North Dakota
Nicole S. Obert
University of Illinois, Urbana-Champaign
David G. Oppenheimer
University of Florida
Ellen Ott-Reeves
Blinn College, Bryan
Laurel Bridges Roberts
University of Pittsburgh
Deemah N. Schirf
The University of Texas, San Antonio
Mark A. Sheridan
North Dakota State University
Richard Showman
University of South Carolina
Phillip Snider Jr.
Gadsden State Community College
Nancy G. Solomon
Miami University
David Tam
University of North Texas
Marty Tracey
Florida International University
Michael J. Wade
Indiana University
Jyoti R. Wagle
Houston Community College System, Central
Andy Wang
The University of Iowa
Cindy Martinez Wedig
University of Texas, Pan American
C. B. Wolfe
The University of North Carolina, Charlotte

Biology Symposium Attendees

Every year McGraw-Hill conducts several General Biology Symposia, which are 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. It also offers a forum for the attendees to exchange ideas and experiences with colleagues they might not have otherwise met. The feedback we have received has been invaluable, and has contributed to the development of *Biology* and its supplements.

2006

Michael Bell
Richland College
Scott Bowling
Auburn University
Peter Busher
Boston University
Allison Cleveland
University of South Florida, Tampa
Sehoya Cotner
University of Minnesota
Kathyrn Dickson
California State College, Fullerton
Cathy Donald-Whitney
Collin County Community College
Stanley Faeth
Arizona State University
Karen Gerhart
University of California, Davis
William Glider
University of Nebraska, Lincoln
Stan Guffey
The University of Tennessee
Bernard Hauser
University of Florida, Gainesville
Mark Hens
University of North Carolina, Greensboro
Jim Hickey
Miami University of Ohio, Oxford
Sherry Krayesky
University of Louisiana, Lafayette
Brenda Leady
University of Toledo
Michael Meighan
University of California, Berkeley
Comer Patterson
Texas A&M University
Debra Pires
University of California, Los Angeles
Robert Simons
University of California, Los Angeles
Steven D. Skopik
University of Delaware
Ashok Upadhyaya
University of South Florida, Tampa
Anthony Uzwiak
Rutgers University
Dave Williams
Valencia Community College, East Campus
Jay Zimmerman
St. John's University

2005

Donald Buckley
Quinnipiac University
Arthur Buikema
Virginia Polytechnic Institute
Anne Bullerjahn
Owens Community College
Garry Davies
University of Alaska-Anchorage
Marilyn Hart
Minnesota State University
Daniel Flisser
Camden County College
Elizabeth Godrick
Boston University
Miriam Golbert
College of the Canyons
Sherry Harrel
Eastern Kentucky University
William Hoese
California State University, Fullerton
Margaret Horton
University of North Carolina, Greensboro
Carol Hurney
James Madison University
James Luken
Coastal Carolina University
Mark Lyford
University of Wyoming
Gail McKenzie
Jefferson State Junior College
Melissa Michael
University of Illinois, Urbana-Champaign
Subhash C. Minocha
University of New Hampshire
Leonore Neary
Joliet Junior College
K. Sata Sathasivan
University of Texas, Austin
David Senseman
University of Texas, San Antonio
Sukanya Subramanian
Collin County Community College
Randall Terry
Lamar University
Sharon Thoma
University of Wisconsin, Madison
William Tyler
Indian River Community College

2004

Jonathan Akin
Northwestern State University of Louisiana
David Asch
Youngstown State University
Diane Bassham
Iowa State University
Donald Buckley
Quinnipiac University
Ruth Buskirk
University of Texas, Austin
Charles Creutz
University of Toledo
Lydia Daniels
University of Pittsburgh
Laura DiCaprio
Ohio University
Michael Dini
Texas Tech University
John Doctor
Duquesne University
Ernest DuBrul
University of Toledo
John Elam
Florida State University
Samuel Hammer
Boston University
Marilyn Hart
Minnesota State University
Marc Hirrel
University of Central Arkansas
Carol Johnson
Texas A&M University
Dan Krane
Wright State University
Karin Krieger
University of Wisconsin, Green Bay
Josephine Kurdziel
University of Michigan
Martha Lundell
University of Texas, San Antonio
Roberta Maxwell
University of North Carolina, Greensboro
John Merrill
Michigan State University
Melissa Michael
University of Illinois, Urbana-Champaign
Peter Niewarowski
University of Akron
Ronald Patterson
Michigan State University
Peggy Pollak
Northern Arizona University
Uwe Pott
University of Wisconsin, Green Bay
Mitch Price
Pennsylvania State University
Steven Runge
University of Central Arkansas
Thomas Shafer
University of North Carolina Wilmington
Richard Showman
University of South Carolina
Michèle Shuster
New Mexico State University
Dessie Underwood
California State University, Long Beach
Mike Wade
Indiana University
Elizabeth Willott
University of Arizona
Carl Wolfe
University of North Carolina, Charlotte

Majors Biology Media Focus Group

Russell Borski
North Carolina State University
Mark Decker
University of Minnesota
John Merrill
Michigan State University
Melissa Michael
University of Illinois, Urbana-Champaign
Randall Phillis
University of Massachusetts, Amherst
Mitch Price
Pennsylvania State University