

Preface

It's not difficult, or even necessary these days, to convince anyone that microbiology is an important subject to study. In recent years anthrax, West Nile virus, SARS, and of course, HIV have already done that job. What can be difficult is helping students understand and apply the challenging concepts of microbiology, and make sense of the good and the bad that come from microorganisms.

With more than 30 years of combined college teaching experience, we have tested numerous teaching strategies to find those that help students succeed in their study of microbiology. We learn more about the subject matter and more about our students with every class we teach, and each time we are impressed by how much our students already know, how hard they are willing to work, and their life aspirations. Our presentation of the concepts in this book has been greatly influenced by our students' insights, feedback, and accomplishments. In addition we have incorporated into the textbook our tried and proven teaching strategies as is seen through our unique organization of the disease chapters, conversational writing style, vivid artwork, and effective pedagogy.

This textbook is also a product of a unique synergy between us as co-authors. Kelly brings to the mix her experience and success in research and teaching, while Kathy is a celebrated author who has gained the respect of instructors and students for her distinctive, easy-to-understand writing style. The end result is timely content and microbiology research embedded in an accessible presentation.

We humbly present this book in the hope that using it will turn readers on to the wonderful world of microbiology, and the fascinating—and sometimes heartbreaking—world of infectious disease.

What Sets This Book Apart?

Distinctive Organization of Infectious Disease Chapters

Following the tradition of microbiology textbooks, the first 16 chapters of *Microbiology: A Systems Approach* provide the basics about microorganisms: what they are, the methods used to study them, human attempts to control them, and our bodies' defenses against them. For chapters 17–23, we have developed an unequaled level of organization in our presentation of the infectious disease material.

Exclusive Chapter Chapter 17, "Diagnosing Infections," is unique among microbiology textbooks: it brings together in one place the methods used to diagnose infectious diseases. It starts with collecting samples from the patient, and details

the biochemical, serological, and molecular methods used to identify causative microbes.

Highly Organized Disease Chapters Like other books, chapters 18–23 present the diseases according to the human organ systems. However, the organization of the material within each of these chapters has been taken to a new level.

The traditional organ system approach makes sense to anyone who has experienced an infection!, but still leaves organizational threads hanging. Within a given organ system chapter, diseases are discussed in random order, there is often no consistent pattern to what is said about a disease.

This book improves upon that approach by organizing the infectious agents according to the symptoms or conditions they cause, instead of in a random order. For example, in the respiratory disease chapter, there is a major heading called "Community-Acquired Pneumonia"—a condition that can be caused by several different microbes. Each of these microbes is discussed under that heading, in a systematic manner. At the end of the section, the microbes are summarized in a **Checkpoint table** called "Community-Acquired Pneumonia." Conditions with only one possible cause, such as pertussis, also end with a Checkpoint table that includes the single causative agent.

CHECKPOINT 21.6 Pertussis (Whooping Cough)

Causative Organism(s)	<i>Bordetella pertussis</i>
Most Common Modes of Transmission	Droplet contact
Virulence Factors	FHA (adhesion), pertussis toxin, tracheal cytotoxin, endotoxin
Culture/Diagnosis	Grown on B-G, charcoal or potato-glycerol agar; diagnosis can be made on symptoms
Prevention	Acellular vaccine (DTaP), erythromycin or trimethoprim-sulfamethoxazole for contacts
Treatment	Mainly supportive; erythromycin to decrease communicability

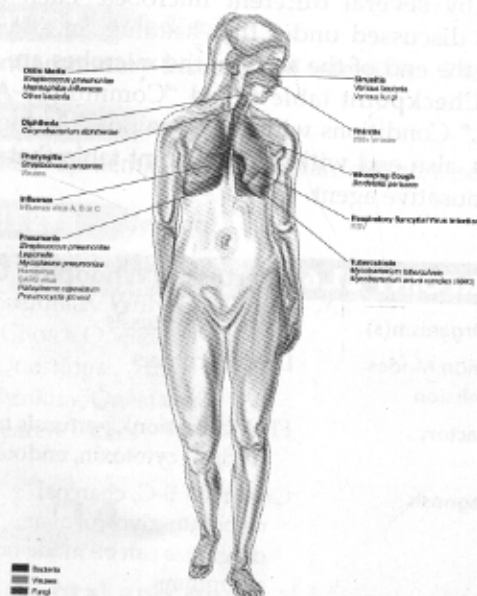
This approach is refreshingly logical, systematic, and intuitive, as it encourages clinical and critical modes of thinking in students—the type of thinking they will be using in their eventual careers in health care. Students learn to examine multiple possibilities for a given condition, and

accustomed to looking for commonalities and differences among the various organisms that cause a given condition. In addition, they learn to consider the kinds of conditions that are caused by only one microbe.

Along with the higher level of organization offered in this book, students are provided with key pedagogical tools at the end of each disease chapter to reinforce and tie together the information they've just learned. Each disease chapter ends with a **summary figure**—a “glass body” that highlights the affected organs discussed in the chapter—and a **taxonomic list of organisms**. The distinctive summary figure lists the diseases that were presented in the chapter, with the microbes that could cause them *color-coded by type of microorganism*. The taxonomic list of organisms is presented in tabular form so students can see the diversity of microbes causing diseases in that system, and appreciate their taxonomic positions.

In summary, the disease presentation in this book makes the world of infectious diseases come together for the student. It presents the information within a consistent organizational structure (known to facilitate learning) and embeds it within a structure that teaches clinical, and critical modes of thinking.

Infectious Diseases Affecting the Respiratory System



Microorganism	Disease	Chapter Location
Gram-Positive Bacteria		
<i>Streptococcus pneumoniae</i>	Otitis media, pneumonia	Otitis media, p. 607 Pneumonia, p. 625
<i>S. pyogenes</i>	Pharyngitis	Pharyngitis, p. 608
<i>Corynebacterium diphtheriae</i>	Diphtheria	Diphtheria, p. 602
Gram-Negative Bacteria		
<i>Haemophilus influenzae</i>	Otitis media	Otitis media, p. 607
<i>Bordetella pertussis</i>	Whooping cough	Whooping cough, p. 641
<i>Mycoplasma pneumoniae</i>	Tuberculosis	Tuberculosis, p. 609
<i>Legionella spp.</i>	Pneumonia	Pneumonia, p. 606
Other Bacteria		
<i>Mycobacterium tuberculosis</i>	Pertussis	Pertussis, p. 607
RNA Virus		
Respiratory syncytial virus	RSV disease	RSV disease, p. 605
Influenza virus A, B, and C	Influenza	Influenza, p. 640
Histoplasma	Haemophilus pneumoniae	Haemophilus pneumoniae, p. 607
SARS-associated coronavirus	SARS	Pneumonia, p. 606
Fungi		
<i>Pneumocystis jirovecii</i>	Pneumocystis pneumonia	Pneumonia, p. 601
<i>Histoplasma capsulatum</i>	Histoplasmosis	Pneumonia, p. 629

*There is some debate about the gram status of the genus *Mycobacterium*; it is generally not considered gram positive or gram negative.

An Engaging Writing Style, Praised by Reviewers

Our goal was to achieve a precise balance in writing, so students will easily comprehend the material without compromising the level of presentation. One of the key strengths of this text comes from our efforts in making difficult concepts understandable, as well as intriguing and exciting for students. We use this consistent, direct approach throughout the text—in the narrative, the illustrations, and throughout the pedagogical aids. Analogies, case studies, and real-world examples also help students relate microbiology to their world.

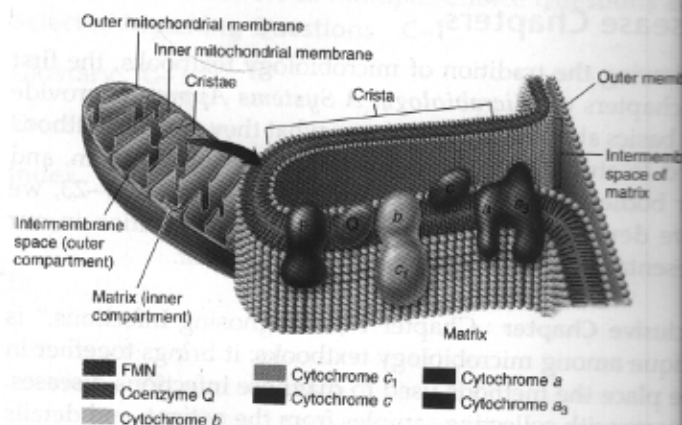
“I rate this book as the highest, for readability, in a college microbiology textbook. I found the writing style to be clear and straightforward without sacrificing completeness.” Todd Herman, UCLA

“I found this textbook very easy to read. I think the sentence structure and vocabulary provide a more conversational style of text than other textbooks that have reviewed or used. In my experience, students prefer this style of writing and are more likely to read the text and understand it.” Valerie A. Watson, West Virginia University

A Vivid Art Program That Explains Itself

Kathy Talaro brings her experience as a teacher, microbiologist, and illustrator to this text. Her insight and expertise provide an inimitable blend of scientific accuracy and artistry. Vivid, multi-dimensional illustrations complement the text, providing a self-contained, concept-specific narrative; it is not necessary to read page content surrounding artwork to grasp concepts being illustrated. Development of the artwork in this manual further enhances learning and helps to build a solid foundation of understanding.

A special Art Consultant Board, composed of experienced instructors, also worked closely with us throughout the development of this book to ensure accuracy and effectiveness in the art.



Pedagogy Designed for the Way Students Learn

Microbiology: A Systems Approach makes learning easier through its carefully crafted pedagogical system. Following is a closer look at some of the key features that our students have taught us are useful.

- All chapters open with **In the News** mysteries to solve. These real-world case studies help students appreciate and understand how microbiology impacts our lives on a daily basis. The solutions appear later in the chapter, after the necessary elements have been presented.

The Main Themes of Microbiology

IN THE NEWS

Severe acute respiratory syndrome (SARS) is a newly identified respiratory infection caused by a novel coronavirus. The SARS pandemic is believed to have originated in the Guangdong Province of China during the fall of 2002. A SARS patient from this region traveled to Hong Kong on February 15th, 2003, and may have infected several guests at a hotel where he resided. One of the hotel guests was a resident of Hong Kong. By February 24th, the hotel resident came down with a fever, chills, dry cough, runny nose, and malaise. Over the next several days, his symptoms worsened to pneumonia, leading to his hospitalization at the Prince of Wales Hospital in Hong Kong.

The Prince of Wales Hospital is a large medical teaching hospital of the Chinese University of Hong Kong. By March 12th, a large-scale outbreak of SARS occurred inside of the hospital. During the initial outbreak, March 12th through 23rd, 2003, 40% of the SARS cases (all of 134) admitted to the Prince of Wales Hospital were hospital workers. SARS is a contagious disease that spreads from person to person primarily through contact with respiratory droplets containing the SARS virus. Chinese University researchers and the Hong Kong Hospital Authority conducted studies to determine why hospital workers were so vulnerable to SARS at this hospital.

- Can you think of what factors contributed to the increased rate of SARS transmission seen among hospital workers?
- What precautions would you take in caring for SARS patients?

CHAPTER OVERVIEW

- Microorganisms, also called microbes, are organisms that require a microscope to be readily observed.
- In terms of numbers and range of distribution, microbes are the dominant organisms on earth.
- Major groups of microorganisms include bacteria, algae, protozoa, fungi, parasitic worms, and viruses.
- Microbiology involves study of numerous areas involving cell structure, function, genetics, immunology, host defense, epidemiology, and ecology.
- Microorganisms are essential to the operation of the earth's ecosystems, as planktonic bacteria, decomposers, and symbionts.

- A **Chapter Overview** at the beginning of each chapter provides students with a framework from which to begin their study of a chapter.
- In chapters 1–16 and 24, major sections of the chapter are followed by **Checkpoints** that repeat and summarize the concepts of that section. In the disease chapters (18–23) the Checkpoints are in the form of the disease tables described earlier.
- **Insight** readings allow students to delve into material that goes beyond the chapter concepts and consider the application of those concepts. The Insight readings are divided into four categories: Discovery, Historical, Medical, and Microbiology.
- All chapters end with a **summary**, and a comprehensive array of **end-of-chapter questions**. The questions are not just multiple-choice, but also critical thinking questions that often have no correct answer. Considering and answering these questions, and even better, discussing them with fellow students, can make the difference between temporary (or limited) learning and true knowledge of the concepts.

Teaching Supplements

McGraw-Hill offers various tools and technology product support *Microbiology: A Systems Approach*. Instructors obtain teaching aids by calling the Customer Service Department, at 800-338-3987, or contacting their local McGraw-Hill sales representative.

Digital Content Manager CD-ROM

This cross-platform CD-ROM is a multimedia collection of visual resources that allows instructors to utilize artwork from the text in multiple formats and create customized classroom presentations, visually based tests and quizzes, dynamic course website content, or attractive printed supplementary material. The assets on this CD-ROM are organized by chapter within the following easy-to-use folders:

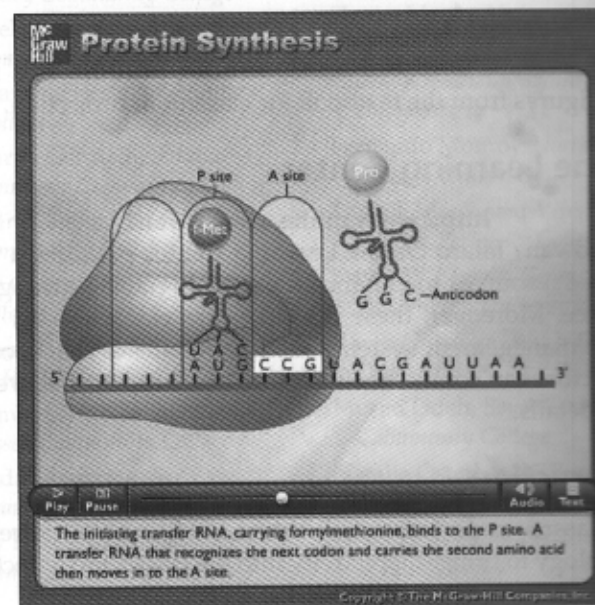
Art Library Full-color digital files of all the illustrations in the book, plus the same art saved in black and white version. These images can be readily incorporated into lecture presentations, exams, or custom-made classroom materials. These images are pre-inserted into blank PowerPoint slides for ease of use.

Photo Library Digital files of all photographs from the text that can be reproduced for multiple classroom uses.

Table Library Every table that appears in the text is provided in digital form.

PowerPoint Lecture Outline Library Ready-made presentations that combine art and lecture notes are provided for each of the 24 chapters of the text. These lecture outlines can be used as they are, or can be tailored to reflect preferred lecture topics and sequences.

Animation Library More than 50 full-color animations are available to harness the visual impact of processes in microbiology. Import these dynamic files into classroom presentation software or use them in online course materials.



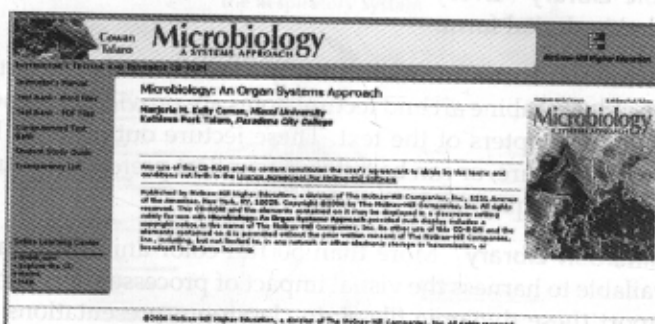
TextEdit Art Library Every illustration from the textbook is provided in PowerPoint. Instructors may revise, move, or delete labels to create customized presentations and exams.

Active Art Library Key figures are saved in manipulable layers that can be isolated and customized to meet the needs of the lecture environment.

Video Library 36 dynamic motion sequences have been produced to bring microorganisms to life for students.

Instructor's Testing and Resource CD-ROM

This cross-platform CD-ROM features a computerized test bank utilizing McGraw-Hill's EZ Test, a flexible and easy-to-use electronic testing program. The program allows instructors to create tests from book-specific items. It accommodates a wide range of question types, and instructors may add their own questions. Multiple versions of the test can be created, and any test can be exported for use with course management systems such as WebCT, BlackBoard or PageOut. The program is available for Windows and Macintosh environments. Word files of the test bank are included for those who prefer to work outside of the test-generator software. The Instructor's Manual is also available on this CD-ROM in both Word and PDF formats.



Transparencies

This set of 300 overhead transparencies includes key, full-color figures from the textbook for classroom projection.

Online Learning Center

<http://www.mhhe.com/cowan1>

The Cowan/Talaro Online Learning Center provides a vast array of resources to enhance the teaching and learning experience. Moreover, these resources are easily loaded into course management systems such as WebCT or Blackboard. Instructors can contact their McGraw-Hill representative for more details.

eInstruction

The classroom performance system (CPS) utilizes wireless technology to bring interactivity into the classroom or lecture

hall. Instructors and students receive immediate feedback through wireless response pads that are easy to use and engage students. eInstruction can assist instructors by:

- Taking attendance
- Administering quizzes and tests
- Creating a lecture with intermittent questions
- Using the CPS grade book to manage lectures and student comprehension
- Integrating interactivity into their PowerPoint presentations

Course Management Systems

Text-specific content is available for the most popular course management systems, including WebCT, Blackboard, eCollege, and McGraw-Hill's own PageOut. Instructors can quickly and easily set up a course website that includes specific quizzes, additional readings, interactives, and animations that support the McGraw-Hill text they are using. The content is taken from the Online Learning Center that accompanies the textbook. McGraw-Hill provides this service to adopters at no additional charge to students, and also provides customer support ranging from general technical support to staff training.

Learning Supplements

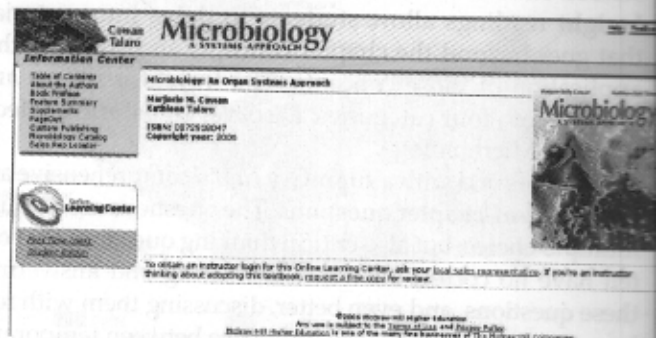
Students may order supplemental study materials by contacting their local bookstore.

Online Learning Center

<http://www.mhhe.com/cowan1>

Students can visit this book-specific website to find a variety of resources to enhance their learning. The resources support each chapter in the textbook, and some of the features include:

- Self-quizzing
- Animations of key processes
- Electronic flashcards to review key vocabulary
- Additional clinical case presentations
- Internet exercises to encourage use of the Internet as a resource to gather and evaluate information



Student Study Art Notebook

This handy study aid, a bound and printed notebook containing all of the artwork from the text, allows students to jot notes during lecture and complete self-tests to identify and work through microbiological processes.

Student Study Guide

A valuable student resource, written by Nancy Boury, the Student Study Guide goes beyond the standard multiple-choice and true-false self-quizzing. The author has provided a wealth of study assets, including key concepts, vocabulary review, self-tests, and more.

Microbes in Motion CD-ROM

Microbes in Motion is a cross-platform, interactive CD-ROM that brings microbiology to life through interactive video, audio, animations, and hyperlinking. It is an easy-to-use tutorial that is ideal for self-quizzing, class preparation, or review of microbiological concepts.

HyperClinic CD-ROM

Students will have fun with this interactive CD-ROM while learning valuable concepts and gaining practical experience in clinical microbiology. Packed with more than 100 case studies and over 200 pathogens supported with audio, video, and interactive screens, students will gain confidence as they take on the role of the professionals.

Acknowledgments

We have collected a stack of papers that seems to be five feet high; this stack is the written record of the careful consideration that our reviewers gave to early versions of this book. We are deeply grateful to every one of the expert instructors listed here, who took the time to comb through each chapter and point out errors or confusing wording or organization. Each of them has brought to bear on this book what their students have taught them. A wealth of experience, knowledge, and dedication to students is represented in this list of names! We sincerely thank them for the vast improvements they brought to this book.

Reviewers

Elizabeth Wheeler Alm, *Central Michigan University*
 Penny P. Antley, *University of Louisiana at Lafayette*
 Marcie L. Baer, *Shippensburg University*

Gail Baker, *Laguardia Community College*
 A. Clyde Blauer, *Snow College*
 Clifford W. Bond, *Montana State University*

Kathryn Brooks, *Michigan State University*
 Linda D. Bruslind, *Oregon State University*
 D. Kim Burnham, *Oklahoma State University*
 Robert M. Carey, *Pima Community College*
 Daniel E. Cayton, *El Centro College*
 Naowarat Cheeptham, *The University College of the Cariboo*
 Jim Collins, *University of Arizona*
 Judith A. Coston, *Bossier Parish Community College*
 Sarah Crawford, *Connecticut State University*
 John R. Dankert, *University of Louisiana at Lafayette*
 Janet M. Decker, *University of Arizona*
 Charles J. Dick, *Pasco-Hernando Community College*
 Bob F. Drake, *Southwest Tennessee Community College*
 David Drake, *University of Iowa*
 Larry E. Eason, *Pasco-Hernando Community College*
 Angela M. Edwards, *Trident Technical College*
 David L. Elmendorf, *University of Central Oklahoma*
 Teresa G. Fischer, *Indian River Community College*
 Katherine Foreman, *Moraine Valley Community College*
 Pamela B. Fouché, *Walters State Community College*
 S. Marvin Friedman, *Hunter College*
 Kathryn Germain, *Southwest Tennessee Community College*
 Sandra Gibbons, *Moraine Valley Community College*
 Judy Gnarpe, *University of Alberta*
 Indhu Gopal, *Carolina's College of Health Sciences*
 Thomas Gorczyca, *Northern Essex Community College*
 Brinda Govindan, *San Francisco State University*
 Judy Haber, *California State University, Fresno*

Richard Hanke, *Rose State College*
 Todd Herman, *University of California Los Angeles*
 James B. Jensen, *Brigham Young University*
 Gilbert H. John, *Oklahoma State University*
 Richard D. Karp, *University of Cincinnati*
 George Keller, *Samford University*
 Scott S. Kinnes, *Azusa Pacific University*
 Dennis J. Kitz, *Southern Illinois University, Edwardsville*
 Kenneth S. Landreth, *West Virginia University*
 Jeff G. Leid, *Northern Arizona University*
 Shawn Lester, *Montgomery College*
 Roger Lightner, *University of Arkansas, Fort Smith*
 William Lorowitz, *Weber State University*
 Bernard MacLennan, *University College of Cape Breton*
 A. Charles McBride, *Ivy Tech State College*
 Colleen McDermott, *University of Wisconsin, Oshkosh*
 Robert J. McDonough, *Georgia Perimeter College*
 Marvita D. McGuire, *Tulsa Community College*
 Sherry Meeks, *University of Central Oklahoma*
 Gloria R. Mihalik, *Lynn University*
 Fernando Monroy, *Northern Arizona University*
 Pamela Moolenaar-Wirsiy, *Georgia Perimeter College*
 David W. Morris, *George Washington University*
 Karen Nakaoka, *Weber State University*
 Murad Odeh, *South Texas Community College*
 Natalie Osterhoudt, *Broward Community College*
 Gregory E. Paquette, *University of Rhode Island*

Jack Pennington, *St. Louis Community College, Forest Park*
 Beverly Perry, *Houston Community College*
 Indiren Pillay, *Southwest Tennessee Community College*
 Nirmala V. Prabhu, *Edison College*
 Judith A. Prask, *Montgomery Community College*
 Davis W. Pritchett, *University of Louisiana, Monroe*
 David Quincey, *Bournemouth University*
 S.N. Rajagopal, *University of Wisconsin, La Crosse*
 Laurie L. Richardson, *Florida International University*
 Luis A. Rodriguez, *San Antonio College*
 Lisa Rutledge, *Columbia State Community College*
 Sarmad Saman, *Massachusetts Bay Community College*
 Todd Sandrin, *University of Wisconsin, Oshkosh*
 Gene M. Scalarone, *Idaho State University*

Virginia Schurman, *Community College of Baltimore County, Essex*
 Teri Shors, *University of Wisconsin, Oshkosh*
 Edward Simon, *Purdue University*
 Kevin Sorensen, *Snow College*
 Angela L. Spence, *Southwest Missouri State University*
 Timothy A. Steele, *Des Moines University*
 Gail A. Stewart, *Camden County College*
 Steven J. Thurlow, *Jackson Community College*
 Michael Troyan, *Pennsylvania State University*
 Jonathan Van Hamme, *The University College of the Cariboo*
 Randy L. Wade, *Los Angeles Harbor College*
 Musau WaKabongo, *Des Moines University*
 Valerie A. Watson, *West Virginia University*
 Dwight D. Wray, *Brigham Young University*

Pamela Moolenaar-Wirsiy, *Georgia Perimeter College*
 Beverly Perry, *Houston Community College*
 Davis W. Pritchett, *University of Louisiana, Monroe*

Luis A. Rodriguez, *San Antonio College*
 Michael Troyan, *Pennsylvania State University*
 Van Wheat, *South Texas Community College*

Art Consultant Panel

We are appreciative of the thoughtful and honest feedback given to us by the art consultant panel. The individuals below reviewed specific figures as they were being developed and provided invaluable comments on presentation, color, style, and clarity. Their feedback has enhanced the quality and effectiveness of the art program.

Kathryn Brooks, *Michigan State University*
 Kathryn Germain, *Southwest Tennessee Community College*
 Todd Herman, *University of California Los Angeles*

Paulette Royt, *George Mason University*
 Gail A. Stewart, *Camden County College*
 Dwight D. Wray, *Brigham Young University*

Case Study Contributors

The 24 case studies that open each of the chapters in this textbook were put together by the authors and a team of instructional designers. Members of the team (besides ourselves) and the case studies they contributed, are listed here.

Linda D. Bruslind, *Oregon State University, Chapter 16*
 Jim Collins, *University of Arizona, Chapter 11*
 Janet M. Decker, *University of Arizona, Chapter 13*
 Pamela B. Fouché, *Walters State Community College, Chapter 7*
 Judy Gnarp, *University of Alberta, Chapter 15*
 Dawn Janich, *Community College of Philadelphia, Chapter 10*
 Karen Nakaoka, *Weber State University, Chapters 4, 8, 9, and 14*

Murad Odeh, *South Texas Community College, Chapter 12*
 Todd Sandrin, *University of Wisconsin, Oshkosh, Chapter 24*
 Teri Shors, *University of Wisconsin, Oshkosh, Chapters 1, 2, 5, and 6*
 Timothy A. Steele, *Des Moines University, Chapter 17*
 Valerie A. Watson, *West Virginia University, Chapter 3*

Text Consultant Panel

The following individuals provided us with invaluable feedback throughout the development of this textbook. Their candid comments helped us fine-tune the breadth and depth of the content, and we are grateful for their input.

William Boyko, *Sinclair Community College*
 Genie Brackenridge, *Waubesa Community College*
 Kathryn Brooks, *Michigan State University*
 Jim Collins, *University of Arizona*
 Rita Connolly, *Camden County College*

Bob F. Drake, *Southwest Tennessee Community College*
 S. Marvin Friedman, *Hunter College*
 Jeff G. Leid, *Northern Arizona University*
 William Lorowitz, *Weber State University*
 Sherry Meeks, *University of Central Oklahoma*

A Note of Thanks from Kelly Cowan

It must be obvious by now that writing a textbook is a group activity. Thank you, Kathy, for giving me the chance to apprentice with you. I am also grateful to Pat Reidy and Colin Wheatley for championing this project at McGraw-Hill. Pat Hesse and her team at McGraw-Hill—Jayne Klein, Rose Koos, Laurie Janssen, Wayne Harms, and the indomitable Tami Petsche—were truly the “Little Engine That Could,” and are responsible for the book coming to fruition. Great thanks are due Indiren Pillay and Teri Shors for their extensive work on the end-of-chapter materials. Nick Nelson and Suzanne Evans, former students of mine who taught me about life as well as learning, proofread the text and the art and did a fabulous job. Their involvement in the project allowed me to sleep a little more soundly. In a much broader sense, I am personally indebted to four important mentors in my career: Ron Doyle at the University of Louisville, Marilyn Fletcher (then at) the University of Maryland, Henk

Busscher at the University of Groningen, and Anne Morris Hooke at Miami University.

Finally, I want to thank my family support team, Paul, Taylor, and Sam. They gave me love, understanding, coffee—and the computer every time I asked for it.

A Note of Thanks from Kathy Talaro

I, too, owe a debt to the McGraw-Hill team, and to Kelly Cowan, for sharing her dynamic and relevant approach to microbiology. She has shaped the textbook into a unique and effective instrument that will be a valued addition to the genre. On a personal note, I wish to recognize my family for supporting and grounding me over the past many years. To the two David B.'s and Nicole: many thanks for putting up with all of that “microbiology talk” over dinner and for keeping me laughing when I most needed it.