

This is an exciting yet challenging time to be teaching and learning about microbiology. With the horrendous events of September 11, 2001 and the subsequent attacks of bioterrorism in the United States, the need to provide accurate and current information about the good and bad microbes seems greater than ever. Almost every day newspaper reports discuss the possibility of another attack using microbial agents or their toxins. Of equal interest, however, are the frequent articles that describe the discovery of microbes in an environment considered impossible to sustain life, the sequencing of another microbial genome, or the death of an individual from a rare infectious disease. Anyone glancing at the front page cannot help but realize the impact that microorganisms have in our daily lives. The announcements of the many scientific advances being made about the microbial world often bring with them vehement arguments related to the science. Are plants that contain genes of microorganisms safe to eat? Is it wise to put antimicrobial agents in soaps and animal feed? What are the chances of finding life on Mars? What agents of biological warfare might the citizens of the world face? This book presents what we believe are the most important facts and concepts about the microbial world and the important role its members play in our daily lives. With the information presented, students should be able to form reasoned opinions and discuss intelligently their views on these questions.

An important consideration in revising this textbook is the diverse interests among students who take an introductory microbiology course today. As always, many students take microbiology as a prerequisite for nursing, pharmacy, and dental programs. A suitable textbook must provide a solid foundation in health-related aspects of microbiology, including coverage of medically important bacteria, antimicrobial medications, and immunization. An increasing number of students take microbiology as a step in the pursuit of other fields, including biotechnology, food science, and ecology. For these students, topics such as recombinant DNA technologies, fermentation processes, and microbial diversity are essential. With the search for the source of the anthrax preparation used in the bioterrorism attacks in the United States, the subject

of techniques of microbial identification become more relevant. Microbiology is also becoming more popular as an elective for biology students, who are particularly interested in topics that highlight the relevance of microorganisms to shaping the biological world. Because of the wide range of career goals and interests of students, we have made a particular effort to broaden the scope of previous editions, providing a more balanced approach, yet retaining our strength in medical microbiology.

Diversity in the student population is manifested not only in the range of career goals, but also in educational backgrounds. For some, microbiology may be their first college-level science course; for others, microbiology builds on an already strong background in biology and chemistry. To address this broad range of student backgrounds, we have incorporated learning aids that will facilitate review for some advanced students, and will be a tremendous support to those who are seeing this material for the first time.

Preparing a textbook that satisfies such a broad range of needs and interests is a daunting task, but also extremely rewarding. We hope you will find that the approach and structure of this edition presents a modern and balanced view of microbiology in our world, acknowledging the profound and essential impact that microbes have on our lives today and their possible roles in our lives tomorrow.

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## Features of the Fourth Edition

Completely updated and including the most current topics in microbiology today, *Microbiology: A Human Perspective*, fourth edition, continues to be a classic. It has always been our goal to present sound scientific content that students can understand and rely upon for accuracy and currency, so that they can succeed in their preparation for meaningful careers. We have used constructive comments from numerous microbiology instructors and their students to continue to enhance the robust features of this proven text.

## Expert Approach to Writing

We, as a strong and diverse team of scientists and teachers, solidly present the connection between microorganisms and humans. Because of our individual specializations and our research and educational backgrounds, we remain in the hub of the scientific community and can provide accurate and modern coverage spanning the breadth of microbiology. More importantly, as teachers, we constantly strive to present material that easily speaks to the students reading it.

We recognize that a textbook, no matter how exciting the subject matter, is not a novel. Few students will read the text from cover to cover and few instructors will include all of the topics covered in their course. We have used judicious redundancy to help present each major topic as a complete unit. We have avoided the chatty, superficial style of writing in favor of clarity and conciseness. The text is not “watered down” but rather provides students the depth of coverage needed to fully understand and appreciate the role of microorganisms in the biological sciences and human affairs.

*“The writing style is very clear, precise, and student friendly. For example, the descriptions of innate and adaptive immunity, their roles and how they interact, are the best of their kind that I have encountered in any textbook.”*  
(Kim Burnham, Oklahoma State University)

*“I loved the analogies and the simplicity of the writing.”*  
(Kathleen Lauber, College of Southern Maryland)

## Instructive Art Program that Speaks a Thousand Words

Microorganisms, by definition, are invisible to the naked eye. It becomes ever more important to allow students to visualize organisms as well as processes to reinforce learning. The art program continues as a key element of the learning process. Each figure in *Microbiology: A Human Perspective* was developed as the narrative was written and is referenced in bold in the supporting text. Colors and symbols are used consistently throughout the text. Legends are short, clear, and descriptive. Various types of art styles are used as needed to bring concepts to life.

**Overview Figures** simplify complex interactions and provide a sound study tool. **Image Pathways** help students to follow the progression of a discussion over several pages by highlighting and visualizing in detail each step of an overview figure.

**Process Figures** include step-by-step descriptions and include supporting text so that the figure walks through a compact summary of important concepts.

**Combination Figures** tie together the features that can be illustrated by an artist with the appearance of organisms in the real world.

**Stunning Micrographs** used generously throughout the text bring the microbial world to life. In the

chapters presenting infectious diseases, these are often combined with photographs showing the symptoms that the organisms cause.

## Unmatched Clinical Coverage

Evans Roberts, Jr.—a member of the author team who is licensed and board certified in internal medicine by the American Board of Internal Medicine, and in public health and medical laboratory microbiology by the American Board of Microbiology—ensures that clinical coverage is accurate, modern, and instructive to those planning to enter health careers. The incomparable treatment of infectious diseases, which are organized by human body systems, is supported with generous photographs, summary tables, case histories, and critical-thinking questions. Elements of the unparalleled clinical coverage include:

- Consistent coverage of all diseases, including individual sections that describe the symptoms, pathogenesis, causative agent, epidemiology, prevention, and treatment.
- Disease summaries that feature a drawing of a human showing symptoms, portals of entry and exit, location of pathology, and a step-by-step description of the infection process for each major disease.
- Case presentations of realistic clinical situations.
- Modern coverage of topics such as emerging diseases, new vaccines, and nosocomial infections.
- Dedicated chapters covering wound infections and HIV.

## Learning System that Actively Involves Students

In today’s classroom, it is important to pursue active learning by students. This edition of *Microbiology* challenges students to think critically by providing several avenues of practice in analyzing data, drawing conclusions, synthesizing information, interpreting graphs, and applying concepts to practical situations. These learning tools, developed by critical thinking expert Robert Allen, will benefit students pursuing any discipline.

## What’s New in This Edition?

We have again **updated coverage** throughout the text to reflect the rapid and sometimes surprising growth in the field of microbiology. This effort is particularly evident in Chapter 15 (**The Innate Immune Response**) and Chapter 16 (**The Adaptive Immune Response**) reflecting the latest thoughts on how the immune system protects us from infectious disease.

**Some coverage has been simplified** in this edition, particularly in the areas of genetics and biotechnology. **More emphasis is given to applications** of basic biotechnology in Chapter 9 (Biotechnology and Recombinant DNA) and basic microbiology in Chapter 31 (Environmental Microbiology: Treatment of Water, Wastes, and Polluted Habitats).

After listening to a large number of microbiology instructors, we have **moved significant coverage of the helminths to our**

**Online Learning Center.** After listening to a large number of microbiology students, we have added even **more summary tables** to facilitate learning. To help both instructors and students, **main headings are now double-numbered** for ease of reference.

### Significantly revised chapters include:

#### Chapter 6

##### Metabolism: Fueling Cell Growth

- Reorganization of coverage of enzymes with a new summary table listing characteristics of enzyme inhibition
- Reorganization and content revision of central metabolic pathways to reflect a more familiar presentation
- Revised separate section entitled “photosynthesis”; expanded to describe the different types of photosynthesis in plants vs. microorganisms with a new summary table comparing photosynthetic mechanisms
- New figures showing the electron transport chain and photosystems

#### Chapter 9

##### Biotechnology and Recombinant DNA

- Significantly revised and reorganized, this chapter now opens with a new section on applications of biotechnology
- Fewer techniques are presented and in less detail
- New summary tables listing recombinant DNA technologies and their applications
- New section on the bioethical concerns surrounding DNA technologies

#### Chapter 15

##### The Innate Immune Response

- Entirely new chapter rewritten, reorganized, and updated with the assistance of an immunologist involved in cutting-edge research; new title reflects current direction of research in immunity
- Focus on new approach of pattern recognition in innate immunity
- New coverage of toll-like receptors in the immune system
- Decreased coverage of complement activation pathways; new overview figure of complement cascade
- New summary table of innate defense mechanisms
- Revised figure of inflammation showing activity within capillaries

#### Chapter 16

##### The Adaptive Immune Response

- Entirely new chapter rewritten, reorganized, and updated with the assistance of an immunologist involved in cutting-edge research; new title reflects current direction of research in immunity

- New opening section introducing humoral and cellular immunity; new overview figure linking roles of humoral and cellular immunity
- New overview section with new figure describing protective outcomes of antibody-antigen binding
- New Future Challenges box on the danger model of immunity

#### Chapter 19

##### Host-Microbe Interactions

- Consolidates topics into major conceptual units that effectively build to key points
- Reorganization now presents two major divisions: (1) principles of infectious disease and (2) mechanisms of pathogenesis
- New discussion of how microorganisms evade host defenses, building on concepts learned in earlier immunology chapters
- New discussion on damaging effects of infection and of the immune response
- New discussion of mechanisms of viral and eukaryotic pathogenesis

##### Other revisions include:

- New coverage of genomics and the threat of bioterrorism
- Updated growth curves including stage of prolonged decline
- New summary tables listing components taking part in DNA replication, transcription, and translation.
- Revision and simplification of mechanisms to control transcription and the *lac* operon
- Updated and expanded coverage of prions and prion disease
- New summary table of diseases caused by *Staphylococcus aureus*
- A new title of chapter 30 reflects the focus on new coverage of microbial communities including microbial mats, techniques to study microbial ecology including FISH and DGGE, and mutualisms between eukaryotes and microbes

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## Teaching Supplements

**Digital Content Manager CD-ROM** The answer to your lecture presentation needs is here! This cross-platform CD is a multimedia collection of visual resources that allows you to utilize artwork from the text in multiple formats. You can create customized classroom presentations, visually-based tests and quizzes, dynamic course website content, or attractive printed support material. See the foldout in this preface for a list of the tools available on the Digital Content Manager and discover what this powerful resource has to offer.

**Online Learning Center** ([www.mhhe.com/nester4](http://www.mhhe.com/nester4)) Through the Nester Online Learning Center, everything you need for effective, interactive teaching and learning is at your fingertips. Moreover, this vast McGraw-Hill resource is easily loaded into course management systems such as Web CT or Blackboard. Contact your local McGraw-Hill representative for details.

**Instructor's Testing and Resource CD-ROM** This cross-platform CD-ROM provides a wealth of resources for the instructor. Supplement features on this CD-ROM include a computerized test bank, utilizing Brownstone Diploma testing software, to quickly create customized exams. This user-friendly program allows you to search for questions by topic, format, or difficulty level; edit existing questions or add new ones; and scramble questions and answers keys for multiple versions of the same test. Word files of the test bank are included for instructors who prefer to work outside of the test-generator software.

Other assets on the Instructor's Testing and Resource CD-ROM are grouped within easy-to-use folders. These resources include the Instructor's Manual and the Laboratory Preparator's Manual.

**Instructor's Manual** Prepared by Michael Lema and Rick Corbett of Midlands Technical College, this valuable resource includes Learning Objectives keyed to the Student Study Guide, correlations to the multimedia resources available with the text, and answers to questions in the text.

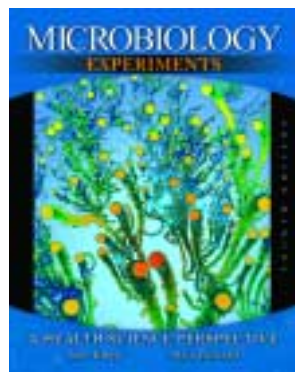
**Transparencies** A set of 300 images from the textbook is provided for classroom projection.

**Projection Slides** Slide sets are available that show clinical examples of diseases or examples of microbial specimens.

**Laboratory Manual** The fourth edition of *Microbiology Experiments: A Health Science Perspective*, by John Kleyn and Mary Bicknell, has been prepared to directly support the text (although it may also be used with other microbiology textbooks). The laboratory manual features health-oriented experiments and endeavors also to reflect the goals and safety regulation guidelines of the American Society for Microbiology. Engaging student projects introduce some more intriguing members of the microbial world and expand the breadth of the manual beyond health-related topics. Newer experiments introduce modern techniques in biotechnology such as use of restriction enzymes and use of a computer database to identify sequence information.

**Preparator's Manual for the Laboratory Manual** This invaluable guide includes answers to exercises, tips for successful experiments, lists of microbial cultures with sources and storage information, formulae and sources for stains and reagents, directions and recipes for preparing culture media, and sources of supplies. The Preparator's Manual is available to instructors through the Online Learning Center.

**PageOut** McGraw-Hill's exclusive tool for creating your own website for your Microbiology course. It requires no knowledge of coding and is hosted by McGraw-Hill.



## Learning Supplements

**Online Learning Center with PowerWeb** [www.mhhe.com/nester4](http://www.mhhe.com/nester4) Student resources on the Online Learning Center support each chapter in the text. Some of the features include:

- Self-quizzing with immediate feedback
- Animations of key processes
- Electronic flash cards to review key vocabulary
- Additional clinical case presentations
- Web exercises encouraging practice of use of the Web to gather and evaluate information

Additional tools available to students through the Online Learning Center include:

**PowerWeb** An online resource that offers access to course-specific current articles refereed by content experts, course-specific real-time news, and weekly course up-dates.

**Online Tutoring** A tutorial service moderated by qualified instructors helps with difficult concepts and is only an e-mail away.

Turn to the inside front cover to learn more about the exciting features provided for students on the Nester Online Learning Center.

**Microbes in Motion CD-ROM** This interactive CD-ROM for both Windows and Mac brings microbiology to life through interactive video, audio, animations, and hyperlinking. This easy-to-use tutorial can go from the classroom to the student's own personal computer. 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 over 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.

**Student Study Guide** This valuable student resource, written by Rick Corbett and Michael Lema of Midlands Technical College, goes beyond the standard multiple choice and true-false self-quizzing. The authors have provided a wealth of study assets to help students truly master the material. In addition to unique learning activities, it includes key concepts, vocabulary review, self-tests, and more.



## Reviewers of the Fourth Edition

Gene Nester, Evans Roberts, and Nancy Pearsall shared a vision many years ago to write a new breed of microbiology textbook especially for students planning to enter nursing and other health-related careers. Today there are other books of this type, but we were extremely gratified to learn that 85% of the students we surveyed intend to keep their copies of *Microbiology: A Human Perspective* because they feel it will benefit them greatly as they pursue their studies in these fields. We offer special thanks to the many students who used the third edition of *Microbiology: A Human Perspective* and who shared their thoughts with us about how to improve the presentation for the students who will use this edition of the text.

Rao Ayyagari's students at Lindenwood University  
David Hurley's students at South Dakota State University  
Steve Larsen's students at Indiana University–Purdue University at Indianapolis  
Ellen Neidle's students at the University of Georgia  
Jennifer Walker's students at the University of Georgia

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We would also like to thank Denise's husband, Richard Moore, who was "forced" to proofread and critique many of the chapters. Although he has no formal scientific education, or perhaps because of that fact, his suggestions have been instrumental in making the text more "reader-friendly." Much to his own surprise, Richard has learned enough about the fundamentals of microbiology, and more recently immunology, to actually become intrigued with the subject.

Once again, our amazing developmental editor, Deborah Allen, deserves special thanks for her tireless contributions and management. While we have no proof, we are convinced that she can leap tall buildings in a single bound. As the "coach" of our team of authors, she always seems to know just what is required to achieve our goals, be it gentle advice or good old-fashioned nagging. Unable to adequately convey our feelings for her talents in a mere paragraph, let us simply say that we feel very fortunate to have Deborah onboard.

Additionally, we would like to thank Joseph Gauthier, Elizabeth McPherson, and Donald Rubbelke for producing new media resources to support us and other instructors who

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We hope very much that this text will be interesting, educational for students, a help to their instructors, and will convey the excitement that we all feel for the subject. We would appreciate any comments and suggestions from our readers.

*Eugene Nester*  
*Denise Anderson*  
*C. Evans Roberts, Jr.*  
*Nancy Pearsall*  
*Martha Nester*