

Preface

THE IMPORTANCE OF THIS NEW EDITION

As the author of *Alcamo's Fundamentals of Microbiology*, this edition marks my second revision since the passing of Ed Alcamo in 2002. Most postsecondary textbooks, including those in the sciences, on average have a new edition published every three years. For this and several other reasons, the Government Accountability Office (GAO) published in 2004 a report, which, among other matters, evaluated the need for many textbooks to be revised so frequently. Therefore, is this revision necessary? The GAO study recommended textbook revisions be delayed until there are substantial changes in content or teaching methods to merit revision. If one were inclined to follow the GAO assessment—and more importantly the opinions and suggestions of many college and university instructors—the time is right for *Alcamo's Fundamentals of Microbiology, Eighth Edition*. Changes in content in this edition reflect the dynamic nature of microbiology, and the integration of new teaching pedagogies signal new approaches to facilitating learning and understanding in today's students.

In terms of content, microbiology is one of the most rapidly advancing scientific disciplines. Even though many of these discoveries may be beyond the technical or practical needs of the students for which this text is designed, many are directly applicable. Anxiety over a possible human pandemic evolving from the avian flu, alarm over the mumps outbreak in the Midwest in the spring of 2006, and health concerns over the 2006 outbreak of *E. coli* in packaged spinach illustrate a few reasons to understand microbiology and its practical applications. As in the previous editions, *Alcamo's Fundamentals of Microbiology, Eighth Edition*, retains the conversational style Ed developed over many editions and continues to pro-

vide you, the student, with up-to-date content so you can read—and evaluate—newspaper or magazine articles about microorganisms with understanding, or, as a future health giver, talk to patients with confidence about infectious diseases.

To perform well in your microbiology course requires a mastery of a substantial amount of new information. To facilitate this understanding and coordinate it with class material, I and the publishing group at Jones and Bartlett have developed a new “learning design” format for the textbook (described below) to make reading easier and more efficient. Most importantly, the design allows you to evaluate better your learning and provides you with the needed tools to probe your understanding; that is, chapter learning aids and assessment drills to evaluate your progress. Realize, a prepared student knows her or his mastery *before* an exam—not *as a result* of the exam!

AUDIENCE

Alcamo's Fundamentals of Microbiology, Eighth Edition, is written for introductory microbiology courses having an emphasis on the biology of human disease. It is geared toward students in health and allied health science curricula such as nursing, dental hygiene, medical assistance, sanitary science, and medical laboratory technology. It also will be an asset to students studying food science, agriculture, environmental science, and health administration. In addition, the text provides a firm foundation for advanced programs in biological sciences, as well as medicine, dentistry, and other health professions.

ORGANIZATION

Alcamo's Fundamentals of Microbiology, Eighth Edition, is divided into seven major areas of concentration. These areas use basic principles as

frameworks to provide the unity and diversity of microbiology. Among the principles explored are the variations in structure and growth of microorganisms, the basis for infectious disease and resistance, and the beneficial effects microorganisms have on our lives.

Part 1 deals with the foundations of microbiology. It includes chapters on the origins of microbiology and the universal concepts that underpin the science. Part 2 then concentrates on the *Bacteria*, the microorganisms most of us think of when we say “germs.” The discussions carry over to Part 3, where the spectrum of bacterial diseases is surveyed. Part 4 looks at the significance of other microorganisms, including viruses, fungi, and the protozoal and multicellular parasites.

In Part 5 of the text, the emphasis turns to infectious disease and the body’s resistance through the immune system. Here, we study the reasons for disease and the means for surviving it. A logical segue is in Part 6, which presents various mechanisms for controlling microorganisms using physical and chemical agents such as heat, radiation, disinfectants, and antibiotics. Part 7 closes the text with brief discussions of how public health measures interrupt epidemics. Some key insights also are given on the positive effects microorganisms exert through biotechnology.

WHAT’S NEW

As mentioned, this edition represents a major make over, a new “learning design” for *Alcamo’s Fundamentals of Microbiology*. In addition, you will see an added emphasis on a global perspective to infection and disease and more emphasis on taxonomy. Besides a detailed update to microbial structure and function, disease information and statistics, and the immune system, a few chapters have been reorganized; however, the sequence and number of chapters remains intact.

Chapter Organization

Chapter 4 on bacterial structure has been expanded with new information on topics such as the bacterial cytoskeleton. This has necessitated moving bacterial growth into its own chapter (Chapter 5). In Part 4, the chapters on protozoa and multicellular parasites have been combined

into one chapter entitled “The Eukaryotic Parasites” (Chapter 17). Part 5 includes the basic material on the immune system, which has been separated into two chapters. Chapter 19 investigates innate immunity while a separate chapter (Chapter 20) now is devoted solely to acquired immunity. The immune system is a complex concept to understand, so two separate chapters better partitions this essential information. Finally, in Part 6, what were separate chapters for the physical and chemical control of microorganisms has been consolidated into one integrated chapter (Chapter 23).

The “Learning Design” Concept

The text format has been improved for reading and learning, and includes activities designed to encourage student interaction and assessment. These design elements form an integrated study and learning package (learning tools) for student understanding and assessment.

- **Chapter Introductions** provide a stimulating thought or historical perspective to set the tone for the chapter.
- **Key Concepts** present statements identifying the important concepts in the upcoming section and alert you to the significance of that written material.
- **Boldface Terms** highlight important terms and ideas in the text.
- **Marginal Definitions** present succinct definitions of notable terms as they enter the discussion.
- **Marginal Drawings** provide visual images of bacterial shapes and cell arrangements (Chapters 9–12) and eukaryotic cells (Chapters 16 and 17).
- **Marginal Chemical Structures** present structural formulas for many of the antimicrobial drugs described in Chapter 24.
- **Concept and Reasoning Checks** allow you to pause and either summarize the information presented in the previous section or critically reason through a question pertaining to the previous section.
- **MicroFocus Boxes** explore interesting topics concerning microbiology or microorganisms.
- **MicroInquiry Boxes** allow you to investigate (usually interactively) some important aspect of the chapter being studied.

■ Rems (Roentgen Equivalent Man): A measure of radiation dose related to biological effect.

Marginal Definition

- **Textbook Cases** are embedded in the disease chapters to help you understand pathogens by presenting contemporary disease outbreaks originally reported by the Centers for Disease Control and Prevention.
- **Figure Questions** (Chapters 2–27) further reinforce your understanding of microbiology concepts described in the text.
- **Summary Tables** pull together the similarities and differences of topics discussed in the chapter.
- **Pronouncing Microorganism Names** (inside front and back covers) helps you correctly pronounce those sometimes tongue twisting microorganism names.
- **Summaries of Key Concepts** condense the major ideas discussed in the chapter. The “learning design” package also includes many useful and important end-of-chapter student assessments.
- **Learning Objectives** outline the important concepts in the chapters through Bloom’s Taxonomy, a classification of levels of intellectual skills important in learning.
- **Self-Test** questions are multiple-choice questions focusing on concrete “facts” learned in the chapter. Let’s face it, there is information that needs to be memorized in order to reason critically.
- **Questions for Thought and Discussion** encourage students to use the text to resolve thought-provoking problems with contemporary relevance.
- **Applications** are questions requiring students to reason critically through a problem of practical significance.
- **Chapter Review** contains questions of a somewhat unconventional type to assist review of the chapter contents.

Being Skeptical

One of the seven types of essay boxes new to this edition is titled “Being Skeptical.” A good scientist is a skeptic and skepticism is an important part of science. Skepticism, unlike cynicism, is not unwilling to accept a claim or observation. Skepticism simply says “Prove it!” Science applies scientific reasoning as the method for proof. Thus, a scientist, such as a microbiologist, must see the evidence and it must be compelling before the observation or statement is provision-

MICROFOCUS 5.2: Being Skeptical Germination of 25 Million-Year-Old Endospores?

Endospores have been recovered and germinated from various archaeological sites and environments. Living spores have been recovered and germinated from the intestines of Egyptian mummies several thousand years old. In 1983, archaeologists found viable spores in sediment lining Minnesota’s Elk Lake. The sediment was over 7,500 years old.

All these reports though pale in comparison to the controversial discovery reported in 1996 by researcher Raul Cano of California Polytechnic State University, San Luis Obispo. Cano found bacterial spores in the stomach of a fossilized bee trapped in amber—a hardened resin—produced from a tree in the Dominican Republic. The fossilized bee was about 25 million-years-old. When the amber was cracked open and the material from the abdomen of the bee extracted and placed in nutrient medium, the equally ancient spores germinated. With microscopy, the cells from a colony were very similar to *Bacillus spheeriscus*, which is found today in bees in the Dominican Republic. Is it possible for an endospore to survive for 25 million years—even if it is encased in amber?

Critics were quick to claim the bacterial species may represent a modern-day species that contaminated the amber sample being examined. However, Professor Cano had carried out appropriate and rigorous decontamination procedures and sterilized the amber sample before cracking it open. He also carried out all the procedures in a class II laminar flow hood, which prevents outside contamination from entering the working area. In addition, the hood had never been used for any other bacterial extraction processes. Several other precautions were added to eliminate any chance that the spores were modern-day contaminants from an outside source. Still, many scientists question whether all contamination sources had been identified.

The major question that remains is whether DNA can remain intact and functional after so long a period of dormancy. Does it really have a capability of replication and producing new vegetative growth? Granted, the DNA presumably was protected in a resistant spore, but could DNA remain intact for 25 million years?

Research on bacterial DNA suggests the maximum survival time is about 400,000 to 1.5 million years. If true, then the 25 million-year-old spores could not be viable. But that is based on current predictions and they may be subject to change as more research is carried out with ancient DNA.

The verdict? It seems unlikely that such ancient endospores could germinate after 25 million years. Perhaps new evidence will change that perception.

MicroFocus Box

ally accepted. The claim is still open to further examination and experimentation.

The “Being Skeptical” essays scattered through the textbook present an often-fantastic statement or claim. The essay then examines the claim using reasoning skills and the scientific process, which is sometimes called the scientific method.

WHY PATHOGENS?

Microorganisms perform many useful services for humans when they produce food products, manufacture organic materials in industrial plants, and recycle such elements as carbon and nitrogen. The emphasis of this book, however, is on the tiny, but significant percentage of microorganisms causing human disease, the so-called pathogens. Why do we emphasize pathogens? Here are several reasons:

- Pathogens have regularly altered the course of human history.
- Pathogens are familiar to audiences of microbiology.
- Pathogens add drama to an invisible world of microorganisms.
- Pathogens illustrate ecological relationships between humans and microorganisms.
- Pathogens point up the diversity of microorganisms.

Moreover, the study of pathogens makes basic science relevant and shows how microbiology interfaces with other disciplines such as sociology, economics, history, politics, and geography. Finally, the study of pathogens helps us to understand contemporary newspaper articles, magazine headlines, and stories on the news. And in the end, that makes us better citizens. Indeed, the famous essayist Thomas Mann once wrote, "All interest in disease is only another expression of interest in life."

SUPPLEMENTS TO THE TEXT

Jones and Bartlett offers an array of ancillaries to assist instructors and students in teaching and mastering the concepts in this text. Additional information and review copies of any of the following items are available through your Jones and Bartlett sales representative or by going to www.bioscience.jbpub.com

For the Student

The web site we developed exclusively for the eighth edition of this text, <http://microbiology.jbpub.com>, offers a variety of resources to enhance understanding of microbiology. The site contains eLearning, a free on-line study guide with chapter outlines, chapter essay questions, key term reviews, and short study quizzes.

The *Study Guide* to accompany this textbook contains important information to help you study, take effective class notes, prepare properly for exams, and even to manage your time effectively. The latter is the single most common reason for poor performance in college courses. The *Study Guide* also contains over 3000 practice exercises and study questions of various types to help you learn and retain the information in the text.

Laboratory Fundamentals of Microbiology, Eighth Edition, is a series of over 30 multipart laboratory exercises providing basic training in the handling of microorganisms and reinforcing ideas and concepts described in the textbook.

Guide to Infectious Diseases by Body Systems is an excellent tool for learning about microbial diseases. Each of the fifteen body systems units presents a brief introduction to the anatomical system and the bacterial, viral, fungal, or parasitic organism infecting the system.

An anthology called *Encounters with Microbiology* brings together "Vital Signs" articles from *Discover Magazine* in which health professionals use their knowledge of microbiology in their medical cases.

For the Instructor

Compatible with Windows and Macintosh platforms, the **Instructor's ToolKit—CD-ROM** provides instructors with the following traditional ancillaries:

- The *Instructor's Manual*, provided as a text file, includes chapter summaries and complete chapter lecture outlines and answers to all the end-of-chapter assessments.
- *Chapter Assessments Answers* provide short answers to figure questions, Concept and Reasoning Checks, and all end-of-chapter materials.
- The *Test Bank* is available as straight text files.
- The *PowerPoint™ Image Bank* provides the illustrations, photographs, and tables (to which Jones and Bartlett Publishers holds the copyright or has permission to reproduce digitally) inserted into PowerPoint slides. You can quickly and easily copy individual images or tables into your existing lecture slides.
- The *PowerPoint Lecture Outline Slides* presentation package provides lecture notes, and images for each chapter of *Alcamo's Fundamentals of Microbiology*. Instructors with the Microsoft PowerPoint software can customize the outlines, art, and order of presentation.