

PREFACE

Since the publication of the first edition nearly 30 years ago, well over one million students have used *Microbiology: An Introduction* at colleges and universities around the world, making it the leading textbook for non-majors microbiology. The tenth edition continues to be a comprehensive beginning text, assuming no previous study of biology or chemistry. The text is appropriate for students in a wide variety of programs, including the allied health sciences, biological science, environmental sciences, animal science, forestry, agriculture, home economics, and the liberal arts.

HALLMARKS OF MICROBIOLOGY: AN INTRODUCTION

We have retained in this new edition features that made the previous editions so popular:

- **An appropriate balance between microbiological fundamentals and applications, and between medical applications and other applied areas of microbiology.** As in previous editions, basic microbiological principles are given greater emphasis than are applications, and health-related applications are featured.
- **Straightforward presentation of complex topics.** Each section of the text has been written with the student in mind. Our book is known for its clear explanations and consistent pedagogy.
- **Clear, accurate, and pedagogically effective illustrations and photos.** Step-by-step diagrams that closely coordinate with narrative descriptions aid student comprehension of concepts. Clear and accurate renderings of processes and structures focus students on what they need to learn. The quantity and quality of electron and light micrographs is unmatched in the market.
- **Flexible organization.** We have organized the book in what we think is a useful fashion while recognizing that the material might be effectively presented in a number of other sequences. For instructors who wish to use a different order, we have made each chapter as independent as possible and have included numerous cross-references. The Instructor's Guide, written by Christine Case, provides detailed guidelines for organizing the material in several other ways.

NEW TO THE TENTH EDITION

Please see pages x–xviii for a visual introduction to the new tenth edition.

The changes in this edition address instructors' biggest challenge in the introductory microbiology course: the wide range of student levels, including student under-preparedness. The tenth

edition meets all students at their respective levels of skill and understanding.

The highlights of the tenth edition can be seen in the new Foundation Figures, the new features that help students check their understanding as they progress through each chapter, and the improved boxes that prepare students to start thinking like a clinician. Content and currency have also been substantially updated.

Foundation Figures

In order to help students focus on and master the core concepts of microbiology, the authors have integrated text and visuals into twenty specially designed Foundation Figures. These Foundation Figures include both a key concept statement that ensures students understand the central concept of the figure and an explanation of how each figure is foundational to further learning in the course. In addition, throughout the entire book the illustration program has been dramatically revised and updated with new art styles and a brighter color palette that has more contrasting colors and more dimensionality.

Features that Help Students Check Their Understanding

New Check Your Understanding questions encourage students to engage interactively with the material and self-assess their understanding of the Learning Objectives as they progress through each chapter. New Draw It questions are now included in the end-of-chapter Review Questions, asking students to sketch a rough diagram or fill in missing parts of a figure or graph. The popular Figure Legend Questions have been retained and improved.

Support for Students to Start Thinking like a Clinician

Revised and redesigned Applications of Microbiology boxes describe current and practical uses of microbiology. New and updated Clinical Focus boxes contain data from the *Morbidity and Mortality Weekly Report* modified into clinical problem-solving questions that help students develop their critical thinking skills and give them an active role while reading. Diseases in Focus boxes replace disease comparison tables, organizing comparative information about similar diseases in a discovery-oriented and visually interesting format that provides a helpful study tool for students.

Updates in Content and Currency

Antimicrobial resistance, biofilms, bioterrorism, and evolution receive special attention and increased emphasis. The immunity chapters—Chapters 16 and 17—have received a careful and sig-

nificant update for increased currency, clarity, and accuracy, without an increase in the level of detail. Taxonomy, nomenclature, and disease incidence data are current through August 2008.

Cutting-Edge Media Supplements

Turn to the inside front cover of this book for an overview of the new MyMicrobiologyPlace website with its simple three-step approach to learning. Pages xiv–xv provide more details about the exciting new student and instructor media, including the MP3 Tutor Sessions, the 3D MicroFlix animations, and the Instructor's Resource DVD/CD-ROM.

CHAPTER-BY-CHAPTER REVISIONS

Every chapter in this edition has been thoroughly revised, and data in the text, tables, and figures have been updated through August 2008 where possible. The main changes for each chapter are summarized below.

Part One

Fundamentals of Microbiology

Chapter 1: The Microbial World and You

- The table “Making Scientific Names Familiar” has been moved to this chapter from Chapter 10.
- Biofilms are introduced.
- Discussion of emerging infectious diseases has been updated, including a section on antibiotic-resistant bacteria.

Chapter 2: Chemical Principles

- Definitions have been expanded, including definitions of *cis* and *trans* fatty acids.
- Figure 2.16 is now a Foundation Figure.

Chapter 3: Observing Microorganisms through a Microscope

- Two-photon microscopy is included.
- Several new photos illustrate microscopic images.
- Figure 3.2 is now a Foundation Figure.

Chapter 4: Functional Anatomy of Prokaryotic and Eukaryotic Cells

- Figure 4.6 is now a Foundation Figure.
- The discussion of flagella, fimbriae, and pili has been revised, as has the discussion of the lipopolysaccharide.
- The discussion of facilitated diffusion has been revised, and a new figure compares types of diffusion across membranes, including aquaporins.

Chapter 5: Microbial Metabolism

- The section on biochemical tests has been expanded.
- New renditions of enzymes are more realistic.
- Figure 5.11 is now a Foundation Figure.
- A new Clinical Focus box illustrates the use of biochemical tests to identify slow-growing mycobacteria.

Chapter 6: Microbial Growth

- The discussion of biofilms previously appearing in Chapter 27 has been moved to this chapter and been significantly updated and expanded.

- Discussion of anaerobic growth media and methods has been updated.
- A discussion of Biosafety Levels has been added, including a figure illustrating Biosafety Level 4.
- A new figure showing differential medium is included.
- Figure 6.15 is now a Foundation Figure.
- A new Clinical Focus box illustrates the role of biofilms in causing nosocomial infections.

Chapter 7: The Control of Microbial Growth

- The definition of *sterilization* has been updated and qualified in consideration of the existence of prions.
- Figure 7.1 is now a Foundation Figure.
- Discussion of ultra-high temperature (UHT) has been clarified.
- New products and newly approved uses are included.
- A new Clinical Focus box illustrates the relationship between improper disinfection and nosocomial infection.

Chapter 8: Microbial Genetics

- Figure 8.2 is now a Foundation Figure.
- Discussion of genetic combination by crossing over has been revised for clarity.
- snRNPs are defined.
- Inducible and repressible operons are explained and compared in separate figures.

Chapter 9: Biotechnology and Recombinant DNA

- Figure 9.1 is now a Foundation Figure.
- Gene silencing, reverse genetics, and real-time PCR are discussed.
- A new Clinical Focus box describes using reverse-transcription PCR to track a norovirus outbreak.

Part Two

A Survey of the Microbial World

Chapter 10: Classification of Microorganisms

- Figure 10.1 is now a Foundation Figure.
- Photos of fossil and living stromatolites are included.
- The use of transport media is explained.

Chapter 11: The Prokaryotes: Domains Bacteria and Archaea

- Several new bacterial groups are discussed: *Pelagibacter*, *Acinetobacter baumannii*, Planctomycetes, *Gemmata obscuriglobus*.
- Discussion of the theoretical minimal size of a bacterium and its genetic requirements has been revised.

Chapter 12: The Eukaryotes: Fungi, Algae, Protozoa, and Helminths

- Examples of new uses of fungi as pesticides are listed.
- Discussion of the oomycetes is expanded to include introduction of *Phytophthora* into the United States. The oomycote life cycle is illustrated in a new figure.
- Heartworm is included.
- A new Clinical Focus box highlights cryptosporidial diarrhea, the most common pathogen associated with swimming.

Chapter 13: Viruses, Viroids, and Prions

- The chapter begins with the use of retroviridae to genetically modify cells.
- Figure 13.15 is now a Foundation Figure.
- Bee colony collapse is mentioned.
- The Clinical Focus box on the evolution and occurrence of avian flu has been updated.

Part Three**Interaction Between Microbe and Host****Chapter 14: Principles of Disease and Epidemiology**

- Figure 14.3 is now a Foundation Figure.
- Statistics on notifiable infectious diseases have been updated.
- A new Clinical Focus box illustrates the emergence of hospital-acquired and community-acquired MRSA.

Chapter 15: Microbial Mechanisms of Pathogenicity

- Discussion of A-B toxins has been expanded and clarified.
- Figure 15.5, action of an exotoxin, has been revised and expanded.
- Figures 15.4 and 15.9 are now Foundation Figures.
- A new Clinical Focus box illustrates role of biofilms and endotoxins in postoperative infections.

Chapter 16: Innate Immunity: Nonspecific Defenses of the Host

- Treatment of several topics has been expanded and/or reorganized and clarified: physical and chemical factors in the first line of defense; formed elements in blood; the lymphatic system (including additional illustrations); adherence, acute-phase proteins, complement, iron-binding proteins, and antimicrobial peptides.
- The role of biofilms in evading phagocytosis is included.
- Figures 16.7 and Figure 16.9 are now Foundation Figures.
- The Applications of Microbiology box on serum collection has been revised to include testing for complement to monitor immune complex diseases in patients.

Chapter 17: Adaptive Immunity: Specific Defenses of the Host

- A new photo depicts actual antibody morphology shown by atomic force microscopy.
- Several important figures have been extensively revised for accuracy and clarity:
 - Figure 17.5. Clonal selection and differentiation of B cells
 - Figure 17.10. Activation of CD4⁺ T cells
 - Figure 17.11. Killing of virus-infected target cell by cytotoxic T lymphocyte
 - Figure 17.19. The dual nature of the immune system (now a Foundation Figure)
- A new photo and illustration (Figure 17.9) show M cells found within Peyer's patches.
- Discussion of the major histocompatibility complex (MHC) has been revised and improved.
- Nomenclature conventions have been updated for T cells (for example, T helper cell, CD4⁺ T cell).

- The discussions of T cells, dendritic cells, and cytokines have been completely revised.
- A new Applications of Microbiology box describes the possible use of IL-12 to treat psoriasis.

Chapter 18: Practical Applications of Immunology

- Figure 18.2 is now a Foundation Figure.
- Discussions of DNA vaccines and adjuvants have been updated and revised.
- The tables of vaccine schedules have been updated.
- A new Clinical Focus box illustrates the success of vaccination in eliminating measles in the U.S. and highlights the importance of measles as a cause of death in developing countries.

Chapter 19: Disorders Associated with the Immune System

- Coverage of blood groups includes a discussion of the relationship between certain blood groups and their relative resistance or susceptibility to certain diseases.
- A discussion of the autoimmune disease psoriasis and its associated arthritis has been introduced, along with the current treatments with monoclonal antibodies.
- The discussion of stem cells has been updated, and a new figure (Figure 19.10) the derivation of stem cells and stem cell lines.
- The discussion of HIV and AIDS has been revised and updated. Especially important is the complete revision of Figure 19.13, which shows the sequence of attachment, fusion, and entry of the virus into the target CD4⁺ T cell.
- Figure 19.16 is now a Foundation Figure.

Chapter 20: Antimicrobial Drugs

- Figure 20.2 is now a Foundation Figure.
- The historical importance of the sulfa drugs is given more prominence.
- The current methods used for the discovery of new antibiotics are discussed, including rapid throughput methods.
- The discussion of antibiotics has been updated to admit new antibiotics. The discussion of antivirals for the treatment of HIV/AIDS has been especially updated and revised to include the latest developments in this constantly changing area.
- The discussion of resistance to antibiotics has been completely revised and expanded, and a new Foundation Figure (Figure 20.20) illustrates the most important target areas for resistance.
- The concluding discussion on the future of antibiotic development and the prospect for unconventional antibiotics has been completely revised and updated.

Part Four**Microorganisms and Human Disease****Chapter 21: Microbial Diseases of the Skin and Eyes**

- The discussion of *Staphylococcus aureus* has been completely rewritten to emphasize the importance of MRSA.

- The discussion of impetigo and scalded skin syndrome has been revised, and discussion of a new disease, Buruli ulcer, has been added.
- Some of the newer treatments for acne now have an expanded discussion.

Chapter 22: Microbial Diseases of the Nervous System

- A new figure (Figure 22.4) illustrates a spinal tap.
- The discussion of cryptococcosis has been revised to include a newer pathogen.
- A brief description of prions has been included to supplement that given in Chapter 13.
- The discussion of chronic disease syndrome has been completely revised and now includes the CDC's diagnostic definition and the alternative name of myalgic encephalomyelitis.

Chapter 23: Microbial Diseases of the Cardiovascular and Lymphatic Systems

- The definitions of the similar terms *septicemia* and *sepsis* have been revised.
- Discussions of brucellosis and rat-bite fever have been completely rewritten.
- The discussion of ehrlichiosis has been revised to include the new terminology of anaplasmosis.
- Discussion of the disease chikungunya fever has been added because of its current spread into temperate climates.
- The discussion of malaria has been revised completely to better differentiate between prophylaxis and therapy.

Chapter 24: Microbial Diseases of the Respiratory System

- The discussion of pertussis has been revised to better describe some of the latest developments, especially the recent increase in cases.
- The discussion of tuberculosis has been updated and revised to include more on extensively resistant strains of the pathogen and some of the more recent testing methods.

- Discussion of influenza has been thoroughly revised and updated, especially the means by which mutants arise and the infectiveness of the avian flu virus.

Chapter 25: Microbial Diseases of the Digestive System

- The discussion of traveler's diarrhea has been rewritten to include the important pathogen enteroaggregative *E. coli*.
- Recent therapeutic drugs for HBV have been included.
- The discussion of noroviruses has been updated with special attention to decontamination methods available to deal with outbreaks.

Chapter 26: Microbial Diseases of the Urinary and Reproductive Systems

- The discussion of vaginal microbiota has been extensively revised.
- The introductory discussion of syphilis, especially relating to recent genetic analysis on its probable origin in the New World, has been revised.
- The discussion of testing for syphilis has been revised.
- The TORCH panel of tests is included.

Part Five

Environmental and Applied Microbiology

Chapter 27: Environmental Microbiology

- The sulfur cycle figure (Figure 27.7) has been completely redrawn.
- The discussion of biodegradable plastics has been revised and updated.

Chapter 28: Applied and Industrial Microbiology

- The discussion of biofuels has been expanded.