

# PREFACE

The ninth edition of *Microbiology: An Introduction* is the leading textbook in the non-majors microbiology market. In the 24 years since the publication of the first edition, more than one million students have used this book at more than 1,000 colleges and universities, making it the best-selling introductory microbiology text around the world. The ninth 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. We have been gratified to hear from instructors and students alike that the book has become a favorite among their textbooks—a learning tool that is both effective and enjoyable.

## HALLMARKS OF MICROBIOLOGY: AN INTRODUCTION

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

- **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 applications, and health-related applications are emphasized. Applications are integrated throughout the text, and considerable attention is devoted to microorganisms in habitats outside the human body. We hope students will gain an appreciation for the fascinating diversity of microbial life, the central roles of microorganisms in nature, and the importance of microorganisms to our daily lives.
- **Straightforward presentation of complex topics.** Each section of the text has been revised with the student in mind, to maintain the clarity of explanation for which our book has become known. Step-by-step diagrams closely coordinated with the narrative descriptions further aid student comprehension of concepts.

- **Integrated learning objectives and end-of-chapter questions** help students check their understanding of key chapter concepts and learn critical problem-solving skills needed in clinical and industrial situations.
- **Applications and discovery-oriented boxes** focus on modern, practical uses of microbiology and biotechnology and emphasize the process of scientific discovery. The application boxes show real people working in science to provide students with examples of career opportunities in microbiology.

## 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 those who wish to use a different order, we have made each chapter as independent as possible and have included numerous cross-references. Fundamentals of microbiology are included in Chapters 1 through 9, and other chapters can be used to illustrate and emphasize topics for specific courses. The various diseases are organized into chapters according to the host organ system most affected. The Instructor's Guide, written by Christine L. Case, provides detailed guidelines for organizing the material in several other ways. A taxonomic guide to diseases covered in the text is included in Appendix F.

## NEW TO THE NINTH EDITION

Cutting edge techniques in biotechnology and clinical identification, RNAi and FISH, are explained and illustrated. A section on the new field of Forensic Microbiology is included. Diseases In Focus boxes allow students to compare diseases that present similar symptoms. Taxonomy and nomenclature as well as disease incidence data are current through June 2005. Chapter 17, that introduces the important topic of adaptive immunology, has been completely revised for clarity, accuracy, and readability. In text references to 30 animations, found on The Microbiology Place website and CD-ROM, that explore key concepts in microbiology are indicated with the animation icon: ✱ A visual introduction to the ninth edition follows the Preface.

## 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 June 2005 where possible. The main changes for each chapter are summarized below.

### PART ONE

#### FUNDAMENTALS OF MICROBIOLOGY

##### Chapter 1, The Microbial World and You

- Applications of modern molecular biology to taxonomy have resulted in new or changed names and taxa for many microorganisms. These new names and taxa, approved by the appropriate international nomenclature committee, are used throughout this edition
- The emerging infectious disease discussion includes West Nile Virus, bovine spongiform encephalopathy, Avian influenza, Ebola hemorrhagic fever, severe acute respiratory syndrome (SARS), and cryptosporidiosis

##### Chapter 2, Chemical Principles

- New study questions use microbiological examples

##### Chapter 3, Observing Microorganisms Through a Microscope

- Quorum sensing and bacterial interactions are discussed
- New section on scanning acoustic microscopy (SAM)

##### Chapter 4, Functional Anatomy of Prokaryotic and Eukaryotic Cells

- Revised discussion of gram stain, plasma membrane
- New section on acid fast cell walls
- Gram-positive and gram-negative flagella are compared

##### Chapter 5, Microbial Metabolism

- A discussion of anoxygenic photosynthesis

##### Chapter 6, Microbial Growth

- The discussion of the toxic forms of oxygen has been rewritten to better relate to destruction of microbes by phagocytosis

##### Chapter 7, The Control of Microbial Growth

- New products and newly-approved uses are included

##### Chapter 8, Microbial Genetics

- Important enzymes in DNA replication, expression, and repair are listed in a new table
- New Morbidity & Mortality Weekly Report box describes the use of genomics to track a disease (West Nile encephalitis)

##### Chapter 9, Biotechnology and Recombinant DNA

- RNA interference (RNAi) is illustrated in a new figure
- Forensic microbiology is included

### PART TWO

#### A SURVEY OF THE MICROBIAL WORLD

##### Chapter 10, Classification of Microorganisms

- New discussion of several bacteria that have been recently discovered by means of RNA analysis
- Ribotyping and FISH are described

##### Chapter 11, The Prokaryotes: Domains Bacteria and Archaea

- Phylogenetic classification of prokaryotes is in accordance with *Bergey's Manual of Systematic Bacteriology*, second edition (2005)

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

- New Clinical Problem Solving box describes leishmaniasis in the Middle East
- Fungal names have been updated

##### Chapter 13, Viruses, Viroids, and Prions

- New Morbidity & Mortality Weekly Report box describing crossing the species barrier using Avian influenza as the example
- The one-step bacteriophage curve has been replaced with one-step virus growth curves showing virus growth and patterns of infection
- New photographs compare viral entry by fusion and endocytosis

### PART THREE

#### INTERACTION BETWEEN MICROBE AND HOST

##### Chapter 14, Principles of Disease and Epidemiology

- New section on factors that determine the distribution and composition of normal microbiota with an expanded Table 14.1
- New discussion of probiotics
- New Clinical Problem Solving box describes a nosocomial outbreak
- Data for figures (AIDS, Lyme disease, and typhoid fever) and tables are current through June 2005

##### Chapter 15, Microbial Mechanisms of Pathogenicity

- New section on the conjunctiva
- New section on membrane ruffling
- Revised Table 15.2 on diseases caused by exotoxins

##### Chapter 16: Innate Immunity: Nonspecific Defenses of the Host

- New section on toll-like receptors (TLRs)
- New section on dendritic cells
- New sections on transferrins and antimicrobial peptides

- New summary Table 16.3 covers innate immunity
- New Applications of Microbiology box on serum collection

#### **Chapter 17: Adaptive Immunity: Specific Defenses of the Host**

- Completely rewritten chapter includes an historical context to introduce concepts and terminology in an easy-to-follow format
- Art has been redrawn for accuracy and ease of understanding

#### **Chapter 18: Practical Applications of Immunology**

- The discussion of monoclonal antibodies has now been moved to this chapter
- Definitions for terms such as “sensitivity” and “specificity” are now included

#### **Chapter 19: Disorders Associated with the Immune System**

- The discussion of certain allergies, especially to peanuts and latex, has been improved and expanded
- The relationship between the immune system and cancer and the discussion of Acquired Immunodeficiency Syndrome (AIDS) have been rewritten and expanded

#### **Chapter 20: Antimicrobial Drugs**

- Several new antimicrobial drugs have been introduced, such as the antiviral *adefovir dipivoxil* (Hepsera), the antiprotozoan agent *nitazoxanide*, and a new antifungal *tinidazole*
- There is now a discussion of RNAi to selectively block protein synthesis in important pathogens

### **PART FOUR MICROORGANISMS AND HUMAN DISEASE**

#### **Chapter 21: Microbial Diseases of the Skin and Eyes**

- New discussion of the causes of toxic shock syndrome (TSS) makes a clear distinction between TSS caused by staphylococci and streptococci
- New Clinical Problem Solving box on infections in the gym

#### **Chapter 22: Microbial Diseases of the Nervous System**

- New discussion of lyssavirus-related encephalitis
- Expanded the discussion of amebic encephalitis includes primary amebic meningoencephalitis and granulomatous amebic encephalitis
- New Clinical Problem Solving box on a recent case of human rabies

#### **Chapter 23: Microbial Diseases of the Cardiovascular and Lymphatic Systems**

- Rat bite fever now has a full discussion
- New discovery that the animal reservoir for the Ebola virus is fruit bats
- New Clinical Problem Solving box on tularemia from pet rodents

#### **Chapter 24: Microbial Diseases of the Respiratory System**

- An important disease endemic in Asia and Australia, melioidosis, has been introduced; cases of this disease also occurred among European visitors in the tsunami-affected areas surrounding the Indian Ocean in 2004
- New discussion of the influenza-like epidemic of the SARS-associated corona-virus
- Updated discussion of the 1918 Spanish flu pandemic and a description of the 2005 resurrection of the 1918 virus
- New Clinical Problem Solving box on a legionellosis outbreak

#### **Chapter 25: Microbial Diseases of the Digestive System**

- New discussion of the important disease condition, *Clostridium-difficile*-associated-diarrhea
- New discussion of waterborne *Vibrio* bacterial infections related to Hurricane Katrina
- New Clinical Problem Solving box on a foodborne salmonellosis outbreak; includes relative risk calculation

#### **Chapter 26: Microbial Diseases of the Urinary and Reproductive Systems**

- New discussion of vaccines that promise to block development of cervical cancer caused by certain strains of human papilloma viruses
- New Clinical Problem Solving box with updated information on antibiotic resistant gonococci

### **PART FIVE ENVIRONMENTAL AND APPLIED MICROBIOLOGY**

#### **Chapter 27: Environmental Microbiology**

- New discussion of the Blue Flag campaign by an international body that identifies beaches in the world that meet sanitation standards
- New Microbiology In the News box on illnesses after Hurricane Katrina resulting from the breakdown of sewage disposal and water purification systems

#### **Chapter 28: Applied and Industrial Microbiology**

- The discussion of radiation and high pressure for food preservation has been expanded

## ACKNOWLEDGEMENTS

In preparation for this textbook, we have benefited from the guidance and advice of a large number of microbiology instructors across the country. The reviewers listed on the next page provided constructive criticism and valuable suggestions at various stages of the revision. We gratefully acknowledge our debt to these individuals.

We also thank the staff at Benjamin Cummins for their dedication to excellence. Leslie Berriman, our executive editor, successfully kept us all focused on where we wanted this revision to go. Carla Breidenbach's careful attention to continuity and detail in her copyedit of both text and art served to keep concepts and information clear throughout. Janet Vail and Wendy Earl expertly guided the text through the production process. Linda Jupiter effectively managed the large art program. The photo researcher, Maureen Spuhler, made sure we had clear and striking images throughout the book. Yvo Reizebos created the interior design and did a wonderful job with the cover. Techbooks/GTS did their usual outstanding job moving this book quickly and beautifully through composition; the skilled team was led by Sandie Sigris. Stacey Weinberger guided the book through the manufacturing process. Leslie Austin expertly guided the production of the supplements, with support from David Novak.

We would all like to acknowledge our spouses and families, who have provided invaluable support throughout the writing process.

Finally, we have an enduring appreciation for our students, whose comments and suggestions provide insight and remind us of their needs. This text is for them.

Gerard J. Tortora  
Berdell R. Funke  
Christine L. Case

## NINTH EDITION REVIEWERS

Joel Adams-Stryker, *Evergreen Valley College*  
Joan Baird, *Rose State College*  
Tobie Bogart, *Jefferson State Community College*  
Kari Cargill, *Montana State University*  
Lee Couch, *University of New Mexico*  
Katherine Foreman, *Moraine Valley Community College*  
Joe Francis, *The Master's College*  
Stephen Greenwald, *Gordon College*  
Keith R. Hench, *Kirkwood Community College, Iowa City*  
Dawn Janich, *Community College of Philadelphia*  
Richard D. Karp, *University of Cincinnati*  
V. Karunakaran, *St. Francis Xavier University*  
Judy Kaufman, *Monroe Community College*  
Michael A. Lawson, *Missouri Southern State University*  
Jean Lu, *University of Tennessee, Martin*  
Anne LaGrange Loving, *Passaic County Community College*  
Brian K. Martin, *University of Iowa*  
Richard L. Myers, *Southwest Missouri State*  
Klaus R. L. Nüsslein, *University of Massachusetts, Amherst*  
Judy L. Penn, *Shoreline Community College*  
Laraine Powers, *East Tennessee State University*  
Thomas F. Reed, *Brevard Community College*  
Stephen Y. K. Seah, *University of Guelph*  
Julie Shaffer, *University of Nebraska, Kearney*  
Teri Shors, *University of Washington, Oshkosh*  
Ralph E. Smith, *Colorado State University*  
David S. Treves, *Indiana University Southeast*  
Jane A. Weston, *Genesee Community College*  
Ruth A. Wrightsman, *Saddleback College*