



Preface

The seventh edition of *Microbiology: An Introduction* continues to be a comprehensive text for students in a wide variety of programs. Among these are allied health sciences, biological sciences, environmental studies, animal science, forestry, agriculture, home economics, and liberal arts. It is a beginning text, assuming no previous study of biology or chemistry.

During the 18 years since the publication of the first edition, this book has been used at more than 1000 colleges and universities by over 800,000 students, making it the best selling introductory text around the world. 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.

We have retained in this new edition the 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 in 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.
- **The 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 applications boxes show real people doing science to provide students with examples of career opportunities in microbiology.

Features of the Seventh Edition

Our primary goal for the seventh edition of *Microbiology: An Introduction* was to again update the book throughout, making certain it reflects the important new discoveries and reclassification of microbes during the past few years. This updating is evident in such topics as emerging infectious diseases, the phylogenetic classification of prokaryotes in accordance with the forthcoming 2nd edition of *Bergey's Manual of Systematic Bacteriology*, phylogenetic classification of fungi and protozoa, chromosome mapping and genomics, DNA chips, trichothecene mycotoxins, acute-phase proteins, vaccine safety, new groups of antibiotics, revised discussion of bioremediation and biofilms, new advances in microscopy, diagnostic immunology, AIDS, and industrial uses of microbes. At the same time, we wanted to maintain a manageable length with an emphasis on clear coverage of the fundamental principles of microbiology. Every page and every figure of the book was scrutinized with these goals in mind. The narration has been updated throughout and every element of the art program has been revised, refined, and updated.

The following list highlights the major changes in this edition:

- **NEW In-text instructions for using technology.** Within the Study Outlines at the end of each chapter, icons for the Student Tutorial Version 2.0 direct students to the appropriate topic, subtopic and interactive activity on the CD. In addition, new end-of-chapter “Learning with Technology” sections give students specific instructions for completing relevant CD-ROM and website exercises and quizzes for each chapter. Students will now find it easier to make the best use of their two free CD-ROMs (the Microbiology Interactive Student Tutorial Version 2.0 and Bacteria ID) as well as The Microbiology Place website.
- **NEW The Microbiology Place Web site** (www.microbiologyplace.com) This new, in-depth, subscription-based web site contains exciting and highly interactive microbiology study aids and teaching resources. The site includes tutorial animations, simulations, chapter quizzes, articles, web links, case studies, a syllabus manager, answers to the end-of-chapter study questions, and a Microbe of the Month contest. A FREE 12-month subscription is included with each new student copy of the text.
- **Updated Applications boxes.** To stay abreast of new developments in the field, most boxes have either been updated or are new to the Seventh Edition. *Applications of Microbiology* boxes focus on modern, practical uses of microbiology and biotechnology. *Microbiology in the News* boxes make sense of stories in today’s headlines. *Morbidity and Mortality Weekly Report* boxes review the latest epidemiological cases from the CDC. *New Clinical Problem Solving* boxes use case histories adapted from recent issues of *Morbidity and Mortality Weekly Report* to encourage critical thinking in the examination of a clinical problem.
- **An exceptional art program includes many new micrographs and figures.** Well-developed, full-color illustrations throughout the book support and enhance the text. Key concepts and questions appear in figure legends to encourage students to think critically about illustrations.

Key features of the illustration program include:

Consistent use of symbols and colors. Molecules such as phosphate groups (Ⓢ) and ATP (Ⓢ) are the same color and shape throughout the book, enabling students to progress from familiar parts of illustrated processes to unfamiliar ones with confidence.

Orientation diagrams. These miniature versions of overview illustrations, with appropriate parts highlighted, have been retained and expanded.

Step-by-step descriptions. Step-by-step descriptions, in both the narration and illustrations, walk students through important microbiological processes and help them visualize the order of events. Color-coded numbers link text and figure legends to corresponding art.

Micrograph icons. Icons appear throughout the book to identify the types of microscopes used in the micrographs. Red **SEM** (scanning electron micrographs) icons and **TEM** (transmission electron micrographs) icons indicate the use of colorized micrographs. The **LM** icon indicates light micrographs.

Approximately 350 key illustrations are included in the transparency acetate package, with additional selections provided in the Digital Library Art CD-ROM. See “Supplementary Materials for the Instructor.”

Chapter Highlights of the Seventh Edition

Every chapter in this edition has been thoroughly revised, and all the data in the text, tables, and figures have been updated through January 2000 where possible. The main changes for each chapter are summarized below.

Part One: Fundamentals of Microbiology

- **Chapter 1, The Microbial World and You** Living organisms are classified into Bacteria, Archaea, and Eukarya domains. Emerging infectious disease discussion includes bovine spongiform encephalopathy, *E. coli* O157:H7, Ebola hemorrhagic fever, *Hantavirus* pulmonary syndrome, and cryptosporidiosis. Topics are reorganized and several new photos are included.
- **Chapter 2, Chemical Principles,** includes an enhanced discussion of enzymes.
- **Chapter 3, Observing Microorganisms Through a Microscope,** has revised illustrations and an atomic-force micrograph.
- **Chapter 4, Functional Anatomy of Prokaryotic and Eukaryotic Cells,** includes new illustrations of eukaryotic cells and a revised discussion of eukaryotic cells to include peroxisomes and centrosomes.
- **Chapter 5, Microbial Metabolism,** includes revised inset diagrams of metabolic pathways.

- **Chapter 6, Microbial Growth** Hyperthermophiles are included with a new diagram illustrating the relationships between hydrothermal vent worms and their symbiotic bacteria.
- **Chapter 7, The Control of Microbial Growth**, includes several new and updated discussions including: biocides, plasma gas sterilization, bisphenols (triclosan), conditions that influence microbial control, and relative susceptibility of microbes to biocides. A new *Clinical Problem Solving* box shows the link between resistance to chemical disinfectants and hospital-acquired infections.
- **Chapter 8, Microbial Genetics**, has been carefully revised to include 5'–3' orientation of DNA and RNA. Miniature orientation diagrams have been added to figures to show the relationship of specific processes to vertical and horizontal gene transmission. Chromosome mapping and genomics are described, and DNA chips are introduced.
- **Chapter 9, Biotechnology and Recombinant DNA**, has been revised to emphasize microbiological techniques such as selection and mutation. Antisense DNA technology is introduced, and the use of biotechnology to make blue jeans is described in a new box.

Part Two:

A Survey of the Microbial World

- **Chapter 10, Classification of Microorganisms** Phylogenetic classification of prokaryotic organisms is updated to reflect application of rRNA sequencing and *Bergey's Manual of Systematic Bacteriology*, Second Edition. Figures of domains include taxa that students will encounter in Chapters 11 and 12.
- **Chapter 11, The Prokaryotes: Domains Bacteria and Archaea**, has been completely revised to reflect the phylogenetic classification of prokaryotes, in accordance with *Bergey's Manual of Systematic Bacteriology*, Second Edition. Learning objectives encourage students to develop dichotomous keys to practice differentiating between bacteria and to learn characteristics of selected bacteria.
- **Chapter 12, The Eukaryotes: Fungi, Algae, Protozoa, and Helminths** The phylogenetic classification of fungi and protozoa is updated. An emerging infectious disease is introduced in a new MMWR box on *Pfiesteria* and possible estuarine-associated syndrome.

- **Chapter 13, Viruses, Viroids, and Prions** A figure showing how prions can be infectious is added. The MMWR box on AIDS risk to health care workers is updated.

Part Three:

Interaction Between Microbe and Host

- **Chapter 14, Principles of Disease and Epidemiology** The pioneering epidemiologic works of Snow, Semmelweis, and Nightingale are included. A new *Clinical Problem Solving* box describes an actual nosocomial outbreak of streptococcal toxic-shock syndrome. Morbidity data on nosocomial infections, AIDS, Lyme disease, and tuberculosis are updated. There is a revised discussion of nosocomial infections and incidence and prevalence of disease.
- **Chapter 15, Microbial Mechanisms of Pathogenicity** Trichothecene mycotoxins are included.
- **Chapter 16, Nonspecific Defenses of the Host**, includes a new box that describes nitric oxide activation in macrophages. The role of normal microbiota in nonspecific resistance is discussed, and acute-phase proteins are included.
- **Chapter 17, Specific Defenses of the Host: The Immune Response**, contains an expanded discussion of colostrum as a factor in immunity. There is an updated and revised discussion of apoptosis, or programmed cell death. Figure 17.18, which describes the dual nature of the immune system, has been extensively revised.
- **Chapter 18, Practical Applications of Immunology**, includes a new discussion on vaccine safety. There is also expanded coverage of the development of new and novel vaccines, better administration methods for vaccines, and ways to increase the effectiveness of present vaccines, such as the use of adjuvants. New disease diagnostic methods are also included.
- **Chapter 19, Disorders Associated with the Immune System** The section on AIDS has been thoroughly updated, and now includes coverage of the theoretical origins of the virus and the beginning of the epidemic, the theoretical concepts of the pathology of the disease, a discussion of new tests for HIV infection and for the detection of the virus in donated blood, and an updated discussion of the progress of the infection worldwide. The MMWR box on AIDS drugs is also updated.

- **Chapter 20, Antimicrobial Drugs** The new groups of antibiotics, streptogramins, is included, and there is a revised discussion of many commonly used antibiotics. The topic of rising resistance to antibiotics, antibiotic safety, and the search for entirely new antibiotics is extensively updated and revised.

Part Four: Microorganisms and Human Disease

- **Chapter 21, Microbial Diseases of the Skin and Eyes**, contains a revised discussion of acne and its treatment; new artwork illustrates the latency of certain herpes viruses; the childhood disease roseola has been added; and the discussion of eye infections caused by the use of contact lenses has been updated and revised. A new *Clinical Problem Solving* box describes an emerging necrotizing mycobacterial disease.
- **Chapter 22, Microbial Diseases of the Nervous System** A new *Clinical Problem Solving* box describes an actual case of rabies and a new figure illustrates the pathogenesis of rabies. Recent data comparing the incidence of meningitis attributed to different organisms is included. In the discussion of leprosy, the terms now used by the World Health Organization to describe the stages have been introduced. A discussion of the outbreak of the arbovirus disease, West Nile Virus, in New York, has been added. The discussion of prion-causing diseases has been updated and expanded.
- **Chapter 23, Microbial Diseases of the Cardiovascular and Lymphatic Systems** An entirely new discussion of the disease leishmaniasis has been introduced. The discussion of brucellosis has been completely revised. The discussion of anthrax has been revised with an emphasis on its possible use as an agent of biological terrorism. The discussions about cat-scratch disease and schistosomiasis have been updated and revised. A new *Clinical Problem Solving* box describes the re-emergence of malaria in the United States.
- **Chapter 24, Microbial Disease of the Respiratory System** The discussion of otitis media has been updated and expanded; the disease caused by respiratory syncytial virus extensively updated and revised; the potential for new vaccines for influenza is described. The new drugs now available for treat-

ment of influenza are discussed. A new *Clinical Problem Solving* box follows diagnosis of an actual case of streptococcal pneumonia.

- **Chapter 25, Microbial Diseases of the Digestive System** Methods for detecting the serious pathogen *Escherichia coli* 0157:H7 are discussed. The discussion of Hepatitis C is expanded. A new *Clinical Problem Solving* box describes a multistate outbreak of shigellosis from one source.
- **Chapter 26, Microbial Diseases of the Urinary and Reproductive Systems** Diagnostic methods for syphilis have been updated and revised. The discussion of genital herpes has been updated and expanded. A new *Clinical Problem Solving* box describes a urinary tract infection among athletes.

Part Five: Environmental and Applied Microbiology

- **Chapter 27, Environmental Microbiology** The discussion of acid deposition (acid rain) has been revised, and there is an expanded discussion of bioremediation and biofilms. There is also more coverage of the forms of life that are not dependent upon energy inputs from sunshine, with a special emphasis on microbial life found deep in the rocks of the earth's mantle.
- **Chapter 28, Applied and Industrial Microbiology**, contains an expanded discussion of irradiation of food. There is also a revised discussion of microbiological processes in (copper) ore extraction.

Course Sequences

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 Instructor's Guide provides detailed guidelines for organizing the material in several other ways. The various diseases are organized into chapters according to the host organ system most affected. A taxonomic guide to diseases covered in the text is included in Appendix F.

A Comprehensive Teaching and Learning Package

The supplementary materials developed by Benjamin Cummings for the Seventh Edition of Microbiology are more innovative and thorough than ever before—in print, on CD-ROM, and on the Web—for instructor and student alike.

Supplementary Materials for the Student

- **REVISED Microbiology Interactive Student Tutorial CD-ROM Version 2.0** Included with every text, this CD includes tutorials, interactive activities, and simulations covering microbiology's toughest topics: viruses, microbial growth, genetics, biotechnology, microbial interactions, metabolism, biodiversity, and immunology. The new, easy-to-use interface emphasizes the interrelationships of microbiology concepts and provides a direct link to The Microbiology Place Web site. Version 2.0 features five new interactive activities: Using PCR to identify microbes in environmental samples, Nitrogen cycle, Gene cloning practice, Virus identification, Host and pathogen responses during infection, and three new simulations: The effect of sewage treatment on waterways, Industrial fermentations in a bioreactor, and Enzyme inhibitors drugs. It also includes a complete glossary with pronunciations and quizzes for each chapter. FREE with text.
- **NEW The Microbiology Place Web site** (www.microbiologyplace.com) FREE 12-month subscription with every student copy of the book. (See "Features of the Seventh Edition" for more details.)
- **Bacteria ID CD-ROM** This comprehensive computer simulation program teaches students how to identify unknown bacteria. It contains more than sixty species of bacteria, including sixteen human pathogens, and a choice of approximately 50 different tests. Bacteria ID exercises, written by Christine L. Case, are integrated into appropriate chapters in the text in the "Learning with Technology" sections. Instructions for getting started using the CD-ROM are included in Appendix G. Packaged FREE with text.
- **REVISED Student Study Guide** by Berdell Funke (0-8053-7585-6) Revised for the new edition, the study guide includes concise explanations of

key concepts, definitions of important terms, art labeling exercises, critical thinking problems, and a variety of self-test questions with answers.

- **NEW Microbiology: A Photographic Atlas for the Laboratory** by Steve K. Alexander and Dennis Strete (0-8053-2732-0) Tailored for the introductory microbiology laboratory, this atlas contains approximately 400 high-quality, color photographs that demonstrate the results of laboratory procedures and the morphology of important microorganisms.
- **REVISED Laboratory Experiments in Microbiology, Sixth Edition** by Ted Johnson and Christine Case (0-8053-7589-9) Includes 57 classroom-tested experiments that meet ASM recommendations for the laboratory core curriculum considered essential to teach in every introductory microbiology laboratory. These experiments reinforce lecture concepts in metabolism, growth, genetics, and immunology and also promote critical thinking, laboratory thinking skills, and good laboratory practices. A **Preparation Guide** (0-8053-7586-4) is available to instructors to aid in the preparation of lab sessions.
- **Microbiology Coloring Book** by I. Edward Alcamo and Lawrence Elson (0-06-041925-3) This unique study tool contains 105 plates, including text and illustrations to color, which enhance understanding and comprehension of important microbiological concepts.

Supplementary Materials for the Instructor

All supplemental teaching materials are available to qualified adopting instructors. Please contact your local Benjamin Cummings sales consultant or call our Customer Service at 781-944-3700 x5100. Some package items may not be available to adopters outside of the United States.

- **REVISED Instructor's Guide and Test Bank** (0-8053-7584-8) Written and revised by Christine L. Case, the Instructor's Guide contains teaching tips, alternative course outlines, ideas for using special text features, answers to text questions, and suggestions on how to incorporate the use of technology into the classroom. The Test Bank features over 1200 multiple-choice questions with answers as well as 3–5 essay questions per chapter.
- **UPDATED Computerized Test Bank CD-ROM** (Test Gen 3.0 0-8053-7588-0 Windows/Macintosh)

Easy-to-use testing program allows you to view and edit electronic questions from the Test Bank, create multiple tests, and print them in a variety of formats.

- **EXPANDED Transparency Acetates** (0-8053-7591-0) Features approximately 350 key illustrations from the text, 50% more than in the previous edition package.
- **NEW Digital Library: Instructor's Presentation CD-ROM** (0-8053-7545-7) Includes all illustrations from the text and several tables which can be edited and customized for lecture presentations. Images can be easily exported into PowerPoint or course Web pages in three formats: images with labels and leaders, images with leaders only, and images with no labels or leaders. Cross platform CD-ROM.
- **NEW Course Management Systems, including WebCT, Blackboard, and eCollege** Useful for on-line course management and distance learning courses, content selected from The Microbiology Place and the entire computerized Test Bank is available in the three leading course management systems. Please contact your local Benjamin Cummings sales consultant for more details.

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created the interior design and the beautiful cover. GTS Graphics did their usual outstanding job moving this book quickly and beautifully through composition; the skilled team was led by Sandie Sigrist. Stacey Weinberger guided the book through the manufacturing process. In addition, Erin Joyce did an excellent job preparing the manuscript and managing the extensive supplements package. Larry Olsen expertly guided the production of the supplements.

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