



Preface

The authors are proud to present the 12th edition of *Brock Biology of Microorganisms* (BBOM 12/e). The roots of this book go back nearly 40 years, but its main objective has never wavered: to present the basic principles of microbiology in a clear and exciting way. We hope that the 12th edition of what is now a textbook classic continues in this vein and inspires a new generation of microbiologists to choose careers in this fascinating field.

Microbiology today places unusual demands on students and instructors alike. It also places unusual demands on textbook authors. The knowledge base in microbiology is simply enormous, and as authors, our job is to describe the principles along with a reasonable amount of supporting material. Thus, to maintain the authority that users of this book have become accustomed to, and also to keep the book within bounds, two new coauthors have joined the BBOM author team. David Clark, an expert in bacterial genetics and molecular biology and the author of two popular textbooks in molecular biology, has authored the chapters in BBOM that deal with these topics. Paul Dunlap, an expert in bacterial systematics and microbial evolution, has authored the microbial diversity and evolution chapters. Madigan and Martinko have authored the remaining chapters. Along with our publisher, Benjamin Cummings, who took over this project midstream from Prentice Hall, we feel we have produced a book that both students and instructors will find enticing and exciting.

WHAT'S NEW IN THE 12TH EDITION?

Instructors who have taught from BBOM in the past will be quite comfortable with this new edition. As usual, the chapters are organized into modules by numbered head, which allows instructors to build their courses as they see fit. In addition, study aids and review tools are an integral part of the text. Our new MiniReviews feature, which debuts with the 12th edition, is intended to refresh students' understanding and challenge their mastery of the principles as they work their way through a chapter. Also new to this edition is the location of the newly-named Review of Key Terms feature, which now summarizes a chapter's key terms and complements the challenging review questions that form the heart of the end-of-chapter review materials. A comprehensive glossary and index wrap up the learning package.

All of these learning aids are displayed in a new, more open design that gives the figures and other elements in the book some breathing room and has allowed us to present the material in a more visually appealing way. Supporting the narrative is a spectacular illustration program, with every piece of art revised as needed for content, clarity, or color contrast. The distinctive illustrations are accurate and highly instructive. The

art complements (and in many cases integrates) the hundreds of photos in this text, many of which are new to this edition.

Our Microbial Sidebars in BBOM 12/e are fun reads of enrichment material related to chapter themes. Several new Microbial Sidebars were written for this edition, including "Microbial Growth in the Real World: Biofilms" (Chapter 6); "Did Viruses Invent DNA?" (Chapter 10); "Mimivirus and Virus Evolution" (Chapter 19); "Synthetic Biology and Bacterial Photography" (Chapter 26); "Probiotics" (Chapter 28); "SARS as an Example of Epidemiological Success" (Chapter 33); "Special Pathogens and Viral Hemorrhagic Fevers" (Chapter 35); and "Spinach and *Escherichia coli* O157:H7" (Chapter 37).

Although the 12th edition is about the same length as the 11th edition, careful editing by the author team has allowed several new chapters to debut in this edition. Chapter 8 (Archaeal and Eukaryotic Molecular Biology) focuses on the molecular biology of *Archaea* and their relationships to eukaryotic cells. Chapter 12 (Genetic Engineering) describes the tools that underlie the revolution in molecular biology. Chapter 14 (Microbial Evolution and Systematics) is a fresh new approach to issues surrounding the origin of life and microbial evolution. Chapter 26 (Biotechnology) reviews the basic science behind the biotech revolution and presents several spectacular examples of the benefits of biotechnology to human medicine, and plant and animal agriculture. Chapter 30 (Immunology in Host Defense and Disease) pulls together many of the applied aspects of immunology and shows how the immune response keeps us healthy. Coupled with these new chapters are many heavily reworked chapters. Readers will especially appreciate the more phylogenetic approach to the systematics of both prokaryotes and eukaryotes in this new edition as well as the expanded ecology material that includes some exciting and experimentally tractable microbial symbioses. Material on microbial genomics has also been greatly updated to reflect the pace and excitement of research in this area today.

CHAPTER-BY-CHAPTER REVISIONS

BBOM 12/e is the textbook of microbiology for both the beginning student and the seasoned researcher; it displays the perfect mix of principles and details. Major topics include general principles (structure/function, metabolism and growth), molecular biology/genetics, genomics, evolution and microbial diversity, metabolic diversity, microbial ecology, biotechnology and industrial microbiology, control of microbial growth, basic and applied immunology, and complete coverage of infectious diseases organized by mode of transmission. In addition, BBOM 12/e maintains a theme of evolution and ecology from beginning to end and is the only book that recognizes the importance and unique biology of *Archaea*. See highlights as follows.

Chapter 1

- New coverage on the antiquity and extent of microbial life and on careers in microbiology
- Expanded coverage of the contributions of Louis Pasteur

Chapter 2

- Broad coverage of all forms of microscopy
- An updated snapshot of microbial diversity

Chapter 3

- The essentials of cell chemistry with an emphasis on what students really need to know to understand how cells work

Chapter 4

- A streamlined chapter focused on the principles of prokaryotic cell structure and function

Chapter 5

- New discussion on the chemical elements of life
- Major coverage of catabolic principles plus an overview of essential anabolic reactions
- A new box entitled "The Products of Fermentation and the Pasteur Effect" that ties together the concepts of fermentation and respiration

Chapter 6

- Expanded coverage of cell division processes supported by spectacular new art and color photos
- A new box entitled "Microbial Growth in the Real World: Biofilms"

Chapter 7

- A substantially revised treatment that brings together the essential principles of molecular biology in *Escherichia coli*, the model species of *Bacteria*

Chapter 8

- A brand-new chapter that compares/contrasts the molecular biology of *Archaea* with that of *Eukarya* and *Bacteria*
- A new box entitled "Inteins and Protein Splicing"
- Coverage of RNA interference (RNAi), research that garnered a 2006 Nobel Prize

Chapter 9

- Major updates of the regulation of gene expression, one of the hottest areas in microbiology today
- New material on negative and positive control, global control, quorum sensing, gene regulation in *Archaea*, regulation of sporulation in *Bacillus*, the *Caulobacter* life cycle, and RNA-based regulation

Chapter 10

- The essential principles of virology plus a snapshot of viral diversity
- New coverage of subviral entities, including prions and viroids
- An intriguing new box entitled "Did Viruses Invent DNA?"

Chapter 11

- A streamlined chapter that now deals exclusively with bacterial genetics: chromosomes and plasmids, mutation, and genetic exchange
- New coverage of genetic exchange in *Archaea*

Chapter 12

- A discussion of modern *in vitro* molecular methods, molecular cloning, and genetic manipulations, all brought together in one chapter as a prelude to genomics

Chapter 13

- Microbial genomics as we know it today. Coverage of genome function and regulation, the evolution of genomes, and the exciting field of metagenomics

Chapter 14

- New detailed coverage of the origin of life and endosymbiosis
- Expanded coverage of theoretical and analytical aspects of molecular evolution and microbial phylogeny

Chapters 15–17

- Prokaryotic diversity presented in a phylogenetic context. Chapter 15 covers all five subdivisions of *Proteobacteria*, and Chapter 16 covers other well-studied lineages of *Bacteria*. Chapter 17 updates the biology of *Archaea*.
- Spectacular photo- and electron micrographs that guide the reader through the diversity of *Bacteria* and *Archaea*
- All bacterial names updated to the latest in nomenclatural standards

Chapter 18

- A revised treatment of the cell biology and diversity of microbial eukaryotes
- A truly phylogenetic rather than taxonomic treatment of eukaryotic microbial diversity based on multiple gene and protein analyses

Chapter 19

- Viral diversity from bacteriophages through animal and plant viruses organized by replication mechanism
- An exciting new box focused on giant viruses entitled "Mimivirus and Virus Evolution"

Chapters 20–21

- Coverage of metabolic diversity in two reorganized chapters that group related processes: Chapter 20, phototrophy, chemolithotrophy, and important biosyntheses; Chapter 21, catabolism of organic compounds
- Coverage of new metabolic processes, such as proton reduction as an anaerobic respiration and the mechanism of anoxic hydrocarbon oxidation

Chapter 22

- All the latest methods in microbial ecology, including new coverage of cutting-edge methods such as phylochips, T-RFLP, and stable isotope probing

Chapter 23

- Principles of microbial ecology and descriptions of major microbial habitats
- Expanded coverage of biofilms, including new photos of the development of *Pseudomonas aeruginosa* biofilms

Chapter 24

- Microbial ecology with a focus on nutrient cycles, bioremediation, and microbial animal and plant symbioses
- New, richly illustrated coverage of the *Aliivibrio*–squid symbiosis

Chapter 25

- The principles behind major commercial microbial fermentations
- Expanded coverage of wine production

Chapter 26

- Biotechnology with the emphasis on products rather than methods
- Expanded coverage of transgenic plants and animals
- A fascinating new box entitled “Synthetic Biology and Bacterial Photography” that ties basic research into a unique microbial application

Chapter 27

- An introduction to microbial growth control, in particular, antibiotics and their mode of action
- Expanded coverage of antibiotic resistance and infection control

Chapter 28

- Revised treatment of the human normal flora based on molecular microbial community analyses
- Expanded discussion of virulence factors using *Salmonella* as an example and microbial toxins and toxin mechanisms
- A new box entitled “Probiotics” that answers the question: Do live bacterial supplements really have any benefit?

Chapters 29–31

- The world of immunology: Chapter 29 (the essentials), Chapter 30 (host defenses and applications), and Chapter 31 (immune mechanisms at the molecular level). All chapters are modular so that instructors can pick and choose topics that work best in their courses.
- Major revisions to art in all of these chapters in order to greatly improve consistency

Chapter 32

- A streamlined treatment of modern immunological and molecular methods used in clinical diagnostics

Chapter 33

- Updates of the HIV–AIDS pandemic and other important emerging infectious diseases
- A snapshot of the rapidly changing picture in healthcare-associated disease and infection control
- A new box entitled “SARS as an Example of Epidemiological Success” that connects SARS surveillance with the control of other rapidly emerging diseases

Chapter 34

- Major human diseases organized by mode of transmission
- Updated and expanded coverage of streptococcal and staphylococcal diseases and increased antibiotic resistance
- Expanded coverage of influenza and scenarios for a pandemic
- A new section on human papillomavirus infection as a preventable and treatable sexually transmitted disease that can lead to cancer

Chapter 35

- An updated chronicle of the spread of West Nile virus across the United States and the implications of this avian disease for human health
- An exciting new box entitled “Special Pathogens and Viral Hemorrhagic Fevers” that describes an important branch of the U.S. Centers for Disease Control (CDC) that deals with extremely dangerous pathogens

Chapter 36

- Expanded coverage of water quality assessment methods, including current U.S. Environmental Protection Agency standards

Chapter 37

- Discussion of “aseptic processing,” a new preservation method in the food industry
- An update on *Salmonella* as a food pathogen
- A timely new box entitled “Spinach and *Escherichia coli* O157:H7” that explores the transmission of this food pathogen by plant as well as animal food products