

PREFACE

Books are the carriers of civilization. Without books, history is silent, literature dumb, science crippled, thought and speculation at a standstill. They are engines of change, windows on the world, lighthouses erected in a sea of time.

Barbara Tuchman

Microbiology is an exceptionally broad discipline encompassing specialties as diverse as biochemistry, cell biology, genetics, taxonomy, pathogenic bacteriology, food and industrial microbiology, and ecology. A microbiologist must be acquainted with many biological disciplines and with all major groups of microorganisms: viruses, bacteria, fungi, algae, and protozoa. The key is balance. Students new to the subject need an introduction to the whole before concentrating on those parts of greatest concern to them. This text provides a balanced introduction to all major areas of microbiology for a variety of students. Because of this balance, the book is suitable for courses with orientations ranging from basic microbiology to medical and applied microbiology. Students preparing for careers in medicine, dentistry, nursing, and allied health professions will find the text just as useful as those aiming for careers in research, teaching, and industry. A quarter/semester or two each of biology and chemistry is assumed, and an overview of relevant chemistry is also provided in appendix I.

Organization and Approach

The book is organized flexibly so that chapters and topics may be arranged in almost any order. Each chapter has been made as self-contained as possible to promote this flexibility. Some core topics are essential to microbiology and have been given more extensive treatment. The chapters that cover these topics (chapters 2–19 and 30–33) are somewhat longer than others and may be combined with a selection of noncore chapters to achieve the desired orientation, whether basic, applied, or medical. The text is available not only in a casebound version but also as three separate paperbound volumes. Volume one covers the more general aspects of microbiology (chapters 1–28); volume two, immunology and medical microbiology (chapters 29–39); and volume three, microbial ecology and

applied microbiology (chapters 40–44). Thus, the complete text is available as a boxed set, or its separate volumes can be used in courses with a specific focus.

The book is divided into 11 parts. The first 5 introduce the foundations of microbiology: the development of microbiology, the structure of microorganisms, microbial growth and metabolism, microbial genetics, the control of microorganisms, and the nature of viruses. In this second edition, the microbial genetics unit directly follows microbial growth and metabolism (Part Two) and discusses genetics before the introduction to viruses (Part Five). Part Six is a survey of the microbial world. The bacterial survey closely follows the organization of *Bergey's Manual of Systematic Bacteriology*. Because of the importance and uniqueness of archaeobacteria, the second edition contains a separate chapter on them. Although principal attention is devoted to bacteria, eucaryotic microorganisms receive more than usual coverage. Fungi, algae, and protozoa are important in their own right. The introduction to their biology in chapters 26–28 is essential to the understanding of topics as diverse as clinical microbiology and microbial ecology. Part Seven discusses symbiotic associations and parasitism in depth, providing a good foundation for the later survey of specific diseases. Three chapters in Part Eight describe in detail all major aspects of the immune response. Part Nine begins with an introduction to epidemiology and clinical microbiology, followed by a survey of the major human microbial diseases. The disease survey is primarily organized taxonomically on the chapter level; within each chapter, diseases are covered according to mode of transmission. This approach provides flexibility and allows the student easy access to information about any disease of interest. The survey is not a simple cataloguing of diseases; diseases are included because of their medical importance and their ability to illuminate the basic principles of disease and resistance. Part Ten focuses on the relationship of microorganisms to aquatic and terrestrial

environments. Chapter 40 presents the general principles underlying microbial ecology and environmental microbiology so that the chapters on aquatic and terrestrial habitats can use them without excessive redundancy. Part Eleven concludes the text with an introduction to food and industrial microbiology. Five appendices aid the student with a review of some basic chemical concepts and with extra information about important topics not completely covered in the text.

Besides major organizational changes, every chapter has been thoroughly revised and updated. Examples of more significant changes are the following:

1. Sections on the polymerase chain reaction and techniques for inserting genes into eucaryotic cells have been added (chapter 14).
2. The effects of rRNA sequence studies on bacterial taxonomy are described in more detail (chapter 20).
3. New diseases, such as peptic ulcer disease (chapter 37), have been added, and the AIDS material has been combined into one section (chapter 36).
4. The Universal Precautions are described (box 34.1 and the endnotes).
5. A new unit on marine microbiology has been added (chapter 41).
6. The use of recombinant DNA techniques in industrial microbiology is described (chapter 44).

This text is designed to be an effective teaching tool. A text is only as easy for a student to use as it is easy to read. Readability has been enhanced by using a relatively simple, direct writing style, many section headings, and an organized outline format within each chapter. The level of difficulty has been carefully set with the target audience in mind. During preparation of the second edition, every sentence was carefully checked for clarity and revised when necessary. The American Society for Microbiology's *ASM Style Manual* conventions for nomenclature and abbreviations have been followed as consistently as possible.

The many new terms encountered in studying microbiology are a major stumbling block for students. This text lessens the problem by addressing and reinforcing a student's vocabulary development in three ways: (1) no new term is used without being clearly defined (often derivations are also given)—a student does not have to be familiar with the terminology of microbiology to use this text; (2) the most important terms are printed in boldface when first used; and (3) an extensive, up-to-date, page-referenced glossary is included at the end of the text.

Because illustrations are critical to a student's learning and enjoyment of microbiology, all illustrations in the second edition are full-color, and as many color photographs as possible have been used. Color not only enhances the text's attractiveness but also increases each figure's teaching effectiveness. More than 90 new illustrations have been added, and all line art has been produced under the direct supervision of the authors and designed to illustrate and reinforce specific points in the text. Consequently, every illustration is directly

related to the narrative and specifically cited where appropriate. Great care has been taken to position illustrations as close as possible to the place where they are cited. Illustrations and captions have been reviewed for accuracy and clarity.

Themes in the Book

At least seven themes permeate the text, though a particular one may be more obvious at some points than are others. These themes or emphases are the following:

1. The development of microbiology as a science
2. The nature and importance of the techniques used to isolate, culture, observe, and identify microorganisms
3. The control of microorganisms and reduction of their detrimental effects
4. The importance of molecular biology for microbiology
5. The medical significance of microbiology
6. The ways in which microorganisms interact with their environments and the consequences of these interactions
7. The influences that microorganisms and microbiological applications have on everyday life

These themes help unify the text and enhance continuity. The student should get a feeling for what microbiologists do and for how this affects society.

Aids to the Student

It is hard to overemphasize the importance of pedagogical aids for the student. Accuracy is most important, but if a text is not clear, readable, and attractive, up-to-dateness and accuracy are wasted because students will not read the text. Students must be able to understand the material being presented, effectively use the text as a learning tool, and enjoy reading the book.

To be an effective teaching tool, a text must present the science of microbiology in a way that can be clearly taught and easily learned. Therefore, many aids are included to make the task of learning more efficient and enjoyable. Following the preface, a special section addressed to the student user reviews the principles of effective learning, including the SQ4R (survey, question, read, revise, record, and review) study technique. Each chapter contains the following:

1. *Opening quote*: The opening quote is designed to perk student interest and provide perspective on the chapter's contents.
2. *Chapter outline*: The chapter outline, with page numbers, includes all major headings in the chapter. This helps the reader locate particular topics of interest.
3. *Chapter concepts*: Several statements briefly summarize the most important concepts the student should master.
4. *Chapter preface*: One or two short paragraphs preview the chapter's contents and relate it to the rest of the text. The preface is not a summary but allows the student to put the chapter in perspective at the start.

5. **Boldfaced terms:** Important terms are emphasized and clearly defined when they are first used. The number of boldfaced terms has been substantially increased in this edition.
6. **Chapter summaries:** A series of brief, numbered statements is designed to serve more as a study guide than as a complete, detailed summary of the chapter.
7. **Key terms:** A list of all boldfaced terms is provided at the end of the chapter to emphasize the most significant facts and concepts. Each term is page-referenced to the page on which the term is first introduced in the chapter.
8. **Review questions and activities:** Two kinds of review questions appear in each chapter. A small box with one to five brief review questions is located at the end of most major sections. These questions help the student master the section's factual material and major concepts before continuing with the chapter. The "Questions for Thought and Review" section at the end of the chapter contains factual questions and some synthetic questions to aid the student in reviewing, integrating, and applying the knowledge gained and principles learned.
9. **Additional reading:** References are provided for further study. Most are reviews, monographs, and *Scientific American* articles rather than original research papers. Publications cited in these reviews introduce sufficiently interested students to the research literature. References through the middle of 1992 have been included.
10. **Cross-reference notes:** These notes refer the student to *major* topics that are difficult and may need review in order to understand the current material. They also point the student either forward or backward to a related item of unusual interest or importance. The second edition contains more cross-references in each chapter.
11. **Boxed readings:** Two types of boxed reading material are provided. Small boxes scattered throughout the text point out practical applications of microbiology related to the subjects being discussed. Most chapters also contain one or two larger boxes, which describe items of interest that are not essential to the primary thrust of the chapter. Topics include currently exciting research areas, the practical impact of microbial activities, items of medical significance requiring a more lengthy treatment than possible in the short boxes, historical anecdotes, and descriptions of extraordinary microorganisms.

Besides the chapter aids, the text also contains a glossary, an index, and five appendices. The *glossary* defines the most important terms from each chapter and includes page references. Where desirable, phonetic pronunciations are also given. Most of the glossary definitions have not been taken directly from the text but have been rewritten to give the student further understanding of the item. To improve ease of use, the

second edition has a single *index* rather than three. It has been expanded to make text material more accessible. The *appendices* aid the student with extra review of chemical principles and metabolic pathways and provide further details about the taxonomy of bacteria and viruses. A brief introduction to helminth diseases is also included.

Supplementary Materials

Many supplementary materials are available to help instructors with their presentations and general course management.

1. An *Instructor's Manual*, written by Ralph Rascati, Kennesaw College, gives examples of lecture/reading schedules for courses with various emphases and suggests appropriate audiovisual materials. In addition, the number of test questions has been increased to about 60 for each chapter. This extensive battery of more than 2,600 test items is a powerful instructional tool.
2. The *WCB TestPak* is a computerized testing service offered free on request to adopters of this text. It provides a call-in/mail-in test preparation service. A complete test item file is also available on microcomputer diskette for use with either Apple IIe/IIc or IBM compatible computers.
3. A *Student Study Guide* by Ralph Rascati contains chapter objectives, focus questions, mastery tests, and other activities to aid student comprehension.
4. A set of 125 full-color acetate *transparencies* is available and may be used to supplement classroom lectures.
5. A set of *projection slides* provides further examples of microorganisms and diseases to supplement the illustrations in the text.
6. An *electronic study guide* by Medi-Sim is available in IBM and Macintosh formats for student purchase. This program contains approximately 2,000 page-referenced questions that review the material covered in *Microbiology*. Based on incorrect answers, this study guide provides the student a page-referenced study plan for each chapter.
7. A second edition of the *laboratory manual, Laboratory Exercises in Microbiology* by John P. Harley and Lansing M. Prescott, has been prepared to accompany the text. This manual is directly correlated with the text and designed to be used with it (although it may be used easily with other microbiology textbooks). Like the text, the laboratory manual provides a balanced introduction to laboratory techniques and principles that are important in each area of microbiology. The class-tested exercises are modular and short so that an instructor can easily choose only those exercises that fit his or her course. The second edition of the manual contains recipes for all reagents and media. Each exercise in this manual is also available as a customized, one-color separate. Specific lab exercises can be

combined with one's own materials. The local Wm. C. Brown Publishers representative should be contacted for more details on this custom publishing service.

A lab resource guide has been prepared by David Mardon of Eastern Kentucky University. It has complete answers to all laboratory report questions.

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