

Preface

Microbiology and the World at Large

During this revision, I have spent a great deal of time reviewing a nonstop stream of new information related to microbiology. Being immersed in this—my favorite subject for almost 40 years—I am once again reminded of the extraordinary importance and impact of microorganisms. But even more than ever before, I am struck how much having even a modest knowledge of microorganisms could help to improve the outlook for most of the world's population. Think of the topic that seems to have dominated the news of late—the threat from bird flu. Then think of how much more could be done to control it if more people realized that it is transmitted by invisible viruses that can be present in the air, on their hands, on objects in their environment, and even in the food they were eating. It wouldn't take a great deal of education—just teaching simple nonmedical precautions such as hand washing with ordinary soap, care in disposal of dead animal carcasses, using the sun and hot water to sanitize utensils and clothing, and better awareness of contact with bodily secretions that could transmit the agent. This little knowledge would make a world of difference in public health and treatment. It could greatly curb the transmission of this and many other infectious agents.

You will probably be challenged in your own lifetime by a constant stream of these types of concerns. Some of the problems you will potentially face are drug-resistant bacteria, emerging infectious diseases, and diseases of medical progress that originate from opportunistic pathogens. The difference for you is that you will act from understanding and confidence of measures you can take rather than from fear. That is just one of the many gifts you will derive from studying this subject. At the same time, you will also develop an understanding of the ways microbes are essential to the basic functioning of the earth itself.* It is this balanced view that we have been working to develop from the very first edition of this textbook.

What Sets This Book Apart?

If it hasn't already hit you, it will soon become evident that microbiology is a complex interdisciplinary science that covers a broad range of subjects. It extends from the basic biology and chemistry of cells to the roles of microbes in the natural world, their use in industrial production, and their involvement in the human condition.

* To read a fascinating dialogue concerning the "love/hate" relationship we have with microbes, type: *The DNA Files Planet of the Bugs* into a search engine and download a transcript.

It truly does offer something for everyone, whether your purpose is to prepare for a health profession, to gain skills for technical work, or simply to improve your practical knowledge of this invisible world.

Engaging, Straightforward Presentation

The primary aims of this book have been to present guiding principles in a straightforward and readable style that is neither too wordy nor too simplistic and to explain complex topics clearly and vividly. I have continued to organize the content in a logical order that builds on concepts from one chapter to the next. Having many different levels and cognitive styles for students increases retention, understanding, and success in learning.

A Vivid, Self-Explanatory Art Program

The illustration program has been developed to coordinate with the text and to assist in the visualization of abstract concepts. I have hand tailored each unique illustration with an eye to be scientifically accurate and attractive. Many illustrations can stand alone and serve as a focal point for understanding, review, and discussion.

Early Introduction of Taxonomy and Survey of Microbial Groups

What's unique about the format of this text is how early I introduce taxonomy (chapter 1) and survey microbial groups (chapters 4, 5, and 6). The rationale is that we begin to use scientific names from the very beginning, and by having a working background students are eased into the later chapters that present classification. I have always felt that microbes are the "stars of the show," and that students have a far greater appreciation for later topics of nutrition, metabolism, genetics, and microbial control if they already know significant details about the main characters—bacteria, viruses, and eucaryotic microorganisms.

Disease Chapters

The pathogens chapters (18–25) are organized by microbial group (taxonomy) because many users feel this orientation has greater coherence and concentrates more on infectious agents than anatomy and physiology. All characteristics of the microorganism and its diseases may be presented simultaneously. This system will not only be familiar to students from their laboratory work, but it helps them maintain a more distinct separation between microbial groups and their diseases.

What's New with This Edition?

Since the science of microbiology is constantly changing and evolving, the textbook must also change and evolve to stay current and continue to be useful and relevant. This edition sees a major revision of most chapters. I have asked two of our contributors from

the Fifth Edition to continue in this capacity: Barry Chess, a fellow teacher at Pasadena City College, and Kelly Cowan of Miami University of Ohio. I have welcomed their help in writing new sections and Insight boxes, suggesting ideas for new and improved figures, editing and updating text, and improving chapter overviews, summaries, and questions.

OVERVIEW OF CHANGES TO *Foundations in Microbiology*, Sixth Edition

General Content Updates and Revisions

The text and visual programs of every chapter have been thoroughly revamped. Changes include new and revised artwork and photographs, rewritten and reorganized text, the addition of new questions and boxes, and the integration of new discoveries or treatments. Statistics have been updated as close to press time as possible. I have endeavored to maintain length by careful editing and by weighing the addition of new material and boxes with the removal or condensation of existing topics.

The importance and activities of biofilms have been either added or expanded in chapters 4, 7, 12, 13, 21, and 26. Chapter 25 contains an expanded section on influenza and its vaccines; hepatitis C is given greater coverage; the AIDS section is reorganized and updated; and prions are covered in greater detail. To see a complete list of detailed changes and updates, please contact your McGraw-Hill sales representative.

New and Revised Chapters on Immunology and Medical Laboratory Testing

Significant changes have been made in the areas of host defenses and immunology.

- Chapter 14, now titled "Nonspecific Host Defenses," is devoted primarily to innate responses. Figures on inflammation, phagocytosis, blood cells, and complement have been revised.
- Most discussions of adaptive immunity have been moved to chapter 15, now titled "Specific Immunity and Immunization." This chapter now begins with the classification of types of immunity. The text and figures on T cell reactions have been reorganized and simplified, and the section on vaccines from the previous edition's chapter 16 has been inserted into the end of the chapter.
- The immunopathology chapter from the previous edition (17) is now chapter 16 in the Sixth Edition, "Disorders in Immunity."
- Brand new to the Sixth Edition is chapter 17, "Diagnosing Infections." Bringing together in one place the methods used to diagnose infectious diseases, the chapter starts with collecting samples from the patient and details the biochemical, serological, and molecular methods used to identify causative microbes.

New Chapter Opening Case Studies

One of the most exciting changes involves the chapter openers. They have been revamped to present "Real Case Studies

in Microbiology." These studies showcase actual situations in health care and other areas of applied microbiology gleaned from clinical journals and other reliable sources. The idea behind using case studies is to place some of the concepts and examples from that chapter in practical context. As students read the body of the text they will discover clues about the "mystery illness." The answers to these case studies are provided in a section at the end of the chapter just before the summary.

Enhanced Visuals

Most of the illustrations have been recast with brighter colors and a more three-dimensional effect. As in previous editions, the illustration program is carefully tied to the text description and the drawings are abundantly labeled. Wherever possible, I have shortened the length of legends and placed the descriptive information strategically into the figure itself.

Insight Boxes

The boxed topics have been renamed as "Insights" and fit into one of four categories: Historical, Medical, Discovery, and Microbiology. Several new boxes have been added to the text, but we have tried to keep the total number from three to five per chapter. To emphasize that the information in boxes has relevance and is useful to learn, a question has been added to each box that will be answered on the website. This allows instructors to assign the boxes and the questions if they wish.

A Note About . . .

In most chapters, I have added to the number of short discussions—called "A Note About . . ."—set off from the rest of the text. These help to clarify or further explain an aspect of the immediate subject or terminology. An example of this feature is "A Note About Biofilms and Drug Resistance" on page 366 that explains this important connection.

End-of-Chapter Questions

The question sections have been carefully edited, and most chapters contain revised and new questions. The answers to multiple-choice questions appear in appendix E. Suggested page references have been added to the concept questions to cue students to the main location of the topic. The answers to the concept questions are available to the instructor on the website.

A Special Note About Usage and Style

There may be confusion about the spelling and usage of certain words in textbooks. One source revolves around the terms prokaryote and eucaryote, which is how they will be spelled in this textbook. There is an alternate spelling which uses the Greek “k,” as in prokaryote. Both of them are considered valid, and it really an editorial choice which selects one or the other. I decided some time ago to adopt the spelling used by *Bergey’s Manual*, one of the standard guides for bacteria.

The other usage has to do with the Gram stain, an important identification method discovered by and named for the Danish bacteriologist Christian Gram. When the stain itself is named or used as a noun, for example as in Gram staining or the Gram stain method, the name is capitalized. When the term is used as part of a modifier, as in gram-positive and gram-negative, the name is in lowercase. Note that the “G” will always be capitalized in heads. This is the style adopted by the American Society for Microbiology.

In the past few years, editors of medical textbooks and journals have been deleting the possessive form for diseases that are named for a person. Thus, Crohn’s disease becomes Crohn disease and Kaposi’s sarcoma becomes Kaposi sarcoma. This has the double benefit of shortening the term and removing the onus that the disease “belongs” to its discoverer.

Tips on Learning to Gain Understanding

Most of you are probably taking this course as a prerequisite to health science programs in nursing, dental hygiene, medicine, pharmacy, optometry, or physician assistance. Because you are preparing for a profession that involves interactions with patients, you will be concerned with infection control and precautions, which in turn requires you to think about microbes and how to manage them. This means you must not only be knowledgeable about the characteristics of bacteria, viruses, and other microbes, their physiology, and primary niches in the world, but you must have a grasp of disease transmission, the infectious process, disinfection procedures, and drug treatments. You will also need to understand how the immune system interacts with microorganisms and the effects of immunization. All of these areas bring their own vocabulary and language—much of it new to you—and mastering it will require time, motivation, and preparation. A valid question is: “How can I learn this information so as to be successful in the course as well as retain it for the future?”

Right from the first, you will be guided by how your instructor has organized your course. Since there is more information than could be covered in one semester or quarter, your instructors will select what they want to emphasize and construct a reading and problem assignment that corresponds to lectures and discussion sessions. Many instructors have a detailed syllabus or

study guide that directs the class to the specific content areas and vocabulary words. Others may have their own website to distribute assignments and even sample exams. Whatever materials are provided, this should be your primary guide in preparing for study.

The next consideration involves your own learning style and what works best for you. To be successful, you must commit essential concepts and terminology to memory. A list of how we retain information called the “pyramid of learning” has been proposed by Edgar Dale: We remember about 10% of what we read; 20% of what we hear; 30% of what we see; 50% of what we see and hear; 70% of what we discuss with others; 80% of what we experience personally; and 95% of what we teach to someone else.

There are clearly many ways to go about assimilating information—but mainly, you need to become involved in reading, writing, drawing simple diagrams, and discussion or study with others. This means you must not just read the book but also to gather the most important points from it. You must attend lecture and laboratory sessions to listen to your instructors or teaching assistants explain the material. Notes taken during lecture can be rewritten or outlined to organize the main points. This begins the process of laying down memory. You should go over concepts with others—perhaps a tutor or study group—and even take on the role of the teacher-presenter part of the time. It is with these kinds of interactions that you will not just rote memorize words but *understand* the ideas and be able to apply them later.

A way to assess your understanding and level of learning is to give yourself examinations. You may use the exams in the text, study guide, or make up your own. One technique for self-quizzing is to make a set of flash cards that goes with your notes (which is in itself a great learning exercise). Then you can use the cards to get immediate feedback about what you know one concept or vocabulary word at a time. A beneficial side effect of this technique is that you are getting in the frame of mind for taking an exam, which will be the basis for most of your evaluations.

Another big factor in learning is the frequency of studying. It is far more effective to spend an hour or so each day for two weeks than a 14-hour cramming session on one weekend. The brain cannot commit information to memory nonstop—it needs periods of rest. If you approach the subject in small bites and remain connected with the terminology and topics, over time you will find it all fitting together. In the final analysis, the process of learning comes down to self-motivation and attitude. There is a big difference between forcing yourself to memorize something to get by and really wanting to know and understand it. Therein is the key to most success and achievement, no matter what your final goals. And though it is true that mastering the subject matter in this textbook can be challenging, millions of students will attest to how worthwhile it has been in their professions and everyday life.