

Preface

A SAMPLING OF CLIPS FROM HEADLINE STORIES AFTER 9/11/01

"The FBI and U.S. Postal Service are offering a \$2.5 million reward for information that helps solve the case labeled 'Amerithrax.' Investigators have interviewed more than 5,000 people and spent more than \$13 million on scientific testing."

"In June, the FBI drained and searched a pond in Frederick, Md., but found no evidence. Frederick is the home of the Army Medical Research Institute of Infectious Diseases, one of the nation's main anthrax research centers."

"Five people died, all from inhalation anthrax, between Oct. 5 and Nov. 21, 2001. Seventeen others were sickened by inhalation or cutaneous anthrax. At least three of those are postal workers who continue to recover and have not returned to work."

"The consequences of a successful biological attack, especially if the infection were readily communicable, could far exceed those of a chemical or even a nuclear event," the medical council said. Given the ease of travel and increasing globalization, an outbreak anywhere in the world could be a threat to all nations."

"Smallpox, anthrax, bubonic plague—a smart terrorist could use any of these deadly diseases to wreak havoc on thousands or even millions of Americans. Yet there aren't enough antibiotics and vaccines in stockpile, public-health facilities can't handle a 'surge,' and most law enforcement agencies have no idea how to cope with a crisis. 'I do not believe it is a question of whether a lone terrorist or terrorist group will use infectious disease agents to kill unsuspecting citizens; I'm convinced it's really just a question of when and where.'"

Microbiology in a New Age

In the fall of 2001, at about the time the previous edition of this textbook was going to press, shattering events occurred that have swept microbiology into the spotlight with a vengeance. The possibility of using microorganisms as weapons was no longer mere speculation. One effect of these revelations has been a heightened awareness of

microorganisms unlike any in past memory, especially among the students in my classes. On many occasions, my colleagues and I have had to spend a significant portion of class time in discussions relating to this topic, separating fact from fiction, and expanding on the latest potential "threat" from news reports. Many sessions were spent answering questions such as *"What is anthrax and how is it treated? How could smallpox come back after all these years? Are the vaccines for preventing infections safe? What is the chance I can get SARS, or how did West Nile Valley Fever get to North America?"* Giving voice to these concerns has been a bittersweet educational experience. Of course, it has been gratifying to observe the high level of interest in this subject and to be able to use real life circumstances to teach basic concepts—for example, how to sterilize mail to destroy anthrax spores, the kind of treatments available for biological agents, or exploring the epidemiology of the "pathogen of the week." My other, conflicting, reaction has involved the unfortunate and somewhat overblown fears about microbes these happenings have instilled in many people. More than ever before these small, ubiquitous, mostly beneficial organisms are the subjects of misunderstanding and anxiety.

At such an extraordinary time, there is a serious need for useful, accurate information about microorganisms and their activities, so the public can operate from a basis of knowledge and understanding rather than fear or rumor. Part of this education must help maintain a balanced view of the infectious nature of microbes alongside their undeniable importance in the functioning of the earth. This has been our primary goal for the past four editions, and we have undertaken this fifth revision from that same point of view. Once again, we want our students—all of you—to come away from a course of study prepared for any personal or professional challenges, to develop in your thinking from the unknown to the known, and to be the voices of reason during trying times.

As you will see, microbiology is a complex interdisciplinary subject that covers a broad scope of information, from the basic biology of cells and their function to the roles of microbes in the global ecosystem, in industrial production, and—yes—in disease. It truly does offer something for everyone, whether your purpose is to prepare for a health profession, to gain skills for technical work, to become informed about practical applications in your daily life, or to improve your knowledge of these smallest inhabitants of the biological world.

Emphases and Changes in the Fifth Edition

We have been fortunate to have the assistance of four able specialists for this edition—three microbiologists and one physician—to support what had previously been the responsibility of just the author. These contributors include:

Barry Chess, my fellow instructor at Pasadena City College
Charles Wright of Baltimore County Community College
Marjorie Kelly Cowan of Miami University of Ohio
Steve Hecht of Grand Valley State University

They have shared the daunting task of overseeing many of the miniscule details that all revisions require. I have welcomed their help in writing new sections and feature boxes, suggesting ideas for new and improved figures, editing and updating text, and refreshing chapter overviews, summaries, and questions. Although this textbook has always been a labor of love, I found this collaboration beneficial, and it has released me to concentrate on content and illustrations without having to pore over every word.

As in previous revisions, we have strived to retain basic content that is the foundation of microbiology while introducing pertinent new developments in the many fields that are part of this science. Our aims can be summarized as:

- to keep the book readable and accurate for a wide range of student levels and abilities
- to introduce topics in a logical order so that early concepts and terms can be used as a foundation for later ones
- to use illustrations, maps, flow charts, analogies, and tables to improve assimilation of information by students with different learning styles
- to make difficult concepts accessible and understandable
- to provide a background for practical applications
- to inspire lifelong learning in the subject
- to incite excitement and awe of this dynamic science

IMPROVED ART PROGRAM

A significant element in any science textbook is the visual program. We set our sights anew on fine-tuning the appearance and readability of the artwork and photographs.

- Every figure in the text has been reviewed, and at least 60% of them have been revised or completely redone.
- Consistency in presentation has been imposed so that elements are presented in the same manner from chapter to chapter.
- Whenever feasible, we have moved the legends into the figure itself and placed them close to the step being described.
- We have also simplified certain illustrations that were too crowded and improved the accuracy and flow of others.
- Special attention has been given to the number and accuracy of labels on art and photographs.
- Many hours have been spent searching for top-notch photographs, some of which were supplied by the author.
- Since many users have commented on their appreciation of illustrated tables and flow charts, we have developed several new ones.

STREAMLINING PRESENTATIONS

The breadth of this discipline makes covering it something of a juggling act. Foremost, it is necessary to sufficiently cover the great variety of topics in microbiology. It is also critical to include ample descriptive background to go with the illustrations. On the other hand, we must also acknowledge that this book is generally used for a one-semester course, and that students' time for reading is not unlimited. Given these concerns:

- We have tightened the content by editing, rewording, simplifying, and removing non-essential detail, without cutting important concepts.
- Being mindful to not minimize important concepts some boxes have been removed or re-positioned in the text flow, and some reference material has been moved to the appendix.
- All initial references to figures, tables, and boxes have been boldfaced, and important sequential ideas or concepts have been numbered or bulleted within the text.
- In recognition of the serious nature of bioterrorism, we have included new boxes and sections on this topic as well as on emerging diseases.

Other alterations to streamline the chapters include compressed chapter overviews and more abbreviated summaries. Our extensive review questions have been well received, and so we have retained the three types of questions as in previous editions. Most chapters have additional questions, including several that involve analysis of figures. As in the past, much attention has been paid to vocabulary and pronunciation, and we have added new terms to the glossary.

USING THE INTERNET

In my own Internet searches over the past two years, I have discovered hundreds of excellent websites that cover topics in a pertinent and relevant manner. A computer connected to the World Wide Web can offer dynamic experiences that a textbook cannot. It can display animations, videos, and interactive graphics, quizzes, and case studies that enhance and extend your textbook readings. Since this science advances so rapidly, events that happen tomorrow cannot possibly be found in your textbook. Also, some of these websites were located only after long searches, and I felt that if someone didn't point the readers towards them, they would remain obscure.

- Specific websites that I have found particularly useful and instructive are listed at the chapter level on the Online Learning Center at www.mhhe.com/talaro5.
- Suggestions for exercises you can use with these URL addresses are presented at the end of each chapter.
- Keep in mind that this textbook has its own dedicated website with text-specific activities and study aids that are available at www.mhhe.com/talaro5.

Teaching and Learning Supplements

McGraw-Hill offers various tools and teaching products to support the fifth edition of *Foundations in Microbiology*. Students can order supplemental study materials by contacting your local bookstore. Instructors can obtain teaching aids by calling the Customer Service

Department at 800-338-3987, visiting our Microbiology website at www.mhhe.com, or contacting your local McGraw-Hill sales representative.

Digital Content Manager This multimedia collection of visual resources allows instructors to utilize artwork from the text in multiple formats to create customized classroom presentations, visually-based tests and quizzes, dynamic course website content, or attractive printed support materials. The digital assets on this cross-platform CD-ROM are grouped by chapter within the following easy-to-use folders.

Active Art Library Key figures are saved in manipulable layers that can be isolated and customized to meet the needs of the lecture environment.

Animations Library Numerous full-color animations of key microbiology processes are provided. Harness the visual impact of processes in motion by importing these files into classroom presentations or course websites.

Art Libraries Full-color digital files of all illustrations in the book, plus the same art saved in unlabeled and gray scale versions, can be readily incorporated into lecture presentations, exams, or custom-made classroom materials. These images are also pre-inserted into blank PowerPoint slides for ease of use.

Photo Libraries Digital files of instructionally significant photographs from the text can be reproduced for multiple classroom uses.

PowerPoint Lectures Ready-made presentations that combine art and lecture notes have been specifically written to cover each chapter of the text. Use the PowerPoint lectures as they are, or tailor them to reflect your preferred lecture topics and sequences.

Tables Library Every table that appears in the text is provided in electronic form. You can quickly preview images and incorporate them into PowerPoint or other presentation programs to create your own multimedia presentations. You can also remove and replace labels to suit your own preferences in terminology or level of detail.

INSTRUCTOR TESTING AND RESOURCE CD-ROM

This cross-platform CD-ROM provides a wealth of resources for the instructor. Supplements featured on this CD-ROM include a computerized test bank utilizing Brownstone Diploma testing software to quickly create customized exams. This user-friendly program allows instructors to search for questions by topic, format, or difficulty level; edit existing questions or add new ones; and scramble questions and answer keys for multiple versions of the same test.

Word files of the test bank are included for those instructors who prefer to work outside of the test generator software.

TRANSPARENCIES

McGraw-Hill provides 450 color *Overhead Transparencies* of text line art and numerous photos.

COURSE DELIVERY SYSTEMS

With help from our partners, **WebCT**, **Blackboard**, **TopClass**, **eCollege**, and other course management systems, professors can take complete control over their course content. These course cartridges also provide online testing and powerful student tracking features.

FOR THE STUDENT

Online Learning Center www.mhhe.com/talaro5

The OLC offers an extensive array of learning and teaching tools. The site includes quizzes for each chapter, links to websites related to each chapter, interactive activities, and case studies.

Student Study Guide by Nancy Boury, Iowa State University
The author provides study objectives, chapter overviews, test-taking strategies, crossword puzzles, multiple-choice questions, critical thinking questions, matching exercises, and pathway mapping problems to reinforce the concepts in each section of the text. Answers to the objective questions are included.

HyperClinic 2 CD-ROM by Lewis Tomalty and Gloria Delisle
Evaluate realistic case studies that include a patient history and description of signs and symptoms. Students can either analyze the results of physician-ordered clinical tests to reach a diagnosis or evaluate a case study scenario and then decide which clinical samples should be taken and which diagnostic tests should be run. More than 200 pathogens are profiled, 105 case studies presented, and 46 diagnostic tests covered. PC compatible.

Microbes in Motion 3 CD-ROM

This interactive, easy-to-use general microbiology CD-ROM helps students actively explore and understand microbial structure and function through audio, video, animations, illustrations, and text. 18 books cover topics from microbial genetics to vaccines. Mac and Windows compatible.

A Message to Students

Most of you are probably taking this course as a prerequisite to a health science program such as nursing, dental hygiene, medicine, pharmacy, or physical therapy. Because you are preparing for a career in 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 metabolism, 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.

TIPS ON LEARNING TO GAIN UNDERSTANDING

The challenge of this type of technical course is, “How can I best learn this information in a way to be successful in the course as well as retain it for the future?”

To begin, probably the most important consideration is how the college and instructor have organized your course. Since there is more information than could be covered in the usual course, your instructor will select what he/she wants 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 quick list of how we retain information comes from Edgar Dale, who prioritizes the pyramid of learning as follows: 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
- 95% of what we teach to someone else

It should be obvious from this list that there are many ways to go about assimilating information, but mainly, you need to use all of your senses—to read, to write, draw diagrams, do lab work, take exams, and study with others. This means you must spend the time not just to read the book but also to write down notes as you go along. It means that you attend lecture and discussion 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 discuss 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 substantial way to experience the material personally is to give yourself examinations. You may use the exams in the text, study guide, or make up your own. One strategy 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 assess 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 is how most of your evaluations will be given.

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 to refresh itself. 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. Then the day before an exam, all you have to do is review.

FEATURES OF THE TEXT HELP YOU STUDY

This textbook has several features that facilitate learning.

Chapter Overviews are quick statements about chapter content to show you the main concepts in the chapter.

Chapter Capsule with Key Terms contain key words and concepts together in outline form. They also make for a useful guide to review the material.

Chapter Checkpoints serve as a quick “snapshot” review of the main points of a section.

End of chapter questions are varied to give you experience in answering different types of exam questions. At the end of chapter 1, there is a description of how these questions are meant to be answered. Multiple choice questions can be used to quickly test yourself on what you know (answers are in the appendix). They are chosen from random information in the text, and it is likely that if you get them correct, you have adequate preparation. The same is true for the matching questions.

The **concept questions** require more in-depth knowledge and will demand that you write several sentences or even paragraphs to show your mastery of a given idea.

The **critical-thinking questions** are “brain teasers” that give you some problem solving experience after you have learned the basics of a certain concept. Many of them involve case studies, models, interpretations of graphs, comparisons, and lab exercises. They give you experience in applying microbiology to real life situations.

In the final analysis, the process of learning comes down to self-motivation. There is a big difference between having to memorize something to get by and really wanting to know and understand it. We feel strongly about the inherent value and fascination of microbiology. It is up to you to become emotionally involved in it yourself and get caught up in the wonder of learning about this new world. 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, it can certainly be accomplished by any students with a “can do” attitude. Millions of students who have already succeeded will attest to this fact.

IN RECOGNITION AND TRIBUTE

Once again, the team from McGraw-Hill has outdone itself in providing first-rate support throughout this revision. In addition to the valuable services of four new contributors, I am delighted to have Jean Sims Fornango once again as my senior developmental editor. Jean is truly a modern “Renaissance woman,” skilled in all areas of publishing, well versed in the arts and sciences, and an all-around inspiration. I can always count on Jean to place things in perspective, to offer great insights, to help make decisions that keep the textbook moving in the right direction. She is the epitome of grace under pressure. Another publishing gem is Rose Koos, reprising her role as the production editor for this project. As involved as the author and developmental editor are in keeping the book project on track, the production editor must have her finger on the pulse of literally “everything.” She must tackle the overwhelming task of overseeing the finest details that go into the finished product—from a little typo to a paging problem to an illustration run amok—all the while remaining cool, calm, and collected. I

would like to recognize our Senior Sponsoring Editor, Patrick Reidy, who has been a strong supporter of expanding our illustration program and trying new ways of presenting the material and figures.

Other members of the team deserving special mention include Carrie Burger, an experienced and able photo editor; Karen Pugliano, the photo researcher, who negotiated expertly for the very best photographs available. I would like to credit Wayne Harms for using his distinct touch to create an elegant book and cover design. No tribute would be complete without praising the valuable contributions of our publisher, Marty Lange, and our Marketing Manager, Tami Petsche. Many kudos to the folks out in the trenches, those sales representatives who handle the huge responsibility of presenting this textbook to college instructors. You are an integral part of this publishing team and we would be working in a vacuum without you.

I also wish to thank my colleagues in the Natural Science Division at Pasadena City College for their continued encouragement and interest. I want to make special mention of our Dean, Dr. Bruce Carter. He has been instrumental in allowing me to adjust my schedule to work on the text, and has assisted in the upgrading of the microbiology lab to make it a first class place to teach science. I also want to thank Barry Chess, Tom Belzer, and John Stantzos for their friendship and long time support for this project. Last but certainly not least in my heart and mind are my students, who come to the subject eager to learn and prepared to experience the marvelous world of microbiology.

To paraphrase Blanche Dubois, I do "count on the kindness of reviewers" to provide a critical eye and give suggestions for changes and improvements. Thus, I want to salute the new team of reviewers that helped with this edition. I have been a reviewer myself, so I know that it is not an easy job to evaluate another person's work critically yet constructively. I can always rely on them to see things that I have missed or to share their own classroom experiences on how a certain figure or treatment works in the everyday world. This collaboration has been instrumental in shaping the finished product. At this tenth anniversary of *Foundations*, I wish to express my gratefulness for all of the students and instructors who have used the book and written personal comments to me over the years. You have made the many years I have spent in developing this book worthwhile.

This textbook has been thoroughly inspected by the author, editors, reviewers, and contributors, and we have tried to make it as error-free as possible. Since no process is 100% accurate, some errors can still be missed, so we would appreciate any feedback from readers who find typos, missing labels, or omissions, or errors in content. I may be reached by email at ktalaro@aol.com or at www.mcgraw-hill.com.

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