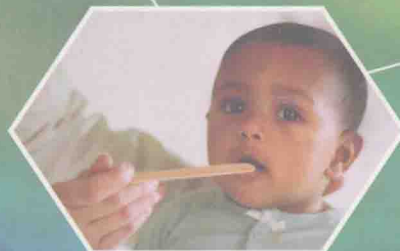
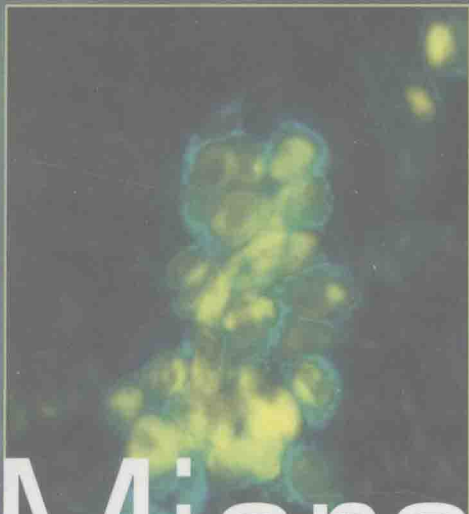


Barry L. Batzing

Microbiology

AN INTRODUCTION





Microbiology

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Barry L. Batzing
State University College of New York at Cortland

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Preface

I cannot think of a more exciting and meaningful field of study than microbiology. All students should take a microbiology course. When I was in college, I became captivated by its blend of biology and chemistry and its relevance to my everyday life. It contributes to our understanding of health and disease and general principles that govern life, such as molecular genetics.

I've always been proud of being a microbiologist. In 1981, my college, the State University of New York at Cortland, awarded its first honorary degree to Dr. Donald A. Henderson. Dr. Henderson directed the World Health Organization's program that succeeded in eradicating smallpox in the late 1970s. I remembered what Louis Pasteur had said—"the future will belong to those who will have done most for suffering humanity"—and I thought how wonderful it was that my college was recognizing the contributions of microbiology to understanding this dreaded disease and to eliminating the suffering it caused. Today, we are on the verge of eliminating polio and measles, and it is microbiologists who are at the forefront of research into today's health scourges—AIDS, tuberculosis, and malaria.

Principles

I have been teaching microbiology for twenty-five years. During this time I have examined many textbooks for possible class use and the choices have left me wanting something else. Why? I find microbiology texts missing features I think would engage students more in the subject and help them with their studies. For example, human-interest stories can be used to develop topics, and visual learning aids such as concept maps can be used to highlight key points and summarize complex topics.

I also have been dissatisfied with the focus of most microbiology texts. Pathogens and the diseases they cause usually are presented in the context of regions of the body they affect. This plays off the background most students pursuing careers in medical and allied health fields have, namely courses in anatomy and physiology. However, it seems to me that what is crucial for all medical and health professionals is an acute awareness of the epidemiology of microbial pathogens—their reservoirs, how they are spread, and the means by which we can interfere with their transmission. An understanding and appreciation of the epidemiology of communicable diseases lends itself to practical and cost-effective approaches to controlling communicable diseases. Epidemiology also affords the opportunity to highlight personal experiences of individuals and groups of people—how they contracted a pathogen, how their bodies responded, what we need to do to treat them, and how to contain or prevent future outbreaks.

Special Features

Each chapter focuses on central issues. I oppose the practice of "mentioning" virtually every aspect of a topic. Textbooks at the introductory level need to provide students with the

background necessary to pursue a subject without overwhelming them. They should not be encyclopedic. Textbooks should aid understanding and stimulate interest. This requires careful attention to selection of topics and the manner in which material is presented. It is not enough, nor is it effective, to load every sentence with esoteric facts and specialized terminology.

Virtually every recent study of science education concludes that we must focus on understanding rather than on memorization of as many facts as possible. We must take the time, in our classrooms and in our textbooks, to foster understanding. This requires that we present information in creative ways that encourage students to think about subjects they are studying. To pursue this goal, *Microbiology* takes the following approaches:

- **Focus on *key topics*** to establish a solid foundation, aid understanding, and stimulate interest
- **Accentuate *visual presentation of material*** to reinforce text and encourage students to visualize and work with information. Components of the visual presentation include
 - Organizational charts and flow diagrams
 - Concept maps
 - Exceptional drawings
 - Large, clear photos and electron micrographs
 - Full color throughout
- **Integrate *real-life stories into the body of the text*.** Accounts of case histories and news stories related to outbreaks of communicable diseases are incorporated directly into chapters rather than isolated as special boxes. Many of these accounts come from *Morbidity and Mortality Weekly Report* but many have been collected from other news sources and books. I have taken this approach to keep the attention of the reader and to give examples directly in the context of specific topics rather than separating them from topics. I think that these personal accounts stimulate interest and serve as outstanding examples to develop depth of understanding of topics. By placing them in the flow of the text, they will be read, absorbed, and enjoyed.
- **Reflect on topics with *special topic sections*.** There are two types of special topic sections, *Scope It Out*. . . and *At the Interface*. Both are health-oriented and integrated into the text to summarize or reflect on information and to encourage students to think about the importance of topics and possible implications of issues. *Scope It Out*. . . sections are mainly human interest stories, such as the potential medical consequences faced by a woman who was bitten by her pet cat. *At the Interface* articles deal mainly with research in medical microbiology and its applications.

- **End-of-chapter aids.** At the end of each chapter there is a list of Key Terms in the chapter, ten Review Questions, ten Critical Thinking Questions, and a Group Activity. Critical Thinking questions probe depth of understanding and reveal applications to real-life situations. Group Activities bring small groups of students together to study and work with material, usually by engaging them in real-life situations.

The visual presentation of information will be an outstanding feature of this text. One of the most difficult tasks facing students in any science course is organizing information. We need to provide students with a variety of learning paths, including visualizing relationships and organizational patterns instead of only listing facts. We need to prompt students to work with information rather than just memorize it. Textbooks need to foster information use.

High quality, focused graphics make presentations more effective. When scientists and people in business make presentations, they rely heavily on graphics to make information stand out. In fact, we criticize speakers whose slides or overheads are of poor quality. Today's students come from a world in which graphics play a central role—television programs, music videos, posters—students are adapted to having information presented visually. When we present information otherwise, we are being counterproductive. We are not challenging students, but rather presenting information in a foreign way; instead of helping students, we make it more difficult for them to achieve understanding.

I have chosen to write the chapters dealing specifically with microorganisms and disease from the perspective of the *route of transmission* of the microbial pathogens. I believe that there are only a few exceptions for which this is not the most beneficial approach. Traditionally, most introductory texts focus on the *body region* affected, but how many health professionals rely primarily on this type of information? In general, no matter what the disease, the major focus of public health is on *prevention and control*. These aspects of diseases are addressed most effectively when there is a clear understanding of how a disease is acquired; for microbial pathogens, this means the route of transmission. A clear example is seen in acquired immunodeficiency syndrome (AIDS). Most health professionals, including nurses, deal primarily with issues of AIDS transmission, and not with the pathological activity of the human immunodeficiency virus in specific body cells. Almost all of the literature, in the form of brochures, posters, and television presentations, which is disseminated by public health departments and medical groups, focuses on issues of transmission. And this is true not just for AIDS, but for most other communicable diseases as well, such as Lyme disease, hepatitis A, gonorrhea, and measles. Recent attention given these diseases focuses almost exclusively on transmission of the etiologic agents.

By addressing diseases caused by microorganisms from the perspective of route of transmission, I also will be

able to focus on information that can make discussions much more personal to students as well. Information on the number of cases of a disease (even in particular regions of the country and in specific cities), the incidence of a disease, case histories, and epidemiological investigations, all can serve to stimulate student interest.

Other Important Aspects

Microbiology is written as an introduction to microbiology for sophomore-junior level students in allied health programs. These students will have had a high school biology course and either an introductory college biology course or a course in anatomy and physiology. Although written primarily for students with majors in health-related areas, the text also is suitable for general introductory microbiology courses for nonmajors. In addition to health-oriented topics, it also includes areas such as microbial ecology and industrial microbiology.

Supplements and Other Media

A full suite of instructional and learning resources has been developed to complement this text.

Internet Resources for Instructors and Students

- **InfoTrac® College Edition**—A free four-month subscription to this extensive online library is enclosed with every new copy of *Microbiology: An Introduction*, giving both instructors and students access to the latest news and research articles online—updated daily and spanning four years. This easy-to-use database of reliable, full-length articles (not abstracts) from hundreds of top academic journals and popular sources is ideal for launching lectures, igniting discussions, and opening whole new worlds of information and research for students.
- **WebTutor™ on WebCT and Blackboard**—For students, WebTutor offers real-time access to a full array of study tools, including flashcards (with audio), practice quizzes, online tutorials, and Web links. Instructors can use WebTutor to provide virtual office hours, post syllabi, set up threaded discussions, track student progress with the quizzing material, and more. WebTutor provides rich communication tools, including a course calendar, asynchronous discussion, “real time” chat, a whiteboard, and an integrated e-mail system. This student-to-student interaction has enormous potential to enhance each experience with the course content. (WebCT ISBN: 0-534-38404-8; Blackboard ISBN: 0-534-38750-0).

Instructor Resources

- *Instructor's Manual with Test Bank*—This comprehensive instructor's guide contains chapter outlines, key terms, demonstration ideas, and instructions for incorporating InfoTrac® College Edition into your course. The manual's test bank includes more than 1500 questions in several formats including multiple-choice, true/false, essay, and short answer. (ISBN: 0-534-37565-0).
- *ExamView® Computerized Testing*—With ExamView Computerized Testing instructors can easily create and customize tests. ExamView's *Quick Test Wizard* provides a step-by-step guide through the process of creating and printing a test in minutes. (Cross-platform CD-ROM ISBN: 0-534-37567-7).
- *Multimedia Manager: A Microsoft® PowerPoint® Tool*—Designed specifically for this *Microbiology: An Introduction*, this powerful CD-ROM helps instructors to create great multimedia lectures quickly and easily. Nearly all of the text's illustrations and photos are offered both on PowerPoint® slides and as .jpg files to allow for easy image manipulation. (ISBN: 0-534-38626-1).
- *Transparency Acetates*—A set of over 200 full-color illustrations and photographs from the text. (ISBN: 0-534-37568-5)
- *Gene Discovery Lab*—This molecular technique CD-ROM/Web site provides a virtual laboratory environment that allows users to explore concepts by simulating molecular techniques. Exciting, interactive, and visual, Gene Discovery Lab augments a molecular lab course. The program's realistic simulations allow users to conduct experiments they wouldn't otherwise be able to perform, due to time constraints, replication constraints, or lack of the proper facilities. (ISBN: 0-534-37717-3).
- *Laboratory Manual for Microbiology*—This manual contains a carefully selected set of lab exercises covering both classic and non-traditional experiments, with an emphasis on the development of critical-thinking skills and an understanding of the scientific method. It offers the opportunity to implement innovative, engaging, and effective labs, which have been class-tested for years. (ISBN: 0-534-37564-2).
- *Microbiology for Health Careers*—This updated resource will help you increase your knowledge of important clinical infections. This best-selling text includes current information on today's most important topics including HIV, hepatitis B (HBV), and hepatitis C. (ISBN: 0-7668-0917-X).

Student Resources

- *Study Guide*—The **Study Guide** features chapter summaries and important concepts, plus more than 2,000 questions in multiple formats including matching key terms, fill-in-the-blank, multiple choice, true/false, essay/short answer, table completion, and labeling exercises, as well as an appendix with answers to all questions. (ISBN: 0-534-37566-9)
- *An Electronic Companion to Accompany Beginning Microbiology*—This interactive CD-ROM from Cogito Learning Media, Inc. is bundled free with every new copy of *Microbiology: An Introduction*. It includes a comprehensive tutorial, quizzes, and exercises about microbiology. It allows students to study all the details of microbiology and to visualize the complex processes they learn about in the course. *CD Connections* features in the text point students to the CD-ROM for further study.
- *Essential Study Skills for Science Students*—Written specifically for science students, this book discusses how to develop good study habits, sharpen memory, learn more quickly, get the most out of lectures, prepare for tests, produce excellent term papers, and improve critical-thinking skills. (ISBN: 0-534-37595-2).

Reviewers

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For the actual production of this book, I am indebted especially to my developmental editor Elisa Adams. Elisa always was positive and nurturing in her comments. She was constantly challenging me to bring current issues into the text—every batch of edited manuscript arrived with clippings from newspapers and magazines. Much of my early career was spent working with electron microscopes, and I wanted to include the best electron micrographs in this book. I thank all the microbiologists who have provided me with their electron micrographs so students can have the best possible look at the structures related to microbial functions.

I am also extremely appreciative of the people at Wadsworth and Brooks/Cole who have escorted this book through production, including Nina Horne, Marie Carigma-Sambilay, Heather Dutton, Teri Hyde, John-Paul Ramin, Rebecca Eisenman, and Samuel Subity.

Lastly, all of us who have spent our lives teaching undergraduates know the continuing joy of interacting daily with students—responding to their questions, helping them understand difficult information, seeing their perspectives, experiencing their enthusiasm. Without the desire to teach undergraduates—to be a part of their lives and to have them be a part of mine—there would be no incentive to undertake a project of this magnitude.

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