

Preface

"Did you see the interesting article in the newspaper about . . . ?" Every instructor of microbiology has started a lecture with these, or similar, words. And always for the same reason: to impress upon our students that microbiology is not only important but is, in fact, relevant to all our lives. For microbiologists, and those who already intend to enter the field, this battle of relevance has already been won, but for the vast majority of students who are taking microbiology as a prelude to nursing, dental hygiene, or another allied health profession, the science only seems to come alive when linked to everyday experiences. Usually we, as microbiologists, recognize the story in the paper or the blurb on the radio as a living example of the impact of microbiology on our lives and try to share that with our students. Unfortunately, news stories do not always adhere to our syllabi, and many of these wonderful teaching moments go unexploited.

For Whom Is This Lab Manual Written?

Written for students entering the allied health fields, *Laboratory Applications in Microbiology: A Case Study Approach*, is designed to use real-life examples, or case studies, as the basis for exercises in the laboratory. Over the past few years, the number of lecture texts utilizing case studies has grown rapidly, and for good reason—case studies work! This book is the only lab manual focusing on this means of instruction, an approach particularly applicable to the microbiology laboratory. All the microbiological theory in the world means little if students cannot understand the importance of a Gram stain, antibiogram, or other laboratory procedure.

What Sets This Lab Manual Apart?

This book was created to make the microbiology lab a more valuable experience by reconnecting the *what* and *how* of microbiology with the sometimes forgotten *why*. Although Latin names, complex media, and complicated assays will always be a part of the curriculum, the context of the exercises has been expanded so that the reason for completing a specific task will be clear from the outset. Several features of the book are used to accomplish this goal and serve to distinguish it from other microbiology lab manuals.

Case Studies

The first 34 exercises begin with actual cases taken from the scientific literature. After reading each case, several questions help to define the most important issues and how they should be addressed. As the exercise is completed, new techniques, media, and observational tools are introduced, all with the goal of solving the issues presented in the case. Evidence has shown that the use of case studies boosts learning, develops critical thinking skills, increases retention of students in the classroom, and even reduces the incidence of academic dishonesty. Simply put, students learn more, learn faster, and retain more with case studies than with traditional instruction methods. Although this seems obvious to those of us who cannot wait to share the day's news story with our class, the results are backed up by empirical evidence. In one study focused on instructors who use cases, 97 percent reported that students who were taught with cases learned new ways to think about an issue; 95 percent reported that students took a more active part in the learning process; and 92 percent reported that students were more engaged in classes, truly remarkable numbers.

Progression of Exercises Promotes Active Learning

Material in each of the first 34 exercises has been carefully organized so that students develop a solid intellectual base beginning with a particular technique, moving through the case study, and finally applying new knowledge to unique situations beyond the case study. Immediately following the case and introductory material, pre-lab questions help students to focus on the important aspects of the case, developing a framework for what they will need to do *prior to the lab*, most of which require two or three periods. Between the multiday labs, questions are posed to ensure that the students understand what they have just done, the results they should expect, and the significance of those results. Post-lab questions require applying the knowledge gained from the case study to broader questions, facilitating the connection between the exercise and the real-life application.

While the first 34 exercises focus on case studies, the *why* of microbiology, the *how* of the subject has not been forgotten. The final 56 exercises serve as a thorough compendium of common microbiological methods. These exercises are

presented in such a way that students will develop critical thinking skills simply by deciding on a particular course of action. All similar techniques, such as selective and differential media or biochemical tests, are grouped together, and each exercise begins with a brief overview. By reviewing these, a student may select an appropriate test, media, or staining technique from the many available, ensuring that they have decided on not only what information they need, but how to go about getting it. Written to clearly guide students while also pointing out the importance of a particular technique, this portion of the manual provides detailed, well-illustrated procedures that stand by themselves or can be used in conjunction with the case studies in the front of the book. This is particularly helpful when undertaking unknowns, as each student's unknown culture will require a unique set of procedures for complete identification. A data sheet in the appendix provides a single location for students to record their test results, reinforcing the importance of recordkeeping in the laboratory.

Extensive Flowcharts for Bacterial Identification

Exercise 34 introduces the concept of bacterial identification, using a case study recounting the recognition of *Legionella pneumophila* as the causative agent of Legionnaires' disease. Within this exercise, 43 flowcharts are used to help identify bacterial unknowns commonly seen in the microbiology laboratory, a far more extensive collection than the one or two found in most manuals. This exercise also serves as an introduction to the techniques section of the manual, allowing students to quickly decide which diagnostic techniques are applicable to their particular unknown culture.

A Self-Contained Resource for the Microbiology Laboratory

In the workplace, allied health professionals are expected to evaluate a situation and find a solution using whatever resources are available to them. This book serves as a self-contained resource, with everything a student needs to solve a problem in the microbiology laboratory. A **glossary** provides definitions of all microbiological terms used in the book, a rarity in the field. **Appendices** contain the formula of every media and reagent used, in addition to **tutorials** covering universal techniques such as the use of pipettes and spectrophotometers as well as the preparation of media. Each exercise also includes a **link to applicable websites**, such as the CDC homepage for each pathogenic microorganism encountered. In short, this book will help students develop the ability to solve problems.

Teaching and Learning Supplements

McGraw-Hill offers various tools and technology products to support *Laboratory Applications in Microbiology: A Case Study Approach*. Instructors can obtain teaching aids

by calling the McGraw-Hill Customer Service Department at 1-800-338-3987, visiting our Microbiology catalog at www.mhhe.com/microbiology, or contacting their local McGraw-Hill sales representative.

Text Website

Save valuable class time, and help students practice critical laboratory concepts. The *Laboratory Applications in Microbiology: A Case Study Approach* website (<http://www.mhhe.com/chess>) offers a wealth of learning and teaching tools. Instructors will appreciate having access to all teaching resources online, such as the digital photo atlas, instructor's manual, and more.

- **Digital Photo Atlas** includes all images and photos from the lab manual, which can be reproduced for multiple laboratory classroom uses.
- **Instructor's Manual** incorporates a listing of equipment needed for performing all experiments, procedures for setting up experiments, and answers to post-lab questions.
- **Pre- and Post-Lab Quizzing** The pre-lab quiz directs students to carefully read introductory material and examine the entire laboratory contents. After successfully answering the pre-lab quiz, the students are prepared to become involved in the laboratory exercise. The post-lab quiz will ensure that students not only understand the lab procedure, but also recognize its applications.

Acknowledgments

To understand the debt of thanks I owe to those around me, you would have to first see my lecture notes. Wads of notebook paper festooned with chicken scratch, covered with cryptic comments written in lab marker, stained, frayed, and worn to tatters. Now look at this book. The difference between the two is largely the work of others and to them I say thank you. Beginning with my students, who have always let me know (usually kindly) when I have just not gotten my point across. You have made me a better teacher. Also deserving of thanks are the people I spend my days with in the microbiology lab at Pasadena City College: Mary Timmer, laboratory technician extraordinaire, and John Stantz, the other half of the summer team (we are a well-oiled microbiology machine). Our conversations over the past 12 years about the things we could do in the lab keep popping into my head and in many cases popping out onto the page. Special thanks go out to Jessica Edwards, a friend, colleague, and talented microbiologist who often helps me to look at what we do from a new perspective. If you ever plan to be stranded at O'Hare airport for 12 hours, I highly recommend taking Jessica along! The suggestions, both large and small, of these three people have done much to shape this book. Lastly, it has been about a dozen years since Kathy Talaro said something along the lines of "Maybe you should look into doing a little writing, I know some people . . ." Thank you, Kathy.

Of course, without the team at McGraw-Hill, instead of this book you'd be holding my lecture notes in your hands right now. The process of creating a book from an idea is amazing and more than a little awe-inspiring from time to time. Many, many thanks go out to Michelle Watnick (publisher), Jim Connely (sponsoring editor), April Southwood (project manager), Tami Petsche (marketing manager), and Kathy Loewenberg (developmental editor), consummate professionals all. A special thank you to Ashley Zellmer (editorial coordinator), who kept this project on track and even went the extra mile to laugh at my jokes.

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Throughout the entire process of development, an amazing team of reviewers had my back. They helped to shape the content, procedures, order, and depth of this project. Their constructive criticism helped this to be a better book than I could ever have written on my own and I thank them wholeheartedly.

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To the Student

As an introductory student in microbiology, you may find that the reasons behind a particular exercise appear overly complex. Such is the nature of science, but the reasons should, at the very least, be apparent. The first step in closing the chasm between the scientific and the everyday is to understand, always, how each step relates to the overall objective. It is just as important to understand *why* you are doing something as it is to understand *what* it is you are doing. If you can master both the *why* and the *what*, then your success in microbiology will be assured.

This book was written with you in mind. In other words, everything in this book has been written to support something. That means that the introductory material helps to explain the case study, the photos and diagrams are used to clarify procedures, the glossary contains definitions of microbiological terms, and websites are provided if you would like further information on a topic. When you are using this book, please, **use** this book. If the meaning of a sentence is unclear, look to the accompanying figure; if a word is a mystery, use the glossary; if space is provided for a detailed drawing, give it your best shot—it will all be important soon. A well-used book becomes weathered as knowledge moves from the book to the reader, and a lab book is no different in this regard. Dog-eared pages, drawings, notes, circled definitions, are all part of learning, and the physical process of making the book yours parallels the intellectual process of making the information yours. This is as true with microbiology as it is with any other interest, job, or hobby. Take the steps to own the book, and you'll own the information within.