

Preface

Now in its Ninth Edition, *Laboratory Experiments in Microbiology* is valued by instructors and students for its comprehensive coverage of every area of microbiology, its user-friendly laboratory reports, and its clear, straightforward organization. Containing 57 thoroughly class-tested exercises, this manual provides basic microbiology techniques with applications for undergraduate students in diverse areas, including the biological sciences, the allied health sciences, agriculture, environmental science, nutrition, pharmacy, and various preprofessional programs. It is designed to supplement any nonmajors microbiology textbook. Coauthored by Christine L. Case, this manual is an ideal companion to *Microbiology: An Introduction*, Tenth Edition, by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case.

OUR APPROACH

This laboratory manual has two primary goals—teaching microbiology techniques and showing students the importance of microbes in our daily lives and their central roles in nature. Most of the exercises are investigative by design and require the students to evaluate their experimental results and draw conclusions. We hope in this way to promote analytical reasoning and provide students with a variety of opportunities to reinforce the technical skills they have learned. We also highlight practical uses of microbiology by including material with direct applications to procedures performed in clinical and commercial laboratories.

With a strong emphasis on laboratory safety, this laboratory manual encourages students not only to learn but also to practice safety techniques so that safety becomes part of their professional behavior. We have included a safety contract that students can hand in to their instructors to indicate that they understand safety requirements. (For specific safety suggestions, see the section titled Specific Hazards in the Laboratory on page xi and the sections of the Introduction that follow it.) We also alert students with yellow safety boxes at key points in the exercises. These safety boxes are marked with either a biohazard icon  or a general safety icon  indicating appropriate safety techniques.

ORGANIZATION

This manual is divided into 14 parts. The introduction to each part explains the unifying theme for that part. Exercises in the first four parts provide sequential development of fundamental techniques. The remaining exercises are as independent as possible to allow instructors to select the most desirable sequence for their course. The exercises are organized as follows.

OBJECTIVES This introductory section defines the specific skills or concepts to be mastered in the exercise. The objectives can easily be used as the basis for assessment.

BACKGROUND This narrative section provides definitions and explanations for each exercise. Students should refer to their textbook for more detailed explanations of the concepts introduced in the laboratory exercises.

MATERIALS This comprehensive list includes supplies, media, and equipment needed for the exercise.

CULTURES This list identifies the living organisms required for the exercise.

TECHNIQUES REQUIRED This section provides a list of techniques from earlier exercises in the manual needed to complete the current exercise.

PROCEDURE At the core of each exercise, this section provides step-by-step instructions, stated as simply as possible and frequently supplemented with diagrams. Questions are occasionally asked in the Procedure section to remind the student of the rationale for a step.

LABORATORY REPORT Designed to help students learn to collect and present data in a systematic fashion, the laboratory report concludes each exercise. Students are first asked to write the *Purpose* of the exercise so they can relate their laboratory work to their learning. Where appropriate, students are asked to formulate their *Hypotheses*. Tables are provided to record *Results*. Occasionally, students are asked to write their *Expected Results* using information provided in the Background and their own experience. The questions in *Conclusions* are designed to lead the student from a collection of data or observations to a conclusion. In most instances, the results for each student team will be

unique; they can be compared with the information given in the Background and other references but will not be identical to that information. The *Questions* reinforce the conclusions and ask the student to interpret results. The range of questions requires students to think about their results, recall facts, and then use this information to answer the questions. *Critical Thinking* questions are designed to help students use their new knowledge and practice analytical skills.

OVERALL CHANGES IN THE NINTH EDITION

In revising this manual for the Ninth Edition, the overall goal was to make this manual even more navigable and visually effective for students and instructors. The following changes have helped us to fulfill that goal.

- **A dramatically updated art program** features precise illustrations re-rendered in a contemporary, realistic, full-color style. Detailed, full-color photographs, once grouped together in a 16-page insert, now appear alongside the relevant exercise, allowing students to clarify their experiments and better interpret their results. New illustrations have been added to Exercises 20, 22, 29, and 52 to further illustrate and explain complex procedures.
- **Eye-catching full-color design** engages the student while highlighting this manual's trademark clear organization and presentation.
- **User-friendly subheads added to Background material** help organize and illuminate lengthier information for students.
- **A new exercise on parasitic helminths** provides students with valuable practice in microscopic observation and estimating sizes of microscopic organisms.
- **Additional student practice in building and using dichotomous keys** is provided in Exercises 10, 12, and 16, encouraging students to organize their new information, develop their analytical skills, and prepare to use keys to identify unknowns in later exercises.
- **Fecal coliforms and enterococci, in addition to total coliforms**, are used to detect contamination of water in Exercise 53, *Microbes in Water: Membrane Filter Technique*, in accordance with *Standard Methods*.
- **Coverage of secondary transmission and tracking disease by locating the index case** have been added to Exercise 39, *Epidemiology*.
- **Combined or rearranged exercises** respond to reviewer suggestions and now more closely match

the order and progression of many microbiology laboratory courses. For example, aseptic technique is introduced earlier in a new Part Two, *Handling Bacteria*; the two fungi exercises are combined into a single exercise; unknown identification and *Bergey's Manual* are introduced earlier, in Part Five, *Microbial Metabolism*; and rapid identification methods have been moved to appear later in the manual, in Part Thirteen, *Microorganisms and Disease*.

- **A Conclusions section in each exercise's Laboratory Report** guides students through the process of interpreting their results.

PREPARATION GUIDE

The comprehensive *Preparation Guide* (ISBN 0-321-57566-0) provides all the information the instructor needs to set up and teach a laboratory course with this manual. It includes the following:

- General instructions for setting up the lab
- Information on obtaining and preparing cultures, media, and reagents, and expected results for each of the biochemical tests and cultures used
- A master table showing the techniques required for each exercise
- Cross-references for each exercise to specific pages in *Tortora/Funke/Case Microbiology: An Introduction*, Tenth Edition.
- For each exercise: helpful suggestions, detailed lists of materials needed, and answers to all the questions in the student manual

To make *Laboratory Experiments in Microbiology*, Ninth Edition, easy to use, we have carefully designed the experiments to use inexpensive, readily available, nonhazardous materials. Moreover, the exercises have been thoroughly tested in our classes in Minnesota and California by students with a wide variety of talents and interests. Our students have enjoyed their microbiology laboratory experiences; we hope yours will, too!

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A SPECIAL NOTE TO STUDENTS

This book is for you. The study of microbiology is dynamic because of the diversity of microbes and the variability inherent in every living organism. Outside the laboratory—on a forest walk or tasting a fine cheese—we experience the activities of microbes. We want to share our excitement for studying these small organisms. Enjoy!

Ted R. Johnson and Christine L. Case