

Preface

To the Instructor

The 22 laboratory sessions in this manual have been designed to introduce beginning students to the major concepts of biology, while keeping in mind minimal preparation for sequential laboratory use. The laboratories are coordinated with *Essentials of Biology*, a general biology text that covers all fields of biology. In addition, this Laboratory Manual can be adapted to a variety of course orientations and designs. There are a sufficient number of laboratories and exercises within each lab to tailor the laboratory experience as desired. Then, too, many exercises may be performed as demonstrations rather than as student activities, thereby shortening the time required to cover a particular concept.

Laboratory Resource Guide

The Laboratory Resource Guide, an essential aid for instructors and laboratory assistants, free to adopters of the *Essentials of Biology*, is online at www.mhhe.com/maderessentials4. The answers to the Laboratory Review questions are in the Laboratory Resource Guide.

Customized Editions

With McGraw-Hill Create™ you can easily rearrange the labs in this manual and combine them with content from other sources, including your own syllabus or teaching notes. Go to www.mcgrawhillcreate.com to learn how to create your own version of the *Essentials of Biology Laboratory Manual*.

The Exercises

All exercises have been tested for student interest, preparation time, estimated time of completion, and feasibility. The following features are particularly appreciated by adopters:

Integrated opening: Each laboratory begins with a list of Learning Outcomes organized according to the major sections of the laboratory. The major sections of the laboratory are numbered on the opening page and in the laboratory text material. This organization will help students better understand the goals of each laboratory session.

Self-contained content: Each laboratory contains all the background information necessary to understand the concepts being studied and to answer the questions asked. This feature will reduce student frustration and increase learning.

Scientific process: All laboratories stress the scientific process, and many opportunities are given for students to gain an appreciation of the scientific method. The first laboratory of this edition explicitly explains the steps of the scientific method and gives students an opportunity to use them.

Student activities: Sequentially numbered steps guide students as they perform each activity. Some student exercises are Observations (designated by a tan bar) and some are Experimental Procedures (designated by a blue bar). A time icon appears whenever a procedure requires a period of time before results can be viewed.

Live materials: Although students work with living material during some part of almost all laboratories, the exercises are designed to be completed within one laboratory session. This facilitates the use of the manual in multiple-session courses.

Virtual labs: McGraw-Hill's LearnSmart Labs™ are available where noted to accompany many labs in this manual. These outcomes-based lab simulations assess a student's knowledge and adaptively correct deficiencies, allowing the student to learn faster and retain more knowledge with greater success.

Laboratory safety: Laboratory safety, a listing on the website www.mhhe.com, will assist instructors in making the laboratory experience a safe one. Throughout the laboratories, safety precautions specific to an activity are highlighted and identified by a caution symbol.

Improvements This Edition

In general, laboratories have been revised to (1) improve the Introduction so that it becomes an integral part of the laboratory experience; (2) improve the Laboratory Review so that questions better reflect the Learning Outcomes; and (3) use inexpensive plastic transfer pipets when doing exercises that require the use of chemical solutions and test tubes.

Laboratory 1 Scientific Method The laboratory was rewritten to improve the flow and better emphasize the scientific method.

Laboratory 2 Measuring with Metric At adopters' request, study of, and practice with, the metric system has been separated from microscopy and now is presented in a separate laboratory.

Laboratory 7 Cellular Reproduction By following the suggestions of adopters, a laboratory has been created that gives students an exercise to do as they learn the phases of mitosis.

Laboratory 8 Sexual Reproduction In separating meiosis from mitosis, students will engage in an exercise that allows them to see how meiosis introduces genetic variations in the gametes.

Laboratory 9 Patterns of Inheritance The laboratory was rewritten to streamline the experiments to provide students with the opportunity to do hands-on genetics experiments.

Laboratory 12 Evidences of Evolution This laboratory now offers an engaging exposure to plant, animal, and primate fossils. Molecular data to support evolutionary principle were revised.

Laboratory 14 Plant Evolution This laboratory is now based on the latest evolutionary tree of plants and begins with a look at charophytes.

Laboratory 16 Animal Evolution This laboratory includes the newest evolutionary tree of animals and has been shortened to permit use in a single laboratory period.

Laboratory 19 Energy Requirements and Ideal Weight This relevant laboratory is new to the lab manual and provides an easy way for students to decide how best to achieve and maintain an ideal weight.

Laboratory 20 Basic Mammalian Anatomy II This laboratory now begins with coverage of the cardiovascular system.

Laboratory 21 The Nervous System and Senses This laboratory was reorganized to include the spinal cord under the Central Nervous System. The Peripheral Nervous System is better explained and reviewed.

To the Student

Special care has been taken in preparing the *Essentials of Biology Laboratory Manual* to enable you to **enjoy** the laboratory experience as you **learn** from it. The instructions and discussions are written clearly so that you can understand the material while working through it. Student aids are designed to help you focus on important aspects of each exercise. Student learning aids are carefully integrated throughout this manual:

The Learning Outcomes set the goals of each laboratory session and help you review the material for a laboratory practical or any other kind of exam. The major sections of each laboratory are numbered, and the Learning Outcomes are grouped according to these topics. This system allows you to study the chapter in terms of the outcomes presented.

The Introduction to the laboratory reviews necessary background information required for comprehending the work you will be doing during the laboratory session. Also, specific information provided before each of the Observations and Experimental Procedures will assist you in being engaged while you do these activities.

The Observations and Experimental Procedures require your active participation. Space is provided in tables for you to record the results and conclusions of observations and experiments. Space is also provided for you to answer questions pertaining to these activities.

Observation: An activity in which models, slides, and preserved or live organisms are observed to achieve a learning outcome.

Experimental Procedure: An activity in which a series of steps uses laboratory equipment to gather data and come to a conclusion.

If you are asked to formulate explanations at the end of an Observation or Experimental Procedure, you should be sure you are truly writing an explanation or conclusion and not just restating the observations made. To do so, you will need to synthesize information from a variety of sources including:

1. Your experimental results and/or the results of other groups in the class. If your data are different from those of other groups in your class, do not erase your answer; add the other groups' answers in parentheses.
2. Your knowledge of underlying principles. Obtain this information from the laboratory Introduction or the appropriate section of the laboratory and from the corresponding chapter of your text.
3. Your understanding of how the experiment was conducted and/or the materials used. (If by chance the results seem inappropriate, it's possible the ingredients were contaminated or you misunderstood the directions. If this occurs, consult with other students and your instructor to see if you should repeat the experiment.)

The Laboratory Review Each laboratory ends with approximately 10 to 12 short-answer questions that will help you determine if you have accomplished the learning outcomes for the laboratory. The answers to these questions are found in the *Laboratory Resource Guide*.

Color Bars, Time Icon, and Safety Boxes

 **Observations** are identified by the color bar shown to the left. Whenever you see this color, you know that the activity will require you to make careful observations and answer questions about these activities.

 **Experimental Procedures** are identified by the color bar shown to the left. Whenever you see this color, you know that the activity will require you to use laboratory equipment to perform an experiment and answer questions about this experiment.

 **A time icon** is used to designate when time is needed for a reaction to occur. You may be asked to start these activities at the beginning of the laboratory, proceed to other activities, and return to these when the designated time is up.

 **A safety icon** throughout the manual alerts you to any specific activity that requires a cautionary approach. Read these boxes, and follow the advice given in the box and/or your instructor when performing the activity.

The Laboratory Review is a set of questions covering the day's work. Do all the review questions as an aid to understanding the laboratory. Your instructor may require you to hand in these questions for credit.

Laboratory Preparation

It will be very helpful to you to read the entire laboratory chapter before coming to lab. **Study** the introductory material and the Observations and Experimental Procedures so you know ahead of time what you will be doing that week and how it correlates with the lecture material. If necessary, to obtain a better understanding, read the corresponding chapter in your text. If your text is *Essentials of Biology* by Sylvia S. Mader, the "text chapter reference" column in the table of contents at the beginning of the *Essentials of Biology Laboratory Manual* lists the corresponding chapter in the text.

Student Feedback

If you have any suggestions for how this Laboratory Manual could be improved, you can send your comments to:

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