PREFACE

TO THE STUDENT AND INSTRUCTOR

A biochemistry laboratory course, now offered at most colleges and universities in the world, is an essential component in the training of students for careers in biochemistry, molecular biology, chemistry, and related molecular life sciences such as cell biology, neurosciences, and genetics. Both the American Society for Biochemistry and Molecular Biology (ASBMB) and the American Chemical Society (ACS) highly recommend that biochemistry majors complete such a course. Biochemistry lab courses provide students the knowledge and skills needed for future research participation at the undergraduate and graduate level, and for jobs in the biotechnological and pharmaceutical industry.

The purpose of this book is to serve as a resource to enhance student learning of theories, techniques, and methodologies practiced in the biochemistry teaching and research lab. The extensive availability of laboratory experiments published in journals and the desire of instructors to design their own projects and teaching styles have lessened the need for laboratory manuals. Lab instructors are especially eager to introduce new student-centered education methods such as problem-based learning (PBL), research-based learning, Process Oriented Guided Inquiry Learning (POGIL), and other "active-learning" styles into their labs. However, because published experiments and homemade lab manuals usually contain only procedures, there is an increased need for a companion text like this one to explain the theories and principles that underpin laboratory activities.

WHAT'S NEW IN THIS EDITION?

Student learning will be enhanced by the following additions and changes:

- New, cutting-edge topics introduced include membrane-based chromatography (Chapter 5), less toxic electrophoresis dyes (Chapter 6), nanodrop spectrophotometric analysis (Chapter 7), and using gene synthesis in protein expression (Chapter 11).
- An entirely rewritten section on using computers and the Internet in biochemistry (Chapter 2).
- New content on how to conduct research in biochemistry and related molecular life sciences (Chapter 2).
- An increase in the number of end-of-chapter study problems and a new organization of answers in Appendix IX.
- Chapter openers that begin with a content listing of topics and page numbers, which make it easier for students to find specific topics.
- An increase in the number of study exercises within chapters so students can readily check their knowledge on a topic before they move on to a new topic.

- Completely updated references including books, journal articles, and especially Web sites at the end of each chapter.
- Updates to all three appendices located on the book's Companion Website.

ORGANIZATION AND PEDAGOGICAL FEATURES OF THE BOOK

The book begins with an introduction to skills and concepts that students must master including safety issues, communicating lab results, preparation of solutions, pipetting, statistics, buffers and pH, measurement of protein and nucleic acid solutions, radioisotopes, use of the computer and the Internet, and other general laboratory procedures and principles. The historical development of general techniques is explored and followed by discussion of current applications (Chapters 1–3).

Chapters 4–11 provide an introduction to the core techniques and instrumentation that may be applied to the study of all biomolecules and biological processes: centrifugation, chromatography, electrophoresis, spectroscopy, ligand-protein binding, methods in molecular biology, protein purification, and Internet databases. An important premise in this section is that the expansion of our knowledge in biochemistry and related molecular life sciences is dependent upon the continued development of powerful analytical techniques, especially instrumentation and computers.

The book has a Companion Website that is composed of three appendices. The first appendix is an introduction to teaching the biochemistry lab. Topics covered include a discussion of different teaching methods and the concepts and skills that should be part of a biochemistry laboratory course. The second appendix is a listing of proven experiments and projects that have been published in biochemistry education journals. The list gives instructors the opportunity to select laboratory exercises that are compatible with their backgrounds and expertise and with available instrumentation and facilities. Special efforts were made to include projects integrating traditional topics in biochemistry with the modern topics of genomics and proteomics. The current list has approximately 250 experimental projects and will be updated on a periodic basis. The third appendix is a listing of useful Web sites for each chapter, which will be updated as necessary.

The concepts and techniques incorporated in this book have been selected by reviewing undergraduate laboratory curricula recommended by ASBMB, the Biochemical Society (United Kingdom), and the ACS. In addition, the author's opinion, seasoned by 30 years of teaching and research, was an important, but perhaps biased, resource.

The book has been written with a special focus on student learning in the teaching and research laboratory. Several features are present that will assist students in mastering laboratory concepts and skills, as follows:

Use of Computers and the Internet

The computer is now being applied to all aspects of the collection, analysis, and management of biochemical data; hence, computer use is integrated thoroughly into all sections of the book. Chapter 2 introduces students to the computer and to Web sites that maintain directories, lab protocols, and databases for biochemistry

and molecular biology. All chapters have a special section on computer applications and often tables listing Web sites pertinent to topics in the chapter. In addition, Appendix I contains a complete and updated list of Web sites and software associated with topics in each chapter.

End-of-Chapter Study Problems

Several study problems are provided for student practice at the end of each chapter. Questions deal with both theoretical and procedural aspects of the chapter, and often ask students to analyze actual laboratory data. Answers to all odd-numbered questions are provided in Appendix IX.

Study Exercises Within Chapters

Several study exercises have been incorporated into the text of each chapter. These exercises give students the opportunity to review a topic and check their knowledge before they move on to the next section.

Further Reading and Study

Each chapter ends with an abundant list of literature references including Web sites that provide either a more detailed theoretical background or an expanded explanation of procedures and techniques.