

Preface

The field of biocatalysis is at a crossroads. On one hand, the frontier of research races ahead, propelled by advances in the database-supported analysis of sequences and structures as well as the designability of genes and proteins. Moreover, the “design rules” for biocatalysts have emerged from vague images on the horizon, to come into much clearer view. On the other hand, experienced practitioners from other areas as well as more and more students entering this field search for ways to obtain the level of knowledge in biocatalysis that advances their own agenda. However, both groups find a rapidly growing field with too little *guidance* towards the research front and too little *structure* in its guiding principles. In this situation, this book seeks to fill the gap between the research front and the area beyond basic courses in biochemistry, organic synthesis, molecular biology, kinetics, and reaction engineering. Students and practitioners alike are often left alone to bridge the gulf between basic textbooks and original research articles; this book seeks to cover this intermediate area.

Another challenge this book strives to address results from the interdisciplinary nature of the field of biocatalysis. Biocatalysis is a synthesis of chemistry, biology, chemical engineering, and bioengineering, but most students and practitioners enter this field with preparation essentially limited to one of the major contributing areas, or at best two. The essence of biocatalysis, as well as most of its current research, however, is captured in the interdisciplinary overlap between individual areas. Therefore, this work seeks to help readers to combine their prior knowledge with the contents and the methods in this book to make an integrated whole.

The book is divided into three parts:

- Chapters 1 through 7 cover *basic tools*. Many readers have probably encountered the contents of some chapters before; nevertheless, we hope to offer an update and a fresh view.
- Chapters 8 through 14 expand on *advanced tools*. While command of such advanced concepts is indispensable in order to follow, much less to lead, today's developments in biocatalysis, the mastering of such concepts and tools cannot necessarily be expected of all practitioners in the field, especially if their major course of study often did not even touch on such topics.
- Chapters 15 through 20 treat *applications* of all the tools covered in previous chapters. “Applications” here encompass not just industrial-scale realization of bio-

catalysis but also new intellectual frontiers in biological catalysis that are possible with today's technologies, such as rapidly expanding DNA databases or comprehensive coverage of three-dimensional structure analysis for many enzymes.

In the early part of the book, several chapters have a fairly clear emphasis on chemistry, biology, or chemical engineering. Chapters on the isolation of microorganisms (Chapter 3), molecular biology tools (Chapter 4), protein engineering (Chapter 10), or directed evolution (Chapter 11) have a distinct biological flavor. Chemistry is the main topic in the chapters on applications of enzymes as products (Chapter 6), in bulk and fine chemicals (Chapter 7), and in pharmaceuticals (Chapter 13). Chemical engineering concepts predominate in the chapters on biocatalytic reaction engineering (Chapter 5) or on processing steps for enzyme manufacture (Chapter 8). Other chapters contribute a perspective from biochemistry/enzymology, such as characterization of biocatalysts (Chapter 2) and methods of studying proteins (Chapter 9), or from informatics, most notably bioinformatics (Chapter 14).

Finally, a word on the history of this book: the idea for the present work originated during a lectureship of one of us (A.S.B.) as an adjunct faculty member at the Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen in Aachen, Germany, for nine years while he was working at Degussa in Wolfgang, Germany. Time and time again, students enjoyed the interdisciplinary nature and coverage of biocatalysis but lacked adequate preparation in those basic tools that were not provided during their courses for their respective major, be it chemistry, biology, or chemical engineering. Similar observations were made when teaching biocatalysis or related subjects at the Georgia Institute of Technology in Atlanta/GA, USA. One of the aims of this book is to take readers back to scientific fundamentals often long forgotten, to let them to participate in the joy of discovery and understanding stemming from a multi-faceted picture of nature. While scientific fundamentals are a source of immense satisfaction, applications with an impact in the day-to-day world are just as important. Two of the biggest challenges facing mankind today (and not exclusively the industrial societies) are maintenance and improvement of *human health*, and maintenance and improvement of *the environment*. Biocatalysis aids the first of these goals through its selectivity in generating ever more complex pharmaceutically active molecules, and the second goal by opening new routes to both basic and performance chemicals with the aim of achieving sustainable development.

We hope that you enjoy reading this book. We encourage you to contact us to voice your opinion, gripe, laud, discuss aspects of the book, point out errors or ambiguities, make suggestions for improvements, or just to let us know what you think. The easiest way to do this is via email at bommariu@bellsouth.net or andreas.bommarius@alum.mit.edu.

We wish you pleasant reading.

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