Preface

Writing this book, we wanted to present the concepts of physical chemistry and molecular structure that underlie biochemical processes from a biochemist's perspective. The content of the book is equally well accessible to students and scientists with backgrounds in physics, chemistry or biology, but is particularly intended for bachelor and master students of life science curricula. The book will also be useful as an introductory text to more advanced students from other fields, and should serve as a reference for Ph.D. students and young researchers.

The book is organized in four parts: thermodynamics, kinetics, molecular structure and stability, and biophysical methods. To limit theoretical treatments to biologically relevant systems, we left out quantum mechanics and statistical thermodynamics. Each individual chapter is followed by a set of problems that should illustrate the principles treated in the chapter and put them into a biochemical context. The commented solutions to the problems are collected in a separate Solutions Manual. References for the work cited in the text are summarized at the end of each chapter, together with advanced literature that provides additional information and may serve as a starting point for delving into a particular subject.

The first part provides background on thermodynamic principles. Early on in the text, we have tried to illustrate the relevance of these thermodynamic concepts for biochemical systems. Electrochemistry is also treated in this part because it is presented from a thermodynamic point of view.

The second part presents kinetics in a somewhat non-traditional way. We have chosen to start with pre-steady state kinetics. This approach allows us to introduce many basic principles, which we can then build upon in the subsequent treatment of the more traditional steady-state enzymology. We also included a rather complete derivation of integrated rate laws and velocity equations.

In the third part, molecular interactions relevant for biological molecules are reviewed in light of the thermodynamic principles from the first part of the book. The principles of protein and nucleic acid structures are presented, striving for a balance between comprehensiveness and a focus on aspects that are important for life sciences. This part assumes a basic knowledge of the concepts of chemical bonds, orbitals and hybridization.

The fourth part deals with biophysical techniques and their applications to the study of biological macromolecules and their interactions. The selection naturally reflects our own preferences and areas of expertise. We included widely used techniques that should be accessible to most researchers when trying to answer a particular biochemical question. Standard biochemical methods, such as gel electrophoresis and chromatography, have been omitted. For the techniques most frequently used in a biophysical laboratory, a section on "potential pitfalls" may help to avoid common mistakes. Many well-established methods, among them fluorescence microscopy and mass spectrometry, have been developed much further in recent years. We incorporated these novel developments and include specific application examples.

Cross-references within and between all parts of the book serve to emphasize common themes and to highlight recurrent principles. Boxes throughout the main text illustrate the relevance of a particular topic, provide additional information on applications, or show derivations of formulas, but may be skipped without breaking the flow of reading.

The appendix is specifically tailored to the requirements of the four main Parts. We only list constants and units discussed in the text, and restrict the treatment of mathematical concepts to operations that are used in the book. The appendix is meant to be a convenient reference, not a substitute for a thorough training in mathematics.

We hope that this book is an enjoyable read, provides inspiration, and motivates students and researchers alike to dive deeper into biophysical chemistry.

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