

PREFACE

Biology is the study of living species. The historic origin of biology is descriptive in nature, a classification and description of the various biological species. Modern biology is far different and seeks to understand living phenomena on a molecular basis. The incredible amount of information available and the databases of this information are staggering, the most obvious example being the nucleotide sequence of the human genome. In essence, biology has moved from a qualitative to a quantitative science. Inevitably, this requires a theoretical framework and associated mathematics. Physical chemistry provides this framework for molecular structure and chemical reactions, the components of all biological systems that ultimately must be understood.

Traditionally, physical chemistry has been a major training component for chemists, but not for biologists. This has been attributed to the relatively sophisticated mathematical underpinnings of rigorous physical chemistry. However, the concepts of physical chemistry can be understood and applied to biology with a minimum of mathematics.

This volume attempts to present physical chemistry in conceptual terms using mathematics only at an upper level of elementary calculus, a level required for all science students. Nevertheless, the approach is quantitative in nature, with explicit calculations and numerical problems. Examples from biology are used to illustrate the principles, and problems are appended at the end of each chapter. This book is intended to serve as a one-semester introduction to physical chemistry for undergraduate biology majors and as a refresher course for first-year graduate students. This book combines two volumes published earlier, *Thermodynamics and Kinetics for the Biological Sciences* and *Spectroscopy for the Biological Sciences*. These two books have been integrated with some additions and modification. The most notable addition is a chapter on the hydrodynamics of macromolecules. Hydrodynamics is the basis of several important laboratory techniques used in molecular biology, and understanding the underlying concepts will permit better use of the methods and development of new methods.

We begin with a discussion of thermodynamics, a subject that provides a convenient framework for all equilibrium phenomena. This is followed by chemical kinetics, the quantitative description of the time dependence of chemical reactions. For both subjects, multiple applications to biology are presented. The concepts associated with spectroscopy and structure determination are then considered. These topics deal with the molecular nature of matter and the techniques used to characterize molecules and their interactions. The concluding section of the book

includes the important subjects of ligand binding to macromolecules, hydrodynamics, and mass spectrometry. The coverage of this book represents the minimal knowledge that every biologist should have to understand biological phenomenon in molecular terms (in my opinion!).

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