PREFACE

Over the past several years, I have organized and taught a core course in Modern Biophysics Techniques at the University of California Davis. Graduate students in biophysics, chemistry, physics, and engineering enroll in the class to survey the physical techniques that scientists use to study biology.

Introducing the diverse and complex field of biophysics in an academically rigorous but interesting way poses daunting challenges. Indeed, the course has undergone many transformations and has tried on many styles: seminar/journal club, lecture/lab, and just plain didactic lecture formats. These, however, have achieved limited success, because they either assume a strong mathematics/physical-science background or reduce the physical science to a pedestrian level of knowledge, or demand that students trudge along with the expert researchers. None have attracted the interest of biology, physiology, or medical students, who must search for the biological meaning within biophysics.

One major obstacle to developing an attractive but scholarly course centers on the balance between formalism and perspective. Each biophysics technique requires a mastery of a challenging set of physical-science/mathematics formalism. Yet even with mastery the reader may still not gain a biomedical perspective. How will these biophysical techniques help clarify the complex issues in biology? Moreover, how will the course deal with biomedical students' reluctance to overcome the imposing physical-science/mathematical formalism in order to gain new perspectives on biology?

These considerations have given rise to the series *Handbook of Modern Biophysics*. The books in this series will bring current biophysics topics into focus and expand as the field of biophysics expands, so that biology and physical-science students or researchers can learn fundamental concepts and apply new biophysics techniques to address biomedical questions. However, the chapter structure will recognize the demand for explicating the conceptual framework of the underlying physics formalism and for casting perspectives on the biomedical applications. Each chapter will have a bipartite structure: the first part establishes the fundamental physics concepts and describes the instrumentation or technique, while the second illustrates current applications in addressing complex questions in biology. With the addition of problem sets, further study, and references, the interested reader will be able to further explore the ideas presented.

In the first volume, *Fundamental Concepts in Biophysics*, the authors lay down a foundation for biophysics study. Rajiv Singh opens the book by pointing to the central importance of "Mathematical Methods in Biophysics." William Fink follows with a discussion on "Quantum Mechanics Basic to Biophysical Methods." Together, these two chapters establish some of the principles of mathematical physics underlying many biophysics techniques. Because computer modeling forms an intricate part of biophysics research, Subhadip Raychaudhuri and colleagues introduce the use of computer modeling in "Computational Modeling of Receptor–Ligand Binding and Cellular Signaling Processes." Yin Yeh and coworkers bring to the reader's attention the physical basis underlying the common use of fluorescence spectroscopy in biomedical research in their chapter "Fluorescence Spectroscopy." Electrophysiologists have also applied biophysics techniques in the study of membrane proteins, and Tsung-Yu Chen et al. explore

stochastic processes of ion transport in their "Electrophysiological Measurements of Membrane Proteins." Michael Saxton takes up a key biophysics question about particle distribution and behavior in systems with spatial or temporal inhomogeneity in his chapter "Single-Particle Tracking." Finally, in "NMR Measurement of Biomolecule Diffusion," Thomas Jue explains how magnetic resonance techniques can map biomolecule diffusion in the cell to a theory of respiratory control .

This book thus launches the *Handbook of Modern Biophysics* series and sets up for the reader some of the fundamental concepts underpinning the biophysics issues to be presented in future volumes.

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