

Preface

Membranes are highly complex, dynamic structures that are fundamental to life. It is likely that life could not have begun if the first collections of primitive proteins, nucleic acids, and so on were not encapsulated inside a primal, semipermeable membrane. Every living organism on planet Earth is now and always has been surrounded by a plasma membrane. Although biological membranes are more similar than they are different in their compositions and structures, it is their differences that account for diverse membrane functions. Great progress in understanding how membranes work continues to be made, but it is likely that membranes will remain the next great frontier in the life sciences.

Membrane studies can be roughly divided into three arenas—composition, structure, and function. The first edition of this book, *An Introduction to Biological Membranes: From Bilayers to Rafts*, focused on composition and structure, while this second edition, *An Introduction to Biological Membranes: Composition, Structure, and Function*, is a greatly expanded version of the first edition, integrating many aspects of complex biological membrane functions with the composition and structural components featured in the first edition.

A single membrane is composed of hundreds of proteins and thousands of lipids, all in constant flux. Every aspect of membrane structural studies involves parameters that are very small and very fast. Parameters of interest to this book range in size from microns (μ , 10^{-6} m) to Angstroms ($\text{\AA}$, 10^{-10} m) and in time from milliseconds (ms, 10^{-3} s) to picoseconds (ps, 10^{-12} s). Both size and time ranges are so

vast that multiple instrumentations must be used, often simultaneously. As a result, a variety of highly specialized and esoteric biophysical methodologies are often utilized.

Like the first edition, the second edition is presented in a single voice (ie, I am the sole author). The purpose of this book is to address salient features of membranes as a broad introduction aimed at college seniors and beginning graduate students. It is written in the form of a textbook and hopefully does not get bogged down in overly detailed, technical minutia. As in the first edition, the emphasis is placed on what can be gleaned from a particular biophysical technique and not the sophisticated theory behind the instrumentation. In other words, the presented experiments can best be described as “biophysics light” and should be understandable by anyone interested in membranes. Choosing what should be included and what excluded from the book reflects my personal research experience that has been based on the biophysics and biochemistry of model membrane systems. There is also an emphasis placed on who actually were the pioneers of membrane studies. I have found that most contemporary membranologists have little idea how the problems they study originated. And often these early pioneers were quite interesting and even eccentric characters! The last chapter of this book, Chapter 25, is a timeline of the most important discoveries in membrane science from about 540 BC to the present.

Writing these two books has been a task that is beyond any one individual. It was

certainly beyond me. No one can possibly be an expert in all aspects of membrane science. The field of membranes has just become too enormous for one individual to tackle. However, the other option of presenting the material as a large, multiauthored compendium results in an unevenly written book that is too technical and can only be understood by researchers who are already experts in their narrow field of study. While multiauthored compendiums have their place in membrane studies, they are essentially non-cohesive collections of loosely related review articles that are written by experts, for experts. The authors approach aspects of membranes from very different backgrounds

and writing styles. As a result, multiauthored compendiums are comprehensive but hard to read and are essentially "preaching to the choir." In contrast, my book is an introductory textbook aimed at a more general audience. It took me the past 11 years, writing 7 days a week, to finish. I am almost completely blind, type with one finger, and have no clerical help. And every day I think of additional things that should have been included.

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