Preface

The tremendous progress made over the last decade in our understanding of biomembranes calls for a new gestalt in a book about their structure and function. The need for such a book was apparent as I labored to capture the explosion of information about the structure and organization of biological membranes for my course on membrane biochemistry. Applications of new techniques and whole new methodologies have changed both how we acquire knowledge of the membrane and how we view it. For many years, the difficulties in crystallization of membrane proteins caused a scarcity of structural detail. Now sophisticated diffraction analysis allows description of fluid lipid bilayers, and high-resolution structures have been determined for a variety of membrane proteins. Each new high-resolution structure of a membrane protein that graces a journal cover offers new insights into membrane functions. And yet, a full understanding of each new structure and its lipid environment is built on foundations of membrane biochemistry that derive from basic physical and life sciences.

This book combines a physicochemical analysis of the membrane milieu with the latest structural biology on membrane lipids and proteins to give an exciting portrayal of biomembranes. The book's title, *Membrane Structural Biology*, emphasizes the successes of structural biology in revealing exciting details of many membrane components. To see the impact of structural biology on biochemistry textbooks, one need only compare a biochemistry book from 25 years ago with a current textbook, in which colorful and detailed molecular structures illustrate the functions of biomolecules and mechanisms of complex biochemical processes. A textbook on membrane biochemistry can only now approach that transformation to molecular detail, drawing from x-ray crystal structures, lipid diffraction and liquid crystallography, and computational modeling.

To cover these advances and their foundations in one comprehensive volume, this book moves from basic membrane biochemistry to detailed examples of membrane structural biology. It includes numerous new topics, such as phase diagrams of lipid raft mixtures, reconstitution using bicelles and nanodiscs, binding domains of amphitropic proteins, effects of elasticity on folding of membrane proteins, a biological scale for identification of transmembrane helices, bioinformatics and proteomics of membrane proteins, and joint refinement of x-ray and neutron diffraction data for lipid bilayers. It offers explanations of techniques as varied as statistical methods for prediction of transmembrane sequences, surface effects in binding and kinetics, protein folding studies, liquid crystal theory, and molecular dynamics simulations.

Written at a level appropriate for advanced students and scientists new to the field, *Membrane Structural Biology* assumes a background familiarity with the concepts covered in an undergraduate biochemistry course. Although it includes a wide range of material in a broad and rapidly moving field, the book is not encyclopedic. Nor does it provide the thousands of references to the scientific papers on which it is based. That literature is vast, but fortunately it is readily accessible with the search engines now available. Readers who want to learn more can get started with the key references to seminal papers and reviews provided for each chapter. They can study the papers cited in the figure captions and can easily search for other contributions from those authors. A thorough familiarity with the examples described in the book will provide the reader with a solid foundation for further studies, including the exploration of other important topics, such as membrane fusion, chemotaxis, endocytosis, and membrane recycling.

It is a challenge to cover the full scope of this burgeoning field, including new methodologies and latest developments. Though it is my hope that the number of typographical and/or factual errors in this text will be small, I welcome the readers of this first edition to send me their corrections so that they may be incorporated into the next edition.

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