

Contents

1	Molecular Membrane Biochemistry	1
1.1	Membrane Architecture	1
1.2	Chemistry and Physics of Membrane Lipids	3
1.3	Membrane Proteins	6
1.3.1	Protein Structure	6
1.3.2	Membrane Protein Structure	13
1.3.3	Membrane Protein Insertion in Natural Membranes	16
1.3.4	Hydrophobic Effect and Protein Folding	18
1.4	Micro- and Nanostructure of Biomembranes	24
	References	27
2	Physicochemical Properties of Lipids and Macromolecules in Higher Level Organization	31
2.1	Lipid Monolayers at the Interface: Two Dimensional Structures	31
2.1.1	Phases at the Air Water Interface	32
2.1.2	Monolayer Compressibility	34
2.1.3	Mixing Properties of the Monolayers at the Interface	35
2.2	Langmuir-Blodgett Films	36
2.3	Structures at the Air-Water Interface	37
2.3.1	Brewster Angle Microscopy	37
2.3.2	Atomic-Force Microscopy (AFM)	38
2.4	Protein- and Peptide-Lipid Interactions in Monolayers	39
2.4.1	Interfacial Studies for Understanding Enzyme Activity	40
2.4.2	Adsorption of Soluble Proteins to Lipid Monolayers	41
2.4.3	Peptide Interaction with Monolayers	42
2.4.4	The Membrane Associated Surfactant Proteins	43
2.5	Structures of Lipids in Aqueous Environments	45
2.5.1	Hydrophobic Effect and Lipid Self-aggregates	47
2.5.2	Liposomes	49
2.5.3	Supported Membrane Systems	49

2.5.4	Giant Unilamellar Vesicles (GUVs)	49
2.5.5	Bilayer Compressibility and Bilayer Surface Pressure	51
2.6	The Lipid-Phase Transition: Some Experimental Approaches	52
2.6.1	Differential Scanning Calorimetry of Lipids	52
2.6.2	Fluorescence Anisotropy	53
2.6.3	³¹ P-Nuclear Magnetic Resonance Spectroscopy	56
2.6.4	AFM in Force Spectroscopy (FS) Mode	58
	References	59
3	Lateral Distribution of Membrane Components and Transient Lipid-Protein Structures.	63
3.1	Lateral Distribution in Reconstituted Systems	63
3.2	Lipid Phase Separation and Phase Diagrams of Lipid Mixtures	65
3.3	Lateral Segregation of IMPs: Experimental Evidence	70
3.4	Boundary, Non-boundary and Bulk Lipids	76
3.5	Hydrophobic Match and Mismatch	81
3.6	Curvature Stress and the Fluid Surface Model	84
3.7	Lipid Rafts	85
	References	85
4	Dependence of Protein Membrane Mechanisms on Specific Physicochemical Lipid Properties	89
4.1	Gibbs Energy and ATP Synthesis: The Lipid Coupling	89
4.2	Protein Activity Related to Specific Phospholipids	93
4.3	Dependence of Protein Activity on Lipid Packing, Order Parameter and Temperature	98
4.4	Interactions of Lung Surfactant Through Lipid Monolayers	102
4.5	The Lipid-Protein Interface	103
4.6	Thermodynamic Framework and Nanomechanics of IMP Activity	107
4.7	Identification of Lipids at the Membrane Lipid-Protein Interface	110
4.8	An Integrative Model for Lactose Permease	113
4.9	A Word on Multidrug Resistance Mediated by Membranes	114
	References	114

Membrane Protein – Lipid Interactions: Physics and
Chemistry in the Bilayer

Borrell, J.H.; Domènech, Ò.; Keough, K.

2016, XIV, 116 p. 66 illus., 43 illus. in color., Softcover

ISBN: 978-3-319-30275-1