
Preface

Every cell in our body contains a great variety and number of permeability pathways for various organic and inorganic ions, water, metabolites, nutrients, and signaling molecules. Maintenance and precise control of gating within these pathways are fundamental principles of life as these underlie basic cellular functions such as communication, contractility, and metabolism. This book focuses on the strategies, approaches, methods, and protocols for studying a large family of proteins that form ionic channels in the plasma membrane and intracellular membranes of cells. Like other permeability pathways of biological membranes, ion channels are essential for life as they generate action potentials and regulate synaptic transmission in neurons and muscle cells, underlie intracellular Ca^{2+} signalling, and contribute to the charge separation across plasma membranes. Not surprisingly, genetic deficiencies or acute deregulations of ion channel activity, trafficking, or degradation often cause or contribute to severe human disorders (often called “channelopathies”) and pathologies, e.g., arrhythmias, epilepsies, chronic pains, deafness, diabetes, and many others. Conversely, ion channels are increasingly recognized as therapeutic targets.

Slightly over half a century ago, ion-selective channels in the plasma membrane were postulated by Alan Hodgkin and Andrew Huxley as a purely theoretical concept. Now, at the beginning of the twenty-first century, hundreds of ion channel genes are cloned, and the currents conducted by many of them are exhaustively characterized. Some ion channels are assigned with clear physiological functions while some are linked to human diseases, and, for a handful of them, functional structures are proposed. This is tremendous progress, yet there is even more that we do not know. The aim of the present book is twofold: firstly, using practical examples from the cutting-edge current research, we will take a look back at the major methods and approaches that allowed us to progress to our current understanding of ion channel function, structural design, and biological roles; and secondly, we will try to look forward and identify approaches that will lead us to future discoveries.

This book will be of interest to specialists in academia and industry looking for specific methodology in studying ion channels. It will be helpful for lecturers and advanced students in the university classroom as well as for anyone interested in the state-of-the art biomedical toolkit.

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Methods and Protocols

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