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# Book Review

## Ion Channels—Molecules in Action

**Ion Channels.**
**By David J. Aidley and Peter R. Stanfield.**
New York: Cambridge University Press. (1996). 307 pp. $29.95 paperback; $80.00 hardcover.

Since the discovery of ion channels in excitable membranes of the nervous system, ion channels have been found in practically every eukaryotic cell type that has been studied, as well as in some prokaryotes. In addition to signaling in the nervous system, other cellular functions that involve ion channel activities include regulation of the flow of salt and water across epithelia, control of the release of hormones such as insulin, and regulation of cell volume, migration, differentiation, and cell death.

Key to the physiological function of an ion channel is its ability to allow only certain ions to go through, only under particular circumstances. Remarkable understanding of these two aspects of channel function, permeability and gating, has been achieved in biophysical studies.

How can a calcium channel allow only $Ca^{2+}$ ions to go through even though $Na^{+}$ ions are of nearly the same size and are much more abundant under physiological conditions? How does a potassium channel select for the larger $K^{+}$ ions over the smaller $Na^{+}$ ions, given that millions of $K^{+}$ ions stream through the channel in single file in a second so that there is less than 1 $\mu$s of interaction between the channel and a $K^{+}$ ion?

How do ion channels control the electrical potential across the membrane? How are the activities of voltage-gated ion channels controlled in turn by this electrical potential?

How do ion channels gauge the energy level and control insulin release accordingly? What are the mechanisms for neurotransmitters to alter ion channel activities? How might ion channels in intracellular membranes be signaled, for example, to release calcium from internal stores?

Which ion channels are targeted by valium and barbiturates and how are they affected by these compounds? What about the dihydropyridines used to treat heart diseases and hypertension? Or the sulphonylurea drugs used to treat diabetes?

How were answers to these questions formulated at a time when all that the biophysicists had were glass electrodes, bottles of salt, a plethora of toxins that organisms of all five kingdoms have used to modify ion channel activities, and the biophysicists' own analytical power? How have the various theories progressed since the cloning of several families of ion channels?

These are just a sample of the questions that one may have but might have been afraid to ask in a casual way, for fear of confronting an unfamiliar field that abounds with jargon, along with the unfriendly look of some equations and wiggly traces. The new *Ion Channels* book by David J. Aidley and Peter R. Stanfield offers an easy and smooth initiation.

Max Delbrück used to remind us that, when we want to explain something, we should always assume that the listener has zero knowledge and infinite intelligence. Aidley and Stanfield came close to fulfilling Delbruck's demand, as they gave clear and concise introduction to the physics, chemistry and molecular biology used for ion channel research. For example, to begin a discussion of electricity they did not neglect to say that "charges of the same sign repel each other and those of the opposite sign attract each other." Nor did they simply mention these facts as "just so"; references are provided for the curious and just about enough background is given for the terms and concepts central to studying the workings of ion channels. Whereas this feature should make their book popular among undergraduate students, what distinguishes this book from standard textbooks is the inclusion of some details of the experimental design, so as to allow the reader to have a better feel of how the studies were done and how the abstract theories emerged from the data.

An emphasis of this book is on molecular approaches of ion channel studies. The authors have done a fantastic job in presenting a balanced view and in pointing out unsettled areas. As expected for an active field, however, new developments (e.g., determination of the ClC chloride channel subunit stoichiometry) appear at a steadfast pace since the printing of this book last year. The reader should also remember that for certain topics, such as the mechanism for the muscarinic suppression of the M current, the jury is still out. As true for all successful modern textbooks, this book can only aim at providing the foundation, so that the reader will be prepared to catch up on the latest from reading review articles and research papers.

What makes this new book accessible is that the entire book deals with one issue: how ion channels work. It leaves out questions concerning the physiological roles of ion channels, for example, in processing and transmitting signals of the nervous system. One obvious suggestion for additional reading is Bertil Hille's classic, *Ionic Channels of Excitable Membranes* ([1992] Sinauer Associates, Sunderland, Massachusetts), a book which has had tremendous impact over the ion channel field. In this era of genome projects where one may come across channel sequences more readily than clues to the function of these channels, one could first consult the *Ion Channels* book for a more up-to-date treatment of studies of cloned channels, and then go to Hille's book for further ideas concerning channels of known function but unknown molecular structure.

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## Books Received

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