

Physical Biology of the Cell

Rob Phillips, Jané Kondev, and Julie Theriot
Garland Science, New York, 2009.
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The rapidly growing field of quantitative biology has emerged in the past decade as a result of the development of quantitative experimental methods in the life sciences. The hallmarks of the new field are experiments that generate



quantitative data and interpretation of that data in the light of quantitative models. The emergence of quantitative biology poses special challenges to biologists and to

physicists eager to make a contribution. On the one hand, traditional biology training often neglects the mathematical tools necessary to build quantitative models. On the other, physics training has historically involved the application of quantitative models to quantitative data, but physicists usually do not know enough biology to ask the right questions. Even worse, due to their different backgrounds, the two groups often lack even the ability to communicate with each other.

Physical Biology of the Cell by Rob Phillips, Jané Kondev, and Julie Theriot squarely addresses the issue of bringing the physics and biology communities closer together. Written by a very bright team of quantitative biologists with combined training in physics and biology, the book aims to be both an introduction to molecular and cellular biology for physicists and an introduction to physics for biologists. Although that task sounds daunting, the authors fully and impressively deliver.

Many ingredients combine to make the book work. The lucid language and numerous figures (albeit unfortunately only in black and white) are easy to follow, regardless of a reader's background. The overall size, though intimidating at first sight, is one of the work's great strengths, since it allows the authors to give issues the attention they require. New terms from both the biological and physical sciences are first used casually and then explained in detail. That treatment allows readers familiar with a term to feel at home and readers unfamiliar with it to assimilate the new concept almost without notic-

ing that they have just learned something. For those whose appetite has been whetted, the end of each chapter challenges their understanding with several problems and plenty of suggestions for further and more specialized readings.

The physicist who wants to learn about biology will appreciate that the book uses a framework and language familiar to physicists while conveying the fascination of the marvels of nature. Also included are explanations of fundamental experimental methods and influential biological experiments in special "Experiments Behind the Facts" sections. The biologist curious about physical methods will welcome the book's strong focus on biology. The authors never introduce a concept just because it is nice physics. Rather, they introduce only as much physics and mathematics as are necessary for a given biological problem. Sections titled "Math Behind the Models" and "Tricks Behind the Math" introduce the mathematical concepts. Along the same lines of simplicity and directness, the book provides many back-of-the-envelope estimates and is based on the philosophy that formulas should be no more complicated than what can be written with a stick in the sand, as illustrated on the book cover.

Because of its focus on biological problems and keeping the mathematics manageable, the text is not suitable for teaching a graduate biophysics course that includes a lot of discussion of phase transitions and critical phenomena. It is, however, ideal for a first introduction to quantitative biology for physicists and biologists alike, and could also serve well as the foundation for an advanced undergraduate course in physical biology.

It is certainly no coincidence that the title of the book resembles that of *Molecular Biology of the Cell* by Bruce Alberts and colleagues (5th edition, Garland Science, 2008), a must-read for anyone interested in molecular biology. *Physical Biology of the Cell* might well become a similar classic for anyone who heeds its mantra "quantitative data demand quantitative models." It will give both physicists and biologists a useful introduction into the other camp's methods and ways of thinking. And as a result, future generations of physicists and biologists will be able to work together to attack 21st-century life-science challenges.

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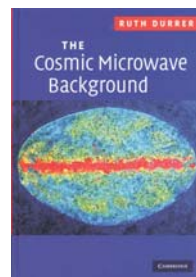
The Cosmic Microwave Background

Ruth Durrer
Cambridge U. Press, New York,
2008. \$80.00 (401 pp.).
ISBN 978-0-521-84704-9

A Primer on the Physics of the Cosmic Microwave Background

Massimo Giovannini
World Scientific, Hackensack, NJ,
2008. \$75.00 paper (474 pp.).
ISBN 978-981-279-142-9

The cosmic microwave background is relic radiation emitted about 300 000 years after the Big Bang, when the universe was only about 1/1000 of its present size. At that



time, light and matter decoupled and light began to permeate space, traveling in all directions more or less unobstructed. The 1965 discovery of the CMB was commemorated by the Nobel Prize awarded in 1978 to Arno Penzias and Robert Wilson.

That discovery was followed by intense experimental and theoretical effort that unraveled two important features of the CMB. First, its spectrum is the most perfect blackbody spectrum known and corresponds to a temperature of about 2.7 K. Second, the CMB, although very uniform, is not perfectly so. It has small temperature fluctuations of roughly one part in 100 000 that encode information about the distribution of matter in the universe at the time the CMB was emitted. The discoveries of those two features yielded a second Nobel Prize for CMB work—to George Smoot and John Mather in 2006.

Today, the CMB is one of cosmology's most important objects of study. Its potency lies in that the fluctuations in the early universe were small and therefore can be fully treated by perturbation the-

