Introduction to Experimental Biophysics: Biological Methods for Physical Scientists

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Peliti's *Statistical Mechanics in a Nutshell*—originally published in Italian (Bollati Boringhieri, 2003)—is a fantastic reference for those who know the subject, teach it, or need a quick technical reminder, especially on the topic of phase transitions, which are consistently featured in modern-day discussions and one that Walecka's book omits. Browsing Peliti's book reminded me of such texts as Kerson Huang's *Statistical Mechanics* (2nd edition, Wiley, 1987); David Chandler's *Introduction to Modern Statistical Mechanics* (Oxford University Press, 1987); and Mehran Kardar's *Statistical Physics of Particles* and *Statistical Physics of Fields* (both published by Cambridge University Press, 2007).

Of the books under review, *Statistical Mechanics in a Nutshell* provides the more general overview, with topics such as the renormalization group method. It includes a good mix of fundamental thermodynamics, phase behavior, and other key subjects. Even so, I do not see it as a standalone book for introductory students, even if they are energetic and serious; they will need an expert teacher or practitioner to make the ideas become more vivid in the classroom.

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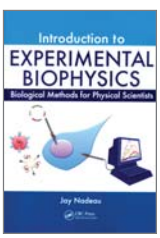
Introduction to Experimental Biophysics

Biological Methods for Physical Scientists

Jay Nadeau
CRC Press, Boca Raton, FL, 2012.
$89.95 (641 pp.).
ISBN 978-1-4398-2953-0

Each year a number of physicists leave various disciplines to become biophysicists. Those converted physicists are challenged to learn various life-science laboratory techniques applicable to molecular biology, microbiology, biochemistry, and cell biology, among other subfields. They also must become familiar with the spectroscopic, microscopic, and other important physical techniques that are now staples of many biological physics labs.



Those challenges highlight the need for effective laboratory manuals, protocols, guides, and other instructional material. Jay Nadeau's *Introduction to Experimental Biophysics: Biological Methods for Physical Scientists* is an ambitious text aimed at educating new graduate students about the important and most common techniques used in a modern biological physics laboratory; it could also serve nicely as a reference manual for advanced graduate students of new or underused protocols. Whereas most existing texts of its kind are aimed at educating biologists or biochemists, Nadeau's is aimed at young biophysicists and more seasoned researchers transferring to the field.

Introduction to Experimental Biophysics includes chapters that cover basic concepts behind commonly used biological techniques—for example, transfection, protein purification, and protein crystallography. Other, more physically flavored chapters discuss the concepts behind microscopy, surface chemistry, inorganic nanoparticles, and quantum dots. Each chapter contains protocols and the conceptual reasoning behind them, which is often useful to physicists performing biological experiments for the first time. Specific gems of the book include an overview in chapter 1 of the physical principles common in biological systems; a detailed experimental overview in chapter 5 of x-ray protein crystallization and a useful troubleshooting section to help novices; and a number of extremely useful discussions in chapter 10 on surface modification and functionalization. Surface preparation is particularly important in biophysics: If done incorrectly, it can ruin an otherwise beautiful experiment. The end of each chapter includes extensive references, information about equipment suppliers, helpful websites and software, and additional experimental protocols.

Despite its more than 600 pages, the book is still lacking in some aspects. Perhaps that's not surprising, given its broad scope and ambitious nature. First, most chapters give few details about advanced techniques. For instance, in chapter 6, which covers light microscopy, only one paragraph discusses total internal reflection fluorescence microscopy. Nowhere does the book mention optical or magnetic tweezers, which are used in force spectroscopy and are prevalent in modern biological physics laboratories. Further, various microscopies are discussed in multiple chapters, with electron microscopy (only scanning EM and not transmission EM) addressed in chapter 8 and atomic force microscopy presented in chapter 10.

The book does not mention techniques that use phospholipids, has insufficient information on chromatographic techniques, and lacks a discussion of the usefulness of centrifugation. New entrants to the field would benefit from learning about the best strategies to extract data—a skill that is not always obvious to beginners—and from knowing the limits of the various techniques, as was done in the troubleshooting section of chapter 5 on protein crystallization and in the example experiments for flow cytometry in chapter 7.

Overall, the many outstanding qualities of *Introduction to Experimental Biophysics* should make it an essential part of the biophysicist's collection. For new students, it is best partnered with the following texts. *At the Bench: A Laboratory Navigator* (Cold Spring Harbor Laboratory Press, 2005), by Kathy Barker, contains useful information about the social forces that shape the establishment of laboratories and how to cope with working in the lab on a daily basis. And *Principles and Techniques of Biochemistry and Molecular Biology* (7th edition, Cambridge University Press, 2010), edited by Keith Wilson and John Walker, provides useful basic information, including a table of units and standard formulas needed to analyze biochemical data.

Introduction to Experimental Biophysics assumes readers are already acclimated to the lab and can figure out for themselves how to analyze the data, if only they could get the data using the right biological experimental techniques. This book is likely to become increasingly useful with future editions and iterations, but in its current state, other sources—most likely collaborating biologists—will be required to fill in the gaps.

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Neither Physics nor Chemistry

A History of Quantum Chemistry

Kostas Gavroglu and Ana Simões
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$40.00 (351 pp.).
ISBN 978-0-262-01618-6

The way new areas of science are birthed is similar to the way continental masses are formed: by the contact and