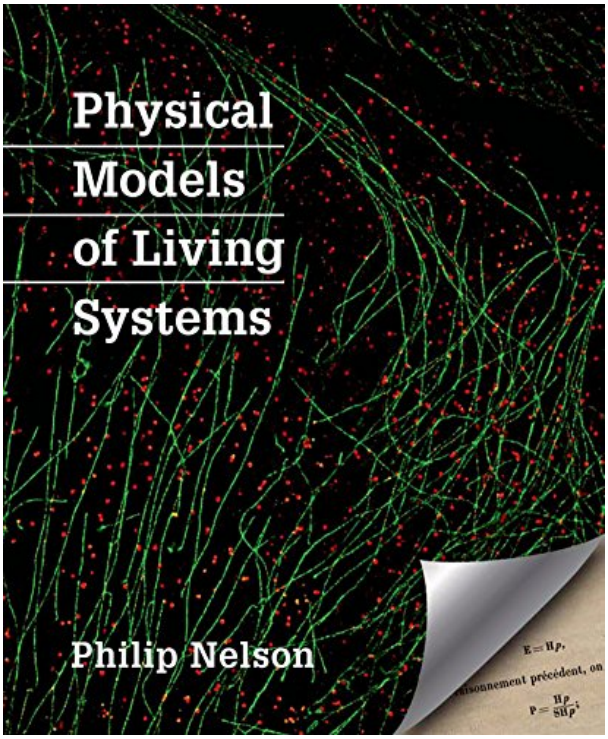
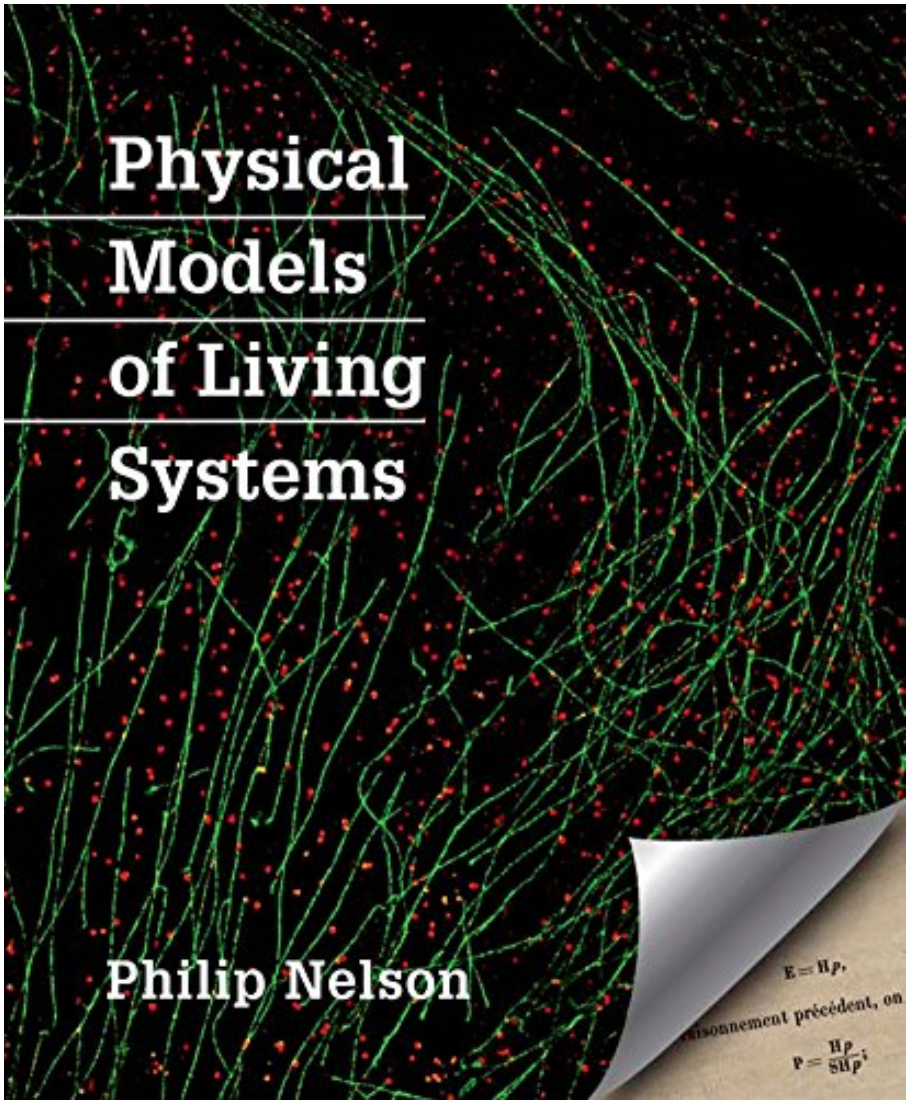
PHYSICAL MODELS OF LIVING SYSTEMS BY PHILIP NELSON





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Review

"Philip Nelson has done a terrific job.... There are numerous traits that make this text unique among the very many books of biological physics.... The presentation of materials is developed in an innovative fashion.... There is a nice balance between conceptual examples and end-of-the-chapter problems.... This book shows a nice intercalation of fundamental laws, brief descriptions of computational strategies for acquiring quantitative information, as well as their implications in biological physics and areas beyond that, including signaling processes, genetic switches, and cellular oscillators.... Physical Models of Living Systems... will benefit undergraduates as well as others with interests in genomics, proteomics, cellular signaling, bioengineering, regenerative medicine, and synthetic biology." -- Liviu Movileanu in American Journal of Physics

Particularly compelling for its smooth integration of biological experiments, physical models, and computational exercises. Readers who complete the text will be well equipped with the computational and mathematical skills needed for a quantitative understanding of a range of biological systems.... Thanks to Nelson's skillful writing and the excellent accompanying online resources, this book will appeal to a broad audience and teach even a beginner how to solve problems numerically." -- Prof. Eva-Maria Collins in Physics Today

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About the Author
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Written for intermediate-level undergraduates pursuing any science or engineering major, Physical Models of Living Systems helps students develop many of the competencies that form the basis of the new MCAT2015. The only prerequisite is first-year physics. With the more advanced "Track-2" sections at the end of each chapter, the book can be used in graduate-level courses as well.

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Most helpful customer reviews

5 of 5 people found the following review helpful.
Tools for understanding a wide range of biological systems
By Winston Smith
This book is aimed at undergraduate physics students who want to construct quantitative, predictive models of biological systems. The book is not a general introduction to biology - plenty of other books do that job. This book is not really even an introduction to biological physics. (Nelson did that in his earlier book, Biological Physics: Energy, Information, Life.) Rather this book introduces a set of mathematical tools and physical ideas and then shows how they can be applied to a diverse set of real problems in biology and medicine. As the author is a physicist, many of his chosen applications and examples come from current research areas in biological physics: superresolution microscopy (Chapter 6), which was recognized with a Nobel Prize in 2014, is just one example. But still the applications cover a broad range of topics, from bacterial mutations, chemostats and drug testing to superresolution microscopy, genetic oscillators and

transcriptional bursting.

The first half of the book focuses on random processes in biology. It introduces basic concepts of probability and statistics such as continuous and discrete probability distributions, Poisson processes, conditional probability, Bayes Theorem, maximum likelihood, etc. It then uses these tools to construct models for some of the applications mentioned above (mutations, superresolution, bursting, etc.). Probabilistic and statistical tools are of high importance these days as scientists increasingly use photon-counting or single molecule techniques to study processes inside individual living cells.

The second half of the book mostly focuses on regulatory models and mechanisms. The basic tools are such ideas as birth-death processes, phase portraits, regulatory networks, genetic switches and oscillators, feedback and nonlinearity. The book applies these ideas to (for example) the lac system, transcription, positive and negative regulation (trp operon), circadian oscillators, etc.

Each chapter offers a handful of homework problems. Many of them are quite interesting and go beyond the simple plug & chug. Some problems are explicitly biological while others are not. The problems span the full range from fairly conceptual or intuitive to moderately mathematical, to rather complex, perhaps even requiring some programming skill in Matlab or equivalent.

Overall I recommend the book highly. It does a great job of developing some fundamentally important mathematical and physical ideas with high precision and clarity and then applying them to a nice array of important (often classic) biological problems. It is probably best suited for the advanced undergraduate physical science major: Nelson keeps the biology jargon to a minimum and assumes very little prior biology knowledge beyond (say) AP Biology ... but he does not hesitate to use any/all mathematical tools needed. For the reader to benefit from this book, it is much more important to have good facility with basic calculus than to have prior exposure to biology beyond high school. Nelson's writing style is careful but informal; undergraduates with math skills should find the book very readable. More advanced readers who already have a command of the math and physics content will still find the book interesting because of the diversity of biological applications that it covers.

2 of 2 people found the following review helpful.
Marvelous new book in quantitative biology and biological physics
By J.J. Collins
There is growing interest in quantitative biology and biological physics, driven in part by the rising popularity of synthetic biology and systems biology. However, the development of educational materials has not kept pace with this emerging interest. Phil Nelson's marvelous new book nicely fills this gap and will serve as a fantastic resource for the field. The book is designed as a textbook, and thus can serve as the basis for undergrad and mezzanine undergrad/grad-level courses. The writing style is clear and accessible, and the examples and homework problems have been carefully designed and presented to enable students to become proficient in key concepts and principles at the interface of physics and molecular biology. The topics covered include viral dynamics, gene regulation, stochastic gene expression, and genetic switches and oscillators. Students and professors alike will love this book.

2 of 2 people found the following review helpful.
Excellent new book for undergrads and grad students alike.
By Stephanie Palmer
This book is a fantastic tool for students at the advanced undergraduate to graduate level. The section on randomness in biology is very clearly written with excellent problems and examples. The sections on the Luria-Delbruck experiment are particularly well-laid-out. Poisson Processes (Ch 7) was a favorite of my students and serves as the best example, in my opinion, of how to teach this material. Later chapters on

visual processing are equally well-written. Overall, a wonderful book through and through.

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