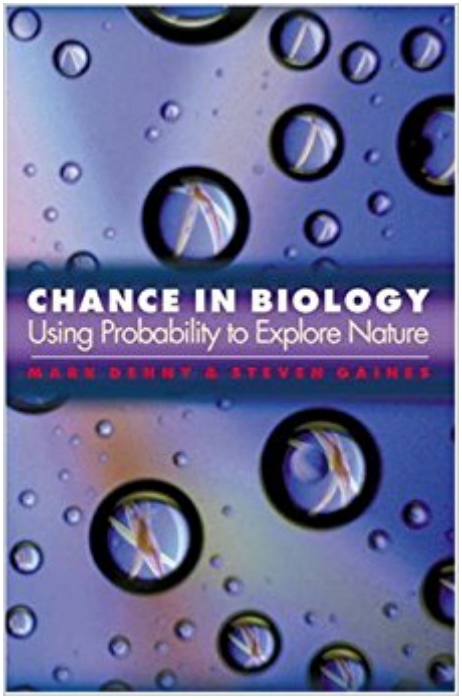
# Chance In Biology



## Synopsis

Life is a chancy proposition: from the movement of molecules to the age at which we die, chance plays a key role in the natural world. Traditionally, biologists have viewed the inevitable "noise" of life as an unfortunate complication. The authors of this book, however, treat random processes as a benefit. In this introduction to chance in biology, Mark Denny and Steven Gaines help readers to apply the probability theory needed to make sense of chance events--using examples from ocean waves to spiderwebs, in fields ranging from molecular mechanics to evolution. Through the application of probability theory, Denny and Gaines make predictions about how plants and animals work in a stochastic universe. Is it possible to pack a variety of ion channels into a cell membrane and have each operate at near-peak flow? Why are our arteries rubbery? The concept of a random walk provides the necessary insight. Is there an absolute upper limit to human life span? Could the sound of a cocktail party burst your eardrums? The statistics of extremes allows us to make the appropriate calculations. How long must you wait to see the detail in a moonlit landscape? Can you hear the noise of individual molecules? The authors provide answers to these and many other questions. After an introduction to the basic statistical methods to be used in this book, the authors emphasize the application of probability theory to biology rather than the details of the theory itself. Readers with an introductory background in calculus will be able to follow the reasoning, and sets of problems, together with their solutions, are offered to reinforce concepts. The use of real-world examples, numerous illustrations, and chapter summaries--all presented with clarity and wit--make for a highly accessible text. By relating the theory of probability to the understanding of form and function in living things, the authors seek to pique the reader’s curiosity about statistics and provide a new perspective on the role of chance in biology.

## Book Information

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## Customer Reviews

"An excellent introduction to the uses of probability theory for a reader who is more familiar with biology than with mathematics . . . Denny and Gaines have done a valuable service to biologists who are interested in a quantitative approach to life sciences."--Paul Janmey, Nature Cell Biology "A lively, well-written text. . . . A student who reads this book closely will come away with a much deeper appreciation for the universality of diffusion mechanics in science, the deep connections between the distributions central to inferential statistics, the importance of extreme events and how to deal with them analytically, and, most importantly, the power and limitations inherent in the underpinning of the inferential statistics that the student has learned elsewhere."--Mark R. Patterson, American Scientist "This is a fantastic book. Indeed, one would be hard-pressed to find a more readable and lucid introduction to probability theory."--Gary B. Gillis, Journal of Experimental Biology

"This is a thoroughly delightful and scholarly tour through the theory and application of probability and statistics in biology. The reader will learn much about the fundamentals of stochastic processes, as well as much about the biology itself. The best of mathematical biology."--Simon Levin, Princeton University "Chaos need not imply anarchy--it’s a law abiding state permitting proper predictions. But how to deal with it? Finally we have a guidebook to the rules of the random road, thanks to Denny and Gaines. Better still, it has biological breadth, with processes from cellular to oceanic scales coming in for analysis and providing material for examples. Even better, it’s engagingly written, with grace, clarity, and wit."--Steve Vogel, Duke University "This is a lively undergraduate text that explores the meaning of chance, develops the rules of probability, and explains how random processes affect biological materials and living things. Examples range from the survival of plankton to the size of waves, from the impact of thermal agitation on auditory perception to the likelihood of deafening sounds. Reasonable mathematical expectations, interesting problems, thoughtful solutions. Overall, a stimulating and enlightening work."--Howard C. Berg, author of Random Walks in Biology

*Chance in Biology* is one of the best science books I have ever read (and I have read quite a few

of them). This book applies probability theory (along with other topics in math and physics) to biological phenomena. A big PLUS for this book is that the authors intentionally wrote the book to be accessible to an educated but nonspecialized audience.I really enjoyed the authors' discussion of random walks applied to 'genetic drift' (the likelihood that offsprings' genomes will be different than their parents') and a surprising application of probability theory to elastic materials found in nature.I also enjoyed their chapter on the probability of extreme phenomena -- which is an obviously useful topic that gets short shrift in many probability and statistics books I have seen. They even use baseball statistics in that chapter!Another interesting part of this book was the discussion and the practice problems dealing with Bayes' Theorem. The concepts discussed in this book is something that all health care officials and lawyers should familiarize themselves with.Some caveats about the book:(a) The reader should be familiar with the 1st year of college calculus. While it is is possible that someone with only an understanding of algebra can get a lot out of the book, the calculus would help. I should note that you do not need to know a lot of calculus and someone who is 'mathophobic' could still get a lot out of the book.(b) This book does not deal too much with inferential statistics. This book focuses in on probability, which is the cornerstone of statistics. However, when it does touch upon inferential statistics, it does a superb job.(c) I wish the authors spent a little bit of time going over Markov Chains (random walks is a type of Markov Chain and the book does deal with that but without talking about MC explicitly). But that is a minor complaint.Rounding out my praise for this book is the fact that most of the chapters have practice problems and ALL of the problems have solutions to them at the back of the book. I can't even begin to tell you how great having all of the solutions for all of the problems is for self-study/comprehension. The problems provided are no 'toy problems' either ... they are actually extremely helpful in not only testing one's grasps of the materials but also in illuminating and extending the points made in the particular chapter.Other miscellanous positive things about *Chance in Biology*:- a sample MATLAB program to simulate random phenomenon (in the solution to one of the practice problems)- a chapter that deals with 'noise' .... interesting for those interested in Chaos- authors make an excellent distinction between non-deterministic random/stochastic phenomena vs. deterministic Chaos- many more good things!!!Bottom-line: If you are at all interested in probability, applied math, physics, chemistry, or biology, you should buy this book.

Biology progressed from natural history to its great depth and breadth in part from the inclusion of truly quantitative ideas from math, physics, and chemistry. The mantle of greatest expositor of these ideas in recent times may have passed from Stephen Vogel (his excellent books are well worth

reading) to Mark Denny. Here, with Steven Gaines, he takes us into extreme events, the limits of our ability to hear and to see, the elasticity of spider silk, and more. The math is demanding, but it should be; Denny and Gaines make no bones about it, but reward the reader. Denny's book, Air and Water, is equally a pleasure to read.