

Comparative Biomechanics

Life's Physical World



Steven Vogel is James B. Duke Professor Emeritus of Biology at Duke University. His numerous books include *Glimpses of Creatures in Their Physical Worlds* (Princeton) and *Cats' Paws and Catapults* (Norton).

Why do you switch from walking to running at a specific speed? Why do tall trees rarely blow over in high winds? And why does a spore ejected into air at seventy miles per hour travel only a fraction of an inch? *Comparative Biomechanics* is the first and only textbook that takes a comprehensive look at the mechanical aspects of life—covering animals and plants, structure and movement, and solids and fluids. An ideal entry point into the ways living creatures interact with their immediate physical world, this revised and updated edition examines how the forms and activities of animals and plants reflect the materials available to nature, considers rules for fluid flow and structural design, and explores how organisms contend with environmental forces.

Drawing on physics and mechanical engineering, Steven Vogel looks at how animals swim and fly, modes of terrestrial locomotion, organism responses to winds and water currents, circulatory and suspension-feeding systems, and the relationship between size and mechanical design. He also investigates links between the properties of biological materials—such as spider silk, jellyfish jelly, and muscle—and their structural and functional roles. Early chapters and appendices introduce relevant physical variables for quantification, and problem sets are provided at the end of each chapter. *Comparative Biomechanics* is useful for physical scientists and engineers seeking a guide to state-of-the-art biomechanics. For a wider audience, the textbook establishes the basic biological context for applied areas—including ergonomics, orthopedics, mechanical prosthetics, kinesiology, sports medicine, and biomimetics—and provides materials for exhibit designers at science museums.

- Problem sets at the ends of chapters
- Appendices cover basic background information
- Updated and expanded documentation and materials
- Revised figures and text
- Increased coverage of friction, viscoelastic materials, surface tension, diverse modes of locomotion, and biomimetics

Praise for the previous edition:

"A delightful and comprehensive textbook that is perfect for undergraduates and those of us who need a refresher. . . . Throughout the book, Vogel introduces the formulae and principles that matter in a clear manner, and illustrates them with a dizzying array of biological and physical examples. . . . [T]his book is tremendous fun to read. Vogel writes with an effervescent sense of delight in his subject. The text is laced with wit and humor, and sprinkled with eclectic examples of nature's many marvels. None of the fun, however, diminishes the clarity."

—**Daniel E. Lieberman, *Nature***

"Science books are generally read for three reasons: it is assigned, it provides an introduction to an unfamiliar field, or because it is a truly enjoyable read. Great science books meet all three. . . . With *Comparative Biomechanics*, Vogel has now produced a book that meets all three criteria of a great science book."

—**Scott Turner, *Quarterly Review of Biology***

"I tried skim-reading Steven Vogel's *Comparative Biomechanics*. . . but was compromised: the volume has so many little gems scattered throughout that my eye got caught by the glitter and couldn't escape. In earlier books, Vogel introduced

biomechanics piecemeal. Now he has written an integrated textbook on the subject."

—**Julian F. V. Vincent, *Science***

"Personal anecdotes connect the material to the happenings of everyday life, creating a book that will be well received and remembered by students. Nearly every example is accessible to common experience and easy to comprehend. . . . Excellent, clean line diagrams illustrate nearly every important concept. Each chapter begins with an eclectic and often amusing quotation drawn or paraphrased from the experiences of the author. This typifies the familiar style brought forward in this important and timely work, which will surely become the book of choice for courses in comparative biomechanics."

—**Choice**

"[Vogel] is that rare animal, a biologist who is at once fluent in mathematics, conversant with physics and physical chemistry, and an accomplished practical engineer. More than that, the quality of Vogel's writing allows him to convey complex ideas clearly and make them so accessible that his books are hard to put down."

—**H.C. Bennet-Clark, *Bioscience***

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