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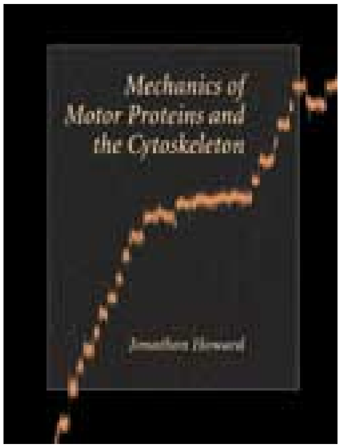

Mechanics of Motor Proteins and the Cytoskeleton

Jonathon Howard, Max Planck Institute for Molecular Cell Biology and Genetics

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About This Title

Motor proteins are molecular machines that convert chemical energy from ATP hydrolysis into mechanical work, which powers cell motility. Over the last ten years, single-molecule techniques and structural studies have led to rapid progess in understanding how these biological motors operate. How do they move? How do they generate force? How much fuel do they consume, and with what efficiency? *Mechanics of Motor Proteins and the Cytoskeleton* brings these new findings together.

This book is for biology, physics, and engineering students who want to learn about the principles of protein mechanics and how it applies to the morphology and motility of cells. Understanding how motors and the cytoskeleton operate requires mechanical concepts such as force, elasticity, damping, and work. Introductory physics textbooks address these concepts, yet they are concerned primarily with macroscopic systems, whose motions are qualitatively different from the highly damped, diffusive motion of individual molecules.

Mechanics of Motor Proteins and the Cytoskeleton provides a physical foundation for molecular mechanics. Part I explains how small particles like proteins respond to mechanical, thermal, and chemical forces, Part II focuses on cytoskeletal filaments, and Part III focuses on motor proteins. The treatments are unified in the respect that they are organized around principles rather than proteins: chapters are centered on topics such as structure, chemistry, and mechanics, and different filaments or motors are discussed together.

The book assumes a rudimentary knowledge of cell biology as well as freshman physics, though all concepts are introduced from first principles, and numerous boxed examples and figures aid the non-mathematical reader. For the mathematically inclined, detailed proofs of important results are included in the Appendix.

About the Author(s)

Jonathon Howard is currently a Professor of Physiology and Biophysics at the University of Washington in Seattle. In July, 2001, his research group will move to Dresden, Germany, where he is a Director of the Max Planck Institute for Molecular Cell Biology and Genetics. He earned a Ph.D. in Neurobiology at Australian National University, doing postdoctoral research there as well as at the University of Bristol and the University of California, San Francisco. Dr. Howard's current research interests include the mechanics of motor proteins and the cytoskeleton and mechanoelectrical transduction by sensory receptors. The recipient of several scholarships and fellowships, he most recently received a MERIT Award from the National Institutes of Arthritis and Musculoskeletal and Skin Diseases. The writing of *Mechanics* *of Motor Proteins and the Cytoskeleton* was inspired by Dr. Howard's teaching of a course on Cell Motility at the University of Washington.

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Reviews and Commentary

"The cytoskeleton is an area of intense research and we are in danger of drowning in a sea of facts. What should we try to teach our students about it? . . . a textbook is needed which starts from first principles and leads to an understanding of the dynamics of the system. And here is that book."
–Edwin Taylor, *Nature*

"The book is a great launching point for gaining a biophysical understanding of the current detailed literature of motility which is increasingly filled with mathematical models describing motility data. As such, it will benefit students of a wide range of biological and physical backgrounds who are interested in understanding the nuts-and-bolts of cellular motility."
–Stephen J. King, *Cell*

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Other motor proteins include dyneins and kinesins, as well as non-muscle myosins. In addition to muscle contraction and amoeboid movement, these motors carry out such diverse tasks as the beating of cilia and the transport of vesicles within cells. To further compound the story, the cytoskeletal filaments are not just passive tracks; their polymerization drives a number of biological mechanisms, including the separation of chromosomes during mitosis, the intracellular movement of infectious agents, and protrusion of the acrosomal processes of some sperm.