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Introduction

Biology is wet and dynamic. Molecules, subcellular organelles, and cells, immersed in an aqueous environment, are in continuous riotous motion. Alive or not, everything is subject to thermal fluctuations. What is this microscopic world like? How does one describe the motile behavior of such particles? How much do they move on the average? Questions of this kind can be answered only with an intuition about statistics that very few biologists have. This book is intended to sharpen that intuition. It is meant to illuminate both the dynamics of living systems and the methods used for their study. It is not a rigorous treatment intended for the expert but rather an introduction for students who have little experience with statistical concepts.

The emphasis is on physics, not mathematics, using the kinds of calculations that one can do on the back of an envelope. Whenever practical, results are derived from first principles. No reference is made to the equations of thermodynamics. The focus is on individual particles, not moles of particles. The units are centimeters (cm), grams (g), and seconds (sec).

Topics range from the one-dimensional random walk to the motile behavior of bacteria. There are discussions of Boltzmann's law, the importance of kT, diffusion to multiple receptors, sedimentation, electrophoresis, and chromatography. One appendix provides an introduction to the theory of probability. Another is a primer on differential equations. A third lists some constants and formulas worth committing to memory. Appendix A should be consulted while reading Chapter 1 and Appendix B while reading Chapter 2. A detailed understanding of differential equations or the methods used for their solution is not required for an appreciation of the main theme of this book.

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