

Preface

In many respects, we understand the structure of the universe better than the workings of living cells. Scientists can calculate the age of the Sun and predict when it will cease to shine, but we cannot explain how it is that a human being may live for eighty years but a mouse for only two. We know the complete genome sequences of these and many other species, but we still cannot predict how a cell will behave if we mutate a previously unstudied gene. Stars may be 10^{43} times bigger, but cells are more complex, more intricately structured, and more astonishing products of the laws of physics and chemistry. Through heredity and natural selection, operating from the beginnings of life on Earth to the present day—that is, for about 20% of the age of the universe—living cells have been progressively refining and extending their molecular machinery, and recording the results of their experiments in the genetic instructions they pass on to their progeny.

With each edition of this book, we marvel at the new information that cell biologists have gathered in just a few years. But we are even more amazed and daunted at the sophistication of the mechanisms that we encounter. The deeper we probe into the cell, the more we realize how much remains to be understood. In the days of our innocence, working on the first edition, we hailed the identification of a single protein—a signal receptor, say—as a great step forward. Now we appreciate that each protein is generally part of a complex with many others, working together as a system, regulating one another's activities in subtle ways, and held in specific positions by binding to scaffold proteins that give the chemical factory a definite spatial structure. Genome sequencing has given us virtually complete molecular parts-lists for many different organisms; genetics and biochemistry have told us a great deal about what those parts are capable of individually and which ones interact with which others; but we have only the most primitive grasp of the dynamics of these biochemical systems, with all their interlocking control loops. Therefore, although there are great achievements to report, cell biologists face even greater challenges for the future.

In this edition, we have included new material on many topics, ranging from epigenetics, histone modifications, small RNAs, and comparative genomics, to genetic noise, cytoskeletal dynamics, cell-cycle control, apoptosis, stem cells, and novel cancer therapies. As in previous editions, we have tried above all to give readers a conceptual framework for the mass of information that we now have about cells. This means going beyond the recitation of facts. The goal is to learn how to put the facts to use—to reason, to predict, and to control the behavior of living systems.

To help readers on the way to an active understanding, we have for the first time incorporated end-of-chapter problems, written by John Wilson and Tim Hunt. These emphasize a quantitative approach and the art of reasoning from experiments. A companion volume, *Molecular Biology of the Cell, Fifth Edition: The Problems Book* (ISBN: 978-0-8153-4110-9), by the same authors, gives complete answers to these problems and also contains more than 1700 additional problems and solutions.

A further major adjunct to the main book is the attached Media DVD-ROM disc. This provides hundreds of movies and animations, including many that are new in this edition, showing cells and cellular processes in action and bringing the text to life; the disc now includes all the figures and tables from the main

book, pre-loaded into PowerPoint® presentations. Other ancillaries available for the book include a bank of test questions and lecture outlines, available to qualified instructors, and a set of 200 full-color overhead transparencies.

Different groups of readers will use different parts of the book. We anticipate that researchers, laboratories, and libraries will wish to have the full set of chapters in a single printed volume, as in the present Reference Edition. For those who prefer to have the core cell biology chapters in a somewhat more portable form, a Student Edition is also available, containing Chapters 1–20 as printed pages and Chapters 21–25 (on multicellular systems) in electronic (PDF) form on the accompanying disc.

Full details of the conventions adopted in the book are given in the Note to the Reader that follows this Preface. As explained there, we have taken a drastic approach in confronting the different rules for the writing of gene names in different species: throughout this book, we use the same style, regardless of species, and often in defiance of the usual species-specific conventions.

As always, we are indebted to many people. Full acknowledgments for scientific help are given separately, but we must here single out some exceptionally important contributions: Julie Theriot is almost entirely responsible for Chapters 16 (Cytoskeleton) and 24 (Pathogens, Infection, and Innate Immunity), and David Morgan likewise for Chapter 17 (Cell Cycle). Wallace Marshall and Laura Attardi provided substantial help with Chapters 8 and 20, respectively, as did Maynard Olson for the genomics section of Chapter 4, Xiaodong Wang for Chapter 18, and Nicholas Harberd for the plant section of Chapter 15.

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Lastly, and with no less gratitude, we thank our spouses, families, friends and colleagues. Without their patient, enduring support, we could not have produced any of the editions of this book.