Preface

"The key to every biological problem must finally be sought in the cell, for every living organism is, or at sometime has been, a cell."

E. B. Wilson, cell biologist (1925)

The eight decades since Wilson wrote these words have seen a transformation in our understanding of how cells work. The key to the central mystery—how cells store, use, and transmit hereditary information—has been found, and it has opened up a new world. This revolution in biology is among the great adventures of human discovery. Through the perspective of cell biology, we can now explain the fundamental machinery of life and begin to map out a unified picture of the astonishing diversity of organisms and phenomena that it gives rise to, from the chemistry of a bacterium or the shaping of a leaf to the processes that allow us to move, think, talk, and experience the world around us. We can trace the ancestry of our own chemical components through the genetic instructions that specify them—instructions that we share with other organisms to an extent that Wilson could never have imagined. In this way, we have learned to see ourselves in a new light, as close cousins to all other living things.

The new knowledge has brought many practical benefits, including improvements in human health and prosperity. At the same time, it has led to ethical debates and controversy over issues such as genetic testing for inherited diseases, the balancing of environmental risks with benefits, genetic modification of crops and animals, the use of DNA fingerprinting in court cases, and the possibility of human reproductive cloning. These are only a few of the biology-based issues that we have to grapple with today. The successful application of the new knowledge will require many difficult decisions for us as citizens. A basic understanding of cell biology is needed if these decisions are to be intelligent ones.

Our original purpose in writing this book was to provide a straightforward explanation of the workings of a living cell. By "workings," we mean principally the way in which the molecules of the cell—especially the protein, DNA, and RNA molecules—cooperate to create a system that feeds, moves, grows, divides, and responds to stimuli—one, in short, that is alive. By "straightforward," we mean an account that can be easily understood by a reader approaching modern biology for the first time. The need for a short, clear account of the essentials of cell biology became apparent to us while we were writing *Molecular Biology of the Cell (MBoC)*, which is now in its fourth edition. *MBoC* is a large book aimed at advanced undergraduates and graduate students specializing in the life sciences or medicine. Many students and educated lay people who require an introductory account of cell biology would find this text too detailed for their needs. *Essential Cell Biology (ECB)*, in contrast, is designed to provide the fundamentals of cell biology that are required by anyone to understand the biomedical, as well as the broader biological issues that affect our lives.

ECB is as short and simple as we can make it, and we have reduced technical vocabulary to a minimum. In this second edition, we have brought the book completely up to date, with a new emphasis on genomes, including an overview of the human genome sequence and a new chapter on How Genes and Genomes Evolve. In response to requests from many

users of the first edition, we have added a chapter on Genetics, Meiosis, and the Molecular Basis of Heredity. There are also new sections on many topics that are frequently in the news, including stem cells, cloning, DNA microarrays, programmed cell death, and cancer. The second edition also features a new series of "How We Know" sections, one for each chapter. Using both classical and current experiments, these sections illustrate how biologists tackle important questions and how their experimental results shape future ideas. As before, the diagrams in *ECB* emphasize central concepts and are stripped of unnecessary details. The key terms introduced in each chapter are highlighted when they first appear and are collected together at the end of the book in a large, illustrated glossary. We have not listed references for further reading: those wishing to explore a subject in greater depth are encouraged to consult the extensive reading lists in *MBoC4* and on the *MBoC4* Web site.

A central feature of the book is the many questions that are presented in the text margins and at the end of each chapter. These are designed to provoke students to think about what they have read and to encourage them to pause and test their understanding. Many questions challenge the student to place the newly acquired information in a broader biological context, and some have more than one valid answer. Others invite speculation. Answers to all the questions are given at the end of the book; in many cases these provide a commentary or an alternative perspective on material presented in the main text.

For those who want to develop their active grasp of cell biology further and to get a deeper understanding of how cell biologists extract conclusions from experiments, we recommend *Molecular Biology of the Cell, Fourth Edition: A Problems Approach,* by John Wilson and Tim Hunt. Though written as a companion to *MBoC,* this contains questions at all levels of difficulty and is a goldmine of thought-provoking problems for teachers and students. We have drawn upon it for some of the questions in *ECB,* and we are very grateful to its authors.

As never before, new imaging and computer technologies have increased our access to the inner workings of living cells. We have tried to capture some of the excitement of these advances in *Essential Cell Biology 2 (ECB2) Interactive,* a CD-ROM disk that is included with each book. It contains over one hundred video clips, animations, molecular structures, and high-resolution micrographs—all designed to complement the material in individual book chapters. One cannot watch cells crawling, dividing, segregating their chromosomes, or rearranging their surface without a sense of wonder at the molecular mechanisms that underlie these processes. We hope that *ECB2 Interactive* will motivate and intrigue students while reinforcing basic concepts covered in the text, and thereby will make the learning of cell biology both easier and more rewarding. Each chapter of the book concludes with a list of multimedia highlights from *ECB2 Interactive.*

The authors of the first edition are pleased to welcome Karen Hopkin to the team. Trained as a biochemist, Karen now writes about science, and her main responsibility has been to make the book clear, accessible, and fun to read. As with *MBoC,* each chapter of *ECB* is the product of communal effort, with individual drafts circulating from one author to another. In addition, many people have helped us, and these are credited in the Acknowledgements that follow. We would be remiss, however, if we did not offer special thanks to Bill Sullivan: as an experienced teacher of genetics, he was instrumental in shaping the new chapter on Genetics, Meiosis, and the Molecular Basis of Heredity.

Despite our best efforts, it is inevitable that there will be errors in the book. We encourage readers who find them to let us know at science@garland.com, so that we can correct these errors in the next printing.