

# Essential Cell Biology

An Introduction to the  
Molecular Biology of the Cell



Alberts • Bray  
Johnson • Lewis  
Raff • Roberts • Walter



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Molecular Biology of the Cell

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**Front cover:** The photograph shows mitosis in the early syncytial *Drosophila* embryo. The metaphase spindles are stained for microtubules (*red*) and DNA (*blue*). (Courtesy of Douglas R. Daily and William Sullivan, University of California at Santa Cruz.)

**Back cover:** The authors, Bruce Alberts, Dennis Bray, Alexander Johnson, Julian Lewis, Peter Walter, Keith Roberts, and Martin Raff (*clockwise from upper left*). (Photograph by Craig Dawson, Media Solutions, San Francisco.)

# Preface

What does it take to be educated? The question of what core knowledge needs to be passed on to students has provoked strong arguments as long as educational institutions have existed. As we approach the twenty-first century, a basic understanding of the cell as the unit of living matter must surely become an integral part of that core. The revolutionary advances over the past 50 years in our understanding of how cells work are among the great triumphs of human discovery.

We can now explain the chemistry that makes life possible and allows us to move, think, talk, and experience the world around us. We have learned how to trace back the ancestry of each of the large molecules in our cells through other organisms that share them. We have gained a dramatically improved appreciation of who we are in relation to other living things. The new knowledge has also had many practical benefits, leading to biological discoveries of importance for our future health and prosperity. Genetic testing for health screening, genetic engineering of foods, the invention of new medicines, the use of DNA fingerprinting in court cases, and the balancing of environmental risks with benefits are but a few of the biology-based issues all of us now need to grapple with. The successful application of the new wealth of knowledge in the next century will require many difficult decisions by local citizens, who will need a basic understanding of cell biology to make them.

Our purpose in writing this book, then, is 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 proteins, the DNA, and the RNA—cooperate to create a system that feeds, moves, responds to stimuli, grows, and divides—one, in short, that is alive. By “straightforward,” we mean an account that can be easily understood by first- or second-year undergraduates with little background in biology. 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)*. *MBoC*, which is now in its third edition, is aimed at advanced undergraduates specializing in the life sciences or medicine, and it is clear that many students requiring a general account of cell biology find it too specialized and too heavy for their needs.

An initial attempt to write an abbreviated version of *MBoC* by simple pruning proved futile. We painfully learned that writing an introductory text requires a new approach and that the clay must be thrown again. The present book, then, is freshly written. We have retained the same stylistic and graphical features and the same emphasis on central concepts over facts as in *MBoC*. But the scope and level are very different. Here we focus on the properties that are common to most eucaryotic cells and that are necessary to an understanding of how any individual cell lives and reproduces itself. The organs and systems of

multicellular organisms, the process of development, the myriad disorders that affect humans and which increasingly can be understood in cell biological terms have all been subordinated to our central theme.

The book has been designed for clarity. The text is as short and simple as we can make it, and we have reduced technical vocabulary to a minimum. In order to present the central ideas without distractions we have omitted the names of the scientists involved, as well as the personal stories that lie behind each scientific conclusion. The diagrams have been drawn to emphasize concepts and are stripped of unnecessary details. 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; in a textbook at this level, we feel that this choice is best left to the individual teacher. Readers wishing to explore a subject in greater depth are encouraged to consult the extensive reading lists in *MBoC*.

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 to 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 offered at the end of the book; in many cases these give a commentary or an alternative perspective on material in the main text.

As with *MBoC*, each chapter of this book is the product of a communal effort, with individual drafts circulating from one author to another. In addition we were helped by many people. A number of scientists gave advice on specific areas, including Raoul Andino, Elizabeth Blackburn, Christine Guthrie, Tim Hunt, Joachim Li, and Norman Pace. We received extensive comments from university teachers and students, which were collected and collated by Valerie Neal. The teachers were Jerry Brand, University of Texas at Austin; Heinz Gert de Couet, University of Hawaii; Michael A. Goldman, San Francisco State University; W. Michael Gray, Bob Jones University; Michael Lewitt, Anglia University; Herbert Lin, National Research Council; Linda Matsuuchi, University of British Columbia; Sheldon S. Shen, Iowa State University; and Jim Shinkle, Trinity University. The students were from Bob Jones University and San Francisco State University. Eleanor Lawrence edited each chapter, often several times, and taught us to write at what we hope is the appropriate level. We are enormously grateful to all of these individuals for their invaluable help.

The staff at Garland Publishing were ever helpful and encouraging. Ruth Adams saw long before anyone else the potential value of such a book. The illustrations, which were created by Keith Roberts, were constructed on the computer with skill and flair by Nigel Orme. The book was designed by John M-Roblin, copyedited by Douglas Goertzen, and produced by Perry Bessas. Donna Scholes led an enthusiastic team of market researchers who collected opinions and suggestions from many teachers. Anne Vinnicombe, the Production Chief, was a recent but vital addition to the Garland team, taking on our hectic schedules at short notice.



Most of the book was written in St. John's Wood, London, where we were supported by the staff at Garland's London office. We are grateful to Emma Hunt, Nasreen Arain, Sheila Archibald, and Matthew Day for their unflagging help. Miranda Robertson led this team and supervised every detail of the writing process—from the editing of text, to the marshaling of secretaries, stationery supplies, and food. As in the past, we were nourished in style by Emily Preece Foden. Perhaps some day she will put down her Sabatier and write the "The *MBoC* Cookbook." But not yet, Emily, not yet.

Finally, we are indebted to Libby Borden, President of Garland Publishing. Six years after the mantle of authority was thrust upon her by the untimely death of Gavin Borden, Libby runs the company with humanity and style. Her encouragement and support have never faltered. Without her there would be no book.

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, so that we can correct them in the next printing (e-mail: [ecb@garland.com](mailto:ecb@garland.com); fax: 212-414-0659). For more information about the textbooks available from Garland Publishing, visit our website: <http://www.garlandpub.com/> and specifically for *Essential Cell Biology* visit: <http://www.essentialcellbiology.com/>

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