Preface

Welcome to *The Problems Book*, which aims to help students appreciate the ways in which an understanding of how cells work, as discussed in *Molecular Biology of the Cell*, Sixth Edition, by Alberts et al., can be further explored through experiments and simple calculations. As always, we hope to stimulate our readers to ask questions as well as to learn and digest the stories that "the big book" tells. In real life, knowledge and understanding come from research, which entails curiosity, puzzlement, doubt, criticism, and debate as well as performing experiments. Groping one's way through the fog of uncertainty during a project is a slow and often discouraging process; eureka moments (even if one is lucky) are few and far between. Nevertheless, those moments catch the essence of the drama, and we have tended to focus on them, where we have been able to cast them in the form of a problem. In this way, for student and teacher alike, we hope to encourage a questioning attitude to biology. Without curiosity there would be neither science nor scientists.

We have been making up problems together since 1985, and the revision leading to this new edition of *The Problems Book* has taken us more than four years. There are several new things about this edition. First, the book is now in color. As well as improving its look as a whole, we think this will improve the clarity and intelligibility of the figures. Second, we've added a new type of question, MCAT Style, modeled on the kind of problems that are found in most medical school admissions tests. These were drafted by Doug Kellogg at the University of California, Santa Cruz, and we think they make a great addition to the book. Indeed, we were pleasantly surprised to discover that these questions allowed us to frame problems in new and interesting ways. Elsewhere, we have done a considerable amount of pruning, partly to make space for these new problems and partly to eliminate problems that were showing their age or were no longer relevant to the parent text.

The organization of *The Problems Book* remains largely the same. There are Terms to Learn, Definitions, and True/False sections in every chapter. Next come Thought Problems, of which some are more challenging than others—they may be playful, or serious, but all are designed to make the reader think. Following these is a section called Calculations, designed to deal with quantitative aspects of cell biology. The calculations in this book are mostly very straightforward, usually involving no more than the interconversion of units, yet they provide a solid framework for thinking about the cell. Are cell-surface receptors sparse in the plasma membrane, or jam-packed? Do molecules diffuse across a cell slowly, or in the blink of an eye? Does chromatin occupy most of the nuclear volume, or just a tiny fraction? How fast could a tomato plant grow, theoretically? Numerical analysis of such questions is very important if one is to gain an understanding for the molecular basis of cell biology. The Data Handling section contains research-based problems. Our original brief was to compose problems based on experiments so as to allow readers to get a better feel for the way in which biological knowledge is obtained. It is tremendously important to keep asking, "How do we know that? What's the evidence?" or to wonder how one might go about finding something out. Often it's not at all obvious, often the initial breakthrough was a lucky chance observation, made while investigating some completely different

business. In fact, it takes most of us years of research experience to grasp the idea of how one simple fact "can illuminate a distant area, hitherto dark" (Boveri, 1902). Seeing how these tiny shards of evidence give rise to the big picture often involves considerable imagination as well as a certain discipline, to know how much weight the evidence will bear. We hope we have sometimes, at least, been able to capture the essence of how experiments lead to understanding. To do justice to the authors of the experiments we use in these problems, however, we strongly recommend recourse to the original papers, whose references we always provide.

A newly compiled section, Medical Links, contains problems of particular interest to health science students.

We hope that the organization and classification of problems will help both student and teacher to find what they are looking for. How should this book be used? We composed it by a process of constant dialogue and discussion, and we suspect that the most fruitful use of the problems will be to stimulate discussions in class, or between students. Tackling selected problems as homework will also surely help. Teachers have told us that they find ideas for exam questions here, and all the answers to our questions are now provided in *The Problems Book*, for many of these problems are difficult to answer and are not intended to be set as tests. Rather, we hope that readers will be intrigued (as we were) by the questions we ask, and after thinking a bit will want to see what the answer is, what form the discussion takes, and how to get at thinking about this particular kind of a problem.

The answers to the end-of-chapter problems in *Molecular Biology of the Cell*, Sixth Edition can also be found in the back of this book, including the answers to newly written problems for Chapters 21 through 24.

As always, we want to hear from our readers, for despite our best efforts, we do not always get things right. Please email John Wilson at jwilson@bcm.edu or Tim Hunt at tim.hunt@cancer.org.uk with your comments or queries, and we'll do our best to answer them.