# Preface to the Second Edition

It has pleased us to know how useful the first edition of *Cell Biology* has been for both undergraduate and graduate students. We have benefited from using the book in the classroom and from helpful feedback from our students. We have also benefited from feedback from other teachers and their students, particularly Ursula Goodenough at Washington University in St. Louis. This experience validated the approach that we used for much of the material but also gave us the opportunity to identify concepts that might be presented more clearly. In response to student feedback, we reduced nonessential jargon by eliminating a number of terms that appeared only once. This helps to move the reader's focus away from nomenclature and toward an understanding of concepts. As part of our concentration on concepts and mechanisms, we moved the larger tables containing lists of specific molecules to chapter appendixes, where they can be consulted as references without disturbing the flow of the text.

We added Chapter 2, which addresses the origin of life and the evolution of the three domains of life. Evolution is not only the most important general principle in biology but also one of this text's major organizing principles.

For the second edition, we recruited a very important new member of our team. Jennifer Lippincott-Schwartz rewrote the material on membrane traffic and reorganized it into three new chapters that cover the endoplasmic reticulum (Chapter 20), the secretory pathway (Chapter 21), and the endocytic pathway (Chapter 22). Her contribution adds a new dimension that brings us up to date in one of the most dynamic areas of cell biology.

Graham Johnson, now a National Science Foundation Graduate Fellow in biophysics at the Scripps Research Institute in San Diego, remains an integral member of our team. For this edition, he added nearly 200 new figures and revised 500 figures from the first edition. His artistic gift and keen insights are evident in each of the illustrations.

Cell biology is an incredibly exciting and dynamic science. To keep our information current, we updated each chapter with the latest data about how cells work at the molecular level. Many new insights derived from real time microscopy of live cells expressing fluorescent fusion proteins. Examples include (1) the discovery that slow axonal transport is really just intermittent fast transport, (2) the discovery that many nuclear proteins are surprisingly mobile, and (3) the observation of flux of subunits within the mitotic spindle. Some particularly informative new insights came from crystal structures of a riboswitch, a new ABC translocator, several carrier proteins, several ion channels, the signal recognition particle receptor GTPase, SecYE translocon, clathrin, the EGF receptor, receptor serine/threonine kinases bound to their ligand, guanylylcyclase receptors, Toll-like receptors, the regulatory subunit bound to PKA, integrins, formins, CAD nuclease, Wee1 kinase, RFC, Mad1, Mad2, apoptosome, the Holliday junction, SCF, and other macromolecules. Careful editing allowed the inclusion of new material without significantly increasing the length of the second edition.

One reviewer of the first edition expressed concern that our coverage of cells and tissues was embedded in chapters on mechanisms. It is true that we place great emphasis on mechanisms at the cellular and molecular level, but we do so by using frequent examples from diverse experimental organisms and specialized cells and tissues of vertebrate animals to illustrate the general principles. The Guide to Figures Featuring Specific Organisms and Specialized Cells that follows the Contents lists figures by organism and cell. The relevant text accompanies the figures. The reader who wishes to assemble a unit on cellular and molecular mechanisms in the immune system, for example, will find the relevant material associated with the figures that cover lymphocytes/immune system.

## Organization of the Book

We use molecular structures as the starting point for explaining how each cellular system is constructed and how it operates. Most of the ten major sections begin with one or more chapters that cover the key molecules that run the systems under consideration. For example, the section on Signaling Mechanisms begins with separate chapters on receptors, cytoplasmic signal transduction proteins, and second messengers. Noting the concentrations of key molecules and the rates of their reactions should help the student to appreciate the rapidly moving molecular environment inside cells.

We retained the general organization of the first edition, particularly the use of introductory chapters that present the machinery used in each cellular system as a precursor to the chapters that integrate concepts and describe the physiology. We moved the mechanism of the Ras GTPase from the signaling section to Chapter 4, which covers biochemical and biophysical mechanisms. This arrangement not only presents Ras as an excellent example of how to dissect an enzyme mechanism by transient kinetic analysis but also provides an early introduction of GTPases that prepares the reader for their inclusion in each subsequent section of the book. The three chapters on the central dogma of molecular biology are grouped together and include an expanded Chapter 15 that covers gene expression, contributed by Jeff Corden; a heavily reworked Chapter 16 that addresses RNA processing, contributed by David Tollervey; and a revised Chapter 17 that encompasses protein synthesis. We moved mitochondria and chloroplasts into the section on organelles, where they share a new Chapter 19 with the other organelle assembled by posttranslational import of proteins, peroxisomes. We incorporated the supplementary chapter on centrosomes included in our 2004 revised reprint edition into Chapter 34 (microtubules).

We explain the evolutionary history and molecular diversity of each class of molecules as a basis for understanding how each system works. And we ask and answer two questions: How many varieties of this type of molecule exist in animals? Where did they come from in the evolutionary process? Thus, readers have the opportunity to see the big picture rather than just a mass of details. For example, a single original figure in Chapter 10 shows the evolution of all types of membrane ion channels followed by text that spells out the properties of each of these families.

After introducing the molecular hardware, each section finishes with one or more chapters that illustrate how these molecules function together in physiological process. This organization allows for a clearer exposition regarding the general principles of each class of molecules, since they are treated as a group rather than specific examples. More important still, the operation of complex processes, such as signaling pathways, is presented as an integrated whole, without the diversions that arise when it is necessary to introduce the various components as they appear along the pathway. Teachers of short courses may choose to concentrate on a subset of the examples in these systems chapters, or they may choose to use parts of the hardware chapters as reference material.

The seven chapters on the cell cycle that conclude the book clearly illustrate our approach. Having now covered the previous sections on nuclear structure and function, gene expression, membrane physiology, signal transduction and the cytoskeleton, and cell motility, the reader is prepared to appreciate the coordination of all cellular systems as step by step the cell transverses the cell cycle. This final section begins with a chapter that deals with general principles of cell cycle control and proceeds with chapters on each aspect of cell growth and death (including apoptosis), each integrating the contribution of all the cellular systems.

The chapters on cellular functions integrate material on specialized cells and tissues. Epithelia, for example, are covered under membrane physiology and junctions; excitable membranes of neurons and muscle under membrane physiology; connective tissues under the extracellular matrix; the immune system under connective tissue cells, apoptosis, and signal transduction; muscle under the cytoskeleton and cell motility; and cancer under the cell cycle and signal transduction. We use clinical examples to illustrate physiological functions throughout the book. This is possible, since connections have now been made between most cellular systems and disease. These medical "experiments of nature" are woven into the text along with laboratory experiments on model organisms.

Most of the experimental evidence is presented in figures that include numerous micrographs, molecular structures, and key graphs that emphasize the results rather than the experimental details. Original references are given for many of the experiments. Many of the methods used will be new to our readers. The chapter on experimental methods in cell biology introduces how and why particular approaches (such as microscopy, classical genetics, genomics and reverse genetics, and biochemical methods) are used to identify new molecules, map molecular pathways, or verify physiological functions.

In this new edition, our Student Consult site provides live links to the Protein Data Base (PDB). As in the first edition, each of the numerous structures displayed in the figures comes with a PDB accession number. With Student Consult, the reader now can access the PDB to review original data, display an animated molecule, or search links to the original literature simply by clicking on the PDB number in the on-line version of our text.