

# CELLS



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# CELLS

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# Preface


*CELLS* is a new cell biology textbook written primarily for advanced undergraduate and graduate students taking their first course in cell biology. It is also a resource for scientists who wish to learn more about topics outside of their field. A key objective in developing this book was to present the content, gleaned from decades of research, in a format that provides students with the information they need to achieve a solid foundation in cell biology without overwhelming them with too much detail. Focusing solely on cell biology allowed the team of contributors, lead editors, and scientific advisors and editors to incorporate the current research in the field, thoroughly cover each topic, and provide ample illustrations of cellular processes at the molecular level, without being too unwieldy.

This book covers the structure, organization, growth, regulation, movements, and interactions of cells, with an emphasis on eukaryotic cells. These topics are presented in 17 chapters grouped into seven parts, beginning with the definition of a cell, continuing on to the components of cells and the regulation of cell functions, and ending with cell diversity. Plant cells and prokaryotic cells are covered in separate chapters to emphasize this diversity while highlighting the properties shared by all cells.

Each chapter was written by one or more experts in the subject area. The material that these scientists provided was reviewed by a panel of advisors, who offered essential input. The lead editors and scientific editors endeavored to keep the big picture and overarching philosophy of the text in focus, while editing the text and illustrations for consistent use of terminology and level of exposition.

The design of *CELLS* is intended to enhance pedagogy. Chapters are divided into sections with declarative titles that emphasize the main points. Each section begins with a set of key concepts that enables readers to grasp the important ideas at the outset. To stimulate students' interest in future work, chapters include a section called "What's next?" that describes some of the interesting questions that researchers are tackling. Key review and research articles have been listed for students interested in the experiments that led to the current understanding of each topic.

The artists, in collaboration with the authors and editors, have developed the illustrations to be as self-explanatory as possible, with such features as "grab and go" figure titles and text boxes that lead the reader through a figure. Liberal use of well-labeled micrographs and molecular structures helps students to recognize cellular components and understand relationships between structure and function. Whenever possible, the schematic figures take into account the relative sizes of molecules. Colors and molecular shapes, the latter based on atomic structures where known, are used in a consistent manner throughout the book.

The print version is integrated with a website, accessible through <http://bioscience.jbpub.com/cells>, which provides access to related resources that are referenced in the text with symbols such as **MBIO : 1-0001**. For example, students can refer to the website for additional information on techniques or content from other texts, such as *GENES* by Benjamin Lewin. The website also contains interactive figures, animations, and videos, visual aids that are essential to understanding the dynamic nature of cells. These online images are indicated by the symbol  to the left of figure legends in this book. The interactive figures include micrographs with labels that can be turned on and off as well as atomic structures that can be rotated to facilitate recognition of key features of cells and molecules, respectively. In addition, biochemistry chapters are provided on the website as background material for readers who have not completed coursework in the subject or who wish to brush up on it. The accompanying Instructor's ToolKit includes PowerPoint slides of all figures in *CELLS*, all animations and videos, a large collection of test questions, and lecture outlines based on the key concepts.

We are grateful to all the scientists who made this book possible by providing essential micrographs and other images, as well as the journal and book publishers for permission to reproduce them. The credits are listed in the figure legends. In the case of atomic structure images that we generated from RSCB Protein Data Bank files, the original publications are listed on a separate page.

We welcome suggestions for revisions or corrections, which can be sent to us at [info@jbpub.com](mailto:info@jbpub.com).



# Acknowledgments

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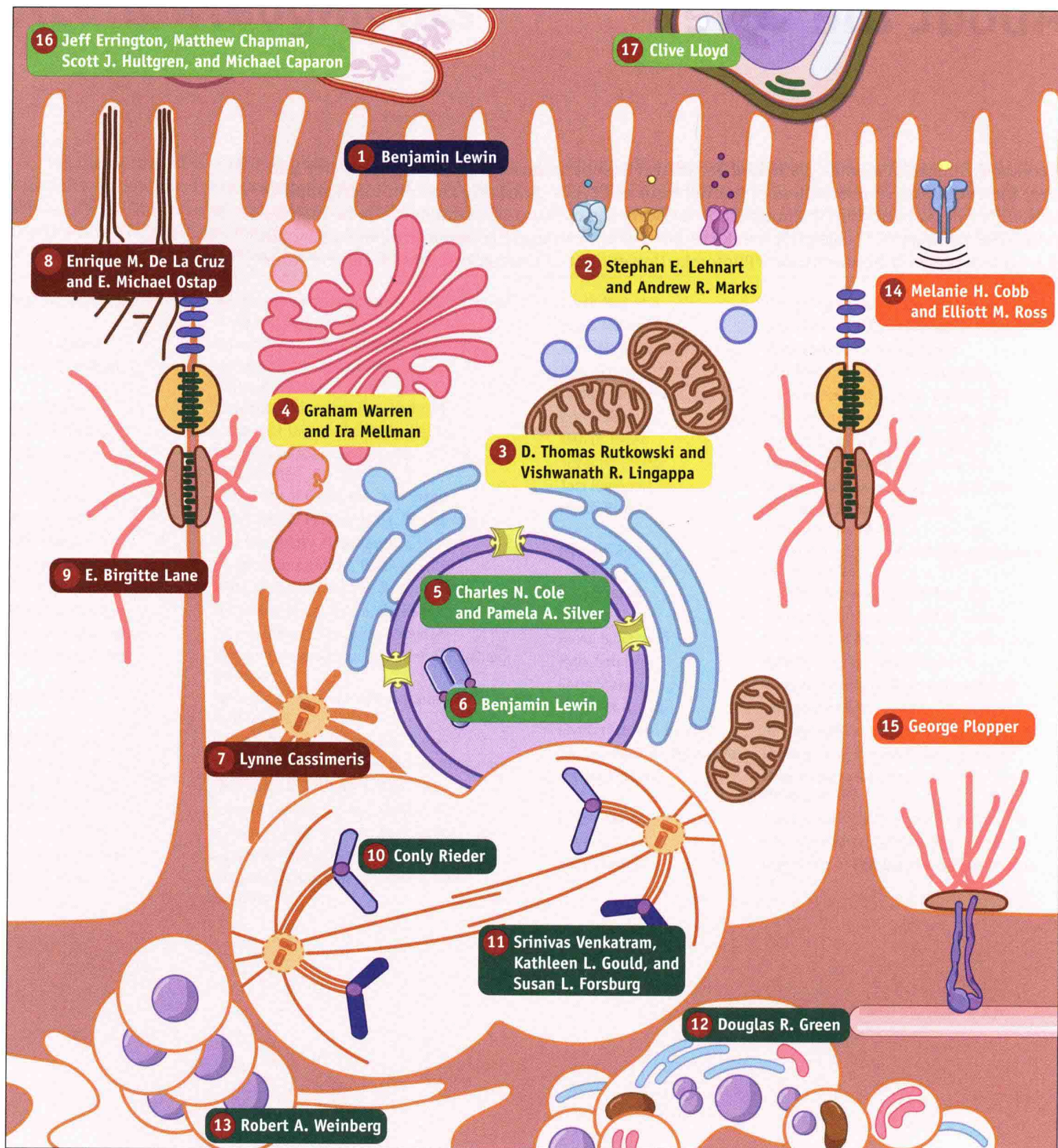
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# About the cover

A composite image of animal, plant, and bacterial cells superimposed on a phylogenetic tree indicates the evolutionary relatedness of the different cell types. Scanning electron micrograph of *Salmonella typhosa* bacterium © Phototake (left); scanning electron micrograph of a bone marrow stem cell © Dr. Gary D. Gaugler/Phototake (upper right); scanning electron micrograph of a grain of geranium pollen © Dennis Kunkel/Phototake (lower right). Concept: Leslie Pond. Design: Anne Spencer.



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# Abbreviations

A	Adenine or adenosine
ADP	Adenosine diphosphate
AMP	Adenosine monophosphate
cAMP	Cyclic AMP
ATP	Adenosine triphosphate
ATPase	Adenosine triphosphatase
bp	Base pair(s)
C	Cytidine or cytosine
cDNA	Complementary DNA
CDP	Cytidine diphosphate
CMP	Cytidine monophosphate
CTP	Cytidine triphosphate
DNA	Deoxyribonucleic acid
DNAase	Deoxyribonuclease
G	Guanine or guanosine
GDP	Guanosine diphosphate
GlcNAc	N-Acetyl-D-glucosamine
GMP	Guanosine monophosphate
GTP	Guanosine triphosphate
$\Delta G$	Free energy change
kb	Kilobases or kilobase pairs
Mb	Megabases or megabase pairs
mRNA	Messenger RNA
MW	Molecular weight
Pi	Inorganic phosphate
PPi	Inorganic pyrophosphate
RNA	Ribonucleic acid
RNAase	Ribonuclease
rRNA	Ribosomal RNA
tRNA	Transfer RNA
T	Thymine or thymidine
U	Uracil
UDP	Uridine diphosphate
UMP	Uridine monophosphate
UTP	Uridine triphosphate

Units	
Å	Angstrom
D or Da	Dalton
g	Gram
h or hr	Hour
M	Molar concentration
m	Meter
m or min	Minute
N	Newton
S	Svedberg unit
s or sec	Second
v	Volt

Amino acids		
A	Ala	Alanine
C	Cys	Cysteine
D	Asp	Aspartic acid
E	Glu	Glutamic acid
F	Phe	Phenylalanine
G	Gly	Glycine
H	His	Histidine
I	Ile	Isoleucine
K	Lys	Lysine
L	Leu	Leucine
M	Met	Methionine
N	Asn	Asparagine
P	Pro	Proline
Q	Gln	Glutamine
R	Arg	Arginine
S	Ser	Serine
T	Thr	Threonine
V	Val	Valine
W	Trp	Tryptophan
Y	Tyr	Tyrosine

## Prefix

(Abbreviation)	Multiple
mega (M)	$10^6$
kilo (k)	$10^3$
deci (d)	$10^{-1}$
centi (c)	$10^{-2}$
milli (m)	$10^{-3}$
micro ( $\mu$ )	$10^{-6}$
nano (n)	$10^{-9}$
pico (p)	$10^{-12}$



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