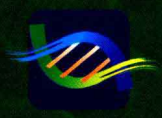


教育部高等教育司推荐
国外优秀生命科学教学用书

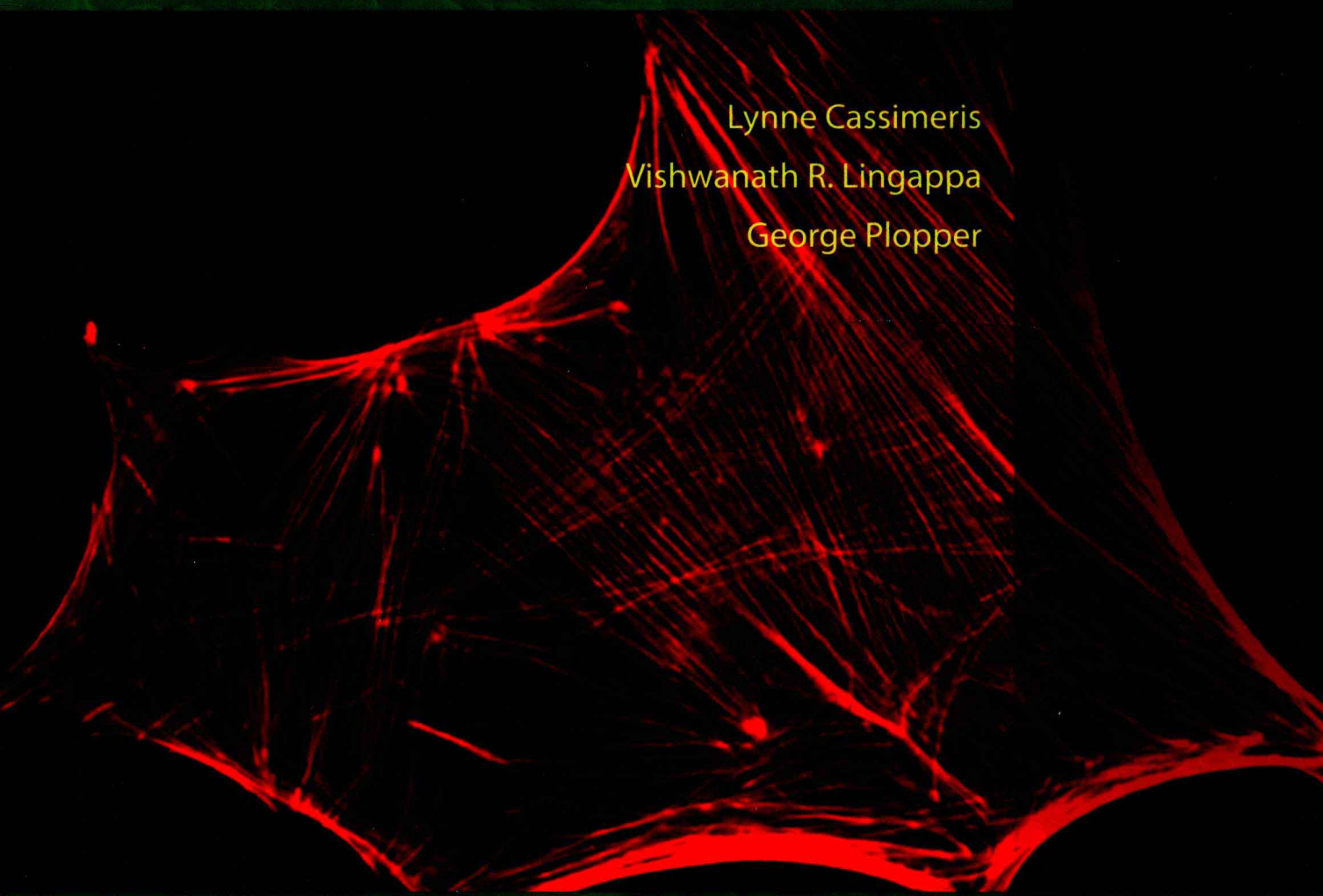
LEWIN 细胞生物学

第2版 影印版

LEWIN'S CELLS

Second Edition

Lynne Cassimeris
Vishwanath R. Lingappa
George Plopper



高等教育出版社
HIGHER EDUCATION PRESS

教育部高等教育司推荐
国外优秀生命科学教学用书

LEWIN
细胞生物学

XIBAO SHENGWUXUE

第2版 影印版

LEWIN'S CELLS

Second Edition

Lynne Cassimeris
Vishwanath R. Lingappa
George Plopper

高等教育出版社·北京
HIGHER EDUCATION PRESS BEIJING

图字：01－2011－0473 号

ORIGINAL ENGLISH LANGUAGE EDITION PUBLISHED BY
Jones & Bartlett Learning
40 Tall Pine Drive
Sudbury, MA 01776

图书在版编目(CIP)数据

Lewin 细胞生物学 = Lewin's Cells：第 2 版：英文/(美) 卡西默里斯(Cassimeris, L.), (美) 林加帕(Lingappa, V. R.), (美) 普洛伯(Plopper, G.) 编著. —影印本. —北京：高等教育出版社, 2011. 4
ISBN 978－7－04－032183－8
Ⅰ. ①L… Ⅱ. ①卡…②林…③普… Ⅲ. ①细胞生物学－高等学校－教材－英文 Ⅳ. ①Q2

中国版本图书馆 CIP 数据核字(2011)第 047308 号

封面图片说明(李慧惠　陈建国　供图)
体外培养的星形胶质细胞用罗丹明标记的鬼笔环肽染色，显示细胞内应力纤维和黏着斑的分布。

策划编辑 王　莉　高新景　**责任编辑** 高新景　**封面设计** 张　楠　**责任印制** 刘思涵

出版发行	高等教育出版社	**咨询电话**	400－810－0598
社　　址	北京市西城区德外大街 4 号	**网　　址**	http://www.hep.edu.cn
邮政编码	100120		http://www.hep.com.cn
印　　刷	北京中科印刷有限公司	**网上订购**	http://www.landraco.com
开　　本	889×1194　1/16		http://www.landraco.com.cn
印　　张	48	**版　　次**	2011 年 4 月第 1 版
字　　数	1 200 000	**印　　次**	2011 年 4 月第 1 次印刷
购书热线	010－58581118	**定　　价**	89.00 元

本书如有缺页、倒页、脱页等质量问题，请到所购图书销售部门联系调换

物料号　32183－00

Preface

Eighty years ago, the cellular world opened up. The electron microscope granted us, for the first time, a detailed perspective of basic cellular structures, and the ultracentrifuge allowed us to biochemically isolate and characterize fractions of cytoplasmic and nuclear material. Geneticists could investigate the relationship between the ever-shifting chromosomal structure and the molecular mechanisms of genetic inheritance—an effort that culminated with the triumphant revelation of the structures of DNA and RNA and a translation of the genetic code.

But we have come a long way from there. We have perfected our understanding of genes themselves, adjusting our definition from "determinants of a genetic phenotype," to "protein-encoding segments of DNA," and now, more precisely, "units of genomic information required for the transcription of functional messenger RNA or noncoding RNA." And we are still learning about the proteins these mRNAs produce. The RSCB Protein Data Bank (PDB) was established in 1971 as an international repository for structural data, but it did not truly begin to grow until the early 1990s. Now, in 2010, it holds more than 60,000 structures and is expanding at the rate of about 7,000 structures per year. For now, X-ray crystallography and nuclear magnetic resonance are the only techniques available for the determination of macromolecular structures at high resolution. Important advances in other methods, however—including visualization of fluorescently tagged proteins in living cells and new types of electron microscopy—are describing cellular structures and processes in ever-increasing detail.

What this all means is that the scope of biological questions that can be asked has been fundamentally changed. The new field of structural genomics has enabled us to relate increased structural resolution to functional changes, providing powerful insights at deeper levels of understanding. With our growing ability to process huge data sets, complete characterizations of cellular structures such as the nuclear pore complex and the centrosome, which are constructed from hundreds of proteins, may soon be attainable.

Perhaps most exciting is the combination of structural and mechanistic information with developments in genetics, biochemistry, and physiology—the primary vision of the emerging field of systems biology. Most cell biologists today recognize that only a comprehensive approach to research, from the nuclear pore complex to the extracellular matrix, will begin to lift the veil from the cellular processes underlying cystic fibrosis, epilepsy, and cancer.

Any cell biology textbook must provide a current perspective of the structure, function, and regulation of biological systems, but in today's world it is imperative that we also present the subject in the context of biochemistry and molecular biology, genomics, histology and pathology, and physiology. Thoroughly revised and updated, *Lewin's CELLS, Second Edition,* turns a new and sharper lens on the fundamental units of life.

Audience

This second edition, expanded and updated from Benjamin Lewin's *CELLS*, is geared for advanced undergraduate and graduate students taking a first course in cell biology. A key objective in developing this book was to present the concepts and mechanisms underlying cell structure and function, gleaned from decades of research, in a format that provides students with the information necessary for a solid foundation in cell biology, without overwhelming them with too much detail. The major goal of the team of lead editors and 26 expert authors has been to incorporate the current research in the field, thoroughly cover each topic, and provide ample illustrations of cellular processes at the molecular level—but without being unwieldy.

New and Key Features

Lewin's CELLS, Second Edition, covers the structure, organization, growth, regulation, movement, and interactions of cells, with an emphasis on those in the eukaryotic domain. These topics are presented in 21 chapters grouped into seven parts, beginning with the definition of a cell, providing background on basic cellular processes, 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 their diversity while highlighting the properties shared by all cells.

Areas of New Coverage

Chapters from the first edition were thoroughly updated and revised by their original authors, 26 experts in diverse areas of cell and molecular biology and biochemistry.

This second edition also includes several entirely new chapters:

Chapter 2, Bioenergetics and Cellular Metabolism
Chapter 3, DNA Replication, Repair, and Recombination
Chapter 4, Gene Expression and Regulation
Chapter 5, Protein Structure and Function

The following list highlights some other areas of key content updates:

- Chapter 9, Nuclear Structure and Transport, discusses the dramatic increase in our understanding of nuclear pore complex structure, organization, and biogenesis, and the nature of the molecular environment found in the central channel of the NPC, which ensures selectivity in transport. Also updated substantially is the discussion of RNA export, focusing on recent advances in our understanding of export of mRNA, tRNA, ribosomal subunits, and microRNAs.
- Chapter 10, Chromatin and Chromosomes, now contains an extensive discussion of histone variants and the roles they play in chromosome segregation, transcription, and DNA repair.
- Chapter 13, Intermediate Filaments, shows how mutations in keratin genes have been linked to skin blistering diseases.
- Chapter 14, Mitosis, explains how errors in chromosome attachment to the mitotic spindle are detected and corrected. It also discusses mitosis as a pharmacological target for development of anticancer drugs.
- Chapter 15, Cell Cycle Regulation, explains the mechanisms responsible for cell proliferation and the way these mechanisms are controlled to prevent chromosome damage.
- Chapter 16, Apoptosis, includes an expanded discussion of the inflammasome, a structure that senses danger signals and responds to them.
- Chapter 18, Principles of Cell Signaling, features a discussion of Abl and the development of inhibitors and resistance in the treatment of chronic myelogenous leukemia. The authors have also added improved protein structures that illustrate important regulatory principles.
- Chapter 19, The Extracellular Matrix and Cell Adhesion, discusses the role of the extracellular matrix during the evolution of multicellularity. It also contains an expanded discussion of various integrin-based complexes in vivo.
- Chapter 21, Plant Cell Biology, covers newly discovered proteins that predict the plane of cell division. It also includes advances showing that microtubules provide tracks for the movement of cellulose-synthesizing enzymes.

Design

The design of *Lewin's CELLS, Second Edition,* is specifically 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 enable 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 articles have been listed for students interested in the experiments that led to the current understanding of each topic, and additional references to original research papers and reviews are available on this book's Student Companion Web Site. Each chapter in *Lewin's CELLS, Second Edition*, now includes several **Concept and Reasoning Checks**, allowing students to test their understanding of the material just presented. Pedagogy has also been enhanced by adding special feature boxes to highlight **Medical Applications**, **Historical Perspectives**, and **Methods and Techniques** used to study cell processes (for a list of these features, see page xvii).

The artists, in collaboration with the authors and editors, have developed the illustrations to be as self-explanatory as possible, with such features as 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.

Supplements to the text

Jones and Bartlett Publishers offers an impressive array of ancillaries to assist instructors and students in teaching and mastering the concepts in this text. Additional information and review copies of any of the following items are available through your Jones and Bartlett Publishers sales representative or by going to www.jbpub.com/biology.

For the student

The **Student Companion Web Site** we developed exclusively for the second edition of this text, http://biology.jbpub.com/lewin/cells, offers a variety of resources to enhance understanding of cell biology. Students will find chapter summaries and study quizzes that help them to review the key concepts,

as well as an interactive glossary, flashcards, and crosswords to aid with memorization of key terms. The site also contains a selection of 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 diagrams and micrographs with labels that can be turned on and off as well as short videos with labels showing the progression of key processes. For those students who wish to explore topics in cell biology in greater depth, a list of important research papers and reviews is also provided for every chapter in the book, along with links to related sites on the Web.

For the instructor

Compatible with Windows® and Macintosh® platforms, the *Instructor's Media CD-ROM* provides instructors with the following traditional ancillaries:

- The **PowerPoint® Image Bank** provides the illustrations, photographs, and tables (to which Jones and Bartlett Publishers holds the copyright or has permission to reproduce digitally) inserted into PowerPoint slides. Instructors can quickly and easily copy individual images or tables into their existing lecture slides.
- The **PowerPoint Lecture Outline Slides** presentation package provides lecture notes and images for each chapter of *Lewin's CELLS, Second Edition*. Instructors with the Microsoft® PowerPoint software can customize the outlines, art, and order of presentation.
- The Instructor's Media CD also contains more than 350 interactive **figures, animations, and videos**.

A *Test Bank* (prepared by Esther Siegfried at Pennsylvania State University, Altoona) is also available. The questions are presented in straight text files that are compatible with most course man agement software.

Acknowledgments

We thank the many scientists who provided advice informally throughout the development of this book and the following scientific advisors, who read portions of the text and made many valuable suggestions:

Stephen Adam	Northwestern University Feinberg School of Medicine, Chicago, IL
Tobias Baskin	University of Massachusetts, Amherst, MA
Harris Bernstein	National Institutes of Health, Bethesda, MD
Fred Chang	Columbia University, New York, NY
Louis DeFelice	Vanderbilt University, Nashville, TN
Paola Deprez	Institute of Microbiology–ETH, Zurich, Switzerland
Arshad Desai	University of California, San Diego, CA
Paul De Weer	University of Pennsylvania, Philadelphia, PA
Biff Forbush	Yale University, New Haven, CT
Joseph Gall	Carnegie Institution, Baltimore, MD
Emily Gillett	Harvard Medical School, Boston, MA
Rebecca Heald	University of California, Berkeley, CA
Alistair Hetherington	Bristol University, Bristol, United Kingdom
Harald Herrmann	German Cancer Research Center, Heidelberg, Germany
Philip Hinds	Tufts–New England Medical Center, Boston, MA
Jer-Yuan Hsu	University of California, San Diego, CA
Martin Humphries	University of Manchester, Manchester, United Kingdom
James Kadonaga	University of California, San Diego, CA
Randall King	Harvard Medical School, Boston, MA
Roberto Kolter	Harvard Medical School, Boston, MA
Susan LaFlamme	Albany Medical Center, NY
Rudolf Leube	Johannes Gutenberg University, Mainz, Germany
Vivek Malhotra	University of California, San Diego, CA
Frank McCormick	University of California, San Francisco, CA
Akira Nagafuchi	Kumamoto University, Kumamoto City, Japan
Roel Nusse	Stanford University, Palo Alto, CA
Andrew Osborne	Harvard Medical School, Boston, MA
Erin O'Shea	Harvard University, Cambridge, MA
Marcus Peter	University of Chicago, Chicago, IL
Suzanne Pfeffer	Stanford University, Stanford, CA
Tom Rapoport	Harvard Medical School, Boston, MA
Ulrich Rodeck	Thomas Jefferson University, Philadelphia, PA
Michael Roth	University of Texas Southwestern Medical Center, Dallas, TX
Lucy Shapiro	Stanford University, Palo Alto, CA
Thomas Shea	University of Massachusetts, Lowell, MA
David Siderovski	University of North Carolina, Chapel Hill, NC
Mark Solomon	Yale University, New Haven, CT
Chris Staiger	Purdue University, West Lafayette, IN
Margaret A. Titus	University of Minnesota, Minneapolis, MN
Livingston Van De Water	Albany Medical Center, NY
Miguel Vicente-Manzanares	University of Virginia, Charlottesville, VA
Patrick Viollier	Case Western Reserve University, Cleveland, OH
Claire Walczak	Indiana University, Bloomington, IN
Junying Yuan	Harvard Medical School, Boston, MA
Sally Zigmond	University of Pennsylvania, Philadelphia, PA

We are also grateful to all the scientists who made this book possible by providing essential micrographs and other images, as well as to the journal and book publishers for permission to reproduce them. The credits are listed in the figure legends.

We welcome suggestions for revisions or corrections, which can be sent to us at info@jbpub.com.

Contributors

Lead Editors

Benjamin Lewin founded the journal *Cell* in 1974 and was Editor until 1999. He also founded the Cell Press journals *Neuron, Immunity,* and *Molecular Cell.* In 2000, he founded Virtual Text, which was acquired by Jones and Bartlett Publishers in 2005. He is the original author of *Genes* and *Essential Genes.*

Lynne Cassimeris is a Professor in the Department of Biological Sciences at Lehigh University in Bethlehem, PA. She studies microtubule assembly dynamics and mitosis.

Vishwanath R. Lingappa is Senior Scientist at Bioconformatics Laboratory, CPMC Research Institute; Chief Technology Officer at Prosetta Corporation; and Emeritus Professor of Physiology at the University of California, San Francisco. His research is in protein biogenesis. He practices internal medicine as a volunteer physician at San Francisco General Hospital and has coauthored textbooks of physiology and pathophysiology.

George Plopper is an Associate Professor at Rensselaer Polytechnic Institute. He studies signal transduction and cellular behavior induced by extracellular matrix binding.

Authors

Raymond Ochs is a Professor of Pharmaceutical Sciences at St. John's University in New York. His research concerns regulation of intermediary metabolism and control by intracellular calcium ion.

Jocelyn E. Krebs is an Associate Professor of Biological Sciences at the University of Alaska, Anchorage. Her lab studies DNA repair and transcription in the context of chromatin structure in the yeast *Saccharomyces cerevisiae* and the role of chromatin remodeling during vertebrate development in the frog *Xenopus laevis.*

David G. Bear is Professor of Cell Biology and Physiology and Assistant Dean for Admissions at the University of New Mexico School of Medicine and is Professor and Chair of Chemistry and Chemical Biology at the University of New Mexico. His research interests focus on the assembly and intracellular trafficking of messenger RNA ribonucleoprotein complexes in striated muscle cells, muscular dystrophies, and muscle cell cancers.

Stephen J. Smerdon is joint head of the Division of Molecular Structure at the MRC National Institute for Medical Research, UK, where he works on the structural biology of a variety of cell signaling pathways, particularly the regulation of DNA-damage complex assembly by phosphorylation-dependent mechanisms.

Stephan E. Lehnart is a Professor of Translational Cardiology at the Center of Molecular Cardiology of the University of Goettingen Medical Center and an Adjunct Associate Professor at the University of Maryland Biotechnology Institute. His major research interests are membrane transport mechanisms that control intracellular calcium cycling in the heart and other organs that contribute significantly to disease processes.

Andrew R. Marks is the Clyde and Helen Wu Professor of Medicine and Chair and Professor of the Department of Physiology and Cellular Biophysics at Columbia University. He works on how macromolecular signaling complexes regulate ion channel function in muscle and nonmuscle systems. He is a member of the Institute of Medicine of the National Academy of Sciences, American Academy of Arts and Sciences, and the National Academy of Sciences.

D. Thomas Rutkowski is an Assistant Professor in the Department of Anatomy and Cell Biology at the University of Iowa Carver College of Medicine. His lab studies how cells adapt to chronic protein misfolding stress in normal physiology and disease.

Vivek Malhotra is the Chair of Cell and Developmental Biology at CRG in Barcelona, Spain. His laboratory has long been involved in the mechanism of protein secretion and Golgi organization.

Graham Warren is the Scientific Director of the Max F. Perutz Laboratories, Vienna, Austria, and his laboratory studies the structure, function, and biogenesis of the Golgi apparatus.

Ira Mellman is Vice President of Research Oncology at Genentech, Inc., in San Francisco, California. His research focuses on the cell biology of the immune response (specifically the role of dendritic cells in T-cell stimulation) and on the signals that control the formation and function of epithelial cells.

Charles N. Cole is a Professor of Biochemistry and of Genetics at Dartmouth Medical School. His interests have included nuclear transport, regulation of cellular transformation and immortalization, RNA metabolism, microRNAs, and breast cancer.

Pamela A. Silver is a Professor of Systems Biology at Harvard Medical School. Her interests have included nuclear transport, organization of the genome, RNA dynamics, and synthetic biology.

Enrique M. De La Cruz is an Associate Professor of Molecular Biophysics and Biochemistry at Yale University. His laboratory uses biochemical and biophysical techniques to investigate the mechanisms of actin- and myosin-based motility. His work also focuses on motor properties of RNA helicases.

E. Michael Ostap is a Professor of Physiology at the University of Pennsylvania School of Medicine and is a member of the Pennsylvania Muscle Institute. His laboratory uses cell biological, biochemical, and biophysical techniques to investigate the mechanisms of cell motility. His work is currently focused on the study of unconventional myosins.

Birgit Lane is Executive Director of the Institute of Medical Biology in Singapore. She studies intermediate filaments, particularly keratins, and the part they play in normal tissue resilience and in human diseases.

Conly L. Rieder is a Senior Research Scientist and Chief of the Wadsworth Center's Laboratory of Cell Regulation. The Wadsworth Center is a research arm of the New York State Department of Health. He is also a Professor in the Department of Biomedical Sciences, State University of New York at Albany. Dr. Rieder has spent over 30 years researching how cells divide.

Kathleen L. Gould is Professor and Vice-Chair of Cell and Developmental Biology at Vanderbilt University School of Medicine and an Investigator of the Howard Hughes Medical Institute. Her laboratory studies the mechanism and regulation of cytokinesis in the fission yeast *Schizosaccharomyces pombe*.

Susan L. Forsburg is a Professor in Molecular and Computational Biology at the University of Southern California. Her laboratory studies DNA replication and genome dynamics in the fission yeast *Schizosaccharomyces pombe*.

Douglas R. Green is the Chair of Immunology at St. Jude Children's Research Hospital in Memphis, TN. His laboratory studies the process of apoptosis and related forms of cell death.

Robert A. Weinberg is the Daniel K. Ludwig and American Cancer Society Professor for Cancer Research at the Massachusetts Institute of Technology and a founding member of the Whitehead Institute for Biomedical Research. His research is focused on the molecular mechanisms that control cell proliferation and the formation of tumors.

Elliott M. Ross is a Professor in the Graduate Programs in Molecular Biophysics and Cell Regulation and the Department of Pharmacology at the University of Texas Southwestern Medical Center in Dallas. His group studies information processing in G-protein signaling networks.

Melanie H. Cobb is a Professor in Pharmacology and the Graduate Programs in Cell Regulation and Cancer Biology at the University of Texas Southwestern Medical Center at Dallas. Her group studies regulation and function of protein kinases with an emphasis on MAPK pathways and WNKs.

Matthew Chapman is an Associate Professor at the University of Michigan and the 2009 recipient of the university's Class of 1923 Teaching Award. His lab studies the function and biogenesis of bacterial amyloid fibers.

Jeff Errington is Director of the Institute for Cell and Molecular Biosciences at Newcastle University. He works on the cell cycle and cell morphogenesis of bacteria.

Clive Lloyd is a Project Leader at The John Innes Centre, Norwich, UK. He studies the role of the cytoskeleton in plant growth and development.

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
ΔG	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

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

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

Brief contents

内容详见本书数字课程。

Contents