EXHIBIT K

MOLECULAR BIOLOGY OF THE CELL

THIRD EDITION

Bruce Alberts • Dennis Bray
Julian Lewis • Martin Raff • Keith Roberts
James D. Watson



Garland Publishing, Inc.
New York & London

Text Editor: Miranda Robertson
Managing Editor: Ruth Adams
Illustrator: Nigel Orme
Molecular Model Drawings: Kate Hesketh-Moore
Director of Electronic Publishing: John M-Roblin
Computer Specialist: Chuck Bartelt
Disk Preparation: Carol Winter
Copy Editor: Shirley M. Cobert
Production Editor: Douglas Goertzen
Production Coordinator: Perry Bessas
Indexer: Maija Hinkle

Bruce Alberts received his Ph.D. from Harvard University and is currently President of the National Academy of Sciences and Professor of Biochemistry and Biophysics at the University of California, San Francisco. *Dennis Bray* received his Ph.D. from the Massachusetts Institute of Technology and is currently a Medical Research Council Fellow in the Department of Zoology, University of Cambridge. *Julian Lewis* received his D.Phil. from the University of Oxford and is currently a Senior Scientist in the Imperial Cancer Research Fund Developmental Biology Unit, University of Oxford. *Martin Raff* received his M.D. from McGill University and is currently a Professor in the MRC Laboratory for Molecular Cell Biology and the Biology Department, University College London. *Keith Roberts* received his Ph.D. from the University of Cambridge and is currently Head of the Department of Cell Biology, the John Innes Institute, Norwich. *James D. Watson* received his Ph.D. from Indiana University and is currently Director of the Cold Spring Harbor Laboratory. He is the author of *Molecular Biology of the Gene* and, with Francis Crick and Maurice Wilkins, won the Nobel Prize in Medicine and Physiology in 1962.

© 1983, 1989, 1994 by Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson.

All rights reserved. No part of this book covered by the copyright hereon may be reproduced or used in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or information storage and retrieval systems—without permission of the publisher.

Library of Congress Cataloging-in-Publication Data
Molecular biology of the cell / Bruce Alberts . . . [et al.].—3rd ed.
p. cm.
Includes bibliographical references and index.
ISBN 0-8153-1619-4 (hard cover).—ISBN 0-8153-1620-8 (pbk.)
1. Cytology. 2. Molecular biology. I. Alberts, Bruce.
[DNLM: 1. Cells. 2. Molecular Biology. QH 581.2 M718 1994]
QH581.2.M64 1994
574.87—dc20
DNLM/DLC
for Library of Congress 93-45907
CIP

Published by Garland Publishing, Inc.
717 Fifth Avenue, New York, NY 10022

Printed in the United States of America

15 14 13 12 10 9 8 7 6 5 4 3

Front cover: The photograph shows a rat nerve cell in culture. It is labeled (*yellow*) with a fluorescent antibody that stains its cell body and dendritic processes. Nerve terminals (*green*) from other neurons (not visible), which have made synapses on the cell, are labeled with a different antibody. (Courtesy of Olaf Mundigl and Pietro de Camilli.)

Dedication page: Gavin Borden, late president of Garland Publishing, weathered in during his mid-1980s climb near Mount McKinley with MBoC author Bruce Alberts and famous mountaineer guide Mugs Stump (1940–1992).

Back cover: The authors, in alphabetical order, crossing Abbey Road in London on their way to lunch. Much of this third edition was written in a house just around the corner. (Photograph by Richard Olivier.)

making it possible to record the flow of current through individual ion channels in the patch.

pathogen (adjective **pathogenic**)
An organism or other agent that causes diseases.

PCR (polymerase chain reaction)
Technique for amplifying specific regions of DNA by multiple cycles of DNA polymerization, each followed by a brief heat treatment to separate complementary strands.

peptide bond
Chemical bond between the carbonyl group of one amino acid and the amino group of a second amino acid—a special form of amide linkage. (*See* Figure 2–7.)

peptide map
Characteristic two-dimensional pattern (on paper or gel) formed by the separation of the mixture of peptides produced by the partial digestion of a protein.

peroxisome
Small membrane-bounded organelle that uses molecular oxygen to oxidize organic molecules. Contains some enzymes that produce and others that degrade hydrogen peroxide (H_2O_2).

pH
Common measure of the acidity of a solution: "p" refers to power of 10, "H" to hydrogen. Defined as the negative logarithm of the hydrogen ion concentration in moles per liter (M). Thus pH 3 (10^{-3} M H^+) is acidic and pH 9 (10^{-9} M H^+) is alkaline.

phage—*see* **bacteriophage**

phagocyte
General term for a professional phagocytic cell—that is, a cell such as a macrophage or neutrophil that is specialized to take up particles and microorganisms by phagocytosis.

phagocytosis
Process by which particulate material is endocytosed ("eaten") by a cell. Prominent in carnivorous cells, such as *Amoeba proteus*, and in vertebrate macrophages and neutrophils. (From Greek *phagein*, to eat.)

phenotype
The observable character of a cell or an organism.

phosphatase—*see* **phosphoprotein phosphatase**

phosphatidylinositol
An inositol phospholipid. (*See* Figure 15–29.)

phosphodiester bond
A covalent chemical bond formed when two hydroxyl groups are linked in ester linkage to the same phosphate group, such as adjacent nucleotides in RNA or DNA. (*See* Figure 2–10.)

phosphoinositide—*see* **inositol phospholipid**

phospholipid
The major category of lipid molecules used to construct biological membranes. Generally composed of two fatty acids linked through glycerol phosphate to one of a variety of polar groups.

phosphoprotein phosphatase
Enzyme that removes a phosphate group from a protein by hydrolysis.

phosphorylation
Reaction in which a phosphate group becomes covalently coupled to another molecule.

photon
Elementary particle of light and other electromagnetic radiation.

photosynthesis
Process by which plants and some bacteria use the energy of sunlight to drive the synthesis of organic molecules from carbon dioxide and water.

phylogeny
Evolutionary history of an organism or group of organisms, often presented in chart form as a phylogenetic tree.

pinocytosis
Type of endocytosis in which soluble materials are taken up from the environment and incorporated into vesicles for digestion. Literally, "cell drinking."

plasma membrane
Membrane that surrounds a living cell.

plasmid
Small circular DNA molecule that replicates independently of the genome. Used extensively as a vector for DNA cloning.

plasmodesma (plural **plasmodesmata**)
Communicating cell-cell junction in plants in which a channel of cytoplasm lined by plasma membrane connects two adjacent cells through a small pore in their cell walls.

plastid
Cytoplasmic organelle in plants, bounded by a double membrane, that carries its own DNA and is often pigmented. Chloroplasts are plastids.

platelet
Cell fragment, lacking a nucleus, that breaks off from a megakaryocyte in the bone marrow and is found in large numbers in the bloodstream. It helps initiate blood clotting when blood vessels are injured.

plus end
The end of a microtubule or actin filament at which addition of monomers occurs most readily; the "fast-growing" end of a microtubule or actin filament. The plus end of an actin filament is also known as the barbed end. (*See* Panel 16–1, pp. 824–825.)

point mutation
Change of a single nucleotide in DNA, especially in a region of DNA coding for protein.

polar bond
Covalent bond in which the electrons are attracted more strongly to one of the two atoms, creating a polarized distribution of electric charge.

polar molecule
Molecule in which there is a polarized distribution of positive and negative charges due to an uneven distribution of electrons. Polar molecules are likely to be soluble in water.

polymer
Large molecule made by forming a series of covalent bonds that link multiple identical or similar units (monomers).

polymerase chain reaction—*see* **PCR**