

SECOND EDITION

# Understanding Environmental Health

*How We Live in the World*

**Nancy Irwin Maxwell, DSc**

Director, Communications and Dissemination Core  
Partners in Health and Housing Prevention Research Center  
Boston University School of Public Health



JONES & BARTLETT  
LEARNING

*World Headquarters*  
Jones & Bartlett Learning  
5 Wall Street  
Burlington, MA 01803  
978-443-5000  
info@jblearning.com  
www.jblearning.com

Jones & Bartlett Learning books and products are available through most bookstores and online booksellers. To contact Jones & Bartlett Learning directly, call 800-832-0034, fax 978-443-8000, or visit our website, [www.jblearning.com](http://www.jblearning.com).

Substantial discounts on bulk quantities of Jones & Bartlett Learning publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones & Bartlett Learning via the above contact information or send an email to [specialsales@jblearning.com](mailto:specialsales@jblearning.com).

Copyright © 2014 by Jones & Bartlett Learning, LLC, an Ascend Learning Company

All rights reserved. No part of the material protected by this copyright may be reproduced or utilized in any form, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner.

*Understanding Environmental Health: How We Live in the World, Second Edition* is an independent publication and has not been authorized, sponsored, or otherwise approved by the owners of the trademarks or service marks referenced in this product.

This publication is designed to provide accurate and authoritative information in regard to the Subject Matter covered. It is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional service. If legal advice or other expert assistance is required, the service of a competent professional person should be sought.

#### **Production Credits**

Publisher: Michael Brown  
Editorial Assistant: Chloe Falivene  
Editorial Assistant: Kayla Dos Santos  
Production Assistant: Leia Poritz  
Senior Marketing Manager: Sophie Fleck Teague  
Manufacturing and Inventory Control  
Supervisor: Amy Bacus

Composition: Lapiz  
Cover Design: Michael O'Donnell  
Cover Image: © Kang Khoon Seang/Shutterstock, Inc.  
Printing and Binding: Edwards Brothers Malloy  
Cover Printing: Edwards Brothers Malloy

**To order this product, use ISBN: 978-1-4496-6537-1**

#### **Library of Congress Cataloging-in-Publication Data**

Maxwell, Nancy Irwin.

Understanding environmental health : how we live in the world / Nancy Maxwell. — 2nd ed.  
p. ; cm.

Includes bibliographical references and index.

ISBN 978-1-4496-4770-4 (pbk.) -- ISBN 1-4496-4770-7 (pbk.)

I. Title.

[DNL: 1. Environmental Health. 2. Environmental Pollutants—adverse effects. 3. Environmental Pollution—adverse effects. 4. Environmental Pollution—prevention & control. WA 30.5]  
613'.1--dc23

2012035688

6048

Printed in the United States of America

17 16 15 14 13 10 9 8 7 6 5 4 3 2 1

# In memory of

Benjamin L. Maxwell, Scott R. Maxwell,  
and Edward J. Murphy,  
whose experiences brought home  
the human cost of environmental illness



# Contents

Preface.....	vii
Acknowledgments .....	ix
<b>Chapter 1</b>	
<b>A Preview of Environmental Health.....</b>	<b>1</b>
<b>Chapter 2</b>	
<b>The Science and Methods of Environmental Health.....</b>	<b>5</b>
2.1 Understanding Environmental Hazards to Human Health .....	9
2.2 Responding to Environmental Hazards to Human Health.....	52
2.3 Precautionary Approaches in Environmental Health Policy .....	63
Study Questions .....	66
References.....	67
<b>Chapter 3</b>	
<b>Living with Nature .....</b>	<b>71</b>
3.1 Infectious Disease .....	72
3.2 Poisons in Nature .....	101
3.3 Allergy and Asthma.....	103
3.4 Natural Disasters .....	104
3.5 Naturally Occurring Radiation .....	106
Study Questions .....	114
References.....	114
<b>Chapter 4</b>	
<b>Producing Energy.....</b>	<b>119</b>
4.1 Energy from Fossil Fuels.....	120
4.2 Electricity from Nuclear Fuel.....	156

4.3 Alternatives to Fossil and Nuclear Fuels.....	171
Study Questions .....	184
References.....	185
<b>Chapter 5</b>	
<b>Producing Manufactured Goods .....</b>	<b>193</b>
5.1 Synthetic Organic Chemicals.....	196
5.2 Toxic Metals.....	207
5.3 Nano-Scale Materials.....	210
5.4 Physical Hazards in the Workplace.....	211
5.5 Asthma-Causing Agents in the Workplace.....	217
5.6 Patterns in Exposure to the Products and Byproducts of Manufacturing.....	217
5.7 Regulation of Industrial Chemicals and Wastes .....	221
Study Questions .....	229
References.....	229
<b>Chapter 6</b>	
<b>Producing Food .....</b>	<b>237</b>
6.1 Modern Crop Production Practices .....	238
6.2 Modern Livestock Production Practices.....	250
6.3 Impacts of Modern Agriculture on Global Climate .....	264
6.4 Modern Fishing .....	264
6.5 From Source to Table.....	266
6.6 Organic Farming and Locally Grown Foods .....	268
6.7 Regulation of Food and the Activities That Produce It .....	270
Study Questions .....	277
References.....	277
<b>Chapter 7</b>	
<b>Living in the World We've Made.....</b>	<b>285</b>
7.1 The “Metabolism” of Communities.....	286
7.2 Management of Sewage Wastes.....	291
7.3 Drinking Water: Public Systems and Private Wells.....	303
7.4 Solid Waste and Its Management.....	309
7.5 Urban Settings in Less Developed Countries .....	322
7.6 The Built Environment in More Developed Countries.....	325
7.7 Lifestyles: Things We Do, Things We Use .....	330
7.8 Sharing Global Impacts and Resources .....	342
Study Questions .....	345
References.....	346
<b>Appendix.....</b>	<b>353</b>
<b>Glossary.....</b>	<b>355</b>
<b>Index .....</b>	<b>385</b>

# Preface

This second edition of *Understanding Environmental Health: How We Live in the World* incorporates updates to scientific understanding, changes in practice and policy, and important events of recent years. At the same time, it preserves the essence of the first edition, with only modest changes to the scope and structure of individual chapters.

An introductory text like this one, which frames environmental health for a broad group of students, should leave its readers with a permanent awareness of environmental influences on health, as well as an appreciation of the societal roots of those influences. It should prepare public health students who are not focusing in environmental health to engage the environmental health issues that will cross into their professional lives in other domains of public health. And it should be useful outside the public health sphere, introducing students of the natural environment to the public health aspects of environmental issues.

*Understanding Environmental Health* is briefer than most introductory environmental health texts. It provides the essential information about environmental health needed by the Master of Public Health (MPH) student, and it is designed to stand alone in an introductory course for students in concentrations other than environmental health—in fact, I first developed the book while teaching just such a course. At the same time, the brevity of the book gives instructors flexibility to customize their course content by assigning additional readings. With such supplemental readings, this book is appropriate as the core resource for a unified introductory course in environmental health for MPH students in all concentrations, as now offered in many schools and programs in public health. It is also suitable as the environmental health text in a survey course in public health or environmental studies—and in a variety of interdisciplinary courses spanning other fields. Further, the book has been used successfully in higher-level undergraduate courses.

In light of the varied science backgrounds of the students who will use this book, its treatment of science content is designed for readers who have different starting points yet need to end up with the same understanding of the subject matter. An early chapter presents

the fundamental science and methods of environmental health, much of which may be unfamiliar even to students with strong science backgrounds. In the rest of the text, sidebars present small bites of general science information at the point where it is first needed to understand an environmental health issue. This format directly addresses the challenge of students' varied science preparation, allowing each reader to fill in, along the way, whatever gaps in background knowledge he or she may have.

The book's organization also reflects its intended readership. Environmental health is a sprawling and diverse field, embracing many topics. Traditional topics in the field reflect professional specializations or regulatory domains; as a result, these topics are a mix of hazards (such as toxic chemicals or ionizing radiation), settings (such as occupational health), and environmental media (such as air or water pollution). For those outside the field—a core audience for this textbook—these categories do not easily add up to a coherent whole.

To provide that coherence, this text, more than most, tells a connected narrative, with chapters on the various things people do, as individuals or societies, that create environmental health hazards. After a brief introductory chapter and a substantial chapter on the science and methods of environmental health, there are chapters on the hazards of living in the natural world, including infectious disease, natural disasters, and naturally occurring radiation; producing energy from fossil fuels, nuclear fuels, and alternative sources; producing manufactured goods, with the associated pollution; producing food through an industrialized agricultural system; and living in communities, from local to global. Traditional environmental health topics fit easily in this larger framework; as an aid to instructors, a table in the Appendix locates traditional topics within this book's chapter structure. The book's organization gives instructors considerable flexibility in allocating class time to different topics over the course of a term.

Finally, this text offers a number of pedagogical features that serve both instructor and student. The writing style is direct and free of jargon, weaving together narration, explanation, and science. With the nontechnical reader in mind, the text makes explicit many assumptions and connections that are often left implicit, thus guiding the student through unfamiliar territory. Key terms are highlighted in the text and appear in an extensive glossary of more than 500 items. Learning objectives and study questions are provided for each chapter, and supplemental materials for both instructor and student are available online. The text is enriched by photographs and supported by diagrams, graphs, and tables that summarize or explain important concepts and processes. One series of tables, building chapter by chapter, sets out the complex U.S. regulatory framework for environmental health.

I hope this book will leave students with a basic understanding of environmental influences on health. But more than that, I hope they will gain an appreciation of the ways in which we all make the environment we live in, and a sense of how our future choices might differ from past ones.

Nancy Irwin Maxwell



# Acknowledgments

In writing the first edition of this text, I benefited greatly from the wisdom and generosity of colleagues at the Boston University School of Public Health who reviewed draft chapters: Richard Clapp, ever my first reader and formerly a teacher of the introductory environmental health course; Wendy Heiger-Bernays, teacher of the more intensive survey course for students focusing in environmental health; Michael McClean, a committed teacher and insightful critic; and Roberta White, who as my department chair supported this endeavor in ways large and small. As graduate teaching assistants, Gregory Howard, Patricia Janulewicz, Jessica Nelson, and Megan Romano gave helpful feedback as we used the first edition in manuscript form. My colleague Madeleine Scammell generously used the full manuscript and then the book in teaching, and shared her thoughts as I planned the second edition; and Richard Clapp has again fielded with grace the varied queries I sent his way. As in the first edition, any errors that remain are my own.

I thank the many students to whom I taught environmental health because they in turn taught me what this textbook should be like. And thanks are also due to Mike Brown, publisher for Jones & Bartlett Learning, who had a long wait for my original manuscript but didn't give up; to the anonymous reviewers who provided comments on the manuscripts for both editions; and to the editorial staff who turned the manuscripts into books.

Finally, I thank my husband, Keith Maxwell, who has been a sounding board, critical reader, and voice of encouragement throughout the writing of both editions. I would not have reached the end of this long road without his support.

