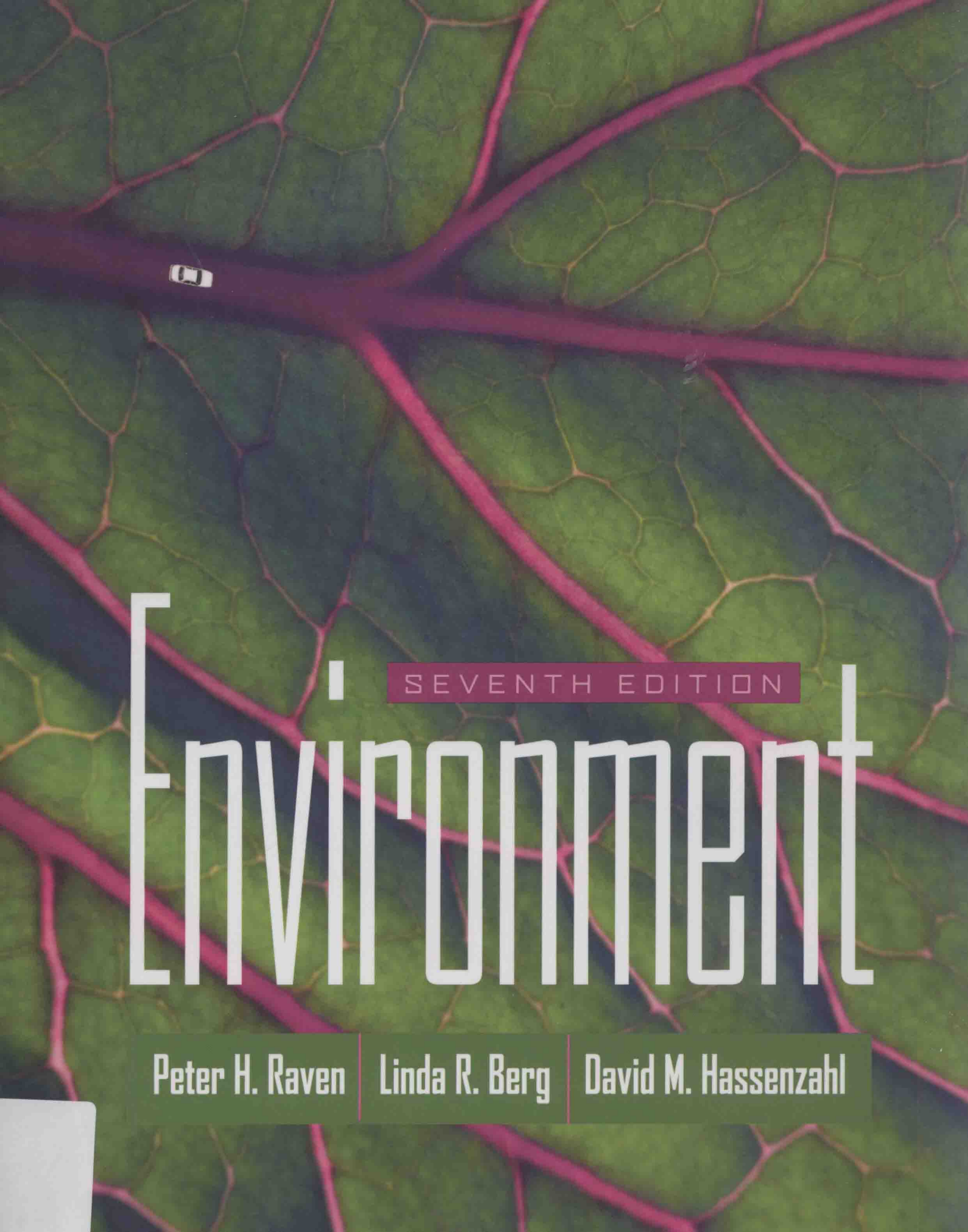
SEVENTH EDITION
Environment
Peter H. Raven
Linda R. Berg
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7th Edition

Environment

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To our family, friends, and colleagues who gave freely of their support and knowledge as we prepared the seventh edition of *Environment*.

Especially to
Pat, Alice, Elizabeth, Francis, and Kate
Alan, Jennifer, and Pat
Hilary, Mikaela, and Kobe

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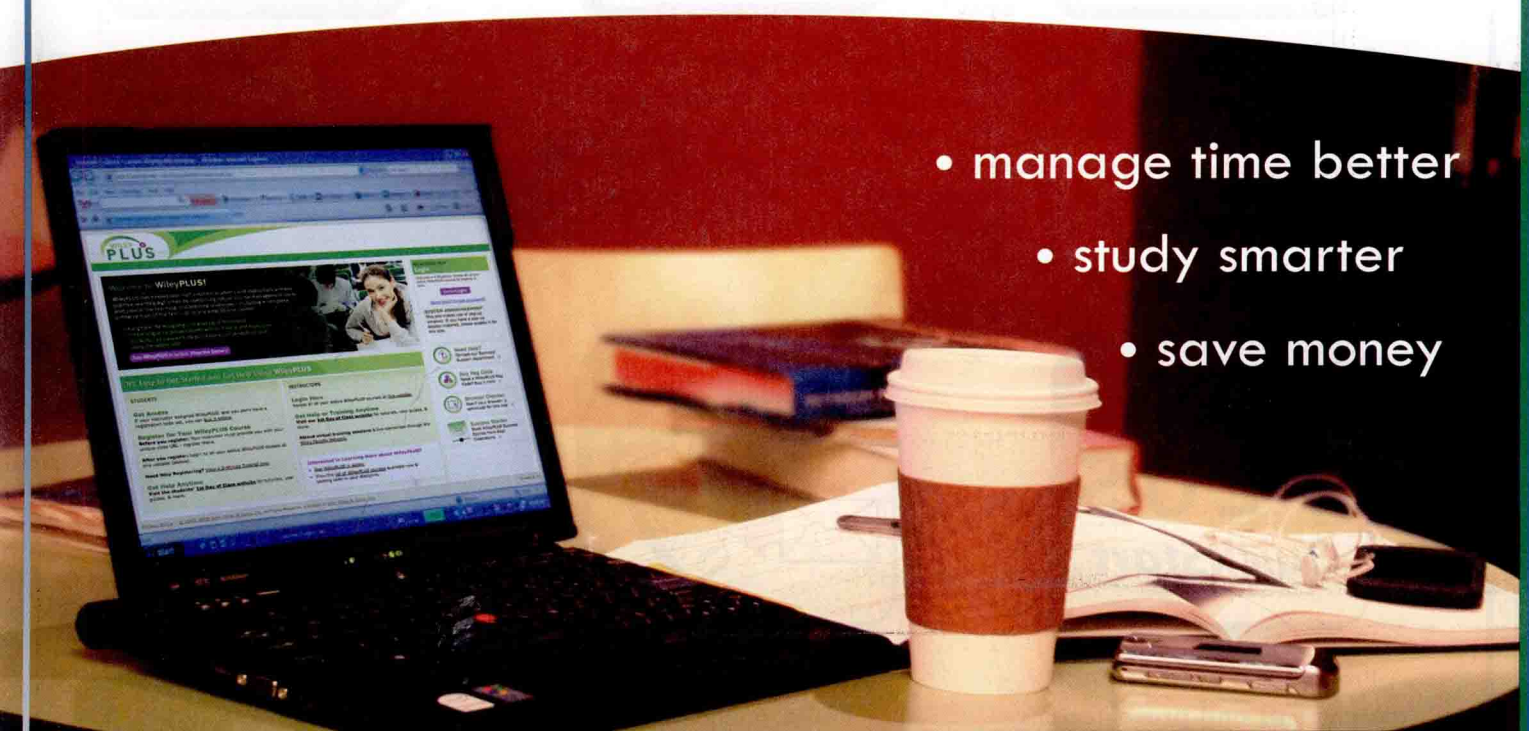

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Environment 7th Edition

Preface

Fluctuating global oil prices and accumulating evidence of rapid climate change are two of the most serious challenges we face today. These problems make some of the major environmental problems our society has faced in the past—smog, hazardous waste sites, and ozone layer depletion—appear relatively simple in comparison. Too often, people consider science as irrelevant to their daily lives. Yet the choices we make—even those as simple as taking a long shower instead of a short one or driving a few blocks instead of walking—have an impact on energy issues and climate change. It is critical that students learn about the science behind these and other environmental issues of our century, not only because they will make decisions about energy and climate change but also because they will experience the repercussions if these problems are not dealt with effectively.

The overarching concept of environmental sustainability has never been more important to the field of environmental science than it is today. Sustainability, a central theme of *Environment*, is integrated throughout the text. Yet the more we learn about the environment, the more we realize that interactions among different components of the environment are many and complex. Therefore, a second important theme of *Environment* is environmental systems. Understanding how change to one component affects other processes, places, and organisms is essential to managing existing problems, avoiding future problems, and improving the world we live in.

From the opening pages, we acquaint students with current environmental issues—issues that have many dimensions and that defy easy solutions. We begin by examining the scientific, historical, ethical, governmental, and economic underpinnings of environmental science. This provides a conceptual foundation for students that they can then bring to bear on the rest of the material in the book. We next explore the basic ecological principles that govern the natural world and consider the many ways in which humans affect the environment. Later chapters examine in detail the effects of human activities, including overpopulation, energy production and consumption, depletion of natural resources, and pollution. Throughout *Environment*, 7th Edition, we relate the topics of a given chapter to energy issues and climate change, which further reinforces the interactions of environmental systems.

While we avoid unwarranted optimism when presenting these problems, we do not see value in the gloomy predictions of disaster so commonly presented by the media. Instead, we encourage students to take active, positive roles to understand and address the environmental challenges of today and tomorrow.

Raven, Berg, and Hassenzahl's *Environment*, 7th Edition, is intended as an introductory text for undergraduate students, both science and nonscience majors. Although relevant to all students, *Environment*, 7th Edition is particularly appropriate for those majoring in education, journalism, government and politics, and business, as well as the traditional sciences. We assume that our students have very little prior knowledge of environmental science. Important ecological concepts and processes are presented in a straightforward, unambiguous manner.

All of the chapters have been painstakingly researched, and extraordinary efforts have been made to obtain the most recent data available. Both instructors and students will benefit from the book's currency because environmental issues and trends are continually changing.

Environment, 7th Edition, integrates important information from many different fields, such as biology, geography, chemistry, geology, physics, economics, sociology, natural resources management, law, and politics. Because environmental science is an interdisciplinary field, this book is appropriate for use in environmental science courses offered by a variety of departments, including (but not limited to) biology, geology, geography, and agriculture.

Use of an Effective Learning System in *Environment*, 7th Edition

Learning environmental science is a challenging endeavor. A well-developed pedagogical plan that facilitates student mastery of the material has always been a hallmark of *Environment*. The 7th Edition has continued to refine the **learning system** to a higher, more effective level. Pedogogical features in this seventh edition include:

Chapter Introductions illustrate certain concepts in the chapter with stories about some of today's most pressing environmental issues.

World View and Closer to You reminders at the end of each chapter's introduction direct students to visit www.wiley.com/college/raven where they can watch, read, and listen to **local and global news stories** relating to a chapter. **Suggested Reading** lists for each chapter are also available online to provide current references for further learning.

Learning Objectives at the beginning of each section head indicate in behavioral terms what the student must be able to do to demonstrate mastery of the material in the chapter.

Review Questions at the end of each section give students the opportunity to test their comprehension of the learning objectives.

EnviroNews features provide additional topical material about relevant environmental issues.

NEW EnviroNews on Campus report on recent campus and student efforts to improve the environment.

Meeting the Challenge boxes profile environmental success stories.

You Can Make a Difference boxes suggest specific courses of action or lifestyle changes students can make to improve the environment.

Tables and Graphs, with complete data sources cited at the end of the text, summarize and organize important information.

Marginal Glossaries, located within every chapter, provide handy definitions of the most important terms.

Case in Point features offer a wide variety of in-depth case studies that address important issues in the field of environmental science.

NEW Energy and Climate Change is a new, special chapter feature in this edition which relates energy and/or climate change to the topics in each chapter. This feature is easy to locate because it has an icon—a compact fluorescent light bulb superimposed over the sun. This icon also appears in the body of each chapter, wherever energy and climate change are discussed.

Review of Learning Objectives with Key Terms restate the chapter learning objectives and provide a review of the material presented. Boldfaced selected key terms, including marginal glossary terms, are integrated within each summary, enabling students to study vocabulary words in the context of related concepts.

Critical Thinking and Review Questions, many new to this edition, encourage critical thinking and highlight important concepts and applications. At least one question in each chapter provides a systems perspective; **NEW** another question relates climate and energy to the chapter. **NEW** visual questions have been added to each chapter.

Take a Stand features appear at the end of every chapter and ask students to enter into a debate about an issue or controversy from the chapter. Students then visit our **web site** to find links for researching the situation and tools for organizing their arguments.

The **Appendices** at the end of the book include information on Basic Chemistry; Graphing; Models and Modeling; Units of Measure; and Abbreviations, Formulas, and Acronyms.

The ***2008 World Population Data Sheet***, provided by the Population Reference Bureau, is folded into the text (inside the back cover) and is intended to be pulled out for classroom use. Chapter 8 provides a student assignment of population questions based on the data sheet.

Updated and Expanded Art Program of *Environment*, 7th Edition

We have continued to enhance the 7th Edition visually with an art program that reinforces and expands concepts discussed in the text. Numerous photographs and cartoons elaborate relevant issues and add visual detail. Area maps feature insets of hemispheric locator maps. Examples of new line art include Figures 1.7 (ecological footprints); 3.7 (relationship between photosynthesis and cellular respiration); 4.5 (connections between acorns and Lyme disease); 5.20 (structure of a hurricane); 6.26 (map of national marine sanctuaries); 8.9 (metapopulations); 9.9 (graph of contraceptive use and TFR); Chapter 10 unnumbered figure (graph of projected CO_2 emissions with different levels of urbanization in India); 11.2 (energy flow diagram for US 2007 energy use); Chapter 15 unnumbered figure (pie chart on soil and agriculture); 16.11 (depletion times for nonrenewable resources); 17.1 (levels of biodiversity); 19.12 (environmental effects of industrialized agriculture); 21.11 (changes in plant hardiness zones); 24.8. (energy savings for recycled bottles and cans).

Major Changes in the Seventh Edition

A complete list of all changes and updates to the 7th Edition is too long to fit in the Preface, but several of the more important changes to each chapter follow:

Chapter 1, Introducing Environmental Science and Sustainability, has a new chapter introduction on energy and climate.

In **Chapter 2, Environmental Laws, Economics, and Ethics,** environmental policies were updated through the early Obama administration.

Chapter 3, Ecosystems and Energy, has an expanded discussion of why organisms do not refute the second law of thermodynamics.

A new EnviroNews on colony collapse disorder in bees is in **Chapter 4, Ecosystems and Living Organisms.**

Chapter 5, Ecosystems and the Physical Environment, has a new chapter introduction on the 2008 earthquake in China.

A new end-of-chapter paragraph on climate change and dissolved oxygen in the ocean appears in **Chapter 6, Major Ecosystems of the World.**

A new table of 10 World Health Organization Facts on Global Burden of Disease was added to **Chapter 7, Human Health and Environmental Toxicology.**

Throughout **Chapter 8, Population Change,** human population data, including all graphs and tables, are updated. Chapter 8 also has a new EnviroNews on immigration to Canada.

A new Meeting the Challenge box on The Poverty Action Lab was added to **Chapter 9, Addressing Population Issues.**

Chapter 10, The Urban World, has a new end-of-chapter paragraph on energy, climate change and vulnerable cities.

A new policy section in **Chapter 11, Fossil Fuels,** includes a new table comparing the advantages and shortcomings of a variety of energy sources.

Chapter 12, Nuclear Energy, has a new EnviroNews on the Megatons to Megawatts program.

Chapter 13, Renewable Energy and Conservation, contains a new section on future power sources for vehicles.

A new Case-in-Point on the floods of 2008 was added to **Chapter 14, Water: A Limited Resource.**

Chapter 15, Soil Resources, has a new end-of-chapter paragraph on energy, climate change, and agricultural soil erosion.

Chapter 16, Mineral Resources, now includes the rock cycle.

Chapter 17, Biological Resources, contains a new chapter introduction on tigers.

Chapter 18, Land Resources, includes a new end-of-chapter paragraph on energy, climate, and deforestation of the Amazonian rain forest.

Coverage of world food security was expanded in **Chapter 19, Food Resources,** including a new table.

Chapter 20, Air Pollution, has a new Meeting the Challenge on Low Carbon Fuel Standards.

Chapter 21, Global Climate Change, contains an updated section on climate change and disease, including a new table based on a 2008 paper on climate change and disease in North America.

Chapter 22, Water Pollution has a new chapter opener on the December 2008 Tennessee coal ash spill.

A new You Can Make a Difference on Controlling Household Pests is included in **Chapter 23, Pest Management.**

The section on phytoremediation was expanded and updated in **Chapter 24, Solid and Hazardous Wastes.**

Chapter 25, Tomorrow's World, has a new end-of-chapter paragraph on energy, climate, and environmental diplomacy.

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NEW • **Energy and Climate Change Video** This news video component links the topics of the Energy and Climate Change feature to the broader world enabling students to see the both the broad reach of climate change as well as local consequences.

- **EarthNews Radio.** A collection of MP3 news audio clips produced specifically for Wiley environmental science texts by the Environmental News Network. These clips provide students with engaging discussion by many leading scientists discussing pressing environmental concerns. Each clip is accompanied by questions written by Joy Sales Colquit which can be assigned in *WileyPLUS*. Students may also download the clips and listen to them via iPods or other MP3 players.
- **Animations.** Select text concepts are illustrated using flash animation for student self-study or classroom presentation.

- *WileyPLUS* includes many opportunities for self-assessment linked to the relevant portions of the text. Students can take control of their own learning and practice until they master the material.

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NEW • **Energy and Climate Change Video Lecture Launchers.** This news video component links the topics of the Energy and Climate Change feature to the broader world enabling students to see the both the broad reach of climate change as well as local consequences. Each news video is accompanied by contextualized commentary and questions written by Patricia Mynster, University of Nevada, Las Vegas, which can be assigned in *WileyPLUS*.

- **Test Bank** by David Gillette and Jeff Wilcox of University of North Carolina, Asheville is available on both the instructor companion site and within Wiley PLUS. Containing approximately 60 multiple choice and essay test items per chapter, this test bank offers assessment of both basic understanding and conceptual applications. The *Environment, 7/e* Test Bank is offered in two formats: MS Word files and a Computerized Test Bank. The easy-to-use test-generation program fully supports graphics, print tests, student answer sheets, and answer keys. The software's advanced features allow you to create an exam to your exact specifications.
- **Instructor's Manual** originally by our co-author, David Hassenzahl, University of Nevada-Las Vegas and revised by Jody Terrell, Texas Woman's University is available on both the instructor companion site and within *WileyPLUS*. The Instructor's Manual now provides over 90 creative ideas for in-class activities. Also included are lecture outlines prepared by Joy Sales Colquitt and answers to all End-of-Chapter and Review Questions prepared by Jessica O'Leary.
- **All Line Illustrations and Photos** from *Environment 7/e*, in jpeg files and PowerPoint format are available both on the instructor companion site and within *WileyPLUS*.
- **Biology Visual Library** containing all of the line illustrations in the textbook in jpeg format, as well as access to numerous other life science illustrations from other Wiley texts is available in *WileyPLUS* and on the instructor companion site.
- **PowerPoint Presentations** by Elizabeth Johnson, Post University are tailored to *Environment 7e*'s topical coverage and learning objectives. These presentations are designed to convey key text concepts, illustrated by embedded text art. An effort has been made to reduce the number of words on each slide and increase the use of visuals to illustrate concepts. Available on the instructor companion site and within *WileyPLUS*.
- **Personal Response System** questions by Peter Van Walsum of University of Maine are specifically designed to foster student discussion and debate in class. Available on the instructor companion site and within *WileyPLUS*.
- **Animations.** Select text concepts are illustrated using flash animation for student self-study or classroom presentation.

Book Companion Site

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For Students

- World View and Closer to You news stories
- Quizzes for student self-testing authored by Blase Maffia, University of Miami
- Biology NewsFinder; Flash Cards; and Animations
- Authored by Chris Migliaccio of Miami-Dade Community College-Wolfson Campus and Elaine Hanford of Colin County Community College. Quantitative and Essay Questions, Take a Stand (described above) and Useful Website Links.

For Instructors

- Biology Visual Library; all images in jpg and PowerPoint formats.
- Instructor's Manual; Test Bank; Lecture PowerPoint Presentations.

Instructor Resources are password protected.

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THE PROFESSIONAL ENVIRONMENT

The success of *Environment*, 7th Edition is due largely to the quality of the many professors and specialists who have read the manuscript during various stages of its preparation and provided us with valuable suggestions for improving it. In addition, the reviewers of the first six editions made important contributions that are still part of this book.

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About the Authors

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Dr. Raven is a Trustee of the National Geographic Society and is a Past President of the American Association for the Advancement of Science. He is the recipient of numerous prizes and awards, including the prestigious National Medal of Science in 2001, the highest award for scientific accomplishments in this country; Japan's International Prize for Biology; the Environmental Prize of the Institut de la Vie; the Volvo Environment Prize; the Tyler Prize for Environmental Achievement; and the Sasakawa Environment Prize. He also has held Guggenheim and MacArthur fellowships.

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During her career as a professional science writer, Dr. Berg has authored or coauthored several leading college science textbooks. Her writing reflects her teaching style and love of science.

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DAVID M. HASSENZAHL is an internationally recognized scholar of risk analysis. His research focuses on incorporating scientific information and expertise into public decisions, with particular emphasis on the management, interpretation, and communication of uncertainty. Dr. Hassenzahl has spent the past two decades addressing environmental management from a systems perspective on subjects as diverse as nuclear waste, climate change, toxic chemicals, and public health. He holds a B.A. in Environmental Science and Paleontology from the University of California at Berkeley, and a Ph.D. in Science, Technology and Public Policy from Princeton University's Woodrow Wilson School of Public and International Affairs.

Dr. Hassenzahl is the Founding Dean of the School of Sustainability and the Environment at Chatham University. He is widely recognized for his environmental educational efforts, and has received the Society for Risk Analysis Outstanding Educator Award and the UNLV Foundation Distinguished Teaching Award. He serves on the Council of the Society for Risk Analysis and the Steering Committee of the recently established Association of Environmental Studies and Sciences. Prior to his academic career, Dr. Hassenzahl worked in the private sector as an environmental manager at a pulp and paper mill, and in the public sector as an inspector for the (San Francisco) Bay Area Air Quality Management District.

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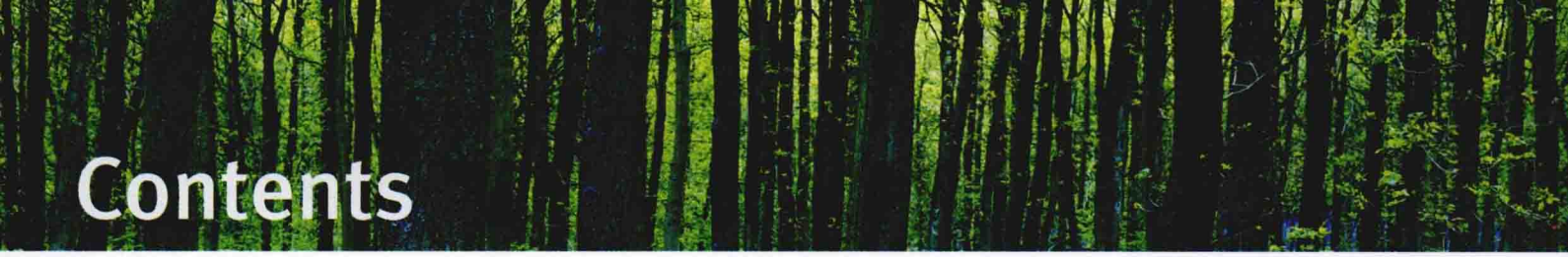

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