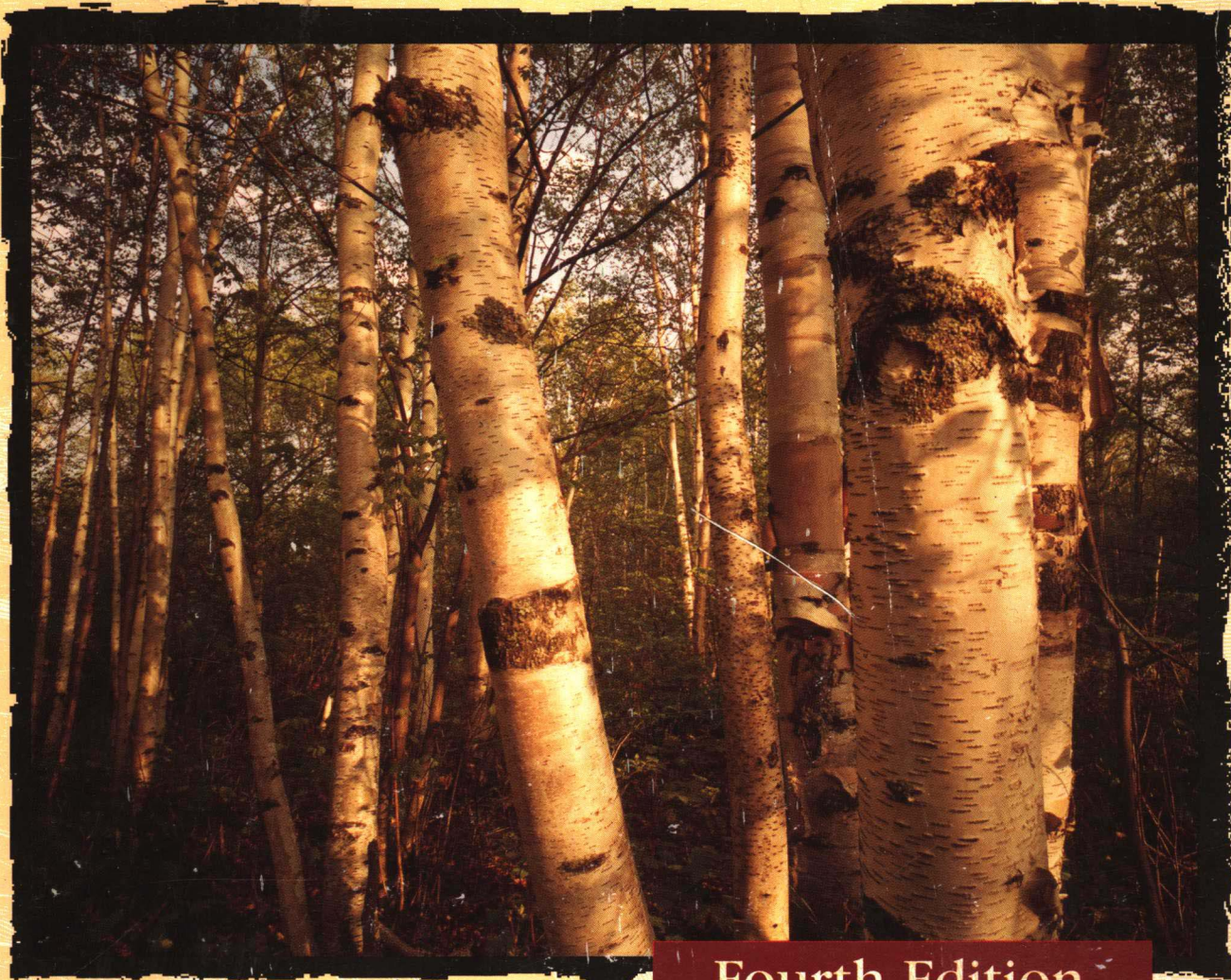


ENVIRONMENTAL SCIENCE

A Study of
Interrelationships

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Fourth Edition

Eldon D. Enger
Bradley F. Smith

ENVIRONMENTAL SCIENCE

A Study of
Interrelationships

Fourth Edition

Eldon D. Enger

Delta College

Bradley F. Smith

Delta College



Wm. C. Brown Publishers

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PREFACE

The study of environmental science is interdisciplinary. Because it is a broad area of study, it is important to develop its many aspects simultaneously, so that the reader may acquire a unified understanding of environmental issues and concerns.

Most environmental issues are best understood when historical background is provided and political, economic, and social implications are integrated with purely scientific information. This text thoroughly explores all facets of environmental issues and provides a comprehensive, readable, and objective treatment of this complex field. The authors have diligently avoided the inclusion of personal biases and fashionable philosophies.

Environmental Science: The Study of Interrelationships is designed for a one-semester, introductory course. Students from a wide range of disciplines will find it informative and interesting. The text is not a catalog of facts; appropriate facts are used to develop concepts, and concepts are carefully and effectively exemplified. The concept of interrelatedness is central to the text; understanding this concept will enable students to grow in their capacity for intelligent environmental decision making.

Organization and Content

This book is divided into five parts and twenty chapters. It is organized to provide an even and logical flow of concepts and to treat this complex field in a clear and thorough manner.

Part 1 establishes the theme of the book in chapter one by presenting the complexity of interrelations inherent in dealing with the human use of the Great Lakes. Many different constituencies use this tremendous resource, and in so doing often infringe on the desires of others. Chapter two broadens the philosophical base needed to examine environmental issues by discussing various ethical and moral stands that people take regarding environmental issues.

Part 2 develops the ecological principles that are basic to an understanding of environmental interactions and the flow of matter and energy in ecosystems. All living systems can be described in terms of the flow of energy through them. The efficiency of energy flow and the intricacies of interorganism interaction are developed, as is the creative process of natural selection. Principles of population structure and organization are also developed in this section, with particular attention being paid to the implications of these principles to human population problems.

Part 3 focuses on energy. A major emphasis is on the historically important fossil fuels that have been responsible for the development of the major economies of the world. Because of the current concerns about the role nuclear power should play in the energy equation of developed nations, the topic of nuclear power is covered in detail.

Part 4 focuses on how human use of the natural world has resulted in changes in natural ecosystems. The historical development of human effects on major ecosystems and types of organisms is presented. Land, water, and soil use practices are major topics. Because of the heavy use of pesticides in agriculture, this topic is also covered in this section.

Part 5 deals with major types of pollution and the economic, political, and risk analyses involved in determining government policy. Air pollution, solid waste, and hazardous and toxic wastes are covered in this section.

New to This Edition

Several organizational and content changes have been made in this edition.

1. Chapter 2, **Environmental Ethics**, has been substantially rewritten to include a more global perspective and to clarify material in previous editions of this text.
2. Chapter 16, **Risk and Cost: Elements of Decision Making**, is a new chapter that highlights risk analysis and cost-benefit analysis as it applies to environmental problems. It also discusses the difference between real and perceived risk and the importance of the perceptions of the public in formulating environmental policy.
3. Chapter 18 is a new chapter on solid waste, which deals with methods of disposal, source reduction, and recycling.
4. Chapter 20, **Environmental Policy and Decision Making**, is completely rewritten to emphasize changes in environmental policy between the two Earth Days in North America and other parts of the world, and the changes that seem to forecast the nineties as an environmental decade.
5. Two chapters on land-use planning issues have been consolidated into one chapter.
6. Two chapters on water-use issues have been consolidated into one chapter.

7. Fifteen new boxes have been added including: Chief Seattle's lament, the periodic table of elements, the northern spotted owl, the Greens, and the alar controversy.
8. Since the text has been produced in a full-color format, all illustrations have been reevaluated and most have been changed to reflect the addition of color.
9. All data have been updated to include the most recent information available, considering the rapid rate of change in this field.

Special Features and Learning Aids

1. Each of the five parts of the text begins with an **introduction** that places the upcoming chapters in context for the reader by recalling previously discussed material and by describing the organization of the chapters to come.
2. Each chapter begins with a set of learning **objectives**, an **outline**, a list of **key terms**, and a **conceptual diagram**—all of which give the student a broad overview of the interrelated forces that are involved in the material to be discussed. The student is encouraged to refer to these resources while reading and reviewing the chapter.
3. Chapters conclude with a **case study**, **summary**, and **review questions**. The case studies have been specifically selected to allow the reader to apply the chapter concepts to actual situations. Review questions are related to the chapter objectives, and thus serve to reinforce understanding of basic concepts and principles.
4. To dramatize and clarify text material, each chapter includes a number of **tables**, **charts**, **graphs**, **maps**, **drawings**, or **photographs**. Each illustration has been carefully chosen to provide a pictorial image or an organized format for showing detailed information, which helps the reader comprehend the chapter material.
5. Each chapter also includes one or more **boxed items**. These point out the far-reaching effects of environmental forces and exemplify the interrelationships

that are central to understanding environmental issues. They are intended to interest the reader and reflect current concerns related to chapter content.

6. The text concludes with a **list of active environmental organizations**, a **metric conversion chart**, **suggested readings**, a thorough **glossary**, and an **index**.

Useful Ancillaries

An **instructor's manual** accompanies the text. It includes chapter outlines, objectives, and key terms; a range of test and discussion questions; suggestions for demonstrations; and suggestions for audiovisual materials and other teaching aids. The Instructor's Manual also provides **additional case studies** for instructors who wish to use additional concrete examples of how the concepts in the chapter can be applied to the real world.

2. A set of **fifty-one transparencies** is also available to users of the text. The transparencies duplicate text figures that clarify essential ecological, political, economic, social, and historical concepts.
3. A completely revised **Laboratory Manual** is available that features thirty exercises on environmental topics. The manual can be adapted to a variety of situations, including rural and urban, northern and southern, desert and forestland, coastal and inland. A **Laboratory Resource Guide** can also be ordered that specifies procedures, objectives, and equipment for each exercise. For courses using computers, a software program on the chi-square is also available in IBM (ISBN 14176-01).
4. *You Can Make a Difference* by Judith Getis is a practical guide for students and consumers to heighten environmental awareness and to encourage participation as a traveler on the Spaceship Earth.
5. **WCB TestPak** rounds out the supplementary materials. It is a computerized testing service available to adopters of this text. It provides either a call-in/mail-in testing service, or, if you have access to an Apple® IIe or IIc, or to an IBM® PC, you can receive a complete test-item file on a microcomputer diskette.

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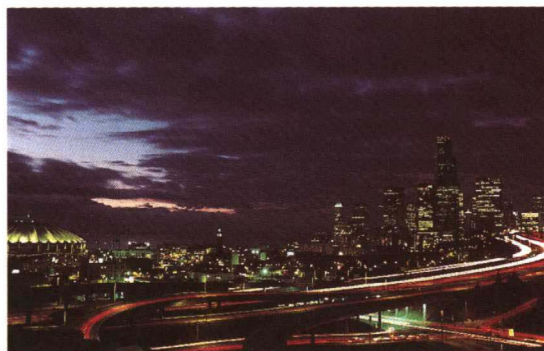
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PART ONE

Interrelatedness



Environmental science has evolved as an interdisciplinary study that seeks to describe problems caused by our use of the natural world. In addition, it seeks some of the remedies for these problems. An understanding of three major areas of information is necessary to deal with this complex topic. First, it is important to understand the natural processes (both physical and biological) that operate in the world. Second, it is important to appreciate the role that technology plays in our society and its capacity to alter natural processes as well as solve problems caused by human impact. Third, the complex social processes that are characteristic of human populations must be

understood and integrated with knowledge of technology and natural processes to fully appreciate the role of the human animal in the natural world.

Chapter 1 deals with a specific issue that illustrates how all of these areas are interrelated. This chapter introduces the central theme of interrelatedness by analyzing the competing demands placed on a unique natural resource—the Great Lakes. Chapter 2 discusses the differences that can exist between individuals in a society and the different behaviors exhibited, depending on whether the person is acting as an individual, as a part of a corporation, or as a part of government.

CHAPTER ONE

The Great Lakes: A Study of Interrelationships

Objectives

After reading this chapter, you should be able to:

Understand why environmental problems are complex and interrelated.

Realize that environmental problems are tied to social, political, and economic issues.

Understand that acceptable solutions to environmental problems are not often easy to achieve.

Understand that all organisms have an impact on their surroundings.

Appreciate that individuals view environmental problems from different perspectives.

Understand what is meant by an ecosystem approach to environmental problem solving.

Chapter Outline

The Ecosystem Approach

Setting the Stage

The Formation of the Great Lakes

Competing Uses and Demands on the Great Lakes

Industrial Uses

Box 1.1 Atmospheric Deposition Loadings of Toxic Chemicals to the Great Lakes

Shipping

Agricultural and Other Land-Use Activities

Recreation

The Decision Makers

Box 1.2 Saginaw Bay Remedial Action Plan

Box 1.3 Foreign Organisms Invading the Great Lakes