

Environmental Science

The Natural Environment and Human Impact

Andrew R.W. Jackson & Julie M. Jackson

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Environmental Science

The Natural Environment and Human Impact

second edition

Andrew R. W. Jackson & Julie M. Jackson

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Preface to the second edition

Environmental science is a rapidly developing field. Since the publication of the first edition of this text, in 1996, a significant number of new environmental issues have come to the fore. This new edition of *Environmental Science* therefore includes a sizeable amount of new and topical material. Most notably, this takes the form of a new chapter (Chapter 10) that examines the exploitation of biological resources, together with four new case studies covering BSE, genetically modified crops, arsenic contamination of drinking water in the Ganges Delta, and the problems surrounding the disposal of radioactive waste. New material is also incorporated within other chapters, for example the El Niño–Southern Oscillation (ENSO), described in Chapter 4, and endocrine-disrupting substances, discussed in Chapter 14.

Additionally, other areas that were covered in the first edition have developed significantly since 1996 and consequently needed reappraisal. For example, the Montreal Protocol has been strengthened over recent years and its implementation is now resulting in noticeable effects (Chapter 15).

We also took the opportunity, afforded to us by the preparation of a new edition, to improve the overall accessibility of the book. We have sought to achieve this by incorporating a number of new features. These include learning objectives at the start of each chapter, colour plates, a glossary, a *Lecturers' guide* available to adopters from the publishers, and a supporting website (<http://www.booksites.net>).

ARW Jackson
JM Jackson
December 1999

Preface to the first edition

Modern techniques of environmental science allow us to explore our surroundings in ways that were unimaginable until relatively recently. These explorations have not only revealed the natural world in ever finer detail, they have also provided evidence to suggest that the activity of humans is, for the first time, causing changes to the environment on a global scale. Heightened interest in the nature and quality of our surroundings is reflected in the growing amount of published work concerning environmental issues, both in the press and in more specialist literature.

This book was written to provide a clear and authoritative introductory environmental science text. It strives to bridge the gap between the popularist and specialist environmental publications. It introduces the reader to the basic concepts and vocabulary necessary to explore complex environmental issues and problems.

Environmental science will primarily be of use to first-year undergraduate students of the environmental sciences, including environmental biology and environmental chemistry. However, it will also serve as a reference text for students of related disciplines such as environmental studies and environmental management. The text is constructed in a concise and coherent manner, making extensive use of boxed material, both to explain basic theory and to provide illustrative examples. In order to further enhance the student's learning experience, end of chapter problems and a selection of environmental case studies are included. The latter are intended to provide a starting point for further, independent, investigation into the environmental issues raised.

The book is divided into two main parts: **The Natural Environment** (Chapters 1–10) and **Human Impact on the Natural Environment** (Chapters 11–16). In the first of these, the nature and chemical behaviour of matter is explored, as are the major features and processes of the lithosphere, hydrosphere, biosphere and atmosphere, and the interactions between them. In the second part of the text, the impact of human activities upon the environment, through the exploitation of natural resources and the production of pollutants, is explored in depth. Attention is given in the final chapter to the issue of waste management.

Environmental science is concerned with the presentation of factual information and its scientific interpretation. It does not attempt to deal with either the ethical or legal problems associated with environmental issues. While techniques of environmental management are introduced where relevant in the latter part of this text, this is not a major theme of the book. Readers interested in this aspect of environmental science may wish to read Timothy O'Riordan's book *Environmental Science for Environmental Management* (second edition, Prentice Hall, 2000).

Preface to the first edition

We would like to take this opportunity to explain some of the policies that we have adopted concerning specific units, nomenclature and symbolisms. When writing this book we have used SI units, except where other units are in more common usage in the general literature of environmental science. Conversion factors between SI units and their non-SI equivalents are given in Appendix 2. When referring to specific organisms, it has been our policy to refer to them by their common names, citing their Linnean Latin binomial at first mention only. When using half-cell equations we have represented oxidations as such, rather than as reverse reductions. We have done this to avoid the necessity for the subtraction of half-cell equations when generating full-cell equations. In accordance with convention, we use only reduction potentials when calculating cell potentials. In accordance with the convention used in physical chemistry, units and multiples appear after a solidus (/) in the column headings of tables and the labels on the axes of graphs.

ARW Jackson

JM Jackson

April 1995

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A special mention must be made of our family for their support and encouragement. In particular, we would like to thank our sons, Tom and Hugh, for their patience and understanding during the writing of this new edition.

ARW Jackson
JM Jackson
December 1999

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Case Study 7

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Introduction

Environmental science is the systematic study of the natural and man-made world. It is now a major discipline, reflecting our growing concern about the impact of human activity on the natural world.

The environment may be conceptualised as being composed of a number of interconnected processes and phenomena. These include the formation of rocks, the climate system, the cycling of biologically important elements and the interactions between organisms and their surroundings.

In part, environmental science involves the identification, measurement and classification of these processes and phenomena. Importantly, it also encompasses our attempts to rationalise their existence and to predict how they will alter in the future. Environmental science therefore, like all other sciences, involves detection, classification, measurement, the establishment of experimentally verified laws by hypothesis formulation and testing, and the generation of predictive models.

Environmental science is of importance, not only because it informs us about the world in which we live, but also because it enables us to address more effectively many of the pressing issues that confront the modern world. For this reason, environmental science is increasingly seen as a vital tool in establishing the ground rules by which the environment may be more effectively managed in the future.

The first part of this book (Chapters 1–9) explores the major attributes of the environment in the absence of human activity. It is largely devoted to a detailed examination of the salient characteristics and interactions of the lithosphere (rocks), hydrosphere (water), biosphere and atmosphere (Chapters 3–9). In recognition of the varied backgrounds of the readership, the basic scientific concepts that are required for an understanding of the chemical processes that are central to the environment are set out in Chapters 1 and 2.

The first nine chapters of the book not only describe the natural environment, they also form a firm foundation on which the second part of the book is built. Within the second part, the human impact on the natural environment is examined. In Chapters 10–13, the nature of both finite and renewable resources is explored, together with the processes and patterns of their exploitation. Specifically, we examine biological resources, agricultural land use, mineral extraction and energy production. The consequences of this exploitation are reviewed both within Chapters 10–13 and in Chapters 14 and 15 where the major types of water and atmospheric pollution are described. This part of the book closes with an introduction to the principles and practice of waste management (Chapter 16).

Introduction

Within this book, the reader will find scientific explanations of the causes and potential ramifications of the major environmental issues that currently face us. For example, in Chapter 15, we explore the greenhouse effect and climate change, stratospheric ozone depletion and the phenomena of acid rain and smog. The environmental impact of agricultural land use, including deforestation, salinisation, soil erosion and desertification, are covered in Chapter 11. Also, the importance of the world's biological resources and the consequences of their exploitation are examined in Chapter 10.

This book aims to present a dispassionate, objective and authoritative introductory review of both the natural environment and the impact of human activity on it. It is designed to introduce the reader to the key concepts and vocabulary of environmental science. This learning experience is reinforced by the inclusion of boxes that expand on and illustrate the basic concepts introduced in the text. For ease of access, each of these boxes is assigned to one of the following categories: mini case studies, tool boxes, or further information boxes. To consolidate understanding, each chapter commences with a statement of objectives and closes with a series of problems. Topical case studies follow each of the chapters in the second part of the book (Chapters 10–16). These are designed to stimulate the reader to further investigate and evaluate specific environmental issues, thereby facilitating the development of independent study. A glossary is provided at the end of the text that contains a selection of key terms with which the reader may not be familiar. Additionally, a wider range of key terms is highlighted in the index, directing the reader to those parts of the main body of the text where the terms are either defined or described.

This text is primarily designed for first-year undergraduates of the environmental sciences, including environmental chemistry and environmental biology. However, it will also be of value as a source of background material to students of related disciplines, such as environmental management or environmental studies.

Contents

	Preface to the second edition	xv
	Preface to the first edition	xvii
	Acknowledgements	xix
	Introduction	xxiii
Part One	THE NATURAL ENVIRONMENT	
	The physical environment	1
Chapter 1	The nature and organisation of matter	3
	Chapter objectives	3
	Introduction	3
1.1	Atoms and elements	4
1.2	Ions and ionic compounds	5
1.3	Molecules and covalent compounds	7
1.4	Valency and the Periodic Table of the elements	13
1.5	Oxidation states	13
1.6	Compounds, mixtures, chemical species and chemical reactions	16
1.7	The atomic nucleus and nuclear reactions	20
1.8	Summary	24
1.9	Problems	25
1.10	Further reading	26
Chapter 2	Energy flow, equilibrium and change	27
	Chapter objectives	27
	Introduction	27
2.1	The laws of energy flow	28

2.2	Dynamic equilibrium and spontaneous change	36
2.3	Chemical kinetics	41
2.4	Summary	44
2.5	Problems	45
2.6	Further reading	46
Chapter 3	The Earth's surface	47
	Chapter objectives	47
	Introduction	47
3.1	The crust	47
3.2	Soils	55
3.3	The hydrosphere	67
3.4	Summary	73
3.5	Problems	74
3.6	Further reading	75
Chapter 4	The atmosphere	77
	Chapter objectives	77
	Introduction	77
4.1	The structure and composition of the atmosphere	77
4.2	Weather and climate	83
4.3	Summary	101
4.4	Problems	103
4.5	Further reading	104
Chapter 5	Bioelement cycling	105
	Chapter objectives	105
	Introduction	105
5.1	The oxygen cycles	106
5.2	The carbon cycle	110
5.3	The nitrogen cycle	112
5.4	The phosphorus cycle	116
5.5	The sulfur cycle	118
5.6	Sodium, potassium, calcium and magnesium cycles	121
5.7	Summary	123

5.8	Problems	124
5.9	Further reading	125
	The biological environment	127
Chapter 6	The cellular basis of life	129
	Chapter objectives	129
	Introduction	129
6.1	Prokaryotes and eukaryotes	130
6.2	A comparison between the ultrastructure of eukaryotic plant and animal cells	131
6.3	Mitochondria and the process of cell respiration	131
6.4	Chloroplasts and the process of photosynthesis	134
6.5	The structure of DNA and RNA	137
6.6	Protein synthesis	138
6.7	Chromosomes and cell division	140
6.8	The study of genetics (heredity)	142
6.9	Recombinant DNA technology	145
6.10	Summary	148
6.11	Problems	148
6.12	Further reading	149
Chapter 7	Population dynamics	151
	Chapter objectives	151
	Introduction	151
7.1	Population growth	152
7.2	Population regulation	156
7.3	Human population dynamics	163
7.4	Summary	168
7.5	Problems	168
7.6	Further reading	169
Chapter 8	Biological communities	171
	Chapter objectives	171
	Introduction	171
8.1	Interactions between species	172
8.2	Natural selection	176

Contents

8.3	Species richness	179
8.4	Ecological succession	182
8.5	Summary	185
8.6	Problems	186
8.7	Further reading	186
Chapter 9	Ecosystems and biomes	187
	Chapter objectives	187
	Introduction	187
9.1	Food chains and food webs	188
9.2	Primary production	190
9.3	Energy flow in ecosystems	195
9.4	Secondary productivity	200
9.5	Decomposition	200
9.6	Ecosystem stability	202
9.7	Terrestrial and aquatic biomes	204
9.8	Summary	214
9.9	Problems	214
9.10	Further reading	215
Part Two	HUMAN IMPACT ON THE NATURAL ENVIRONMENT	
	Natural resources	217
Chapter 10	Biological resources	219
	Chapter objectives	219
	Introduction	219
10.1	The nature of biological resources	220
10.2	The importance of biological resources	220
10.3	Direct damage to biological resources	222
10.4	Introduced species	226
10.5	Habitat degradation, loss and fragmentation	230
10.6	The conservation of biological resources	234
10.7	Summary	238
10.8	Problems	239
10.9	Further reading	239
	Case study 1 Genetically modified (GM) crops	240

Chapter 11	Land utilisation: a focus on agriculture and forestry	243
	Chapter objectives	243
	Introduction	243
11.1	Past patterns of land use	244
11.2	Urban and industrial development	244
11.3	Agriculture	244
11.4	Forestry	250
11.5	The impact of agriculture on the environment	252
11.6	Summary	256
11.7	Problems	258
11.8	Further reading	258
	Case study 2 BSE and the British beef crisis	259
Chapter 12	The major extractive industries	263
	Chapter objectives	263
	Introduction	263
12.1	Metals	264
12.2	Building materials	267
12.3	Peat	270
12.4	Fossil fuels	271
12.5	Water	274
12.6	Summary	276
12.7	Problems	279
12.8	Further reading	279
	Case study 3 Arsenic in drinking water in West Bengal and Bangladesh	280
Chapter 13	Energy production	283
	Chapter objectives	283
	Introduction	283
13.1	Energy production and consumption	284
13.2	Sources of energy	286
13.3	Renewable energy	297
13.4	Energy conservation	302
13.5	Summary	302