INTRODUCING PHYSICAL GEOGRAPHY



Second Edition

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Second Edition

Alan Strahler Boston University

Arthur Strahler

Columbia University (emeritus)



John Wiley & Sons, Inc.

New York • Chichester • Weinheim • Brisbane • Singapore • Toronto

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This book was set in New Baskerville by HRS Electronic Text Management and printed and bound by Von Hoffmann Press, Inc. The cover was printed by The Lehigh Press, Inc. The color separations were prepared by Lehigh Press Colortronics.

This book is printed on acid-free paper.

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Library of Congress Cataloging in Publication Data:

Strahler, Alan H.

Introducing physical geography / Alan Strahler, Arthur Strahler. — 2nd ed.

Э.

CI

Includes index.

ISBN 0-471-14713-3 (pbk. : alk. paper)

1. Physical geography.

I. Strahler, Arthur Newell, 1918–.

II. Title.

GB54.5.S77

1997

97-13431

550-dc21

CIP

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Preface

The world around us is changing quickly, and so is our understanding of how it works. In the four years since the manuscript for the first edition of *Introducing* Physical Geography was completed, the component sciences of physical geography have moved forward significantly. Especially relevant is the progress in achieving a better understanding of the relationships among the many components of the global climate system, as well as a new realization of the importance of human impact on climate. Moreover, new environmental events, from earthquakes to hurricanes, have captured the public's attention and can now provide an updated context for demonstrating the principles of physical geography to beginning students and relating them to their life experiences. Accordingly, the primary goal of our Second Edition is to incorporate these new developments in science as well as appropriate references to recent, newsworthy environmental events.

The second goal of our revision of *Introducing Physical Geography* is to enhance our learning environment by making the text more effective in communicating the concepts of physical geography. To accomplish this goal, we use a visualization strategy. Today's students are accustomed to learning visually and interactively, and our text will be more effective if it helps students visualize the concepts that they are learning. Our visualization strategy is described more fully in a following section.

CONTENT

Introducing Physical Geography has been written for a one-semester or one-quarter course in which a majority of students are nonmajors fulfilling a college science requirement. These students need to learn how to reason logically, to understand the nature of cause and effect, and to become acquainted with fundamental scientific principles. Physical geography can easily provide the context for this learning, and it has the added advantage of being relevant to many aspects of students' everyday experiences. For this audience, the appropriate focus is on the broad concepts of physical geography and their application, and this is the focus we have adopted for this book.

In designing the content of *Introducing Physical Geography*, we have emphasized the standard curriculum for

physical geography that has evolved over the years. The sequence of topics is deliberately conventional and eminently teachable. However, as experienced instructors of physical geography, we know that the conventional curriculum is difficult to cover in a one-semester or one-quarter course. Every instructor has to come to grips with this fact. Our approach in this book has been to provide a balanced level of coverage of the field, so that when an instructor chooses to emphasize a particular area of science—climatology or geomorphology, for example—a firm foundation is there. If a topic is deemphasized, the text will provide a basic level of understanding that can stand without lecture support.

Physical geography is a broad field that draws from many component sciences. In developing the topical coverage for *Introducing Physical Geography*, we have had to make difficult decisions about what to include and what to omit. We have constantly asked, "Is this topic really necessary? Do other topics depend on it? Is it essential for understanding the big picture? Will it be useful and important to a nonscience major a year from now?" In producing a book of reasonable size and length, we have not had the luxury of including topics and concepts that are secondary to the book's main mission.

Second Edition Changes

In preparing the second edition, faculty and student reviewers greatly helped us to fine tune our content and presentation. Some of the more significant changes made in response to reviewers are:

- Revising and editing chapter opening features (*Putting You in the Picture* essays) to be more focused and consistent from chapter to chapter.
- Moving text coverage of air pollution into a multipage Eye on the Environment feature within Chapter 4 and adding a new Eye on the Environment feature on Hurricane Andrew in Chapter 6.
- Enlarging global maps in Chapters 7, 8, and 9 to show more detail.
- Broadening Chapter 8 to focus on global ecosystems, extending our treatment of global vegetation to include basic concepts of plant and animal ecology. Biome descriptions now include examples of typical or characteristic fauna.

- Revising Chapters 10 and 11 to provide a better flow of topics in basic geology and plate tectonics.
- Adding new material on hotspots, sea floor spreading, and shield volcanoes to Chapter 12, accompanied by a new global map of volcano locations.
- Improving the treatment of aquifers and salt water intrusion in Chapter 14.
- Moving karst and cavern material from Chapter 16 to Chapter 14.
- Improving the art program by making changes throughout the text, including the addition of two new photos of cloud types to Chapter 4, a new mass wasting process diagram to Chapter 13, and a new figure on types of coastlines to Chapter 17. We have also sharpened block diagrams in Chapters 15 and 16.

In addition to these changes, we have also incorporated the latest knowledge in a number of rapidly moving areas of science by

- Updating ozone layer status in the *Eye on the Environment* feature of Chapter 2.
- Updating global temperatures and projections of global warming in Chapter 3 and enhancing material on variability in climate as a result of climate change.
- Updating sea level rise projections in Chapter 3.
- Adding coverage of thermohaline ocean current circulation with text and a new figure in Chapter 5.
- Carrying over new earthquake material on the Northridge and Kobe earthquakes in Chapter 12 from the Update edition.
- Updating material on the stability of the Western Antarctic Ice Sheet in Chapter 18.
- Updating material on environmental issues and events since the Rio Earth Summit in the Epilogue.

Science News

The Environmental Update Edition of *Introducing Physical Geography*, published in 1996, added an appendix of Science News articles selected for relevance to text topics, and we have retained this popular feature. However, we have selected an entirely new set of 24 features from 1996 and 1997 issues for our Second Edition. The selections are primarily designed to provide the latest information on global change topics, but include items from ecology, plate tectonics, and the human environment as well. They are now specifically keyed to the running text, using an icon and number in the style shown here: SCIENCE NEWS 11

THE LEARNING ENVIRONMENT

Structure

Students need orientation as they read a textbook. Where are we in the scheme of this book? What topics will be covered next? Why are they important? How do they relate to topics that have already been presented? Forty years of classroom lecturing have convinced us of the importance of helping students understand the structure of a course as they learn, and we have carried this idea forward in our Second Edition.

We begin the book with a Prologue, in which the student becomes an astronaut stationed on the moon and embarks on a journey home to earth. On this journey, the student sees the planet at ever-increasing scales, first as a whole, then as a realm of the four great spheres, then as regions differentiated by climate, vegetation, and soils, and finally as a collection of individual landforms as the return spacecraft proceeds to a touchdown. The journey is both a metaphor and model for the learning to come.

We continue the involvement of the student as we open each chapter with a feature entitled *Putting You in the Picture*. Rather than simply preview the chapter's contents, this essay personalizes the chapter with an experience or topic that directly involves the student. For example, in Chapter 6 the student reads an account of experiencing Hurricane Andrew as it devastated the South Florida coast in 1992. In Chapter 15, the student is introduced to the erosive power of rivers by riding a raft down the Colorado River through the Grand Canyon. Most of these essays are written in the second person to involve the student more directly.

Communicating the connectivity between topics within and across chapters is essential in guiding the student through the subject matter of physical geography. The first few paragraphs of each chapter are specially written to provide an orientation to the material to come, and transitional paragraphs continue within the text whenever an important new subject begins. To enhance the forward linkages, we provide a brief final section, *A Look Ahead*, that puts the present chapter in perspective and leads into the next one.

Students enjoy learning that their new knowledge is important and useful. To help reinforce text material and provide relevance, we include a short *Eye on the Environment* feature within each chapter. These essays focus the concepts of the chapter on a specific environmental topic. Many are concerned with global climate and climatic change, which is a frequent concern of news and documentary coverage on television and appears often in the popular press.

The book concludes with an Epilogue that raises the environmental implications of the physical geography that the student has learned. In an extended script for a news broadcast from the mid-twenty-first century, students picture how life might change in the future as human impacts continue to reshape our planet. The news broadcast leads into a discussion of the most serious environmental issues facing the human species and the prognosis for the earth's immediate future.

Learning Tools

To help students master text material, we provide a number of learning tools. To build the necessary vocabulary, we have identified the dozen or so key terms that are most important in each chapter with the use of **boldface**. Less important terms are identified in *italics*. All terms are defined in our *Glossary*, which contains over 1000 individual entries and includes many terms that are part of a basic science vocabulary.

As another aid to learning, we have embedded in the text a number of brief key statements that focus on important concepts. They are set apart from the text in a larger type face and marked by color bars for easy identification.

Our suite of end-of-chapter materials is also designed to reinforce key concepts and ideas of the chapter. A summary, *In Review*, covers all the major concepts of the chapter. The list of *Key Terms* gathers together the critical vocabulary of the chapter. *Review Questions* are designed as oral or written exercises that require description or explanation of important ideas and concepts. *Visualizing Exercises* utilize sketching or graphing as a way of focusing attention on key illustrations. Also provided are *A Deeper View* questions that require more synthesis or the reorganization of knowledge in a new context.

VISUALIZATION

Our visualization strategy focuses on helping students form lasting visual images of the processes of physical geography. The strategy involves three components: illustrations, word pictures, and a CD-ROM.

Illustrations and Word Pictures

The art program for *Introducing Physical Geography*, entirely new in the first edition, provides scientific accuracy with visual appeal. It captures the essence of key concepts using both accurate and effective graphics and interesting and attractive photos.

Another important part of the visualization theme is building word pictures that will stay in students' minds, serving as milestones along a journey of discovery. Clear word pictures must be painted to lay out and connect scientific ideas and images and place them in the context of their linkages to other processes and concepts. This involves not only accurate descriptions of processes within the main body of the text, but also virtual images in which the students experience the processes directly. These are present throughout the book, from the astronaut's journey from moon to earth in our Prologue, through the *Putting You in the Picture* essays that open each chapter, to the future news broadcast in our *Epilogue*. Throughout, the idea is to create striking images that will personalize the processes students are studying and connect them to their own lives.

CD-ROM

A vital part of our visualization strategy is to provide a CD-ROM as an integral part of the text. Using this device, we can extend the learning from the textbook into a multimedia environment, drawing on motion, color, and sound to illustrate key concepts and processes. By publishing this book with an integral CD-ROM, we ensure that every student has access to the complete array of learning tools that we have developed for physical geography. The CD-ROM includes four main types of information:

- 13 original animations that enable visualization of key concepts and processes.
- 11 minutes of film and video sequences to show landscape processes in action.
- Over 300 captioned photos from the authors' collections.
- Over 300 graphic art illustrations taken from the text.

By viewing the animations, students can visualize processes that are difficult to describe in words or show with fixed art. Examples include: the revolution of the earth around the sun and the seasons; the Coriolis effect; wave cyclone development; adiabatic heating and cooling; and margins of tectonic plates. A special animation provides an overlay tool for students to inspect and compare patterns of climate, vegetation, and soils for continental-sized regions.

Film and video sequences illustrate the processes of physical geography in action. Examples include: waterfalls; wave action and coastal landforms; volcanoes and their formation; landscapes of plate tectonic margins; and convectional precipitation.

The photos are color slides from the authors' personal collections, each with a caption explaining its content. For ease of use, the slides are keyed to the chapters to which they are most directly related. The graphic art from the text is also presented with captions and figure numbers.

To link the CD-ROM with the text, small icons like the one at the end of this paragraph are placed with the running text and illustration captions in the book. The CD comes complete with viewing software for PCs and Macintoshes and also includes a searchable keyword index tool to help guide users to the materials illustrating specific concepts. Besides providing a student supplement, the CD-ROM is designed to be used by the instructor in computer video-equipped classrooms as a teaching tool.

SUPPLEMENTS

On-Line Study Guide. Students will be able to interact over the Internet with a study guide at any time during the term with the On-Line Study Companion. Each chapter includes practice quizzes; e-mail functionality for sending work to instructors, teaching assistants, and peers; tutorials for selected topics; hot links to current World Wide Web sites; and other Internet services, all designed to make the On-Line Student Companion both a solid study resource and a perfect component of any distance learning or Web-delivered course. The address is: http://www.wiley.com/college/strahler.

Exercise Manual. Written by the textbook authors, Arthur and Alan Strahler, the Exercise Manual builds on the students' knowledge of physical geography developed through class lecture and textbook study and puts this knowledge to use by solving problems based on course topics. It provides all data, figures, and maps needed for the exercises, which are keyed into the parent textbook. An instructor's version of the Exercise Manual provides the answers to all the exercises.

Instructor's Web Resource. Instructors adopting Introducing Physical Geography will be issued a password that will provide access to a wide range of instructional resources on a protected Wiley Web site. These include test banks, chapter outlines, and a Supplements Integrator, a guide to using the Web for active learning in the physical geography course with a chapter-by-chapter list of well-maintained URLs hot-linked to Web sites. The Supplements Integrator cross references for each chapter the resources to which the instructor has access from across our multimedia offerings, including the animations, movies, photos, and drawings on the Visualization CD-ROM; the overhead transparency set; the slide set; and the On-Line Student Companion. The dynamic nature of this site also allows the publisher to post current events, maps, and other news and developments related to physical geography, from Wiley and the authors. The address is: http://www.wiley.com/college/strahler.

Full-color Overhead Transparencies. Over 115 full-color transparencies from the text are provided in a form suitable for projection in the classroom. These illustrations will also be available as slides.

Supplementary Slide Set. Approximately 150 slides of graphic art and photos, some from the authors' personal collections, are available.

ANOTHER TITLE BY THE AUTHORS

Physical Geography: Science and Systems of the Human Environment (Wiley, 1997) provides a more thorough overview of physical geography, emphasizing a systems approach. The organization is slightly different, with global climate expanded to three chapters and with soils and two biogeography chapters concluding the text rather than immediately following global climates. Systems are threaded throughout, with special systems boxes providing examples of the systems approach. The book also includes a sequence of optional quantitative boxes that supplement important concepts with simple formulas and calculations.

ACKNOWLEDGMENTS

The preparation of *Introducing Physical Geography*, Second Edition was greatly aided by the reviewers who read and evaluated the various parts of the manuscript. They include

Tanya Allison, Montgomery College Joseph M. Ashley, Montana State University Roger Balm, Rutgers State University David Bixler, Chaffey Community College Kenneth L. Bowden, Northern Illinois University David Butler, University of North Carolina, Chapel Hill

Les Dean, Riverside Community College Christopher H. Exline, University of Nevada Jerry Green, Miami University Clarence Head, University of Central Florida Peter W. Knightes, Central Texas College Christopher S. Larsen, State University of New York, Buffalo

James F. Petersen, Southwest Texas State University Clinton Rowe, University of Nebraska-Lincoln Carol Shears, Ball State University

Carol I. Zinser, State University of New York, Plattsburgh

We were delighted by the comments we received from our student reviewers at the University of Central Florida: Kevin Chibar, Bryan M. Ciervo, Gerrit A. Lemmen, and Scott Vanderbeck.

We also thank the reviewers who read and evaluated the manuscript for the first edition:

Ted Alsop, Utah State University
Kevin Anderson, Augustana College
Joseph M. Ashley, Montana State University
George Aspbury, Illinois State
David Castillon, Southwest Missouri State University
Randall Cerveny, Arizona State University
Richard Crooker, Kutztown University
Don Gary, Nicholls State University
Roland L. Grant, Eastern Montana College

Maurice Hackett, Southwest Missouri State University Richard Hackett, Oklahoma State University Vance Halliday, University of Wisconsin Peter Herron, University of Calgary Julie Laity, California State University, Northridge Jeffrey Lee, Texas Tech Richard Mackinnon, Allan Hancock College Andrew Marcus, Montana State University Bernard McGonigle, Community College of Philadelphia Marilyn Raphael, University of California at Los Angeles Vatche Tchakerian, Texas A&M University John Watkins, University of Kentucky Jan Westerik, Concord College Kenneth White, Nicholls State University Thomas Wikle, Oklahoma State

We thank David McCracken for his creative and painstaking work on the CD-ROM storyboards, Jerry Shue of The Pennsylvania State University for helping us develop the concepts for the animations and movies, Mary Lee and Sid Nolan of Academic Media Network for their work on the CD-ROM videos, Ed Burke of

I-Media for putting our CD-ROM ideas into action, and Fred Schroyer for his comparative analysis.

It is with particular pleasure that we thank the staff at Wiley for their long hours of careful work in the preparation and production of our *Second Edition*. They include our editor, Nanette Kauffman; our developmental editors Barbara Heaney and Pui Szeto; our newmedia editor, Fadia Stermasi; our photo editor, Kim Khatchatourian; our designer, Harry Nolan; our illustration editor, Edward Starr; our marketing manager, Catherine Beckham; and our supplements editor Barbara Bredenko. Special thanks go to our production editor, Sandra Russell, for keeping us all on track during the complicated job of turning words and sketches into books and CD-ROMs.

Alan Strahler Cambridge, Massachusetts

Arthur Strahler Santa Barbara, California

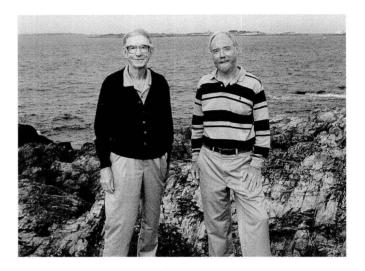
October 1, 1997

About the Authors

ABOUT THE AUTHORS

Alan Strahler (b. 1943) received his B.A. degree in 1964 and his Ph.D degree in 1969 from The Johns Hopkins University, Department of Geography and Environmental Engineering. He has held academic positions at the University of Virginia, the University of California at Santa Barbara, and Hunter College of the City University of New York, and is now Professor of Geography at Boston University. With Arthur Strahler, he is a coauthor of seven textbook titles with six revised editions on physical geography and environmental science. He has also published over 90 articles in the refered scientific literature, largely on the theory of remote sensing of vegetation. He has also contributed to the fields of plant geography, forest ecology, and quantitative methods. His work has been supported by over \$4 million in grant and contract funds, primarily from NASA. In 1993, he was awarded the Association of American Geographers/Remote Sensing Specialty Group Medal for Outstanding Contributions to Remote Sensing.

Arthur Strahler (b. 1918) received his B.A. degree in 1938 from the College of Wooster, Ohio, and his Ph.D. degree in geology from Columbia University in 1944. He was appointed to the Columbia University faculty in 1941, serving as Professor of Geomorphology from 1958 to 1967 and as Chair of the Department of Geology



from 1959 to 1962. He was elected as a Fellow of both the Geological Society of America and the Association of American Geographers for his pioneering contributions to quantitative and dynamic geomorphology, contained in over 30 major papers in leading scientific journals. He is the author or coauthor with Alan Strahler of 16 textbook titles with 12 revised editions in physical geography, environmental science, the earth sciences, and geology. His most recent new title, Understanding Science: An Introduction to Concepts and Issues, published by Prometheus Books in 1992, has been widely reviewed as an introductory college text on the philosophy of science.

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*"EOE" indicates Eye on the Environment feature