

Geosystems

Fourth Edition

Robert W. Christopherson



Geosystems

An Introduction to Physical Geography

Fourth Edition

Robert W. Christopherson

American River College

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.....
*To all the students and teachers of Earth, our home planet,
and a sustainable future.*

And to an inspiring mentor, the late Margaret E. Trussel, “Mees.”

Preface

Welcome to physical geography in the new century! The fourth edition of *Geosystems* builds on the success achieved by the first three editions in the United States, Canada, and elsewhere. Students and teachers alike express appreciation for the systems organization, readability, scientific accuracy, up-to-date coverage and relevancy, clarity of the summary and review sections, the functional beauty of the photographs, art, cartography, and the many integrated figures in the text that combine media.

This author thanks the Text and Academic Authors Association for awarding *Geosystems*, third edition, its 1998 national book award for excellence in the physical sciences (see <http://www.winonanet.com/taa/NOTABLE/christopherson.html>). The fourth edition improves on these established merits, respectfully presenting physical geography as an important Earth systems science. An informed citizenry requires meaningful education about our life-sustaining environment; that is the purpose of this book.

Geosystems Communicates the Science of Physical Geography

The goal of physical geography is to explain the spatial dimension of Earth's dynamic systems—its energy, air, water, weather, climate, tectonics, landforms, rocks, soils, plants, ecosystems, and biomes. Understanding human-Earth relations is part of the challenge of physical geography—to create a holistic (or complete) view of the planet and its inhabitants.

Geosystems analyzes the worldwide impact of environmental events, synthesizing many physical factors into a complete picture of Earth system operations. A good example is the 1991 eruption of Mount Pinatubo in the Philippines. The global implications of this major event (one of the largest eruptions the 20th century) are woven through seven chapters of the book (see the new Figure 1-6 for a summary). Our update on global climate change and its related potential effects is part of the fabric in six chapters. These content threads, among many, weave together the variety of interesting and diverse topics crucial to a thorough understanding of physical geography.

Systems Organization Makes *Geosystems* Flow

Each section of this book is organized around the flow of energy, materials, and information. *Geosystems* presents

subjects in the same sequence in which they occur in nature. In this way you and your teacher logically progress through topics which unfold according to the flow of individual systems, or in accord with time and the flow of events. See Figure 1-7 for an illustration of this systems organization.

For flexibility, *Geosystems* is divided into four parts, each containing chapters that link content in logical groupings. The diagram on the next page from Figure 1-8 illustrates our part structure. A quick check of the Table of Contents and this illustration shows you the order of chapters within these four parts.

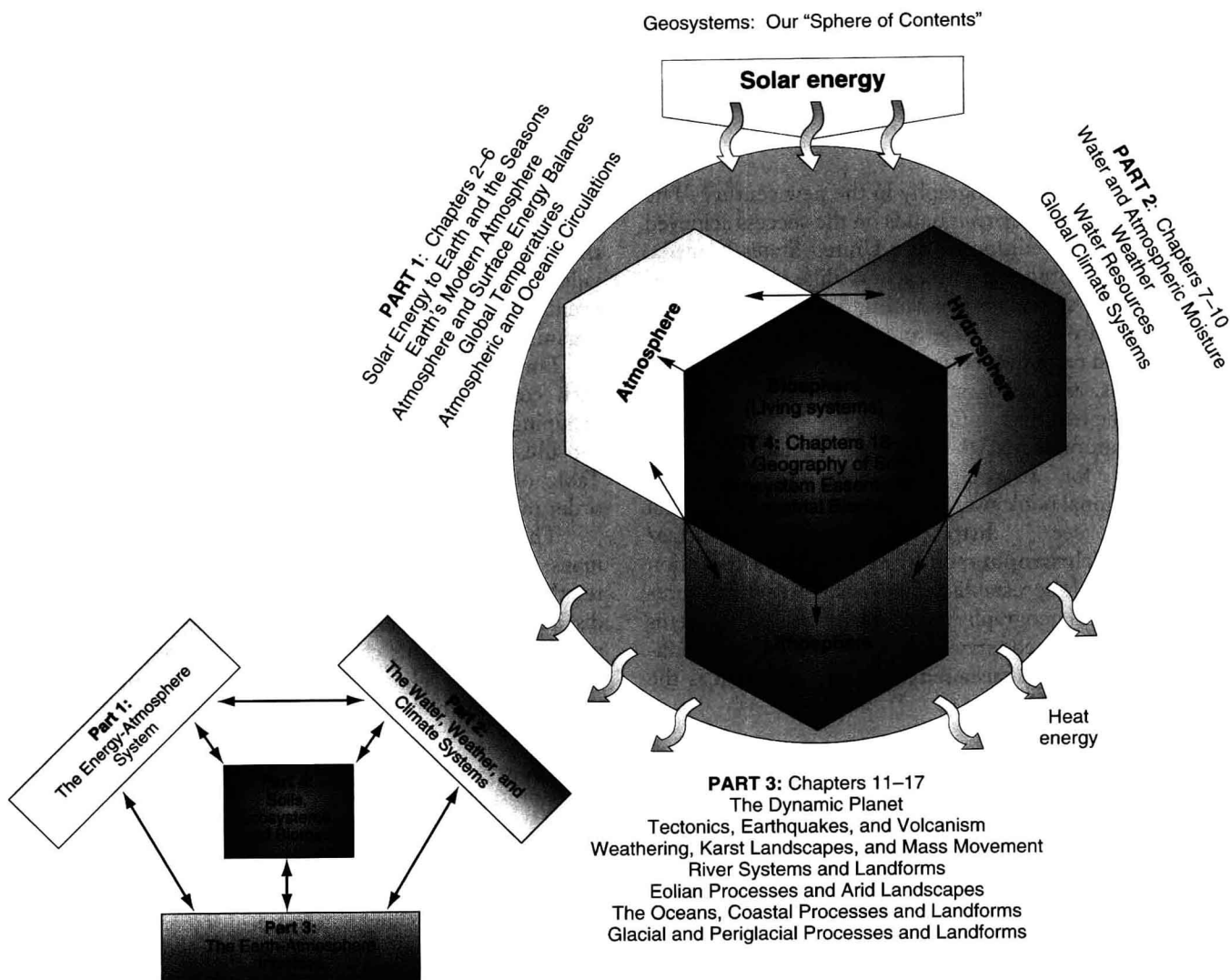
The text culminates with Chapter 21, "Earth, Humans, and the New Millennium," a unique capstone chapter that summarizes physical geography as an important discipline to help us understand Earth's present status and possible future. This chapter is sure to stimulate further thought and discussion, dealing as it does with the most profound issue of our time, Earth's stewardship.

Geosystems is a Text That Teaches

Geosystems is written to assist you in the learning process. Three heading levels are used throughout the text and precise topic sentences initiate each paragraph to help you outline and review material. **Boldface** words are defined where they first appear in the text. These terms and concepts are collected in the Glossary alphabetically, with a chapter-number reference. *Italics* are used in the text to emphasize other words and phrases of importance. Also, every figure has a title that summarizes the caption.

An important continuing feature is a list of Key Learning Concepts that opens each chapter, stating what you should be able to do upon completing the chapter. These objectives are keyed to the main headings in the chapter. At the end of each chapter is a unique Summary and Review section that corresponds to the Key Learning Concepts. Grouped under each learning concept is a narrative review that redefines the boldfaced terms, a key terms list with page numbers, and specific review questions for that concept. You can conveniently review each concept, test your understanding with review questions, and check key terms in the glossary, then return to the chapter and the next learning concept. In this way, the chapter content is woven together with specific concept threads.

A Critical Thinking section ends each chapter, challenging you to take the next step with information from the chapter. The key learning concepts help you deter-



mine what you want to learn, the text helps you develop information and more questions, the summary and review helps you assess what you have learned and what more you might want to know about the subject, and the critical thinking provokes action and application.

New *Career Link* essays feature geographers in a variety of professional fields practicing their spatial analysis craft. You will read about a cartographer-GIS practitioner, a weather forecaster at the Forecast Systems Lab, an environmental scientist, a hydrologist with the National Weather Service, a snow avalanche specialist, an expert on global scale ecosystems, and a student just entering the GIS workplace.

Continued coverage of Canadian physical geography includes text, figures, and maps of periglacial landscapes and Canadian soils (a new Appendix B and color soils map). Canadian data on a variety of subjects are portrayed on 28 different maps in combination with the United

States—physical geography does not stop at the United States–Canadian border!



Nineteen "Focus Study" essays, some completely revised and several new to this edition, provide additional explanation of key topics as diverse as the stratospheric ozone predicament, solar energy collection and wind power, forecasting the near-record 1995–1998 hurricane seasons, the 1997–1998 El Niño phenomenon, status of the High Plains Aquifer using new maps, floodplain strategies, an environmental approach to shoreline planning, the Mount St. Helens eruption, the 1998 status of the Colorado River, and the loss of biodiversity.



Forty-two "News Reports" relate topics of special interest. For example: GPS, careers in GIS, a 34-kilometer sky dive to study the atmosphere, jet streams and airline flight times, how one culture harvests fog, the

UV Index, coordination of global climate change research with many URLs presented, the disappearing Nile Delta, artificial scouring of the Grand Canyon to restore beaches and habitats, how sea turtles read Earth's magnetic field, and threats to the Arctic National Wildlife Refuge.

We now live on a planet served by the Internet and its World Wide Web, a resource that weaves threads of information from around the globe into a vast fabric. The fact that we have Internet access into almost all the compartments aboard Spaceship Earth is clearly evident in *Geosystems*. Many entry points link directly from the words in a chapter to an Internet source allowing you to be up-to-the minute in understanding and facts. You will find nearly 200 URLs (Internet addresses) in the body of the text for instant reference. Given the fluid nature of the Internet, every effort was made to keep these listings up-to-date at press time. If some URLs changed since publication, you can most likely find the new location using elements of the old address.

Such ready availability of worldwide information allowed your author to illustrate content with a fascinating array of examples, to further verify accuracy and add relevancy, and to update content. Any textbook equipped for the new information millennium is going to be different from those of just eight years ago when the first edition of *Geosystems* appeared. Textbooks, especially in dynamic fields like geography must be tapped into these streams of scientific discoveries and environmental events. *Geosystems* is in the new millennium in content, relevancy, and application.

The Geosystems Learning/Teaching Package

The fourth edition provides a complete physical geography program for you and your teacher.

For You the Student:

- ***Student Study Guide***, Fourth Edition (ISBN: 0-13-010853-7), by Robert Christopherson. The study guide includes additional learning objectives, a complete chapter outline, critical thinking exercises, problems and short essay work using actual figures from the text, and a self-test with answer key in the back.
- ***Geosystems WWW Site***: This site gives you the opportunity to further explore topics presented in the book using the Internet. The site contains numerous review exercises (from which you get immediate feedback), exercises to expand students' understanding of physical geography and resources for further exploration. This website provides an excellent opportunity from which to start using the Internet for the study of geography. Please visit the site at www.prenhall.com/christopherson.

- ***Science on the Internet: A Student's Guide*** (ISBN: 0-13-021308-X) by Andrew T. Stull is a student's guide to the Internet and World Wide Web specific to geography.



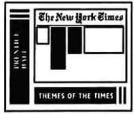
Virtual Fieldtrip CD, a CD-ROM by Jeremy Dunning and Larry Onesti, is included with your text. Here you will go on 12 dramatic field trips keyed to specific sections of the text.

For You the Teacher:

Geosystems is designed to give you flexibility in presenting your course. The text is comprehensive in that it is true to each scientific discipline from which it draws subject matter. This diversity is a strength of physical geography, yet makes it difficult to cover an entire book in a school term. You should feel free to customize use of the text based on your specialty or emphasis. The four-part structure of chapters, systems organization within each chapter, focus study and news report features, all will assist you in sampling some chapters while covering others to greater depth. The following materials are available to assist you—have a great class!

- ***Instructor's Resource Manual*** (ISBN: 0-13-010846-4), by Robert Christopherson. The Instructor's Resource Manual, intended as a resource for both new and experienced teachers, includes a variety of lecture outlines, additional source materials, teaching tips, advice on how to integrate visual supplements, and various other ideas for the classroom.
- ***Prentice Hall Presentation Manager CD-ROM***, Fourth Edition (ISBN: 0-13-011325-5), contains most of the figures and some of the photographs from the text. The software makes customizing your multimedia presentations easy. You can organize figures in any order you want, add labels, lines, and your own artwork to them using an overlay tool, integrate materials from other sources, edit and annotate lecture notes, and then have the option of placing your multimedia lecture into another presentation program such as *PowerPoint*.
- ***Geosystems Test Bank*** (ISBN: 0-13-010847-2), by Robert Christopherson and Marcus Gillespie of Northwest Missouri State University. This collaboration has produced the most extensive test item file available in physical geography. (*Mac Test Manager* 0-13-010849-9 and *IBM/DOS Test Manager* 0-13-010848-0 are available).
- ***Overhead Transparencies*** (ISBN: 0-13-010840-5) include 150 illustrations from the text, all enlarged for excellent classroom visibility. And, ***Slide Set*** (ISBN: 0-13-010852-9) includes illustrations and some photographs from the text.

- **Applied Physical Geography—Geosystems in the Laboratory**, Third Edition (ISBN: 0-13-011324-7), by Robert Christopherson and Gail Hobbs of Pierce College. Reviewer comments and the feedback from users were very positive for the second edition. The new third edition is the result of a careful revision. Eighteen lab exercises, divided into logical sections, allow flexibility in presentation. Each exercise comes with a list of learning concepts. Our manual is the only one that comes with its own complete glossary. A **Solutions and Answers Manual** is available to teachers (ISBN: 0-13-015669-8).



Prentice Hall–New York Times Themes of the Times supplements, *Geography* and *The Changing Earth*, reprint significant recent articles on related topics. These are available at no charge from your local Prentice Hall representative, in quantities for all your students.

Acknowledgments

As in all past editions, I first recognize my family, for they have endured the time at work, yet never wavered in their belief in *Geosystems*' goals—my Mom, sister Lynne, brothers Randy and Marty, and our children Keri, Matt, René, and Steve. And now the next generation: Chavon, Bryce, Payton, and our newest, Brock. When I look into our grandchildren's faces it tells me why we need to work toward a sustainable future; one for the children.

I give special gratitude to all the students, and my colleague Philip Renner, over these past 29 years at American River College for defining the importance of Earth's future, for their questions, and their enthusiasm. To all students and teachers, and to a special mentor of mine Margaret Trussel, this text is dedicated.

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mere words are inadequate. I am in awe of her endless hours cataloging photographs, preparing our figure and photo logs, skill at cropping photos, copy editing, proofing art and final pages, and obtaining permissions. Her natural sense of the Home Planet and love for the smallest of living things is evident in the beautiful and insightful photographs she contributed to this edition. And, she is my best friend.

Physical geography teaches us a holistic view of the intricate supporting web that is Earth's environment and our place in it. Dramatic changes that demand our understanding are occurring in many human-Earth relations in this new millennium. All things considered, this is an important time for you to be enrolled in a physical geography course! The best to you in your studies—and *carpe diem*!

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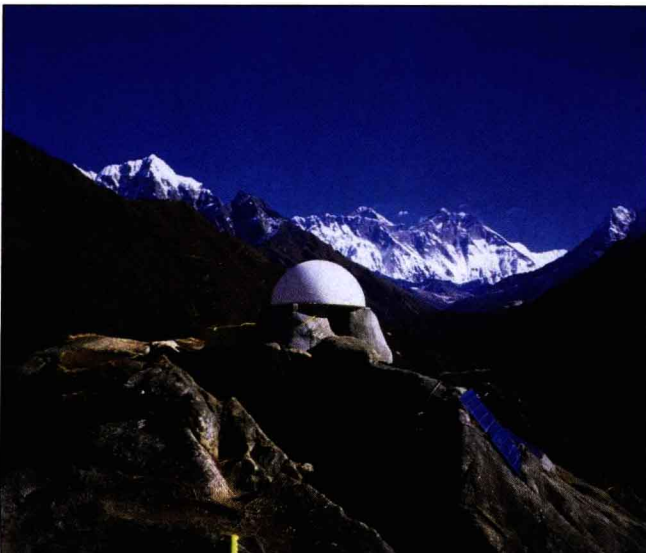
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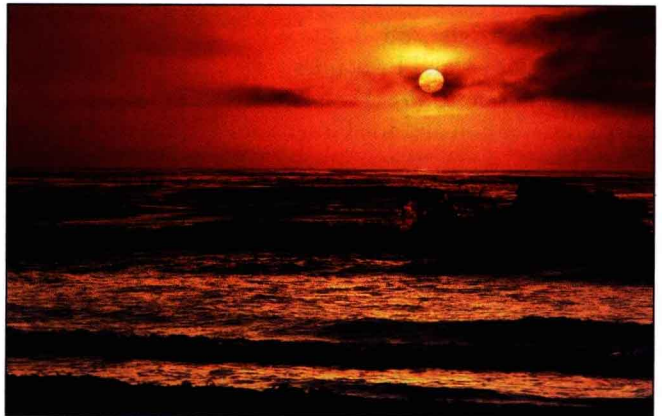
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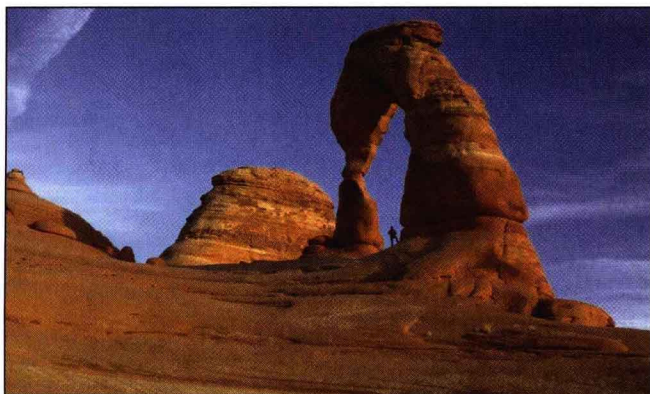
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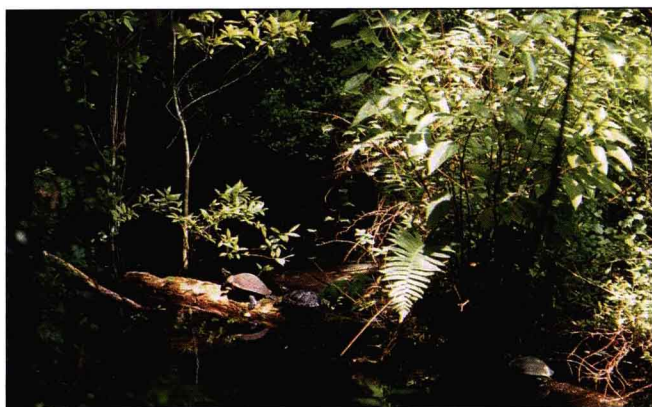
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