



INTRODUCING
**PHYSICAL
GEOGRAPHY**

6th Edition

ALAN STRAHLER

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Sixth Edition

Introducing Physical Geography

Alan Strahler

BOSTON UNIVERSITY

WILEY

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Preface

Welcome to the Sixth Edition of *Introducing Physical Geography*! Our latest edition takes a fresh look at the book's second half, covering soils, Earth materials, surface processes, and landforms, while retaining the features adopted in the Fifth Edition. Chapters 10 through 17 have been largely revised and restructured to provide both a better flow of concepts and updated treatments in many areas. Here's what's new:

- Chapter 10, *Global Soils*, now begins with sections focused on soil chemistry and soil moisture, and presents soil orders grouped by maturity, climate, parent materials, and organic matter.
- Chapter 11, *Earth Materials and Plate Tectonics*, has been reorganized to proceed from geologic time to Earth's inner structure, rock types, and the cycle of rock change. We follow that discussion with our distinctive coverage of plate tectonics.
- Chapter 12, *Tectonic and Volcanic Landforms*, places tectonic landforms first in this edition, rooting the discussion more firmly in the context of plate tectonics. Our treatment of earthquakes is also revised and restructured.
- Chapter 13, *Weathering and Mass Wasting*, sorts weathering processes more specifically in this edition, according to their physical and chemical nature, and presents types of mass wasting organized by substrate moisture (dry to wet) and speed of action (fast to slow).
- Chapter 14, *Freshwater of the Continents*, focuses on a more direct flow of concepts, from groundwater to surface water, streamflow, and flooding.
- Chapter 15, *Landforms Made by Running Water*, organizes the discussion of fluvial processes by erosion, transportation, and deposition, and breaks out stream gradation and evolution at a top level to lead into fluvial landforms.
- Chapter 16, *Landforms Made by Wind and Waves*, separates processes and landforms more directly, leading to a better understanding of coastline development and specific dune types. Tsunamis are covered here as a wave phenomenon.
- Chapter 17, *Glacial and Periglacial Landforms*, has been restructured to ensure a better flow of

information, from types of glaciers to glacial processes and on to landforms, integrating both alpine and continental glaciers. Periglacial processes now are discussed in this chapter, including permafrost and mass wasting.

For this edition we have also revised and refined these features:

- We updated the *Eye on Global Change* feature, which leads off many chapters, with new data and information. Likewise, the *Focus on Remote Sensing* feature, appearing in several chapters, has been updated, as needed.
- We restyled the art, and added many new photos.
- To maintain relevance and student interest, we updated our examples of natural phenomena, to include more recent hurricanes, tornados, volcanic eruptions, landslides, earthquakes, floods, and wildfires.
- Finally, we renewed our chapter opening photos, from the collection of the renowned photographer Yann Arthus-Bertrand, featuring images from his new book *The New Earth From Above 365 Days*. Each provides a fresh viewpoint on the contents of the chapter at hand.

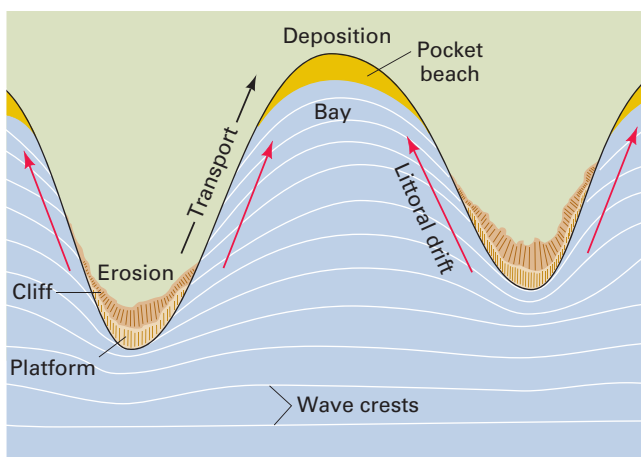
Even as we have moved forward in the areas just noted, we have maintained our emphasis in the Fifth Edition on visual learning. By juxtaposing graphics and photos, we effectively and synergistically develop and illustrate facts and concepts. Many of these art pieces also incorporate text blocks, highlighted with callout lines to particular parts of the photos or graphics; these aid learning more effectively than in-narrative explanations alone. We have also retained the use of “windows,” text boxes within certain columns to reinforce important key concepts and add visual interest. The *In Review* section at the end of each chapter reads like an abstract, encapsulating the key concepts and relevant terms in short bullet points. The review questions, visualizing exercises, and essay questions all offer opportunities for students to reinforce and demonstrate the knowledge they have acquired.

Geo Media Library

This easy-to-use website features animations, videos, and interactive exercises, making it possible to quickly reinforce and illustrate key concepts from the text. Students can use these resources for tutorials, as well as a self-quizzing device to complement the textbook and enhance their understanding of geography. Easy integration of this content into course management systems and homework assignments enables instructors to conveniently integrate multimedia with their syllabi and more traditional reading and writing assignments.

Resources in the Geo Media Library include:

Animations: Key diagrams and drawings from our rich signature art program have been animated to produce a virtual experience of difficult concepts. Such animations are crucial to the understanding of this content for visual learners.

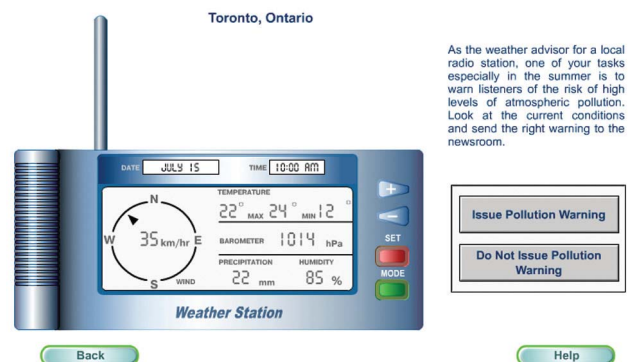


Videos: Brief video clips provide real-world examples of geographic features, and put these examples into context with the concepts covered in the text.



Simulations: Computer-based models of geographic processes allow students to manipulate data and variables so they may explore and interact with virtual environments.

Weather Stations Interactivity.

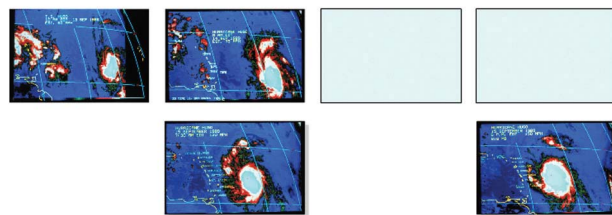


Interactive Exercises: Learning activities and games build off our presentation material, giving students an opportunity to test their understanding of key concepts and explore additional visual resources.

Remote Sensing and Climate Interactivity.

Hurricanes

Take a look at these four satellite images of Hurricane Hugo from the 13th to the 15th September 1989. Click on each image and drag to the boxes above to show the correct chronological order of the images.



These are enhanced infrared images

[About images](#)

[Help / Hint](#)

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- Students can achieve concept mastery with the help of additional study tools such as online self-assessments, videos, animations, and flashcards, all presented in a media-rich, structured environment that is available 24/7.

- Instructors can personalize and manage their courses more effectively by tracking content and assessments to learning objectives, assignments, grade tracking, ability to upload assessments, and more.

In addition to the instructor and student resources provided on our book's companion website, *WileyPLUS* offers these additional features:

1. **Google Earth Lecture Tours:** New to this edition, interactive Google Earth tours, developed by Alan Halfen, University of Kansas, can be used by instructors as supplemental lecture material or as stand-alone lectures. Written for Chapters 11 through 17, each tour follows the basic chapter layout and contains links at each stop to key terms and definitions. Instructors can edit the tours as well as manipulate them using the navigation control to better present the specific topic under instruction. The tours also include an instructor guide and a note-taking guide for students.
2. **Google Earth Topical Tours:** Topic-specific tours developed by Professor Randy Rutberg, CUNY Hunter, on glaciers, igneous rocks, plate boundaries, and sedimentary rocks give students an in-depth review and an engaging look at the world around them.
3. **## contextualized animations and videos,** tagged to learning objectives chapter content, including 12 new animations.

Google Earth™

For Introducing Physical Geography Sixth Edition

The Sixth Edition of *Introducing Physical Geography* incorporates the diverse resource of Google Earth™. Through satellite imagery shown in the text and online tours available for each chapter using Google Earth™, instructors and students can view and interact with landforms and landscapes anywhere on the globe, to better demonstrate and learn how the processes of physical geography work. Completing the online resources available when taking a chapter tour in Google Earth™ are study tools such as new Google Earth™ lecture tours, topical tours, and bonus practice with interactivities.

Earth from Above

An Aerial Portrait of Our Planet

Since 1990, photographer Yann Arthus-Bertrand has flown over hundreds of countries to compile an aerial portrait of our planet. His photographs invite all of us to reflect upon the future of Earth and its inhabitants. Over the past 50 years, we humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. Everywhere, under the assaults of humankind, our planet's ecosystem appears to be deteriorating—freshwater, oceans, forests, air, arable land, open spaces, cities. . . . In whatever form of media—books, exhibitions, websites, films, posters—“Earth from Above” reminds us that each and every one of us is responsible for the future of the Earth. And because each one of us plays a part, we all have the duty to act. For more on the work of Yann Arthus-Bertrand go to www.yannarthusbertrand.org; and for more on how you can participate in the recovery of Earth's ecosystem, go to www.goodplanet.org.

www.yannarthusbertrand.org
www.goodplanet.org

Toward a Sustainable Development

Since 1950, worldwide economic growth has been considerable, and global production of goods and services has multiplied by a factor of 8. During this same period, while the world's population has a little more than doubled, the volume of fish caught has multiplied by 5, and the volume of meat produced by 6. The demand for energy has multiplied by 5; oil consumption has multiplied by 7; and carbon dioxide emissions, the main cause of the greenhouse effect and global warming, by 5. Since 1900, freshwater consumption has multiplied by 6, chiefly to provide for agriculture.

And yet, 20 percent of the world's population has no access to sources of drinking water, 25 percent are without electricity, and 40 percent have no sanitary installation; 820 million people are underfed, and half of humanity lives on less than \$2 a day. In other words, a fifth of the world's population lives in industrialized countries, consuming and producing in excess and generating massive pollution. The remaining four-fifths live in developing countries and, for the most part, in poverty.

Overexploitation of resources leads to the constant degradation of our planet's ecosystem, and severely limits supplies of freshwater, ocean water, forests, air, arable land, and much more.

That's not all. By 2050, the Earth will have close to 3 billion additional inhabitants. These people will live, for the most part, in developing countries. As these countries develop, their economic growth will jockey for position with that of industrialized nations—within the limits of ecosystem Earth.

If every individual living on the planet were to consume as much as a person living in the Western world, we would need three planets the size of Earth to satisfy all their needs. Fortunately, there is a way we can meet everyone's needs while preserving natural resources for future generations: We must actively promote and support technologies that are less polluting and less water and energy-consuming. Referred to as *sustainable development*, this approach to living on Earth represents progress for humanity: to consume not *less*, but *better*.

The current situation on Earth is not irreversible, but we need to begin making changes immediately. We have the opportunity to turn toward more sustainable development, one that allows us to improve the living conditions of the world's citizens and to satisfy the needs of generations to come. This development would be based on an economic growth that is respectful both of humans and the natural resources of our unique planet.

Such development requires that we improve production methods and change our consumption habits. With the active participation of all the world's citizens, each and every one of us can make a valuable contribution to the future of the Earth and humankind, starting right now.

The Earth from Above



Introduction
Physical Geography and the Tools Geographers Use



Chapter 1
The Earth as a Rotating Planet



Chapter 2
The Earth's Global Energy Balance



Chapter 3
Air Temperature



Chapter 4
Atmospheric Moisture and Precipitation



Chapter 5
Winds and Global Circulation



Chapter 6
Weather Systems



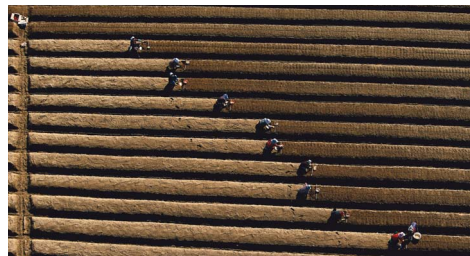
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Global Climates and Climate Change



Chapter 8
Biogeographic Processes



Chapter 9
Global Biogeography



Chapter 10
Global Soils



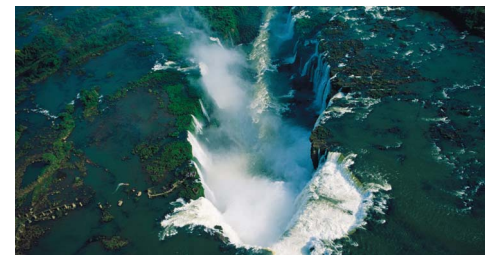
Chapter 11
Earth Materials and Plate Tectonics



Chapter 12
Tectonic and Volcanic Landforms



Chapter 13
Weathering and Mass Wasting



Chapter 14
Freshwater of the Continents



Chapter 15
Landforms Made by Running Water



Chapter 16
Landforms Made by Waves and Wind



Chapter 17
Glacial and Periglacial Landforms

Book Companion Website

On the companion website to this text— www.wiley.com/college/strahler—you will find a wealth of study and practice materials, including:

Student Online Resources

- *Self-quizzes*: Chapter-based multiple-choice and fill-in-the-blank questions.
- *Annotated Weblinks*: Useful weblinks selected to enhance chapter topics and content.
- *Lecture Note Handouts*: Key images and slides from the instructor PowerPoint presentations are made available so that, when in class, students can focus on the lecture, annotate figures, and add their own notes.
- *Media Library*: Link to the media library for students to explore key concepts in greater depth using videos, animations, and interactive exercises.

Concept Caching

- This online database of photographs explores what a physical feature looks like. Photographs and GPS coordinates are “cached” and categorized along with core concepts of geography. Professors can access the images or submit their own by visiting www.ConceptCaching.com.

Instructor Resources

- This section includes all student resources, plus:
 - *PowerPoint Lecture Slides*: Chapter-oriented slides, along with lecture notes and text art.
 - *Computerized Test Bank*: Multiple-choice, fill-in-the-blank, and essay questions, available in both Respondus and Diploma.
 - *Instructor's Manual*: Lecture notes, learning objectives, guides to additional resources, and teaching tips for enhancing the classroom experience.
 - *Clicker Questions*: A set of questions for each chapter that can be used during lectures to check understanding using PRS, HITT, or CPS clicker systems.
 - *Image Gallery*: Both line art and photos from the text.

Acknowledgments

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In closing, I would like to acknowledge the debt I owe to my former coauthor, Arthur Strahler, who contributed so much to the field of education in physical geography in the 49 years of his collaboration with John Wiley & Sons, and his 29 years of collaboration with me. I deeply wish he could still be at my side today as the coauthor of *Introducing Physical Geography*, Sixth Edition.

Alan Strahler
 Boston, Massachusetts
 December, 2012

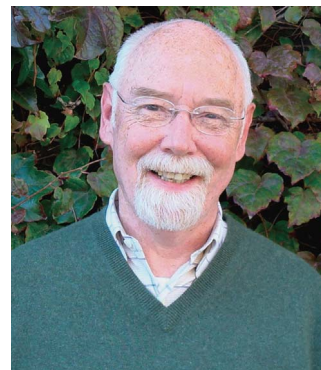
About the Author

Alan Strahler, presently Professor of Geography at Boston University, earned his PhD degree in Geography from Johns Hopkins, in 1969. He has published more than 250 articles in the refereed 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. In 2011, Professor Strahler received the William T. Pecora Award from the Department of the Interior and the National Aeronautics and Space Administration for his outstanding contributions to understanding the Earth by means of remote sensing. In 2009, his work in geographic education was recognized with an award from the SAIC Estes Memorial Teaching Award from the American Society of Photogrammetry and Remote Sensing. He also received the Association of American Geographers/Remote Sensing Specialty Group Medal

for Outstanding Contributions to Remote Sensing, in 1993.

Professor Strahler holds the honorary degree DSHC from the Université Catholique de Louvain, Belgium, awarded in 2000, and is a Fellow of the American Association for the Advancement of Science.

With the late Arthur Strahler, he is the coauthor of 7 textbook titles, with 13 revised editions, on physical geography and environmental science. He is also the author or coauthor of *Visualizing Physical Geography*, first and second editions, and *Visualizing Weather and Climate*, both titles in the Wiley Visualizing Series.



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Sixth Edition

Introducing Physical Geography

Introduction

Physical Geography and the Tools Geographers Use

This traditional village in Madagascar, in a fertile highland area south of the capital, has a unique geography and relation to its surroundings. A cluster of houses on the brow of a hill occupies the village center, with walled kitchen gardens and crops that need frequent tending nearby. Field crops occupy the hilltop and gentler slopes, while forest grows on the steeper slopes. Human settlements have a physical setting that places bounds on the kinds of human activities that take place there. In this book, we will focus on the natural processes that shape the physical landscape and provide the habitat of the human species.



TRADITIONAL VILLAGE NEAR AMBATOLAMPY, MADAGASCAR

©Yann Arthus-Bertrand/Altitude

Introducing Geography

HUMAN AND PHYSICAL GEOGRAPHY

Spheres, Systems, and Cycles

THE SPHERES—FOUR GREAT EARTH REALMS
SCALE, PATTERN, AND PROCESS
SYSTEMS IN PHYSICAL GEOGRAPHY
TIME CYCLES

Physical Geography, Environment, and Global Change

GLOBAL CLIMATE CHANGE
THE CARBON CYCLE
BIODIVERSITY
POLLUTION
EXTREME EVENTS

Tools in Physical Geography

Maps and Cartography

MAP PROJECTIONS
SCALES OF GLOBES AND MAPS
SMALL-SCALE AND LARGE-SCALE MAPS
CONFORMAL AND EQUAL-AREA MAPS
INFORMATION CONTENT OF MAPS
MAP SYMBOLS
PRESENTING NUMERICAL DATA ON THEMATIC MAPS

The Global Positioning System

Geographic Information Systems

SPATIAL OBJECTS IN GEOGRAPHIC INFORMATION SYSTEMS

KEY ELEMENTS OF A GIS

Remote Sensing for Physical Geography

COLORS AND SPECTRAL SIGNATURES
THERMAL INFRARED SENSING
ACTIVE SENSING—RADAR AND LIDAR
DIGITAL IMAGING
SATELLITE ORBITS
LANDSAT, MODIS, AND THE EARTH OBSERVING SYSTEM

Earth Visualization Tools

GOOGLE EARTH
OTHER EARTH VISUALIZATION TOOLS



Physical Geography and the Tools Geographers Use

Geography is a modern discipline with ancient roots. But what is geography? What are the big ideas of physical geography? How is physical geography related to global climate change? Biodiversity? Extreme events? Geographers use special tools to study the Earth. How do maps depict the Earth's curved surface on a flat piece of paper? How does a geographic information system (GIS) work? How do geographers use remote sensing? These are some of the questions we will answer in our Introduction.

Introducing Geography

What is geography? Put simply, **geography** is the study of the evolving character and organization of the Earth's surface. It is about how, why, and where human and natural activities occur and how these activities are interconnected.

To get a better understanding of geography, think of it as having two sides. One side, which we can term **regional geography**, is concerned with how the Earth's surface is differentiated into unique *places*. Take Vancouver, British Columbia, for example (Figure I.1) What makes Vancouver unique? Is it its spectacular setting where the Pacific Ranges meet the Pacific Ocean? The marine west-coast climate that provides its mild and rainy winters and blue summer skies? Its position as a seaport gateway to Asia? Its English roots combined with dashes of French, Asian, and even Russian culture? In fact, all of these attributes contribute to making Vancouver the unique place that it is.

Although places are unique, the physical, economic, and social processes that form them are not. Thus, geographers are concerned with discovering, understanding, and modeling the processes that differentiate the Earth's surface into places. This is the other side of geography, which we can term **systematic geography**. Why are pineapples cheap in Hawaii and expensive in Toronto? Oranges cheap in Florida and expensive in North Dakota? Steak cheap in Kansas City and expensive in Boston? These are examples of a simple principle of economic geography—that prices include transportation costs and that when goods travel a longer distance, they are usually more

expensive. Discovering such principles and extending them to model and predict spatial phenomena is the domain of systematic geography. To summarize, geographers study both the “vertical” integration of characteristics that define a place and the “horizontal” connections between places.

What makes geography different from other disciplines? Geography adopts a unique set of perspectives to analyze the world and its human and natural phenomena. These perspectives include the spatial viewpoint of geographers, the interest of geographers in the synthesis of ideas across the boundaries of conventional studies, and geographers' usage of tools to represent and manipulate spatial information and spatial phenomena. Figure I.2 shows these perspectives in the form of a cube, with each perspective displayed on a different face.

The first unique perspective of geography is its spatial **viewpoint**. Geographers are interested not only in how something happens, but also where it happens and how it is related to other happenings nearby and far away. The spatial viewpoint can focus at three levels. At the *place* level, geographers study how processes are integrated at a single location or within a single region. For example, a physical geographer may study the ecology, climate, and soils of a national park. At the *space* level, geographers look at how places are interdependent. An economic geographer may examine how flows of goods, information, or money connect cities and towns that are of different sizes and at different distances apart. Geographers also look at human and natural activities at different *scales*, sometimes zooming in for a close look at



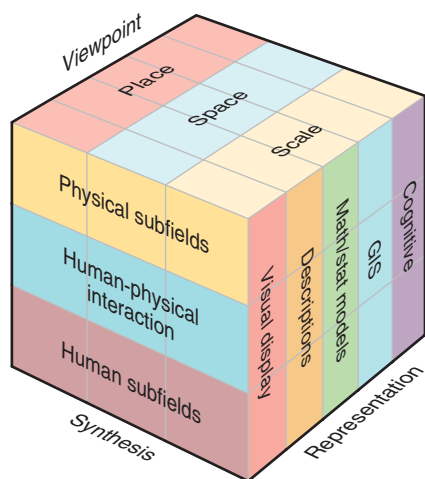
Al Harvey/All Canada Photos/©Corbis

1.1 Vancouver, British Columbia

This cosmopolitan city enjoys a spectacular setting on the Strait of Georgia, flanked by the Pacific and Vancouver Island Ranges.

EYE ON THE LANDSCAPE What else would the geographer see?

A For the physical geographer, Vancouver’s environment combines snow-capped peaks eroded by glaciers, conifer forests adapted to the cool, maritime climate, and an arm of the ocean that erodes the coast by wave and tidal action. **B** For the human geographer, the image shows a center of economic activity marked by Vancouver’s office and residential towers. Areas of low buildings document the differentiation of the city into districts with diverse characters and history. The road and freeway network demonstrates the city’s reliance on cars and trucks to move people and goods within the city. **C** The physical environment interacts with human activity through Vancouver’s role as a port city, where land- and waterborne transportation modes meet. Large commercial vessels in the bay mingle with sailboats and powerboats, highlighting the importance of the city’s marine setting to both shipping and recreation.



1.2 Perspectives of geography

The three unique perspectives of geography—its spatial viewpoint, its synthesis of related fields, and its representation of spatial processes and information—are diagrammed as three dimensions occupying the sides of a cube.

something small, or pulling back for an overview of something large. Often, what looks important at one scale is less important at another.

The second perspective of geography is **synthesis**. Geographers are very interested in putting together ideas from different fields and assembling them in new ways—a process called synthesis. Of particular interest to geographers are studies that link conventional areas of study. In physical geography, for example, a biogeographer may investigate how streamside vegetation affects the flood flow of rivers, thus merging the physical geography subfields of ecology and hydrology. The many connections between environmental processes and human activities are also subjects of geographic synthesis. For example, a classic study area in geography is perception of hazards: Why do people build houses next to rivers or beaches when it is only a matter of time before floods or storms will wash their homes away? Here, geographers study the interaction of hydrology

with perception and cognitive learning.

The third perspective of geography is geographic **representation**. Here, geographers develop and perfect tools for representing and manipulating information spatially. *Cartography*—the art and science of making and drawing *maps*—is a subfield of geography that focuses on *visual display* of spatial relationships. Visual display also includes remote sensing—acquiring images of the Earth from aircraft or spacecraft and enhancing them to better display spatial information. *Verbal descriptions* use the power of words to explain or evoke geographic phenomena. *Mathematical and statistical models* predict how a phenomenon of interest varies over space and through time. *Geographic information systems* store, manipulate, and display spatial information in very flexible ways. *Cognitive representation* refers to spatial relationships as they are stored in the human brain—mental mapping of real space into the subjective space that people experience.

Taken together, the perspectives of viewpoint, synthesis, and representation define geography as a unique discipline that focuses on how the natural

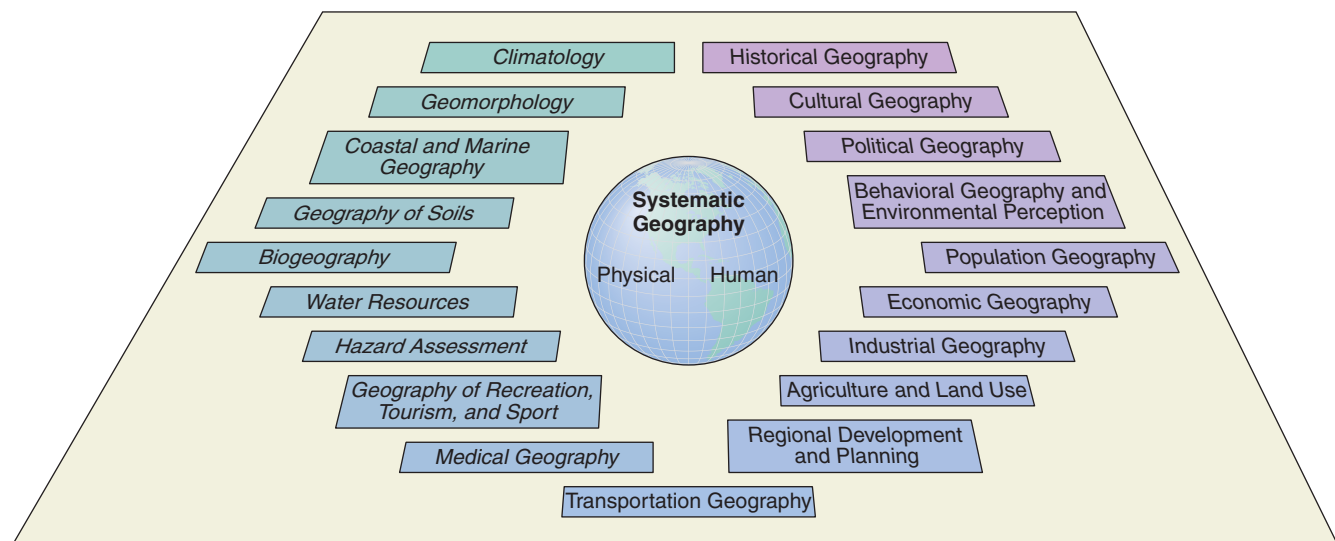
Geography as a discipline has a unique set of perspectives. Geographers look at the world from the viewpoint of geographic space, focus on synthesizing ideas from different disciplines, and develop and use special techniques to represent and manipulate spatial information.

and human patterns of the Earth's physical and cultural landscape change and interact in space and time.

HUMAN AND PHYSICAL GEOGRAPHY

Like many other areas of study, geography has a number of subfields, each with a different focus but often overlapping and interlocking with other subfields. We can organize these subfields into two broad realms: **human geography**, which deals with social, economic and behavioral processes that differentiate places; and **physical geography**, which examines the natural processes occurring at the Earth's surface that provide the physical setting for human activities. Figure I.3 is a diagram showing the principal fields of physical and human geography. Reading downward from the left, we see five fields of physical geography, from climatology to biogeography, which are illustrated in Figure I.4. These topics are the main focus of this text.

Climatology is the science that describes and explains the variability in space and time of the heat and moisture states of the Earth's surface, especially its land surfaces. Since heat and moisture states are part of what we call weather, we can think of climate as a description of average weather and its variation at places around the world. Chapters 1–7 will familiarize you with the essentials of climatology, including the processes that control the weather we experience daily. Climatology is also concerned with climate



I.3 Fields of systematic geography

Physical and human geography have many interrelated subfields.

change, past, present, and future. One of the most rapidly expanding and challenging areas of climatology is global climate modeling, which we touch on in several chapters. This field attempts to predict how human activities, such as converting forestland to agricultural use, or releasing CO₂ by burning fossil fuels, will change global climate.

Geomorphology is the science of Earth surface processes and landforms. The Earth's surface is constantly being altered under the combined influence of human and natural factors. The work of gravity in the collapse and movement of Earth materials, as well as the work of flowing water, blowing wind, breaking waves, and moving ice, acts to remove and transport soil and rock and to sculpt a surface that is constantly being renewed through volcanic and tectonic activity. The closing chapters of our book (Chapters 12–17) describe these geomorphic processes, while the basic geologic processes that provide the raw material are covered in Chapters 11–12. Modern geomorphology also focuses on modeling landform-shaping processes to predict both short-term, rapid changes, such as landslides, floods, or coastal storm erosion, and long-term, slower changes, such as soil erosion in agricultural areas or as a result of strip mining.

The field of **coastal and marine geography** combines the study of geomorphic processes that shape shores and coastlines with their application to coastal development and marine resource utilization. Chapter 16 describes these processes and provides some perspectives on problems of human occupation of the coastal zone.

Geography of soils includes the study of the distribution of soil types and properties and the processes of soil formation. It is related to both geomorphic processes of rock breakup and weathering, and to biological processes of growth, activity, and decay of organisms living in the soil (Chapter 10). Since both geomorphic and biologic processes are influenced by the surface temperature and availability of moisture, broad-scale soil patterns are often related to climate.

Biogeography, covered in Chapters 8 and 9, is the study of the distributions of organisms at varying spatial and temporal scales, as well as the processes that produce these distribution patterns. Local distributions of plants and animals typically depend on the suitability of the habitat that supports them. In this application, biogeography is closely aligned with *ecology*, which is the study of

Five major fields of physical geography are: climatology, geomorphology, coastal and marine geography, geography of soils, and biogeography.

the relationship between organisms and environment. Over broader scales and time periods, the migration, evolution, and extinction of plants and animals are key processes that determine their spatial distribution patterns. Thus, biogeographers often seek to reconstruct past patterns of plant and animal communities from fossil evidence of various kinds. *Biodiversity*—the assessment of biological diversity from the perspective of maintaining the diversity of life and life-forms on Earth—is a biogeographic topic of increasing importance, due to ongoing and increasing human impact on the environment. The present global-scale distribution of life-forms as the great biomes of the Earth provides a basic context for biodiversity.

In addition to these five main fields of physical geography, two others are strongly involved with applications of physical geography: water resources and hazards assessment. **Water resources** is a broad field that couples basic study of the location, distribution, and movement of water, for example, in river systems or as groundwater, with the utilization and quality of water for human use. This field involves many aspects of human geography, including regional development and planning, political geography, and agriculture and land use. We touch on water resources briefly in this book, in Chapters 14 and 15, where we discuss water wells, dams, and water quality.

Hazards assessment is another field that blends physical and human geography. What are the risks of living next to a river, and how do inhabitants perceive those risks? What is the role of government in protecting citizens from floods, or assisting them in recovery from flood damages? Answering questions such as these requires not only knowledge of how physical systems work, but also how humans, as both individuals and societies, perceive and interact with their physical environment. In this text, we develop an understanding of the physical processes of floods, earthquakes, landslides, and other disaster-causing natural events as a background for appreciating hazards to humans and their activities.

Many of the remaining fields of human geography have linkages with physical geography. For example, climatic and biogeographic factors may determine the spread of disease-carrying mosquitoes (medical geography). Mountain barriers may isolate populations and increase the cost of transporting goods from one place to another (cultural geography, transportation geography). Unique landforms and landscapes may be destinations for tourism (geography of recreation, tourism, and sport). Nearly all human activities take place in a physical environment that varies in space and time, so the physical processes that we examine in this text provide a background useful for further learning in any of geography's fields.

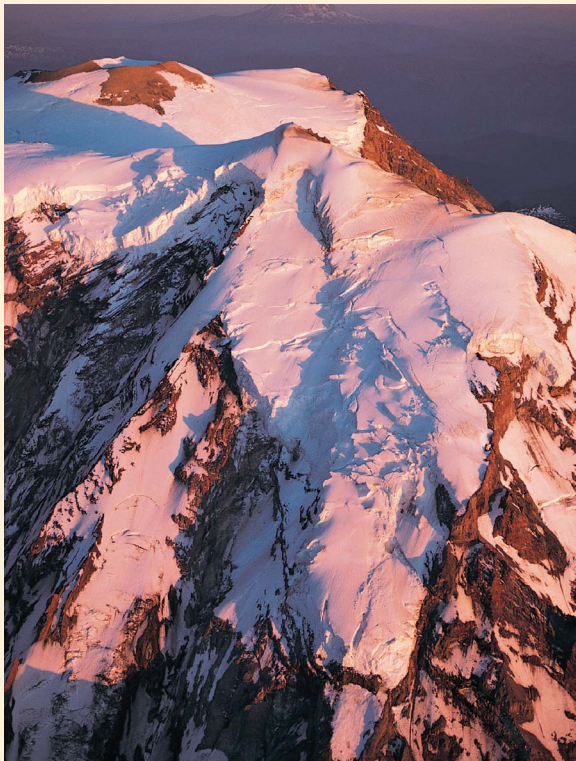
1.4 Fields of physical geography

The principal subfields of physical geography covered in this book are climatology, biogeography, geography of soils, geomorphology, and coastal and marine geography.



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▼ **GEOMORPHOLOGY**
Geomorphology is the study of landform-making processes.



Digital Vision/Getty Images, Inc.

▲ **CLIMATOLOGY**
Climatology studies the transfers of energy and matter between the surface and atmosphere that control weather and climate.

James Randle/Getty Images, Inc.





Elena Kalistratova/Getty Images, Inc.

▲ **BIOGEOGRAPHY**

Biogeography examines the distribution patterns of plants and animals and relates them to environment, migration, evolution, and extinction.

◀ **COASTAL AND MARINE GEOGRAPHY**

Coastal and marine geography examines coastal processes, marine resources, and their human interface.

GEOGRAPHY OF SOILS ▶

Soils are influenced by their parent material, climate, biota, and time.

Fletcher & Baylis/Photo Researchers, Inc.

