

PREFACE

Welcome to the ninth edition of *Elemental Geosystems*! This edition features updated content, new active learning activities to engage students, and many new photos and illustrations. We continue to build on the success of the first eight editions, as well as the companion texts, *Geosystems*, now in its tenth edition; *Geosystems, Canadian Edition*, fourth edition; and the newest *Geosystems Core*, first edition. Students and teachers appreciate the systems organization, integration of figures and text, student-friendly language, and overall relevance to what is happening to Earth systems in real time.

New to the Ninth Edition

Nearly every page of *Elemental Geosystems*, Ninth Edition, presents new content in text and figures and new features that help students relate physical geography topics to the real world and apply concepts as they learn. New features, activities, and learning resources include:

- A new **Everyday Geosystems** feature at the beginning of each chapter invites students to explore the “why” and “how” application of physical geography concepts to everyday phenomena. Example topics are:
 - How much water is needed to produce the food I eat? (Chapter 6)
 - What kind of damage occurs during a river flood? (Chapter 12)
 - Have you noticed fewer bees in your neighborhood? (Chapter 16)
- **Mobile Field Trip Videos** have students accompany acclaimed photographer and pilot Michael Collier in the air and on the ground as he explores iconic landscapes of North America and beyond. Students scan Quick Response (QR) links in the book to access the 20 videos as they read. Videos are also available in Mastering Geography with assignable quizzes.
- **Project Condor Quadcopter Videos**, linked via QR codes, take students out into the field through narrated quadcopter footage, exploring the physical processes that have helped shape North America’s Mountain West landscapes. Readers scan Quick Response (QR) links in the book to access the videos as they read. Videos are also available in Mastering Geography with assignable quizzes.
- New **Work It Out** activities in each chapter give students a chance to practice basic conceptual or quantitative reasoning. Integrated into appropriate sections of each chapter, these activities give students the opportunity to demonstrate understanding of learned concepts and practice critical thinking as they read.
- New **Apply Concepts** features, part of the text’s hallmark *Focus Studies*, are active learning tasks that compel students to reflect on the information they have learned and perform short activities.
- New **Questions to Consider** within the *Human Denominator* feature in each chapter ask students to interpret graphs and maps in the feature and connect information to topics within the chapter.
- New **Interactive Mapping** exercises at the end of each chapter direct students to GIS-inspired MapMaster 2.0 interactive maps in Mastering Geography, where they can access, create, manipulate, and analyze maps related to each chapter’s topic.
- New **Earth Systems Connections** feature includes systems diagrams at the end of each chapter summarize the cascading system operations that are the basis for chapter organization. These flow diagrams emphasize the inputs, actions, outputs, and human–Earth connections relevant to each chapter.
- New **Geospatial Analysis** exercises at the end of each chapter are mini-lab activities, sending students outside the book to access and explore online science tools and data sets from sources such as NASA, USGS, and NOAA, performing critical geospatial data analysis.
- New and revised **illustrations and maps** improve student learning in every chapter with the latest visualizations and data from physical geography. Hundreds of new photos and images bring real-world scenes into the classroom.

Content Updates & Hallmark Features

Every chapter has seen significant updates to content. Select chapter content changes include:

- **Chapter 5, Atmospheric Water and Weather:** We updated, reorganized, and clarified content throughout, added a new section on precipitation processes, and expanded our discussion of thunderstorms.
- **Chapter 8, Climate Change:** This edition features extensive updates to our stand-alone chapter on climate change, offering an overview of climate change science. The chapter explores paleoclimatology, climate feedbacks, evidence and causes of present climate change, climate models and projections, and steps we can take to moderate Earth’s changing climate.
- **Chapter 17, Biogeography and Terrestrial Biomes:** We expanded our coverage of biogeography, including a new *Geosystems Now* feature on grizzly bears and ecological corridors in the Rocky Mountains.

- Eighteen **Focus Studies**, with either updated or new content, explore relevant applied topics in greater depth and are a popular feature of the *Geosystems* texts. These essays delve deeper into specific subjects related to each chapter. Eleven new Focus Study topics for this edition include:
 - Geographers Monitor Earth’s Forests from Space (Chapter 1)
 - Forms of Energy (Chapter 2)
 - Human Responses to Wind Chill and Heat Stress (Chapter 3)
 - The 2015 Northern Hemisphere Tropical Cyclone Season (Chapter 5)
 - Melting Permafrost Releases Greenhouse Gases in the Arctic (Chapter 8)
 - Human-caused Earthquakes on the Increase (Chapter 10)
 - Is Summer Heat a Trigger for Yosemite Rock-falls? (Chapter 11)
 - Sand Dunes Protect Coastlines during Super-storm Sandy (Chapter 13)
 - Greenland and Antarctica: Melting at the Edges of the Continental Ice (Chapter 14)
 - The 1930s Dust Bowl: Regional-Scale Soil Erosion (Chapter 15)
 - Summer Fog Protects the World’s Tallest Trees (Chapter 17)
- The chapter-opening **Geosystems Now** features present brief original case studies and current issues in geography and Earth systems science. The 20 new *Geosystems Now* topics in the ninth edition include citizen science in the 21st century (Chapter 1), marine debris and ocean circulation (Chapter 4), the U.S. Pacific Northwest earthquake hazard (Chapter 10), and coral reefs in decline (Chapter 13). Many of these features emphasize linkages across Earth systems, exemplifying the *Geosystems* approach. In this edition, these features include several questions to help students review, and Quick Response links to relevant videos and animations.
- **Geosystems in Action** features focus on key topics, processes, systems, or human–Earth connections. In every chapter, these features offer a one- to two-page highly visual presentation of a topic central to the chapter, with active learning questions and links to media in Mastering Geography, as well as a GeoQuiz to aid student learning. The feature is updated and streamlined from the past edition.
- **The Human Denominator** feature at the end of every chapter links chapter topics to human examples and applications. The feature includes updated maps, photos, graphs, and other diagrams to provide visual examples of many human–Earth interactions. In this edition, all Human Denominators end with new *Questions to Consider*.
- **Key Learning Concepts** appear at the outset of each chapter, helping students prioritize chapter learning objectives. Each chapter concludes with the *Key Learning Concepts Review*, which summarizes the chapter using the opening objectives.
- *Elemental Geosystems* continues to use **embedded URLs within the text**, linking to original science sources. More than 60 appear in this edition. These allow students to pursue topics of interest to greater depth, or to obtain the latest information about weather and climate, tectonic events, or floods.
- The book is supported by Mastering Geography, the most widely used and effective online homework, tutorial, and assessment system with resources for before, during, and after class. Assignable media and activities include Geoscience Animations, videos, *Mobile Field Trip* videos, *Project Condor* Quadcopter videos, *Encounter* Google Earth™ explorations, GIS-inspired MapMaster™ interactive maps, Hazard City context-rich problems, GeoTutor coaching activities on the toughest topics in geography, end-of-chapter questions and exercises, reading quizzes, and Test Bank questions. Students have access to *Dynamic Study Modules* that provide each student with a customized learning experience. Students also have access to a text-specific Study Area with study resources, including a Pearson eText version of *Geosystems*—all at www.masteringgeography.com.
- **Learning Catalytics**, a “bring your own device” student engagement, assessment, and classroom intelligence system, is integrated with Mastering Geography.

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From Robert: The year 2017 marked the 25th anniversary of the first *Geosystems* edition in 1992. In that edition, I covered the *First Assessment Report* of the IPCC; the geospatial sciences are essential in explaining dynamic Earth systems and the changes underway. I thank my family for believing in this work, especially the next generation: Chavon, Bryce, Payton, Brock, Trevor, Blake, Chase, T yenna, and Cade. When I see our grandchildren’s faces, I see why we work toward a sustainable future.

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Physical geography teaches us a holistic view of the intricate supporting web that is Earth's environment and our place in it. Dramatic global change is under way in human–Earth relations as we alter physical, chemical, and biological systems. Our attention to climate change science and applied topics is in response to the impacts we are experiencing and the future we are shaping.

All things considered, this is a critical 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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