



Preface

As with previous editions, *Applications and Investigations in Earth Science* is intended to be a supplemental tool for achieving an understanding of the basic principles of geology, oceanography, meteorology, and astronomy. While enrolled in what may be their first, and possibly only, Earth Science course, students will benefit from putting the material *presented* in the classroom to *work* in the laboratory. Learning becomes more significant when accomplished by discovery.

Ninth Edition Features

One of the goals for this ninth edition was to minimize the need for lengthy presentations at the start of each lab session. This allows more time for student involvement in lab activities, as well as more time for instructors to interact with students individually or in small groups. Here is a list of important features associated with this new edition:

- **Revised organization.** Previous users of this lab manual will see that the order of the exercises in Part I Geology has been changed. It now reflects the topic order associated with *Earth Science 15th edition*, the textbook most often used in conjunction with this lab manual. Of course, because exercises are largely self contained, they may be assigned in a different order.
- **New lab exercise on *Volcanism and Volcanic Hazards*.** At the urging of several reviewers and past users of this lab manual, a new exercise has been added. *Exercise 5: Volcanism and Volcanic Hazards* examines the nature of volcanic eruptions and the formation and characteristics of different types of volcanoes. The new exercise also explores some of the geologic hazards associated with volcanoes.
- **Pre Lab Videos.** Each lab is accompanied by a Pre Lab Video, prepared and narrated by Professor Callan Bentley. Each lesson examines and explains the key ideas explored in the exercise, thereby largely eliminating the need for a pre-lab lecture by the instructor.
- **A design and layout that promotes user flexibility.** Each exercise is divided into sections that include background material and one or more related activities for students to complete. This layout makes it easier for instructors to customize each exercise to fit the allotted lab period and their individual teaching preferences. The design also effectively ties figures and tables to the associated activities.
- **Mastering™ Geology.** Mastering Geology is an online homework, tutorial, and assessment program designed to work with this lab manual to engage students and improve results. Interactive, self-paced activities provide individualized coaching to help students stay on track. With a wide range of activities available, students can actively learn, understand, and retain even the most difficult Earth Science concepts. Materials in Mastering Geology include Pre-Lab Videos, Geoscience Animations, Mobile Field Trips, “Project Condor” Quadcopter videos, GIS-inspired Map-Master 2.0 interactive maps, *In the News* articles, Key Term Study Tools, and an optional Pearson eText.
- **SmartFigures—art that teaches.** Inside most exercises are *SmartFigures*. Students may use a mobile device to scan the Quick Response (QR) code next to a SmartFigure to view enhanced, dynamic art. Each 2- to 4-minute feature is a mini-lesson that examines the concepts illustrated by the figure. Several new SmartFigures have been added to this new edition. In addition to the Tutorials that appeared in the previous edition, there are now several SmartFigure Animations and SmartFigure Videos. SmartFigures is truly *art that teaches*.
- **Exercises that are largely self-contained.** Significant effort has been put into making the exercises less reliant on traditional text material and/or direct faculty instruction. In some cases, additional background material is provided within the exercise. Questions that rely heavily on outside material have been modified or replaced. We are confident that this approach makes exercises more useful and meaningful for students as well as instructors.
- **Inquiry-based lab experiences.** Whenever possible, the exercises provide hands-on learning. We also endeavor to engage students in gathering and analyzing scientific data to improve their critical reasoning skills.
- **Content and illustrations revised to improve clarity.** Our many years in the classroom have made us keenly aware of the frustration that students and instructors face when instructions, illustrations, and questions are unclear. Likewise, we recognize that instructors are genuinely interested in making learning experiences meaningful for their students. With those ideas in mind, the exercises were reviewed not only by Earth Science faculty but also by a support team with educational backgrounds other than Earth Science—a reflection, essentially, of the majority of the students who utilize this manual.



We sincerely hope that this ninth edition enhances the planning and implementation of instructional goals of all faculty—those who have used our materials for many years as well as those who bring fresh ideas and perspectives to the classrooms of the twenty-first century.

Acknowledgments

Writing a laboratory manual requires the talents and cooperation of many people. It is truly a team effort, and we authors are fortunate to be part of an extraordinary team at Pearson Education. In addition to being great people to work with, all are committed to producing the best textbooks possible. Special thanks to our Executive Editor at Pearson Education, Christian Botting. We appreciate his enthusiasm, hard work, and quest for excellence. We also want to acknowledge our conscientious Content Producer, Becca Groves for the skills she exhibited in keeping this project on track.

As always, we want to acknowledge the production team, led by Patty Donovan at SPi-Global, who turned our manuscript into a finished product. The team included copy editor Kitty Wilson, compositor SPi Global, and proofreader Linda Duarte. These talented people are true professionals, with whom we are very fortunate to be associated.

We owe special thanks to a number of other people who were critical to this project:

- Working with Dennis Tasa, who creates the manual's outstanding illustrations, is always enjoyable and rewarding. We value his amazing artistic talent, imagination, and extraordinary patience with extensive revisions. Dennis and his excellent staff have definitely strengthened an already outstanding art program.
- We value the support of Teresa Tarbuck of Vincennes University, whose editorial assistance greatly enhanced this ninth edition. She helped make the exercises more current, readable, and engaging.
- Callan Bentley has been an important contributor to this edition of *Applications and Investigations*. Callan is a professor of geology at Northern Virginia Community College in Annandale, where he has been honored many times as an outstanding teacher. He is a frequent

contributor to *Earth* magazine and author of the popular geology blog *Mountain Beltway*. Callan was responsible for preparing the Pre Lab Videos as well as many of SmartFigures that appear throughout this manual.

Appreciation also goes to our colleagues who prepared in-depth reviews of prior editions and the current edition. Their critical comments and thoughtful input helped guide and strengthen our efforts. Special thanks to:

Glenn Blaylock, Laredo Community College
Nahid Brown, Northeastern Illinois University
Brett Burkett, Collin County Community College
James Cunliffe, Nashville State Community College
Dora Devery, Alvin Community College
Carol Edson, Las Positas College
Ethan Goddard, St. Petersburg College
Roberta Hicks, Memorial University of Newfoundland
Jane MacGibbon, University of North Florida
Remo Masiello, Tidewater Community College
Mark Peebles, St. Petersburg College
Colleen Petosa, Tarrant County College
Melissa Ranhofer, Furman University
Jeffery Richardson, Columbus State Community College
James Sachinelli, Atlantic Cape Community College
Brian Scheidt, Mineral Area College
Jana Svec, Moraine Valley Community College
Krista Syrup, Moraine Valley Community College

Last, but certainly not least, we gratefully acknowledge the support and encouragement of our wives, Joanne Bannon and Nancy Lutgens. Preparation of *Applications and Investigations in Earth Science*, ninth edition, would have been far more difficult without their assistance, patience, and understanding.

Ed Tarbuck
Fred Lutgens