Preface

Laboratory Manual in Physical Geology has been developed by the geoscience education community for the benefit of our students and is produced under the auspices of the American Geosciences Institute (AGI) and the National Association of Geoscience Teachers (NAGT). For decades and continuing through the present day, it has been the most widely adopted manual available for teaching laboratories in introductory geology and geoscience.

The idea for this jointly sponsored laboratory manual originated with Robert W. Ridky (past president of NAGT and member of the AGI Education Advisory Committee), who envisioned a manual made up of the “best laboratory investigations written by geology teachers.” To that end, this edition represents the cumulative ideas of more than 225 contributing authors, 35 years of evolution in geoscience and geoscience education, the comments of faculty peer reviewers and geoscience professionals, instructors and their students who have used past editions since the laboratory manual was first published in 1986.

Proceeds from the sale of the Laboratory Manual in Physical Geology provide substantial financial support for the work of AGI and NAGT, benefiting the entire geoscience community.

New and Different in the 12th Edition

New editions of the Laboratory Manual in Physical Geology are developed because our science is continually evolving. New technologies, new data, and new hypotheses are being applied to the geosciences, as geoscientists strive to apply new knowledge and expertise to a society trying to cope with challenges related to water, energy, mineral resources, natural and human-induced environmental hazards, and global change. An ever-changing Laboratory Manual in Physical Geology is essential for AGI and NAGT to fulfill their missions in helping to educate and inform the public and to facilitate the development of the next generation of geoscientists.

The team that developed the new edition of this classic laboratory manual sought to preserve features that are familiar and valued by the geoscience education community while making revisions that were requested by users or deemed necessary to better reflect current developments in the geosciences.

Major Changes

- New Laboratory. The 12th edition includes a new laboratory (Lab 17) that focuses on a few important geological aspects of climate change. Six activities are provided to help guide student exploration of data and concepts related to climate change and the lab bring into focus some of the implications of a warming climate.

- Earth System Science. The idea of Earth as a system is now a more explicit thread throughout the lab manual. By describing students to Earth as a network of interacting systems, we hope they will better to understand the interconnectedness and interdependencies of our Earth environment. An introduction to systems thinking in geoscience is provided in Lab 1, and key words related to Earth system science are highlighted with in-text callouts in all chapters.

- Rock and Mineral Identification. New text and graphics have been added to the labs concerned with minerals and rocks to clarify the process of specimen identification. Specifically, new determinative tables for the field identification of igneous, sedimentary, and metamorphic rocks have been included that are broadly similar to tables in earlier editions. A new flow chart for the identification of unknown minerals has also been included. New photographs and photomicrographs add to already extensive explanations of form, texture, and composition to help students understand how to identify specimens.

- Learning Goals. Each lab activity now begins with a statement of learning goals for students as they work through the assignment. Typically, the learning goal is a statement of what a student will gain in working on that activity, such as experience working with data, increased understanding of materials or processes, or a chance to synthesize information and place it into a meaningful context.

- “Digging Deeper” Content and Activities. Content that might be considered somewhat advanced or suitable for enrichment beyond the basic educational needs of a student are identified with a “Digging Deeper” callout.

Incremental Changes

- Text. Portions of the supporting text in the 12th edition are new or have been revised, generally based on suggestions and reviews by faculty and students. Some material that was considered extraneous has not been included in the new edition. Great care has been taken to compose supporting text that is scientifically correct, uses the appropriate geoscience terms correctly, is comprehensible by undergraduate college students, and is well supported with illustrations.

- Activities. There are 11 new or significantly revised activities in the 12th edition in addition to the activities in the new climate-change lab, for a total of 17 new or
revised activities. The revisions were primarily intended to improve clarity or update content.

- **Photographs.** There are just over one hundred new photographs in the 12th edition. All of the new photographs of rock and mineral specimens are the result of very high-resolution macro photography enhanced by focus-stacking technology.

- **Maps.** Map scales throughout the lab book have been adjusted to make it easier for students to determine distances on maps using simple proportions. New topographic maps are based on the most current U.S. topographic map product published digitally by the USGS. Many of the maps have been simplified to reduce irrelevant elements and improve clarity.

- **Illustrations.** There are nearly 150 new or revised graphics, and countless minor revisions in the art components of the lab manual thanks to the remarkable contributions of Dennis Tasa.

- **Reordering of Lab Chapters.** The laboratory devoted to studying earthquakes is now located after the lab on Earth structures, because of the obvious connection between faults, folds, and earthquakes.

- **Reordering of Lab Activities.** Some of the lab activities featured in the previous edition are reordered within the respective labs in order to better follow the flow of information in the introductory text. In a few cases, the content of previous lab activities has been redistributed for clarity or to adjust the time needed to complete an activity. A full accounting of these types of changes is provided in the Instructor Resource Manual that is available to teachers from Pearson.

### Familiar Features in the 12th Edition

This edition contains the tried-and-tested strengths of eleven past editions of the Laboratory Manual in Physical Geology that have benefited students and teachers over more than three decades, along with updates that are consistent with current understanding in geoscience. The outstanding features listed below remain a core part of this manual.

#### Pedagogy for Diverse Styles/Preferences of Learning

Hands-on multisensory-oriented activities with samples, cardboard models, and GeoTools appeal to concrete/kinesthetic learners. High-quality images, maps, charts, diagrams, PowerPoints™, cardboard models, and visualizations appeal to visual/spatial learners. Activity sheets, charts, lists, supporting text, and opportunities for discourse appeal to linguistic/verbal/read-write learners. Presentation graphics (PowerPoint) and video clips appeal to auditory/aural learners. This content will be available on Mastering Geology. Numerical data, mathematics, models, graphs, systems, and opportunities for discourse appeal to logical/abstract learners.

#### Format and Pedagogical Framework

- **Big Ideas and Engaging Chapter Openers.** Every laboratory opens with an engaging image and a statement of Big Ideas, which establish the overall conceptual themes upon which the laboratory is based. Big Ideas are concise statements that help students understand and focus on the lab topic.

- **Supporting Text as a Persistent Reference.** The text that appears before the Activity section of each chapter serves two goals. One is the practical goal of providing essential information to students so that they can succeed in working through the Activities. The second is to provide students with a coherent body of information that will remain after the Activities are completed, and after the Activity pages are removed from the book.

- **Activities.** Laboratory geoscience courses should be environments where students engage directly with specimens, maps, photographs, data, and the processes of measurement and analysis. The 105 activities in the 12th edition are based on common samples and equipment that are available in typical geoscience teaching laboratories. Having access to such a large number of activities allows an instructor to select and adapt activities according to course content and level of difficulty. Because most activities do not require sophisticated equipment, they can also be assigned for students to complete as pre-laboratory assignments, lecture supplements, homework, or recitation topics.

- **Learning Goals.** As noted above, a new feature in the 12th edition is a statement of learning goals at the top of every activity worksheet.

- **Reflect & Discuss Questions.** Most activities conclude with a Reflect & Discuss question designed to foster greater accommodation of knowledge by having students apply what they learned to a new situation or to state broader conceptual understanding.

- **Continuous Assessment Options.** The pedagogical framework and organization provide many options for continuous assessment. Grading of students’ work is easier because all students submit their own work in a similar format. Instructors save time, energy, and resources because they no longer need to photocopy and distribute worksheets to supplement the manual.

#### Other Key Features

- **Outstanding Art.** Dennis Tasa’s brilliant artwork reinforces the visual aspect of geology and enhances student learning. We are continuing a process begun with the previous edition that will ultimately make all of our illustrations more accessible to people with color blindness or other vision-related issues. We are committed to a geoscience community that is diverse, inclusive, and welcoming to all.

- **Language and Geoscience Terminology.** We have continued the tradition of using vocabulary appropriate to undergraduate students in the 12th edition and have sought to keep geoscience jargon to a necessary
minimum. Rock and mineral terms are used in a way that is consistent with the published standards of the International Mineralogical Association and the International Union of Geological Sciences, as well as with the latest edition of the American Geoscience Institute (AGI) Glossary of Geology. The complete AGI Glossary of Geology is available in print, as an e-book for Kindle and Nook, as an app for mobile devices (available at the Apple Store and at Google Play), and online for universities and companies (but not for individuals; www.americangeosciences.org/pubs/glossary).

- Math. Geoscience is based largely on quantitative observations, measurements, and descriptions. Students are assumed to have an average understanding of basic high-school mathematics, although most of the mathematics needed to complete activities in this lab book is at a middle-school level. Through laboratory activities, we help students to refresh or develop useful math skills as they are needed to understand the material.

- GeoTools, GPS and UTM. Rulers, protractors, a sediment grain size scale, UTM grids, and other laboratory tools are available to cut from transparent sheets at the back of the manual. No other manual provides such abundant supporting tools! Students are introduced to GPS and UTM and their application in mapping. UTM grids are provided for most scales of U.S. and Canadian maps.

Pre-Lab Videos
Links to Pre-Lab videos are found on the chapter-opening pages of each lab and are accessed via a Quick Response (QR) code or URL. These videos allow students to come to lab better prepared and ready to immediately benefit from their engagement with lab exercise. The videos can be viewed during the students’ own preparatory time and review key concepts relevant to the lab activities. The videos, created by Callan Bentley (Northern Virginia Community College), are personable and friendly, and assure students that they will be able to successfully complete the lab activities by following a clear series of steps. Students can download free QR reader apps from the Apple App Store or Google Play.

Enhanced Learning Options
- Transferable Skill Development and Real-World Connections. Many activities have been designed or revised for students to develop transferrable skills and make connections that are relevant to their lives and the world in which they live. For example, they learn how to obtain and use data and maps that will enable them to make wiser choices about where they live and work. They evaluate their use of Earth resources in relation to questions about resource management and sustainability. They learn to use resources provided by the U.S. Geological Survey, JPL-NASA, NOAA, Google Earth and other online sources of reliable data and analysis about Earth’s resources, hazards, changes, and management.
- The Math You Need (TMYN) Options. Throughout the laboratories, students are referred to online options for them to review or learn mathematical skills using The Math You Need, When You Need It (TMYN). TMYN consists of modular math tutorials that have been designed for students in any introductory geoscience course by Jennifer Wenner (University of Wisconsin–Oshkosh) and Eric Baer (Highline Community College).
- Mobile-Enabled Media and Web Resources. Quick Response (QR) codes give students with smartphones or other mobile devices instant access to supporting online media content and websites.

Instructor Support
An Instructor Resource Manual for Laboratory Manual in Physical Geology, 12th edition, is available online to verified teachers via their Mastering account (www.mastering-geology.com). The Instructor Manual has been designed to help seasoned and new professors alike, offering a detailed listing of changes between the 11th and 12th editions, teaching tips, information to help teachers prepare for each lab, answers and explanations for each activity, a list of web resources, and the source references for the laboratory topic. Also available for each chapter are JPEG images of each of the figures as well as a PowerPoint document with all the figures. Contact your Pearson representative for access information and instructions (www.pearson.com/us/contact-us/find-your-rep.html).

Educational Technology from Pearson
Mastering Geology
The Mastering Geology platform delivers engaging, dynamic learning opportunities—focused on course objectives and responsive to each student’s progress—that are proven to help make course material accessible and to help them develop their understanding of difficult concepts. Robust diagnostics and unrivalled gradebook reporting allow instructors to pinpoint the weaknesses and misconceptions of a student or class to provide timely intervention.

- Pre-lab video quizzes help students come to lab better prepared and ready to immediately get started with the lab exercise.
- Post-lab quizzes assess students’ understanding and analysis of the lab content.

Learn more at www.masteringgeology.com.

Learning Catalytics
Learning Catalytics™ is a “bring your own device” student engagement, assessment, and classroom intelligence system. With Learning Catalytics you can:

- assess students in real time, using open-ended tasks to probe student understanding.
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- improve your students’ critical-thinking skills.


- access rich analytics to understand student performance.
- add your own questions to make Learning Catalytics fit your course exactly.
- manage student interactions with intelligent grouping and timing.

Learning Catalytics is a technology that has grown out of twenty years of cutting edge research, innovation, and implementation of interactive teaching and peer instruction. Available integrated with Mastering Geology. To learn more, go to www.learningcatalytics.com.

About the Editor

Vince Cronin is an award-winning geoscience educator who has served as a teaching assistant, teacher, or laboratory coordinator for introductory physical geology courses taught at several private and public colleges and universities since 1978. Dr. Cronin is currently Professor of Geosciences at Baylor University and is a licensed and certified professional geologist whose experience in applied and academic geology is quite broad. His research has included plate kinematics, crustal deformation, active faulting, elastic stratigraphy, topics in engineering geoscience, and geoethics.

Contribute Your Ideas

The continued enhancement and success of the Laboratory Manual in Physical Geology depends on constructive criticisms, suggestions, and new contributions from the students and teachers who use it. We welcome all constructive input that will contribute to the positive evolution of this resource. With your help, this lab manual will continue to develop in a beneficial way for students and for the geoscience community served by AGI and NAGT. Please continue to submit your ideas, suggestions, and constructive criticisms directly to the editor: Vince Cronin (Vince_LM_Editor@CroninProjects.org).

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