GEOLOGY

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If you are interested in Earth—how it developed and what may happen to it in the future, how it functions as a complex physical and chemical system and why we should care, where life originated and how and why our planet supports us, and how our actions affect the world around us—a major in geology may be right for you.

The Department of Geology possesses extensive rock, mineral, and fossil collections as a basis from which to investigate Earth, a micro X-ray-fluorescence (micro-XRF) spectrometer for mapping rock and mineral elemental compositions, a powder X-ray diffractometer (powder-XRD) for determining mineral identities, research-grade stereo and petrographic microscopes, and rock and sediment-sample processing equipment. The department also houses the College’s scanning electron microscope (SEM) equipped with an energy-dispersive X-ray-fluorescence spectrometer (EDS) for micron-scale elemental analyses. Additional research equipment available for student use, shared with other departments in the Division of Natural Sciences, includes a C,H,N,O,S elemental analyzer, an inductively coupled plasma atomic emission spectrometer (ICP-AES) for determining elemental compositions, and the Colby Compass, a research boat equipped with an array of instrumentation for real-time environmental analyses.

Colby’s setting provides an intriguing and exciting area for field study, enabling students to integrate field and laboratory experiences. Students are encouraged to engage in independent and honors research projects with faculty. Research opportunities are offered routinely during the summer by departmental faculty at Colby and abroad.

Fieldwork is an integral part of geology courses and introduces students to various aspects of local and regional geology. Multi-day off-campus trips are scheduled regularly to localities and areas of particular geologic interest, such as the Hartford Basin of Connecticut, the Mohawk Valley or Catskill Mountains of New York, the classic Joggins and Brule localities in Nova Scotia, and late Paleozoic rocks of New Brunswick. The department also provides off-campus international experiences, including study in Bermuda.

The Geology Department offers both a major and a minor for students with different interests. The point scale for retention of the major applies to all courses taken in the major; no requirement may be taken satisfactory/unsatisfactory. Students should consult regularly with their advisor in selecting courses appropriate for meeting their goals for post-graduation employment and/or graduate study.

Requirements for the Major in Geology

Requirements for the geology major are:

- A 100-level gateway course (Geology 122, 123, 125, 127, or 141)
- Four core courses (Geology 228, 231, 254, and 262)
- Four geology elective courses numbered 200 or above
- Three credits of geology seminar (Geology 391)
- Geology 494 or six credits of honors-thesis research (Geology 483/484); and
- Two cognate courses from the following list: Biology 163, 164; Chemistry 121, 122, 141, 142, 147; Computer Science 151, 152, 153; Physics 141, 143, 145; Math 121, 122; and Statistics 212.

Geology majors may substitute one course in biology, chemistry, computer science, GIS, mathematics, physics, or statistics numbered 200 or above (excluding Statistics 212) for one of the four geology elective courses. A single independent research project earning at least four credit hours of Geology 491/492 during the student’s senior year also may count as a major elective. Additional course work in chemistry, physics, and mathematics beyond the minimum requirements is strongly encouraged to broaden students’ skill sets and maximize options after graduation. Students should consult one of the major advisors in the first and second years regarding election of languages and other Colby-required courses.

Requirements for Honors in Geology

The Geology Department’s honors program involves a substantial research component in the student’s senior year, with no fewer than six credit hours of Geology 483/484 and completion of a thesis detailing this work. Participation in the honors program requires a 3.5 GPA in the major by the end of the junior year before a faculty sponsor can consider the project. The honors program involves presentation of a research proposal to a faculty committee early in the fall semester, drafting and approval of introductory sections before January, submission of a full draft of the thesis for review by spring break, and approval of the final thesis by the faculty committee. Satisfactory progress will result in credit for Geology 483 and 484. Successful completion of an honors research project, and the major, will enable the student to graduate with “Honors in Geology.” Students who wish to pursue an even more intensive research agenda should consider the Senior Scholars Program, an all-campus honors program in which half the student’s academic credits in the senior year are devoted exclusively to a major research project.
Requirements for the Minor in Geology

A minor in geology is available to students majoring in other disciplines who also desire an introductory understanding of the earth sciences. Minor programs are tailored to the needs of individual students; courses should be elected in consultation with the minor advisor. Requirements are:

- A 100-level gateway course (Geology 122, 123, 125, 127, or 141)
- Four geology courses selected from courses numbered 228 and above.

Course Offerings

**[GE111]** Geology of National Parks  U.S. national parks and monuments will provide the focus for an introduction to basic geologic processes, including plate tectonics, geologic time, weathering and erosion, volcanism, earthquakes, caverns, shorelines, and the rock cycle. After an introduction to the regional geology of the United States, the focus will shift to the parks and monuments within these regions. Students will become aware of aspects of physical and historical geology, regional geography, environmental issues, the aesthetics of nature, and the interactive processes that have shaped the country. A field trip to Acadia National Park is included. Lecture only.  *Three credit hours.*  N.

**[GE121]** Earth Systems Chemistry I  Listed as Chemistry 121.  *Four credit hours.*  N, Lb.

**[GE122]** Earth Systems Chemistry II  Listed as Chemistry 122.  *Four credit hours.*  N, Lb.

**GE123s** How to Build a Habitable Planet  Examines fundamental chemical and physical Earth processes operating at timescales from minutes to billions of years; how these processes evolved over Earth's 4.56-billion-year history and changed Earth into an ideal environment for complex life; the methods scientists use to understand Earth processes and develop this deep-time record of global change; and how human activity is currently altering global processes and impacting Earth's habitability. High-school-level chemistry is recommended but not required to succeed in the course.  *Prerequisite:* Credit cannot be earned for both this course and Geology 122, 125, 127, or 141.  *Four credit hours.*  N, Lb.  SULLIVAN

**GE125f** From Stardust to Planets  Explores the physical and chemical evolution of the Earth in the context of solar system formation. By studying the development of the terrestrial (rocky) planets, students will be introduced to fundamental concepts in geology. As students investigate geologic processes on other planetary bodies, they will develop a deeper understanding of our own planet's evolution and geology. We will focus on important questions, such as "How did Earth become a habitable planet?" and "How has humanity impacted the Earth's evolution?" High-school-level chemistry is recommended but not required to succeed in the course.  *Prerequisite:* Credit cannot be earned for both this course and Geology 122, 125, 127, or 141.  *Four credit hours.*  N, Lb.  DUNN

**GE127f** Pale Blue Dot: Earth Through Time  Carl Sagan referred to Earth as a Pale Blue Dot containing the entire history of our species. Geologists understand that Earth also contains a history of its own. This course focuses on the evolution of Earth from its origin 4.56-billion years ago to today. It will include study of the chemical, biological, physical, and geologic processes that have shaped Earth since its inception. Concepts of deep time, the evolution of life on Earth, and the impacts of life on the atmosphere, oceans, and climate will be major components of the course. High-school chemistry and biology will be useful, but students will be able to succeed without them.  *Prerequisite:* Credit cannot be earned for both this course and Geology 122, 123, 127 or 141.  *Four credit hours.*  N, Lb.  RUEGER

**GE1XXs** TBD  *Four credit hours.*  GEIGER-ORTIZ

**GE228s** Earth Materials  Highlights the properties, classification, and origin of rocks and minerals. Students will learn the basic principles of crystallography and mineral chemistry, and how igneous and metamorphic rocks are used to interpret Earths history. In the lab portion of the course, students will identify and classify minerals and rocks using both macroscopic and microscopic techniques. Through regularly scheduled reading assignments, students will learn how fundamental principles of mineralogy and petrology are applied to current research in Earth Science. Includes two required field trips extending into the athletic zone, and a required weekend field trip.  *Prerequisite:* Chemistry 122 or Geology 123, 125, 127, or 141.  *Four credit hours.*  N.  DUNN

**GE231f** Earth Structure and Tectonics  Applies fundamental concepts of stress and strain to understand the different styles of deformation at convergent, divergent, and transform plate boundaries; the physical and chemical mechanisms that control the strength of plate-bounding fault zones; how these deformation mechanisms change with increasing depth in Earth; and how to read the rock record of plate-tectonic deformation. Students also will develop fundamental field-observation skills, and practice written and graphical communication skills as they are applied in the Earth sciences. Three required field trips extend into the athletic zone.  *Prerequisite:* Chemistry 122 or Geology 123, 125, 127, 141, or 146.  *Four credit hours.*  N, W2.  SULLIVAN
GE242] Hydrogeology  Examines the fundamental principles of hydrogeology and introduces geophysical techniques (surface and borehole) used to investigate flow through the subsurface. Designed to provide the tools necessary to understand and characterize groundwater systems. Topics include the hydraulic properties of rocks, aquifer storage and subsidence, flow potential, analysis of pumping tests conducted in water wells, and interpretation of geophysical field data. Includes lecture, homework from textbook, oral presentation, and analysis of a variety of geophysical logs.  
Prerequisite: Chemistry 122 or Geology 123, 125, 127 or 141 and Mathematics 121, 122, or 161.  
Three credit hours.  N.  MORIN

GE254f  Mountains to Sea: Introduction to Geomorphology  An examination of the processes driving landscape change over time with field-based study in Maine. Students will measure sediment-transport processes, analyze and interpret satellite imagery using R-Studio, synthesize field measurements of stream flow and sediment size, and communicate their data and interpretations in writing, orally, and graphically. A mix of lectures, discussions, student presentations, lab exercises, and field study. Includes two required field trips extending into the athletic zone, and a required one-day weekend field trip.  
Prerequisite: Chemistry 122 or Geology 123, 125, 127, or 141.  Four credit hours.  N.  GEIGER-ORTIZ

[GE256] Sedimentation and Stratigraphy  A module-based course in which students learn how to apply sedimentary rocks to interpreting Earth's stratigraphic record and develop a fundamental understanding of sediments and resulting rock types found in Earth's sedimentary successions. Modules include (1) the analysis of drill cores from coastal deposits in the Carboniferous of Alabama, (2) field and laboratory analysis of Silurian-Devonian carbonate sequences in New York State, and (3) an exercise in which the principles of sequence stratigraphy will be modeled. Students will learn to evaluate the sedimentary rock record over space and time using currently accepted approaches and models. Includes a required one-day weekend field trip. Previously listed as Geology 356.  
Prerequisite: Chemistry 122, or Geology 123, 125, 127, or 141.  Four credit hours.  W2.

[GE262] Earth's Climate: Past, Present, and Future  Takes a systems approach to studying Earth's climate by linking the primary systems operating at Earth's surface, i.e., lithosphere, atmosphere, biosphere, hydrosphere, cryosphere. Explores the mechanisms that shape environmental evolution across a range of time scales, including the role of humans, and uses past (paleo) records of change to place modern climate change in geological context. Students will engage with material through problem sets, data analysis, interactive lectures, primary literature synthesis, and writing. Laboratory projects will provide hands-on opportunities to develop local records of past environmental change. Includes a required one-day weekend field trip.  
Prerequisite: Chemistry 122 or Geology 123, 125, 127, or 141.  Four credit hours.  N.

[GE279] Geology of Bermuda  Students will learn how the island of Bermuda, subjected to a variety of geologic processes, has evolved over the past two million years. They will be exposed to the scientific method and how geologists study the Earth, its materials, and its processes. During field and laboratory observations, students will investigate how organisms, including humans, and sedimentary processes have shaped Bermuda; how sediment is formed, moved, consolidated, and lithified; and the interrelationships between geology and biology. They will gain an appreciation of the complexities of living on an island and the anthropogenic impacts on a fragile ecosystem. Cost in 2018: $2,700.  
Prerequisite: Chemistry 122, or Geology 123, 125, 127 or 141.  Three credit hours.  N, Lb.

[GE331] Plate Tectonics  Primary-literature-synthesis course that guides students through the topic of plate tectonics from the development of the theory to some modern-day theories on crustal growth and plate-boundary processes. Students will be able to (1) piece together a broad-scale interpretation of the evolution of a plate boundary using data and interpretations gleaned from the primary scientific literature and (2) use basic thermochronologic, geophysical, geological, and geospatial data sets to interpret plate boundaries. Improving students’ verbal and written communication skills while providing an experience in accessing, reading, and assimilating scientific literature.  
Prerequisite: Geology 231 or permission of the instructor.  Four credit hours.

[GE332] Igneous and Metamorphic Petrology  Teaches students to identify igneous and metamorphic rocks and to understand the physical and chemical processes responsible for their formation. Students learn how to use and evaluate a variety of data sets, and they develop skills using a petrographic microscope and the scanning electron microscope (SEM). They also develop interpersonal, critical-thinking, and communication skills that enable them to discuss petrologic processes in the broader geologic context of tectonic setting.  
Prerequisite: Geology 228.  Four credit hours.

[GE335] Geologic Field Methods  Students will learn how to conduct and manage multi-day geologic mapping projects; use field observations and data to interpret the geologic history of different environments in Maine; produce detailed geologic reports based on surface geology; and hone their written, graphical, and interpersonal communication skills. Includes two required three-day weekend field trips.  
Prerequisite: Geology 231 or permission of the instructor.  Four credit hours.  W2.

[GE351s] The Record of Life on Earth  Using original research as an educational platform, students learn how to acquire and assess scientific data, to reference and synthesize primary literature, and to justify their arguments and conclusions in both written and oral forms. Provides a greater understanding of the processes responsible for a fossil record, its classification, the use of these data in evolutionary
theory, the dynamics of individuals and populations or organisms over space and time, and the application of paleontological data to understanding ecological response to climate change, perturbation, and extinction mechanisms. **Prerequisite:** Chemistry 122 or Geology 123, 125, 127 or 141, or one year of Biology. Three credit hours. N. RUEGER

**[GE361] Topics in Geochemistry** Covers fundamental topics in geochemistry, including principles of equilibrium thermodynamics, pH, alkalinity, weathering reactions, redox reactions, trace elements, and stable and radioactive isotopes. Through lecture, problem sets, and primary literature, students explore the theory and application of a range of geochemical approaches used to study Earth-system processes. Students develop critical thinking skills through the interpretation of primary datasets and literature, and they improve their written and oral presentation skills by communicating scientific findings. **Prerequisite:** Chemistry 122, or Geology 123, 125, or 141. Chemistry 142 and at least one of the following: Geology 225, 231, 254, 256, 262, Chemistry 217, or Environmental Studies 276. Four credit hours. KOFFMAN

**GE363f Paleoceanography** This primary literature synthesis course examines past global change through the lens of the marine sedimentary record. Students explore the major physical and geochemical proxies used in paleoceanographic research and focus on understanding the major scientific questions addressed, methods and instrumentation used, and advantages and limitations of each proxy tool. Students also develop critical thinking skills through the interpretation of primary datasets and literature, and improve their written and oral presentation skills through communicating scientific findings. **Prerequisite:** Geology 262 or permission of the instructor. Four credit hours.

**GE391fs Geology Seminar** Paper discussions and presentations from invited guest lecturers on topics of current interest in all areas of the geosciences. Majors must complete three seminars during their course of study. Nongraded. One credit hour. GEIGER-ORTIZ, SULLIVAN

**[GE483] Senior Honors Project** A culminating, research-intensive experience in which students engage in an original project with the expectation that results will be of significantly high caliber to warrant publication after review by committee. The final written report will be in a selected journal format, and project results will be presented formally in a professional context. Students should consult with major advisors during their junior year to learn about on-campus and off-campus opportunities and experiences that can be used in preparation for undertaking an honors program. **Prerequisite:** Permission of the instructor. Three or four credit hours.

**[GE483J] Senior Honors Project** Noncredit.

**GE491f, 492s Independent Study** Independent research experience supervised by a faculty member. Research projects earning three or more credit hours over one or more semesters require a final written report and a formal presentation in a professional setting. **Prerequisite:** Permission of the instructor. One to four credit hours. FACULTY

**[GE494] Topics in Geoscience** A capstone experience in which students explore a cutting-edge scientific topic in great depth. Students will hone skills introduced throughout the Geology majors, including assimilating, analyzing, and interpreting the scientific literature and communicating in writing, orally, and graphically. Students will also gain experience communicating specialized scientific topics to a general audience. May be repeated for credit. May include up to three required weekend field trips. **Prerequisite:** Junior or Senior standing. Four credit hours. W3.