GEOLOGY

Students may complete a major or minor in Geology. Within the major, students may complete a concentration in geochemistry.

The department seeks to give students a well-rounded Earth science education that balances fundamental knowledge of geology with broadly applicable problem-solving and communication skills. The integrated science of geology combines biology, chemistry, and physics as they apply to the workings of Earth and other planets. Well-trained geoscientists are increasingly in demand to address the environmental challenges and natural resource limitations of the modern world. A central tenet for understanding and predicting Earth processes and environmental change is the ability to decipher past Earth history from geologic records. Thus, the major in Geology includes study of the physics and chemistry of Earth materials and processes; the history of the Earth and its organisms; and the range of techniques used to investigate the past and present workings of the Earth system. Experiential learning is an important part of geology training. Field trips, lab work, and other practical experiences are part of many of our courses and student research projects.

Major Requirements

Twelve courses are required for the major:

Code	Title	Units
GEOL B101	How the Earth Works	1
GEOL B202	Mineralogy and Crystal Chemistry	1
GEOL B203	Biosphere Through Time	1
GEOL B204	Structural Geology	1
GEOL B205	Sedimentary Materials and Environments	1
Select at least two semester of quantitative or computational coursework [1]		2
Select a two-semester sequence of CHEM or PHYS:		2
CHEM B103 & CHEM B104	General Chemistry I and General Chemistry II	
PHYS B101 & PHYS B102	Introductory Physics I and Introductory Physics II	
PHYS B121 & PHYS B122	Modern Physics and Classical Mechanics	
GEOL B399 & GEOL B400	Senior Capstone Seminar and Senior Thesis	1
Select either two advanced geology courses or one advanced geology course and an additional upper-level course in biology, chemistry, mathematics, physics, or computer science		2
Total Units		**12**

[1] e.g. MATH B101 Calculus I and MATH B102 Calculus II or alternates approved by your adviser

The writing requirement for the major in Geology is fulfilled through completion of GEOL B202 Mineralogy and Crystal Chemistry, GEOL B204 Structural Geology and GEOL B205 Sedimentary Materials and Environments, all of which are writing attentive.

Additional courses in the allied sciences are strongly recommended and are required by most graduate schools. A student who wishes to follow a career in geology is encouraged to enroll in a summer field course (not offered in the Tri-Co), usually following completion of the 200-level courses for the major.

Senior Capstone

All Geology majors participate in a senior capstone experience, which is a year-long course series (GEOL B399 Senior Capstone Seminar/GEOL B400 Senior Thesis), totaling one credit, that combines an independent project and a weekly seminar. The independent project gives students the opportunity and experience of creatively developing their own academic project; following through on that project; getting constructive feedback on that project; revising and improving that project; and submitting a report or other product that effectively communicates the project's outcomes. Students' independent projects may take a variety of creative forms and are developed in consultation with the student's agreed upon advisor. Ideally the independent project is organized, planned, and arranged by the student and advisor by the end of the student's junior year. So as not to overload any one faculty member in the department, the total number of students will, as best as possible, be distributed across the faculty evenly, with preference given to those students whose projects overlap the expertise of a given faculty member.

The focus of the capstone seminar is to reinforce students' ability to address geoscience questions and to communicate their findings orally and in writing. Students and faculty meet once every week to develop skills necessary to complete their independent projects, discuss topics related to scientific literacy and practice, and prepare students for the next step in their careers.

Concentration in Geochemistry

The geochemistry concentration encourages students majoring either in Geology or in Chemistry to design a course of study that emphasizes Earth chemistry. Paperwork for the concentration should be filed at the same time as the major work plan. For a Geology major with a concentration in geochemistry, the following are required:

Code	Title	Units
GEOL B101	How the Earth Works	1
GEOL B202	Mineralogy and Crystal Chemistry	1
GEOL B203	Biosphere Through Time	1
GEOL B204	Structural Geology	1
GEOL B205	Sedimentary Materials and Environments	1
GEOL B399	Senior Capstone Seminar	0.5
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
CHEM B211	Organic Chemistry I	1
or CHEM B231	Inorganic Chemistry	
Select one of the following:		1
GEOL B302	Low-Temperature Geochemistry	
GEOL B305	Igneous and Metamorphic Petrology	
GEOL B350	Advanced Topics in Geology (requires major advisor approval)	
Select one additional 300-level geochemistry-themed GEOL course or one additional advanced CHEM course		
Total Units		**9.5**

For a Chemistry major with a concentration in geochemistry, the following are required in addition to Chemistry major requirements (see Chemistry major advisor):

Code	Title	Units
GEOL B101	How the Earth Works	1
GEOL B202	Mineralogy and Crystal Chemistry	1
Select two additional 300-level geochemistry-themed GEOL courses including the following:		2
GEOL B302	Low-Temperature Geochemistry	
GEOL B305	Igneous and Metamorphic Petrology	
GEOL B350	Advanced Topics in Geology (requires Geology major advisor approval)	
Total Units		**4**

For course planning advice, contact Pedro Marenco (Geology) or Sharon Burgmayer (Chemistry) (on leave semesters I & II).

Honors

Honors are awarded to students who have outstanding academic records in Geology and allied fields and whose independent project is judged by the department faculty to be of the highest quality.

Minor Requirements

A minor in Geology consists of two 100-level Geology courses, and any four of the 200- or 300-level courses offered by the department. Two 0.5 credit courses may be combined to count toward one of the 100-level courses. Alternatively, an additional 200- or 300-level course may be substituted for one of the 100-level courses to meet the minor requirements.

GEOL B101 How the Earth Works (1 Unit)
An introduction to the study of planet Earth—the materials of which it is made, the forces that shape its surface and interior, the relationship of geological processes to people, and the application of geological knowledge to the search for useful materials. Laboratory and fieldwork focus on learning the tools for geological investigations and applying them to the local area and selected areas around the world. Three lectures and one afternoon of laboratory or fieldwork a week. One required one-day field trip on a weekend.

GEOL B104 The Science of Climate Change (1 Unit)
A survey of the science behind climate change. Students will analyze climate data, read primary scientific literature, examine the drivers of climate change, and investigate the fundamental Earth processes that are affected. We will also examine deep-time climate change and the geologic proxies that Earth scientists use to understand climate change on many different time scales. This course is appropriate for students with little to no scientific background but is geared toward students who are considering a science major. Two 90-minute lectures per week.

GEOL B107 Geology of Coal, Oil, and Nuclear Energy (1 Unit)
This course covers the fundamentals of coal, oil, and nuclear, with an emphasis on their environmental and climate impacts. Concepts to be developed include the geologic formation of these materials, their relationships with the biosphere and geochemistry, and the long-term environmental consequences of their extractions. Students will conduct specimen and data analysis, field sampling, and lab work in order to examine local environmental impacts related to mining and drilling, as well as global impacts related to climate change. Emphasis will be placed on the scientific process, and how scientists obtain, process, and interpret data. No previous scientific training is required; however, a basic proficiency with data analysis in Excel or R is beneficial, as this course will rely heavily on data analysis.

GEOL B108 Earth's Oceans: Past, Present, and Future (1 Unit)
This course is designed to expose students to the fundamentals of oceanography with an emphasis on how Earth's oceans are tied to life and climate and how we study these links in the present and in the fossil record. We will spend much time understanding how the modern ocean works and how biogeochemical cycles interact with it. A major focus will be how we can use the ocean's past and present to make predictions about its future. This is a flipped course in which students study pre-recorded presentations outside of class. Class time is devoted to labs, demonstrations, and other activities.

GEOL B112 Geology in Film (1 Unit)
Geologic processes make for great film storylines, but filmmakers take great liberty with how they depict scientific "facts" and scientists. We will explore how and why filmmakers choose to deviate from science reality. We will study and view one film per week and discuss its issues from a geologist's perspective.

GEOL B202 Mineralogy and Crystal Chemistry (1 Unit)
The crystal chemistry of representative minerals as well as the relationship between the physical properties of minerals and their structures and chemical compositions. Emphasis is placed on mineral identification and interpretation. The occurrence and petrography of typical mineral associations and rocks is also covered. Lecture three hours, laboratory at least three hours a week. One required field trip on a weekend. Prerequisite: introductory course in Geology or Chemistry (both recommended, one required). This is course fulfills a Writing Attentive requirement.

GEOL B203 Biosphere Through Time (1 Unit)
We will explore how the Earth-life system has evolved through time by studying the interactions between life, climate, and tectonic processes. During the lab component of the course, we will study important fossil groups to better understand their paleoecology and roles in the Earth-life system. Prerequisite: GEOL B101, GEOL B108, or GEOL B209.

GEOL B204 Structural Geology (1 Unit)
An introduction to the study of rock deformation in the Earth's lithosphere viewed from all scales - from the microscopic (atomic scale) to the macroscopic (continental scale). This class focuses on building a foundation of knowledge and understanding that will allow students to broaden their appreciation and understanding of the complexity of the Earth system and the links between geologic structures at all scales and plate tectonics. Three lectures and three hours of laboratory a week, plus a required three-day, weekend field trip. Prerequisite: GEOL 101 and MATH 101.

GEOL B205 Sedimentary Materials and Environments (1 Unit)
An introduction to sediment transport, depositional processes, and stratigraphy, with emphasis on interpretation of sedimentary sequences and the reconstruction of past environments. Three lectures and one lab a week, plus a one-day field trip on a weekend. Prerequisite: GEOL B101 or B108 or instructor permission. Recommended: GEOL B202 and B203.Recommended: GEOL B202 and B203. This is course fulfills a Writing Attentive requirement.

GEOL B206 Energy Resources and Sustainability (1 Unit)
An examination of issues concerning the supply of energy required by humanity. This includes an investigation of the geological framework that determines resource availability, aspects of energy production and resource development and the science of global climate change. Two 90-minute lectures a week. Suggested preparation: one year of college science.

GEOL B209 Natural Hazards (1 Unit)
A quantitative approach to understanding Earth processes that impact human societies. We will examine earthquakes, volcanic eruptions, landslides, storms, and floods and explore the risks that they pose to communities. Course emphases include the fundamental physical principles and processes that govern natural hazards, approaches to mitigating the effects of natural disasters and responding in their aftermath, and examples of natural disasters from the recent and historical past. Lecture three hours a week.

GEOL B210 Cataloging Collections (1 Unit)
This course is an introduction to cataloguing as an integral component of museum collections management. Students will consider the history, theories, and practices of cataloguing as a museum practice as it relates to the different objectives of various types of museums (art, natural history, science, history, zoological). Students will explore how cultural attitudes, institutional policies, and social expectations have historically influenced, and continue to shape, the development of collections management policies and procedures, while undertaking projects related to collections research and cataloguing. They will evaluate and recommend standardized vocabularies to build a collections database that accommodates more complex histories while optimizing searchability. They will engage with instructors who are actively involved in the professional operations of and calls to "decolonize" collections, becoming trained in the fundamentals of cataloguing collections as they actively rethink these structures and contribute to object records.

GEOL B299 Geology Field Short Course (0.5 Unit)
Geology majors choosing to participate in the annual Fall- or Spring-Break Geology Department Field Trip must enroll in GEOL B299. Enrollment in this class does not guarantee a spot on the field trip. Several pre-trip class meetings help maximize student engagement on the trip by providing a forum for discussing the assigned readings. During the week-long field trip, students are exposed to geologic field methods while visiting sites that exemplify different geology from that at sites near campus. Geologic methods introduced may include proper field notetaking, mapping and measuring geologic structures, and interpreting geologic history. Culminating work introduces students to geologic illustration and report writing. A passing grade requires full participation and engagement by the student before, during and after the field trip. At least one post-trip meeting is held on campus to synthesize the material covered, and to go over students' final reports. Prerequisite: GEOL B101; and GEOL B202, B203, B204 or B205.

GEOL B302 Low-Temperature Geochemistry (1 Unit)
Stable isotope geochemistry is one of the most important subfields of the Earth sciences for understanding environmental and climatic change. In this course, we will explore stable isotopic fundamentals and applications including important case studies from the recent and deep time dealing with important biotic events in the fossil record and major climate changes. Prerequisites: GEOL B101 or GEOL B108, and at least one semester of chemistry or physics, or permission of instructor.

GEOL B304 Tectonics (1 Unit)
Plate tectonics and continental orogeny are reviewed in light of the geologic record in selected mountain ranges and certain geophysical data. Three hours of lecture and a problem session a week. Prerequisite: GEOL 204 or permission of instructor.

GEOL B305 Igneous and Metamorphic Petrology (1 Unit)
The study of igneous and metamorphic rocks, including their origins and modes of occurrence. The focus is on understanding how these rocks form, and on applying a combination of field methods, laboratory techniques, and theoretical understanding to interpret the origins of igneous and metamorphic rocks. The class will build on the study of mineralogy by examining assemblages of coexisting minerals, and what those assemblages reveal about the pressure, temperature, and chemical conditions under which a rock must have formed. For a culminating term project, we will conduct an intensive study of local metamorphic rocks. Three lecture hours weekly and one weekly lab. One weekend field trip. Prerequisites: GEOL B202.

GEOL B310 Introduction to Geophysics (1 Unit)
An overview covering how geophysical observations of the Earth's magnetic field, gravity field, heat flow, radioactivity, and seismic waves provide a means to study plate tectonics and the earth's interior. Three class hours a week with weekly problem sets. Prerequisite: one year of college physics or with permission of professor.

GEOL B314 Marine Geology (1 Unit)
This course covers the physical, chemical and biological factors that shape marine environments, with emphasis on coastal ecosystems and landforms, and the implications of climate change for humans in the coastal zone. Meets twice weekly for a combination of lecture and discussion. Includes a mandatory day-long field trip to the Mid-Atlantic US coast. Prerequisite: two GEOL or BIOL courses, or ENVS H201 plus one course in GEOL or BIOL.

GEOL B350 Advanced Topics in Geology (1 Unit)
This is a topics course. Course content varies. Recent topics include Geology and Colonialism, Carbonate Petrology, Appalachian Geology, Advanced Evolution, The Snowball Controversy, and Climate Change.

GEOL B399 Senior Capstone Seminar (0.5 Unit)
A capstone seminar course required for all Geology majors. All Geology seniors will be required to participate in this two-semester seminar that meets bi-weekly for 2 hours for a total of 1.0 credit (0.5 credits per semester). Enrollment required in two half-credit courses, one in the fall and one in the spring semester of the senior year. The focus of the capstone seminar is to reinforce students' ability to address geoscience questions and to communicate their findings orally and in writing. Students and faculty will meet once every other week to help students develop the skills necessary to complete their independent projects, discuss topics related to scientific literacy and practice, and prepare students for the next step in their careers.

GEOL B400 Senior Thesis (0.5-1 Unit)
Rising seniors will undertake an independent project in addition to mandatory full participation in the senior capstone seminar. This student project is conducted under the supervision of a faculty advisor(s). The project plan is initially developed and agreed upon by conference between the supervising faculty member(s) and the student. Most of the research is conducted independently by the student. The advisor serves as a source of ideas concerning scientific literature, methodologies, and financial support. The advisor may visit and inspect the research sites, laboratory or model, and offer advice on how the research should be conducted or modified.

GEOL B403 Supervised Research (0.5-1 Unit)
Optional laboratory or field research on a wide variety of topics, open to junior or senior majors. Interested students must consult with department faculty members as early as possible, preferably before the start of the semester, in order to choose a faculty supervisor. The student and faculty supervisor meet early in the semester to plan the research and discuss gradable outcomes (e.g., final research paper). Requires permission of the instructor and the major advisor.

GEOL B415 Teaching Assistant (0.5 Unit)

ARCH B570 Geoarchaeology (1 Unit)
Societies in the past depended on our human ancestors' ability to interact with their environment. Geoarchaeology analyzes these interactions by combining archaeological and geological techniques to document human behavior while also reconstructing the past environment. Course meets twice weekly for lecture, discussion of readings and hands on exercises. Prerequisite: one course in anthropology, archaeology or geology.

BIOL B236 Evolution (1 Unit)
A lecture/discussion course on evolutionary biology. This course will cover the history of evolutionary theory, population genetics, molecular and developmental evolution, paleontology, and phylogenetic analysis. Lecture three hours a week.

BIOL B250 Computational Methods in the Sciences (1 Unit)
A study of how and why modern computation methods are used in scientific inquiry. Students will learn basic principles of analyzing, modeling, and visualizing scientific data through hands-on programming exercises. Content will draw on examples from across the life sciences. This course will use the Python programming language. No prior programming experience is required. Six hours of combined lecture/lab per week.