

# GEOLOGY (BRYN MAWR)

## Department Website:

<https://www.brynmawr.edu/geology>

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. Field and lab experiences are essential parts of geology training, and field trips and lab work are part of all introductory courses, most other classes, and most independent research projects.

## Major Requirements

Thirteen courses are required for the major: GEOL B101 (How the Earth Works), GEOL B202 (Mineralogy), GEOL B203 (Biosphere through Time), GEOL B204 (Structural Geology), GEOL B205 (Sedimentary Materials and Environments), GEOL B208 (Super Lab), at least two semesters of quantitative or computational coursework (e.g., MATH B101 and MATH B102 or alternates approved by your adviser), a two-semester sequence of CHEM (CHEM B103-CHEM B104) or PHYS (PHYS B101-PHYS B102 or PHYS B121-PHYS B122), GEOL B399, and either two advanced geology courses or one advanced geology course and an additional upper-level course in biology, chemistry, mathematics, physics, or computer science.

The writing requirement for the major in Geology is fulfilled in GEOL B203 (Biosphere through Time). This course includes a semester-long research project culminating in a scientific manuscript based on material collected in the field by enrolled students.

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 are encouraged to attend a summer field course, usually following the completion of the 200-level courses.

All Geology majors participate in a senior capstone experience (GEOL B399), which is structured into a two-semester seminar that meets weekly for 1.5 hours for a total of 1.0 credit (0.5 credits per semester). The focus of the capstone seminar is to reinforce students' ability to address geoscience questions and to communicate their findings orally and in writing. The team-taught senior seminar integrates the student's major curriculum with weekly speakers or peer-led discussions on cutting-edge research, and on the impact and relevance of geology to modern society.

## Thesis

At the discretion of the department faculty, rising seniors may undertake an independent thesis project (GEOL B398) in addition to mandatory full participation in the senior capstone seminar (GEOL B399). Student thesis projects must be supervised by a faculty advisor. The senior thesis is modeled after a Master's thesis project but is scaled down for the different time frame (one year versus two years) and educational level of a senior undergraduate student. The thesis project plan is initially developed and agreed upon through consultation between the supervising faculty member(s) and the student. This is usually done during the second semester of a students' junior year. Most of the research is conducted independently by the student. The advisor serves as a source of ideas concerning scientific literature, methodologies, and project 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.

If approved to undertake a senior thesis, a student will enroll in GEOL B398 each of their final two semesters for a total of 1.0 credit (0.5 credits per semester). The thesis option adds the equivalent of one course to the standard Geology major requirements. The first semester will focus on thesis topic formulation, background research, and initiation of appropriate data acquisition. At the end of the first semester, the student must submit a formal written project proposal to department faculty members. This research proposal must demonstrate the student's ability to successfully complete a thesis during the following semester. Following review of submitted proposals, students or faculty members may choose or recommend, respectively, not to continue the independent thesis, in which case the student would not enroll for the second semester of GEOL B398.

## Requirements for Honors

Honors are awarded to students who have outstanding academic records in Geology and

allied fields, have completed an independent senior thesis project, and whose research 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.

## Concentration Requirements

### Concentration in Ge archaeology

The ge archaeology concentration allows students majoring in Anthropology, Archaeology, or Geology to explore the connections among these fields with respect to how our human ancestors interacted with past environments, and how traces of human behavior are preserved in the physical environment. In Geology, the ge archaeology concentration consists of 13 courses: GEOL B101, GEOL B202, GEOL B203, GEOL B204, GEOL B205, GEOL B208, GEOL B270, and GEOL B399; two semesters of chemistry; two semesters of math, statistics, or computational methods; either ARCH B101 or ANTH B101; and one 200- or 300-level elective from among current offerings in Anthropology or Classical and Near Eastern Archaeology. Paperwork for the concentration should be filed at the same time as the major work plan. For course planning advice, consult with Don Barber (Geology), Casey Barrier (Anthropology) or Peter Magee (Archaeology).

### 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: GEOL B101, GEOL B202, GEOL B203, GEOL B204, GEOL B205, GEOL B208, and GEOL B399; CHEM B103 (General Chemistry) and CHEM B104 (General Chemistry II); CHEM B211 (Organic Chemistry) or CHEM B231 (Inorganic Chemistry); GEOL B302 (Low Temperature Geochemistry) or GEOL B305 (Igneous and Metamorphic Petrology) or GEOL B350 (requires major advisor approval); one additional 300-level geochemistry-themed GEOL course or one additional advanced CHEM course. For a Chemistry major with a concentration in geochemistry, the following are required in addition to Chemistry major requirements (see Chemistry major advisor): GEOL B101 (How the

Earth Works), GEOL B202 (Mineralogy/Crystal Chemistry), two additional 300-level geochemistry-themed GEOL courses including GEOL B302 (Low Temperature Geochemistry) or GEOL B305 (Igneous and Metamorphic Petrology) or GEOL B350 (requires Geology major advisor approval). For course planning advice, contact Pedro Marenco (Geology) or Sharon Burgmayer (Chemistry).

## Faculty at Bryn Mawr

### Don Barber

Associate Professor of Geology and Environmental Studies on the Harold Alderfer Chair in Environmental Studies and Chair of Environmental Studies

### Selby Hearth

Associate Professor of Geology

### Pedro Marenco

Associate Professor of Geology

### Katherine Marenco

Senior Lecturer in Geology

### Arlo Weil

Marion Bridgman Slusser Professor in the Sciences and Professor and Chair of Geology

## Courses

### GEOL B101 HOW THE EARTH WORKS (1.0 Credit)

*Arlo Weil, Katherine Marenco*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

**(Offered:** Fall 2024)

### GEOL B104 THE SCIENCE OF CLIMATE CHANGE (1.0 Credit)

*Selby Hearth*

**Division:** Quantitative

**Domain(s):** C: Physical and Natural Processes

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.

**(Offered:** Spring 2025)

### **GEOL B107 GEOLOGY OF COAL, OIL, AND NUCLEAR ENERGY (1.0 Credit)**

*Selby Hearth*

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 (1.0 Credit)**

*Pedro Marenco*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

**(Offered:** Spring 2025)

### **GEOL B202 MINERALOGY AND CRYSTAL CHEMISTRY (1.0 Credit)**

*Selby Hearth*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

**(Offered:** Fall 2024)

### **GEOL B203 BIOSPHERE THROUGH TIME (1.0 Credit)**

*Katherine Marenco, Pedro Marenco*

**Division:** Natural Science

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.

**(Offered:** Fall 2024)

### **GEOL B204 STRUCTURAL GEOLOGY (1.0 Credit)**

*Arlo Weil*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

**(Offered:** Spring 2025)

### **GEOL B205 SEDIMENTARY MATERIALS AND ENVIRONMENTS (1.0 Credit)**

*Don Barber, Katherine Marenco*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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. (Offered: Spring 2025)

### **GEOL B206 ENERGY RESOURCES AND SUSTAINABILITY (1.0 Credit)**

*Don Barber*

**Division:** Natural Science

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.

(Offered: Fall 2024)

### **GEOL B209 NATURAL HAZARDS (1.0 Credit)**

*Katherine Marenco*

**Division:** Natural Science; Quantitative

**Domain(s):** C: Physical and Natural Processes

A quantitative approach to understanding the earth processes that impact human societies. We consider the past, current, and future hazards presented by geologic processes, including earthquakes, volcanoes, landslides, floods, and hurricanes. The course includes discussion of the social, economic, and policy contexts within which natural geologic processes become hazards. Case studies are drawn from contemporary and ancient societies. Lecture three hours a week.

(Offered: Spring 2025)

### **GEOL B210 CATALOGING COLLECTIONS (1.0 Credit)**

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 Credit)**

*Pedro Marenco*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

(Offered: Spring 2025)

### **GEOL B302 LOW-TEMPERATURE GEOCHEMISTRY (1.0 Credit)**

*Pedro Marenco*

**Division:** Natural Science

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.

(Offered: Spring 2025)

### **GEOL B304 TECTONICS (1.0 Credit)**

*Arlo Weil*

**Division:** Natural Science

**Domain(s):** C: Physical and Natural Processes

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.

(Offered: Fall 2024)

**GEOL B305 IGNEOUS AND METAMORPHIC PETROLOGY (1.0 Credit)***Selby Hearth***Division:** Natural Science**Domain(s):** C: Physical and Natural Processes

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 (1.0 Credit)***Arlo Weil***Division:** Natural Science

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 B350 ADVANCED TOPICS IN GEOLOGY (1.0 Credit)****Division:** Natural Science

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. (Offered: Spring 2025)

**GEOL B399 SENIOR CAPSTONE SEMINAR (0.5 Credit)***Arlo Weil***Division:** Natural Science

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.

**(Offered:** Fall 2024)**GEOL B400 SENIOR THESIS (0.5 Credit)***Arlo Weil*

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.

**(Offered:** Spring 2025)**GEOL B403 SUPERVISED RESEARCH (0.5 Credit)***Don Barber***Division:** Natural Science

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.

**(Offered:** Fall 2024, Spring 2025)**GEOL B415 TEACHING ASSISTANT (0.5 Credit)***Katherine Marenco*