

GEOLOGY (BRYN MAWR)

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 at Bryn Mawr field trips and lab work are part of all introductory courses, most other classes, and most independent research projects.

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

MAJOR REQUIREMENTS

Thirteen courses are required for the major: GEOL 101 and 102 or 103; 202, 203, 204, and 205; at least two semesters of quantitative or computational coursework, e.g., MATH 101 and 102 or alternates approved by the advisor; a two semester sequence of CHEM (103-104) or PHYS (101-102 or 121-122); GEOL 399; 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 203. 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 should plan 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 399), 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 in writing and orally. The team-taught senior seminar integrates the student's major curriculum with weekly speakers or peer-led discussions on cutting edge research, and the impact and relevance of geology to modern society.

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 IN GEOARCHAEOLOGY

The geoarchaeology 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 geoarchaeology concentration consists of 13 courses: GEOL 101 or 102 or 103; 202, 203, 204, 205, 270, and 399; two semesters of chemistry; two semesters of math, statistics or computational methods; either ARCH 101 or ANTH 101; and one 200- or 300-level elective from among current offerings in Anthropology or Classical and Near Eastern Archaeology.

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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) 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 in addition to Geology Major requirements: CHEM 103 (General Chemistry) and CHEM 104 (General Chemistry II), CHEM 211 (Organic Chemistry) or CHEM 231 (Inorganic Chemistry), GEOL 302 (Low Temperature Geochemistry) or GEOL 305 (Igneous and Metamorphic Petrology) or GEOL 350 (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 101 (How the Earth Works), GEOL 202 (Mineralogy/Crystal Chemistry), two additional 300-level geochemistry-themed GEOL courses including GEOL 302 (Low Temperature Geochemistry) or GEOL 305 (Igneous and Metamorphic Petrology) or GEOL 350 (requires Geology major advisor approval).

For course planning advice, contact Pedro Marengo, Lynne Elkins (Geology) or Sharon Burgmayer (Chemistry).

SENIOR PROJECT

At the discretion of the department faculty, rising seniors may undertake an independent thesis project (GEOL 403) in addition to mandatory full participation in the senior capstone seminar (GEOL 399). 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. 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 403 each of her 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 her thesis during the following semester. Following review of submitted proposals, students or faculty members may choose or recommend, respectively, not to complete the independent thesis, in which case the student would not enroll for the second semester of GEOL 403.

REQUIREMENTS FOR HONORS

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

FACULTY

Selby Cull-Hearth (*on leave Spring 2018*)
Associate Professor of Geology

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

Pedro Marengo
Associate Professor of Geology

Katherine Marengo
Lecturer in Geology

Arlo Weil
Chair and Professor of Geology

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COURSES

GEOL B101 HOW THE EARTH WORKS

Katherine Marengo, Arlo Weil

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 2017)

GEOL B102 EARTH: LIFE OF A PLANET

Staff

The history of the Earth from its beginning, including its climate and tectonic history and the evolution of the living forms that have populated it. Three lectures, one afternoon of laboratory a week. A required two-day (Sat-Sun) field trip is taken in April. (Not offered 2017-2018)

GEOL B103 EARTH SYSTEMS AND THE ENVIRONMENT

Staff

This integrated approach to studying the Earth focuses on interactions among geology, oceanography, and biology. Also discussed are the consequences of human energy consumption, industrial development, and land use. Two lectures and one afternoon of laboratory or fieldwork per week. A required field trip is taken in April. (Not offered 2017-2018)

GEOL B109 QUANTITATIVE PROBLEMS IN THE EARTH SCIENCE

Staff

An introduction to quantitative methods used for solving problems in Earth science. We will examine a wide variety of geologic questions: seismicity and earthquakes, volcanic activity, landslide triggers, flooding patterns, and more. We will then practice a range of quantitative techniques to approach those questions, both from a broad, global perspective and by examining current, relevant case studies. Prerequisite: Quantitative Readiness Required. (Not offered 2017-2018)

GEOL B110 FOCUS: EXPLORING TOPICS IN THE EARTH SCIENCES

Staff

This is a half -semester focus course. (0.5 credits)
(Not offered 2017-2018)

GEOL B125 FOCUS: GEOLOGY IN FILM

Staff

This is a half semester Focus course. 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. (0.5 credits) (Not offered 2017-2018)

GEOL B202 MINERALOGY AND CRYSTAL CHEMISTRY

Staff

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). (Not offered 2017-2018)

GEOL B203 BIOSPHERE THROUGH TIME

Katherine Marengo, Pedro Marengo

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. (Offered Fall 2017)

GEOL B204 STRUCTURAL GEOLOGY

Arlo Weil

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,

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weekend field trip. Prerequisite: GEOL 101 and MATH 101. (Offered Spring 2018)

GEOL B205 SEDIMENTARY MATERIALS AND ENVIRONMENTS

Don Barber

An introduction to sediment transport, depositional processes, and stratigraphic analysis, 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. Prerequisite: GEOL 101, 102, or 103 or permission of instructor. Recommended: GEOL B202 and B203. (Offered Spring 2018)

GEOL B206 ENERGY RESOURCES AND SUSTAINABILITY

Don Barber

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 2017)

GEOL B208 GEOLOGY SUPER LAB

Pedro Marengo

Students will learn the fundamentals of geological laboratory analysis via measurements on geological materials chosen by the students. We will utilize the analytical equipment and techniques available in the Geology Department including (but not limited to) X-ray diffractometry, thin-section petrography, carbon isotope mass spectrometry, and inductively-coupled plasma mass spectrometry. Emphasis will be placed on data processing and quantitative analysis of large datasets. Prerequisites: GEOL 101, GEOL 202, one other 200 level course, junior/senior status. (Offered Spring 2018)

GEOL B209 NATURAL HAZARDS

Katherine Marengo

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. Prerequisite: one semester of college science or permission of instructor. (Offered Spring 2018)

GEOL B260 ORIGIN STORIES: FROM THE BIG BANG TO MOTHER EARTH

Staff

This is a co-taught intermediate science course, instructed by a Geology and Physics professor, that will focus on the core scientific principals related to Cosmology, Physics and Geology that help address fundamental questions regarding the origin of the Universe, the origin of time, the origin of stars and our own solar system, and the origin of Earth, its atmosphere, hydrosphere and biosphere. The course will be a mix of fundamental scientific principles used to scaffold a deeper understanding of how scientists have come to understand and question stories of origin. Group discussions will be informed by close reading of scientific texts, and occasional problem sets. (Not offered 2017-2018)

GEOL B299 GEOLOGY FIELD SHORT COURSE

Arlo Weil

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 include proper field note-taking, 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, B102 or B103; and GEOL B202, B203, B204 or B205. (0.5 credits) (Offered Fall 2017)

GEOL B302 LOW-TEMPERATURE GEOCHEMISTRY

Pedro Marengo

Stable isotope geochemistry is one of the most important subfields of the Earth sciences for

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understanding environmental and climatic change. In this course, we will explore stable isotopic fundamentals and applications including a number of important case studies from the recent and deep time dealing with important biotic events in the fossil record and major climate changes. Prerequisites: GEOL 101 or GEOL 102, and at least one semester of chemistry or physics, or professor approval. (Offered Fall 2017)

GEOL B304 TECTONICS

Staff

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. (Not offered 2017-2018)

GEOL B305 IGNEOUS AND METAMORPHIC PETROLOGY

Staff

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 202. (Not offered 2017-2018)

GEOL B310 INTRODUCTION TO GEOPHYSICS

Staff

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. (Not offered 2017-2018)

GEOL B314 MARINE GEOLOGY

Staff

An introduction to oceanography, coastal processes, and the geomorphology of temperate and tropical shorelines. Includes an overview of the many parameters, including sea level change, that shape coastal environments. Meets twice weekly for a combination of lecture, discussion and hands-on exercises, including a mandatory multi-day field trip to investigate developed and pristine sections of the Mid-Atlantic US coast. Prerequisite: One 200-level GEOL course OR one GEOL course AND one BIOL course (any level), OR advanced BIOL major standing (junior or senior). (Not offered 2017-2018)

GEOL B350 ADVANCED TOPICS IN GEOLOGY

Arlo Weil

This is a topics course. Course content varies. Current topic description: This class explores the Appalachians, including investigation of the: margin of eastern Laurentia prior to orogeny, orogenic activity within the continental plates involved in Pangea amalgamation; evidence and ramifications for opening and closing of the major Paleozoic oceans; and implications of these tectonic events on Earth surface systems. This course involves paleontological, geochemical, and stratigraphic approaches of inquiry, and is discussion based with a focus on primary literature. (Offered Spring 2018)

GEOL B398 SENIOR SEMINAR

Staff

At the discretion of the department faculty, rising seniors may undertake an independent thesis project in addition to mandatory full participation in the senior capstone seminar. This student thesis is conducted under the supervision of a faculty advisor(s). The undertaking of a thesis is modeled after a Master's thesis project, but is scaled down for the shorter time frame (one versus two years) and educational level of a senior undergraduate student. The thesis 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. (Not offered 2017-2018)

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GEOL B399 SENIOR CAPSTONE SEMINAR

Staff

A capstone seminar course required for all Geology majors. All Geology seniors will be required to participate in this two-semester seminar that meets weekly for 1.5 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 seminar will be to integrate the student's major curriculum into open peer-led discussions on cutting edge research in the many diverse fields of Geology, to discuss the impact and relevance of Geology to modern society, and to work on oral and written communication skills. (Offered Fall 2017 and Spring 2018)

GEOL B403 SUPERVISED RESEARCH

Staff

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 2017 and Spring 2018)

GEOL B425 PRAXIS III

Staff

Independent or group projects with a significant emphasis on community outreach and service. Projects usually focus on addressing environmental issues through collaborative work with off-campus practitioners. Prerequisites: advanced standing in the environmental studies concentration or permission of the instructor. (Not offered 2017-2018)