

Department of Geosciences

Professor: *French (Chair)*

Associate Professor: *Besancon, Brabander, Hawkins*

Assistant Professor: *Argow*

Instructor in Geosciences Laboratory: *Gilbert, Mattison, Waller*

Geoscientists see the global environment as the sum of interactions between the solid Earth, water in its various forms, the atmosphere and living organisms including ourselves. Understanding the Earth's dynamically linked atmosphere, oceans and rocky infrastructure as the stage for human activities will be increasingly important if we are to make wise decisions about such issues as resource development, environmental health, and climate change, to name a bare few. The Geosciences Department offers courses with traditional geological perspectives on earth materials and earth history, as well as courses focused on modern settings like wetlands or polluted industrial sites where humans and nature collide. Course work is complemented by research opportunities grounded in both approaches.

All courses with laboratory meet for two periods of lecture and one three-hour laboratory session weekly.

GEOS 101 Earth Processes and the Environment with Laboratory

Brabander, Mattison

The Earth is home to more than six billion people and millions of kinds of animals and plants. Geologic processes both rapid (earthquakes and landslides) and slow (mountain building and sea level rise) are intimately linked with sustaining this diversity of life. This course will examine these and other processes in which the atmosphere, geosphere, and biosphere are linked via the flow of energy and mass. Laboratory and field trips will introduce skills needed to observe and document processes shaping our environment. Problem solving in small groups during class time will foster critical thinking, and classroom debates between larger teams will focus research and communications skills on current issues in geosciences such as building and removing dams, and the science surrounding global climate change.

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement. Not open to students who have taken 102.

Distribution: Natural and Physical Science. Fulfills the Quantitative Reasoning overlay course requirement.

Semester: Fall Unit: 1.25

GEOS 102 The Dynamic Earth with Laboratory

Besancon, Mattison

Introduction to geologic processes ranging from microscopic growth of mineral crystals to regional erosion and deposition by water, wind, and ice to volcanism and earthquakes associated with global plate motions. A particular focus of the course will be to better understand the interactions between human activities and the geologic environment. Laboratory and field trips.

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement. Not open to students who have taken 101.

Distribution: Natural and Physical Science. Fulfills the Quantitative Reasoning overlay course requirement.

Semester: Spring Unit: 1.25

GEOS 110 The Coastal Zone: Intersection of Land, Sea, and Humanity with Laboratory

Argow

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. This first year course will focus on physical processes that frame ecological and human interactions within the dynamic coastal environment. At local beaches and shorelines, students will observe, sample, and measure coastal processes in action to answer such questions as: Why do some beaches lose sand, where does it go, and what should we do about it? What are coastal wetlands, and how do they form and function? Field trips will be supplemented by information drawn from popular and scientific literature and media. The final project will involve field and laboratory research on local coastal issues, including management implications. Weekend field trip required. This course is for all first year students interested in the natural world, how it works, and why.

Prerequisite: Open to first-year students only.

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 111 The Yucca Mountain Problem: Where Should We Put Nuclear Waste?

Besancon

Choices about disposal of radioactive materials will affect countless future generations. Focusing on the proposed storage facility at Yucca Mountain, Nevada, we will examine the important scientific questions that must be answered for long-term safety of a nuclear repository. Students will learn the scientific principles governing risk assessment, groundwater movement, volcanism, earthquakes, and the groundwater properties of the repository rocks, and how each affects the safety of the proposed containment facility. We will also examine the evidence and methods used to predict how the waste and the containers designed to hold it will behave for long periods. Students will identify key issues and produce small group projects examining some of the scientific issues raised by this controversial proposal.

Prerequisite: Open only to first-year students.

Distribution: Natural and Physical Science

Semester: Fall, Spring Unit: 1.0

GEOS 200 The Earth and Life through Time with Laboratory

Argow

The Earth and life have been continually changing throughout the 4.6 billion years of Earth history. We will explore these changes, including the tectonic evolution of mountain ranges, the changing landscapes and environments across the North American continent, and the origin, evolution, and extinction of the various life forms that have inhabited our planet. Laboratory will provide the students with the opportunity to examine Wellesley's extensive fossil collection and visit local field sites. *Normally offered in alternate years.*

Prerequisite: [100], 101, or 102

Distribution: Natural and Physical Science

Semester: Spring Unit: 1.25

GEOS 201/ES 201 Methods and Problems in Environmental Science with Laboratory

Brabander

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. Problems in environmental science are inherently multidisciplinary and often require a diverse skill set to analyze and solve. This course will focus on developing a toolbox of skills including field methods, geochemical analysis (natural waters, soils, and other environmental materials), and modeling with a goal of being able to frame and solve environmental problems. Students will conduct semester-long research projects and will present their results in a final poster session. Laboratory. *Students may register for either GEOS 201 or ES 201 and credit will be granted accordingly.*

Prerequisite: One of the following: 101, 102, ES [100], ES 101 or permission of the instructor.

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 203 Earth Materials with Laboratory

Hawkins

The solid Earth is composed of a wide range of materials including minerals, rocks and soils. Some of these are as familiar as building stone or bathroom cleanser in everyday life, while others must be sought in natural settings like mountain ranges or flood plains. This course will examine both the physical and chemical properties of earth materials and the processes that lead to their formation. Identification and interpretation of earth materials in the field and in the laboratory (via X-ray diffraction and microscopic analysis) will also be emphasized. Laboratory and field trips. *Normally offered in alternate years.*

Prerequisite: 101 or 102

Distribution: Natural and Physical Science

Semester: Fall Unit: 1.25

GEOS 205 Vertebrate Paleontology: Revolutions in Evolution

Mattison

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. From fish to amphibian, “reptile” to mammal, dinosaur to bird, organisms on Earth have adapted to moving continents, climate variations and fluctuating sea levels. Students will piece together the history of vertebrate life using the paleontologist’s tools: the fossil record, functional morphology, phylogeny and paleoecology. Two weekend field trips will be required. *Normally offered in alternate years.*

Prerequisite: 101, 102, BISC 111 or permission of the instructor.

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.0

GEOS 206 Structural Geology with Laboratory

Hawkins

This course will consist of weekly outings to nearby field areas where sedimentary stratification, lava flows and other igneous features, metamorphic foliations, unconformities, folds and faults can be seen in outcrop. Indoor sessions will introduce maps, cross sections and stereographic projection as methods for representing such structures, and establish the physical and tectonic conditions under which they form. Course will conclude with a student-led field trip and written field guide. Rain gear will be necessary. *Normally offered in alternate years.*

Prerequisite: 203 or permission of the instructor. Not open to students who have taken [GEOS 306].

Distribution: Natural and Physical Science

Semester: Fall Unit: 1.25

GEOS 208 Oceanography

Argow

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. Covering 71% of the Earth’s surface and encompassing 98% of Earth’s water, the oceans are perhaps the most distinctive feature of our planet. Why does Earth have water? Why are the oceans salty? And what should every Congresswoman know about the largest habitat on Earth? Oceans impact humanity in countless ways, by controlling climate, navigation, and food and mineral resources. Come explore shoreline processes, submarine volcanism, tsunamis, tides, waves, ocean currents, ocean basin sediments, El Niño events, coral reefs, the deep abyss, and more.

Prerequisite: One of the following: 101, 102, ES [100], ES 101, CHEM 105, CHEM 120, PHYS 103, PHYS 104, PHYS 107, ASTR 100 or permission of the instructor. Not open to students who have taken [GEOS 100].

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.0

GEOS 210/ES 210 Hydrogeology - Water and Pollutants with Laboratory

Besancon

Investigation of water supply and use. Principles of surface and groundwater movement and water chemistry are applied to the hydrologic cycle to understand sources of water for human use. Mathematical groundwater models are used to understand groundwater movement and pollutant plumes. Quantity and quality of water and the limitations they impose are considered. Laboratory. Normally offered in alternate years. *Students may register for either GEOS 210 or ES 210 and credit will be granted accordingly.*

Prerequisite: 101 or 102 or permission of instructor

Distribution: Natural and Physical Science or Mathematical Modeling

Semester: Fall Unit: 1.25

GEOS 211 Geology and Human Affairs

NOT OFFERED IN 2008-09. Meeting challenges like groundwater protection, nuclear waste disposal, and future petroleum production must start with an understanding of the characteristics and history of a variety of geologic settings. This course will illustrate this approach through case studies highlighting Cape Cod glacial deposits contaminated by chemical spills from the Massachusetts Military Reservation, volcanic geology of the proposed nuclear waste repository at Yucca Mountain, Nevada and sedimentary rocks hosting oil resources in the Alaskan National Wildlife Refuge. There will be emphasis on reading and interpreting topographic and geologic maps as well as one required field trip. *Normally offered in alternate years.*

Prerequisite: 101, 102, ES [100] or 101.

Distribution: Natural and Physical Science

Semester: N/O Unit: 1.0

GEOS 213/ASTR 203 Planetary Geology

Bauer (Astronomy)

Spacecraft observations have revealed a breathtaking diversity of geologic features in the solar system, from ancient river valleys on Mars and violent volcanic eruptions on Io to ice fountains on Enceladus and the complex surfaces of comets. From a comparative point of view, this course examines the formation and evolution of the planets and small bodies in the solar system. Topics will include: volcanism, tectonic activity, impacts, and tides. *Students may register for either GEOS 213 or ASTR 203 and credit will be granted accordingly. Normally offered in alternate years.*

Prerequisite: Fulfillment of the basic skills component of the Quantitative Reasoning requirement and any 100-level GEOS or ASTR course.

Distribution: Natural and Physical Science

Semester: Fall Unit: 1.0

GEOS 220 Volcanoes: Agents of Global and Regional Change with Wintersession Laboratory

Besancon

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. From Mount Saint Helens to Vesuvius to Krakatau, volcanoes affect global climate, change landscape evolution, and are sometimes the cause of tremendous disasters. Understanding the wide variety of phenomena associated with volcanoes provides a broad perspective on how science can be used to protect lives and further human needs and interests. Using geologic literature, Internet search, and a general text, we will study case histories of volcanoes on earth and through the solar system. Written papers and oral presentations will be important parts of the course. Required laboratory will be two weeks in and near Hawaii Volcanoes National Park during Wintersession and requires payment of additional fees. *Normally offered in alternate years. Subject to Dean's Office Approval.*

Prerequisite: Permission of the instructor and 101, 102 or ES [100] or ES 101.

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 230 Earth from Above: Maps, Remote Sensing, and GIS

NOT OFFERED IN 2008-09. Paper maps and photographs are moving into digital form. Governments, consulting firms, and scientists use geographic information systems (GIS) and image analysis to manage natural resources, administer city infrastructure, search for water supplies, analyze land use, investigate relationships between environmental factors, and prepare maps of all types. Assignments examine a variety of problems in natural science and geography using ArcGIS software. *Normally offered in alternate years.*

Prerequisite: [GEOS 100], 101, 102, ES [100] or ES 101.

Distribution: Natural and Physical Science

Semester: N/O Unit: 1.0

GEOS 240 Climate Past and Future

NOT OFFERED IN 2008-09. The documented phenomenon of global warming raises pressing questions about future climate trends and what the world's population might expect if temperatures continue to rise. The science of this problem spans many spheres of Earth activity from present-day oceanic and atmospheric circulation to the geologic record of Pleistocene ice sheets and more extreme climatic events in the far distant past. Even plate motions have climatic impacts as increased volcanism associated with rapid sea floor spreading increases atmospheric carbon dioxide. This course will explore the dynamics of the modern climate system as well as multiple factors influencing climate history. All of these approaches are important for geoscientists and nonscientists alike who must promote intelligent action on global initiatives addressing problems such as anthropogenic carbon dioxide emissions. *Normally offered in alternate years.*

Prerequisite: 101, 102, ES [100] or ES 101.

Distribution: Natural and Physical Science

Semester: N/O Unit: 1.0

GEOS 250 Research or Individual Study

Prerequisite: Open by permission to students who have taken three Geosciences courses including 101 or 102. This course cannot be counted towards the minimum major in Geosciences.

Distribution: None

Semester: Fall, Spring Unit: 1.0

GEOS 250H Research or Individual Study

Prerequisite: Open by permission to students who have taken three Geosciences courses including 101 or 102. This course cannot be counted towards the minimum major in Geosciences.

Distribution: None

Semester: Fall, Spring Unit: 0.5

GEOS 304 Sedimentology with Laboratory

Argow

Sedimentary rocks cover most of the Earth's present surface and contain evidence for past environments over geologic time. Understanding modern sedimentary processes allows us to better recognize and interpret past environments as they are recorded in sedimentary strata. Studying sedimentary rock sequences is important both for understanding recurrent environmental fluctuations such as sea level change and for maximizing natural resources such as groundwater and petroleum. Sedimentary processes take on further significance because they take place in popular human habitats including coastlines and flood plains. Lectures, readings, and discussions will focus on topics such as production of sediment via weathering, sediment transport, and characteristics and interpretation of modern and ancient depositional environments. Laboratory exercises and Boston-area field trips emphasize field methods, rock identification, and data collection, analysis and interpretation. *Normally offered in alternate years.*

Prerequisite: 203 or permission of the instructor.

Distribution: Natural and Physical Science

Semester: Spring Unit: 1.25

GEOS 308 Wetlands Science with Laboratory

Argow

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. Wetlands are among the most important environments on Earth, yet are widely undervalued and misunderstood. Wetland science is an exciting, growing field, critical to addressing issues ranging from modern shoreline stabilization to fossil fuel extraction. This course will focus on sediment-water interactions that create and maintain saltwater and freshwater wetland environments, and on the roles played by organisms within the geologic framework. Field trips to nearby wetlands will provide opportunities to make observations, collect samples and develop research questions in consultation with scientists studying and managing wetlands. These will be complemented by laboratory sessions introducing techniques for sample analysis and by relevant readings. Final reports will be submitted to organizations like the National Park Service or National Estuarine Research Reserves. Two weekend field trips required. *Normally offered in alternate years.*

Prerequisite: 203, 208, or permission of the instructor.

Distribution: Natural and Physical Science

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 309 Petrology with Laboratory

Besancon

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. Study of the origin and occurrence of igneous and metamorphic rocks which make up most of the earth's crust. The earth generates magmas, primarily along plate boundaries, and they carry heat upward as they rise into the crust or onto the surface, forming igneous rocks. Heat, pressure, and deformation generate new minerals and textures in rocks. Students will decipher the sources and history of rocks using chemical and physical models and tools. Laboratory includes study of rocks in thin section and a project study of rocks collected on Boston area field trips. *Normally offered in alternate years.*

Prerequisite: 203 or permission of the instructor.

Distribution: Natural and Physical Science or Mathematical Modeling

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 315/ES 315 Environmental Geochemistry with Laboratory

Brabander

NOT OFFERED IN 2008-09. OFFERED IN 2009-10. Accurately predicting the fate and transport of naturally occurring toxic elements and anthropogenic compounds in the environment requires a broad set of multidisciplinary skills. This course introduces geochemical approaches including mass balance, residence time, isotope fractionation, and thermodynamic and kinetic modeling necessary to fingerprint sources of pollutants and track them in water, soil, and plants. These fundamentals will be explored in several classic case studies and in semester-long geochemical research projects conducted by small groups. Laboratory. *Normally offered in alternate years. Students may register for either GEOS 315 or ES 315 and credit will be granted accordingly.*

Prerequisite: One course above the 100-level in two of the following disciplines: geosciences, chemistry, biological sciences or environmental studies; or permission of the instructor.

Distribution: Natural and Physical Science or Mathematical Modeling

Semester: N/O. Offered in 2009-10. Unit: 1.25

GEOS 320 Isotope Geochemistry

Brabander

This seminar-style course will use the primary literature to study state-of-the-art techniques in isotope geochemistry. Radiogenic, cosmogenic, and stable isotope systematics will be explored with applications ranging from geochronology, tectonics, fate and transport of pollutants, and the use of isotopes to trace biogeochemical processes. Field trips to Boston area isotope labs and opportunities for collaborative research projects will complement the seminar. *Normally offered in alternate years.*

Prerequisite: 201 and CHEM 205; or GEOS/ES 315 or permission of the instructor.

Distribution: Natural and Physical Science

Semester: Fall Unit: 1.0

GEOS 350 Research or Individual Study

Prerequisite: Open by permission to juniors and seniors.

Distribution: None

Semester: Fall, Spring Unit: 1.0

GEOS 360 Senior Thesis Research

Prerequisite: By permission of department. See Academic Distinctions.

Distribution: None

Semester: Fall, Spring Unit: 1.0

GEOS 370 Senior Thesis

Prerequisite: 360 and permission of department.

Distribution: None

Semester: Fall, Spring Unit: 1.0

Directions for Election

For students entering Wellesley in Fall of 2007 and later: A major in geosciences includes eight geosciences courses (a minimum of 8 units of course work), at least six of which must be taken at Wellesley. Entry into the major may be through GEOS 101 or GEOS 102. Four 200-level courses are required, normally to include GEOS 200, GEOS 203 and GEOS 206. Three 300-level courses are required, one of which must be GEOS 304 and one of which may be GEOS 350, GEOS 360 or GEOS 370.

For students entering before the fall of 2007, entry into the major may be through [GEOS 100], GEOS 101, GEOS 102, ES [100] or ES 101. Four 200-level courses are required, two of which must come from the group of GEOS 200, 201 and 203. Three 300-level course are also required, one of which may be GEOS 350/360/370.

For both groups of entering students, four complementary courses from mathematics, biological sciences, chemistry, physics, astronomy, or computer science are also required, and two of these must come from the same discipline. The department also recommends that students majoring in geosciences take a geology field course, either the MIT 12.114-12.115 sequence offered in alternate years by MIT or a summer geology field course offered by another institution.

Graduate Studies: Students considering graduate school are urged to take two semesters of mathematics, two of chemistry and two of physics. Students will choose an appropriate set of complementary courses with the guidance of a departmental advisor.

A minor in geosciences consists of five courses, including GEOS 101 or GEOS 102 and at least one course at the 300-level.

Honors

The only route to honors in the major is writing a thesis and passing an oral examination. To be admitted to the thesis program, a student must have a grade point average of at least 3.5 in all work in the major field above the 100-level; the department may petition on her behalf if her GPA in the major is between 3.0 and 3.5. See Academic Distinctions.