

# GEOSCIENCES

## **GEO 101 Introduction to Earth Processes and History (4 Credits)**

Geology is a study of the Earth. In this course, students examine the processes that formed the Earth and that have continued to change the planet during its 4.57 billion year history. In rocks, minerals and the landscape, geologists see puzzles that tell a story about Earth's past. Students develop their geologic observation skills. The class investigates the origins of minerals and rocks and the dynamic processes that form volcanoes, cause earthquakes, shape landscapes, create natural resources and control the climate—today as well as during the Earth's past. Students learn to view the Earth with a new perspective and appreciate how the planet is constantly changing, even if at extremely slow rates. Students planning to major in geosciences should take GEO 102 concurrently. {N}

**Fall**

## **GEO 102 Exploring the Local Geologic Landscape (2 Credits)**

The Connecticut Valley region is rich with geologic features that can be reached by a short van ride from Smith. This is a field-based course that explores geology through weekly trips and associated assignments during which we examine evidence for volcanoes, dinosaurs, glaciers, rifting continents, and Himalayan-size mountains in Western Massachusetts. This class, when taken in conjunction with any other 100-level course, can serve as a pathway to the Geoscience major. Preference given to students taking GEO 101 concurrently and students who have previously taken a Geoscience course. Enrollment limited to 17. {N}

**Fall**

## **GEO 104 Global Climate Change: Exploring the Past, the Present and Options for the Future (4 Credits)**

This course provides the basic scientific background on how human activity is altering the planet. The class examines the modern climate system, how it has changed throughout the course of Earth's history, and how to predict what might happen in the future. Students answer questions such as "What did the planet look like the last time carbon dioxide levels in the atmosphere were this high?" and "What on Earth is geoengineering?". The goal of this class is to provide the context and scientific understanding needed to address climate change effectively. {N}

**Fall**

## **GEO 108 Oceanography: An Introduction to the Marine Environment (4 Credits)**

An introduction to the global marine environment, with emphasis on the carbon cycle, seafloor dynamics, submarine topography and sediments, the nature and circulation of oceanic waters, ocean-atmosphere-climate interactions and global climate change, coastal processes, marine biologic productivity, and issues of ocean pollution and the sustainable utilization of marine resources by humans. One required field trip. {N}

**Spring**

## **GEO 150/ ENV 150 Mapping our World: An Introduction to Geographic Information Systems (4 Credits)**

Offered as GEO 150 and ENV 150. A geographic information system (GIS) enables data and maps to be overlain, queried and visualized in order to solve problems in many diverse fields. This course provides an introduction to the fundamental elements of GIS and applies the analysis of spatial data to issues in geoscience, environmental science and public policy. Students gain expertise in ArcGIS—the industry standard GIS software—and online mapping platforms, and carry out semester-long projects in partnership with campus offices or local conservation organizations. Enrollment limited to 20. {N}

**Fall**

## **GEO 209 Water and Hydrogeologic Systems (4 Credits)**

Water is a critical resource for sustaining ecosystems and human needs. This course takes a scientific view of all aspects of the hydrologic cycle, focusing on processes that move water through Earth's freshwater system. Discussions include global precipitation patterns, watersheds, rivers and lakes, streamflow, storm water and flooding, surface/ groundwater interactions and groundwater flow. Discussions address human usage and contamination of water with an eye toward protecting water quality and supply. Students work with real hydrologic data from case studies. Prerequisites: GEO 101 and 102, GEO 108, or GEO 102 and any other 100-level GEO lecture course. Enrollment limited to 20. {N}

**Fall**

## **GEO 221 Mineralogy (5 Credits)**

A project-oriented study of minerals and the information they contain about planetary processes. The theory and application to mineralogic problems of crystallography, crystal chemistry, crystal optics, x-ray diffraction, quantitative x-ray spectroscopy and other spectroscopic techniques. The course normally includes a weekend field trip to see minerals in the field. Prerequisite: GEO 101 and GEO 102; GEO 108; FYS 103; or GEO 102 with any other GEO 100-level course. GEO 102 can be taken concurrently. Recommended: CHM 111 or equivalent. Enrollment limited to 18. {N}

**Spring**

## **GEO 222 Petrology (5 Credits)**

An examination of typical igneous and metamorphic rocks in the laboratory and in the field in search of clues to their formation. Lab work emphasizes the microscopic study of rocks in thin sections. The course normally includes a weekend field trip (e.g. Cape Ann or Vermont) which is an important part of the course. Prerequisite: GEO 221. Enrollment limited to 18. {N}

**Fall**

## **GEO 223 Geology of Active Volcanoes (1 Credit)**

A field-based course to examine volcanic materials and processes at locations with active volcanoes, such as Oregon, Hawaii, Costa Rica, Iceland and Italy. Discussions include eruptive styles and cycles; magmatic evolution; lava fountains, flows, lakes, and tubes; normal faulting; crater formation; landscape development; and destruction. Participants must be physically fit and prepared for considerable hiking in rough terrain. Prerequisites: completion of an introductory level geology course. Preference given to Geosciences majors. Enrollment limited to 15. Instructor permission required. {N}

**Spring, Variable**

**GEO 231 Invertebrate Paleontology and the History of Life (5 Credits)**

A study of the major evolutionary events in the history of life, with a special focus on marine invertebrates. Special topics include evolution, functional adaptations, paleoenvironments, the origin of life, mass extinction and origination, and how life has changed through time. One weekend field trip (optional). Prerequisite: GEO 101 and GEO 102; GEO 108; or GEO 102 with any other GEO 100-level course. GEO 102 can be taken concurrently; open also to students who have fulfilled the basis for the BIO major. Enrollment limited to 18. {N}

**Fall**

**GEO 232 Sedimentary Geology (5 Credits)**

A project-oriented study of the processes and products of sediment formation, transport, deposition and lithification. Modern sediments and depositional environments of the Massachusetts coast are examined and compared with ancient sedimentary rocks of the Connecticut River Valley and eastern New York. Field and laboratory analyses focus on the description and classification of sedimentary rocks, and on the interpretation of their origin. The results provide unique insights into the geologic history of eastern North America. Two weekend field trips. Prerequisites: GEO 101 and GEO 102; GEO 108; or GEO 102 with any other GEO 100-level course. GEO 102 can be taken concurrently. Enrollment limited to 22. {N}

**Fall**

**GEO 241 Structural Geology (5 Credits)**

The study and interpretation of rock structures with emphasis on the mechanics of deformation, behavior of rock materials, methods of analysis and relationship to plate tectonics. Laboratories involve computer-based analysis of the map patterns of geologic structures, the mechanics of their formation and field trips during the lab period to connect local examples of structures to New England tectonics. Prerequisite: GEO 101 and GEO 102, or GEO 108, or FYS 103, or GEO 102 with any other GEO 100-level course. Enrollment limited to 20. {N}

**Spring**

**GEO 251 Geomorphology (5 Credits)**

The study of landforms and their significance in terms of the processes that form them. Selected reference is made to examples in the New England region and the classic landforms of the world. During the first part of the semester laboratories involve learning to use geographic information system (GIS) software to analyze landforms. During the second part of the semester laboratories include field trips to examine landforms in the local area. Prerequisite: GEO 101, GEO 102, GEO 108 or FYS 103. Enrollment limited to 18. {N}

**Spring**

**GEO 301 Aqueous Geochemistry (5 Credits)**

This project-based course examines the geochemical reactions between water and the natural system. Water and soil samples collected from a weekend field trip serve as the basis for understanding principles of pH, alkalinity, equilibrium thermodynamics, mineral solubility, soil chemistry, redox reactions, acid rain and acid mine drainage. The laboratory emphasizes wet-chemistry analytical techniques. One weekend field trip. Prerequisites: One geoscience course and (CHM 108 or CHM 111). Enrollment limited to 16. {N}

**Spring**

**GEO 302 Field Studies of the Desert Southwest (5 Credits)**

This field-oriented course examines the diverse stratigraphic record of mass extinction and Snowball Earth as well as structural complexities preserved in Death Valley and adjacent areas. A required week-long field trip takes place in January followed by a semester-long course in the spring semester. Field analyses include measuring stratigraphic sections and field mapping. Prerequisites: GEO 231 or GEO 232 or GEO 241. Enrollment limited to 10. Instructor permission required. {N}

**Spring, Variable**

**GEO 311 Modeling the Earth: Data Analysis in the Geosciences (4 Credits)**

Major advances in understanding of Earth's physical processes have been made through analysis and interpretation of datasets, including precise tracking of plate tectonic motions, the rate and significance of modern climate change and sea level rise, and the timing and environmental conditions of extraordinary events in Earth history. This course introduces programming and analysis skills using Python to import, query, model and visualize geoscience datasets, with applications drawn from seismology, climate change, hydrology and geochemistry. Prerequisite: GEO 101, GEO 102, GEO 104, GEO 106, GEO 108, GEO 112, a GEO-based FYS or equivalent. Enrollment limited to 20. {M}{N}

**Fall, Alternate Years**

**GEO 334 Carbonate Sedimentology (5 Credits)**

Students in this class engage in detailed studies of the formation of carbonate sediments and rocks through participation in a required 7-10 day field trip to one of the modern tropical carbonate-producing environments (such as the Bahamas) during January interterm, followed by semester-long research projects based on the data and specimens collected in the field. Students present their results at Celebrating Collaborations in April. Class discussion topics include the history of carbonate rocks from the Precambrian to the present. Interested students should contact the course instructor. Students are responsible to partially cover expenses associated with the January trip. Prerequisite: GEO 231 or GEO 232. Enrollment limited to 8. Instructor permission required. {N}

**Spring, Variable**

**GEO 341 Seminar: Advanced Studies in Geobiology (4 Credits)**

This course examines the record of life from a geobiological perspective. The course covers the interactions between life and the environment from the early Earth through to the Modern. The class explores microbial metabolisms, isotopic systems and their interrelated nature from the Proterozoic to the Recent. Students read recent peer-reviewed papers from the literature to inform class discussions, and students present material in class. Prerequisites: GEO 221 or GEO 231. Restrictions: Juniors and seniors only. Enrollment limited to 12. Instructor permission required. {H}{N}

**Fall, Spring, Variable**

**GEO 361 Tectonics (4 Credits)**

A broadly-based examination of tectonics, the unifying theory of geology. The class discusses lithospheric plate movements, the creation and destruction of Earth's crust, the formation of mountain belts and sedimentary basins, the dynamic coupling of crust and mantle, and how these processes have shaped the Earth through time. Emphases includes critical reading of the primary literature, communication of scientific ideas orally and in writing and the central role of tectonics in uniting diverse fields of geology to create a cogent picture of how the Earth works. Prerequisite: any two 200-level courses in geosciences, one of which may be taken concurrently. {N}

**Fall, Alternate Years**

**GEO 399 Research Practicum in Earth History: Inquiry and Collaboration Through Research (4 Credits)**

This course enables students to engage with independent research projects in Paleontology, Earth History, and Geobiology, with an emphasis on collaborative work. Some goals of this class are to 1) develop a frame for how scientists build expertise through collaboration; 2) develop skills in team building and problem solving; 3) develop lab research skills and expertise in project design; 4) gather and interpret data in support of a research project; and 5) present the data in a poster presentation. May be repeated once for credit. Enrollment limited to 15. Instructor permission required.

**Fall, Spring, Annually**

**GEO 400 Advanced Work or Special Problems in Geosciences (1-4 Credits)**

Instructor permission required.

**Fall, Spring**

**GEO 430D Honors Project (4 Credits)**

Department permission required.

**Fall, Spring**

**GEO 432D Honors Project (6 Credits)**

Department permission required.

**Fall, Spring**