Geological Sciences

Department of Geological Sciences

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Overview

Geology is the science of earth. It is primarily based on the study of materials exposed on Earth's surface and is therefore an outdoor science. The term 'geology' applies to numerous scientific subdisciplines (for example, environmental geology, geochemistry, geophysics, glaciology, hydrogeology, mineralogy, paleontology, planetary geology, stratigraphy, structural geology, volcanology) that interact with each other and collectively focus on increasing our knowledge of Earth, the processes that shape it, and our physical and evolutionary relations to Earth and to its other inhabitants.

Geologists apply their knowledge in a variety of ways. Some problems geologists work on are strictly practical: we use geophysics, geochemistry, and stratigraphic mapping skills in exploration for mineral, water, and energy resources. We gauge the extent of ground water or soil pollution and devise strategies for remediation using sophisticated hydrologic, geochemical, or geophysical computer models. We use knowledge of volcanic eruptions and slope stability to reconstruct past natural disasters and, based on this, predict and protect against future threats. We use glacial geology and sedimentary records to reconstruct the climate history of the planet and glaciology to understand and predict the evolution of continental ice sheets and glaciers . Geologists may also apply their knowledge toward problems in basic science: We analyze the magmatic activity at mid-ocean ridges that forms the ocean floor, develop hypotheses about the formation of surface features on Mars, and use remotely sensed data in computer models to predict large-scale Earth processes. We strive to understand the interaction of Earth systems and their linkage to the history of life through the processes of evolution to obtain key insights into our own history. Practical and theoretical aspects of geology aid us in providing information about living consciously and using our resources wisely so that governments and societies can make informed decisions about our stewardship of earth.

About our Degrees

The undergraduate curriculum provides a comprehensive background in each of the major areas of modern geology through a required sequence of courses in geology and basic undergraduate courses in chemistry, physics, and calculus. In addition to the core courses in geology, a wide range of electives offers exposure to more specialized topics.

Acceptance Criteria

Minimum GPA of 2.0 overall.
Minimum grade of C in GLY 101 or GLY 103.

Degree Requirements

Please see Degrees and Policies.

About our Courses

The typical class size for:

Freshman/introductory courses is: 50-300
Sophomore/intermediate courses is: 30-40
Upper level/advanced courses is: 15-25

In the Department of Geology, what do teaching assistants (TAs) do?

TAs teach laboratory sections in almost all courses for the major and freshman level courses, as well as lead field trips and assist in grading. Except in special circumstances, all lectures are given by faculty.

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For course descriptions, please see Courses.

About our Faculty

There are thirteen full-time faculty members, six adjunct professors, fourteen research professors, several emeritus professors and usually one or two part-time instructors in the department. Faculty members have extensive research experience and well-established international reputations. Dr. Charles E. Mitchell received the Milton Plesur Teaching Award, which is presented by the UB Student Association and he has also received the rank of SUNY Distinguished Teaching Professor.

See a list of our Undergraduate Faculty.

Transfer Policy

The Department of Geology has articulation agreements with several colleges in the region. Students should consult with the advisement office at their present college for more details. The College of Arts and Sciences Student Advisement and Services Office at UB also may be consulted. To request a transfer of credit for a geology course not listed at either advisement office, submit a request to the director of undergraduate studies along with a course description from the college catalog and a course syllabus.

Extracurricular Activities

The undergraduate students have a geology club, UB Geological Society (UBGS), which sponsors such things as special lectures by visiting geologists, field trips to sites of geological interest, special outings, picnics, and camping trips. Officers are elected each year.

See the UB Student Association.

Practical Experience and Special Academic Opportunities

Notable Program Features

Field Camp: The 6-credit field camp course is the highlight of the undergraduate program. It is held for four weeks during the early summer in Wyoming, Utah, and Colorado and operates from a mobile base camp. The course teaches applied geological field methods.

Undergraduate Research and Practical Experience

There are numerous opportunities for undergraduates to get involved in the exciting research activities within the Department of Geology. Undergraduates have been involved in research topics as diverse as glacial geology, watershed hydrology and planetary geology, and have worked in Alaska, Greenland, South America, and here in New York State. Many of these opportunities come with partial funding. Students generally register for independent study with a faculty advisor, so they earn credits while learning about how research is conducted and building their resume.

Honors, Awards, and Scholarships

Honors
In addition to the usual academic honors offered to students upon graduation, the department offers an honors program. Candidates must have junior status, maintain a minimum GPA of 3.25, complete a senior thesis, and complete two geology courses in addition to the usual departmental degree requirements.

Reginald H. Pegrum Award
This award is available to graduating geology majors. Dr. Reginald H. Pegrum, founder of the department, established an annual award to be presented to an outstanding graduate majoring in geology. The student selected is presented with a check and a certificate.

Gilbert Jaffe Memorial Award
This award is given to graduating seniors in geology, with preference given to a student excelling in marine geology or environmental science. The award consists of a check and a certificate.

Duttweiler Field Camp Award
This award is given to one or more outstanding female student(s) attending the Department of Geology's summer field camp, thanks to the generousity of alumna Dorthea Duttweiler. An award is presented to the top female attendees.

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Career Information and Further Study

According to the Bureau of Labor Statistics, geoscientists held about 33,600 jobs in 2008, while another 8,100 were employed as environmental scientists and hydrologists, excluding the many individuals who held environmental science and geosciences faculty positions at colleges and universities. About 23 percent of geoscientists were employed in architectural, engineering, and related services and 19 percent worked for oil and gas extraction companies. State agencies such as state geological surveys and state departments of conservation employed another 9 percent of geoscientists. Eight percent worked for the federal government, including geologists, geophysicists, and oceanographers, mostly within the U.S. Department of the Interior for the U.S. Geological Survey (USGS) and within the U.S. Department of Defense. Among hydrologists, 26 percent were employed in architectural, engineering, and related services, and 19 percent worked for management, scientific, and technical consulting services. The federal government employed about 27 percent of hydrologists, mostly within the U.S. Department of the Interior for the U.S. Geological Survey (USGS) and within the U.S. Department of Defense.

Employment projections suggest an 18 % increase in all geoscience jobs between 2008 and 2018. Due to the relatively low number of qualified geoscience graduates and the large number of expected retirements, opportunities are expected to be good in most areas of geoscience. Employment in management, scientific, and technical consulting services should continue to grow as more geoscientists work as consultants. Many geoscientists work in the exploration and production of oil and gas. In the long term, continued high oil prices are expected to maintain demand for workers who can find new resource deposits. Demand will also be spurred by a continuing emphasis on the need for energy, environmental protection, responsible land management, and water-related issues.

Salary Information

According to the American Geological Institute's recent report on the Status of Geoscience Workforce, starting salaries in geosciences have been competitive with other science and engineering fields. Salary estimates released by Bureau of Labor Statistics for 2009 indicated that the mean annual salary for geoscientists was $92,710. Geoscientists in the petroleum and mining industries earned the highest salaries ($136,270) and those in state government earned the least ($62,550). Geoscientist faculty earned a mean annual salary of $74,770 in 2008. Additionally, according to the National Association of Colleges and Employers, average starting salaries for college graduates with geoscience bachelor's degrees were $40,786 in 2007.

According to the National Association of Colleges and Employers, beginning salary offers for 2005 graduates with bachelors degrees in geology and the geological sciences averaged about $39,365 a year; graduates with a masters degree averaged $41,100; graduates with a doctoral degree averages $57,500.

Degree Options

The Department of Geology offers BA and BS degrees, and maintains a strong undergraduate research program. The curriculum for both degrees includes courses of instruction in the major areas of modern geology, with emphasis on field and laboratory studies and their quantitative interpretation. The department also conducts a comprehensive month-long summer geological mapping course - with field sites located in Colorado, Utah, and Wyoming - to integrate all that students have learned.

Our BS program is designed for students who enter directly into geology-related employment upon graduation (e.g., energy resources, environmental consulting, state or national geological surveys), as well as for those who continue on to graduate school. The B.A. program offers more flexibility in coursework and is designed for students interested in careers outside of geology that require a strong geological background, such as environmental law, high school earth-science teaching, government policy, and nature writing.

The geology department also offers a combined BA/MA program designed to be completed in five years, compared to the six years needed for completion of a conventional BA followed by an MA. This program is designed for students interested in careers outside of geology but requiring graduate-level schooling. Any geology major who meets the requirements (see the combined BA/MA program chart) may apply to the combined program during the second semester of their junior year in the BA program.

Degrees Offered

Undergraduate: BA, BS, Minor
Combined: BA/MA
Graduate: MA, MS, PhD

Links to Further Information About this Program

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- Undergraduate Catalog
- Undergraduate Admissions
- Graduate Admissions
- Department of Geology
- College of Arts and Sciences

Geological Sciences - B.S.

Acceptance Criteria

Applications should be made after completion of the first introductory course, GLY 101 Global Environmental Science. A grade of C or better in that course and an overall average of at least 2.0 are required. A grade of C or better in that course and an overall average of at least 2.0 are required.

Advising Note

To graduate, minimum GPA of 2.3 in all courses required for the degree.

Prerequisite Courses

GLY 101 Global Environmental Science or GLY 103 Evolution of the Earth and Solar System

Required Courses

CHE 101 General Chemistry
CHE 102 General Chemistry
GLY 102 Global Environmental Science or GLY 104 Evolution of the Earth and Solar System
GLY 106 Geological Mapping Techniques
GLY 215 Soft Rock I: Sedimentology
GLY 216 Soft Rock II: Paleontology and Stratigraphy
GLY 305 Mineralogy
GLY 306 Petrology
GLY 312 Surface Processes and Hydrology I
GLY 313 Surface Processes and Hydrology II
GLY 325 Geophysics
GLY 326 Structural Geology/Global Tectonics
GLY 407 Geological Field Training (minimum GPA of 2.0 in geology courses required to attend this required summer field camp)
MTH 121 Survey of Calculus and Its Applications I
MTH 122 Survey of Calculus and Its Applications II
PHY 101 College Physics I
PHY 102 College Physics II
PHY 151 College Physics I Lab
PHY 152 College Physics II Lab
Two 400-level GLY courses (not GLY 493, GLY 497, GLY 498, or GLY 499)

Summary
Total required credit hours for the major: 82

See Baccalaureate Degree Requirements for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR
Fall CHE 101, GLY 101, MTH 121
Spring CHE 102, GLY 102, MTH 122

SECOND YEAR
Fall GLY 215, PHY 101, PHY 151
Spring GLY 106, GLY 216, PHY 102, PHY 152

THIRD YEAR
Fall GLY 305, GLY 326
Spring GLY 306, GLY 325
Summer GLY 407 (minimum GPA of 2.0 in geology courses required to attend this required summer field camp)

FOURTH YEAR

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Fall GLY 312, one 400 level GLY course (not GLY 493, GLY 497, GLY 498, or GLY 499)
Spring GLY 313, one 400 level GLY course (not GLY 493, GLY 497, GLY 498, or GLY 499)

Geological Sciences - B.A.

Acceptance Criteria

Applications should be made after completion of the first introductory course, GLY 101 Global Environmental Science. A grade of C or better in that course and an overall average of at least 2.0 are required.

Advising Note

To graduate, minimum GPA of 2.3 in all courses required for the degree.

Prerequisite Courses

GLY 101 Global Environmental Science or GLY 103 Evolution of the Earth and Solar System

Required Courses

CHE 101 General Chemistry
GLY 102 Global Environmental Science or GLY 104 Evolution of the Earth and Solar System
GLY 106 Geological Mapping Techniques
MTH 121 Survey of Calculus and Its Applications I
PHY 101 College Physics I
PHY 151 College Physics I Lab
Three of the following two-semester sequences (six courses)
GLY 215 - GLY 216 Soft Rock: Sedimentology/Paleontology/Stratigraphy
GLY 305 - GLY 306 Mineralogy/Petrology
GLY 312 - GLY 313 Surface Processes and Hydrology (I and II)
GLY 325 - GLY 326 Geophysics/ Structural Geology and Global Tectonics

Summary
Total required credit hours for the major: 48

See Baccalaureate Degree Requirements for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR
Fall MTH 121, PHY 101, PHY 151, GLY 101
Spring GLY 102

SECOND YEAR
Fall CHE 101, one 200 or 300 level GLY course
Spring GLY 106, one 200 or 300 level GLY course

THIRD YEAR
Fall Two 200 or 300 level GLY courses
Spring Two 200 or 300 level GLY courses
Summer GLY 407 (recommended; minimum GPA of 2.0 in geology courses required to attend this summer field camp)

FOURTH YEAR
Fall and Spring Any GLY courses (optional)

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Acceptance Criteria

Minimum GPA of 3.0 in all courses required for the major.
Completion of the prerequisite courses.
Two letters of recommendation from faculty members.

Prerequisite Courses

Any two of the following: GLY 215, GLY 305, GLY 312, GLY 325.

Required Courses

GLY 101-102 Global Environmental Science or GLY 103-104 Evolution of the Earth and the Solar System
CHE 101 General Chemistry
GLY 106 Geological Mapping Techniques
MTH 121 Survey of Calculus and Its Applications I
PHY 101 College Physics I
PHY 151 College Physics I Lab
Three of the following two-semester sequences (six courses)
GLY 215-GLY 216 Soft Rock: Sedimentology/Paleontology/Stratigraphy
GLY 305-GLY 306 Mineralogy/Petrology
GLY 312-GLY 313 Surface Processes and Hydrology (I and II)
GLY 325-GLY 326 Geophysics/ Structural Geology and Global Tectonics

Summary
Total required credit hours for the undergraduate portion: 48
Total required credit hours for the BA/MA: 76

See Baccalaureate Degree Requirements for general education and remaining university requirements.

Recommended Sequence of Program Requirements

FIRST YEAR
Fall MTH 121, PHY 101, PHY 151, GLY 101
Spring GLY 102

SECOND YEAR
Fall CHE 101, one 200 or 300 level GLY course
Spring GLY 106, one 200 or 300 level GLY course

THIRD YEAR
Fall Two one 200 or 300 level GLY courses
Spring Two one 200 or 300 level GLY courses
Summer GLY 407 (minimum GPA of 2.0 in geology courses required to attend this summer field camp)

FOURTH YEAR
Fall and Spring Graduate course work approved by the graduate committee.

FIFTH YEAR
Fall and Spring Graduate course work approved by the graduate committee, successful completion of a project

Geological Sciences - Minor

Acceptance Criteria

Applications should be made after completion of the first introductory course, GLY 101 Global Environmental Science. A grade of C or better in that course and an overall average of at least 2.0 are required.

Required Courses

GLY 101 Global Environmental Science or GLY 103 Evolution of the Earth and Solar System

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GLY 102 Global Environmental Science or GLY 104 Evolution of the Earth and Solar System
GLY 106 Geological Mapping Techniques
GLY 215 Soft Rock I: Sedimentology
GLY 216 Soft Rock II: Paleontology and Stratigraphy
GLY 312 Surface Processes and Hydrology I or GLY 325 Geophysics
GLY 313 Surface Processes and Hydrology II or GLY 326 Structural Geology/Global Tectonics
GLY 407 Geological Field Training (recommended)

Summary
Total required credit hours for the minor: 26

GLY 101: Global Environmental Science

Credits: 0
Semester(s): Fall
Type: LAB

Introduces important geological processes that have environmental impacts, ranging from earthquakes and volcanic hazards to landslides and flooding. The framework for learning these processes includes the water and rock cycle. Covers discussions of environmental philosophy and the significance for society of the environmental findings of science. The laboratory involves field measurements of streams, map analysis, an examination of fossils as they relate to the environment, meteorite impacts, and common rock-forming minerals. The GLY 101/GLY 102 sequence fulfills the university's general education natural science requirement.

GLY 102: Global Environmental Science

Credits: 0
Semester(s): Spring
Type: LAB

Offers an interdisciplinary discussion of both natural and human-induced global environmental change at various scales (space and time). Provides a comprehensive description of how advances in the physical, biological, and geological sciences are being integrated to understand the interplay between the Earth's components (atmosphere, hydrosphere, lithosphere, and biosphere). Topics include the Earth's building blocks, the Earth through time, natural hazards, natural resources, and Earth system cycles (such as weather, climate change, and atmospheric pollution). The GLY 101/GLY 102 sequence fulfills the university's general education natural science requirement.

GLY 103: Evolution of the Earth and Solar System

Credits: 0
Semester(s): Fall
Type: LAB

Overview of Earth's major physical phenomena, including mountain-building, volcanoes, plate tectonics and hydrologic processes. Emphasizes the interaction of Earth's processes and features as a global system and how these compare to those on other planets in the Solar System. Requires one field trip. Lab emphasizes major geologic processes, such as river development, impact cratering, and rock formation. The GLY 103/GLY 104 sequence fulfills the university's general education natural science requirement.

GLY 104: Evolution of the Earth and Solar System

Credits: 3
Semester(s): Spring
Pre-requisites: GLY 103
Type: LEC/LAB

Examines the history of geology, the character of organic evolution, and the interaction of geological and biological processes that produce the history of the Earth. Emphasizes the geologic and biologic events that created and shaped Western New York. Lab focuses on the development of geologic regions in Western New York, the Moon and Mars. The GLY 103/GLY 104 sequence fulfills the university's general education natural science requirement.

GLY 106: Geological Mapping Techniques

Credits: 3
Semester(s): Spring
Type: LEC/LAB

Introduces geological maps, cross sections and stratigraphic columns, the primary tools for conveying information in the earth sciences. Covers basic map-reading skills, mapmaking and cross-section construction, and interpretation. Introduces stereoscopic aerial photography and satellite imagery.

GLY 108: Geology of the National Parks

Credits: 3
Semester(s): Fall
Type: LEC

Explores the beauty of some of our nation's most spectacular national parks, including the Grand Canyon, Yellowstone, Hawaiian Volcanoes National Park, Bryce Canyon, and Acadia. Examines the fundamental geologic principles that allow understanding of how these unique landscapes were formed and how they change through time. Also examines how people affect the parks and how science enters into national policy decisions about their future.

GLY 137: The Dinosaurs

Credits: 3
Semester(s): Spring
Type: LEC

Explores dinosaurs as a biological group: their origin, anatomy, life

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habits, evolution, and extinction. Evaluates revolutionary new ideas on their physiology, behavior, and significance in the history of life. Uses dinosaurs to exemplify important evolutionary phenomena. There may be visits to the Buffalo Museum of Science and the Royal Ontario Museum, Toronto.

GLY 215: Soft Rock I: Sedimentology

Credits: 4
Semester(s): Fall
Type: LEC/LAB

Introduction to the origin of sedimentary rocks, including analysis of sediments and transport mechanisms, depositional environments, and recognition of common sedimentary rock types. Requires labs and field trip.

GLY 216: Soft Rock II: Paleontology and Stratigraphy

Credits: 4
Semester(s): Spring
Pre-requisites: GLY 215
Type: LEC/LAB

Examines the character of the fossil record, its role in illuminating the nature of the evolutionary process, life's history, and use in interpretation of the age and environment of deposition of sedimentary rocks. Requires labs and field trip.

GLY 305: Mineralogy

Credits: 1
Semester(s): Fall
Type: LAB

Presents the fundamental principles of mineralogy, including mineral chemistry, mineral identification, phase diagrams, mineral structures, and elementary crystallography. Emphasizes environmentally important minerals. Requires lab.

GLY 306: Petrology

Credits: 4
Semester(s): Spring
Pre-requisites: GLY 305
Type: LEC/LAB

Presents the fundamental principles of petrology, including origin, occurrence, and evolution of igneous and metamorphic rocks. Integrates geochemical principles based on phase equilibria with interpretation of mineral assemblages present in common rocks. Plate tectonics and regional distribution of rock types form the broad framework for the course materials. Requires a field trip.

GLY 309: Ecology

Credits: 3
Semester(s): Fall
Type: LEC

Course uses field exercises to illustrate major concepts of modern ecology, and the techniques and procedures used in ecological research.

GLY 310: Ecological Methods

Credits: 2
Semester(s): Fall
Type: LEC/LAB

Field exercises to illustrate major concepts of modern ecology, and the techniques and procedures used in ecological research.

GLY 312: Surface Processes and Hydrology I

Credits: 4
Pre-requisites: GLY 102 Or GLY 104 Or GLY 106
Type: LEC/LAB

Acquaints students with near-surface geomorphic and hydrologic processes, their interpretation, and their role in shaping landforms. Studies the occurrence and movement of water on and within the earth including basic hydrostatics, hydrology, hydrogeology and open-channel flow hydraulics. Introduces quantitative and computer-based methods of analysis in geomorphology, hydrology and environmental geology. Requires labs and field trips.

GLY 313: Surface Processes and Hydrology II

Credits: 4
Semester(s): Spring
Pre-requisites: GLY 312
Type: LEC/LAB

Second semester of two-semester sequence. See GLY 312 for course description. Requires labs and field trip.

GLY 325: Geophysics

Credits: 4
Semester(s): Fall
Type: LEC/LAB

Introduces the fundamental concepts required to understand the scientific basis for plate tectonics, including deep Earth structure and theories of mantle convection. Describes major whole-Earth geophysical techniques (active-source seismology, earthquake seismology, gravity, magnetics, and heat flow). Uses general examples as well as specific case studies to support current tectonic theories. Practical application and hands-on use of seismic, gravity, and magnetic instrumentation take place in labs. Requires labs and one weekend field trip.

GLY 326: Structural Geology/ Global Tectonics

Credits: 4
Semester(s): Spring
Type: LEC/LAB

Introduces students to the description, classification and interpretation of geological structures, including faults, folds and joints. Describes these structures in terms of their tectonic setting (extensional, strike-slip, contractional). In labs, introduces practical techniques for structural analysis.

GLY 400: Comparative Paleobiology

Credits: 4

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Semester(s): Spring
Type: LEC/LAB

Presents major tools and concepts employed in the collection and analysis of morphological data (via geometric morphometrics and cladistics) in studies of the systematics, taxonomy, and evolutionary history of organisms, principally animals. Emphasizes practice rather than theory. Requires substantial written work.

GLY 405: Economic Geology

Credits: 3
Semester(s): Spring
Pre-requisites: GLY 305
Type: LEC/LAB

This course will describe the nature and origin of the raw materials that sustain modern life styles and developed societies. Lectures will emphasize the formation of economic deposits of metallic and non-metallic minerals, methods of mineral exploration and exploitation, and the environmental consequences of utilizing mineral resources. The laboratory will focus on identification of ore and associated gangue minerals using microscopic and macroscopic methods.

GLY 407: Geological Field Training

Credits: 3-6
Semester(s): Summer
Type: LEC

Applied field methods in geology. Geologic field trips and mapping from a mobile base in the western United States. Mapping projects include surficial deposits in Colorado and areas of increasingly complex sedimentary structure in Utah and Wyoming. This course is conducted outdoors and requires walking over difficult terrain and some exposure to the elements.

GLY 409: Advanced Ecology

Credits: 3
Semester(s): Fall
Pre-requisites: GLY 309 or BIO 309
Type: LEC

Offered odd calendar years

Advanced course in the foundations of ecology emphasizing population and community ecology. Supplements lectures on basic ecological principles and models with discussions of both current and historically important issues.

GLY 411: Marine Ecology

Credits: 3
Type: LEC

Surveys tropical marine ecosystems, with an emphasis on coral reef communities. Examines processes controlling abundance and distribution of marine taxa using primary literature. LEC

GLY 412: Field Course in Tropical Marine Ecology

Credits: 2
Semester(s): Fall
Type: LAB

Offered even calendar years

An intensive two week field course in the Bahamas focusing on coral reef communities. Combining lectures, fieldwork, and laboratory analyses, students conduct in depth studies of Caribbean marine habitats.

GLY 414: Hydrogeology

Credits: 1
Semester(s): Fall
Pre-requisites: GLY 313 or CIE 354 (if not taken during the same semester), or permission of instructor.
Co-requisites: Students must enroll in GLY 414LAB and GLY 414LEC in the same term.
Type: LAB

Examines the occurrence and movement of water in the shallow subsurface, and its importance to water resource development and environmental pollution. Uses basic quantitative techniques for the prediction of water flow through porous and fractured geologic media. Laboratory includes hands-on experience with aquifer testing methods using wells located on campus. Primarily for students interested in the fields of hydrogeology, hydrology, environmental geology, and environmental and geotechnical engineering.

GLY 415: Clay Mineralogy

Credits: 4
Semester(s): Fall
Type: LEC/LAB

Clay minerals are the most abundant minerals at the surface of the earth. As such, they are of extreme importance in understanding environmental problems. In addition, clay minerals have interesting and useful properties that give them important technological value. This course examines the structure and chemistry of clay minerals and attempts to relate these to their properties, both geological and technological. Clay minerals are difficult to study because they typically occur as fine-grained materials and exhibit a wide range of defects.

GLY 417: Stable Isotopes and the Environment

Credits: 3
Type: LEC

Small differences in atomic mass among stable (non-radioactive) isotopes of the same element can give rise to differences in partitioning within the environment. This course explores how isotopes fractionate and how this behavior can be used to understand and decipher complex natural processes. The hydrologic cycle will be used as a staring point to illustrate and develop the framework for applying stable isotopes to examine the broader environment. This will provide a comprehensive knowledge base to apply the interpretation of stable isotope data to research questions in geologic, biologic, and environmental sciences in the second part of the course.

GLY 419: Environmental Geophysics

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Credits: 3
Semester(s): Spring
Pre-requisites: GLY 325
Type: LEC

Introduces the theoretical background and methods of application for several noninvasive near-surface geophysical imaging techniques, including seismic reflection/refraction, microgravity, magnetics, electromagnetics, resistivity, and ground-penetrating radar.

GLY 420: Environmental Geophysics Lab

Credits: 1
Semester(s): Spring
Type: LAB

Provides hands-on experience with several environmental geophysics techniques; includes discussions of experiment design, acquisition, processing and interpretation.

GLY 423: The Hidden Planet: Volcanic Plumbing

Credits: 3
Semester(s): Spring
Type: LEC

Examines the generation, rise, storage, and eventual eruption of magma on Earth and other solid bodies in the solar system. Presents different magmatic compositions and their behaviors, as well as effects of environmental conditions on magma dynamics.

GLY 424: Extraterrestrial Volcanism

Credits: 3
Semester(s): Spring
Type: LEC

Examines volcanic deposits on solid bodies throughout the solar system, including the Moon, Mars, Venus, Io and Europa. Emphasizes understanding how different environments affect the mechanics and subsequent deposits of volcanic eruptions.

GLY 427: Modeling of Geologic Data

Credits: 3
Semester(s): Spring
Type: LEC

Computer modeling of complex processes is becoming more important in a number of geological areas, such as risk assessment, movement of toxic contaminants in an aquifer, crystallization of magmas, and impact cratering. Students develop knowledge of the processes whereby a geological problem is reduced to a mathematical model, the model is translated into a computer program, and the program is utilized to produce numerical and graphical results. The course assumes that students have a good familiarity with digital computers. Any mathematical complexities are explained as the course progresses.

GLY 428: Geological Hazards and Risk

Credits: 3
Semester(s): Fall
Type: LEC

Discusses disasters that may include those related to volcanoes, earthquakes, landslides, windstorms, tsunamis, river floods, and hazardous waste storage. Topics include models of geological phenomena, consequences of hazards, and risk assessment. Case studies analyzed for each phenomenon. A detailed case study focusing on expert elicitation is discussed.

GLY 429: Analysis of Geologic Data

Credits: 3
Semester(s): Fall
Type: LEC

Problems encountered in working with large data sets, formulating statistical hypotheses, and interpreting the analysis in terms of the geologic problem. Includes data from petrology, sedimentation, mineralogy, geophysics, and paleontology.

GLY 431: Volcanology

Credits: 3
Semester(s): Fall
Pre-requisites: GLY 306
Type: LEC

Examines the distribution, tectonic setting, and morphology of volcanoes. Includes investigations into effusive and explosive eruptions, emplacement of eruptive products, and eruption mechanisms.

GLY 432: Colonial Paleobiology

Credits: 3
Semester(s): Fall
Type: LEC/LAB

Examines the morphology, ecology and evolutionary history of colonial invertebrates (hemichordates (including graptolites), bryozoans, cnidarians).

GLY 433: Volcanic Rocks

Credits: 3
Semester(s): Spring
Type: LEC

Selected topics related to the genesis, field description, eruption mechanism, and emplacement process of pyroclastic materials. Theoretical and practical applications including quantitative analysis of data.

GLY 434: Methods in Volcanology

Credits: 3
Type: LEC

This course will introduce the methods most commonly used by volcanologists in monitoring and studying active volcanoes (including geophysical methods: field observations of eruptions; remote sensing and geological mapping). Through a series of case studies, it will illustrate how such data are used to build a picture of how volcanoes work. (LEC, 3)

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GLY 440: Vertebrate Paleontology and Osteology

Credits: 4
Semester(s): Spring
Type: LEC/LAB

Surveys the fossil record of vertebrate animals in order to understand their evolutionary history and the evidences used to reconstruct that history. Expects prior experience in basic paleontology or evolutionary biology.

GLY 443: Marine Geology

Credits: 1
Semester(s): Spring
Type: LAB

Explores igneous, sedimentary, and metamorphic geology and geophysics of ocean basins in light of modern plate tectonic theories. Uses real data to allow understanding of the assumptions and the 'knowns' in marine geology.

GLY 444: Surfaces of Geomaterials

Credits: 3
Semester(s): Spring
Type: LEC/LAB

Describes the theory of surface and interfacial thermodynamic properties, how these properties are experimentally determined, the basis for computations of surface and interfacial free energies, and how the surface properties of minerals can be related to their chemical composition and crystal structures. Gives particular emphasis to those minerals that naturally occur in a colloidal form (the clay minerals), as well as to other geological materials, such as volcanic ash, that can occur in colloidal sizes.

GLY 445: Glacial Geology

Credits: 3
Semester(s): Spring
Type: LEC

Explores the spectacular landscapes created by glaciers and ice sheets. The course provides students with knowledge to understand present and past glacier and ice sheet processes, based on the most up-to-date findings and state-of-the-art techniques. Students get hands-on experience by studying the rich ice sheet history of the Buffalo area. This lecture and lab combination provides students with a comprehensive knowledge base with which they can interpret glacier processes and history from a variety of landform assemblages and surficial sediments found across the northern United States. The laboratory consists of map and aerial photograph, computer, and field exercises.

GLY 453: Quaternary Dating and Paleoclimate

Credits: 3
Semester(s): Spring
Type: LEC

Explores the Earth's large swings in climate over the past 2 million years, how they are documented, the various dating techniques used to place them into a chronological framework, and the implications for how the Earth's climate system operates. Focuses on marine sediment, ice core, and terrestrial archives of glacial and interglacial cycles, abrupt climate change, past warm periods analogous to our future world, and techniques used to date these records.

GLY 454: Topics: Planetary Geology

Credits: 3
Semester(s): Fall
Type: LEC

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Students learn about the processes involved in the formation of the Solar System, and the generation and evolution of planetary surfaces. Primary data, collected by past and present spacecraft and landers is used to demonstrate how geologic processes are both similar and distinct throughout the Solar System.

GLY 458: Macroevolution

Credits: 3
Semester(s): Spring
Type: LEC

Principal issues of macroevolutionary theory (i.e., issues at the species level and above, which are manifest on the scale of geological time) and hones analytical skills as preparation for undertaking graduate research. Evolutionary theory is an interdisciplinary topic that draws on information from ecology, population biology, systematics, anthropology, and paleobiology, and the course presumes prior study of evolutionary aspects of at least one of these areas as preparation.

GLY 462: Aqueous Geochemistry

Credits: 3
Semester(s): Fall
Pre-requisites: CHE 102
Type: LEC/LAB

Presents the chemical principles governing natural water chemistry and the behavior of anthropogenic pollutants. Emphasizes topics such as the evolution of groundwater chemistry, thermodynamics of water-rock interactions at low temperatures, and prediction of pollutant fate in aquatic systems.

GLY 463: Advanced Environmental Hydrogeology I

Credits: 3
Semester(s): Fall
Type: LEC/LAB

Addresses the movement and behavior of contaminants in ground water. Emphasizes the underlying physics of water, solute, and particle transport in lecture, hands-on numerical simulation or field experiments. Prior completion of an introductory hydrogeology course is highly recommended.

GLY 464: Advanced Environmental Hydrogeology II

Geological Sciences

Credits: 3
Semester(s): Spring
Type: LEC/LAB

Studies multi-phase flow in contaminant hydrogeology. Topics include physics and chemistry of multiple phases, modeling of multi-phase flow and transport, and remediation on nonaqueous phase liquids. LEC/LAB

GLY 465: Environmental and Geological Remote Sensing

Credits: 1
Semester(s): Fall
Type: LAB

Covers the fundamentals of remote sensing, extraction of geological, biophysical, or land use/land cover information from remote sensing data, and provides guidance as to how remote sensing data can be used to solve real world environmental and geological problems. Throughout the course the participants will be engaged in rigorous hands-on exercises that will introduce them to digital image processing techniques as well. The participants will learn how to extract and integrate lithologic and environmental information from a wide range of archival remote sensing data, real time remote sensing data, digital elevation models, and maps.

GLY 470: Advanced Structural Geology and Geomechanics

Credits: 3
Semester(s): Spring
Type: LEC

Bridges the gap between more traditional descriptive techniques introduced in introductory structural geology and more advanced quantitative methods used in modern day geomechanical research. Primarily, the course introduces the students to quantitative tools and techniques for the analysis of geologic structures and processes.

GLY 477: Advanced Physical Volcanology

Credits: 3
Semester(s): Spring
Type: LEC

Calculus-based course that provides students with the capability to analyze natural fluid dynamical processes. Topics include rheology of surficial materials, hydrostatics and aerostatics, equations of motion for fluid dynamics including Navier-Stokes equation, open-channel flow, kinematic waves, hydraulic jumps, advection-diffusion, dynamical and geometric similarity. Extensive use of computational tools to analyze flows and to organize fluid dynamical data.

GLY 478: Advanced Field Methods

Credits: 1-3
Type: LEC

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Teaches students to map, analyze, evaluate and interpret field data related to complex geological stratigraphy and structures, natural hazards, and Quaternary deposits. Students study the relationship of their geological work to cultural activities, particularly the exploitation of solid-earth resources and risk assessment. The course consists of in-depth mapping exercises in the field coupled with lectures.

GLY 480: Geological Evolution of North America: Tectonics and Appalachians

Credits: 3
Semester(s): Spring
Type: LEC

Provides students with a familiarity of the elements that support the concepts inherent in plate tectonics. Demonstrates the application of tectonics to the geological history of eastern North America, primarily the Appalachians. Illustrates the multidisciplinary nature of geological synthesis through in-depth studies of classic areas in the Appalachians. Involves an optional spring field trip to the central and southern Appalachians.

GLY 481: Geological Evolution of North America: Western Cordillera

Credits: 3
Semester(s): Fall
Type: LEC

Provides students with a basic familiarity of geology of the western cordillera of North America. Illustrates the multidisciplinary nature of geologic syntheses through in-depth studies of this complex mountain range that extends from Mexico to Alaska. Emphasizes the genesis and emplacement of igneous rocks, major deformational episodes, the cause of earthquakes, mechanism of faults, origin of volcanoes, source of mineral deposits, and major sedimentation stages.

GLY 493: Pegrum Colloquium

Credits: 1
Semester(s): Fall, Spring
Type: SEM

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Familiarizes senior geology students with a broad range of topics that are of current interest to professional geologists. The course also acquaints students with professional presentations. The course consists of a weekly colloquium presented by a researcher active in a field of present import. Preceding the colloquium, readings from scientific journals introduce students to the topic to be discussed.

GLY 497: Departmental Honors Senior Thesis

Credits: 3
Semester(s): Fall, Spring
Type: TUT

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Accepted seniors pursue a specialized, independent study leading to an Honors Thesis. The Department of Geology requires maintenance of a 3.25 or higher GPA, completion of a senior thesis and two additional 400 level Geology courses as well as the usual

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departmental degree requirements.

GLY 498: Undergraduate Research

Credits: 1-3
Semester(s): Fall, Spring
Type: TUT

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Students collaborate with faculty research mentors on an ongoing project in a faculty member's laboratory or conduct independent research under the guidance of a faculty member. This experience provides students with an inquiry based learning opportunity and engages them as active learners in a research setting.

GLY 499: Independent Study

Credits: 1-3
Semester(s): Fall, Spring
Type: TUT

The content of this course is variable and therefore it is repeatable for credit. The University Grade Repeat Policy *does not apply.*

Selection and study of topics not offered as regular courses.