GEOSCIENCES

Department Overview

Geoscience is the study of planet Earth, its materials, the processes that act upon them, and the history of the planet and its life forms since its origin. The mission of Skidmore's geosciences program is to apply the understanding of Earth processes to contemporary issues such as Earth resources, land-use planning, and global change. The program's curriculum includes ocean and atmospheric sciences, Earth surface processes, and the history of global change. Our courses are designed for students with a general interest in the geosciences as well as for students planning to pursue a graduate degree. We accomplish this mission by providing an environment in which students acquire sound scientific problem-solving, research, and communication skills. Geoscience students obtain a strong foundation for lifelong learning, professional development in the geosciences, and enhanced career opportunities in other fields that require a broadly based background in this discipline. A liberal arts degree in geosciences prepares a student for a number of professional activities related to resource management, climatology, oceanography, hydrology, Earth hazards, land-use planning, earth science teaching, and environmental consulting. Our department contributes to the broader mission of the college by providing courses that enhance student awareness of, and appreciation for, Earth's dynamic systems and the scientific methodologies by which they are understood. Our program complements and is complemented by Environmental Studies and Sciences in additional to other natural sciences.

Chair of the Department of Geosciences: Jennifer Cholnoky

Associate Professors: Amy Frappier, Kyle Nichols

Visiting Assistant Professor: Andrew Horst

Senior Lecturer: Jennifer Cholnoky

Research Associate: Darren Gravley

Research Fellow: Brian Frappier

Emeritus Professor: Richard H. Lindemann

Administrative Assistant in Geosciences and Environmental Studies and Sciences: Carol Goody

Affiliated Faculty

Chemistry: Juan Navea

Environmental Studies and Sciences: Kurt Smemo

GIS: Charles Bettigole

Library: Jenna Pitera

Geosciences B.A.

Effective for Students Who Entered Skidmore in Fall 2022 and Beyond

Fulfill the General College Requirements

Code	Title	Hours
GE 101	Earth Systems Science with Lab	
Select an approved course in analytical methods:		4
ID 210	Introduction to GIS (or equivalent)	
Select one of the following supporting sciences, by the end of junior year: [1]		4
CH 125	Principles of Chemistry	
CH 126	Principles of Chemistry	
PY 130	Introductory Physics I with Laboratory: Forces and Energy	
PY 207		
Select one of the following Quantitative Skills courses, by the end of the junior year: [1]		3-4
MA 111	Calculus I	
MS 104	Introduction to Statistics	
MS 204	Statistical Methods	
BI 235	Biostatistics	
EC 237	Statistical Methods	
GE 235	Data Analysis, Modeling, and Scientific Programming: Earth and Environmental Sciences	
Complete the Senior Coda Course		4
GE 377	Senior Seminar In Geosciences	
Select seven additional GE or GP courses to meet the following requirements:		23-28
One 100-level course:		
GE 105	Earthquakes and Volcanoes: the Hazards of Plate Tectonics	
or GE 112	Oceanography: Introduction to the Marine Environment	
Two 200-level courses, at least 3 credits each [2]		
Three 300-level courses, at least 3 credits each [3]		
One must be a Writing in the Major course:		4
GE 211	Climatology	
or GE 301	Hydrogeologic Systems	
or GE 304	Geomorphology	
Additional courses beyond the major requirements may be recommended for you, depending on your personal interests and goals. Talk with a Geosciences faculty member for guidance.		
Total Hours		**42-48**

1 Does not count toward major GPA.

2 Only one may be GE275.

3 Only one may be GE375 Senior Research in Geosciences. ES 308 Soil and Watershed Science for a Crowded Planet may be substituted for one of the 300-level GE courses.

Effective for Students Who Entered Skidmore Prior to Fall 2022

Fulfill the General College Requirements

Code	Title	Hours
GE 101 & GE 377	Earth Systems Science with Lab and Senior Seminar In Geosciences	5
Select an approved course in analytical methods:		4
ID 210	Introduction to GIS	
GE 305	Remote Sensing of the Earth and Environment	
Select one of the following by the end of junior year:		4

CH 125	Principles of Chemistry	
CH 126	Principles of Chemistry	
Select one of the following by the end of the junior year:		3-4
MA 113	Calculus II	
MA 204	Probability and Statistics	
MS 204	Statistical Methods	
GE 235	Data Analysis, Modeling, and Scientific Programming: Earth and Environmental Sciences	
Select one of the following:		4
PY 207		
PY 207H		
BI 107	Molecular and Cellular Foundations of Life	
BI 108	Organismal Biology	
Select eight additional GE or GP courses, including: [1]		24
Select one of the following:		
GE 211	Climatology	
GE 216	Sedimentology	
GE 301	Hydrogeologic Systems	
GE 304	Geomorphology	
GE 306	Oceans and Global Change	
GE 316	Stratigraphy	
Select at least two at the 200 level [2]		
Select at least three at the 300 level [3,4]		
Total Hours		**44-45**

1 One of these may be at the 100 level, (minimum of 3 credits each), excluding GE 399A-D

2 Only 1 of which may be GE 275A-C

3 Only 1 of which may be GE 375A-D

4 ES 308 Soil and Watershed Science for a Crowded Planet may be substituted for one of the 300-level GE courses

Writing Requirement in the Major

As part of the writing-in-the-major requirement, Geoscience students will learn how to clearly propose research ideas and how to concisely convey their findings to broad audiences ranging from other geoscientists to the general public. Students will learn to contextualize their ideas and findings in the existing geosciences knowledge using the standard writing practices of the geosciences.

Learning Objectives for Writing in Geosciences

Students should be able to:

- synthesize and cite information from a variety of sources in their writing;
- articulate clearly hypotheses and methods for scientific research in their writing;
- develop proficiency in expressing results, including addressing uncertainty in the findings;
- convey the implications of findings for the geosciences community and/or the public through their writing; and
- write effective independent and collaborative pieces.

In cooperation with the advisor, a student majoring in geosciences should construct a program to include a broad knowledge of the geosciences in general, as well as specific knowledge of one area of geosciences in greater depth. GE 371 Independent Study in Geosciences is strongly recommended for students who intend to pursue graduate studies or a career in the field.

Geosciences Minor

Code	Title	Hours
Program Requirements		
Select at least two GE courses at the 200 level		6
Select at least two GE courses at the 300 level		6
Select additional GE courses to complete six GE course requirement		6
Total Hours		**18**

Honors

To be recommended for honors in geosciences, students must meet the college requirements of a grade-point average of 3.0 and a 3.5 in the major. Students must also earn at least an A- in GE 371 Independent Study in Geosciences, thereby demonstrating superior accomplishment in the major. Geosciences Honors Forum courses include an optional Honors Add-on with GE 311 Paleoclimatology, HF 300 Honors Forum Seminar.

Course Listing

GE 101 - Earth Systems Science with Lab
Credits: 4
Introduction to Earth's dynamic systems and geologic processes. Student will study the planet from its deep interior to its oceanic, surficial, and atmospheric components to develop a scientific understanding of Earth as a holistic environmental system, of which the biosphere, including humanity, is one component. Within this context, students will examine topics such as rocks and minerals, mountain building, earthquakes, volcanoes, glaciers, surface and groundwater, and resources while also developing quantitative reasoning skills. Students will extend their understanding of our place on Earth by considering the interactions between geologic processes and humans.
Prerequisites: *QR1 or MA 100 or placement at the FQR level or placement at the AQR level.*
Note(s): Five hours of lecture, guided activities, laboratory experiments, field trips, and problem-solving per week. Fulfills QR2 and Natural Science requirements; fulfills Fundamental QR and Scientific Inquiry requirements.

GE 102 - The History Of Earth, Life, And Global Change
Credits: 4
Introduction to the deep time history of biospheric responses to changes in Earth's climatologic and geologic systems. The course draws upon geologic principles and theories to explore the planet's origin and the processes that perpetually modify the global environment. Topics also include the origin of life, the causes and consequences of major environmental crises in Earth's history, and the role of humanity as an agent of global change.
Note(s): Three hours of lecture, two hours of lab per week. Fulfills Natural Sciences requirement; fulfills Scientific Inquiry requirement.

GE 105 - Earthquakes and Volcanoes: the Hazards of Plate Tectonics
Credits: 4
An introduction to the science behind the geologic hazards that result directly from plate tectonic processes: earthquakes and volcanic eruptions. Students will learn the fundamentals of plate tectonic theory and will gain an understanding of the processes responsible for earthquake generation and volcanic eruptions, the settings within which these hazards occur, and secondary hazards that result from earthquakes and volcanoes, such as tsunamis and landslides. Students will also learn how to identify evidence for earthquakes and volcanic eruptions in the ancient geologic record. Laboratory work, problem sets, and field trips will explore the insights and quantitative information that earthquakes and volcanoes provide about the structure, chemical evolution, and processes of the Earth; the preservation of these hazards in the geologic record; and their interactions with the atmosphere, biosphere, and human society.
Prerequisites: *QR1 or MA 100 or placement at the FQR level or placement at the AQR level.*
Note(s): Fulfills QR2 and Natural Sciences requirements; fulfills Fundamental QR and Scientific Inquiry requirements.

GE 112 - Oceanography: Introduction to the Marine Environment
Credits: 4
Introduction to the interaction of physical, chemical, geological, and biological processes operative in the great water bodies that cover nearly three-quarters of the earth's surface. Students will study basic principles of physical and chemical oceanography, marine biology, and marine geology while also developing quantitative reasoning skills. Five hours of lecture, guided activities, laboratory experiments, field trips, and problem-solving per week.
Prerequisites: *QR1 or MA 100 or placement at the FQR level or placement at the AQR level.*
Note(s): Three hours of lecture, two hours of lab per week. Fulfills QR2 and Natural Sciences requirements; fulfills Fundamental QR requirement and Scientific Inquiry requirements.

GE 177 - Introductory Seminar in Geosciences
Credits: 1
A discussion of research and communication in earth sciences, based on journal articles, student research, and oral presentations. Intended for students with little or no geosciences experience.

GE 203 - Material World: Introduction to Natural Resources
Credits: 3
If it's not grown, it must be mined. Without mineral resources, humans would all be living “naked and afraid”. In addition to making human civilization possible, these materials (i.e. metals, industrial minerals, gems, building materials) are the foundation of many national economies and have also complicated and contributed to geopolitical and environmental conflicts throughout history. Understanding Earth’s mineral resources from cradle to grave is an important component for an informed citizenry that is able to meet the wicked problems of an Earth with a growing population and ever changing technologies. In this course, students will learn about the geologic processes integral to the formation and distribution of mineral resources as well as methods of exploration for and extraction of these materials for our use. Related topics include the environmental impacts and remediation associated with resource extraction and resource depletion.
Note(s): Offered as letter only.

GE 204 - Structural Geology
Credits: 4
Bending, breaking, and flowing: Principles of structural geology and rock deformation - An introduction to structural geology, rock deformation, and their relation to plate tectonics. Students will learn the fundamentals of rock mechanics through examination of various structures (folds, faults, joints, shear zones, etc.) found in crustal rocks, and the mechanisms responsible for their formation. Laboratory exercises will emphasize hands-on characterization and data collection/analysis of geologic structures in the field, reading and interpretation of geologic maps, and numerical analysis of structural data. Lectures will cover descriptive analyses of geologic structures, strain and kinematic analysis, dynamic analysis, and how deformation mechanisms operating at the atomic scale control the rheologic behavior of mountain belts and the lithosphere as a whole.
Prerequisites: *GE 101.*

GE 205 - Introduction to Energy Resources
Credits: 3
An exploration of the earth materials and processes used to produce energy. Without energy resources, our days would be a lot darker, less comfortable, and less convenient. Students will learn about the formation and distribution of energy producing materials such as fossil fuels and uranium, increasing their understanding of how this impacts exploration for, extraction of and use of them. Students will also investigate how we harness earth processes like surface water flow, geothermal heat, solar and wind power to generate renewable energy. Throughout the course, students will consider how energy generation intersects with geopolitics, economics, environment, and society, increasing their comprehension of the complexity and nuance associated with using energy resources to meet growing demand and future needs.

GE 207 - Environmental Geology
Credits: 4
Investigation of Earth's environments as viewed through the study of surficial and crustal geologic processes. Emphasis is on natural and anthropogenic phenomena including earthquakes, volcanoes, floods, landslides, climate change, soil erosion, pollution, waste management, and energy resources. Laboratories and field trips highlight geologic perspectives on the environment.
Note(s): Three hours of lecture, three hours of lab per week. Fulfills Natural Sciences requirement; fulfills Scientific Inquiry requirement.

GE 208 - Origin and Distribution of Natural Resources
Credits: 4
A survey of the origin, distribution, and exploitation of energy (e.g., petroleum, methane, coal, uranium) and mineral (e.g., metal, gem, agricultural fertilizer) resources throughout the world. The dependence of industrialized nations upon Earth's energy and mineral resources is at the root of many national economies as well as many of the major environmental and geopolitical conflicts of our time. Future economic and population growth are certain to multiply demands for Earth resources, a fact that urges that there be an educated citizenry capable of making databased decisions regarding their availability and utilization. Related topics include shrinking resource reserves, environmental degradation, and the relative merits of various resource strategies.
Prerequisites: *GE 101 or GE 102 or GE 207.*

GE 209 - Earth Materials
Credits: 4
An exploration of the nature, compositions, and origins of Earth materials (i.e., rocks, minerals, mineraloids) that are central to understanding Earth system history. Students will study the attributes of the minerals, rocks, and soils of Earth's lithosphere focusing on petrogenic processes within the context of the tectonic history of North America. Field and laboratory work will provide students with the skills and methodologies required to prepare Earth materials for study and to conduct their own petrographic analyses. Lectures, discussions, and in-class student team presentations teach the concepts and insights required to interpret petrogenic processes and tectonic environments of Earth materials.
Prerequisites: *GE 101.*
Note(s): Three hours of lecture, three hours of lab per week.

GE 211 - Climatology
Credits: 4
Introduction to the basic components of Earth's climate system: the atmosphere, ocean, cryosphere, lithosphere, and biosphere. The course investigates the basic physical processes that determine climate and the links among the components of the climate system, including the hydrologic and carbon cycles and their roles in climate, climate stability, and global change. Topics also include climate patterns and forecasting climate, as well as their applications and human impacts.
Note(s): Three hours of lecture, two hours of lab per week. Fulfills Natural Sciences requirement; fulfills Scientific Inquiry requirement.

GE 216 - Sedimentology
Credits: 4
The scientific study of sedimentary bodies and the processes by which they form. Emphasis is placed on the actualistic application of Holocene models to the recognition and interpretation of ancient depositional environments. Field and laboratory work include the description, classification, and interpretation in outcrop, hand specimen and thin section.
Prerequisites: *GE 102 or GE 112.*
Note(s): Three hours of lecture, three hours of lab per week. Fulfills Natural Sciences requirement; fulfills Scientific Inquiry requirement.

GE 229 - Introduction to Geophysics
Credits: 4
A study of the active physical processes in the earth. Students will apply ideas and tools of physics to earth science problems by examining topics such as stress and strain, heat transport, fluid advection, gravity, seismology, and magnetism. Students will study earth phenomena including rock deformation, glacier mechanics, earthquakes, and earth's magnetic field, and conduct analysis of geophysical data and apply physical models to earth science problems. Four hours of combined lecture and lab per week.
Prerequisites: *MA 111 (can be taken concurrently) and one course in either physics or geosciences, or permission of the instructor.*
Note(s): Four hours of combined lecture and lab per week.

GE 235 - Data Analysis, Modeling, and Scientific Programming: Earth and Environmental Sciences
Credits: 4
An introduction to data analysis methods, modeling, and scientific programming using examples from climatology, geology, environmental science, and oceanography. Topics include descriptive statistics; sampling theory; least-squares fitting; timeseries analysis; data interpolation and contouring; modeling methods; and data visualization techniques. Students will write original computer scripts to manipulate data sets, model Earth and environmental processes, and solve quantitative problems. This course is appropriate for students pursuing computer programming skills for the earth and environmental sciences.
Prerequisites: *MA 109 or MA 111 and placement at the AQR level or completion of an FQR course or QR1 or permission of the instructor.*
Note(s): Fulfills Natural Science requirement; fulfills Applied QR requirement.

GE 251 - Special Topics in Geosciences
Credits: 1-4
A variety of topics at the intermediate level, for students with interest in geosciences. Topics may include geochemistry, planetary geology, global tectonics, petroleum geology, and global bio-events. Topics will be selected based on student interest and background. May be repeated multiple times for credit with different topics, pending department approval.
Prerequisites: *will vary based on course topic.*
Note(s): Courses offered for 1 or 2 credits will not count toward major or minor requirements.

GE 275 - Introductory Research in Geoscience
Credits: 1-3
An introductory exploration of research in the geosciences. Students plan, design, and implement a small research project from the laboratory or field in coordination with a faculty member. This experience allows students at various stages of their careers to sample research methodologies in particular subdisciplines of geosciences.
Prerequisites: *Completion of one 100-level course in the geosciences or requirements set forth by individual instructors plus permission of instructor.*

GE 300 - 300 Level Elective
Credits: 3

GE 301 - Hydrogeologic Systems
Credits: 4
An advanced course on the physical processes of water transport and accumulation on the surface and in the shallow subsurface environments, as well as environmental impacts on water quality. Students will learn the scientific principles of the hydrologic cycle, including precipitation, evapotranspiration, infiltration, surface runoff, groundwater flow, and surface-groundwater interaction. Students will apply these principles to investigate how land-use change, such as agriculture and urban development, change the quantity, quality, and distribution of water in our environment. Throughout the course, students will use case studies and field data to apply their knowledge to real-world problems.
Prerequisites: *GE 101 or GE 207 or ES 105.*
Note(s): Three hours of lecture, three hours of lab per week. Two mandatory Saturday field trips.

GE 302 - Reading the Sedimentary Record: Sedimentology and Stratigraphy
Credits: 4
The study of sedimentary processes and the sequence and architecture of sedimentary strata in relation to Earth history. Sediments and sedimentary rocks cover most of the Earth, house critical resources, and underpin our understanding of the history of plate tectonics and climate change, and the evolution of life. Students learn to apply modern-process-based models for recognizing and interpreting depositional environments. From this basis, students will then focus on the classification and correlation of more ancient sedimentary rocks and their interpretation, exploring the respective roles of tectonics, climate, and organisms in the development of continents and sedimentary basins over geologic time. Laboratory exercises emphasize characterization and data collection/analysis of sedimentary materials in the field, hand specimen and thin section, and data analysis including using data visualization tools.
Prerequisites: *GE 101 or GE 105 or GE 112 or GE 211 or permission of instructor.*

GE 304 - Geomorphology
Credits: 4
Analysis of the geologic and climatic factors that control the evolution of topography. Lab study is concentrated on the physical character of the United States and on the geologic configurations that determine landform distribution and therefore are the basis for physical subdivision.
Prerequisites: *GE 101 or GE 207 .*
Note(s): Two hours of lecture, three hours of lab per week.

GE 305 - Remote Sensing of the Earth and Environment
Credits: 4
An exploration of methods of remote sensing used in modern observations of Earth processes. Students will examine the physical principles of remote sensing within the context of key Earth systems such as the atmosphere, the cryosphere, and the terrestrial and ocean biospheres. Students will explore topics such as vegetation cycles, weather observations, the atmospheric ozone layer, and digital elevation model development. Laboratory work and student projects will include manipulation and interpretation of remote imagery to classify ground cover, detect environmental change, and observe spatial and temporal patterns in Earth processes. Three hours of lecture, 3 hours of lab per week.
Prerequisites: *GE 101 or concurrent enrollment in GE 101 and ID 210 or approved GIS course or permission of the instructor.*

GE 306 - Oceans and Global Change
Credits: 4
An exploration of accelerated change in Earth's systems and the profound effects that are occurring or are predicted to occur in the oceans. Students will explore topics such as the impacts of ice melt and increasing temperatures on ocean circulation, the spread of low-oxygen conditions and ocean acidification, shifts in marine species distributions and the loss of biodiversity, the implications of ocean-related geoengineering, and the effects of human resource extraction from the sea. Discussion and writing assignments will center around readings taken from the primary oceanographic literature and will emphasize the role of Earth system models in predictions of future change.
Prerequisites: *GE 112 or GE 211.*

GE 309 - Field Techniques
Credits: 4
An advanced course in the techniques used for field mapping. The course concentrates on the instruments of mapping and how to use them, including pace and compass, altimeter, plane table and alidade, topographic map and air photo base. In addition there is the study of some basic subsurface geologic techniques such as structural contour maps, isopach maps, and well log analysis and correlation.
Note(s): Two hours of lecture, three hours of lab, and one hour of discussion per week.

GE 310 - Paleobiology
Credits: 4
An advanced study of the morphology, taxonomy, and evolution of fossil organisms; the major events in the 3.6 billion-year history of Earth's biota; and the processes of fossil preservation/destruction. The ecology of fossil organisms, reconstruction of paleo-environments and paleocommunities, as well as the forcing mechanisms that perpetually alter Earth's marine and terrestrial environments are emphasized throughout. Laboratory and field work provide firsthand experience in the application of the fundamental concepts and principles of paleobiology to the observation, analysis, and interpretation of ancient life forms.
Prerequisites: *GE 102.*
Note(s): Three hours of lecture, three hours of lab per week.

GE 311 - Paleoclimatology
Credits: 3
An advanced course that examines the history of Earth's climate, the physical processes that influence it and their interaction, as well as controlling mechanisms. Emphasis is placed on biogeochemical cycles, atmospheric and oceanic chemistry and circulation patterns through time, the influences of volcanic aerosols and asteroid impacts on climate, icehouse and greenhouse cycles, and the climates of the Phanerozoic.
Prerequisites: *GE 101 or GE 102 or GE 211 or permission of instructor.*
Note(s): Optional Laboratory: Honors Add-on, HF3XX- Paleoclimatology Practicum. 1-credit.

GE 316 - Stratigraphy
Credits: 4
Study of lithologic and biologic units of sedimentary strata, their classification, correlation, and use in environmental and geographic reconstructions. Emphasis placed on the respective roles of organisms, geosynclines and tectonic events in the development of continents and sedimentary basins.
Prerequisites: *GE 216.*
Note(s): Three hours of lecture, three hours of lab per week.

GE 320 - Global Biogeochemical Cycles
Credits: 4
An introduction to global biogeochemical cycles, i.e., the transport and transformation of substances in the environment through physical, chemical, and biological processes with profound implications for climactic and ecological processes. In seminar, students will address methods used to measure and model elemental fluxes and decipher changes in biogeochemical cycles over time as well as examine processes and reactions controlling the distribution and fluxes of nutrients and other important chemical species within and between Earth's principle spheres. In laboratory, students will use Stella software to translate their conceptual knowledge of biogeochemical cycles into quantitative dynamic system models of the Earth System representing the past, present, or future in equilibrium and perturbed states.
Prerequisites: *MA 109 or MA 111 and prior fulfillment of the natural science requirement.*

GE 351 - Advanced Topics in Geology
Credits: 1-3
Offered to either small groups of students or on an individual basis, allowing the student to study in depth areas of the science that are not offered on a regular basis. Specific topics will vary each time the course is taught and might include hydrology, glaciology, micropaleontology, or computer applications in geology.
Prerequisites: *Two GE courses unless otherwise specified.*

GE 352 - Special Topics Geology
Credits: 3

GE 371 - Independent Study in Geosciences
Credits: 1-4
Advanced research in the geosciences, generated and designed by the student in consultation with and under the supervision of a member of the department. Although the ideal research project includes suitably balanced literature, field, laboratory, and interpretive components, the requirements of individual topics may dictate a focus on one or more of these aspects of conducting scientific research. Research results will include a written report submitted to the faculty supervisor and an oral presentation to the department.

GE 375 - Senior Research in Geosciences
Credits: 1-4
An opportunity for qualified seniors to plan, design, and implement a research project from the laboratory or field in coordination with a faculty member.
Prerequisites: *Permission of instructor and senior status.*

GE 377 - Senior Seminar In Geosciences
Credits: 1
A one-credit seminar designed to incorporate critical skills acquired throughout the student's undergraduate geosciences experience. In this course students will be part of a team that synthesizes and interprets primary date taken from the literature. During the first part of the seminar, student teams will participate in discussions of current geosciences literature selected within each faculty member's discipline, whereas for the rest of the course students are responsible for choosing literature according to their own interests, and leading discussions based on those texts.
Note(s): Fulfills Senior Experience Coda requirement.

GE 399 - Professional Internship in Geology
Credits: 1-4
Professional experience at an advanced subject level for juniors and seniors with substantial academic and cocurricular experience in the major field. With faculty sponsorship and department approval, students may extend their educational experiences by working on specialized research projects with outside professional earth scientists.
Note(s): Must be taken S/U.