Geology (GEO)

Major and Minor in Geology

Department of Geosciences, College of Arts and Sciences

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Minors of particular interest to students majoring in Geology and Earth and Space Sciences: Environmental Studies (ENS), Marine Sciences (MAR), engineering minors

Geology (GEO)

The Department of Geosciences offers two undergraduate programs: the Geology major, leading to a Bachelor of Science degree, and the Earth and Space Sciences major, leading to a Bachelor of Arts degree. Minimum course requirements for the B.S. program in Geology are detailed below. For requirements for the B.A. program in Earth and Space Sciences, see the entry in the alphabetical listing of Approved Majors, Minors, and Programs. Upon declaring the major, the student is assigned a faculty advisor who will assist in the selection of a course sequence leading to the degree. Students should consult frequently with their faculty advisors regarding their progress and regarding appropriate science courses. Because the position of the scientist in society is responsible and complex, the student is cautioned to pay careful attention to general education in the arts, humanities, and social sciences.

Geology

The science of geology is focused on evaluation of the physical and chemical characteristics of the Earth and other planets and the processes that have controlled evolution of these characteristics over time. The B.S. program has built-in flexibility to allow majors to choose from a variety of electives in environmental geoscience, planetary geoscience, geophysics and geochemistry. This allows students to develop a major that best reflects their interests and career goals, by allowing students to build upon the core curriculum by selecting 15 credits of upper-level science/mathematics electives from both within and outside of the Geosciences. The major aims to provide the student with maximum preparation to carry out graduate and professional work in each of these fields. Students graduating with a B.S. in Geology typically go on to graduate school or obtain professional employment with environmental consulting firms or various government organizations.

Requirements for the Major and Minor in Geology

Requirements for the Major

The major in Geology leads to the Bachelor of Science degree. All courses offered for the major must be passed with a letter grade of C or higher.

Completion of the major requires 65 to 68 credits.

A. Required departmental courses

• GEO 103 The Earth Through Time
• GEO 113 Historical Geology Laboratory
• GEO 102 The Earth and GEO 112 Physical Geology Laboratory
• GEO 306 Mineralogy
• GEO 309 Structural Geology
• GEO 403 Sedimentation and Stratigraphy
• GEO 407 Igneous and Metamorphic Petrology

B. Required courses in the related sciences

• MAT 131, MAT 132 Calculus I, II (See Note 1 below). If students do not place into MAT 125 or 131 on the basis of the math placement examination, MAT 123 is a required course for the major.
• CHE 131, CHE 132 General Chemistry
• PHY 131/PHY 133, PHY 132/PHY 134 Classical Physics I, II and labs or PHY 141/PHY 133, PHY 142/PHY 134 Honors Physics and labs or PHY 125/126/127 Classical Physics A/B/C and labs PHY 133/134.

C. Related science electives

A set of upper-division science courses, totaling 20 credits, that has been approved by the department.
D. Upper-Division Writing Requirement

All students majoring in Geology must submit two papers (term papers, laboratory reports, or independent research papers) to the director of undergraduate studies for Department evaluation by the end of the junior year. If this evaluation is satisfactory, the student will have fulfilled the upper-division writing requirement. If it is not, the student must fulfill the requirement before graduation.

Students should consult with the department advisor to ensure that their plan for completing the Upper Division Writing Requirement is consistent with university graduation requirements for General Education. Students completing the Stony Brook Curriculum (SBC) must complete a course that satisfies the "Write Effectively within One's Discipline" (WRTD) learning objective to graduate. The Upper Division Writing Requirement is consistent in most cases with the SBC learning outcomes for WRTD.

Notes:

1. The following alternate beginning calculus sequences may be substituted for MAT 131, MAT 132 in major requirements or prerequisites: MAT 125, MAT 126, MAT 127 or MAT 141, MAT 142 or MAT 171. Equivalency for MAT courses achieved by earning the appropriate score on a University mathematics placement examination will be accepted as fulfillment of the requirement without the necessity of substituting other credits. For detailed information about the various calculus sequences, see "Beginning Mathematics Courses" under the entry for the Department of Mathematics and the individual course descriptions.

Suggested Clusters of Science Electives:

Students with interest in Geology:
- GEO 310 Introduction to Geophysics
- GEO 315 Groundwater Hydrology
- GEO 320 Glacial Geology
- GEO 405 Field Camp
- GEO 487 Senior Research in Geology

Students with interest in Environmental Geoscience:
- GEO 305 Field Geology
- GEO 315 Groundwater Hydrology
- GEO 316 Geochemistry of Surficial Processes
- GEO 347 Remote Sensing
- GEO 420 Environmental Analysis and Remote Sensing/GIS
- MAR 340 Environmental Problems

Students with interest in Geological Oceanography:
- GEO 310 Introduction to Geophysics
- GEO 316 Geochemistry of Surficial Processes
- GEO 318 Engineering Geology and Coastal Processes
- GEO 353 Marine Ecology
- MAR 304 Waves, Tides, and Beaches

Honors Program in Geology

Students in the Geology major who have maintained a grade point average of 3.50 in natural sciences and mathematics through the junior year may become candidates for Departmental honors in Geology by applying to the Department.

In addition to the academic program, the student must complete an honors thesis, which is evaluated by a committee composed of the student's advisor and two other science faculty members including one from outside of the Department. If the honors program is completed with distinction and the student has maintained a minimum 3.50 grade point average in all coursework in natural sciences and mathematics, honors are conferred.

Requirements for the Minor

For students majoring in other areas who are interested in obtaining a fundamental understanding of the earth sciences, a minor concentration in Geology is available. The Geology minor acquaints students with earth materials, the origin and evolution of life on earth, and physical processes that have shaped the earth through time.

All courses offered for the minor must be passed with a letter grade of C or higher. Completion of the minor requires 20 credits.

Geology
- GEO 103 and GEO 113
- GEO 102 The Earth and GEO 112 Physical Geology Laboratory
- Twelve additional credits from among GEO courses numbered 300 or higher. Courses must be approved by a departmental advisor.

Sample Course Sequence for the Major in Geology
A course planning guide for this major may be found here.

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| **FALL** | |  | |
| GEO 310 | | upper-division science elective | 3 |
| GEO 458 | | upper-division SBC | 0 |
| upper-division science elective | | upper-division SBC | 3 |
| upper-division SBC | | upper-division SBC | 3 |
| upper-division SBC | | upper-division SBC | 3 |
| Total | |  | 15 |

| **SPRING** | |  | |
| GEO 459 | | upper-division science elective | 0 |
| upper-division science elective | | upper-division science elective | 3 |
| upper-division science elective | | upper-division science elective | 3 |
| upper-division science elective | | upper-division SBC | 3 |
| SBC | | upper-division SBC | 3 |
| Total | |  | 15 |
What are the secondary global effects on societal infrastructure, on public health, on international trade? How do societal differences cause varied local responses and affect the global impact? This course focuses on evaluating the global effects of several recent geological disasters. Scientific and popular news sources are used to explore the underlying natural phenomena and the nature and global distribution of the effects from geologic, economic, and public health perspectives.  

**GEO 105: Energy Resources for the 21st Century**

Today we are faced with the challenge of driving the economies of modern civilization with new energy resources. This course looks at the current energy sources to assess their long term sustainability. In particular, this course examines fossil fuels, from the geologic processes that create them through their utilization. This course evaluates the impact on the global environment and the finiteness of each resource. Nuclear, geothermal, solar, wind, hydro, tidal, and other energy sources will be evaluated. This course projects forward to anticipate needs and evaluate future resources for time scales of 10, 20, 50, and 100 years. It identifies the technical advances that are required to meet the future energy needs. The emphasis of the course is to provide a vision of the current global energy setting. It develops tools that enable critical thinking on issues that interface society and science. Homework assignments will use the internet for accessing relevant information and spreadsheet (such as Excel) and Google Earth to evaluate this information.

**DEC:** E  
**SBC:** SNW  
**3 credits**

**GEO 112: Physical Geology Laboratory**

Rock and mineral identification, introduction to topographic and geologic maps.  

**Pre- or Corequisite:** GEO 102  
**1 credit**

**GEO 113: Historical Geology Laboratory**

An introduction to basic techniques used for interpreting geological history. Topics include interpretation of topographic and geological maps and cross sections, introduction to fossils, and basic stratigraphic techniques. One three-hour laboratory per week.  

**Pre- or Corequisite:** GEO 103  
**1 credit**

**GEO 115: Making the Invisible Visible: Polarized light microscopy**

Light interacts with crystals and through this interaction reveals information on the composition of the crystals and their internal atomic arrangement. This course provides a hands-on exploration of the construction of the polarized light microscope, its use in investigating the behavior of polarized visible light passing through crystals, and how the observed behavior can be used to identify natural and synthetic crystalline materials. The scientific material covered is of particular relevance to students interested in chemistry, physics, materials science, and planetary and geological science. Two 80-min lectures and one three-hour laboratory per week for a 4-week period.
Consideration is also given to broader geologic and landscape evolution are examined field methods. Modern terrestrial processes apply to local geology, including training in stratigraphy, volcanism, and tectonics, as they evolve. Emphasis is given to sedimentation, and context for recorded events in human provide a foundation for the chronology rock units in the Turkana Basin, Kenya, to geological concepts to the sediments and a field course that applies fundamental geochronology (with emphasis on the.

A survey of the origin, distribution, and importance to modern civilization of the fuels and minerals won from the earth. Geology of mineral resources and problems of finding, extracting, and supplying fossil fuels, metallic ores, water, and non-metallic commodities to industry and community as well as the ultimate limits of their abundances. Environmental concerns related to the exploitation of mineral resources with review of legislation and other steps being taken to minimize environmental damage.

Prerequisite: one D.E.C. E or SNW course
DEC: H
SBC: STAS
3 credits

GEO 305: Field Geology
Geological field studies on and near the Stony Brook campus. Labs emphasize mapping techniques and field studies of glacial and environmental geology, and include geophysical and hydrological analyses and mapping. Course consists of two three-hour sessions per week, divided between lecture and outdoor labs.

Prerequisites: GEO 102/112 or GEO 112 and 103 and 113 or GEO 112 and 101 and 111
SBC: EXP+
3 credits

GEO 306: Mineralogy
Topics include basic crystallography, crystal chemistry, and identification of the important rock-forming and ore minerals. Included are the fundamentals of optical crystallography: indices of refraction, isotropic, uniaxial, and biaxial minerals; optical indicatrix theory and interference figures. Laboratory exercises involve work with crystallographic models, mineral samples, refraction oils and the polarizing light microscope. Three hours of lecture and one three-hour laboratory per week.

Prerequisites: GEO 102 and 112; CHE 131
SBC: TECH
4 credits

GEO 307: Global Environmental Change
An analysis of the physical, chemical, and biological processes in the atmosphere, hydrosphere, lithosphere, and biosphere that are susceptible to change either from natural or anthropogenic causes. In addition to focusing on the processes, this course will examine the spatial/temporal scales of environmental changes, their consequences to systems including our economic, political, and social systems, and will consider our responsibility and capability in managing systems in a sustainable way. This course is offered as both ENV 304 and GEO 307.

Prerequisites: SBC 111, or SBC 113, or ENS 101, or GEO 101, or GEO 102; ENV 115 or CHE 131
DEC: H
SBC: STAS
3 credits

GEO 309: Structural Geology
Principles of structural geology, including classification, criteria for recognition, and mechanics of formation of crustal structural features. Elementary concepts of rock mechanics. Discussion of important tectonic features of the continents and oceans. Accompanying laboratory to cover map interpretation and algebraic and graphical solutions of structural problems. Three hours of lecture and one three-hour laboratory per week. A two-day weekend field trip visits "classic" structural localities in the East. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: GEO 122, or GEO 102 and 112; one semester of calculus; PHY 121/123 or 127/129 or 131/133 or 141 or PHY 125 and 126
4 credits

GEO 310: Introduction to Geophysics
An introduction to theoretical and applied geophysics. Topics in global geophysics include seismology, gravity, geomagnetics and heat flow, with applications to the structure and dynamics of the earth's interior. Students conduct computer-based analysis of geophysical data, some of which they collect using techniques of geophysical exploration and environmental geology. Three hours of lecture per week, plus group field experiments and analysis.

Prerequisites: MAT 127 or 132 or 142 or 171 or AMS 161; GEO 122, or GEO 102 and 112; PHY 122/124 or 132/134 or 142, or PHY 126 and 127
3 credits
GEO 311: Geoscience and Global Concerns
An exploration of how technologically-based problems facing the United States and the world are related to the basic scientific principles that explain the properties of the lithosphere, hydrosphere, and atmosphere. The set of issues include such geoscience-based topics as global warming, fossil fuel resources, nuclear waste disposal, and earthquake prediction and preparedness.
Prerequisite: GEO 101 or 102 or 107 or 122
DEC: H
SBC: STAS
3 credits

GEO 312: Structure and Properties of Materials
This course will explore materials from the viewpoint of their structure and chemistry and how these affect applications. We will discuss different materials (crystals, quasicrystals, glasses, liquids) and their similarities and differences, focusing on the crystalline state. Nanomaterials and their peculiarities in terms of structure and properties will also be considered. Particular attention will be paid to (1) Materials for energy and environment applications, (2) materials for technological applications, and (3) Earth- and planet-forming materials.
Advisory Prerequisite: CHE 131 or PHY 131
3 credits

GEO 313: Understanding Water Resources for the 21st Century
A survey of the world’s water resources and the fundamental processes and concepts that govern their distribution and resupply. Topics to be covered include processes in the hydrologic cycle, water resource supply and demand, water quality, and societal aspects relating to drinking water, and industrial and agricultural water usage. Consideration is given to global water shortages, projected impacts of climate change, water-based conflict, water resource management, and conservation practices. Detail will be devoted to pollution sources, water quality standards, drinking water treatment, and government regulation. Local water issues will also be addressed.
Prerequisite: one D.E.C. E or SNW course
DEC: H
SBC: ESI, STAS
3 credits

GEO 315: Groundwater Hydrology
Physical and chemical principles of geohydrology. Concepts of groundwater geology. Introduction to quantitative models of regional fluid flow and groundwater contamination. Groundwater and geologic processes, with examples from tectonics, petroleum geology, geothermics, and economic mineralization.
Prerequisites: GEO 102 or GEO 122; MAT 127 or MAT 132 or MAT 142 or MAT 171 or AMS 161
3 credits

GEO 316: Geochemistry of Surficial Processes
Chemical principles used in the study of surface and near-surface water, rocks, and soils. Application of equilibrium concepts and reaction rates to reactions involving gases, fluids, and minerals in nature. Consideration of soil properties and processes.
Prerequisites: GEO 122, or 102 and 112; CHE 132 or 142
4 credits

GEO 317: Petrology
Topics focus on the processes that govern the formation and distribution of igneous and metamorphic rocks and their link to the Earth’s mantle, crust, and tectonic regimes. Emphasis will be placed on integrating assessment of the chemical control on compositional diversity through phase diagrams with the study of natural rock suites through hand sample and thin section analysis. Three hours of lecture and one three-hour laboratory per week.
GEO 420: Environmental Analysis Using Remote Sensing and Geographic Information Systems

The use of aerial and satellite imagery in environmental analysis and the manipulation of geographic data sets of all types using Geographic Information Systems. Concentrating on Long Island, each student designs and completes a research project on a particular section of the area, focusing on the habitats of local wildlife, the locations of archaeological sites, coastal regimes, etc. Students should expect to spend approximately 10 hours per week beyond regularly scheduled classes in a University computer laboratory. This course is offered as both ANT 420 and GEO 420.

Prerequisite: Upper-division course in ANT or BIO or GEO or MAR

SBC: TECH

4 credits

GEO 447: Senior Tutorial in Geology

Independent readings in advanced topics. May be repeated once.

Prerequisites: Permission of instructor and chairperson

1-3 credits

GEO 448: Geosciences Colloquium

Every semester, the Department of Geosciences hosts a colloquium series. The series features weekly lectures covering a wide variety of geosciences research topics. The purpose of this course is to expose upper division geoscience students to current research being performed at Stony Brook University and elsewhere. May be repeated up to a limit of 3 credits.

Prerequisite: U3 or U4 status as a GEO or ESS major; Permission of Instructor

1 credit

GEO 458: Speak Effectively Before an Audience

A zero credit course that may be taken in conjunction with any GEO course that provides opportunity to achieve the learning outcomes of the Stony Brook Curriculum's SPK learning objective.

Pre- or corequisite: WRT 102 or equivalent; permission of the instructor

SBC: SPK

S/U grading

GEO 459: Write Effectively in Geology

A zero credit course that may be taken in conjunction with any 300 or 400 level geosciences course, with permission of the instructor. The course satisfies Stony Brook Curriculum's WRTD requirement.

Prerequisite: taken in conjunction with a 300- or 400-level Geosciences course; permission of the instructor

SBC: WRTD

S/U grading

GEO 475: Undergraduate Teaching Practicum I

Work with a faculty member as an assistant in one of the faculty member's regularly scheduled classes. The student is required to attend all the classes, do all the regularly assigned work, and meet with the faculty member at regularly scheduled times to discuss the intellectual and pedagogical matters relating to the course.

Prerequisite: U4 standing; previous preparation in subject field; interview; permission of instructor

SBC: EXP+

3 credits, S/U grading

GEO 476: Undergraduate Teaching Practicum II

Work with a faculty member as an assistant in one of the faculty member's regularly scheduled classes. Students assume greater responsibility in such areas as leading discussions and analyzing results of tests that have already been graded. Students may not serve as teaching assistants in the same course twice.

Prerequisite: GEO 475; previous preparation in subject field; interview; permission of instructor and department

SBC: EXP+

3 credits, S/U grading

GEO 487: Senior Research in Geology

Under the supervision of a faculty member, a major in the department may conduct research for academic credit.

Prerequisites: Permission of instructor and chairperson

SBC: ESI, EXP+

0-6 credits

GEO 488: Internship

Participation in local, state, or national private enterprises, public agencies, or nonprofit institutions. May be repeated to a limit of 6 credits.

Prerequisites: Permission of instructor and department

SBC: EXP+

0-6 credits, S/U grading