**GEO 500: Geosciences Research Seminar**  
Meetings in which first-year graduate students and undergraduates with senior standing learn about the research activities of the Geosciences faculty.  
*Fall, S/U grading*

**GEO 502: GIS for Geologists**  
A practical introduction to geographic information system software. Participants learn to use direct measurement and mathematical techniques to compute the location of features and gain practical experience in rendering imagery and tabular geographic data as layers on maps. The course consists of two three-hour sessions per week for the first five weeks of semester, which include fieldwork, lectures, demonstrations and software-based analysis of data.  
*Fall, 1 credit, Letter graded (A, A-, B+, etc.)*

**GEO 503: Mineral Equilibria**  
Covers the basics of the application of the principles of chemical thermodynamics to the resolution of geochemical and petrological problems. Begins with the first law and continues through phase transitions, properties of fluids, definitions of fugacity and activity of major and trace elements in fluids and molten solutions; configurational entropies; models quantifying nonideal mixing in solid solutions. Additional topics include interpretation of calorimetric studies and/or solubilities of minerals in aqueous solutions.  
*Fall, 3 credits, Letter graded (A, A-, B+, etc.)*

**GEO 504: Geology of the Turkana Basin**  
Students are introduced to the current perspectives on the origins and evolution of the Turkana Basin, Kenya. Students learn how to apply fundamental geological concepts to the sediments and rock units to provide a foundation for the chronology and context for recorded events in human evolution. Emphasis is given to sedimentation, stratigraphy, volcanism, and tectonics, as they apply to local geology, including training in field methods. Modern terrestrial processes and landscape evolution are examined using features present in the Turkana Basin. Consideration is also given to broader geologic events spanning the Oligocene to he present. Geologic concepts are linked to modern and ancient environments, archaeology, and paleoanthropology in northern Kenya. It is a field-based course involving visits to important geological and fossil sites. Graded work includes fieldwork and lab assignments, independent research assignments, quizzes and a final exam. Semesters offered-Fall and Spring. Components- laboratory, lecture, and recitation.  
*Fall, 3 credits, Letter graded (A, A-, B+, etc.)*

**GEO 505: Experimental Petrology Laboratory**  
The course is designed to give the student experience in some or all of the following techniques of experimental petrology: evacuated silica-glass tube experiments, one-atmosphere quenching experiments (with and without controlled atmospheres), 1- to 5-kbar hydrothermal systems (using oxygen buffers where necessary), gas-media experiments up to 7 kbar, and solid-media, piston-cylinder experiments.  
*Spring, alternate years, 1 credit, Letter graded (A, A-, B+, etc.)*

**GEO 507: Petrogenesis**  
Discussion of the origin and evolutionary history of selected types of igneous and metamorphic rocks by integrating the principles of heterogeneous phase equilibria, trace-element and isotopic geochemistry, crystal chemistry, and geologic occurrence. The laboratory component, GEO 527, must be taken concurrently; a common grade for both courses will be assigned. Fall  
*3 credits, Letter graded (A, A-, B+, etc.)*

**GEO 508: The Rock-Forming Minerals**  
Study of the crystal chemistry, intracrystalline cation distribution (homogeneous equilibria) stability, and paragenesis of the rock-forming minerals. Special emphasis is placed on amphiboles, feldspars, micas, and pyroxenes.  
*Fall, 3 credits, Letter graded (A, A-, B+, etc.)*

**GEO 510: Dimensions of Global Change**  
This course is designed to be an intense study in global climate change science. The emphasis will be on modern climate change however, by studying the contributions of paleoclimatology we can gain insight into how the climate system operates. To understand modern climate change and predictions, it is necessary to develop an understanding of natural climate forcing, natural variability and feedbacks in the climate systems. Adding to natural variation are the impacts of anthropogenic forcing. The course will examine the measured and predicted consequences of these anthropogenic forcing.  
*Offered Fall and Summer, 3 credits, Letter graded (A, A-, B+, etc.)*

**GEO 511: Computer Programming for the Geosciences**  
An introduction to object-oriented programming in Java for geoscience students. Participants are required to develop interactive programs to serve as educational or research tools pertaining to topics within the geosciences. These programs, or applets, include a graphical user interface that enables users to control parameters and observe results. The applets are posted on the World Wide Web.  
*Prerequisite: Geosciences graduate standing*

**GEO 512: Structure and Properties of Materials**  
An introductory course that will explore materials from the viewpoint of their structure and chemistry and how these affect applications. Different states of matter (crystals, quasicrystals, glasses, liquids) will be discussed 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.  
*Offered Fall and Summer, 3 credits, Letter graded (A, A-, B+, etc.)*
This course provides the basic concepts underlying modern geographic information science and technology. Emphasis is placed on the principles of GIS for collecting, storing, characterizing, and maintaining data and computer-based techniques for processing and analyzing spatial data. The course includes three hours of lecture, in class exercises and homework projects each week. This is a computer based class with the majority of students work involving GIS computer software. Prerequisite: working knowledge of spreadsheet software

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

GEO 514: Introduction to Physical Hydrogeology


Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 515: Geohydrology


Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 517: Crystal Chemistry

The structure/property/composition relationships in solids. An introduction to the common structure types and how they illustrate principles useful in understanding more complex solid-state materials. Applications of modern scattering techniques to the study of solids, particularly Earth materials, are also included.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 518: Carbonate Sediments

An intensive study of the formation, deposition, lithification, and diagenesis of carbonate sediments. Lectures and seminars emphasize principles of carbonate deposition, facies relationships, and chemistry. Laboratories emphasize binocular and petrographic analysis of recent and ancient carbonates.

Spring, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)

GEO 519: Geochemistry of Natural Waters

A comprehensive quantitative treatment of the processes controlling the chemistry of polluted and unpolluted surface and groundwaters. Topics covered include thermodynamics and kinetics of water-rock interaction; mineral solubility; chemical speciation; redox reactions; adsorptions; carbonate chemistry; and speciation, mobility, and toxicity of metal ions. Based on a knowledge of these processes, the chemical composition of a wide variety of surface and groundwaters is interpreted. Water-quality criteria and their application are also discussed.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 520: Glacial Geology

History of glaciation on earth, formation and dynamics of glaciers and ice sheets; processes of glacial erosion and deposition; and the nature of glacial sediments and landforms particularly relating to the development of Long Island.

Prerequisite: Physical Geology
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 521: Isotope and Trace Element Geology

Application of radiogenic isotopes and trace elements to the petrogenesis of igneous, metamorphic, and sedimentary systems including water-rock interaction in diagenetic and hydrothermal systems. Evaluation of radiogenetic techniques for determining the ages of rocks and minerals.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 522: Planetary Sciences

The chemical, physical, and petrologic properties of meteorites are reviewed. These data and data for the moon and the terrestrial planets are used to form a picture of the origin, chemical evolution, and accretion of planetary material.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 523: Geodatabase and Design

Concepts of geodatabase design and management in geographic information systems (GIS), SQL statements, geographic data types and functions, data entry, and techniques of geographic information structure applications.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GEO 524: Organic Contaminant Hydrology

There are a host of chemical, biological, and physical processes that affect the transport and fate of organic chemicals in natural waters. This course concerns understanding these processes and the structure-activity relationships available for predicting their rates. The major focus of this class is on contaminant hydrology of soil and aquifer environments, and includes the principles behind remediation and containment technologies. This course is offered as both MAR 524 and GEO 524.

Prerequisite: GEO 526 or MAR 503 or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 525: GIS Fundamentals II

GIS Fundamentals II will introduce the applied use of Geographic Information Systems (GIS) which is now used extensively in analytical studies. The course emphasizes the applications of GIS in solving real-world problems. Students are expected to gain an understanding of GIS theory, methodology and most importantly application. Students are also expected to demonstrate abilities of spatial thinking, spatial analysis, and be able to solve practical spatial problems utilizing a GIS.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GEO 526: Low-Temperature Geochemistry

Fundamental principles of chemical thermodynamics and kinetics, including isotope effects, as they pertain to geochemical processes occurring in surface and near-surface environments. Consideration is also given to mass transfer process and reaction pathways.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 527: Petrogenesis Laboratory

Three hours of laboratory per week that corresponds to the content of GEO 507
1 credit, Letter graded (A, A-, B+, etc.)

GEO 528: Carbonate Geochemistry

Examination of the mineralogical and chemical characteristics of the rock-forming carbonates with emphasis on stabilities in the geological environments. Includes study of phase relations; trace and minor element chemistries; and mechanisms of growth, dissolution, and replacement. Use of current research techniques as applied to carbonate minerals.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)
GEO 530: The Geology of Mars
Overview of Mars as a planetary system. Evolution of the planet and its atmosphere through time. Detailed discussion of processes that have shaped the martian surface, including erosion, sedimentation, volcanism, impact cratering, physical and chemical weathering. Comparison of geologic processes on Mars and Earth. Discussion of past and future spacecraft missions to Mars. Three hours of lecture per week.
3 credits, Letter graded (A, A-, B+, etc.)

GEO 531: Crystalline Solids
Principles of symmetry, single-crystal, and powder X-ray diffraction techniques and elements of crystal structure determination are considered. Use of crystallographic data in the study of mineral systems. Laboratory in diffraction techniques includes extensive use of digital computers.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 532: Solid-State Geochemistry
The application of crystallographic techniques to problems in mineral chemistry. Concepts of the crystalline state, order-disorder, atom radii, chemical bonding, atom coordination, solid solutions, and physical properties of minerals. Emphasis on silicate and sulfide crystal structures.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 533: Geochemistry of the Terrestrial Planets
A brief overview of basic principles of geochemistry, including origin of the elements, geochemical and cosmochemical classification of the elements, and a geochemical perspective of the periodic table. This is followed by an examination of the compositions and chemical interactions among the major geochemical reservoirs of the terrestrial planets, including their cores, mantles, crusts, and where relevant, sedimentary shells.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 535: Regional Structure and Tectonics
Formation and development of continental crust in Phanerozoic mountain belts. The structure and origin of ocean crust, magmatic arcs, and continental margin sequences are studied using geophysical, geochemical, and geologic data from ancient and modern examples.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 539: Solid-State Geophysics
Principles of structural geology, including the recognition and the mechanics crustal structural features. Topics include folding and faulting, stress and strain, and the nature of brittle and ductile lineations and foliations in the crust. Three hours of lecture per week. The laboratory component, GEO 569, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: Undergraduate physical geology
3 credits, Letter graded (A, A-, B+, etc.)

GEO 540: Solid Earth Geophysics
An overview of solid earth geophysics. Topics include earthquake and exploratory seismology, gravity, magnetics, geochronology, and heat flow. There is an emphasis on how all of these techniques shed light on the nature of the Earth's interior and dynamics.
Prerequisite: Physical geology, undergraduate physics and calculus
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 542: Inverse Theory
Introduction to the basic concepts of inverse theory and its application to the study of the internal structure of the Earth and related problems.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 543: Stratigraphy
The history and practice of defining units layered rocks and interpreting their spatial relationships. Topics include the basis for the geologic time scale, lithostratigraphic versus chronostratigraphic units, biostratigraphy, magnetostratigraphy, facies patterns and Walther's law, subsurface stratigraphy, and the application of stratigraphy to geological problems. The laboratory component, GEO 563, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: GEO 546 or undergraduate mineralogy and petrology
3 credits, Letter graded (A, A-, B+, etc.)

GEO 544: Remote Sensing in Geosciences
Comprehensive study of commonly used image analysis methods in earth, environmental and planetary sciences. Discussion of physical principles that are the basis for remote sensing techniques. Participants gain practical experience in geologic and environmental problem-solving using satellite imagery.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 546: Mineralogy and Petrology
An introduction to mineralogy and petrology, including crystallography, crystal chemistry, mineral identification, and the processes that govern the formation of igneous and metamorphic rocks. Three hours of lecture per week. The laboratory component, GEO 566, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: Undergraduate physical geology and one year of undergraduate chemistry
3 credits, Letter graded (A, A-, B+, etc.)

GEO 547: Remote Sensing in Geosciences
Application of lattice dynamics and equations of state of solids to studies in high-pressure, high-temperature geophysics. Reviews experimental data from physical acoustics, static and shock wave compression, and theoretical results from finite strain and atomistic models.
Prerequisites: GEO 551 and 552, or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
GE 562: Early Diagenesis of Marine Sediments
The course treats qualitative and quantitative aspects of the early diagenesis of sediments. Topics include diffusion and adsorption of dissolved species; organic matter decomposition and storage; and diageneis of clay materials, sulfur compounds, and calcium carbonates. The effects of bioturbation on sediment diagenesis are also discussed. This course is offered as both MAR 562 and GEO 562.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GE 563: Stratigraphy Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 546. Laboratory work emphasizes practical techniques in stratigraphy.

1 credit, Letter graded (A, A-, B+, etc.)

GE 566: Mineralogy and Petrology Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 546

1 credit, Letter graded (A, A-, B+, etc.)

GE 567: Sedimentary Rocks and Crustal Evolution
An examination of major and trace elements and isotopic composition of terrigenous sedimentary rocks within a framework of tracing the composition and evolution of the continental crust. Emphasis is placed on interpreting sedimentary compositions in terms of provenance and sedimentary history (e.g., weathering, diagenesis, recycling). Relationships between sediment composition and tectonic setting is also examined.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GE 569: Structural Geology Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 549

1 credit, Letter graded (A, A-, B+, etc.)

GE 570: Earthquake Mechanics
A survey of fundamental mechanics aspects of earthquake rupture; reviews concepts of fracture mechanics, elastodynamics, and experimental rock mechanics. Topics include state of stress in the lithosphere, theoretical models of earthquake instability, energetics of faulting, representation of dynamic elastic field generated by earthquakes, and relation of seismic signals to the kinematics and dynamics of seismic source.

Prerequisite: GEO 552 or permission of instructor
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GE 571: Mechanics of Geologic Materials
Elastic, thermal, and anelastic properties of geologic materials. The course emphasizes a thermodynamic characterization of these properties including irreversible thermodynamics and nonhydrostatic thermodynamics. Specific applications to the Earth’s environment are discussed.

Prerequisites: GEO 551, 552, or permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GE 572: Advanced Seismology
Course is intended to expose the student to topics that are at the forefront of current seismological research. Examples include wave propagation in heterogeneous media, earthquake source studies, tsunami generation, and seismic network data analysis.

Prerequisite: GEO 552
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GE 573: Physics of Rocks
Fundamentals of the physical properties of rock in relation to seismology, hydrogeology, geophysical prospecting and geotechnical engineering. Topics include: composition, pore structure and fabric of rocks; elasticity, anelasticity and plasticity; seismic velocity and anisotropy; poroelasticity; electrical, magnetic and hydraulic transport properties.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GE 581: Coastal Engineering Geology
Concepts of the mechanics of earth materials and the physics of surficial processes with applications to the coastal environment and engineering. This course is also offered as MAR 581.

Prerequisites: Enrollment in MESP or OEN program or instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GE 585: Directed Studies
Special studies directed by various faculty members.

Fall, Spring, Summer, 1-3 credits, Letter graded (A, A-, B+, etc.)

GE 587: Hydrogeology Capstone Project
Students will complete an in-depth capstone report based on analysis of original, independent research conducted by the student on a faculty supervisor-approved topic in hydrogeology.

S/U grading

GE 588: Geological Field Methods for Earth Science Teachers
Geologic mapping techniques, geochemical analytical approach, and hydrological methodologies applied in the field to examples on Long Island. These approaches are designed for developing research projects for secondary students in earth science.

Prerequisite: Permission of instructor
Summer, 3 credits, Letter graded (A, A-, B+, etc.)

GE 590: Research Project
Independent research
Fall, Spring, Summer, 1-12 credits, Letter graded (A, A-, B +, etc.)
May be repeated for credit.

GE 599: Research
Independent research for those students established in a research group.
1-12 credits, S/U grading
May be repeated for credit.

GE 600: Practicum in Teaching
Fall and Spring, 0-3 credits, S/U grading
May be repeated for credit.

GE 603: Topics in Petrology
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GE 604: Topics in Planetary Science
May be repeated for credit.

GE 605: Topics in Sedimentary Geology-Paleontology
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.
GEO 607: Topics in Geophysics
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GEO 609: Topics in Mineralogy and Crystallography
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GEO 696: Geoscience Colloquium
A weekly series of research seminars presented by visiting scientists as well as by the faculty. Required every semester of all geoscience graduate students.
Fall and Spring, S/U grading
May be repeated for credit.

GEO 697: Geoscience Seminar
Presentation of preliminary research results and current research problems by students and faculty. Required every semester of all geoscience graduate students.
Fall and Spring, S/U grading
May be repeated for credit.

GEO 698: Geoscience Special Seminar
A weekly series of specialized seminars in which graduate students and faculty discuss specific topics within the subgroups of geology. Research is reviewed, and theses are discussed.
Fall and Spring, S/U grading
May be repeated for credit.

GEO 699: Dissertation Research on Campus
Independent research for Ph.D. degree. Open only to candidates for the Ph.D. who have passed the preliminary examination.
Prerequisite: Advancement to candidacy (G5).
Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

GEO 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

GEO 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.
All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

GEO 800: SUMMER RESEARCH
May be repeated for credit.