**GSCI 165. The Way Life Works. 1 credit.**
Patterns, energy, information, life's machinery, feedback, community and evolution. These are major themes in how life works. This course will use these themes as a backdrop for looking at the way life works.

**GSCI 166. Environment in Context. 2 credit.**
This course will use environmental issues and topics as a unifying concept to introduce ecology, environmental chemistry and evolution. Topics such as resource utilization and conservation, air and water quality issues, ecological succession, community processes, biological diversity and evolution may be used to illustrate the concepts and to demonstrate the relationship between science and public policy.

**GSCI 110. Social Issues in a Global Context. 3 credits.**
This course introduces the discipline of sociology from a macrosociological perspective, emphasizing large-scale changes in social organization and institutions. We examine the global forces that shape societies, and the historical, political, social, cultural and economic origins of contemporary social problems. We consider competing theoretical models used in the study of social change as well as the conceptual and methodological challenges in analyzing societies different from one's own.

**GSCI 140. Microsociology: The Individual in Society. 3 credits.**
This course introduces the discipline of sociology and the subfield of microsociology. We examine the mutually constitutive relationship between the individual and society. Questions addressed include: How does society influence how we think, feel, believe, act, and interact with others? What influences the self, social identity, shared social meanings, social roles, and one's position in society? How do we, as individuals and as members of social groups, recreate, contest, and change society?

**GTHEA 210. Introduction to Theatre. 3 credits.**
Study of the theatre as an art form. Emphasis on introducing students to a broad spectrum of theatrical activity and opinion. Consideration of the components that comprise a theatre event including acting, directing, design, costuming, lighting and playwriting.

**GWRTC 103. Critical Reading and Writing. 3 credits.**
Fosters reflective, critical reading, writing, and research in public discourse, culture, humanities, technology, and science. Challenges students to consider cross-disciplinary modes of inquiry through multiple genres with an attention to enlightened, global citizenship. Emphasizes revising for rhetorical effectiveness. GWRTC 103 fulfills the General Education Cluster One writing requirement and is a prerequisite for all WRITC courses numbered 200 or above.

**Geographic Science**

**Department of Integrated Science and Technology**

**GEOG/HUMN 301. Introduction to Natural Disasters. 3 credits.**
This course is designed to give students an overview of the various types of natural disasters, a look at the world regions that are most vulnerable to each type of disaster, and, a preview of disaster planning, management, relief and response as related to natural disasters.

**GEOG 161. Geospatial Tools and Techniques. 1-6 credits, variable.**
An introduction to the use of geospatial tools, such as geographic information systems (GIS), global positioning systems (GPS) and remote sensing, applied to a variety of areas, including cultural geography, environmental science, ecology, geology and public planning.

**GEOG 200. Geography: The Global Dimension. 3 credits.**
This course promotes global understanding through the study of humans, their institutions and processes, and the resulting interactions between humans and the environment. The course will include the study of Western and non-Western peoples and their social, cultural, political and economic relationships.

**GEOG 210. Physical Geography (2, 2). 4 credits.**
This introductory course is an examination of systems and processes that influence patterns of Earth's atmosphere, biotic communities, soils and landforms at multiple spatial and temporal scales. Included are classroom and laboratory experiences that are geared toward investigating interrelationships among atmospheric conditions, Earth's natural surface characteristics and human-induced modifications of Earth's features.

**GEOG 215. Cartography and GIS. 3 credits.**
An introduction to cartography and geographic information systems (GIS). Basic concepts will be illustrated with examples from a variety of applications including cultural geography, environmental science, land use and planning and business.
GEOG 290. Human Dimensions of Global Change. 3 credits.
This course addresses global change and human development. Conservation, sustainability and development are core themes that will be related to current changes occurring on a global scale. Global changes to be discussed in the course relate to the climate, biodiversity, natural resources, and human populations. Sustainability will be introduced as a dimension of human development. Prerequisite: GEOG 290 with a “C” or better.

GEOG 293. The Geography of Human Genetics, Infectious Diseases and Hunger. 3 credits.
Throughout history, infectious diseases have profoundly affected human populations. Using a case study approach, this course will give students an opportunity to investigate social and historical aspects of infectious disease as well as the microbiology, genetics, biochemistry and medical aspects of human infectious diseases and diet.

GEOG 322. Agricultural Systems. 3 credits.
This course covers four distinct areas: the foundation of agriculture, the nature and distribution of soils on a global basis; the history of agriculture from the original selection of domestic crops to the 20th century; modern industrial agriculture and trade; and alternatives to chemical and energy intensive agriculture in the 21st century. Prerequisite: GEOG 290 with a “C” or better or permission of instructor.

GEOG 325. Environmental Ethics. 3 credits.
Examines the basic principles of resource use including geographic, economic, social and political processes. Explores concepts underlying such issues as resource consumption and conservation, environmental perception, resource and environmental conflict, population growth and control, carrying capacity, and the evolution of the environmental movement.

GEOG 327. Climatology. 3 credits.
The systematic study of the atmosphere with emphasis on such phenomena as temperature, pressure, humidity, air masses and fronts; the occurrence of these phenomena on a global basis; and a detailed survey of the worldwide distribution of climate types. Prerequisite: GEOG 210 with a “C” or better or GEOL 210.

GEOG 328. Global Climate Change. 3 credits.
This course examines the interrelationship of the physical nature of the climate system, climate variability and change, and human activities. Case studies (El Nino, global warming, and stratospheric ozone depletion) are used to investigate how climate affects society, how human activities affect climate, and how non-climatic issues complicate our understanding of the relationship between climate and society. We consider how projections of future weather and climate affect decision-making. Prerequisite: GEOG 210 with a “C” or better.

GEOG 331. Geography of Virginia. 3 credits.
The course will examine the human and physical geography of the development of modern-day Virginia, providing an overview of its prehistory, then tracing its development from the beginning of the seventeenth century through the present. The course will include an analysis of Virginia’s population, resources, and regional landscapes as they have been influenced by physical, cultural, historical, and economic factors. The relationship of Virginia to the rest of the world will also be examined.

GEOG 332. Geography of Europe. 3 credits.
Geographic assessment of regional and national characteristics of the European nations.

GEOG 333. Geography of Russia and the Former Soviet Union. 3 credits.
A study of the people and culture of Russia with an emphasis on their social, economic and political processes and situation. An analysis of how the interaction of geographic, social, political and economic factors affect the lives of the Russian people.

GEOG 334. Geography of East and Southeast Asia. 3 credits.
A survey of the physical and cultural environments of China, Taiwan, Japan, the Koreas, Indochina and the countries of Southeast Asia. Topics covered include weather and climate, physiography, natural resources, population characteristics, political systems, aspects of the economy, and the role that each country plays on the regional and world stage.

GEOG 335. Geography of Africa. 3 credits.
An introduction to the regional Geography of Sub-Saharan Africa that examines the physical geography of the continent, the historical roots of its present political geography, the consequences of its colonial past on communities and cultures as well as its natural resources. Students will examine environmental issues such as resource management, food production, hunger, disease patterns, and management of wildlife. Prerequisite: GEOG 290 with a “C” or better or permission of instructor.

GEOG 336. Environmental Hazards: A Focus on Southeast Asia. 3 credits.
This course will focus on interactions between earth surface systems and social environments to demonstrate the complexity of natural hazards, and particularly those of Southeast Asia. Through regional geography, students will learn differing adaptation mechanisms of societies and cultures unique to the area and some of the natural hazards within the region. Prerequisite: GEOG 210 with a “C” or better or permission of instructor.

GEOG 337. Geography of Latin America. 3 credits.
A study of countries in Latin America which includes their physical landforms, weather and climate, biogeography, natural resource base, attitudes toward the physical environment, characteristics of the economy, the current political role in international activities, and population characteristics that include growth rate, distribution, migration and ethnicity.

GEOG 338. Geography of the Philippine Islands: Problems and Possibilities. 3 credits.
Exploration of the Philippines focuses on poverty, environmental conservation, resource exploitation and ecosystem degradation in upland and marine environments. Topics include population dynamics, political pressure and instability, and urban challenges. The future of the country is investigated on all geographic scales with regard to its role in a globalized world economy.

GEOG 339. Geography of the Caribbean. 3 credits.
This course is designed to give students a general geographical overview of the islands states and territories surrounding the Caribbean Sea. Students will study physical landforms, weather and climate, environmental issues, population characteristics, history, local and regional politics, and economic aspects of political units in the region.

GEOG 340. Biogeography. 3 credits.
This course emphasizes geographical biogeography and is an advanced physical geography class. Included are analyses of spatial patterns of biota from local to global scales and examinations of the systems and processes that result in spatial and temporal patterns of species existence and diversity, community composition, energy pathways, adaptive traits, and human influences on biotic systems and processes. Prerequisite: GEOG 210 with a “C” or better.

GEOG 341. Wilderness Techniques. 3 credits.
Wilderness legislation, legal mandates and wilderness issues are examined. Human impacts due to overuse or conflicting uses are studied, as are the philosophical aspects of wilderness ethics. This course is taught entirely in the field. Camping and hiking are required. Prerequisite: Permission of the instructor.

GEOG 342. Management and Protection of Natural Resources. 3 credits.
This course provides a managerial perspective for protection and management of natural resources. A systems approach for applied management strategies is provided for aquatic, terrestrial, threatened and endangered ecosystems. Topics include application of state, federal, international laws, regulations, policies and guidelines. Students develop management plans and explore jurisdictional resource protection issues.

GEOG 343. Wildlife Management. 3 credits.
An introductory discussion of applied management strategies for wildlife species and their ecological requirements is provided relative to human influences. Management techniques that are useful for determining population or health status are demonstrated for select vertebrate species. The evolution of wildlife laws, policies and management strategies are addressed to provide relevant awareness into the appropriate concepts of wildlife management.

GEOG 344. Economic Geography and Development Issues. 3 credits.
An overview of the classification of economic activities, the factors involved in the location of various types of economic activities and the regional variation in the standard of living associated with economic development. Additional topics include regional economic growth and types of economic systems and development perspectives, the roles that politics and demographics play in the economic development of a country, and the globalization of economic activities.

GEOG 345. Geography of Poverty. 3 credits.
This course provides a geographical perspective on poverty faced by communities and countries of the world today. The focus is on how poverty is defined, measured and mapped, the causes and impacts of poverty, theories for ending poverty and organizations that work to address poverty. It includes a geographical study of communities and countries that have successfully alleviated extreme poverty.

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GEOG 348. Indigenous Geographies. 3 credits.
This course introduces indigenous geographic representations. Topics include territorial sovereignty, traditional resource use, sustainable development, and protection of sacred sites. Students will explore the central geographic practice of cartography, which has taken on new meaning as cultural identification for Indigenous peoples. The use of new technologies to represent traditional understandings of Earth is also explored. Prerequisite: GEOG 230 or permission of instructor.

GEOG 350. Topics in Geography. 1-3 credits.
Examination of geographic topics that are of current interest. Can be repeated as course content changes. Prerequisite: Permission of the instructor.

GEOG/HUMN 360. GIS for Humanitarian Assistance. 3 credits.
In responding to humanitarian crises, governments and aid organizations must deploy aid workers, deliver essential services, set up temporary settlements, and distribute items such as water and food that are needed for survival. Spatial analysis and maps are critical to the success of these efforts. In this course, students learn the basics of Geographic Information Systems (GIS) for humanitarian assistance and learn how relief organizations use GIS in their work.

GEOG 385. Cartography and Geospatial Visualization. 3-6 credits.
This course examines the fundamentals of visualizing spatial data in static and dynamic environments. Students will learn about cartographic design, thematic cartographic techniques, developing spatial data from non-spatial information and with GPS equipment, and geographic visualization. Students will also develop a portfolio of hard copy and soft copy visualizations. Prerequisite: GEOG 215 with a “C” or better.

GEOG 386. Introduction to Geographic Information Science. 3 credits.
An overview of geographic information science and its role in technology and society. Spatial databases and descriptive data will be created and implemented into various geographic information systems. Advanced analytical operations will be used to practice the analysis capabilities of geographic information systems. Prerequisite: GEOG 215 with a “C” or better or permission of the instructor.

GEOG 375. Political Geography. 3 credits.
Geopolitical conflicts and issues are examined. Concepts such as territoriality, nationalism, religious and ethnic struggle, environmental degradation, and freedom and justice are discussed in the context of political unrest. Significant geopolitical theories and social and economic processes are explored.

GEOG 376. Urban Geography. 3 credits.
Study of the city in its geographic setting, giving perspective of modern urban problems, origin and growth of cities and influence of location on city functions. Looks at the internal structure of cities and the influence of the internal structure on its population groups.

GEOG 380. Cultural Geography. 3 credits.
Introduction to cultural geography with emphasis on diversity of language, religion and folklore, as well as culture traits and practices and their historical diffusion. Ties to livelihood, the rural-urban continuum and demographic change are explored, as are factors on philosophy, power, race, class and gender. Exploitation and sustainability will be introduced as dimensions of cultural and environmental interaction.

This course is an introduction to remote sensing, the study of images and other types of data acquired by satellites and aircraft. Topics include the principles underlying multiple type of remote sensing, the properties of common data types, making measurements using aerial photographs, basic digital image processing, and applications. Prerequisite: GEOG 216 with a “C” or better.

GEOG 390. Practicing Geographic Science. 1 credit.
Professional development for students in geography. Educational opportunities and career options. Library and literature research skills. Prerequisites: Junior standing and permission of instructor.

GEOG/BIO 402. Forest Ecology. 4 credits.
A study of the function, structure, and composition of forested ecosystems. The effects of physiography on the distribution of forest communities will be explored. Issues of forest management and restoration will also be considered. Field laboratory topics will include dendrology and sampling techniques within different forest successional stages. Prerequisite: BIO 124 or permission of the instructor.

GEOG 406. Forest Inventory: A Geospatial Approach. 3 credits.
This course teaches forest measurement at the tree, plot, stand, and forest level. It includes heights, stem diameters, volumes, and biomasses of individual trees; fixed and variable radius plots; basal area estimates; sampling designs, and stand and stock table construction. Students learn how geospatial technologies can be used to collect data on forests, make forest inventories more accurate and precise, and assist in performing forest-related analyses and visualizations. Prerequisite: GEOG 230 or permission of instructor.

GEOG 410. Geography and Film. 3 credits.
This course is concerned with the intersection of geography and film. An always-present undercurrent focuses on films whose location and/or culture are an essential backdrop in the cinematic experience. Prerequisite: GEOG 290 or permission of instructor.

GEOG 415. Environment, Landscape and Culture. 3 credits.
This seminar analyzes human-environment interactions as shaped by cultural perceptions, past events, and ecological processes. Place-based and interdisciplinary, landscape studies focus on the unique circumstances of a location and shift temporal and geographic scales to achieve broader understandings of cultural and ecological adaptation and resilience. Methods of historical ecology and field research are introduced. Regional projects underscore readings and research assignments. Prerequisite: GEOG 290 or permission of instructor.

GEOG/ISAT 429. Sustainability: An Ecological Perspective. 3 credits.
This course examines present global environmental impacts and efforts made to change production and consumption patterns toward those that reduce impact on ecosystems or promote increased ecosystems health. The focus lies in understanding the basic resources of productivity including soils, agricultural systems, agroforestry, forestry and aquatic environments and applying solutions on a personal and community level. Prerequisite: GEOG 320, senior standing or permission of the instructor.

GEOG 430. Geography of Crop Plants. 3 credits.
This course evaluates the influence of geography on crops and crop development by examining the evolution, genetic diversity and cultivation of agricultural crops. Topics include the origins of agriculture, patterns of geographic spread, and the interrelationships between domesticated plants and the societies that grow them.

GEOG 465. Topics in GIS. 3 credits.
The course examines varying topical issues in geographic information science. The course may be repeated as course topics vary. Prerequisite: GEOG 386 or permission of the instructor.

GEOG 466. GIS and Geographical Databases. 3 credits.
An introduction to the creation, use and management of digital spatial data used by industry and government. Integration of large spatial data sets into the geographic information system, data management and data exchange, and the geodetic transformation of data sets are emphasized. Digital elevation models, land use data, population data, digital topographic map and street network data will be used. Prerequisite: GEOG 366 or permission of the instructor.

GEOG 467. GIS Project Management. 3 credits.
An entry to geographic information systems (GIS) project management. Basic project management techniques will be applied by defining, designing, implementing and documenting a geographic information system. Prerequisite: GEOG 386 or permission of the instructor.

GEOG 468. Internet Geographic Information Systems. 3 credits.
Theoretical and practical exploration of methods, standards and policies related to the development and utilization of geographic information systems on the Internet. Students will create and utilize distributed geographic data and analytical systems using the World Wide Web and the Internet to address geographical problems. Prerequisite: GEOG 386 or permission of the instructor.

GEOG 469. Applications of Geographic Information Systems. 3 credits.
The course advances the knowledge of GIS in theory and practice by focusing on specific application areas. Spatial databases and complex attribute data will be created, and GIS modeling techniques will be used to solve problems relevant to the specified topic area. The course may be repeated once for additional credit when the topic changes. Prerequisite: GEOG 386 or permission of the instructor.

GEOG 470. Senior Seminar in Environmental Conservation. 3 credits.
The capstone seminar integrates the student’s previous class experiences to provide a holistic exploration of linkages between environmental conservation and human development status and strategies through in-depth analysis of compelling human-environment issues. Topics vary by semester and include environmental politics, global perspectives on population, sustainable communities and global biodiversity. For majors and minors only. Prerequisite: GEOG 320, senior standing or permission of the instructor.

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GEOL 485. Processing Remotely Sensed Data. 3 credits.
This course focuses on computer-based techniques for processing remotely sensed data and applications of these techniques. Subjects covered will include geometric and radiometric correction, image enhancement, data transformations, change detection and quantification, and classification. Both traditional techniques and techniques designed for newly available data types will be examined. Prerequisite: GEOL 385 or permission of the instructor.

GEOL 486. High Spatial Resolution Remotely Sensed Data. 3 credits.
This course focuses on the acquisition and use of high spatial resolution remotely sensed data. Topics include aerial photograph acquisition, digital terrain model creation, orthorectification, object oriented image processing, image fusion, visual image interpretation, collecting and processing LIDAR data, and ethical and legal issues associated with high spatial resolution data. Prerequisite: GEOL 385 or permission of the instructor.

GEOL 490. Senior Research or Field Practicum. 3 credits.
Working with a research adviser, student completes an internship, a study abroad program, or project research. Student delivers interim progress reports and an annotated bibliography or other relevant research products. Prerequisites: GEOL 390 and permission of their research adviser.

GEOL 491. International Studies. 1-3 credits.
Student will make arrangements for the international experience. A research project or work-study project will be designed by the student and faculty member prior to departure. The research of work will be carried out in the country of travel. May not be taken for capstone credit. May be repeated for credit.

GEOL 495. Internship in Geography. 3-6 credits.
Practical experience within a public agency, non-profit or private business utilizing geographic methodology. Work experience will be supervised by an official of the business or agency and a faculty member. Periodic seminars and written reports are required. Prerequisites: Permission of the faculty sponsor and the GS Program Operations Manager. May not be taken for capstone credit.

GEOL 496. Senior Thesis III. 2 credits.
Student completes an independent research project, either alone or within an investigative team, to identify and analyze a geographic problem or phenomenon, and provides a written report and public presentation on the problem analysis and solution. Prerequisites: GEOL 490 and senior standing. Taken during final semester of the GS program.

GEOL 497. Independent Study. 3 credits.
Student performs an independent research project, either alone or within an investigative team, to identify and analyze a problem from a geographic perspective. Prerequisite: Permission of the instructor. May not be taken for capstone credit.

GEOL 499. Honors. 6 credits.
Year course.

Geology

Department of Geology and Environmental Science

*GEOL 102. Environment: Earth. 3 credits.
A study of geological processes causing global change and their impact on human thought. The relationship between some geological processes and life on the Earth is also considered. Not available for major or minor credit in geology. Students may not receive credit for both GEOL 102 and SCI 102. Prerequisite: GSCI 101.

*GEOL 110. Physical Geology. 3 credits.
A systematic study of earth materials and the internal and external processes that affect earth structure and landforms. Topics include the genesis/properties of rocks and minerals, plate tectonics, and the agents of change that affect earth structure and landforms. Includes laboratory. Prerequisite: GEOL 102.

*GEOL 110L. Physical Geology Laboratory. 1 credit.
This laboratory course is designed to complement and supplement the GEOL 110 course. The laboratory and lecture portions must be taken concurrently. Corequisites: GEOL 110.

*GEOL 115. Earth Systems and Climate Change. 3 credits.
This course explores cycles, trends and abrupt events in the Earth system. Analyses of the geologic record and global climate models provide perspective for understanding paleoclimate and future climate changes, including global warming. Current hypotheses for causes of climate change are reviewed, including plate tectonics, orbital cycles, greenhouse gases in the sun’s strength and human activities. The two recurring questions of this class are: What are Earth’s climate stories? How do we know them?

GEOL 130. Quantitative Geology. 2 credits.
An introduction to quantitative techniques used in descriptive and predictive aspects of the earth and environmental sciences, with emphasis on algorithmic approaches. The focus is on pragmatic application of mathematical methods to geologic problems, considering requirements, uses and limitations. Automatic computation is stressed.

GEOL 167. History and Philosophy of the Geosciences. 3 credits.
An introductory experience in the Bachelor of Arts in Earth Science, students will be inculcated in the philosophy of geosciences as an interdisciplinary medium for extending classical science viewpoints to complex earth systems. Students will study the geosciences as distinct among sciences, establishing relevance and value of earth science literacy in professional and personal settings.

An investment of a theoretical principle behind evolutionary systems of all types based on mathematical modeling in chaos, complexity theory and artificial life studies with extensive computer experimentation and examples drawn from physical, chemical, biological, economic and social systems. The purpose is to explore what is common and universal to all evolutionary processes.

*GEOL 210. Applied Physical Geology. 3 credits.
A problem-based study of earth materials and the processes that affect earth structure and landforms. Topics include plate tectonics, the genesis/properties of rocks and minerals, and agents of change that drive surface processes and landform development. Quantitative problem-solving skills will be applied to case studies that address 3D visualization and time-based processes, such as earth materials, solid earth and surface processes, natural hazards and engineering applications. Prerequisite: Either PHYS 140 or PHYS 240 or CHEM 131 or by permission of the instructor. Corequisites: MATH 205 or MATH 220 or MATH 235 or by permission of the instructor.

*GEOL 211. Introduction to Oceanography. 3 credits.
An introduction to the oceanography of coastal environs including barrier islands, estuaries and tidal marshes. The physical, geological and biochemical characteristics of coastal waters will be discussed in the context of the economic and social pressures brought to bear on these areas by an increasing global population. Cannot receive credit for both GEOL 211 and GEOL 401.

GEOL 220. Genetic Mineralogy (2, 2). 3 credits.
A study of mineral genesis. Emphasis is directed toward mineralogical environments, mineral associations and the geology/mineralogy of classical localities. An appreciation of mineral value and aesthetics is incorporated throughout the course.

GEOL 230. Evolution of Earth (3, 2). 4 credits.
An introduction to the evidence, methods and assumptions used by scientists to unravel the Earth’s origin and history. Emphasis on rock analysis/interpretation, modern and ancient processes of mountain building, origin and evolution of life and the history of the North American continent. Prerequisite: GEOL 110L or permission of the instructor.

GEOL 272. Planetary Geology (2, 2). 3 credits.
A survey of currently developing ideas in planetology including origin of the planets, meteorites and planetary interiors. Also included are geologic processes and land forms on the moon and terrestrial planets, their modification under various planetary environments, and analogies to familiar earth land forms. Includes laboratory. Prerequisite: GEOL 110L.

GEOL 280. Mineralogy (3, 2). 4 credits.
A comprehensive study of minerals, including: crystallography, mineral chemistry, x-ray diffraction, mineral optics with thin section recognition using petrographic microscope, and hand specimen identification of both silicate and non-silicate minerals. Prerequisite: GEOL 110L.

GEOL 290. Optical Mineralogy (3, 2). 3 credits.
A study of the optical properties of minerals and mineral identification with the petrographic microscope. Prerequisite: GEOL 280.

GEOL 291. Writing and Communicating in the Geosciences. 1 credit.
This course prepares students for independent research by providing them the fundamental skills in literature searches, writing, critical reading and communication in the geosciences. Prerequisite: GEOL 110 or GEOL 102 or GEOL 115; must take prior to senior year.

GEOL 300. Introduction to Petrology (3, 3). 4 credits.
Igneous and metamorphic processes explained using crystallization theory, phase diagrams, thermodynamics and geochemistry, laboratory study of rocks, their chemical and mineralogical signatures, and their geologic origins. Prerequisites: GEOL 280 and CHEM 131, or consent of instructor.

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