GEOLOGICAL SCIENCES

The options available in the undergraduate program in geological sciences are geology and geophysics and lead to the BA degree. Both options provide a strong basis for understanding the functioning of the Earth system. Students who are uncertain as to which option best suits their needs should contact a departmental advisor or faculty member. In each option, the undergraduate program emphasizes course work in theoretical, laboratory and field-oriented aspects of the geological sciences. The nearby Rocky Mountains provide a natural laboratory for many of these courses.

Students interested in the geological sciences may also wish to consider the Baker Residential Academic Program (see the Undergraduate Residential Programs section). Students who do not wish to pursue a career in the geosciences, or who would like to combine a basic knowledge of geologic sciences with that of some other field, should consider a minor in geological sciences. Students who intend to pursue graduate study in the geological sciences are encouraged to consider developing an honors thesis as part of their undergraduate studies.

The two options available in the undergraduate major offer different focus areas of instruction. Both options offer excellent preparation for students interested in pursuing professional careers, or graduate study, in the geological sciences.

Each option emphasizes knowledge in:

- the ways in which Earth responds to internal and external forces; the physical, chemical and biological evolution of Earth; and the nature of the materials of which the Earth is made;
- the role of physics, chemistry, mathematics and biology in understanding geological processes; and
- the history of discoveries and ideas that have contributed to our current knowledge of Earth and the planetary system.

Course code for this program is GEOL.

Geology Honors Program

Opportunity is provided for qualified geology majors to participate in the geology honors program and graduate with honors (cum laude, magna cum laude or summa cum laude) in geology. Students interested in the honors program should contact the departmental honors advisor during their junior year.

Bachelor's Degree

- Geology - Bachelor of Arts (BA) (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/geological-sciences/geology-bachelor-arts-ba)

Minor

- Geology - Minor (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/geological-sciences/geology-minor)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Abbott, Lon D (https://experts.colorado.edu/display/fisid_145044)
Senior Instructor

Anderson, Robert S (https://experts.colorado.edu/display/fisid_130117)
Distinguished Professor; PhD, University of Washington

Arthurs, Leilani
Assistant Professor; PhD, University of Notre Dame

Bradley, William C.
Professor Emeritus

Budd, David A (https://experts.colorado.edu/display/fisid_101963)
Professor; PhD, University of Texas at Austin

Chin, Karen (https://experts.colorado.edu/display/fisid_122666)
Associate Professor; PhD, University of California-Santa Barbara

Eberle, Jaelyn J. (https://experts.colorado.edu/display/fisid_126544)
Professor; PhD, University of Wyoming

Farmer, G Lang (https://experts.colorado.edu/display/fisid_100498)
Professor; PhD, University of California-Los Angeles

Flowers, Rebecca M (https://experts.colorado.edu/display/fisid_144054)
Associate Professor; PhD, Massachusetts Institute of Technology

Ge, Shemin (https://experts.colorado.edu/display/fisid_101387)
Professor; PhD, Johns Hopkins University

Hynek, Brian Michael (https://experts.colorado.edu/display/fisid_130622)
Associate Professor; PhD, Washington University

Jakosky, Bruce M (https://experts.colorado.edu/display/fisid_105845)
Professor; PhD, California Institute of Technology

Jones, Craig H (https://experts.colorado.edu/display/fisid_105590)
Professor; PhD, Massachusetts Institute of Technology

Kraus, Mary J (https://experts.colorado.edu/display/fisid_100903)
Professor; PhD, University of Colorado Boulder

Larson, Edwin E.
Professor Emeritus

Mahan, Kevin H (https://experts.colorado.edu/display/fisid_143975)
Associate Professor; PhD, University of Massachusetts at Amherst

Marchitto, Thomas (https://experts.colorado.edu/display/fisid_128241)
Associate Professor; PhD, Massachusetts Institute of Technology

Miller, Gifford Hubbs (https://experts.colorado.edu/display/fisid_102374)
Professor; PhD, University of Colorado Boulder

Mojzsis, Stephen J (https://experts.colorado.edu/display/fisid_118484)
Professor; PhD, University of California-San Diego

Molnar, Peter Hale (https://experts.colorado.edu/display/fisid_114528)
Professor; PhD, Columbia University In the City of New York
Mueller, Karl Jules (https://experts.colorado.edu/display/fisid_107629)
Professor; PhD, University of Wyoming

Sepulveda Arelano, Julio Cesar (https://experts.colorado.edu/display/fisid_154923)
Assistant Professor; PhD, University of Bremen (Germany)

Sheehan, Anne (https://experts.colorado.edu/display/fisid_103645)
Professor; PhD, Massachusetts Institute of Technology

Simpson, Carl
Assistant Professor; PhD, University of Chicago

Smyth, Joseph R (https://experts.colorado.edu/display/fisid_101056)
Professor; PhD, University of Chicago

Snell, Kathryn Elaine (https://experts.colorado.edu/display/fisid_155298)
Assistant Professor; PhD, University of California-Santa Cruz

Stempień, Jennifer
Instructor; PhD, Virginia Polytechnic Institute and State University

Stern, Charles R (https://experts.colorado.edu/display/fisid_100941)
Professor; PhD, University of Chicago

Templeton, Alexis S (https://experts.colorado.edu/display/fisid_141202)
Associate Professor; PhD, Stanford University

Tiampo, Kristy F (https://experts.colorado.edu/display/fisid_155908)
Professor; PhD, University of Colorado Boulder

Tilton, Eric Small (https://experts.colorado.edu/display/fisid_126548)
Professor; PhD, University of California-Santa Cruz

Trower, Lizzy
Assistant Professor; PhD, Stanford University

Tucker, Gregory E (https://experts.colorado.edu/display/fisid_130605)
Professor; PhD, Pennsylvania State University

Weimer, Paul (https://experts.colorado.edu/display/fisid_104630)
Professor; PhD, University of Texas at Austin

White, James (https://experts.colorado.edu/display/fisid_102726)
Professor; PhD, Columbia University In the City of New York

Willis, Michael John (https://experts.colorado.edu/display/fisid_158345)
Assistant Professor; PhD, Ohio State University

Courses

GEOL 1010 (3) Exploring Earth
Introductory geology for majors and non-majors. Studies Earth, its materials, its characteristics, its dynamic processes, and how it relates to people. Separate lab (GEOL 1030) is recommended. Credit not granted for both GEOL 1010 and GEOL 1012.

Grading Basis: Letter Grade

Additional Information: GT Pathways: GT-SC2 - Natural Physical Sci Lec
Crse w/o Req Lab

Arts Sci Core Curr: Natural Science
Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 1012 (3) Exploring Earth for Scientists
Studies Earth, its materials, its characteristics, its dynamic processes, and how it relates to people. This course is an introductory geology course suitable for geology and other STEM majors. Like GEOL 1010, but taught at a higher intellectual level with a greater amount of quantitative analysis. Separate lab (GEOL 1030) is recommended. Credit not granted for both GEOL 1010 and GEOL 1012.

Grading Basis: Letter Grade

Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 1020 (3) Dodos, Dinosaurs, and Deinococcus: The History of a Habitable Planet
Examines how the solid, fluid, and living Earth interact, how changes in the oceans, atmosphere and life reflect that interaction over the immensity of geologic time, and how the rock record is analyzed to reconstruct the co-evolution of Earth and life.

Grading Basis: Letter Grade

Additional Information: GT Pathways: GT-SC2 - Natural Physical Sci Lec
Crse w/o Req Lab

Arts Sci Core Curr: Natural Science Sequence
Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 1030 (1) Introduction to Geology Laboratory 1
Features field trips to local points of geologic interest. Studies rocks and topographic and geologic maps. Meets the MAPS requirement for natural science lab, if taken with GEOL 1010.

Recommended: Requisite prior or current registration in 1000-level geology course.

Additional Information: GT Pathways: GT-SC1 - Natural Physical Sci Lec
Crse w/ Req Lab

Arts Sci Core Curr: Natural Science Lab
Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab
MAPS Course: Natural Science Lab or Lab/Lec

GEOL 1040 (3) Geology of Colorado
Reviews the geologic evolution and history of Colorado. It first develops the basic concepts needed to interpret the geology and then systematically shows how the state evolved through geologic time. Designed for those who enjoy understanding the beauty and splendor of the state.

Equivalent - Duplicate Degree Credit Not Granted: GEOL 1020

Additional Information: Arts Sci Core Curr: Natural Science Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 1060 (3) Global Change: An Earth Science Perspective
Focuses on evidence for planetary warming, climate change, glacier and ice-sheet melting and sea level rise both now and in the recent past. Attempts to develop understanding of the interactions within the coupled Earth system that regulate such changes. Utilizes examples from the geological and instrumental records, and evaluates the global warming forecast.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 1060

Additional Information: Arts Sci Core Curr: Natural Science Sequence
Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science
<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Additional Information</th>
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<tbody>
<tr>
<td>GEOL 1150</td>
<td>Water, Energy and Environment: An Introduction to Earth Resources</td>
<td>Explores how geological processes and human populations together affect the quantity, quality and availability of Earth resources. Includes examination of the water cycle and how humans use and modify water; fossil-fuel and mineral resources, and renewable energy options. Sustainable versus non-sustainable use and population growth is considered.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<td>GEOL 1170</td>
<td>Our Deadly Planet</td>
<td>This course investigates those events so dramatic and catastrophic that they have left evidence in the geologic record that suggest they significantly impacted life on the planet. These include, but are not limited to, violent volcanic eruptions, mega-earthquakes and associated tsunamis, landslides and sector collapse on volcanoes, megafloods, rapid climatic change, superstorms, and impacts from asteroids and comets. The intent is to use examples from recent events and processes to frame and interpret evidence for these types of events observed in the rock record.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 1180</td>
<td>Our Microbial Planet</td>
<td>Examines how microorganisms shape the world around us, both throughout the Earth's history and today. Major topics include the origin and evolution of life, the interplay between microbes and the environment, roles of microbes in global change, and applications of microbiology in biotechnology and energy.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 2001</td>
<td>Planet Earth</td>
<td>Explores the dynamics of planet Earth with particular emphasis on the factors that make the planet habitable. Includes examination of heat balance, hydrology, geomorphology, biogeochemistry and climate history through both lecture and lab-based activities. Required for the Geology major, introduces students to the major concepts in contemporary Earth system science.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 2005</td>
<td>Introduction to Earth Materials</td>
<td>Provides introduction to the classification, composition and properties of the materials that compose the Earth, how these materials are studied, and how they are used to interpret Earth history and processes. Required for the Geology major.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 2100</td>
<td>Environmental Geology</td>
<td>Introduces the influences of geologic processes on human lives and the changes human actions cause in geologic systems. Uses examples and case studies from Colorado and the West.</td>
<td>Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences</td>
<td>Letter Grade</td>
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<td>GEOL 3010</td>
<td>Introduction to Mineralogy</td>
<td>Covers origin, occurrence, identification, classification, and uses of minerals with emphasis on applications of mineralogy to economic geology and petrology. Two lectures and one lab per week.</td>
<td>Required: Prerequisite courses of GEOL 1030 and GEOL 2005 (all minimum grade D-).</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 3020</td>
<td>Petrology</td>
<td>Studies field relations, petrography, petrology, chemistry, and origins of igneous and metamorphic rocks by means of lectures, reading, and lab and field experience. Labs include instruction in the fundamentals of optical petrography and the study of rocks in thin section.</td>
<td>Required: Prerequisite course of GEOL 2005 or GEOL 3010 (minimum grade D-).</td>
<td>Letter Grade</td>
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<td>GEOL 3023</td>
<td>Statistics for Geography</td>
<td>Introduces parametric and distribution-free statistics, emphasizing applications to earth science problems.</td>
<td>Equivalent - Duplicate Degree Credit Not Granted: GEOL 3023</td>
<td>Letter Grade</td>
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<tr>
<td>GEOL 3030</td>
<td>Introduction to Hydrogeology</td>
<td>Introduces groundwater flow concepts, hydrologic cycle, physical and chemical properties, flow net, hydraulic potential, geologic controls on heterogeneity and anisotropy, aquifers and aquitards in a geologic system, saturated and unsaturated flow, flow to a well, pumping tests, and role of groundwater in geologic processes.</td>
<td>Required: Prerequisite courses of GEOL 1010 and MATH 1300 or APPM 1350 (all minimum grade D-).</td>
<td>Letter Grade</td>
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GEOL 3040 (3) Global Change: The Recent Geological Record
Geological records in lakes, oceans, deserts, and around glaciers indicate the significant changes in the global systems that have taken place over the last few hundred or thousand years. Explores the timing and nature of these changes. Department enforced prerequisites: any two-course sequence of natural science core courses.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4070
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3050 (2) GIS for Geologists
Provides an introduction to Geographic Information Systems (GIS) techniques focused on geological applications. Covers GIS analyzing, mapping and GPS use. Basic computer skills are a plus before entering the class.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 3070 (3) Introduction to Oceanography
Explores Earth's dynamic oceans. Discusses the disciplines of oceanography including marine geology, chemistry, biology and physical oceanography with emphasis on global change. Specific topics may include: tectonics, currents, biogeochemical cycles, ecology and global warming.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 3070
Recommended: Prerequisite any 1000-level ATOC or GEOL course or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3090 (3) Developing Scientific Writing Skills
Focuses on the development of scientific writing skills. Enhances student ability to write professionally, revise text and review the work of others. Writing assignments integrate the subject matter of different topics in earth science. Department enforced prerequisites: a lower division writing course and one of the following: GEOL 2001 or GEOL 2005 or GEOL 2700 or GEOL 3010 or GEOL 3030 or GEOL 3120 or GEOL 3320 or GEOL 3430 or GEOL 3820.
Additional Information: Arts Sci Core Curr: Written Communication
Arts Sci Gen Ed: Written Communication-Upper

GEOL 3120 (4) Structural Geology
Introduces the basic principles and processes involved in deformation of natural rocks and minerals and the techniques used to analyze a variety of common geological structures (e.g., fractures, folds, fault zones).
Requisites: Requires prerequisite course of GEOL 2005 (minimum grade D-).
Recommended: Prerequisite GEOL 2001.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3300 (3) Extraterrestrial Life
Discusses the scientific basis for the possible existence of extraterrestrial life. Includes origin and evolution of life on Earth; the possibility of life elsewhere in the solar system, including Mars; and the possibility of life on planets around other stars. Department enforced prerequisite: one-year sequence in a natural science.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 3300
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3320 (3) Introduction to Geochemistry
Students build upon principles introduced in general chemistry in order to predict and interpret chemical dynamics in Natural environmental systems. We explore the formation and chemical differentiation of the early Earth, how chemical weathering and mineral dissolution and precipitation modifies the Earth's surface, and how redox biogeochemistry shapes aquatic environments.
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 and MATH 1300 or APPM 1350 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3410 (3) Paleobiology
Surveys morphology, ecology and evolution of ancient animal and plant life and their interactions on Earth. Fossils used to solve geological and biological problems. Department enforced prerequisites: GEOL 1010 and GEOL 1020 or GEOL 2005 or EBIOL 1030 and EBIOL 1040 or EBIOL 1210 and EBIOL 1220.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 3430 (4) Sedimentology and Stratigraphy
Introduces the study of sedimentary rocks emphasizing their origin, characteristics, and interpretation; and the principles and techniques for establishing the temporal order and spatial distribution of sedimentary layers.
Requisites: Requires prerequisite course of GEOL 2005 or GEOL 3010 (minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 3520 (3) Energy and Climate Change: An Interdisciplinary Approach
Examines sources of energy and other resources in light of their availability, use, environmental impact, as well as their impact on policy, economics and values. As fossil fuels are the dominant energy source today, particular emphasis is placed on climate impacts and the carbon cycle. All material is assessed through the lenses of the physical sciences, policy, ethics and economics. Department enforced prerequisite: a two-course sequence in any natural science.
Equivalent - Duplicate Degree Credit Not Granted: ENVS 3520
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3540 (3) Introduction to Petroleum Geology
Discusses the origin and distribution of conventional and unconventional petroleum resources, source rocks, types of traps and seals, reservoir rock properties, exploration methods (seismic data analysis and interpretation, formation evaluation, subsurface mapping), reservoir characterization and modeling, reserves calculations. Department enforced prerequisite: GEOL 1010.
Recommended: Corequisite GEOL 3430.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3720 (3) Evolution of Life: The Geological Record
Discusses the evolution of life on Earth, beginning with the earliest origins and surveying the major steps that led to the rise of higher plants and animals. Covers modern ideas on the causes of periodic mass extinctions in both the marine and terrestrial realms. Emphasizes geologic evidence for the pathways of evolution, using examples from the ordinary to the bizarre.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
GEOL 3820 (4) The Fluid Earth
Examines the myriad forms of fluid behavior found on Earth, from the atmosphere to the inner core. Explores how basic principles of fluid physics may be used to understand a broad range of Earth processes, including mantle convection, atmosphere and ocean dynamics, stream flow, lava spreading, and glacier motion, among others. Covers fundamental fluid concepts such as viscosity, pressure, convection, friction, and free-surface flow. Department enforced prerequisites: MATH 1300 or APPM 1340 and APPM 1345 or APPM 1350.
Recommended: Prerequisites Any 1000 level GEOL class and PHYS 1110.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3950 (3) Natural Catastrophes and Geologic Hazards
Surveys historic and prehistoric natural disasters, their cause and potential for recurrence. Meteorite impact, earthquakes, volcanic eruptions, tsunamis, landslides, floods, magnetic reversals and major extinction events. Department enforced prerequisite: one year of science.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4060 (4) Oceanography
Examines the ocean as a system influencing the Earth’s surficial processes and climate. Composition and properties of seawater, ocean circulation, waves, tides, coastal-, shallow- and deep-water processes, biogeochemical cycles, deep sea sediments. Laboratory emphasizes the use of oceanographic data. Department enforced prerequisite: one semester chemistry or physics or geology.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5060
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 4070 (3) Paleoclimatology
Covers the primary forcings and feedbacks that determine Earth’s energy balance and the resultant climate system on decadal to millennial time scales. Covers ocean/atmosphere circulation, the role of ice sheets in the climate system, monsoons, Holocene climate change and 20th Century warming. Includes coverage of the proxies available to reconstruct climates of the past and the archives that contain these proxies. Department enforced prerequisite: environmental science or geology introduction sequence courses.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 3040
Recommended: Prerequisite natural science majors only.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4093 (4) Remote Sensing of the Environment
Covers acquisition and interpretation of environmental data by remote sensing. Discusses theory and sensors, as well as manual and computerized interpretation methods. Stresses infrared and microwave portions of the spectrum.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5093 and GEOG 4093 and GEOG 5093
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 4130 (3) Principles of Geophysics
Provides an introduction to fundamental geophysics including seismology, geomagnetism, gravity, radiometric dating, and heat flow with applications to plate tectonics and exploration of the subsurface.
Requisites: Requires prerequisite courses of MATH 1300 or APPM 1350 and PHYS 1110 and GEOL 1010 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4150 (2) Planetary Field Geology
Provides an overview of the geology, age and origins of the solid (rocky) planets, dwarf planets and moons of our solar system and the processes that form them from comparative studies from comparative geology. Includes modules on volcanism, rifting, aeolian processes, fluvial erosion, impacts, climate change and paleontology.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5150
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4160 (3) Introduction to Biogeochemistry
Covers fundamentals of biogeochemical cycling, emphasizing water, carbon and nutrient dynamics in terrestrial ecosystems; chemical interactions of atmosphere, biosphere, lithosphere and hydrosphere; natural and human-managed environments. Department enforced prerequisites: GEOL 3320 or EBI0 3270 and CHEM 1011.
Equivalent - Duplicate Degree Credit Not Granted: EBI0 4160 and ENVS 4160
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4215 (3) Geochronology and Thermochronology
Constraining the timing of events and rates of processes is fundamental to earth science research. The field of geochronology and thermochronology is rapidly evolving. Cutting-edge aspects of geochronologic methods and emerging techniques will be especially emphasized. Lectures will emphasize the principles and assumptions of each technique. Seminar discussions will focus on recent papers that demonstrate state-of-the-art applications to diverse problems.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5215
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4241 (4) Principles of Geomorphology
Studies weathering, mass-wasting, fluvial, wind, and marine processes and the resulting landforms.
Equivalent - Duplicate Degree Credit Not Granted: GEOG 4241
Requisites: Requires prerequisite course of GEOG 1011 or GEOL 1010 and MATH 1300 or APPM 1350 or APPM 1340 and APPM 1345 (all minimum grade D-).
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 4270 (3) Marine Chemistry and Geochemistry
Examines the chemical, biological, geological and physical processes affecting (and affected by) the chemistry of the oceans. Topics include: chemical separation in seawater; the marine carbon cycle and its long-term control on atmospheric CO2; the large-scale interdependence of nutrient distributions and biological productivity, chemical tracers of ocean circulation, the chemistry of marine sediments, including early diagenesis.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5270
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Recommended: Prerequisites introductory chemistry, introductory geology, introductory oceanography.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
GEOL 4330 (3) Cosmochemistry
Investigates chemical and isotopic data to understand the composition of the solar system: emphasis on the physical conditions in various objects, time scales for change, chemical and nuclear processes leading to change, observational constraints, and various models that attempt to describe the chemical state and history of cosmological objects in general and the early solar system in particular. Department enforced prerequisite: upper-division undergraduate standing in physical science and upper-division undergraduate chemistry or physics or math courses.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5330 and ASTR 4330 and ASTR 5330
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4474 (4) Vertebrate Paleontology
Discusses the history and evolution of the vertebrates, including the phylogenetic relationships and evolutionary patterns of the major groups. Lab focuses on comparative vertebrate osteology and fossil representation of major groups. Department enforced prerequisites: GEOL 1010 and GEOL 1020 and GEOL 3410.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5474
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4500 (3) Critical Thinking in the Earth Sciences
Deals with controversies within the broad realm of geological sciences, including planetary geology, evolution, paleobiology, global change, environmental issues, plate tectonics, resources, other societal problems, or geologic thought in general. Students are provided the opportunity to analyze and debate scientific issues in the earth sciences. Department enforced prerequisites: GEOL 1010 and GEOL 1030 and GEOL 2001 or GEOL 2005 or GEOL 2700 (minimum grade D-).
Repeatable: Repeatable for up to 6.00 total credit hours.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4550 (3) Petroleum Reservoir Characterization and Modeling
Introduces concepts and methods of petroleum reservoir analysis and 3-D reservoir modeling using subsurface data (cores, well logs, 3-D seismic) and outcrop analogs. Examines petroleum system, petrophysics (lithology, porosity, permeability, capillary pressure, flow units), and sequence-stratigraphic, facies, and structural controls on reservoir properties, heterogeneity and recovery efficiency. Deterministic and stochastic reservoir modeling methods are addressed. Department enforced prerequisites: GEOL 1010 and GEOL 1030 and GEOL 2001 or GEOL 2005 or GEOL 2700 (minimum grade D-).
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5550
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4670 (3) Isotope Geology
Introduces principles of stable and radiogenic isotope systematics in inorganic and organic geochemistry. Emphasizes application of isotopic data to problems in igneous, metamorphic and sedimentary petrology, geobiogeochemistry, and petroleum genesis.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5670
Requisites: Requires prerequisite a course of MATH 1300 or APPM 1350 (minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4675 (3) Stable Isotopes in Paleoclimate and Paleoecology
Explores the use of stable isotope geochemistry for research questions in paleoclimateology and paleoecology. Covers physical and biological drivers of isotopic fractionation, systematics and applications of light elements such as carbon, nitrogen, oxygen, hydrogen, sulfur and boron and some less traditional isotopic systems. Applications include marine and terrestrial paleoclimate proxies and some uses for ecology and paleoecology.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5675
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4700 (1-4) Special Geological Topics
Studies in selected geological subjects of special current interest (for undergraduates).
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4711 (2) Igneous and Metamorphic Field Geology
Applies field techniques to interpretation of igneous and metamorphic rocks. Field exercises and lectures focus on collecting data required to map igneous and metamorphic rock units.
Requisites: Requires prerequisite courses of GEOL 3020 and GEOL 2001 or GEOL 2700 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4712 (2) Structural Field Geology
Explores methods of field study of structure of rocks, including observations, data collection and interpretation to understand geometry of deformation and causative processes and kinematics. Field projects are mapped using different scales, air photos, topographic maps and compass and tape.
Requisites: Requires prerequisite courses of GEOL 2700 and GEOL 3120 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4714 (2) Field Geophysics
Applies geophysical field techniques and data interpretation to studying geological and engineering problems. Fieldwork includes seismic, gravity, magnetic, and electrical measurements.
Requisites: Requires prerequisite courses of GEOL 2001 or GEOL 2700 and MATH 1300 and PHYS 1110 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4715 (2) Field Techniques in Hydrogeology
Introduces various field techniques and data analysis methods in hydrogeologic studies for students in geology, environmental studies, geography, and civil engineering. Exercises include mapping ground water levels, conducting slug and pumping tests, measuring stream flows, interpreting aquifer parameters from geophysical measurements, and using field data for water budget analysis.
Requisites: Requires prerequisite courses of GEOL 3030 and GEOL 2001 or GEOL 2700 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
**Geological Sciences**

**GEOL 4716 (2) Environmental Field Geochemistry**
This is a critical thinking course that makes use of field and laboratory environments. Students learn methods and develop hands-on expertise needed to identify, characterize and interpret the reactions that govern the quality of water in natural systems, through activities in local watersheds.

**Requisites:** Requires prerequisite courses of GEOL 2001 or GEOL 2700 and GEOL 3320 and CHEM 1011 and CHEM 1031 or CHEM 1113 and CHEM 1133 (all minimum grade D-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sci Lab

**GEOL 4717 (2) Field Seminar in Geology and Tectonics**
Studies geologic features in and around Colorado to gain an overview of the geologic and tectonic evolution of the western U.S.

**Requisites:** Requires prerequisite courses of GEOL 2001 or GEOL 2700 and GEOL 3120 or GEOL 3320 or GEOL 3430 or GEOL 4241 (all minimum grade D-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**GEOL 4721 (2) Field Methods in Active Tectonics**
Analysis of active geologic structures, including strike slip fault systems, secondary structures in stepovers and related eruptive centers. Includes the use of digital imagery, elevation models, offset geomorphic features and Quaternary deposits to determine local deformation rates and their relation to plate motions.

**Requisites:** Requires prerequisite courses of GEOL 2700 and GEOL 3120 (all minimum grade D-).

**Recommended:** Prerequisite GEOL 4712.

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**GEOL 4725 (1-4) Field Based Special Topics in Geoscience**
Explores selected geological subjects of special interest in a field setting.

**Equivalent - Duplicate Degree Credit Not Granted:** GEOL 5725

**Repeatable:** Repeatable for up to 8.00 total credit hours. Allows multiple enrollment in term.

**Grading Basis:** Letter Grade

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**GEOL 4840 (1-3) Independent Study in Geology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4841 (1-3) Independent Study-Economic Geology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4842 (1-3) Independent Study-Petrology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4843 (1-3) Independent Study-Sedimentology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4844 (1-3) Independent Study-Structure/Tectonics**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4845 (1-3) Ind Stdy-Geochemistry**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4846 (1-3) Independent Study-Geophysics**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4847 (1-3) Independent Study-Hydrology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4849 (1-3) Independent Study-Paleontology**
Time and credit to be arranged. For advanced undergraduates who have high scholastic standing. Open only upon consultation with department advisor. May be repeated for a total of 7 credit hours.

**Repeatable:** Repeatable for up to 7.00 total credit hours.

**GEOL 4851 (1-3) Independent Study in Geoscience Education**
Repeatable: Repeatable for up to 3.00 total credit hours.

**GEOL 4862 (1-4) Geology Independent Study**
Repeatable: Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**GEOL 4990 (1-3) Honors Thesis**
Supervised project involving original research in any area of the geological sciences. The thesis is submitted to the Honors Program of the College of Arts and Sciences and is orally defended. Must be accepted by the departmental honors committee. Department enforced prerequisite: minimum cumulative GPA of 3.30.

**Additional Information:** Arts Sciences Honors Course