GEOLOGICAL SCIENCES (GEOL)

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. Degree credit not granted for both GEOL 1010 and GEOL 1012.
Additional Information: GT Pathways: GT-SC2 -Natural Physicl Sci:Lec Crse w/o Req Lab
Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Core Curr: Natural Science 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. Degree credit not granted for both GEOL 1010 and GEOL 1012.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 1020 (3) Dodos, Dinos, 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.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 1040
Grading Basis: Letter Grade
Additional Information: GT Pathways: GT-SC2 -Natural Physicl 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 or GEOL 1012.
Recommended: Requisite Concurrent registration in any 1000-level geology course is beneficial but not required.
Additional Information: GT Pathways: GT-SC1 - Natural Physcal Sci:Lec Crse w/ Req Lab
Arts Sci Core Curr: Natural Science Lab
Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences
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

GEOL 1150 (3) Water, Energy and Environment: An Introduction to Earth Resources
Explores how geological processes and human populations together affect the quantitfy, 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.
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 1170 (3) Our Deadly Planet
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.
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 1180 (3) Our Microbial Planet
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.
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

GEOL 2001 (4) Planet Earth
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.
Requisites: Requires prerequisite course of GEOL 1010 or GEOL 2100 or ENVS 1000 (minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 2005 (4) Introduction to Earth Materials
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.
Requisites: Requires prerequisite courses of GEOL 1010 or GEOL 2100 and CHEM 1113 and CHEM 1114 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 2040 (3) The Search for Life in the Universe
Introduces the scientific basis for the possible existence of life elsewhere in the universe. Includes origin and evolution of life on Earth and the search for evidence of life in our solar system, including Mars and Jupiter's moon Europa. Discusses the conditions necessary for life and whether they might arise on planets around other stars.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 2040
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 2100 (3) Environmental Geology
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.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 2700 (2) Introduction to Field Geology
Introduces basic field techniques necessary to collect geologic data and samples, and necessary to map geologic units.
Requisites: Requires prerequisite courses of GEOL 1030 and GEOL 2005 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3010 (3) Introduction to Mineralogy
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.
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 and GEOL 2005 and MATH 1300 or APPM 1350 (all minimum grade D-).
Recommended: Prerequisite GEOL 2005.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 3020 (3) Petrology
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.
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 3023 (4) Statistics and Geographic Data
Introduces computational and statistical tools to solve problems in the geographic domain. Provides an understanding of introductory statistical concepts and applies them to real world problems through lab exercises. Emphasizes spatial data, which requires specialized descriptive and predictive analysis techniques. Demonstrates how to manipulate and visualize data, and make inference using state-of-the art statistics software, applied to various social and earth science problems.
Equivalent - Duplicate Degree Credit Not Granted: GEOG 3023
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 3030 (3) Introduction to Hydrogeology
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.
Requisites: Requires prerequisite courses of GEOL 1150 or GEOL 1010 or GEOL 1012 and MATH 1300 or APPM 1350 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

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.
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 two 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 explores 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 3330 (3) Principles of Geophysics
Provides an introduction to fundamental geophysics including seismology, geomagnetism, gravity, and electromagnetic methods with applications to plate tectonics and exploration of the subsurface.
Requisites: Requires prerequisite courses of MATH 1300 or APPM 1350 and PHYS 1110 or PHYS 1115 and GEOL 2001 (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 EBIO 1030 and EBIO 1040 or EBIO 1210 and EBIO 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 (minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

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 3910 (4) Earth and Planetary Inference
Introduces modern ways to interpret earth science observations in the context of conceptual models. We will learn how earth and planetary scientists synthesize geological, geochemical, and geophysical measurements and theoretical knowledge to make new discoveries and predictions. The tools that will be introduced in the course range from order-of-magnitude estimation techniques to a gentle intro to inverse thinking.

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 Core Curr: 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.
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 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 EBIO 3270 and CHEM 1011.
Equivalent - Duplicate Degree Credit Not Granted: EBIO 4160 and ENVS 4160
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

GEOL 4185 (3) Geomicrobiology
Examines how microbial and chemical processes interact on the Earth¿s surface today and have shaped the planet throughout its history. Emphasis will be placed on how the life styles and chemical ingenuity of microorganisms drive key biogeochemical processes including weathering and transformations of carbon, oxygen, sulfur, iron and nitrogen. Towards this goal, major geologic and evolutionary events will be examined through the lens of microbial diversity, metabolic energetics, microbe-mineral interactions, and molecular biomarkers.
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 or CHEM 1400 and CHEM 1401 (minimum grade D-).
Recommended: Prerequisites GEOL 1180 or MCDB 1150 or GEOL 3320 or EBIO 3400 or ENVS 4160 or EVEN 4484.
Grading Basis: Letter Grade

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
Requisites: Requires prerequisite courses of GEOL 2001 and GEOL 2005 (minimum grade D-).
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 cycling 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 4380 (3) Fundamentals of Stable Isotope Geochemistry
This course teaches students the fundamental principles of stable isotope fractionation during physical and biological processes, and the application of these behaviors to a wide range of important geologic questions. The course will use classic case studies from the geologic record to illustrate these principles.
Requisites: Requires prerequisite course of MATH 1300 or APPM 1350 (minimum grade D-).

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 1020 and GEOL 3410 (or permission from the instructor).
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 4670 (3) Isotope Geology
Introduces principles of stable and radiogenic isotope systematics in inorganic and organic geochemistry. Emphasizes application of isotope data to problems in igneous, metamorphic and sedimentary petrology, geobiochemistry, 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 paleoclimatology 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 Arts Sci Gen Ed: Distribution-Natural Sci Lab

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 Arts Sci Gen Ed: Distribution-Natural Sci Lab

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 or PHYS 1115 (all minimum grade D-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab 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 Arts Sci Gen Ed: Distribution-Natural Sci Lab

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 Arts Sci Gen Ed: Distribution-Natural Sciences

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 perquisite 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 Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 4719 (2) Field Analysis and Tectonics of Crystalline Rocks
Introduces basic and advanced mapping tools and concepts for structural and tectonic analysis of solid-state and magmatic deformation, metamorphism, and fluid flow in igneous and metamorphic rocks. Includes some digital mapping concepts using smartpad and smartphone applications, and computer-based analysis of structure data. Includes multi-day mapping projects in the Front Range, and in western Colorado, southern Wyoming, or northern New Mexico. Also includes introductions to Precambrian tectonic history of western North America and mineral resources of Colorado.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 5719
Requisites: Requires prerequisite courses of GEOL 2700 and GEOL 3120 (all minimum grade D).
Grading Basis: Letter Grade

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 Arts Sci Gen Ed: Distribution-Natural Sci Lab

GEOL 4723 (2) Field Studies in Sedimentology
Provides students experience in observing and interpreting sedimentary rocks in the field. We will visit outcrops in CO and UT spanning a range of depositional environments, including eolian, lacustrine, fluvial, and marine. Developing observational and notetaking skills will be emphasized; students will be responsible for contributing to a group field guide based on their guided field observations at each site.
Requisites: Requires prerequisite courses of GEOL 2700 and GEOL 3430 (all minimum grade D-).

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) Indepedent 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

GEOL 5001 (3) Physics and Chemistry of the Solid Earth
Reviews the physical and chemical characteristics of the solid earth, from the core to the crust, and the processes that govern behavior through the earth. Lectures are supplemented with readings from the recent literature. Topics include convection, phase transitions, melt generation, forces of plate tectonics, origin of continents and lithosphere, continental tectonics, and earthquakes.
Requisites: Restricted to graduate students only.
Recommended: Requisite a course in basic chemistry and a course in physics.
Additional Information: Departmental Category: Graduate Course

GEOL 5002 (3) Physics, Chemistry, and Biology of Sedimentary Systems
Reading and discussion of current issues and themes in the stratigraphic sciences, including stratigraphic and facies analysis, spatial heterogeneity and self-organization, numerical modeling; origin, evolution, mass extinctions, and megatrajectories of life; and paleooceanographic and paleoclimatic signals in sedimentary rocks. Goal is to diversify students' understanding of the role of physics, chemistry, and biology in attacking research problems in sedimentary systems.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5003 (2) Graduate Writing Seminar
Aims at improving graduate student writing, editing, and reviewing skills, while meeting student writing goals. Includes discussion of materials about effective writing, and peer-editing of text that students are producing for their graduate research endeavors.

GEOL 5060 (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.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4060
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5080 (3) Advanced Hydrogeology and Modeling Concepts
Introduces advanced groundwater flow and modeling concepts, equations for steady state and transient flow, saturated and unsaturated flow, finite difference method, application of modeling in geologic processes, radial flow and aquifer parameters, infiltration and groundwater recharge, model calibration, verification and prediction. Department enforced prerequisite: MATH 2300 or Fortran.
Additional Information: Departmental Category: Graduate Course

GEOL 5093 (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 4093 and GEOG 4093 and GEOG 5093
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5110 (3) Geomechanics
Introduces fundamental physical processes important to the transport of heat and mass in the Earth and on Earth's surface. Provides practice with quantitative treatment of geological problems. Solutions for each problem are derived from first principles, including conservation and flux laws. Emphasizes heat conduction and viscous fluid flow. Department enforced prerequisite: restricted to graduate students only and a course in calculus.
Additional Information: Departmental Category: Graduate Course

GEOL 5123 (3) Teaching and Learning in Post-Secondary Science Education
Introduces the science of learning and research-based instructional strategies. Open to students in any STEM discipline considering a career that involves college-level teaching. Students apply research on learning and teaching to the development of instructional materials for a target course they envision teaching at the college level in the future.
Recommended: Prerequisite at least one semester teaching/TAing undergraduate courses (waived with instructor approval).

GEOL 5150 (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 4150
Additional Information: Departmental Category: Graduate Course

GEOL 5185 (3) Geomicrobiology
Examines how microbial and chemical processes interact on the Earth¿s surface today and have shaped the planet throughout its history. Emphasis will be placed on how the life styles and chemical ingenuity of microorganisms drive key biogeochemical processes including weathering and transformations of carbon, oxygen, sulfur, iron and nitrogen. Towards this goal, major geologic and evolutionary events will be examined through the lens of microbial diversity, metabolic energetics, microbe-mineral interactions, and molecular biomarkers.
Grading Basis: Letter Grade

GEOL 5215 (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 4215
Additional Information: Departmental Category: Graduate Course

GEOL 5270 (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 4270
Recommended: Prerequisites introductory chemistry, introductory geology, introductory oceanography.
Additional Information: Departmental Category: Graduate Course

GEOL 5280 (3) Aqueous and Environmental Geochemistry
Explores the fundamentals of low-temperature geochemistry to investigate element speciation and chemical behavior in waters, soils and sediments. Topics include water-rock interaction and weathering, mineral dissolution and precipitation reactions, aqueous complexation, mineral surface chemistry, kinetics, element cycles, and redox biogeochemistry. Includes exposure to spectroscopic tools, computer simulations and microbial geochemistry. Department enforced prerequisite: GEOL 3320 or 2 year of college chemistry.
Additional Information: Departmental Category: Graduate Course

GEOL 5305 (3) Global Biogeochemical Cycles
Focuses on the cycling of elements at the global scale with a particular emphasis on human modification of biogeochemical cycles. Major biogeochemical cycles, their past dynamics, present changes and potential future scenarios will be addressed. Ecosystem to global-scale model of the earth system will be discussed along with global scale measurements of element fluxes from satellites, aircraft and measurement networks. Department enforced prerequisite: restricted to graduate students only, general chemistry and some organic chemistry.
Equivalent - Duplicate Degree Credit Not Granted: ENVS 5840
Additional Information: Departmental Category: Graduate Course

GEOL 5330 (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: graduate standing in physical science and graduate chemistry or physics or math courses.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4330 and ASTR 4330 and ASTR 5330
Additional Information: Departmental Category: Graduate Course

GEOL 5380 (3) Fundamentals of Stable Isotope Geochemistry
This course teaches students the fundamental principles of stable isotope fractionation during physical and biological processes, and the application of these behaviors to a wide range of important geologic questions. The course will use classic case studies from the geologic record to illustrate these principles.
Requisites: Requires prerequisite course of MATH 1300 or APPM 1350 (minimum grade D-).

GEOL 5420 (3) Quaternary Dating Methods
Features in-depth survey of standard and experimental dating methods that provide absolute ages for events of the last two million years of Earth history. Includes theory and application of radiocarbon, uranium series, amino acid, thermo-luminescence, fission track, potassium/argon, hydration, light stable isotopes, and other radioactive techniques.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5430 (3) Paleoceanography and Paleoclimatology
Examines scientific tools, data, and theories related to the dramatically varied past climate of the Earth. Focus will be on marine records of climate change and ocean circulation, but ice cores and other continental archives will also be discussed. Course covers the Cenozoic Era (66 Ma to present), but with particular emphasis on the Quaternary ice age cycles.
Recommended: Prerequisites Introductory geology and introductory oceanography or atmospheric science.
Additional Information: Departmental Category: Graduate Course

GEOL 5474 (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.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4474 and MUSM 5474
Additional Information: Departmental Category: Graduate Course

GEOL 5660 (3) Sedimentology & Geobiology of Carbonates
Carbonate sedimentary rocks are a significant component of the geobiological rock record, capturing a history of organisms and the environments they inhabit. This course will focus on how carbonate sediments are formed, deposited, and lithified and what influences the preservation and alteration of textural and geochemical signals. We will cover facies identification, interpreting depositional environment, and carbonate geochemistry, with a particular emphasis on recent advances and unanswered questions at the intersection of carbonates and geobiology, including the role of microbial carbonate precipitation and/or dissolution in the formation and degradation of stromatolites, carbonate mud, ooids, etc.
Recommended: Prerequisite prior coursework in Sedimentology.

GEOL 5670 (3) Isotope Geology
Introduces principles of stable and radiogenic isotope systematics in inorganic and organic geochemistry. Emphasizes application of isotope data to problems in igneous, metamorphic and sedimentary petrology, geobiochemistry, and petroleum genesis.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4670
Additional Information: Departmental Category: Graduate Course

GEOL 5675 (3) Stable Isotopes in Paleoclimate and Paleoecology
Explores the use of stable isotope geochemistry for research questions in paleoclimatology 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 4675
Grading Basis: Letter Grade
Additional Information: Departmental Category: Graduate Course

GEOL 5690 (3) Tectonic History of the Western United States
Provides students with the practical tools needed to make tectonic interpretations through study of the geologic history of the western United States and the geodynamic models used in interpreting that history. Paleomagnetism, geobarametry, geothermometry, geodynamic modeling, and elements of structural geology and stratigraphy are topics considered in this class.
Requisites: Requires prerequisite courses of GEOL 3120 and PHYS 1110 (all minimum grade D-).
Additional Information: Departmental Category: Graduate Course

GEOL 5700 (1-4) Geological Topics Seminar
Offers seminar studies in geological subjects of special current interest. Primarily for graduate students, as departmental staff and facilities permit.
Repeatable: Repeatable for up to 15.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5701 (2) Super-Problems in Quatrnary Climate
Investigates major problems in the study and understanding of Quaternary climate variation, in seminar format. Each year one major topic will be addressed, such as: the physics and chemistry of the Ice Age ocean circulation; the theory and mechanics of glacial/interglacial atmospheric C02 change; the origins of the 20, 40, and 100 kyr orbital (Milankovitch) climate cycles.
Recommended: Prerequisites Introductory geology and climatology, oceanography, paleoclimatology, or paleoceanography.
Additional Information: Departmental Category: Graduate Course

GEOL 5702 (1) Geomorphology Seminar
Explores the dynamics and forms of the earth's surface through critical reading and discussion of both classical and modern literature.
Repeatable: Repeatable for up to 10.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

GEOL 5703 (1) Seminar in Tectonics
Focuses on a wide variety of topics related to crust, mantle and whole earth tectonics. Published papers from recent peer-reviewed literature are read and discussed. The format and specific topics will vary each semester (e.g., a relatively focused theme or open format) and will in part be determined by the makeup of enrolled students. Department enforced prerequisite: restricted to graduate students only.
Repeatable: Repeatable for up to 6.00 total credit hours.
Grading Basis: Letter Grade
Additional Information: Departmental Category: Graduate Course

GEOL 5704 (1) Carbonates Seminar
Focuses broadly on the topic of carbonates, including sedimentology, geochemistry, and geobiology of carbonates. Each semester will have a distinct theme under these sub-topics. Students will be responsible for leading discussion on individual readings and will be able to provide input on both the theme and the individual reading selections. Upper-level GEOL majors can register with instructor approval.
Repeatable: Repeatable for up to 10.00 total credit hours.

GEOL 5711 (1-3) 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. Department enforced prerequisites: restricted to graduate students only and GEOL 2001 or GEOL 2700 and GEOL 3020.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5712 (1-3) Structural Field Geology
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. Department enforced prerequisites: GEOL 2001 or GEOL 2700 and GEOL 3020.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5714 (2) Field Geophysics
Applies geophysical field techniques and data interpretation to studying geological and engineering problems. Fieldwork includes seismic, gravity, magnetic and electrical measurements. Department enforced prerequisite: restricted to graduate students only and GEOL 2001 or GEOL 2700 and MATH 1300 and PHYS 1110.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5715 (1-3) Field Techniques in Surficial Geology and Geohydrology
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 steam flows, interpreting aquifer parameters from geophysical measurements and using field data for water budget analysis. Department prerequisite: GEOL 2001 or GEOL 2700.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5716 (1-3) Environmental Field Geochemistry
Develops basic field skills in the most commonly performed tasks required for the environmental characterization of solid and aqueous wastes. Media of study include soils, stream sediments, surface waters, ground waters and atmospheric particulates. Department enforced prerequisites: GEOL 2001 or GEOL 2700 and CHEM 1011 and CHEM 1031 or CHEM 1113 or CHEM 1133 and GEOL 3320.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5717 (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. Department enforced prerequisites: restricted to graduate students only and GEOL 2001 or GEOL 2700 and at least one of the following: GEOL 3120 or GEOL 3320 or GEOL 3430.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 5719 (2) Field Analysis and Tectonics of Crystalline Rocks
Introduces basic and advanced mapping tools and concepts for structural and tectonic analysis of solid-state and magmatic deformation, metamorphism, and fluid flow in igneous and metamorphic rocks. Includes some digital mapping concepts using smartpad and smartphone applications, and computer-based analysis of structure data. Includes multi-day mapping projects in the Front Range, and in western Colorado, southern Wyoming, or northern New Mexico. Also includes introductions to Precambrian tectonic history of western North America and mineral resources of Colorado.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 4719
Requisites: Restricted to graduate students only.
Grading Basis: Letter Grade

GEOL 5725 (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 4725
Repeatable: Repeatable for up to 8.00 total credit hours. Allows multiple enrollment in term.
Grading Basis: Letter Grade
Additional Information: Departmental Category: Graduate Course

GEOL 5775 (3) Introduction to Numerical Modeling in Geoscience
Numerical models play an essential role across the geosciences, with applications that include hypothesis exploration, data interpretation, and prediction. This course provides a hands-on introduction to numerical modeling. Students learn scientific programming and modeling concepts by iterating through a series of model-development assignments in Python and Matlab. Applications span a range of topics in the geosciences, with emphasis on physical processes that involve mass, energy, and/or momentum transport.

GEOL 5800 (3) Planetary Surfaces and Interiors
Examines processes operating on the surfaces of solid planets and in their interiors. Emphasizes spacecraft observations, their interpretation, the relationship to similar processes on Earth, the relationship between planetary surfaces and interiors and the integrated geologic histories of the terrestrial planets and satellites.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 5800
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5810 (3) Planetary Atmospheres
Covers the structure, composition, and dynamics of planetary atmospheres. Includes the origin of planetary atmospheres, chemistry and cloud physics, greenhouse effects, climate, and the evolution of planetary atmospheres - past and future.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 5810 and ASTR 5810
Additional Information: Departmental Category: Graduate Course

GEOL 5820 (3) Origin and Evolution of Planetary Systems
Considers the origin and evolution of planetary systems, including protoplanetary disks, condensation in the solar nebula, composition of meteorites, planetary accretion, comets, asteroids, planetary rings and extrasolar planets. Applies celestial mechanics to the dynamical evolution of solar system bodies.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 5820 and ATOC 5820
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5830 (3) Topics in Planetary Science
Examines current topics in planetary science, based on recent discoveries, spacecraft observations and other developments. Focuses on a specific topic each time the course is offered, such as Mars, Venus, Galilean satellites, exobiology, comets or extrasolar planets. Department enforced prerequisite: restricted to graduate students in the physical sciences.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 5830 and ASTR 5830
Repeatable: Repeatable for up to 6.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

GEOL 5835 (1) Seminar in Planetary Science
Studies current research on a topic in planetary science. Students and faculty give presentations. Subjects may vary each semester.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 5835 and ATOC 5835
Repeatable: Repeatable for up to 4.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5840 (1-3) Independent Study-Quaternary Geology
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5841 (1-3) Independent Study-Economic Geology
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5842 (1-3) Independent Study-Petrology
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5843 (1-3) Independent Study-Sedimentology
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5844 (1-3) Independent Study-Structure/Tectonics
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5845 (1-3) Independent Study-Geochemistry
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5846 (1-3) Independent Study-Geophysics
Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5847 (1-3) Independent Study-Hydrology
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Repeatable: Repeatable for up to 7.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 5849 (1-3) Independent Study-Paleontology
Repeatable: Repeatable for up to 7.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

GEOL 5851 (1-3) Independent Study-Sediment Petrology
Repeatable: Repeatable for up to 7.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

GEOL 5852 (1-3) Independent Study--GIS Applications in Quaternary Geosciences
Leads students through quantitative spatial analysis of environmental and paleoclimatic problems. Each student will develop a project from start to finish, with emphasis on raster GIS for building large empirical databases that bear on process and variability.
Additional Information: Departmental Category: Graduate Course

GEOL 5862 (1-4) Geology Independent Study
Repeatable: Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

GEOL 5910 (3) Geothermodynamics
Provides a solid foundation in chemical thermodynamic concepts and calculations as applied to geochemistry and geobiology.

GEOL 6050 (3) Space Instrumentation
Provides an overview of the relevant space environment and process, the types of instruments flown on recent mission and the science background of the measurement principles.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 6050 and ASEN 6050
Grading Basis: Letter Grade
Additional Information: Departmental Category: Graduate Course

GEOL 6060 (4) Petroleum Geology of Turbidite Systems
Covers the exploration and production aspects of petroleum submarine fans and turbidite systems.
Requisites: Requires prerequisite course of GEOL 6330 (minimum grade B).
Additional Information: Departmental Category: Graduate Course

GEOL 6310 (3) Sedimentary Petrology
Covers interpretation of depositional and diagenetic history of sedimentary rocks as determined from thin-section studies. Department enforced prerequisites: GEOL 3010 and GEOL 3020 and GEOL 3430 or equivalents.
Additional Information: Departmental Category: Graduate Course

GEOL 6330 (4) Applied Sequence Stratigraphy and Basin Analysis
Develops skills in the stratigraphic interpretation of seismic reflection data, recognition of sequence stratigraphy in well logs and outcrop and their applications to basin analysis in petroleum exploration. Department enforced prerequisite: restricted to graduate students only and introductory undergraduate physics and sedimentology/stratigraphy.
Additional Information: Departmental Category: Graduate Course

GEOL 6610 (3) Earth and Planetary Physics 1
Offered alternate years. Examines mechanics of deformable materials, with applications to earthquake processes. Introduces seismic wave theory. Other topics include inversion of seismic data for the structure, composition and state of the interior of the Earth.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 6610 and PHYS 6610
Additional Information: Departmental Category: Graduate Course

GEOL 6620 (3) Earth and Planetary Physics 2
Offered alternate years. Covers space and surface geodetic techniques as well as potential theory. Other topics are the definition and geophysical interpretation of the geoid and of surface gravity anomalies; isostasy; post-glacial rebound; and tides and the rotation of the Earth.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 6620 and PHYS 6620
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

GEOL 6630 (3) Earth and Planetary Physics 3
Offered alternate years. Examines the solar system, emphasizing theories of its origin and meteorites. Highlights distribution of radioactive materials, age dating, heat flow through continents and the ocean floor, internal temperature distribution in the Earth, and mantle convection. Also covers the origin of the oceans and atmosphere.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 6630 and PHYS 6630
Additional Information: Departmental Category: Graduate Course

GEOL 6650 (1-3) Seminar in Geophysics
Advanced seminar studies in geophysical subjects for graduate students.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 6650 and PHYS 6650
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Additional Information: Departmental Category: Graduate Course

GEOL 6655 (3) InSAR Processing and Interpretation
Understand the concepts and applications of interferometric synthetic aperture radar (InSAR) and differential InSAR, to include an introduction to physical geodesy and satellite techniques.
Equivalent - Duplicate Degree Credit Not Granted: PHYS 6655
Grading Basis: Letter Grade

GEOL 6670 (2) Geophysical Inverse Theory
Principles of geophysical inverse theory as applied to problems in the Earth sciences, including topography, Earth structure and earthquake locations. Department enforced prerequisites: a course in calculus and a course in computer programming (any language).
Equivalent - Duplicate Degree Credit Not Granted: PHYS 6670
Additional Information: Departmental Category: Graduate Course

GEOL 6940 (1) Master's Candidate for Degree
Requisites: Restricted to graduate students only.
Grading Basis: Pass/Fail
Additional Information: Departmental Category: Graduate Course

GEOL 6950 (1-6) Master's Thesis
Repeatable: Repeatable for up to 6.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

GEOL 6960 (3) Plan II Master's Research
Additional Information: Departmental Category: Graduate Course

GEOL 8990 (1-10) Doctoral Dissertation
All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School section.
Repeatable: Repeatable for up to 30.00 total credit hours.
Additional Information: Departmental Category: Graduate Course