

# GEOSCIENCES-GEOL (GEOL)

## Courses

**GEOL 110 Introduction to Geology-Parks and Monuments (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Understanding the physical processes, natural hazards, earth materials, and natural resources of planet Earth, and the relationship of humans to this planet. Outstanding examples of natural features from national and local parks and monuments, using narrated high-resolution (including aerial) video.

**Prerequisite:** None.

**Registration Information:** This is a partial semester course. Offered as an online course only. Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 120 Geology and Society (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Explore the dynamic Earth system that we call home. Examine the processes that shape the world and create the resources used and the natural hazards faced. Learn about plate tectonics, climate change, minerals, rocks, geologic time, resources, earthquakes, volcanoes, flooding, and landslides. Build scientific skills and an understanding of the scientific process through making observations, interpreting data, performing calculations, reading maps, and evaluating graphs.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 121 Experiential Geoscience Laboratory (GT-SC1) Credit: 1 (0-2-0)**

**Course Description:** Explore the variety of methods used by geoscientists to study the Earth through field trips, examination of datasets, and experiments with physical models. Learn to identify rocks and minerals, read the landscape using maps, measure surface and groundwater, and interpret climate data. Build scientific skills and gain an understanding of how science operates by participating in inquiry activities.

**Prerequisite:** GEOL 110, may be taken concurrently or GEOL 120, may be taken concurrently or GEOL 122, may be taken concurrently or GEOL 124, may be taken concurrently.

**Registration Information:** Sections may be offered: Online. Required field trips. Credit not allowed for both GEOL 121 and GEOL 150.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**GEOL 122 Geoscience--Climate and Environmental Change (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Explore the Earth processes that shape the environment. Examine how Earth systems change and how people contribute to and are affected by these changes. Learn about climate change, the hydrological cycle, rock and mineral formation, weathering and erosion, glaciers, oceans, and plate tectonics. Build scientific skills and an understanding of the scientific process through making observations, interpreting data, performing calculations, reading maps, and evaluating graphs.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Terms Offered:** Fall, Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 124 Earth Resources and Sustainability (GT-SC2) Credits: 3 (3-0-0)**

**Course Description:** Explore the role of Earth resources in building a sustainable society. Learn about the geologic processes that create water, mineral, and energy resources. Examine positive and negative impacts of resource extraction and use. Investigate economic, political, and environmental issues associated with Earth resources. Build scientific skills and an understanding of the scientific process through making observations, interpreting data, performing calculations, reading maps, and evaluating graphs.

**Prerequisite:** None.

**Registration Information:** Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

**GEOL 130 Dinosaurs and their World Credits: 3 (3-0-0)**

**Course Description:** Develops foundational concepts in Earth history, geologic time, the rock cycle, sedimentary geology and depositional environments, plate tectonics, evolutionary biology, paleoecology, and biogeography, to reconstruct and interpret fossil ecosystems and organisms from the Mesozoic. These skills and concepts are introduced through the lens of dinosaur science.

**Prerequisite:** None.

**Registration Information:** Offered as an online course only.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 150 Dynamic Earth (GT-SC2) Credits: 4 (3-3-0)**

**Course Description:** Explore the geology of the dynamic Earth from core to surface and over timescales of hours to millions of years through hands-on activities in the laboratory and field. Learn to identify and interpret Earth materials. Build proficiency in scientific hypothesis testing. Learn how plate tectonic forces shape landscapes and tie dynamic Earth processes to societal interests, including global climate change, natural hazards, and critical natural resources.

**Prerequisite:** None.

**Registration Information:** Must register for lecture and laboratory. Required field trips. Credit allowed for only one of the following: GEOL 110, GEOL 120, GEOL 122, GEOL 124, or GEOL 150. Credit not allowed for both GEOL 121 and GEOL 150.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/ lab (GT-SC1).

**GEOL 154 Earth and Climate Change Through Time Credits: 4 (3-3-0)**

**Course Description:** Explore evolving Earth through the lens of geologic Earth history. Discover the stories of the periods of evolution and mass extinction of biologic life, worldwide changes in climate from ice ages to inland oceans, major geologic events that led to the formation of mountains and oceans, and how these events help to understand the planet. Learn how to determine when rocks formed, and how to interpret past environments, climates, and events from the rock and fossil record.

**Prerequisite:** GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 192 New Student Seminar--Exploring Geosciences Credit: 1 (0-0-1)**

**Course Description:** Geosciences as a field of study; exploration of the major and career paths; strategies for academic success and beyond.

**Prerequisite:** None.

**Restriction:** Must be a: Undergraduate.

**Registration Information:** Freshman and sophomore geology majors only. This is a partial semester course.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 201 Field Geology of the Colorado Front Range Credit: 1 (0-2-0)**

**Course Description:** Geology of the Rocky Mountain Front Range taught primarily through field trips and field exercises, emphasizing hands-on experiences. Learn to make basic field observations and measurements on a variety of rock types and surficial features.

**Prerequisite:** GEOL 121 or GEOL 150.

**Registration Information:** Freshman, sophomore or junior standing only. Geology majors or minors only. This is a partial semester course. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 232 Mineralogy Credits: 3 (2-3-0)**

**Course Description:** Crystal structures, crystal chemistry, rock-forming and economically important minerals, crystal growth and defects, physical properties of minerals.

**Prerequisite:** (CHEM 111, may be taken concurrently) and (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 120 or MATH 124 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255).

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 250 The Solid Earth Credits: 3 (2-2-0)**

**Course Description:** Structure, flow, and composition of the deep Earth; introduction to geophysics; tests of plate tectonic theory.

**Prerequisite:** (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 124) and (MATH 125 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255).

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 275 Climate Change and Earth System Interactions Credits: 3 (3-0-0)**

**Also Offered As:** CLMT 275.

**Course Description:** Investigation of earth system interactions with climate change, including impacts to water cycling, oceans, and ecological responses.

**Prerequisite:** ATS 150 or GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150.

**Registration Information:** Sections may be offered: Online. Credit allowed for only one of the following: CLMT 275, CLMT 350, or GEOL 275.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 310 Earth Materials Credits: 4 (3-3-0)**

**Course Description:** Exploration of what makes up the Earth beneath our feet; minerals, sediments and rocks, and water, organic matter, and hydrocarbons in pore space. Minerals as natural chemical compounds and the fundamental building blocks of rocks. Rocks and sediments as products of igneous, sedimentary, and metamorphic geological process. Interpretation of rock-forming process through observations. Minerals and rocks as essential resources and sources of most materials we use.

**Prerequisite:** (CHEM 111) and (GEOL 110 or GEOL 120 and GEOL 121 or GEOL 121 and GEOL 122 or GEOL 124 and GEOL 121 or GEOL 150).

**Registration Information:** Required field trips. Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 311 Earth's Interior Credits: 3 (2-2-0)**

**Course Description:** Earth's dynamically changing interior, its composition and structure, physical and chemical processes, how these evolved through geologic time. How Earth's internal and surface processes interact to exchange energy and mass. Associated impacts on life and human society. Become familiar with the data and scientific arguments that support understanding of Earth. Methods used to obtain this knowledge and to develop and test hypotheses concerning Earth's interior.

**Prerequisite:** GEOL 110 or GEOL 120 and GEOL 121 or GEOL 121 and GEOL 122 or GEOL 121 and GEOL 124 or GEOL 150.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 312 Earth's Surface Credits: 2 (2-0-0)**

**Course Description:** Examine Earth's surface from bedrock to tree tops. Earth's surface is a constantly evolving layer where rock, soil, water, air, and living organisms interact to shape the landscape, regulate natural habitats, determine the availability of life-sustaining resources, and affect the magnitude and frequency of natural hazards. Gain a coherent introduction to the processes and interactions governing this vital interface.

**Prerequisite:** (GEOL 110 or GEOL 120 and GEOL 121 or GEOL 121 and GEOL 122 or GEOL 121 and GEOL 124 or GEOL 150) and (GEOL 154, may be taken concurrently).

**Registration Information:** Must have concurrent registration in GEOL 313 and GEOL 314.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 313 Earth Systems Credits: 2 (2-0-0)**

**Course Description:** Exploration of interactions and feedbacks between the geosphere, atmosphere, hydrosphere, and biosphere and how they promote a hospitable climate on Earth over geological time. Emphasizing systems thinking, students learn Earth System science tools, including the rock record, geochronology, proxy data, and modeling. Drawing from geologic examples, explore how perturbations are used to probe Earth System mechanics, including potential responses to human-induced greenhouse gas emissions.

**Prerequisite:** (GEOL 110 or GEOL 120 and GEOL 121 or GEOL 121 and GEOL 122 or GEOL 121 and GEOL 124 or GEOL 150) and (GEOL 154, may be taken concurrently).

**Registration Information:** Must have concurrent registration in GEOL 312 and GEOL 314. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 314 Earth's Surface Laboratory Credit: 1 (0-2-0)**

**Course Description:** Covers foundational skills in Earth Systems science. Skills in scientific reasoning, conceptual and computational modeling, quantitative data analysis and reasoning, and field analysis will be developed. Geological information, including quantitative reasoning, will be collected, synthesized, modeled, analyzed, and interpreted in class and presented orally and verbally and through active learning activities.

**Prerequisite:** (GEOL 110 or GEOL 120 and GEOL 121 or GEOL 121 and GEOL 122 or GEOL 121 and GEOL 124 or GEOL 150) and (GEOL 154).

**Registration Information:** Required field trips. Must have concurrent registration in GEOL 312 and GEOL 313.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 332 Optical Mineralogy Credits: 2 (1-2-0)**

**Course Description:** Fundamental light optics in crystalline substances; optical indicatrix; isotropic, uniaxial, and biaxial substances; common minerals in thin section.

**Prerequisite:** GEOL 232, may be taken concurrently.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 340 Glacial Geology Credits: 3 (3-0-0)**

**Course Description:** Glacier physics (mass balance, ice dynamics, heat flow, and hydrology), glacial erosion and sedimentation, glacial landforms, and the relationship between forcings (orbital, climate, tectonic, biological) and glaciations in Earth's history.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (PH 121 or PH 141).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Sophomore standing. Required field trips. Credit not allowed for both GEOL 340 and GEOL 380A2.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 342 Paleontology Credits: 3 (2-3-0)**

**Course Description:** Description of invertebrates, vertebrates, and plants and their distribution in earth history.

**Prerequisite:** GEOL 154.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 343 Dinosaur Paleontology Field Camp Credit: 1 (0-0-2)**

**Course Description:** Develops field-based skills in sedimentology and paleontology, including general sedimentary geology techniques (interpreting depositional environments, measuring section, collecting samples, note taking) and paleontological techniques (prospecting, data collection, excavation, mapping, inventory), to reconstruct and interpret fossil ecosystems.

**Prerequisite:** GEOL 154.

**Registration Information:** Required field trips. Class will spend one week camping at the Denver Museum of Nature and Science field station. Credit not allowed for both GEOL 343 and GEOL 380A3.

**Term Offered:** Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 344 Stratigraphy and Sedimentology Credits: 3 (2-3-0)**

**Course Description:** Description, genesis, correlation, and age of sediments, sedimentary rocks and layered rock sequences.

**Prerequisite:** GEOL 154 with a minimum grade of C.

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Fall.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 364 Igneous and Metamorphic Petrology Credits: 3 (2-2-0)**

**Course Description:** Identification, classification, geochemistry, petrogenesis of igneous and metamorphic rocks; textural interpretation of hand samples and thin sections.

**Prerequisite:** GEOL 310.

**Restriction:** Must not be a: Freshman.

**Registration Information:** Sophomore standing. Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 366 Low-Temperature Geochemistry Credits: 3 (3-0-0)**

**Course Description:** In-depth examination of the application of chemical principles to geochemical systems. Focus on geochemistry primarily through the lens of Earth's surface (marine and terrestrial) environments. Includes gaining a general understanding of the interaction of water with geologic and biological cycles, the natural chemical compositions of water from a range of environments, and the ways in which water chemistry is quantified both analytically and through modeling.

**Prerequisite:** CHEM 113 and GEOL 154 and GEOL 310.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 372 Structural Geology Credits: 4 (3-3-0)**

**Course Description:** Stress and strain in rocks, geometry of deformed rocks, and tectonic principles.

**Prerequisite:** (GEOL 154, may be taken concurrently) and (MATH 125 or MATH 127 or MATH 155 or MATH 160 or MATH 161 or MATH 255) and (PH 121, may be taken concurrently or PH 141, may be taken concurrently).

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 376 Geologic Field Methods Credits: 2 (1-3-0)**

**Course Description:** Scientific, surveying, and mapping methods used in geologic field studies; map and report preparation.

**Prerequisite:** (GEOL 310 and GEOL 311 or GEOL 312, may be taken concurrently and GEOL 313, may be taken concurrently) and (GEOL 344 and GEOL 372, may be taken concurrently).

**Registration Information:** Must register for lecture and laboratory. Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 384 Supervised College Teaching Credits: Var[1-5] (0-0-0)**

**Course Description:** Instruction and practice in laboratory instruction in lower-division departmental courses.

**Prerequisite:** None.

**Registration Information:** Written consent of instructor. A maximum of 10 combined credits for all 384 and 484 courses are counted towards graduation requirements.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 401 Geology of the Rocky Mountain Region Credit: 1 (0-3-0)**

**Course Description:** Field course; geology of the local Rocky Mountain region.

**Prerequisite:** GEOL 154.

**Registration Information:** May be taken up to 3 times for credit. Required field trips.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 415 Critical Zone Science Credits: 3 (3-0-0)**

**Course Description:** Focus on the Earth's terrestrial near-surface environment that sustains most non-marine life on the planet, known as the Critical Zone. Gain experience with the architecture and geologic and geomorphologic context of the Critical Zone in different environments. Explore the interactions between the solid earth, atmosphere, hydrosphere and biosphere that give rise to the Critical Zone, and learn how the Critical Zone modulates various Earth surface processes.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 150 or ESS 210 or GR 210 or SOCR 240) and (CHEM 107 or CHEM 111) and (MATH 155 or MATH 159 or MATH 160 or STAT 301).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Required field trips. Credit not allowed for both GEOL 380A1 and GEOL 415.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 436 Geology Summer Field Course Credits: 6 (0-12-0)**

**Course Description:** Geologic mapping, measuring sections, interpreting geologic history in Colorado. Required comprehensive reports, geologic maps, and cross sections.

**Prerequisite:** GEOL 364 and GEOL 372 and GEOL 376.

**Registration Information:** This is a partial semester course. Required field trips.

**Term Offered:** Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 440 Geodetic and Near-Surface Geophysical Methods Credits: 4 (3-3-0)**

**Course Description:** Introduction to geodetic and near-surface geophysical methods to answer societally-relevant geological and environmental questions. Methods include (i) dataloggers and instruments, (ii) geodetic tools (GNSS surveys, lidar, and Structure from Motion), and (iii) near-surface geophysical methods (ground-penetrating radar, active seismic profiling, and electrical resistivity imaging). Emphasizes learning to collect, analyze/interpret, and synthesize multiple types of geophysical data.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (GEOL 344, may be taken concurrently) and (PH 122 or PH 142) and (MATH 161 or MATH 255).

**Restriction:** Must not be a: Freshman.

**Registration Information:** Sophomore standing. Must register for lecture and laboratory. Required field trips. Credit not allowed for both GEOL 440 and GEOL 480A4.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 442 Applied Geophysics Credits: 4 (3-2-0)**

**Course Description:** Geophysical exploration methods emphasizing hydrocarbon and mineral exploration, hydrogeology, and engineering applications.

**Prerequisite:** GEOL 372 and MATH 161 and PH 142.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 446 Environmental Geology Credits: 3 (3-0-0)**

**Course Description:** Geology applied to environmental problems.

**Prerequisite:** (CHEM 111) and (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (MATH 155 or MATH 160) and (PH 121 or PH 141).

**Registration Information:** Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 447 Mineral Deposits Credits: 3 (2-3-0)**

**Course Description:** Occurrence, origin, and exploration of economic metallic mineral deposits.

**Prerequisite:** GEOL 364 and GEOL 372.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 450 Reservoir Geosciences Fluid Storage & Flow Credits: 3 (2-3-0)**

**Course Description:** Evaluate subsurface geologic reservoir viability, interpret subsurface data, and analyze the processes that control fluid flow and storage, with case studies in sustainable water and energy.

**Prerequisite:** GEOL 344 and GEOL 372, may be taken concurrently.

**Restriction:** Must not be a: Freshman, Sophomore.

**Registration Information:** Junior standing. Must register for lecture and laboratory.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 452 Hydrogeology Credits: 4 (3-3-0)**

**Course Description:** Interaction of water and geologic materials; surface and groundwater; quantitative analysis and geologic effects on quality and flow of groundwater.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 or GR 210) and (MATH 161 or MATH 255) and (PH 121 or PH 141).

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 454 Geomorphology Credits: 3 (2-3-0)**

**Course Description:** Origin of landforms; morphology and processes.

**Prerequisite:** (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 or GR 210) and (STAT 301 or STAT 307 or STAT 315).

**Registration Information:** Must register for lecture and laboratory.

Sections may be offered: Mixed Face-to-Face.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 476 Field Geoscience Capstone Credits: Var[1-6] (0-0-0)**

**Course Description:** Consists of single or multi-day projects that focus on aspects of field description, data collection, and interpretation. Projects include geologic mapping, measuring stratigraphic sections, collecting geophysical and geochemical data in the field, and interpreting field data and geologic history. Produce products such as geologic maps, cross sections, and comprehensive reports.

**Prerequisite:** GEOL 310 and GEOL 311 and GEOL 313 and GEOL 344 and GEOL 372, may be taken concurrently and GEOL 376, may be taken concurrently.

**Registration Information:** This is a partial semester course. Required field trips. May be taken for a maximum of 6 credits.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 477 Isotope Geology and Geochronology Credits: 3 (3-0-0)**

**Course Description:** Principles of radioactive decay that forms the basis for radiometric dating techniques, along with the application of isotope compositions to understanding geologic processes.

**Prerequisite:** GEOL 310.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 492 Seminar Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494A Independent Study: Environmental/Engineering Geology Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494B Independent Study: Geomorphology Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494C Independent Study: Mineralogy/Petrology Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494D Independent Study: Geoscience Field Studies Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494E Independent Study: Paleontology/Stratigraphy Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494F Independent Study: Sedimentology Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494G Independent Study: Structural Geology Credits:**

**Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 494I Independent Study: Geophysics Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 498 Research Credits: Var[1-6] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Registration Information:** Written consent of instructor.

**Term Offered:** Spring.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 530 Advanced Petrology Credits: 3 (2-2-0)**

**Course Description:** Igneous and metamorphic processes and products explored through thermodynamics, phase equilibria, and textural analysis.

**Prerequisite:** GEOL 364.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 535 Microtectonics Credits: 3 (2-2-0)**

**Course Description:** Focuses on microstructural features, processes, mechanisms, and measurements. Structurally interesting rocks especially on the microscale, development of structural fabrics and reactivation, analysis of fault rocks and kinematic indicators especially in fault and shear zones, stress measurement through microstructural indicators, shock deformation/metamorphism in impact structures, chemical changes with deformation, deformation mechanisms, and isotopic investigation of deformation.

**Prerequisite:** GEOL 332 and GEOL 372.

**Registration Information:** Must register for lecture and laboratory. Credit not allowed for both GEOL 535 and GEOL 580A3.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 541 Geostatistics Credits: 2 (2-0-0)**

**Course Description:** Geostatistics for earth science applications. Aquifer and reservoir heterogeneity, spatial data analysis, variogram modeling, spatial estimation, kriging, and geostatistical simulation.

**Prerequisite:** (GEOL 150) and (MATH 161 or MATH 255) and (STAT 301 or STAT 315).

**Registration Information:** Credit not allowed for both GEOL 541 and GEOL 581A5.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 542 Paleoclimate Credits: 3 (3-0-0)**

**Also Offered As:** ATS 542.

**Course Description:** A survey of past climate and Earth system states, from the Archean to the Holocene. Special emphasis on extreme climates and on time periods where there remains substantial model-data disagreement. Role of paleoclimate in understanding future warming and evolution of the Earth system.

**Prerequisite:** GEOL 154.

**Restriction:** Must not be a: Freshman.

**Registration Information:** Credit allowed for only one of the following: ATS 542, ATS 580B1, GEOL 542, or GEOL 580B1.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 543 Carbonate Sedimentology Credits: 2 (1-3-0)**

**Course Description:** Recognition of carbonate grains, cement types, and carbonate depositional environments, and their response to sea-level changes.

**Prerequisite:** GEOL 344.

**Registration Information:** Junior standing.

**Term Offered:** Fall (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 546 Sedimentary Basin Analysis Credits: 3 (3-0-0)**

**Course Description:** Examines tectonic and environmental controls on the development and evolution of sedimentary basins. Emphasis will be given to mechanisms of formation, characteristic depositional patterns, and sediment composition in modern and ancient tectonic settings. Basin Analysis methods include sedimentology, stratigraphy, geochemistry, provenance, and paleocurrent analysis, subsidence modeling, and interpretation of geophysical data.

**Prerequisite:** GEOL 344.

**Registration Information:** Required field trips.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 547 Ore Deposit Geochemistry Credits: 3 (3-0-0)**

**Course Description:** Geochemical techniques applied to the geology, exploration, and environmental analysis of ore deposits.

**Prerequisite:** GEOL 447.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 548 Petroleum Geology Credits: 4 (3-2-0)**

**Course Description:** Comprehensive treatment of the petroleum system with a focus on hydrocarbon exploration and production data and methods.

**Prerequisite:** GEOL 344 and GEOL 372.

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior standing. Must register for lecture and laboratory. Credit allowed for only one of the following: GEOL 548, GEOL 565, or GEOL 581A6.

**Term Offered:** Fall (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 551 Groundwater Modeling Credits: 3 (3-0-0)**

**Course Description:** Groundwater modeling from a geologic perspective. Conceptual models and computer modeling of groundwater flow and solute transport.

**Prerequisite:** CIVE 423 or GEOL 452.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 552 Advanced Topics in Hydrogeology Credits: Var[2-3] (0-0-0)**

**Course Description:** Current literature, new techniques, legislative and political developments in hydrogeology, and appropriate case histories.

**Prerequisite:** GEOL 452.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 553 Use of Tracers in Hydrogeology Credits: 3 (3-0-0)**

**Course Description:** Use of environmental and applied tracers in hydrogeology to understand groundwater flow and transport properties. Environmental tracers are used to determine groundwater age and recharge rates, ground/water surface water interactions and to estimate the average temperature when the groundwater was recharged. Applied tracers are used to determine flow and transport processes in porous media to understand controls on solute transport, especially related to contaminant movement.

**Prerequisite:** CIVE 423 or GEOL 452.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 554 Remote Sensing of the Earth System Credits: 3 (2-2-0)**

**Course Description:** Introduction to the physics and specific applications of common passive and active remote sensing techniques to study the Earth system. Gain an understanding of how to access, process, analyze and interpret remote sensing observations to answer specific research questions focused on the Earth system.

**Prerequisite:** (GEOL 110 or GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150) and (PH 122 or PH 142).

**Restriction:** Must not be a: Freshman, Sophomore, Junior.

**Registration Information:** Senior geology majors or graduate students.

Must register for lecture and laboratory. Credit not allowed for both GEOL 554 and GEOL 580B2.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 570 Plate Tectonics Credits: 3 (3-0-0)**

**Course Description:** Examination of the historical development of plate tectonic theory and its application to understanding geological processes.

**Prerequisite:** GEOL 364 and GEOL 372 and PH 142.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 571 Tectonic Geomorphology Credits: 3 (3-0-0)**

**Course Description:** Interactions between tectonic, climatic and earth surface processes that give rise to mountainous landscapes. Topics range from landscape response to single earthquake events to geochronological tools used to constrain rates of landscape change to orogen-scale interactions and feedbacks between tectonics and climate through lectures, in-class activities, data analysis, modeling, and reading assignments.

**Prerequisite:** GEOL 372 and GEOL 454, may be taken concurrently and MATH 160.

**Registration Information:** Required field trips. One weekend field trip to study tectonic geomorphology in southern CO is required. Credit not allowed for both GEOL 571 and GEOL 581B1.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 572 Advanced Structural Geology Credits: 4 (3-3-0)**

**Course Description:** Rheology, deformation mechanisms, structural associations and advanced methods of structural analysis.

**Prerequisite:** GEOL 436.

**Registration Information:** Must register for lecture and laboratory. Required field trips. Graduate standing can substitute for prerequisite course.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 574 Geodynamics Credits: 3 (3-0-0)**

**Course Description:** Continuum mechanics applied to understanding of deformation within the earth. Stress and strain as tensors, with application to various geological settings; plate flexure and isostasy; steady state and time dependent heat conduction in a geological context; fluid mechanics of the earth.

**Prerequisite:** GEOL 250 and MATH 261 and PH 141.

**Term Offered:** Spring.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 575 Subsurface Geophysical Mapping Credits: 4 (3-2-0)**

**Course Description:** Advanced techniques for creating subsurface geological maps based on seismic reflection and well log data.

**Prerequisite:** GEOL 344 and GEOL 372 and MATH 161 and PH 142.

**Registration Information:** Must register for lecture and laboratory.

**Term Offered:** Spring (even years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 576 Exploration Seismology Credits: 3 (3-0-0)**

**Course Description:** Seismic exploration methods, including theory, data acquisition, and data processing.

**Prerequisite:** GEOL 344 and GEOL 372 and MATH 161 and PH 142.

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 578 Global Seismology Credits: 4 (3-2-0)**

**Course Description:** Quantitative introduction to seismology; basics of seismic data analysis; fundamentals of wave propagation; earthquakes; structure of the Earth.

**Prerequisite:** PH 142 and MATH 261.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 579 Solid Earth Inverse Methods and Practices Credits: 3 (3-0-0)**

**Course Description:** Inverse and parameter estimation theory and applications in the earth sciences in the context of Frequentist and Bayesian approaches to estimating and interpreting data-driven models. Review of linear algebra, statistical, and other mathematical underpinnings, and of basic MATLAB programming. Linear and nonlinear inverse problems. Nonuniqueness, ill-posedness, rank-deficiency. Regularization methods for geophysical problems.

**Prerequisite:** (MATH 161 or MATH 255) and (MATH 229) and (STAT 301 or STAT 315).

**Term Offered:** Spring (odd years).

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 601 Professional Development for Geoscientists Credit: 1 (0-0-1)**

**Course Description:** The conduct of science, role of scientific publications, publication process, proposal writing, responsible conduct of research, and professional ethics.

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** No.

**GEOL 652 Fluvial Geomorphology Credits: 3 (3-0-0)**

**Course Description:** Geomorphology of channels, slopes, and drainage systems.

**Prerequisite:** GEOL 120.

**Restriction:** Must be a: Graduate, Professional.

**Term Offered:** Fall.

**Grade Modes:** S/U within Student Option, Trad within Student Option.

**Special Course Fee:** Yes.

**GEOL 662 Field Geomorphology Credits: 2 (1-2-0)**

**Course Description:** Field-based geomorphologic analysis of landscape forms and processes. Apply appropriate field techniques to address relevant research hypotheses related to advanced subject matter in geomorphology. Analyze and interpret field-based data, orally present findings in a symposium setting, and discuss and critically evaluate relevant literature.

**Prerequisite:** GEOL 454.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Must register for lecture and laboratory. This is a partial semester course. Required field trips. Credit not allowed for both GEOL 662 and GEOL 680A1.

**Term Offered:** Fall.

**Grade Mode:** Traditional.

**Special Course Fee:** Yes.

**GEOL 684 Supervised College Teaching Credits: Var[1-5] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Registration Information:** Written consent of instructor.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 692 Seminar Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 695 Independent Study Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 696 Group Study Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 698 Research Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 699 Thesis Credits: Var[1-18] (0-0-0)**

**Course Description:**

**Prerequisite:** None.

**Restriction:** Must be a: Graduate, Professional.

**Terms Offered:** Fall, Spring, Summer.

**Grade Mode:** Instructor Option.

**Special Course Fee:** No.

**GEOL 798 Research Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**GEOL 799 Dissertation Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.