

GEOSCIENCE (GEO)

GEO 101N - Introduction to Physical Geology. 3 Credits.

Offered autumn and spring. General geology including the work of wind, flowing water, glacial ice, gravity, earthquakes, volcanoes and plate tectonics in shaping the earth.

Gen Ed Attributes: Natural Science Course (N)

GEO 102N - Introduction to Physical Geology Lab. 1 Credit.

Offered autumn and spring. Prereq. or coreq., GEO 101N. A series of laboratory and field experiences designed around basic geologic processes and materials. Familiarization with common minerals, rocks, land forms, and structures. Intended to provide laboratory experience primarily with GEO 101N, but can be taken with or following any of the other freshman GEO courses listed above. Gen Ed Attributes: Natural Science Lab Course (N)

Gen Ed Attributes: Natural Science Course (N)

GEO 103N - Introduction to Environmental Geology. 3 Credits.

Offered autumn and spring. General principles of environmental geology, including the spatial and temporal frameworks involved, Earth's materials (minerals, rocks, water, air), natural hazards, water and air pollution, energy, water, and soil resources, flooding, coastal erosion, and climate.

Gen Ed Attributes: Natural Science Course (N)

GEO 104N - Introduction to Environmental Geology Laboratory. 1 Credit.

Offered autumn and spring. Prereq. or coreq., GEO 103N. A series of laboratory exercises designed around the investigation of environmental geology problems, including natural hazards, water and air pollution, energy, water, and soil resources, flooding, coastal erosion, and climate.

Gen Ed Attributes: Natural Science Lab Course (N)

Gen Ed Attributes: Natural Science Course (N)

GEO 105N - Oceanography. 3 Credits.

Offered spring. The ocean covers 70 % of the globe, and yet vast regions remain unexplored. Interactions between the atmosphere and the sea moderate and control our climate. Nearly 40 % of the world's population lives within 100 kilometers of the coast. The oceans are geographically, environmentally, culturally, and economically critical to society. This course introduces oceanography, including the origin of water and ocean basins; marine resources; atmospheric circulation; air-sea interaction; ocean-climate feedback; currents, tides, and coastal processes; marine ecology; and use and misuse of the oceans.

Gen Ed Attributes: Natural Science Course (N)

GEO 106N - History of Life. 3 Credits.

Offered spring. The evolution of plants, invertebrates and vertebrate animals, highlighting major events in the evolution of life on Earth. Includes laboratory experience with fossils. Gen Ed Attributes: Natural Science Lab Course (N)

Gen Ed Attributes: Natural Science Course (N)

GEO 107N - Natural Disasters. 3 Credits.

Offered intermittently. This course introduces the scientific context and latest research on natural hazards and disasters, including storms, flood, drought, mass wasting (landslides and avalanches), earthquakes and tsunamis, volcanic eruptions, and wildfires.

Gen Ed Attributes: Natural Science Course (N)

GEO 191 - Special Topics. 1-6 Credits.

(R?6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

GEO 191N - Special Topics. 1-6 Credits.

(R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

GEO 211 - Earth's History and Evolution. 4 Credits.

Offered autumn and spring. Prereq., GEO 101N and GEO 102N or GEO 103N and GEO 104N. Traces the history of the Earth since its inception 4.6 billion years ago. Presents scientific theories for the origin of the Earth and the nature of important earth shaping events of the past, including the development of the oceans, atmosphere, and climate.

GEO 225 - Earth Materials. 4 Credits.

Offered autumn. Prereq., GEO 101N and GEO 102N or GEO 103N and GEO 104N, and CHMY 121N or CHMY 141N. Study of minerals and rocks utilizing an Earth Systems approach; mineral identification and paragenesis; survey of the distribution of minerals from the interior to the surfaces of planets and the processes that led to their formation.

GEO 291 - Special Topics. 1-6 Credits.

(R?6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

GEO 304E - Science and Society. 3 Credits.

Offered autumn. Role of scientific knowledge in human societies from the pre-Classical to the present. Discussion of tools for integrating science into ethical, political, and social decisions, including analyses of modern case studies from physical sciences.

Gen Ed Attributes: Ethical & Human Values Course

GEO 305 - Igneous & Metamorph Petrology. 4 Credits.

Offered spring. Prereq., GEO 225 and CHMY 123N or CHMY 143N. Igneous rock associations, igneous processes and origins; metamorphic minerals and phase relationships, metamorphic zones, facies, and conditions; metamorphic environments, metallic minerals and mineral deposits.

GEO 309 - Sedimentation/Stratigraphy. 4 Credits.

Offered spring. Prereq. GEO 211, 225. Origins of sediments and sedimentary rocks; climate, weathering, and weathering products; transport, deposition, and depositional environments of sediments; concepts and methods of stratigraphy including correlation of sedimentary rocks and an introduction to basin analysis.

GEO 311 - Paleobiology. 3 Credits.

Offered spring. Prereq. GEO 101N or GEO 103N or equivalent level Biology. Survey of the major groups of organisms in the geologic record and hands-on study of fossils; application of geologic and biologic data and principles to solve problems in geoscience and bioscience.

GEO 315 - Structural Geology. 4 Credits.

Offered autumn. Prereq., GEO 211, 225. Structures of deformed rocks; mechanical principles; graphical interpretation of structural problems, tectonic principles.

GEO 317 - Planetary Science. 3 Credits.

Offered autumn even-numbered years. Prereq., PHSX 205N/206N or PHSX 215N/216N and M 162, 171. Same as ASTR 351. Physical and geological characteristics of planets, satellites, asteroids, comets, and meteoroids with an emphasis on comparative planetology.

GEO 318 - Climate System Dynamics. 4 Credits.

Offered spring. Prereq., GEO 101N/102N or GEO 103N/104N, GEO 211, M 122 or M 151. An introduction to the processes driving the Earth's climate system using the laws and principles of physics and focused on energy and heat flow to/from and within the earth system. Individual components of the climate system and their couplings and feedbacks are first examined, followed by an integrated view of variability of earth's energy balance over a range of time scales. The course will combine lectures with data analysis and modeling.

GEO 320 - Global Water. 4 Credits.

Offered autumn. Prereq. one semester of college chemistry, WRIT 101 or equivalent, and one intermediate writing course. Water is necessary for life. Without it, life as we know it cannot exist. This course discusses the chemistry of water as it moves through the hydrological cycle. We discuss how water chemistry evolves through atmospheric water, rain water, ground water, surface water, and sea water. Students will have an understanding of the chemical attributes of water in major water reservoirs. Class discussions, formal and informal writing assignments, a short laboratory experiment, and a field trip highlight examples of water chemistry. Students will use excel to solve problems and will learn citation conventions relevant for scientific writing.

Gen Ed Attributes: Writing Course-Advanced

GEO 327 - Geochemistry. 4 Credits.

Offered alternate years. Prereq. one year of college chemistry, one semester of calculus, and one semester of physical geology, or consent of instructor. One semester of mineralogy recommended. The chemical properties of elements control their geological distribution and underlie the basic physical properties of rocks. An understanding of geochemistry will help students understand water chemistry, sediment geochemistry, and igneous petrology. The course covers chemical principles applied to geologic materials and processes, including the origin and chemical composition of earth, atmosphere, and hydrosphere. Principles of stable and radiogenic isotope geochemistry are discussed. Students will use excel to solve problems. Class discussions, problems sets, and exams are used to assess student performance.

GEO 391 - Special Topics. 1-9 Credits.

(R?9) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

GEO 392 - Independent Study. 1-6 Credits.

(R?6) Offered every term. Specific topics of particular interest to individual students.

GEO 398 - Internship. 1-6 Credits.

Offered every term. Prereq., 12 credits in geosciences. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. No more than 3 credits of GEO 398 may be applied to the geosciences minor. A maximum of 6 credits of Internship may count toward graduation.

GEO 420 - Hydrogeology. 4 Credits.

Offered spring. Prereq., GEO 101N-102N; PHSX 205N/206N or PHSX 215N/216N ; M 162 or 171 strongly recommended or consent of instr. Occurrence, movement, quality, and methods of quantification of groundwater. Geological framework and physics of groundwater flow. Supply, contamination, and management problems.

GEO 421 - Hydrology. 3 Credits.

Offered autumn. Prereq. one semester college calculus and physics or consent of instructor. Introduction to the physical mechanisms that drive the water cycle at different scales. The course covers heat, momentum and mass transfer and storage mechanisms in turbulent systems and their role in the global and local climates. At the local scale, the equations that govern surface and subsurface water flows are studied. Along with the overarching goals, students will improve their quantitative skills, will gain experience accessing and reading the professional literature and will improve their capabilities to acquire knowledge independently.

GEO 433 - Global Tectonics. 3 Credits.

Offered autumn. Prereq., GEO 315, M 162, and 2.25 or better overall GPA in geosciences courses. Geodynamics and tectonics of the Earth and other planets. Course material includes methods of observing tectonic processes and tectonic phenomena, both at the surface and in the deep earth, over a wide range of time scales.

GEO 439 - Geophysics. 3 Credits.

Prereqs., PHSX 207N, PHSX 217N, M 162, and M 171, or consent of instructor. We will explore a variety of fundamental topics in geophysics, including Earth formation, Earth structure, plate tectonics, gravity, seismology, heat flow and magnetics. The course will also cover modern geophysical surveying methods, including reflection seismology, refraction seismology, gravity surveying, and magnetic surveying.

GEO 443 - Principles of Sedimentary Petrology. 4 Credits.

Offered autumn. Prereq., GEO 225 or graduate standing. Field, hand specimen and thin section petrology of siliciclastic and carbonate rocks, emphasis on tectonic and diagenetic interpretation of siliciclastic rock and environments of deposition and diagenesis of carbonate rocks.

GEO 460 - Process Geomorphology. 4 Credits.

Offered autumn. Prereq., one semester college calculus and physics. Quantitative examination of landforms, runoff generation, weathering, mechanics of soil erosion by water and wind, mass wasting, glacial and periglacial processes and hillslope evolution.

GEO 482 - Global Change. 3 Credits.

Offered Spring. Same as CCS 482. Prereq., upper division/higher standing in Geosciences or consent of instructor. Lectures, readings, discussions and practicum on the complexity of global climate. Emphasizes the physical, geochemical and geologic processes affecting climate change over geologic and recent time scales.

GEO 488 - Snow, Ice and Climate. 3 Credits.

Offered spring. Prereq., M 121. Study of basic physical processes occurring in snow and ice, and how these processes govern the interaction between frozen water and the climate system. The first half of the course focuses in snow, with special attention to snow formation in the atmosphere, snow metamorphism, water flow through snow, and basic avalanche mechanics. The second half of the course focuses on ice and includes glacier and ice sheet flow dynamics, glacier hydrology, and ice age theory. Graduate students will be required to complete additional problem sets requiring higher level math; perform additional reading assignments; perform at a higher level on assignments and exams where students are asked to outline and describe various physical processes; submit a well researched and reference research proposal that is able to synthesize previous research and provide a sophisticated research plan.

GEO 491 - Special Topics. 1-8 Credits.

(R-8) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses or one-time offerings of current topics.

GEO 492 - Independent Study. 1-6 Credits.

(R-6) Offered every term. Specific topics of particular interest to individual students.

GEO 494 - Senior Geology Seminar. 1-10 Credits.

(R?10) Offered intermittently. Prereq., upper?division standing in geosciences or consent of instr. Independent study of various topics under the direction of a faculty member.

GEO 498 - Internship. 1-6 Credits.

Offered every term. Prereq., 12 credits in geosciences. Extended classroom experience which provides practical application of classroom learning during placements off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. No more than 3 credits of GEOS 398 may be applied to the geosciences minor. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.

GEO 499 - Senior Thesis /Capstone. 3-10 Credits.

(R?10) Offered every term. Prereq., 18 credits in geosciences, WRIT 101 or equivalent, and one intermediate writing course. Independent research project in any geosciences topic supervised by faculty member, and leading to completion of baccalaureate degree.
Gen Ed Attributes: Writing Course-Advanced

GEO 508 - Fundamentals of Academic Research. 2 Credits.

Offered autumn. Prereq., graduate standing. An introduction to research methods and tools in the academic setting intended for first semester graduate students in geosciences. Topics include proposal writing, presenting research results in oral and written formats, using computer tools for research in the geosciences, and ongoing research of department faculty. Level: Graduate

GEO 528 - Sedimentary Basin Analysis. 4 Credits.

Offered intermittently. Influence of allocyclic processes (tectonism, climate, eustacy, etc.) in shaping the evolution of sedimentary basins. Emphasis on integration and synthesis of tools of sedimentary basins analysis, including the study of depositional systems, provenance, paleocurrents, subsidence, sequence stratigraphy, and well logs. Level: Graduate

GEO 540 - The Food-Energy-Water Nexus. 3 Credits.

Offered autumn. Same as NRSM 540. Interdisciplinary course examining interactions between food, energy, and water systems and core concepts and tools at the food-energy-water nexus. Perspectives and connections across scales, sectors, and disciplines (including social and biophysical sciences and engineering) are emphasized. Level: Graduate

GEO 541 - Food-Energy-Water Nexus Field Lab. 2 Credits.

(R-4) Offered spring. Same as NRSM 541. Field-based course connecting theory and practice by examining food-energy-water case studies, conducting interdisciplinary synthesis, and communicating with diverse stakeholders. Combines intermittent in-class meetings and a week-long field trip to regional sites to examine food-energy-water issues on-the-ground and to meet with and learn from producers, managers, policy-makers, and tribal members.

GEO 542 - Food-Energy-Water Seminar. 1 Credit.

(R-4) Offered autumn and spring. Same as NRSM 542. Autumn seminars will focus on building interdisciplinary knowledge of the food-energy-water nexus through presentations from guest speakers, readings, and domestic and international case studies. Spring seminars will focus on building skills for multiple career paths through presentations and guest lectures.

GEO 546 - Seismology and Geodesy. 3 Credits.

Offered Spring. Prereq., PHSX 207N or PHSX 217N or equivalent, M 263 or M 172 or equivalent, and GEO 439 or equivalent, or consent of instructor. We will explore modern topics in geophysics, with a focus on seismology and geodesy. Advanced topics may vary with each offering, but will generally include selections from continuum mechanics, inverse theory, seismic wave propagation, earthquake location, tidal analysis and prediction, GNSS theory and analysis, spheroidal Earth deformation, and surface mass loading. Students will have the opportunity to engage directly with real seismic and geodetic datasets using computational tools, as well as to investigate problems of personal interest through individual research projects. Level: Graduate

GEO 548 - Topics in Cryosphere. 3 Credits.

(R?6 M.S., R?12 Ph.D.) Prereq., graduate standing or consent of instructor. Readings, discussions, lectures, and field experiments on various topics related to snow, ice, and climate processes. Recent topics: meltwater infiltration in snow, glacier hydrology, climate cycles, ice, and sea level rise. Level: Graduate

GEO 560 - Fluvial Geomorphology. 3 Credits.

Offered spring. Prereq., graduate standing or consent of instructor. Application of fluid mechanics to sediment transport and development of river morphology. Form and process in river meanders, the pool?riffle sequence, aggradation, grade, and baselevel. Level: Graduate

GEO 572 - Advanced Hydrogeology. 3 Credits.

Offered autumn. Prereq., GEO 420 or consent of instr. Advanced concepts used in groundwater investigations, including flow systems analysis, hydrogeologic monitoring and sampling, resource evaluation, exploration, development and monitoring, and contaminant transport. Special problem areas in groundwater exploration and management. Level: Graduate

GEO 579 - Chemistry of Hot Springs. 3 Credits.

Offered alternate years. Prereq., one year of college of chemistry or consent of instr. Hydrothermal systems support the most ancient microorganisms and may have been the locus for the first appearance of life on Earth. Terrestrial hot springs are the surface expression of deep circulation of fluids that concentrate elements, opening a window into processes leading to ore formation. This course discusses the chemistry and geology of hydrothermal systems including solute/gas geothermometry, acid/base reactions, oxidation/reduction reactions, mineral equilibrium, and microbial ecology as applied to terrestrial and submarine hydrothermal systems. The course includes an introduction to the use of geochemical models and a field trip to a hot spring system. Students are evaluated on class discussions and presentations, problems sets, and a term paper. Level: Graduate

GEO 582 - Tps Structure & Geophysics. 1-12 Credits.

(R?6 for M.S., R?12 for Ph.D.) Prereq., consent of instr. Offerings on request of graduate students by arrangement with appropriate faculty. Recent topics: structural analysis, Precambrian crustal evolution, field trips on Rocky Mountain structure. Level: Graduate

GEO 583 - Tps Strat, Sed & Paleo. 1-12 Credits.

(R?6 for M.S., R?12 for Ph.D.) Prereq., consent of instr. Offerings on request of graduate students by arrangement with appropriate faculty. Recent topics: evolution of life; Proterozoic stratigraphy; reefs through time. Level: Graduate

GEO 585 - Tps Hydro Low-Temp Geochem. 1-12 Credits.

(R?6 for M.S., R?12 for Ph.D.) Prereq., consent of instr. Offerings on request of graduate students by arrangement with appropriate faculty. Recent topics: field methods, well design, contaminant transport, geochemical modeling. Level: Graduate

GEO 590 - Supervised Internship. 1-12 Credits.

Offered intermittently. Directed individual research and study appropriate to the background and objectives of the student. Level: Graduate

GEO 595 - Special Topics. 1-8 Credits.

(R?8) Offered intermittently. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics. Level: Graduate

GEO 597 - Advanced Problems. 1-10 Credits.

(R?10) Offered intermittently. Prereq., consent of instr. Investigations of geological problems exclusive of thesis or dissertation research. Level: Graduate

GEO 599 - Thesis Research. 1-12 Credits.

(R?6) Offered every term. Prereq., thesis proposal approval. Directed research to serve as thesis for the master degree. Credit assigned upon submittal of final copy of approved and bound thesis. Level: Graduate

GEO 699 - Dissertation Research. 1-12 Credits.

(R?12) Offered every term. Prereq., dissertation proposal approval. Directed research to serve as dissertation for the Ph.D. degree. Credit assigned upon submittal of final copy of approved and bound dissertation. Level: Graduate