GEO - Geology

GEO 103CS Intro to Envrmntl Geology: 4 Credits (3 Lec, 2 Lab)
Application of geologic principles to topical problems in environmental and resource geology. Topics include analysis of environmental issues such as earthquake disaster preparedness, landslides, land use, floods and human occupation, ground water withdrawal and contamination issues, volcanic and coastal hazards, and the response of landscapes and people to resource development (minerals/air/water/energy). Laboratories will be used to analyze and debate data relevant to environmental problems from a geologic perspective.

GEO 105IN Oceanography: 3 Credits (3 Lec)
Introduction to the formation, distribution, history, and resources of the oceans of the world. Emphasis is on the geologic, physical, chemical and biological processes operating in the ocean system, distribution of life in marine ecosystems, effects of human activity on ocean resources and the interdisciplinary perspective necessary to understand ocean dynamics.

GEO 111IN Dinosaurs: 3 Credits (3 Lec)
() Offered on demand. This course provides an introduction to dinosaur paleontology. Students will learn how hypotheses about extinct animals are formulated and tested, with comparisons to modern sedimentary environments and living animals. Recitation sections allow discussion of current research and hands-on experience with sedimentary rocks and fossils. Field trips provide additional education opportunities.

GEO 140IN Planetary Geoscience: 3 Credits (3 Lec)
() Offered on demand. Introduction to the formation, geochemical development, interior and surficial processes, and exobiology of the planets, moons, and other objects of our solar system, as well as known exoplanets. Observations and data relative to planetary interiors, surfaces, and atmospheres, using principles derived from integration of chemical, physical, geologic, biologic, and engineering sciences are addressed.

GEO 211 Earth History and Evolution: 3 Credits (3 Lec)
PREREQUISITE: ERTH 101IN or ERTH 201IN. (Sp) Evolution of the earth and its life from origin to present configuration. Role of plate tectonic processes in the geologic development of the continents and ocean basins. Major evolutionary developments and crises in the history of life

GEO 290R Undergraduate Research: 1-6 Credits (1-6 Other)
PREREQUISITE: Consent of instructor. Directed undergraduate research which may culminate in a written work or other creative project. Course will address responsible conduct of research. May be repeated
Repeatable up to 99 credits.

GEO 291 Special Topics: 1-4 Credits (1-4 Lec)
PREREQUISITE: None required but some may be determined necessary by each offering department. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number
Repeatable up to 12 credits.

GEO 302 Mineralogy and Optical Mineral: 4 Credits (2 Lec, 2 Lab)
PREREQUISITE: ERTH 101IN or ERTH 201IN, CHMY 143
COREQUISITE: CHMY 143. (F) Identification, properties, occurrence, and associations of the rock-forming minerals; introduction to crystallography (crystal classes, lattice types, and external morphology) and crystal chemistry (bonding and crystal structure types); analytical techniques including mineral optics, x-ray, and SEM analysis. Laboratory fee included
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GEO 305 Igneous & Metamorphic Petrology: 4 Credits (2 Lec, 2 Lab)
PREREQUISITE: GEO 302. (Sp) Introduction to the principles of metamorphic petrology; metamorphic facies, reactions, phase equilibria, processes, petrographic analysis, deformation, and interpretation of metamorphism in the context of global tectonics. Introduction to the distribution, mineral associations, and chemical compositions of igneous rocks in the earth's crust and upper mantle. Emphasis is on the use of petrographic features and chemistry to identify igneous rocks and interpret rock-forming processes

GEO 309 Sedimentation and Stratigraphy: 4 Credits (3 Lec, 1 Lab)
PREREQUISITE: GEO 211 and M 172. (F) Physical, chemical, and biological processes and their effects on sediment dispersal, deposition, and diagenesis. Geometry and lateral and vertical relationships between sedimentary rock bodies. Labs emphasize the description and analysis of sedimentary rock bodies. -

GEO 310 Invertebrate Paleontology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 211. () Offered Spring, even years. Investigation of invertebrate organisms and their evolution through time as preserved in the sedimentary rock record. Emphasis is on the morphology, paleoecology, evolution, and stratigraphic and environmental significance of important fossil groups. Labs stress fossil recognition

GEO 312 Dinosaur Paleontology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 211 and BIOB 170IN. Dinosaur Paleontology covers the origin, evolution and extinction of dinosaurs. Topics of special emphasis include phylogeny, the origin of birds, and functional adaptations. Labs examine dinosaur skeletons, their novel adaptations and role in developing evolutionary trees

GEO 315 Structural Geology: 4 Credits (3 Lec, 1 Lab)
PREREQUISITE: GEO 211. (Sp) Geometry, kinematics, and dynamics of natural rock deformation. Laboratory will focus on analytical and graphical techniques of modern structural analysis. Field trip fee required

GEO 330 Paleontology Lab Techniques: 2 Credits (1 Lec, 1 Lab)
PREREQUISITE: GEO 211. () Offered Fall, odd years. Provides laboratory and research experience in vertebrate paleontology, including: training in fossil preparation, identification of osteological specimens, documentation (photographic and scientific illustration), molding and casting, specimen curation, and other skills necessary for professional presentation of research

GEO 411 Vertebrate Paleontology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 211, and BIOB 170IN. () Offered on demand. This course traces the history of vertebrates from the earliest chordates to synapsids, dinosaurs, and hominids. Lectures and labs emphasize phylogeny, anatomy, novel adaptations, and major evolutionary events such as the conquest of land, flight, and mass extinctions

GEO 413 Macroevolution/Fossil Record: 3 Credits (3 Lec)
PREREQUISITE: GEO 310 or GEO 312 or BIOB 375. Macroevolution explores major trends in evolution through geologic time. The course examines such topics as whether communities evolve, cladogenesis, mass extinctions, rates of speciation and extinction, controls of biodiversity, and the role of sex and body size in evolution

GEO 417 Taphonomy: Fossil Preservation: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 309 and GEO 211. () Offered Fall, even years. Scattered dinosaur bones lie entombed in a rock; what do they mean? Taphonomy examines the processes that act on an organism from the time of its death until its discovery and how these processes bias or help in fossil interpretation. Co-convened with GEO 517

GEO 419 Field Paleontology: 2 Credits (2 Lab)
PREREQUISITE: GEO 302. () Offered Summer, even years. This two-week class provides field experience in vertebrate paleontology, including sedimentology, facies analysis, measuring stratigraphic sections, microsite screening, field identification of vertebrate and invertebrate fossils, excavation of fossil specimens, and taphonomic data collecting

GEO 420 Hydrogeology: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: Junior standing, M 161Q or M 172Q; CHMY 143, PHSX 205 or PHSX 220, ERTH 101IN. The relationship between ground-water and other parts of the hydrologic cycle: ground-water availability, movement, chemistry, exploration, geology, and aquifer tests. The ground-water resource in terms of regional supply and human use and intervention

GEO 428 Field Methods: 3 Credits (3 Lec)
PREREQUISITE: GEO 211 and GPHY 284; Student must have received a minimum grade of "C-" in these courses. (Sp) Extensive hiking and outdoor physical challenges require that students be physically fit, responsible, and concerned for their own safety and the safety of others around them. A fee for supplies, transportation, and other logistical expenses may be required. The goal of this course is to introduce the techniques that will allow you to develop basic field geology skills, and provide a foundation for future fieldwork in other Earth Sciences classes, graduate school, and/or careers in the geosciences. In particular, this course will serve as preparation for Geology Field Camp, a capstone course for Earth Science students pursuing the Geology and Paleontology options. The course will involve a mixture of background information delivered through lectures, in-class activities to cement key concepts and train specific techniques, and on- and off-campus field trips

GEO 429R Field Geology: 3 Credits (3 Lab)
PREREQUISITE: GEO 211, GEO 302, GEO 309, GEO 315, and GEO 428; must receive a minimum grade of "C" in these courses. (Su) A capstone course for the geology and paleontology options. Summer field course with application of field procedures and mapping techniques to a variety of geologic problems and exercises. Students will study a range of rock types, sedimentary depositional environments, and structural deformation styles in order to learn the geological and tectonic history of the western North America Cordillera. Extensive hiking and outdoor physical challenges require that students be physically fit. A fee for supplies, transportation, and other logistical expenses is required

GEO 433 Tectonics: 3 Credits (3 Lec)
PREREQUISITE: GEO 315. (F) History of tectonic theory; modern view of plate tectonic processes; Precambrian tectonics; case studies of Phanerozoic orogenic belts; neotectonics; geophysics. Co-convened with GEO 533

GEO 439 Geophysics: 3 Credits (3 Lec)
PREREQUISITE: GEO 211, GEO 302, M 171Q, PHSX 207. Seismology, gravity, isostasy, magnetism and paleomagnetism, electrical methods, radioactivity, geothermics, applied geophysics

GEO 440 Volcanology: 3 Credits (3 Lec)
PREREQUISITE: GEO 302 and GEO 305. () Offered Fall, odd years. Overview of current ideas concerning volcanic eruptions and their resulting deposits, concentrating on examination of processes as elucidated from the study of modern volcanic environments. Required weekend field trip and field trip fee

GEO 443 Principles of Sedimentary Petrology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 302 and GEO 309. (Sp) Detailed analysis and interpretation of the mineralogy, fabric, and genesis of terrigenous clastic and carbonate sedimentary rocks. Use of thin-section microscopy, the scanning electron microscope, and x-ray diffraction techniques are emphasized in the laboratory. Co-convened with GEO 543

GEO 445 Glacial Geology: 3 Credits (3 Lec)
PREREQUISITE: ERTH 307. (F) In-depth study of the processes of glaciation and the resulting land forms. Includes class and library readings, and field examination of features of mountain glaciations

GEO 471 Geochronology and Thermochronology: 3 Credits (3 Lec)
PREREQUISITE: GEO 309, GEO 302, GEO 315, GPHY 284; students must have received a minimum grade of "C-" in these courses. () Offered Spring, odd years. This course will familiarize students with principles of geochronology and thermochronology and applications in Earth and planetary sciences. Topics will include radioactive decay and growth, long- and short-lived radioisotope systems, analytical methods, determining dates and rates of a wide variety processes, and the use of radiogenic isotopes as tracers in Earth and planetary processes. Emphasis will be on fundamentals and systematics of different systems, historical perspectives, analytical methods, data acquisition and applications from recent literature. This course is co-convened with GEO 571

GEO 490R Undergraduate Research: 1-6 Credits (1 Other)
PREREQUISITE: Consent of instructor. (F, Sp, Su) Directed undergraduate research which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. May be repeated
Repeatable up to 12 credits.

GEO 491 Special Topics: 1-4 Credits (1-4 Lec)
PREREQUISITE: Course prerequisites as determined for each offering. Offered on demand. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand. Co-convened with GEO 591
Repeatable up to 12 credits.

GEO 492 Independent Study: 1-3 Credits (1 Other)
PREREQUISITE: Junior standing, consent of instructor, and approval of department head. (F, Sp, Su) Directed research and study on an individual basis
Repeatable up to 6 credits.

GEO 494 Senior Geology Seminar: 1 Credits (1 Other)
PREREQUISITE: Junior standing and as determined for each offering. Topics at the upper division level not covered in regular courses. Students participate in preparing and presenting discussion material
Repeatable up to 4 credits.

GEO 497 Geology Instruction: 1-2 Credits (2-4 Lab)
PREREQUISITE: Junior or senior standing in geology and consent of instructor and Department Head. (F, Sp) Student works as a tutor and undergraduate teaching assistant in a teaching laboratory under close academic supervision. Weekly meeting focuses on geology, teaching, organization of class materials, and student supervision. Weekly lab emphasis on applying active learning concepts in a geologic laboratory context
Repeatable up to 3 credits.

GEO 498 Internship: 2-12 Credits (2 Other)
PREREQUISITE: Junior standing, consent of instructor, and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field
Repeatable up to 12 credits.

GEO 499 Senior Thesis/Capstone: 3 Credits (3 Lec)
PREREQUISITE: Senior standing; minimum 3.0 cum gpa; faculty recommendation. (F, Sp) Senior thesis provides an opportunity to conduct research under the supervision of a faculty member leading to the production of a research paper ("mini-thesis") and an oral presentation to the department or at a professional meeting. Excellent preparation for graduate school and professional work

GEO 508 Depositional Systems: 3 Credits (3 Other)
PREREQUISITE: GEO 309. () Offered on demand. Facies models for terrestrial and marine depositional environments and their application to interpreting the stratigraphic record

GEO 509 Montana Geology: 2 Credits (1 Lec, 1 Other)
PREREQUISITE: Graduate Standing. () Offered on demand. This course is designed to be rigorous overview of Montana's geologic history form the oldest rocks (Archean in the Beartooth Mountains) to the most recent seismic events. As such, it will also serve as a thorough review of many aspects of undergraduate geology, thus helping to prepare new graduate students for their oral comprehensive exams. Readings will be based on the technical literature, such as articles from refereed journals, advanced topical books and special publications of the Geological Society of America, etc

GEO 515 Structural Geology: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: GEO 315 or equivalent. (F) Advanced topics in structural geology and structural analysis; topics may vary with each offering; class research project is required. Field trip fee required

GEO 517 Taphonomy: 3 Credits (2 Lec, 1 Other)
PREREQUISITE: Graduate standing and GEO 448 or GEO 309 and GEO 310 or GEO 312 or GEO 411 or their equivalents. () Offered Fall, even years. Before one can ask questions about a fossil organism's anatomy, paleoecology or evolution, one must clearly understand its geologic context. Taphonomy investigates the death to discovery history of fossils and the biases created by post-mortem processes to the fossil record. Co-convened with GEO 417

GEO 521 Dinosaur Paleontology: 2 Credits (1 Lec, 1 Lab)
(Su) This course is an introduction to Dinosaur Paleontology and Hell Creek Formation of Eastern Montana. It will provide information and hands-on experience in field techniques used in vertebrate paleontology, including interpretation of sedimentary environments and taphonomy. Offered Summer.

GEO 522 Dino Paleontology II: 2 Credits (1 Lec, 1 Lab)
PREREQUISITE: GEO 521. (Su) Offered Summer of even years. This course builds on experience and field techniques acquired from GEO 521 through hands-on participation in on-going paleontology research. Students acquire greater understanding of field data collection and formulation and testing of hypotheses and advanced knowledge of paleoenvironments and geological processes. Offered Summer

GEO 530 Tectonics of Sedimentary Basin: 3 Credits (3 Lec)
PREREQUISITE: Graduate Standing. () Offered Spring of even years. This course examines the plate tectonic setting and controls on development of modern and ancient sedimentary basins. Includes investigation of sediment provenance, facies patterns, methods of basin analysis, and subsidence history

GEO 533 Graduate Tectonics: 3 Credits (3 Lec)
PREREQUISITE: GEO 315. (F) History of tectonic theory; modern view of plate tectonics processes; Precambrian tectonics; case studies of Phanerozoic orogenic belts; neotectonic; geophysics. Graduate students will be required to write an in-depth research paper on a topic chosen in consultation with the instructor. Co-convened with GEO 433

GEO 540 Volcanology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 208IN, GEO 302, and GEO 450. () Offered Fall, odd years. Understand processes by which magma and associated gases rise into the crust and are extruded onto the Earth's surface and atmosphere, interpret the forms of volcanoes and their magmatic products, and provide the necessary background to perform research in volcanology

GEO 543 Graduate Sedimentary Petrology: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: GEO 302. (Sp) Detailed analysis and interpretation of the mineralogy, fabric, and genesis of terrigenous clastic and carbonate sedimentary rocks. Use of thin-section microscopy, the scanning electron microscope, and x-ray diffraction techniques are emphasized in the laboratory. Co-convened with GEO 448

GEO 550 Graduate Igneous Petrology: 3 Credits (3 Lec)
PREREQUISITE: GEO 302, GEO 305. () Offered Fall, even years. Deepening understanding on the application and formation of igneous minerals, including mineral stability, chemical construction, and common ways these minerals are used to interpret igneous processes. Emphasis on the distribution, mineral associations, and chemical compositions of igneous minerals

GEO 571 Geochronology and Thermochronology: 3 Credits (3 Lec)
PREREQUISITE: Graduate Standing, Consent of Instructor
COREQUISITE: GEO 315. () Offered Spring, odd years. This course will familiarize students with principles of geochronology and thermochronology and applications in Earth and planetary sciences. Topics will include radioactive decay and growth, long- and short-lived radioisotope systems, analytical methods, determining dates and rates of a wide variety processes, and the use of radiogenic isotopes as tracers in Earth and planetary processes. Emphasis will be on fundamentals and systematics of different systems, historical perspectives, analytical methods, data acquisition and applications from recent literature. Co-convened with GEO 471
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GEO 575 Professional Paper: 1-6 Credits (1 Other)
PREREQUISITES: Consent of Instructor
A research or professional paper or project dealing with a topic in the field. The topic must have been mutually agreed upon by the student and his or her major advisor and graduate committee.
Dept of Earth Sciences.
Repeatable up to 6 credits.

GEO 583 Applied Geological Hydrology: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: Graduate standing or GEO 420. Application of ground-water principles to ground-water resource, contamination and remediation problems

GEO 585 Mineralogy for Science Teachers: 1 Credits (1 Other)
(Su) This course covers fundamental chemical concepts used in mineralogy, including (but not limited to): a) Crystallography and crystal chemistry b) Physical properties of minerals as related to their crystal structures and chemistry c) Anion classification and naming of minerals d) Gemstones versus everyday minerals (i.e., what makes a gemstone special?) e) Identification of minerals in hand specimen (lab work) f) Identification of minerals in rocks (lab work) g) Brief introduction to thin-section analysis and various analytical techniques of mineral analysis. Offered Summer.

GEO 591 Special Topics: 1-4 Credits (1-4 Other)
PREREQUISITE: Upper division courses and others as determined for each offering. Offered on demand. Courses not required in any curriculum for which there is a particular one time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number. Co-convened with GEO 491
Repeatable up to 12 credits.

GEO 592 Independent Study: 1-4 Credits (1-4 Other)
PREREQUISITE: Graduate standing, consent of instructor, approval of Department Head and Dean of Graduate Studies. (F, Sp, Su) Directed research and study on an individual basis
Repeatable up to 6 credits.

GEO 594 Seminar: 1 Credits (1 Other)
PREREQUISITE: Graduate standing or seniors by petition. (F, Sp) Course prerequisites as determined for each offering. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing and presenting discussion material

GEO 598 Internship: 2-12 Credits (2 Other)
PREREQUISITE: Graduate standing, consent of instructor and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field
Repeatable up to 12 credits.