EARTH SCIENCES (ERTH)

ERTH 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 (ERTH 1030) is recommended. Formerly GEOL 1010. Degree credit not granted for this class and ERTH 1012.
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

ERTH 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 ERTH 1010, but taught at a higher intellectual level with a greater amount of quantitative analysis. Separate lab (ERTH 1030) is recommended. Formerly GEOL 1012.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 1012
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 1020.
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

ERTH 1030 (1) Introduction to Earth Science 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 ERTH 1010 or ERTH 1012. Formerly GEOL 1030.
Recommended: Requisite Concurrent registration in any 1000-level Earth Science 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 Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab
MAPS Course: Natural Science Lab or Lab/Lec

ERTH 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. Formerly GEOL 1040.
Additional Information: Arts Sci Core Curr: Natural Science Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

ERTH 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. Formerly GEOL 1060.
Additional Information: 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

ERTH 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. Formerly GEOL 1150.
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

ERTH 1160 (3) Environmental Geoscience: Where Science Meets Society
This is an introductory-level course designed primarily for freshmen non-science majors. The course targets four main questions at the intersection of geoscience and society. (1) What is science and how is it useful to me? (2) How do Earth processes, particularly natural disasters, impact people? (3) How does the Earth, particularly its natural resources, allow people to live the way we do? (4) How do people impact the environment? The course is designed to not only support students in learning about how science and society intersect in the realm of environmental geoscience, it is also designed to support students¿ development of academic-success and career-ready skills including goal setting, time management, communication, collaboration and teamwork, and more. Formerly GEOL 1160.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 1170.
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: EBIO 1180
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
MAPS Course: Natural Science

ERTH 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 Earth Science major, introduces students to the major concepts in contemporary Earth system science. Formerly GEOL 2001.
Requisites: Requires prerequisite course of ERTH 1010 or ERTH 1012 or ERTH 1020 or ERTH 1040 or ERTH 1060 or ERTH 1150 or ERTH 1170 or ERTH 1180 or ERTH 2100 or ENVS 1000 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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 Earth Science major. Formerly GEOL 2005.
Requisites: Requires prerequisite courses of (ERTH 1010 or ERTH 1012 or ERTH 1020 or ERTH 1040 or ERTH 1060 or ERTH 1150 or ERTH 1170 or ERTH 1180 or ERTH 2100) and CHEM 1113 and CHEM 1114 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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

ERTH 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. Formerly GEOL 2100.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 2110 (4) Physical Science of the Earth System
Covers basic concepts of physics and chemistry, taught in the context of Earth and space science. Small class size and emphasis on student investigations, lab and field work, and active learning make this course particularly appropriate for future K–6 teachers. Students should have completed two high school science courses (college prep level) in order to take this class. Formerly GEOL 2110.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Core Curr: Natural Science Lab

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

ERTH 3005 (3) Mesozoic Monsters: Dinosaurs, Pterosaurs, and Sea Lizards
Origin and evolution of the reptiles that lived during the Mesozoic Era, including dinosaurs, pterosaurs, mosasaurs, and plesiosaurs. Course will focus on evolution, paleobiology, paleoecology, and extinction of these extraordinary animals, and a history of their discoveries. The course also introduces students to the scientific method and how hypotheses in paleontology are formulated and tested. Formerly GEOL 3005.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3010.
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 and ERTH 2005 and MATH 1300 or APPM 1350 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 3020 (4) 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. Formerly GEOL 3020.
Requisites: Requires prerequisite course of ERTH 2005 or ERTH 3010 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 3023 (4) Statistics and Geographic Data
Learn how to use computational and statistical tools to solve problems in the geographic domain and apply introductory statistical concepts to real world problems through lab exercises. Using spatial data you will be trained in powerful specialized descriptive and predictive analysis technique. You will explore 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 Arts Sci Gen Ed: Quantitative Reasoning Math

ERTH 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. Formerly GEOL 3030.
Requisites: Requires prerequisite courses of any 1000-level ERTH lecture course (ERTH 1010, 1012, 1020, 1040, 1060, 1150, 1170, or 1180), ERTH 2001, and (MATH 1300 or APPM 1350) (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3040.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 3050 (3) 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. Formerly GEOL 3050.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 3060 (3) Geology of U.S. National Parks
Reviews the geologic history and evolution of the U.S. national parks. Surveys the regional geology of the U.S., and then the details of each park based on its geologic occurrence and geographic setting. The course is designed for non-majors who enjoy understanding the origins and the beauty of our national parks. Formerly GEOL 3060.
Requisites: Requires prerequisite course of ERTH 1010 or ERTH 1012 (min grade C-).

ERTH 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 ERTH course or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3090.
Requisites: Two of the following: ERTH 2001 or ERTH 2005 or ERTH 2700 or ERTH 3010 or ERTH 3030 or ERTH 3120 or ERTH 3320 or ERTH 3430 or ERTH 3820 (minimum grade C-).
Additional Information: Arts Sci Core Curr: Written Communication
Arts Sci Gen Ed: Written Communication-Upper

ERTH 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). Formerly GEOL 3120.
Requisites: Requires prerequisite courses of ERTH 2001 and ERTH 2005 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 3181 (4) Microbial Planet Laboratory
Provides beginner friendly lab & research experience working on a microbiology project. The course teaches how to conduct original scientific research from hypothesis to experimentation, evaluation and reporting. Students study non-pathogenic microorganisms they isolate themselves from nature as part of the course. Hands-on topics covered in class include how to isolate & culture new microbes; how to observe, describe and classify them; and how to examine their metabolic capabilities such as the production of antibiotics.
Equivalent - Duplicate Degree Credit Not Granted: MCDB 3181
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 or CHEM 1400 and CHEM 1401 (all minimum grade C-).
Recommended: Prerequisite ERTH 1180 or MCDB 1150 or EBIO 1210.

ERTH 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

ERTH 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. Formerly GEOL 3320.
Requisites: Requires prerequisite courses of CHEM 1113, CHEM 1114, ERTH 2001, and (MATH 1300 or APPM 1350). All minimum grade C-.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3320 and GEOL 4130.
Requisites: Requires prerequisite courses of MATH 1300 or APPM 1350 and PHYS 1110 or PHYS 1115 and ERTH 2001 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 3400 (4) Evolution of Continental Ecosystems
Enquiry into the evolution of important ecosystems of the past and present. Biological and geological data for reconstructing ecosystems discussed in detail and applied to creating scenarios of past ecosystems. Emphasizes vertebrates and their structure. Formerly GEOL 3400.

ERTH 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. Formerly GEOL 3410.
Requisites: Requires prerequisites of one of the following: ERTH 1010, ERTH 1012, ERTH 1020, ERTH 1040, ERTH 2001, ERTH 2005, EBIO 1100, EBIO 1210, EBIO 1220, or EBIO 1250 (min grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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. Formerly GEOL 3430.
Requisites: Requires prerequisite courses of ERTH 2001 and ERTH 2005 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 3500 (3) Earth Resources and the Environment
Examines Earth's most important natural resources and their impact on society and the environment. Addresses the geology, occurrence, production, and use of petroleum, coal, mineral, and water resources. Future world energy supply and demand, conservation, and the transition from fossil fuels to non-polluting renewable resources are discussed. Formerly GEOL 3500.
Requisites: Requires prerequisite course of ERTH 1010 or ERTH 1040 or ERTH 1060 (minimum grade C-).
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ERTH 3520 (3) Energy and Climate Change: An Interdisciplinary Approach
Ever think about what keeps the lights on, and what it costs the planet? This course explores the resources we depend on, how we use them, and the impacts they have on climate, policy, and the economy. Since fossil fuels are still the biggest player, we¿ll take a close look at their role in climate change and the carbon cycle. We¿ll connect science to real-world challenges, like making ethical choices and protecting the environment, and you¿ll understand why energy knowledge matters in your own future career. The class is designed to be flexible and supportive, so that it is both manageable and rewarding.
Equivalent - Duplicate Degree Credit Not Granted: ENVS 3520
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3540.
Requisites: Requires prerequisite courses of ERTH 2001 and ERTH 2005 (minimum grade C-).
Recommended: Corequisite ERTH 3430.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 3600 (3) Introduction to Python Programming for Earth Scientists
Introduces students to scientific computing and computer programming using the Python language. Emphasis is on scientific applications such as data input and analysis, plotting, and simulation. Examples are drawn from earth and environmental sciences. Course covers variables, operations, data types, conditionals, loops, data structures, array calculations, and libraries for data analysis and plotting. Coursework is primarily based on weekly programming assignments. Formerly GEOL 3600.
Requisites: Requires prerequisite course of ERTH 2001 (minimum grade C-).
Recommended: Prerequisite Introductory course in ERTH, ENVS, GEOG, ATOC, or EVEN.

ERTH 3630 (3) Great Geological Controversies
Significant Historical and Contemporary Controversial Issues in the Geological Sciences (E.G. AGE OF THE Earth, Ice Ages, Continental Drift, Health Hazards Related to Rocks and Minerals) Are Critically Examined By Means of Reading, Classroom Discussion and Argument, and Written Assignments. Formerly GEOL 3630.

ERTH 3700 (2) Geology of the Front Range
Field-oriented approach to tracing the geologic development of the Colorado Front Range, from the Precambrian to recent times. Field observations provide a framework for discussions of current ideas concerning the geologic evolution of the Front Range. Formerly GEOL 3700.
Recommended: Prerequisite 1000-level ERTH course.

ERTH 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. Formerly GEOL 3720.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 3820.
Requisites: Requires prerequisites of ERTH 2001 and (MATH 1300 or (APPM 1340 and APPM 1345) or APPM 1350) (all minimum grade of C-).
Recommended: Prerequisites Any 1000-level ERTH class and PHYS 1110.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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. Formerly GEOL 3910.

ERTH 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. Formerly GEOL 3950.
Recommended: Prerequisite one year of science.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4001 (1) Earth Science Majors Research Seminar
Reading and discussion seminar to enhance students¿ critical evaluation of research design, assumptions, and presentation of results in the geosciences. Readings will focus on the events involved in the geologic evolution of the American West and its timing. Papers read will employ a variety of geologic and geophysical techniques. Geared towards students completing independent research and interested in pursuing a research-focused career. Development of career/graduate school plan and application materials is covered. Formerly GEOL 4001.
Repeatable: Repeatable for up to 4.00 total credit hours.
Requisites: Requires Prerequisites of ERTH 2005 or ERTH 2001 (all minimum grade C-). Restricted to Earth Science majors only.
Recommended: Prerequisite or corequisite ERTH 2700.

ERTH 4020 (3) Marine Geology
Studies the Geology and Geophysics of the Ocean Basins and Marginal Seas, Including Discussions of Plate Tectonics and History of the Ocean Basins, the Formation of Ocean Crust, the Development of Active and Passive Continental Margins, and Interpretation of the Distribution of Ocean Sediments. Formerly GEOL 4020.

ERTH 4021 (4) Petrology: Evolution of Crustal and Mantle Rocks
Origin, physical, and chemical properties of igneous and metamorphic rocks. This course develops a thermodynamic framework for the interpretation of geologic processes from observed mineral assemblages and rock textures. Laboratory component emphasizes the study of rocks in thin section and hand samples to understand earth processes in the mantle and crust.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5021
Requisites: Requires prerequisite courses of CHEM 1113 and CHEM 1114 and ERTH 2005 and (MATH 1300 or APPM 1350) (all minimum grade C-).
Recommended: Prerequisites ERTH 2001 and ERTH 2700.
Grading Basis: Letter Grade

ERTH 4023 (3) Statistics for Earth Science
Introduction to Parametric and Distribution-Free Statistics Emphasizing Applications to Earth Science Problems. Formerly GEOL 4023.

ERTH 4030 (3) Coastal Processes
Course Will Cover the Physical Processes That Work to Shape the Sedimentary Deposits Located in Various Coastal Environments: Estuaries, Deltas, Fjords, Barrier Islands, Beaches and Lagoons, Glacier Coastal Settings, Paraglacial Coasts, Tidal Flats, and Mangroves. Formerly GEOL 4030.

ERTH 4050 (3) Earthquakes
Covers causes and effects of earthquakes, earthquake prediction, seismic waves, record interpretation, parameters of seismic foci, and seismo-tectonics ofthe world.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5050
Requisites: Requires prerequisite of MATH 1300 or APPM 1350 (min grade C-).
Recommended: Prerequisite one year of natural science.

ERTH 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: GEOG 5093 and GEOG 4093 and ERTH 5093
Requisites: Requires prerequisite course of APPM 1340 1345 or APPM 1350 or ECON 1088 or 3818 or MATH 1081 or 1300 or 1310 or 2510 or ANTH 4000 or BCOR 1020 or GEOG 3023 or ERTH 3023 or PSCI 2075 or PSYC 2111 or SOCY 2061 or 4061 or STAT 4000 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4110 (4) Field Geology
Methods of Geologic Mapping Including Plane Table Surveying and Introduction to Photogrammetry. Formerly GEOL 4110.

ERTH 4120 (3) Advanced Structural Geology and Tectonics
Provides valuable exposure to theory and applications related to deformation (rheology) of solid Earth materials as well as the structural and geophysical characteristics of the world's major orogenic belts. The processes that will be covered span a wide range of Earth's depths, from compaction in sedimentary rocks and flow of ice/salt near Earth's surface to cataclastic mechanisms in fault rocks to plastic flow of deep crust and mantle rock. The course will involve lectures, some in-class and take home problem sets, some local field exercises and field data analysis, classic and modern paper discussions, and a research term project (written and oral presentation).
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5120
Requisites: Requires prerequisite course of ERTH 3120 (minimum grade C-).
Grading Basis: Letter Grade

ERTH 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. Formerly GEOL 4150.
Requisites: Requires prerequisite course of ERTH 2700 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5185, ENVS 4185, and MCDB 4185
Requisites: Requires prerequisite courses (CHEM 1113 or CHEM 1400 or CHEN 1201 or CHEN 1211) and (CHEM 1114 or CHEM 1401 or CHEM 1221) (minimum grade C-).
Recommended: Prerequisites ERTH 1180 or MCDB 1150 or ERTH 3320 or EBIO 3400 or ENVS 4160 or EVEN 4484.
Grading Basis: Letter Grade

ERTH 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: ERTH 5215
Requisites: Requires prerequisite courses of ERTH 2001 and ERTH 2005 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4241 (4) Earth Surface Processes
Earth¿s surface is constantly reshaped by water, ice, wind, and life. This class investigates the earth's landscapes and the processes that modify them, both gradually by slow weathering and erosion, and abruptly through the action of floods, landslides, and other geologic events. We cover surface processes in hillslope, glacial, riverine, desert, and coastal environments. Upon completion of the course, students will have mastered knowledge about diverse surface processes and landforms and applied core geomorphic principles to a variety of landscapes. Students will also learn that understanding surface processes is important for managing natural hazards (e.g., landslides and floods). This course will draw from many disciplines, including geology, geography, physics, chemistry, and biology. The laboratory portion of the course will include quantitative problem solving and field trips to collect and analyze geomorphic data.
Equivalent - Duplicate Degree Credit Not Granted: GEOG 4241
Requisites: Requires prerequisite courses of GEOG 1011 or ERTH 2001 and a calculus course (MATH 1300 or APPM 1350 or (APPM 1340 and APPM 1345)), all minimum grade C-.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence
Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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: ERTH 5270
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors). Requires prerequisite courses of CHEM 1113, CHEM 1114, CHEM 1133, CHEM 1134, and ERTH 2001 (minimum grade C-).
Recommended: Prerequisites introductory chemistry, introductory geology, introductory oceanography.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5330 and ASTR 4330 and ASTR 5330
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors). Requires prerequisite courses of (CHEM 1113 or CHEM 1400 or CHEN 1211) and (PHYS 1110 or PHYS 1115); all minimum grade C-.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4341 (3) The Cryosphere: Earth's Icy Environments
Serves as an advanced introductory course in to the cryosphere for science majors. The course covers the nature of ice and the icy component of the Earth System, and how changing ice affects society. The course will not cover sea ice. Formerly offered as a special topics course.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5341
Requisites: Requires prerequisite course of ERTH 2001 or PHYS 1110 or PHYS 1115 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5380
Requisites: Requires prerequisite courses of (MATH 1300 or APPM 1350) and CHEM 1113 (all minimum grade C-).

ERTH 4440 (3) Morphology and Genesis of Soils
Effects of Climate, Vegetation, Parent Material, Topographic Position, and Time on Development, Classification, and Chemistry of Soils and Paleosols. Geomorphic and Quaternary History Used to Interpret Soils. Lab Is Field Trips to Study Soils in Plains to Mountains Transect. Formerly GEOL 4440.

ERTH 4444 (3) Data Visualization for Earth and Environmental Scientists
Data fluency and visualization are highly desirable skills both inside and outside of academia. This class focuses on the power, theory, best practices, and common pitfalls of programmatic data visualization with hands-on in-class programming sessions and fun weekly data wrangling and visualization exercises using data from across the earth, environmental, and biological sciences. We¿ll be using Quarto/RMarkdown notebooks and tidyverse-style R programming for data wrangling; ggplot2 and its powerful grammar-of-graphics approach for data visualization; and Git & GitHub for code management, collaborative coding, and instructor/peer feedback.
Equivalent - Duplicate Degree Credit Not Granted: EBIO 4444 and EBIO 5444 and ERTH 5444
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Recommended: While some experience with a programming language (R, python, matlab, C++, fortran, or any other) is beneficial, students with no prior programing experience are welcome to take this course.
Grading Basis: Letter Grade

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5474 and MUSM 5474
Requisites: Requires prerequisites ERTH 1020 and ERTH 3410 (minimum grade C-). Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4540 (4) Petroleum Geology
Covers theoretical and applied aspects of petroleum geology and geochemistry. Discusses organic geochemistry, time-temperature models, migration, trapping mechanisms, log analysis, application of facies models in the subsurface, and reservoir geology.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5540
Recommended: Prerequisites course work in structure, stratigraphy, sedimentology, deposits, environment, physics, and chemistry.

ERTH 4611 (3) Organic Geochemistry
Explores the ¿biomarker concept¿ as a tool to elucidate microbial, biogeochemical, and climatic processes in natural systems through three fundamental goals: a) characterization and classification of organic molecules in complex, natural mixtures; b) biosynthesis, transport, transformation, preservation and destruction of organic matter in nature; c) application of lipid biomarkers and their stable isotope composition to study biological, biogeochemical, and climatic processes in modern and ancient systems.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5611
Requisites: Requires prerequisite courses of CHEM 1113, CHEM 1114, CHEM 1133, and ERTH 2001 (all minimum grade C-).
Recommended: Prerequisite ERTH 3320 or ERTH 4270.
Grading Basis: Letter Grade

ERTH 4640 (3) Glaciology
Explores ice physics, snow, glaciers, floating ice, ice in the ground and in the solar system. Emphasizes glaciers and ice sheets, including reconstruction of past glaciations and impacts of ice and snow on society.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5640
Requisites: Requires prerequisite of MATH 1300 or APPM 1350 (min grade C-).

ERTH 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: ERTH 5670
Requisites: Requires prerequisite course of MATH 1300 or APPM 1350 (minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4700 (1-4) Special Earth Science Topics
Studies in selected Earth Science subjects of special current interest (for undergraduates). Formerly GEOL 4700.
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

ERTH 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. Formerly GEOL 4711.
Requisites: Requires prerequisite courses of (ERTH 2001 or ERTH 2700) and ERTH 2005 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 4712.
Requisites: Requires prerequisite courses of ERTH 2700 and ERTH 3120 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 4714.
Requisites: Requires prerequisite courses of ERTH 2001 or ERTH 2700 and ERTH 3330 and MATH 1300 and PHYS 1110 or PHYS 1115 (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 4715.
Requisites: Requires prerequisite courses of ERTH 3030 and (ERTH 2001 or ERTH 2700) (all minimum grade C-).
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sci Lab
Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 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. Formerly GEOL 4716.
Requisites: Requires prerequisite courses of (ERTH 2001 or ERTH 2700) and ERTH 3320 and (CHEM 1011 and CHEM 1031) or (CHEM 1113 and CHEM 1133). All minimum grade C-.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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.. Formerly GEOL 4717.
Requisites: Requires prerequisite courses of (ERTH 2001 or ERTH 2700) and (ERTH 3120 or ERTH 3320 or ERTH 3430 or ERTH 4241). All minimum grade C-.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 4718 (2) Paleoenvironmental Field Techniques
Provides experience in field techniques used to reconstruct paleoenvironments, including sediment coring and cataloging. Emphasis on glacial, lacustrine, bog, soil, and cave environments. Formerly GEOL 4718.
Recommended: Prerequisites one 1000-level ERTH course or other environmental science and ERTH 2700.

ERTH 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: ERTH 5719
Repeatable: Repeatable for up to 4.00 total credit hours.
Requisites: Requires prerequisite courses of ERTH 2700 and ERTH 3120 (all minimum grade C-).
Grading Basis: Letter Grade

ERTH 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. Formerly GEOL 4721.
Requisites: Requires prerequisite courses of ERTH 2700 and ERTH 3120 (all minimum grade C-).
Recommended: Prerequisite ERTH 4712.
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences
Arts Sci Gen Ed: Distribution-Natural Sci Lab

ERTH 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. Formerly GEOL 4723.
Requisites: Requires prerequisite courses of ERTH 2700 and ERTH 3430 (all minimum grade C-).

ERTH 4725 (1-4) Field Based Special Topics in Earth Science
Explores selected geological subjects of special interest in a field setting.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5725
Repeatable: Repeatable for up to 8.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Grading Basis: Letter Grade
Additional Information: Arts Sci Gen Ed: Distribution-Natural Sciences

ERTH 4750 (2) Field Techniques in Snow Hydrology
The purpose of this course is to provide students with a basic introduction to snow hydrology, with training in field methods for measuring snowpack characteristics and geospatial analysis techniques (GIS). Formerly GEOL 4750.

ERTH 4755 (2) Field Geobiology
Provides students technical fieldwork skills in the interdisciplinary field of geobiology, spanning modern environments and to ancient environments in preserved in rock record, and spanning techniques from geochemistry, environmental microbiology, and sedimentology.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5755
Repeatable: Repeatable for up to 8.00 total credit hours.
Requisites: Requires prerequisite courses of ERTH 2700 and ERTH 3430 (all minimum grade C-).

ERTH 4833 (3) Teaching and Learning Earth Systems
Learn and develop pedagogically effective strategies for teaching and understanding Earth Science concepts. Particular emphasis is placed on understanding the importance of geoscience habits of mind (i.e. spatial/temporal reasoning, multiple working hypotheses, geographic context). Focuses upon inquiry and evaluation of evidence, the importance of background knowledge and misconceptions, and developing effective discourse within and outside the classroom.
Equivalent - Duplicate Degree Credit Not Granted: EDUC 5833 and EDUC 4833 and ERTH 5833
Requisites: Requires prerequisite course of ATOC 1060 or ENVS 1000 or ERTH 1010 or ERTH 1020 or ERTH 1060 (minimum grade C-).
Grading Basis: Letter Grade

ERTH 4862 (1-4) Earth Science Independent Study
Students may not enroll in this course without completing the Independent Study Application.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 5862
Repeatable: Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

ERTH 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. Formerly GEOL 4990.
Requisites: Requires prerequisite of minimum cumulative GPA 3.30.
Additional Information: Arts Sciences Honors Course

ERTH 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. Formerly GEOL 5003.

ERTH 5020 (3) Marine Geology
Students will learn about marine geology. Formerly GEOL 5020.

ERTH 5021 (4) Petrology: Evolution of Crustal and Mantle Rocks
Origin, physical, and chemical properties of igneous and metamorphic rocks. This course develops a thermodynamic framework for the interpretation of geologic processes from observed mineral assemblages and rock textures. Laboratory component emphasizes the study of rocks in thin section and hand samples to understand earth processes in the mantle and crust.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4021
Requisites: Restricted to graduate students only.

ERTH 5030 (3) Coastal Processes
Students will learn about coastal processes. Formerly GEOL 5030.

ERTH 5042 (3) Computational Tools in Geosciences
Scientific research and teaching in geological sciences and related disciplines relies increasingly on computational tools. This class aims to introduce graduate students in the geological, geophysical and biogeochemical sciences to a wide range of commonly used concepts and open source data tools to empower them to find the right tool for their computational needs in research and teaching. Previously offered as a special topics course. Formerly GEOL 5042.
Repeatable: Repeatable for up to 6.00 total credit hours.
Recommended: Prerequisite Prior experience with at least one programming language is recommended.

ERTH 5050 (3) Earthquakes
Covers causes and effects of earthquakes, earthquake prediction, seismic waves, record interpretation, parameters of seismic foci, and seismo-tectonics ofthe world.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4050

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

ERTH 5101 (1) Introduction to Earth Science Faculty I
Welcomes and introduces all new graduate students to the Department of Earth Science. Faculty discuss their research and their academic trajectories. The week¿s geology colloquium is discussed. Tutorials from staff introduce how the university works, what funding opportunities exist, and how and when to apply for such funding. Formerly GEOL 5101.
Grading Basis: Letter Grade

ERTH 5102 (1) Introduction to Earth Science Faculty II
Continues to introduce all new graduate students to the Department of Earth Science. Faculty discuss their research and their academic trajectories. The week¿s geology colloquium is discussed. In addition, students craft reports on their intended research. Formerly GEOL 5102.
Grading Basis: Letter Grade

ERTH 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. Formerly GEOL 5110.
Requisites: Restricted to graduate students only.
Recommended: Prerequisite course in calculus.
Additional Information: Departmental Category: Graduate Course

ERTH 5111 (3) Rheology: Fracture and Flow of Rocks
Focuses on the elastic and plastic deformation of planetary materials (e.g. rocks and minerals, melts, tectonic plates, etc.). Topic include stress and strain, failure criterion, fracture propagation, creep (dislocation and diffusion), and deformation of multiphase materials. Formerly GEOL 5111.
Requisites: Restricted to graduate students only.
Recommended: Prerequisite prior coursework in basic chemistry, physics, mineralogy/petrology, and structure/geology.
Grading Basis: Letter Grade

ERTH 5120 (3) Advanced Structural Geology and Tectonics
Provides valuable exposure to theory and applications related to deformation (rheology) of solid Earth materials as well as the structural and geophysical characteristics of the world's major orogenic belts. The processes that will be covered span a wide range of Earth's depths, from compaction in sedimentary rocks and flow of ice/salt near Earth's surface to cataclastic mechanisms in fault rocks to plastic flow of deep crust and mantle rock. The course will involve lectures, some in-class and take home problem sets, some local field exercises and field data analysis, classic and modern paper discussions, and a research term project (written and oral presentation).
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4120
Recommended: Prerequisite ERTH 3120.
Grading Basis: Letter Grade

ERTH 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. Formerly GEOL 5123.
Recommended: Prerequisite at least one semester teaching/TAing undergraduate courses (waived with instructor approval).

ERTH 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. Formerly GEOL 5150.
Repeatable: Repeatable for up to 12.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4185, ENVS 4185, and MCDB 4185
Grading Basis: Letter Grade

ERTH 5210 (3) Advanced Igneous Petrology
Systematic Analysis of Petrology of Igneous Rocks. Emphasizes Integrating Knowledge Obtained from Theory, Experiment, and Field Studies. Formerly GEOL 5210.

ERTH 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: ERTH 4215
Additional Information: Departmental Category: Graduate Course

ERTH 5216 (1) Geochronology Reading and Discussion Seminar
The goals of this reading and discussion seminar are to: 1) learn key aspects of a selected geochronology topic, 2) read, critically evaluate, and discuss peer-reviewed scientific papers that include geochronology data, methods, and interpretations, and 3) set up a framework and appropriate environment in which participants will discuss the ¿next steps¿ to address the big problems associated with each theme. This course will focus on a different geochronology theme each time that it is offered. A theme will be selected based on conversations among interested participants. At the beginning of the semester, weekly discussion topics and associated papers will be chosen to systematically work through concepts associated with that theme. Previously offered as a special topics course. Formerly GEOL 5216.
Repeatable: Repeatable for up to 5.00 total credit hours.

ERTH 5230 (4) Mineral Exploration
Students will learn about mineral exploration. Formerly GEOL 5230.

ERTH 5240 (4) Remote Sensing Image Analysis
Digital image processing emphasizing hands-on computer analysis of space-acquired images. Theory and practice of image enhancement and thematic information extraction. Formerly GEOL 5240.
Requisites: Requires prerequisites of GEOG 4093 or GEOG 5093 or ERTH 4093 or ERTH 5093 (min grade C-).
Recommended: Prerequisite knowledge of multivariate statistics.
Additional Information: Departmental Category: Graduate Course

ERTH 5253 (3) Stable Isotope Fractionation in Biogeochemical Processes
Investigates the origins of stable isotope fractionation in geochemical systems with special emphasis on the role of biological catalysts as key drivers of isotopic effects during biogeochemical transformations. The class will cover a wide range of topics relevant to isotope fractionation including partition functions, diffusional, enzymatic and equilibrium isotope effects, open and closed system behavior, Rayleigh distillation, reservoir effects, enzymatic catalysis, physiological drivers and signal preservation. Formerly GEOL 5253.
Recommended: Prerequisites MATH 1300 or APPM 1350.

ERTH 5260 (3) Field Study of Mineral Deposits
Field Mapping Studies of Ore Deposits, Emphasizing Petrology, Wall Rock Alteration, and Ore Mineralogy. Formerly GEOL 5260.

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

ERTH 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. Formerly GEOL 5280.
Recommended: Prerequisite ERTH 3320 or 2 years of college chemistry.
Additional Information: Departmental Category: Graduate Course

ERTH 5300 (3) Low Temperature Geochemistry
Discussion of Geochemistry of Sedimentary and Near- Surface Environments. Stability Diagrams, Ion Exchange, Weathering, Geochemical Prospecting, and Topics in Thermodynamics. Formerly GEOL 5300.

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ENVS 5840
Requisites: Restricted to graduate students only.
Recommended: Prerequisite general chemistry and some organic chemistry.
Additional Information: Departmental Category: Graduate Course

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

ERTH 5341 (3) The Cryosphere: Earth's Icy Environments
Serves as an advanced introductory course in to the cryosphere. The course covers the nature of ice and the icy component of the Earth System, and how changing ice affects society. The course will not cover sea ice. Formerly offered as a special topics course.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4341
Requisites: Restricted to graduate students only.

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4380
Requisites: Restricted to graduate students only.

ERTH 5410 (3) Ancient Sedimentary Environments
Analysis of sedimentary rock sequences, sedimentary environments, and stratigraphic synthesis. Formerly GEOL 5410.
Requisites: Requires prerequisite ERTH 3430 (minimum grade C-).
Additional Information: Departmental Category: Graduate Course

ERTH 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. Formerly GEOL 5430.
Recommended: Prerequisites Introductory geology and introductory oceanography or atmospheric science.
Additional Information: Departmental Category: Graduate Course

ERTH 5432 (3) Active Tectonics
Considers the physical processes that drive coseismic and interseismic strain in the upper crust on Earth. It is focused on recognition and interpretation of surface strain produced by active faulting, folding and flexure at a range of timescales. This includes defining how coseismic strain cycles act to build geologic structures while considering methods of analysis with rapidly emerging remotely sensed and geochronologic datasets to quantify strain rates for seismic hazard assessment. Formerly GEOL 5432.
Repeatable: Repeatable for up to 6.00 total credit hours.
Recommended: Prerequisite previous coursework in structural geology, geomorphology and remote sensing.
Grading Basis: Letter Grade

ERTH 5444 (3) Data Visualization for Earth and Environmental Scientists
Data fluency and visualization are highly desirable skills both inside and outside of academia. This class focuses on the power, theory, best practices, and common pitfalls of programmatic data visualization with hands-on in-class programming sessions and fun weekly data wrangling and visualization exercises using data from across the earth, environmental, and biological sciences. We¿ll be using Quarto/RMarkdown notebooks and tidyverse-style R programming for data wrangling; ggplot2 and its powerful grammar-of-graphics approach for data visualization; and Git & GitHub for code management, collaborative coding, and instructor/peer feedback.
Equivalent - Duplicate Degree Credit Not Granted: EBIO 5444 and ERTH 4444 and EBIO 4444
Requisites: Restricted to graduate students only.
Recommended: While some experience with a programming language (R, python, matlab, C++, fortran, or any other) is beneficial, students with no prior programing experience are welcome to take this course.
Grading Basis: Letter Grade

ERTH 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: ERTH 4474 and MUSM 5474
Additional Information: Departmental Category: Graduate Course

ERTH 5540 (4) Petroleum Geology
Examines the generation, migration, and accumulation of petroleum, types of petroleum hydrocarbons, sedimentary basins and petroleum systems, source rocks, trapping mechanisms, types of seals, reservoir rocks and their properties, methods of exploration and subsurface mapping, estimating resources and reserves.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4540
Recommended: Prerequisite ERTH 3120 and ERTH 3430 or instructor consent required.

ERTH 5555 (3) Topics in Macroevolution
Macroevolution extends beyond the limits of microevolution by including processes that encompass many species, in both recent and fossils organisms. Some of the topics include evolutionary novelty and innovation, developmental evolution, disparity and diversity dynamics, and extinction. We will survey case studies, methods, and the current literature. Formerly GEOL 5555.
Repeatable: Repeatable for up to 9.00 total credit hours.

ERTH 5570 (1-3) Topical Seminar - Paleobiology and Paleoenvironment
Seminar on Current Topics of Exceptional Interest Built Around a Series of Prominent Invited Speakers. Formerly GEOL 5570.
Repeatable: Repeatable for up to 3.00 total credit hours.

ERTH 5610 (2) Mammalian Micropaleontology
Studies mammalian microfossils. Methods of analysis, collection, and use in stratigraphic problems such as correlation, paleoecology, and earth history. Formerly GEOL 5610.

ERTH 5611 (3) Organic Geochemistry
Explores the ¿biomarker concept¿ as a tool to elucidate microbial, biogeochemical, and climatic processes in natural systems through three fundamental goals: a) characterization and classification of organic molecules in complex, natural mixtures; b) biosynthesis, transport, transformation, preservation and destruction of organic matter in nature; c) application of lipid biomarkers and their stable isotope composition to study biological, biogeochemical, and climatic processes in modern and ancient systems.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4611
Recommended: Prerequisites CHEM 1113 or equivalent from undergraduate degree and ERTH 5270 or ERTH 5280 or ERTH 5305 or ERTH 5675.

ERTH 5612 (3) Techniques in Organic Geochemistry
Explores the techniques in analytical chemistry and organic geochemistry for the study of lipid biomarkers in the environment, which include the following topics: a) Extraction of environmental samples and separation of lipid classes; b) Analysis of apolar lipids using gas chromatography-mass spectrometry (GC-MS); c) Determine the stable isotope composition of lipids using GC-isotope ratio-MS (GC-IR-MS); d) Analysis of polar lipids using high performance liquid chromatography-MS (HPLC-MS). Requires previous coursework in general chemistry and Organic Geochemistry. Formerly GEOL 5612.
Recommended: Prerequisites Introductory or advanced courses in organic chemistry, biochemistry, biogeochemistry, geochemistry, geomicrobiology, paleoclimate, or geology.

ERTH 5620 (5) Field Problems in Vertebrate Paleontology
Field Techniques in Study of Fossil Vertebrates and Their Host Rocks. Four Weeks Field Work, One Week Faunal Analysis. Formerly GEOL 5620.

ERTH 5630 (2) Physics of Remote Sensing
Advanced study of optical and microwave techniques used in remote sensing of the atmosphere, oceans and land with emphasis on the latter. Studies are based on recent literature and text. The course is intended for those who have completed introductory courses in remote sensing fundamentals and Digital Image Analysis. Formerly GEOL 5630.

ERTH 5640 (3) Glaciology
Explores ice physics, snow, glaciers, floating ice, ice in the ground and in the solar system. Emphasizes glaciers and ice sheets, including reconstruction of past glaciations and impacts of ice and snow on society.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4640

ERTH 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: ERTH 4670
Additional Information: Departmental Category: Graduate Course

ERTH 5680 (3) Global Tectonics
Studies geological and geophysical aspects of plate motions along accretionary transforming, subducting, and collisional margins. Relationships of sedimentation, volcanism, metamorphism, and deformation to mountain building are studied in conjunction with examination of type areas. Formerly GEOL 5680.
Requisites: Restricted to graduate students only.

ERTH 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. Formerly GEOL 5690.
Recommended: Prerequisite structural geology and at least one semester of college physics and calculus are strongly recommended.
Additional Information: Departmental Category: Graduate Course

ERTH 5700 (1-4) Earth Science Topics Seminar
Offers seminar studies in geological subjects of special current interest. Primarily for graduate students, as departmental staff and facilities permit. Formerly GEOL 5700.
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

ERTH 5701 (2) Super-Problems in Quaternary 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. Formerly GEOL 5701.
Recommended: Prerequisites Introductory geology and climatology, oceanography, paleoclimatology, or paleoceanography.
Additional Information: Departmental Category: Graduate Course

ERTH 5702 (1-3) Geomorphology Seminar
Explores the dynamics and forms of the earth's surface through critical reading and discussion of both classical and modern literature. Formerly GEOL 5702.
Repeatable: Repeatable for up to 10.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

ERTH 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. Formerly GEOL 5703.
Repeatable: Repeatable for up to 6.00 total credit hours.
Requisites: Restricted to graduate students only.
Grading Basis: Letter Grade
Additional Information: Departmental Category: Graduate Course

ERTH 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 ERTH majors can register with instructor approval. Formerly GEOL 5704.
Repeatable: Repeatable for up to 10.00 total credit hours.

ERTH 5705 (1-3) Seminar in Paleoclimate
Investigates major problems in the study and understanding of past climate variations as preserved in the geologic record. Course format is a seminar-style critical reading and discussion of journal articles in paleoclimatology and paleoceanography. Topical focus varies from year to year. Formerly GEOL 5705.
Repeatable: Repeatable for up to 9.00 total credit hours.
Recommended: Prerequisite prior coursework in geology, climate science, and/or paleoclimate.

ERTH 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. Formerly GEOL 5714.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisites of (ERTH 2001 or ERTH 2700) and MATH 1300 and PHYS 1110 (min grade C-). Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

ERTH 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. Formerly GEOL 5716.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Requisites: Requires prerequisites of (ERTH 2001 or ERTH 2700) and CHEM 1011 and (CHEM 1031 or CHEM 1113 or CHEM 1133) and ERTH 3320 (minimum grade C-).
Additional Information: Departmental Category: Graduate Course

ERTH 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. Formerly GEOL 5717.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.
Requisites: Restricted to graduate students only. Requires prerequisites of (ERTH 2001 or ERTH 2700) and at least one of the following: ERTH 3120 or ERTH 3320 or ERTH 3430 (minimum grade C-).
Additional Information: Departmental Category: Graduate Course

ERTH 5718 (1-3) Paleoenvironmental Field Techniques
Includes field geophysics, environmental, structural, and stratigraphic field geology, and/or field topics in petrology, hydrology, and geomorphology. Formerly GEOL 5718.
Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

ERTH 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: ERTH 4719
Repeatable: Repeatable for up to 4.00 total credit hours.
Requisites: Restricted to graduate students only.
Grading Basis: Letter Grade

ERTH 5721 (2) Classics and Frontiers in Hydrology
The first part of this course studies classic papers in hydrology that include development of fundamental concepts and governing principles governing water flow in subsurface. It will also include benchmark papers that define critical advances in hydrology. The second part of this course focuses on latest research front that spans from theoretical and modeling studies to measuring and monitoring technologies. Formerly GEOL 5721.
Requisites: Restricted to graduate students only.
Grading Basis: Letter Grade

ERTH 5725 (1-4) Field Based Special Topics in Earth Science
Explores selected geological subjects of special interest in a field setting.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 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

ERTH 5755 (2) Field Geobiology
Provides students technical fieldwork skills in the interdisciplinary field of geobiology, spanning modern environments and to ancient environments in preserved in rock record, and spanning techniques from geochemistry, environmental microbiology, and sedimentology. Formerly offered as a special topics course.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4755
Repeatable: Repeatable for up to 8.00 total credit hours.

ERTH 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. Formerly GEOL 5775.

ERTH 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

ERTH 5820 (3) Origin and Evolution of Planetary Systems
Considers the origin and evolution of planetary systems, including proto-planetary 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
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

ERTH 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 9.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

ERTH 5833 (3) Teaching and Learning Earth Systems
Learn and develop pedagogically effective strategies for teaching and understanding Earth Science concepts. Particular emphasis is placed on understanding the importance of geoscience habits of mind (i.e. spatial/temporal reasoning, multiple working hypotheses, geographic context). The course focuses upon inquiry and evaluation of evidence, the importance of background knowledge and misconceptions and developing effective discourse within and outside the classroom.
Equivalent - Duplicate Degree Credit Not Granted: EDUC 4833 and ERTH 4833 and EDUC 5833
Requisites: Restricted to graduate students only.
Grading Basis: Letter Grade

ERTH 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. Department enforced prerequisite: senior level undergraduate physics.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 5835 and ASTR 5835
Repeatable: Repeatable for up to 4.00 total credit hours.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

ERTH 5862 (1-4) Earth Science Independent Study
Students may not enroll in this course without completing the Independent Study Application.
Equivalent - Duplicate Degree Credit Not Granted: ERTH 4862
Repeatable: Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

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

ERTH 5951 (3) Climatic Change Seminar
Cross-Disciplinary Survey of the Evidence for and Theories of Climatic Change. Formerly GEOL 5951.

ERTH 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

ERTH 6241 (1-3) Seminar in Hydrology and Geomorphology
Emphasizes process-oriented research in hydrology andgeomorphology. Sample topics include river mechanics, snow hydrology, and periglacial processes.
Equivalent - Duplicate Degree Credit Not Granted: GEOG 6241
Repeatable: Repeatable for up to 6.00 total credit hours.
Additional Information: Departmental Category: Graduate Course

ERTH 6270 (3) Thermodynamics for Petrologists 2
Advanced Topics in Thermodynamics, Emphasizing Properties of Electrolyte Solutions at Low and High Temperature; Thermodynamics of Silicate Melts; Experimental Methods for Determining Activity Coefficients in Gaseous, Liquid, and Crystalline Solutions; and Linear Algebra Techniques for Manipulation of Multicomponent Rock Compositions. Formerly GEOL 6270.

ERTH 6310 (3) Sedimentary Petrology
Covers interpretation of depositional and diagenetic history of sedimentary rocks as determined from thin-section studies. Formerly GEOL 6310.
Requisites: Requires prerequisites of ERTH 3010 and ERTH 3020 and ERTH 3430 (minimum grade C-).
Additional Information: Departmental Category: Graduate Course

ERTH 6320 (3) Sedimentary Petrology 2
Interpretation of Depositional and Diagenetic History of Seidmentary Rocks as Determined from Thin-Section Studies. Formerly GEOL 6320.

ERTH 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. Formerly GEOL 6330.
Requisites: Restricted to graduate students only.
Recommended: Prerequisite introductory undergraduate physics and ERTH 3430.
Additional Information: Departmental Category: Graduate Course

ERTH 6610 (3) Earth and Planetary Physics 1
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

ERTH 6620 (3) Earth and Planetary Physics 2
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

ERTH 6630 (3) Earth and Planetary Physics 3
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

ERTH 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

ERTH 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

ERTH 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.
Equivalent - Duplicate Degree Credit Not Granted: PHYS 6670
Recommended: Prerequisites a course in calculus and a course in computer programming (any language).
Additional Information: Departmental Category: Graduate Course

ERTH 6690 (3) Advanced Seismology
Students will learn about advanced seismology. Formerly GEOL 6690.

ERTH 6940 (1) Master's Candidate for Degree
Registration intended for students preparing for a thesis defense, final examination, culminating activity, or completion of degree. Formerly GEOL 6940.
Requisites: Restricted to graduate students only.
Additional Information: Departmental Category: Graduate Course

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

ERTH 6960 (1-3) Plan II Master's Research
The Plan II program requires at least 3 credit hours of ERTH 6960 (Plan II Master¿s Research) under the supervision of the advisory committee. Formerly GEOL 6960.
Additional Information: Departmental Category: Graduate Course

ERTH 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. Formerly GEOL 8990.
Repeatable: Repeatable for up to 30.00 total credit hours.
Additional Information: Departmental Category: Graduate Course