Earth and Planetary Science

Overview

UC Berkeley's Department of Earth and Planetary Science (EPS) was the first major center of academic geology in the western United States. Berkeley geologists made the first detailed study of a major earthquake, developed potassium-argon dating, brought the rigor of thermodynamics into geology, and discovered the evidence that a comet impact killed the dinosaurs.

With growing concerns over environmental deterioration and depletion of resources, our focus has broadened to include issues of urgent social relevance. Many departments at Berkeley are involved in environmental questions, ranging from policy, management, economics, engineering to social concerns, but all have to base their conclusions upon a sound scientific understanding of Planet Earth. It is up to geologists, geochemists, and geophysicists to provide that background.

The interests of the faculty cover a broad range of earth sciences. The traditional fields of petrology, mineralogy, mineral resources and structural geology are represented. A rapidly growing field is micro-biogeochemistry. Solid earth geophysics includes a unique combination of expertise in seismology, mineral physics and geodynamics. Our earthquake and tectonics programs benefit from the resources made available through the Berkeley Seismological Laboratory (BSL (http://www.seismo.berkeley.edu)). A vigorous program in geomorphology and surface processes attracts many students. Recently we have added expertise in marine, atmospheric and planetary sciences, with links to related programs in the Departments of Chemistry, Astronomy, Geography and Environmental Science and Policy Management. Additional resources for research are available through the Berkeley Atmospheric Science Center (BASC (http://www.atmos.berkeley.edu)) and the Center for Integrated Planetary Science (CIPS (http://cips.berkeley.edu/entry.html)). Resources for Geochemists include the Center for Isotope Geochemistry (http://www-esd.lbl.gov/CIG) and the Berkeley Geochronology Center (http://bgc.org) . Some of our faculty have strong collaborations with the Earth Science Division at the Lawrence Berkeley National Laboratory (ESD-LBNL (http://www-esd.lbl.gov)) and make extensive use of the Advanced Light Source (ALS).

Research Facilities

Center for Isotope Geochemistry , directed by Professor Donald DePaolo, is a joint research center of both UC Berkeley and Lawrence Berkeley National Laboratory. CIG provides state-of-the-art analyses for measuring concentrations and isotopic compositions of elements in rocks, minerals, fluids and gases in the Earth's crust, oceans, and atmosphere. CIG has seven mass spectrometers that provide high precision isotopic and isotope dilution analyses of Rb, Sr, Nd, Sm, Ca, K, Re, Os, Fe, U, Th, Pb, Ba, La, Ce; clean laboratories; and clean mineral separation and rock preparation laboratories. Materials analyzed are rock, ocean and ground waters, and naturally occurring noble gases.

The Center for Atmospheric Sciences is a new multidisciplinary academic group at Berkeley. It focuses on the processes that maintain and alter the atmosphere's chemical composition and circulation. It also examines the climatic effects of changes in these processes. A special emphasis is the interaction between the geosphere-biosphere and climate, with the atmosphere as the synthesizer of changes at its boundaries, and the communicator of these changes to the other spheres. Center members and associates are from the Department of Earth and Planetary Science, Department of Chemistry, Department of Environmental Science, Policy and Management, Department of Mechanical Engineering, Space Sciences Laboratory, Lawrence Berkeley National Laboratory, among others. Research approaches are multi-faceted, and include: global three-dimensional circulation models, satellite observations, high-precision instrumentation for atmospheric chemistry, aircraft measurements of stratospheric-tropospheric exchange, measurements and simulations of atmosphere-biosphere exchange of trace gases. This diversity permits the Center to pose and attack new questions about past and future climate change.

Berkeley Geomorphology Group prospers because of the diversity of strong research programs across the campus and because of a commitment to undergraduate teaching and graduate training. The core faculty consist of Kurt Cuffey (Geography), William Dietrich, Jim Kirchner, and Michael Manga (Earth and Planetary Science). Their research programs tackle a wide range of topics including glacier mechanics, paleoclimate analysis, hydrology, environmental geochemistry, landscape evolution, hillslope erosion mechanics, fluvial processes, restoration geomorphology, and biologic extinctions and evolutionary processes. These faculty and their students interact and collaborate with many other related groups on campus.

Active Tectonics Group uses an interdisciplinary approach to investigate active tectonic processes and the rheology of the Earth's lithosphere. This approach integrates geodetic, seismologic, geomorphic, and geologic observations with theoretical models to improve scientific understanding of fault zone processes and crustal deformation. Of particular value in this endeavor are space geodetic observations employing the Global Positioning System and Synthetic Aperture Radar Interferometry to precisely measure deformation near active faults, volcanoes, and landslides. Members of the group, led by Roland Bürgmann, often interact closely with colleagues in the Berkeley Seismological Laboratory and the Geomorphology Group.

The Berkeley Geochronology Center is a non-profit research institution dedicated to establishing the evolution of the Earth, its various inhabitants, and its interactions with the rest of our Solar System, throughout the 4.6 billion years of our Planet's existence. BGC scientists determine the ages of rocks and other materials to date important events in geological and biological history. Through understanding such information in geologic context, BGC research provides key insights into such processes as plate tectonics, volcanism, mountain building, mass extinctions, climate change, interactions between the Earth and Solar System, and the evolution of life, including humankind.

The Berkeley Seismological Laboratory (http://seismo.berkeley.edu) **:** The University operates several networks of geophysical instruments in northern California to study earthquakes and tectonic processes at the regional scale: a network of 26 broadband seismometers regionally distributed and linked by continuous telemetry to UC Berkeley forms the core of the monitoring program. In addition, a network of permanent GPS stations and a network of borehole seismometers are maintained and operated by the lab, as well as an on-line archive for earthquake related data in northern California. Research includes the study of earthquake wave propagation through complex structures, the nature of earthquake sources, eigenvibrations of the earth and global tomography.

Center for Computational Geoscience (http://esd.lbl.gov/research/facilities/ccg) **:** Within the Earth Sciences Division at the Lawrence

Berkeley National Laboratory is a facility for modern seismological research which relies heavily upon intensive computational analysis (e.g., acoustic imaging, 3D wave propagation, high resolution inverse earthquake analyses) or large database manipulations. The center is used in a number of Ph.D. and postdoctoral research studies.

The Engineering Geoscience Group teaches and researches Applied Geophysics. It is an integral part of the Geological Engineering Group within the Department of Civil and Environmental Engineering at the University of California at Berkeley. The group formed originally in 1962, to study and encourage the use of geophysical methods in mineral and petroleum exploration programs. Recently, attention has shifted to the more general topic of subsurface mapping and imaging. While research in resource exploration topics is still actively pursued, the group's activities now include work on methodology and instrument development for a variety of near surface applications related to the resolution of geotechnical and environmental problems. In this area, the group works jointly with the Department of Civil and Environmental Engineering on site remediation, near surface hydrology and soil stability projects. Incidentally, geophysical technology developed for use in shallow subsurface regions can also be used as an aid to archeological searches. The technology is also expected to play a key role in resolving contemporary problems associated with the detection and removal of buried explosive ordinance.

Center for Integrative Planetary Science (CIPS) (http://cips.berkeley.edu) is a new organized research unit at the University of California, Berkeley. Our task is to unite scientists and students from many disciplines on a rapidly emerging scientific landscape characterized by striking developments. These discoveries, and others during the past decade, have revealed a remarkable set of connections among many separate traditional sciences: geophysics, astrophysics, meteorology, oceanography, organic chemistry, biology, and planetary science. These disciplines are well represented at Berkeley, where strong research programs with long records of accomplishment have existed for some time in diverse campus departments, the Space Science Laboratory, and the Lawrence Livermore National Laboratory. CIPS takes advantage of these strengths with the integrated study of the physical origin and geochemical evolution of planets and planetary systems. Much of the compelling research about our solar system and other planetary systems will require knowledge across traditional disciplinary boundaries. From the condensation of planets within protoplanetary discs to the geochemical history of planets and moons, future researchers will require frontier knowledge of all related disciplines.

Undergraduate Programs

Atmospheric Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/atmospheric-science) : BA
Environmental Earth Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/environmental-earth-science) : BA
Geology (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/geology) : BA
Geophysics (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/geophysics) : BA
Marine Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/marine-science) : BA
Planetary Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/planetary-science) : BA
Earth and Planetary Science (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/environmental-earth-science/#minorrequirementstext) : Minor

Graduate Program

Earth and Planetary Science (http://guide.berkeley.edu/archive/2014-15/graduate/degree-programs/earth-planetary-science) : MA, PhD (the MA program is only open to students who majored in EPS at Berkeley)

Earth and Planetary Science

EPS 3 The Water Planet 2 Units
An overview of the processes that control water supply to natural ecosystems and human civilization. Hydrologic cycle, floods, droughts, groundwater. Patterns of water use, threats to water quality, effects of global climate change on future water supplies. Water issues facing California.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Summer: 8 weeks - 3.5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 3

EPS 8 Geologic Record of Climate Change 3 Units
This course will review the geologic record of climate change emphasizing how such knowledge can constrain present day thinking about (and predictive models of) future climate change. We will cover the entire spectrum of climate variations, from the formation of the Earth's early atmosophere 4.6 billion years ago to the ice ages to the development of instrumental records.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 6 weeks - 8 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 8

EPS C12 The Planets 3 Units
A tour of the mysteries and inner workings of our solar system. What are planets made of? Why do they orbit the sun the way they do? How do planets form, and what are they made of? Why do some bizarre moons have oceans, volcanoes, and ice floes? What makes the Earth hospitable for life? Is the Earth a common type of planet or some cosmic quirk? This course will introduce basic physics, chemistry, and math to understand planets, moons, rings, comets, asteroids, atmospheres, and oceans. Understanding other worlds will help us save our own planet and help us understand our place in the universe.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 6 weeks - 7.5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: ASTRON C12/L & S C70T

EPS W12 The Planets 3 Units
A tour of the mysteries and inner workings of our solar system. What are planets made of? Why do they orbit the sun the way they do? How do planets form, and what are they made of? Why do some bizarre moons have oceans, volcanoes, and ice floes? What makes the Earth hospitable for life? Is the Earth a common type of planet or some cosmic quirk? This course will introduce basic physics, chemistry, and math to understand planets, moons, rings, comets, asteroids, atmospheres, and oceans. Understanding other worlds will help us save our own planet and help us understand our place in the universe. This course is web-based.
Hours & Format

Summer: 8 weeks - 6 hours of web-based lecture per week

Online: This is an online course.

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Marcy, Militzer

Also listed as: ASTRON W12

EPS 20 Earthquakes in Your Backyard 3 Units
Introduction to earthquakes, their causes and effects. General discussion of basic principles and methods of seismology and geological tectonics, distribution of earthquakes in space and time, effects of earthquakes, and earthquake hazard and risk, with particular emphasis on the situation in California.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Summer: 6 weeks - 5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geophysics 20

EPS C20 Earthquakes in Your Backyard 3 Units
Introduction to earthquakes, their causes and effects. General discussion of basic principles and methods of seismology and geological tectonics, distribution of earthquakes in space and time, effects of earthquakes, and earthquake hazard and risk, with particular emphasis on the situation in California.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Summer: 6 weeks - 5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: L & S C70Y

EPS 24 Freshman Seminar in Earth and Planetary Sciences 1 Unit
The freshman seminar in earth and planetary science is designed to provide new students with an opportunity to explore a topic in geology or earth sciences with a faculty member in a small seminar setting. Topics will vary from semester to semester but will include such possible topics as great voyages of geologic discovery and the role of atmospheric sciences in geologic study.
Rules & Requirements

Repeat rules: Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

Formerly known as: Geology 24

EPS 39A Freshman/Sophomore Seminar 2 - 4 Units
Freshman and sophomore seminars offer lower division students the opportunity to explore an intellectual topic with a faculty member and a group of peers in a small-seminar setting. These seminars are offered in all campus departments; topics vary from department to department and from semester to semester.
Rules & Requirements

Prerequisites: Priority given to freshmen and sophomores

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-4 hours of seminar per week

Summer: 6 weeks - 5-10 hours of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

Formerly known as: Geology 39

EPS 50 The Planet Earth 4 Units
An introduction to the physical and chemical processes that have shaped the earth through time, with emphasis on the theory of plate tectonics. Laboratory work will involve the practical study of minerals, rocks, and geologic maps and exercises on geological processes.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Summer: 8 weeks - 7.5 hours of lecture and 7.5 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 50

EPS 51 Big History--Cosmos, Earth, Life, and Humanity 4 Units
This course explores all four major regimes of history--cosmic history, Earth history, life history, and human history. Bringing together these normally unrelated topics, it seeks to understand the character of history by examining longterm trends and critical chance events, by looking for common causes underlying historical change in all four regimes, and by identifying the novelties that have made each regime unique. It offers a broad perspective for students interested in any one of the historical disciplines, helping them cross the barriers between fields of historical study.
Rules & Requirements

Prerequisites: Sophomore standing, except for freshmen who have previously taken 50

Credit Restrictions: Students will receive no credit for 51 after taking C51 or Letters and Science C70X. A deficient grade in C51 or Letters and Science C70X maybe removed by taking 51.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week
8 weeks - 6 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

EPS C51 Big History -- Cosmos, Earth, Life, and Humanity 4 Units
This course explores all four major regimes of history -- cosmic history, Earth history, life history, and human history. Bringing together these normally unrelated topics, it seeks to understand the character of history by examining longterm trends and critical chance events, by looking for common causes underlying historical change in all four regimes, and by identifying the novelities that have made each regime unique. It offers a broad perspective for students interested in any one of the historical disciplines, helping them cross the barriers between fields of historical study.
Rules & Requirements

Prerequisites: Sophomore standing, except for freshmen who have previously taken 50

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

Instructor: Alvarez

Also listed as: L & S C70X

EPS N51 Big History--Cosmos, Earth, Life, and Humanity 4 Units
This course explores all four major regimes of history--cosmic history, Earth history, life history, and human history. Bringing together these normally unrelated topics, it seeks to understand the character of history by examining longterm trends and critical chance events, by looking for common causes underlying historical change in all four regimes, and by identifying the novelties that have made each regime unique. It offers a broad perspective for students interested in any one of the historical disciplines, helping them cross the barriers between fields of historical study.
Rules & Requirements

Prerequisites: Sophomore standing, except for freshmen who have previously taken 50

Credit Restrictions: Students will receive no credit for N51 after taking 51, C51, or Letters and Science C70X. A deficient grade in 51, C51 or Letters and Science C70X maybe removed by taking N51.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week
8 weeks - 6 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

EPS 80 Environmental Earth Sciences 3 Units
The course describes geologic processes active on and in the earth and man’s interactions with them. Geologic aspects of use of the land and oceans based on an understanding of earth’s environmental processes.
Rules & Requirements

Credit Restrictions: Students will receive no credit for 80 after taking Integrative Biology 80 or Paleontology 15.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 6 weeks - 7.5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EPS C82 Oceans 3 Units
This course offers multidisciplinary approach to begin answering the question "Why are oceans important to us?" Upon a physical, chemical, and geologic base, we introduce the alien world of sea life, the importance of the ocean to the global carbon cycle, and the principles of ecology with a focus on the important concept of energy flow through food webs. Lectures expand beyond science to include current topics as diverse as music, movies, mythology, biomechanics, policy, and trade.
Rules & Requirements

Credit Restrictions: Students will receive no credit for Earth and Planetary Science C82/Geography C82/Integrative Biology C82 after completing Integrative Biology 82 or Earth and Planetary Science N82.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week
8 weeks - 5.5 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: GEOG C82/INTEGBI C82

EPS N82 Introduction to Oceans 2 Units
The geology, physics, chemistry, and biology of the world oceans. The application of oceanographic sciences to human problems will be explored through special topics such as energy from the sea, marine pollution, food from the sea, and climate change.
Rules & Requirements

Credit Restrictions: Students will receive no credit for Earth and Planetary Science N82 after taking Earth and Planetary Science/ Integrative Biology/Geography C82.

Hours & Format

Summer:
6 weeks - 5 hours of lecture per week
8 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

EPS 84 Sophomore Seminar 1 or 2 Units
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.
Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 1.5-3.5 hours of seminar and 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

EPS 98 Directed Group Study 1 - 4 Units
Group studies of selected topics which vary from semester to semester.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Formerly known as: Geology and Geophysics 98

EPS 100A Minerals: Their Constitution and Origin 4 Units
Introduction to structural, compositional, and physical properties of minerals, their analogs and related substances, their genesis in various geological and synthetic processes, and laboratory techniques to identify and investigate minerals. One field trip to selected mineral deposits and visits to laboratories.
Rules & Requirements

Prerequisites: Some background in chemistry and physics

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 100A

EPS 100B Genesis and Interpretation of Rocks 4 Units
Introduction to the principal geologic environments where rocks are formed and displayed. Igneous, sedimentary, and metamorphic processes discussed in the context of global tectonics.
Rules & Requirements

Prerequisites: 100A

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 100B

EPS C100 Communicating Ocean Science 4 Units
For undergraduates interested in improving their ability to communicate their scientific knowledge by teaching ocean science in elementary schools or science centers/aquariums. The course will combine instruction in inquiry-based teaching methods and learning pedagogy with six weeks of supervised teaching experience in a local school classroom or the Lawrence Hall of Science with a partner. Thus, students will practice communicating scientific knowledge and receive mentoring on how to improve their presentations.
Rules & Requirements

Prerequisites: One course in introductory biology, geology, chemistry, physics, or marine science required and interest in ocean science; junior, senior, or graduate standing; consent of instructor required for sophomores

Hours & Format

Fall and/or spring: 15 weeks - 2.5 hours of lecture, 1 hour of discussion, and 2 hours of fieldwork per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Ingram

Also listed as: GEOG C146/INTEGBI C100

EPS 101 Field Geology and Digital Mapping 4 Units
Geological mapping, field observation, and problem-solving in the Berkeley hills and environs leading to original interpretation of geological processes and history from stratigraphic, structural, and lithological investigations. Integration of the Berkeley hills geology into the Coast Ranges and California as a whole through field trips to key localities. Training in digital field mapping, global positioning systems, and laser surveying. Interdisciplinary focus encourages participation by nonmajors.
Rules & Requirements

Prerequisites: 50 or equivalent introductory course in Earth and Planetary Science

Hours & Format

Fall and/or spring: 15 weeks - 7 hours of fieldwork and 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Formerly known as: Geology 101

EPS 102 History and Evolution of Planet Earth 4 Units
Formation and evolution of the earth. Nucleosynthesis; formation of the solar system; planetary accretion; dating the earth and solar system; formation of the core, mantle, oceans, and atmosphere; plate tectonics; heat transfer and internal dynamics; stratigraphic record of environment, and evolution; climate history and climate change.
Rules & Requirements

Prerequisites: 50

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EPS 103 Introduction to Aquatic and Marine Geochemistry 4 Units
Introduction to marine geochemistry: the global water cycle; processes governing the distribution of chemical species within the hydrosphere; ocean circulation; chemical mass balances, fluxes, and reactions in the marine environment from global to submicron scales; carbon system equilibrium chemistry and biogeochemistry of fresh and salt walter; applications of natural and anthropogenic stable and radioactive tracers; internal ocean processes.
Rules & Requirements

Prerequisites: Chemistry 1A, Mathematics 1A or 16A. C82 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Bishop

EPS 104 Mathematical Methods in Geophysics 4 Units
Linear systems. Linear inverse problems, least squares; generalized inverse, resolution; Fourier series, integral transforms; time series analysis, spherical harmonics; partial differntial equations of geophysics; functions of a complex variable; probability and significance tests, maximum likelihood methods. Intended for students in geophysics and other physical sciences.
Rules & Requirements

Prerequisites: Mathematics 53-54

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geophysics 104

EPS 108 Geodynamics 4 Units
Basic principles in studying the physical properties of earth materials and the dynamic processes of the earth. Examples are drawn from tectonics, mechanics of earthquakes, etc., to augment course material.
Rules & Requirements

Prerequisites: 60, PHYSICS 7A, or Mathematics 53, 54

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geophysics 108

EPS 109 Computer Simulations in Earth and Planetary Sciences 4 Units
Introduction to modern computer simulation methods and their application to selected Earth and Planetary Science problems. In hands-on computer labs, students will learn about numerical algorithms, learn to program and modify provided programs, and display the solution graphically. This is an introductory course and no programming experience is required. Examples include fractals in geophysics, properties of materials at high pressure, celestial mechanics, and diffusion processes in the Earth. Topics range from ordinary and partial differential equations to molecular dynamics and Monte Carlo simulations.
Rules & Requirements

Prerequisites: MATH 1A or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

EPS 111 Petroleum Geology 3 Units
Basin development related to plate tectonics. Origin of petroleum: quality, quantity, thermal maturation of organic matter in source rock. Primary and secondary migration. Petroleum composition. Reservoir rock: stratigraphy and geometry. Traps: structural, stratigraphic or combination. Reservoir fluids and energy. Oil provinces, individual fields.
Rules & Requirements

Prerequisites: Introductory course in geology

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 111

EPS 115 Stratigraphy and Earth History 4 Units
Collecting, analyzing, and presenting stratigraphic data; dating and correlating sedimentary rocks; recognizing ancient environments and reconstructing Earth history; seismic and sequence stratigraphy; event stratigraphy and neocatastrophism; applications of stratigraphy to climate change, petroleum geology, and archaeology.
Rules & Requirements

Prerequisites: 50, 100A, 100B, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Alvarez

Formerly known as: Geology 115

EPS 116 Structural Geology and Tectonics 3 Units
Introduction to the geometry and mechanics of brittle and ductile geologic structures; their origins and genetic relation to stress fields and their use as kinematic indicators; case histories of selected regions to elucidate tectonic evolution in different plate tectonic settings. Laboratory exercises will focus on analysis of hand specimens and structural relations portrayed on geologic maps. Several trips to observe geologic structures in the field to supplement laboratory exercises.
Rules & Requirements

Prerequisites: 50

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Burgmann

EPS 117 Geomorphology 4 Units
Quantitative examination of landforms, runoff generation, weathering, mechanics of soil erosion by water and wind, mass wasting, glacial and periglacial processes and hillslope evolution.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 117

EPS 118 Advanced Field Course 4 Units
Advanced geological mapping, intensive field observation, and problem solving in the field areas selected by instructors. Includes preparation of final reports.
Rules & Requirements

Prerequisites: 50, 100A-100B, 101, or consent of instructor; 119 is strongly recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Summer: 6 weeks - 7.5 hours of lecture and 5 hours of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Brimhall

Formerly known as: Geology 118

EPS 119 Geologic Field Studies 2 Units
Two to four weekend field trips to localities of geological interest.
Rules & Requirements

Prerequisites: 101 and consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of fieldwork per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Formerly known as: Geology 119

EPS 122 Physics of the Earth and Planetary Interiors 3 Units
Gravity field, density distribution, and internal seismic structure of the Earth and planets. Constitution, composition, temperature distribution, and energetics of the Earth's interior. The geomagnetic field and the geodynamo, and concepts in seismic imaging and geophysical fluid dynamics. This
course welcomes physics, computer science, engineering and applied maths majors.
Rules & Requirements

Prerequisites: PHYSICS 7A-B, Mathematics 53-54, or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

EPS 124 Isotopic Geochemistry 4 Units
An overview of the use of natural isotopic variations to study earth, planetary, and environmental problems. Topics include geochronology, cosmogenic isotope studies of surficial processes, radiocarbon and the carbon cycle, water isotopes in the water cycle, and radiogenic and stable isotope studies of planetary evolution, mantle dynamics, volcanoes, groundwater, and geothermal systems. The course begins with a short introduction to nuclear processes and includes simple mathematical models used in isotope geochemistry.
Rules & Requirements

Prerequisites: Chemistry 1A-1B, Mathematics 1A-1B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: DePaolo

EPS C129 Biometeorology 3 Units
This course describes how the physical environment (light, wind, temperature, humidity) of plants and soil affects the physiological status of plants and how plants affect their physical environment. Using experimental data and theory, it examines physical, biological, and chemical processes affecting transfer of momentum, energy, and material (water, CO2, atmospheric trace gases) between vegetation and the atmosphere. Plant biometeorology instrumentation and measurements are also discussed.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Baldocchi

Also listed as: ESPM C129

EPS 130 Strong Motion Seismology 3 Units
Generation of seismic waves. Synthetic accelerograms. Instrumentation to measure strong ground motion. Estimation of seismic motion at a site. Ground motion spectra. Influence of soils and geologic structures. Seismic risk mapping.
Rules & Requirements

Prerequisites: Mathematics 54, or equivalent and consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geophysics 130

EPS 131 Geochemistry 4 Units
Chemical reactions in geological processes. Thermodynamic methods for predicting chemical equilibria in nature. Isotopic and chemical tracers of transport processes in the earth. Chemistry of the solid earth, oceans, and atmosphere.
Rules & Requirements

Prerequisites: 100A-100B, Chemistry 1A-1B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Geology 131

EPS C146 Geological Oceanography 4 Units
The tectonics and morphology of the sea floor, the geologic processes in the deep and shelf seas, and the climatic record contained in deep-sea sediments. The course will cover sources and composition of marine sediments, sea-level change, ocean circulation, paleoenvironmental reconstruction using fossils, imprint of climatic zonation on marine sediments, marine stratigraphy, and ocean floor resources.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Ingram

Formerly known as: Geology C145

Also listed as: GEOG C145

EPS 150 Case Studies in Earth Systems 2 Units
Analysis and discussion of three research problems on the interactions of solid earth, hydrologic, chemical, and atmospheric processes. Emphasis is on the synthesis and application of the student's disciplinary knowledge to a new integrative problem in the earth sciences.
Rules & Requirements

Prerequisites: 50, senior standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

EPS C162 Planetary Astrophysics 4 Units
Physics of planetary systems, both solar and extra-solar. Star and planet formation, radioactive dating, small-body dynamics and interaction of radiation with matter, tides, planetary interiors, atmospheres, and magnetospheres. High-quality oral presentations may be required in addition to problem sets and a final exam.
Rules & Requirements

Prerequisites: Mathematics 53, 54; PHYSICS 7A-7B-7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Chiang, de Pater, Marcy

Formerly known as: C149

Also listed as: ASTRON C162

EPS 170AC Crossroads of Earth Resources and Society 4 Units
Intersection of geological processes with American cultures in the past, present, and future. Overview of ethnogeology including traditional knowledge of sources and uses of earth materials and their cultural influences today. Scientific approach to study of tectonic controls on the genesis and global distribution of energy fuels, metals, and industrial minerals. Evolution and diversity of opinion in attitudes about resource development, environmental management, and conservation on public, private, and tribal lands. Impending crisis in renewable energy and the imperative of resource literacy.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Brimhall

Also listed as: L & S 170AC

EPS C171 Geoarchaeological Science 4 Units
This survey and laboratory course will cover a broad range of current scientific techniques used in the field and in the analysis of geoarchaeological materials. The course includes field and laboratory studies in analytical chemistry, geology, petrology/petography and a survey of dating materials in archaeology, the historical development of geoarchaeological science and other aspects of archaeological science applied to geoarchaeological materials.
Rules & Requirements

Prerequisites: 2 and/or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Summer:
6 weeks - 7.5 hours of lecture and 7.5 hours of laboratory per week
8 weeks - 6 hours of lecture and 5.5 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Also listed as: ANTHRO C131

EPS C178 Applied Geophysics 3 Units
The theory and practice of geophysical methods for determining the subsurface distribution of physical rock and soil properties. Measurements of gravity and magnetic fields, electrical and electromagnetic fields, and seismic velocity are interpreted to map the subsurface distribution of density, magnetic susceptibility, electrical conductivity, and mechanical properties.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Rector

Also listed as: CIV ENG C178

EPS C180 Air Pollution 3 Units
This course is an introduction to air pollution and the chemistry of earth's atmosphere. We will focus on the fundamental natural processes controlling trace gas and aerosol concentrations in the atmosphere, and how anthropogenic activity has affected those processes at the local, regional, and global scales. Specific topics include stratospheric ozone depletion, increasing concentrations of green house gasses, smog, and changes in the oxidation capacity of the troposphere.
Rules & Requirements

Prerequisites: Chemistry 1A-1B, PHYSICS 8A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Goldstein

Also listed as: CIV ENG C106/ESPM C180

EPS C181 Atmospheric Physics and Dynamics 3 Units
This course examines the processes that determine the structure and circulation of the Earth's atmosphere. The approach is deductive rather than descriptive: to figure out the properties and behavior of the Earth's atmosphere based on the laws of physics and fluid dynamics. Topics will include interaction between radiation and atmospheric composition; the role of water in the energy and radiation balance; governing equations for atmospheric motion, mass conservation, and thermodynamic energy balance; geostrophic flow, quasigeostrophic motion, baroclinic instability and dynamics of extratropical cyclones.
Rules & Requirements

Prerequisites: Mathematics 53, 54; PHYSICS 7A-7B-7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Chiang, Fung

Also listed as: GEOG C139

EPS C182 Atmospheric Chemistry and Physics Laboratory 3 Units
Fluid dynamics, radiative transfer, and the kinetics, spectroscopy, and measurement of atmospherically relevant species are explored through laboratory experiments, numerical simulations, and field observations.
Rules & Requirements

Prerequisites: Earth and Planetary Science 50 and 102 with grades of C- or higher (one of which may be taken concurrently) or two of the following: Chemistry 120A, 120B, C130, or 130B with grades of C- or higher (one of which may be taken concurrently)

Credit Restrictions: Students will receive 1 unit of credit for C182 after taking 125.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 5 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: CHEM C182

EPS C183 Carbon Cycle Dynamics 3 Units
The focus is the (unsolved) puzzle of the contemporary carbon cycle. Why is the concentration of atmospheric CO2 changing at the rate observed? What are the terrestrial and oceanic processes that add and remove carbon from the atmosphere? What are the carbon management strategies under discussion? How can emission protocols be verified? Students are encouraged to gain hands-on experience with the available data, and learn modeling skills to evaluate hypotheses of carbon sources and sinks.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Fung

Also listed as: ESPM C170

EPS 185 Marine Geobiology 2 Units
Interrelationships between marine organisms and physical, chemical and geological processes in oceans.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Berry

Formerly known as: Geology 185

EPS H195 Senior Honors Course 3 Units
Original research and preparation of an acceptable thesis. May be taken during two consecutive semesters of senior year and may be substituted for six units of the upper division requirement with consent of major adviser.
Rules & Requirements

Prerequisites: Limited to honors candidates

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Formerly known as: Geology H195

EPS 197 Field Study 1 - 4 Units
Written proposal signed by faculty sponsor and approved by major faculty advisor. Supervised experience relevant to specific aspects of students' EPS specialization in off-campus organization. Regular meetings with faculty sponsor and written report required.
Rules & Requirements

Prerequisites: Upper division standing and declared major in Earth and Planetary Science

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Hours & Format

Fall and/or spring: 15 weeks - 3-12 hours of fieldwork per week

Summer:
6 weeks - 7.5-30 hours of fieldwork per week
8 weeks - 6-24 hours of fieldwork per week
10 weeks - 4.5-18 hours of fieldwork per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

EPS 198 Directed Group Study 1 - 4 Units
Group studies of selected topics which vary from semester to semester.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Formerly known as: Geology 198

EPS 199 Supervised Independent Study and Research 1 - 4 Units
Enrollment is restricted by regulations.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:
6 weeks - 2.5-10 hours of independent study per week
8 weeks - 1.5-7.5 hours of independent study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Formerly known as: Geology 199

EPS 200 Problems in Hydrogeology 4 Units
Current problems in fluid flow, heat flow, and solute transport in the earth. Pressure- and thermal-driven flow, instability, convection, interaction between fluid flow and chemical reactions. Pore pressure; faulting and earthquakes; diagenesis; hydrocarbon migration and trapping; flow-associated mineralization; contaminant problems.
Rules & Requirements

Prerequisites: PHYSICS 7A-7B, Chemistry 1A-1B, MATH 53 and 54; open to senior undergraduates with appropriate prerequisites

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics C200 and Geology C200

EPS 203 Introduction to Aquatic and Marine Geochemistry 4 Units
Introduction to marine geochemistry: the global water cycle; processes governing the distribution of chemical species within the hydrosphere; ocean circulation; chemical mass balances, fluxes, and reactions in the marine environment from global to submicron scales; carbon system equilibrium chemistry and biogeochemistry of fresh and salt walter; applications of natural and anthropogenic stable and radioactive tracers; internal ocean processes.
Rules & Requirements

Prerequisites: Chemistry 1A, Mathematics 1A, or 16A. C82 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Bishop

EPS 204 Elastic Wave Propagation 3 Units
Wave propagation in elastic solids; effects of anelasticity and anistropy; representation theorems; reflection and refraction; propagation in layered media; finite-difference and finite-element methods.
Rules & Requirements

Prerequisites: 104 or equivalent; 121; PHYSICS 105

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 204

EPS 207 Laboratory in Observational Seismology 3 Units
Group problem solving of current seismological topics. Analysis, inversion, and numerical modeling of seismic waveform data to investigate questions regarding the physics of the earthquake source and seismic wave propagation. Application of current developments and techniques in seismological research.
Rules & Requirements

Prerequisites: 121 or 130 or 204 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 207

EPS 209 Matlab Applications in Earth Science 2 Units
Introduction to Matlab programming with toolboxes. Applications come from Earth sciences and related fields including biology. Topics range from image processing, riverbed characterization, landslide risk analysis, signal processing, geospatial and seismic data analysis, and machine learning to parallel computation. Designed for beginning graduate students.
Rules & Requirements

Prerequisites: Some programming experience in any language

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

EPS 210 Exploration, Ore Petrology, and Geochemistry 4 Units
Overview of geological, petrological, and geochemical analysis of ore forming processes including sedimentary, magmatic, hydrothermal, and geothermal resources. Geochemical rock buffers and hydrothermal phase equilibria. Electro-geochemistry of near surface oxidation of primary ores related to climate change, hydrological evolution, and tectonics. Exploration for earth materials for conventional and sustainable technologies including multiple junction semiconductor photo-voltaic cells. Mass balance modeling of ore-forming systems and soils. Environmental management of exploration sites. Lab includes macroscopic and X-ray identification of ore and alteration minerals and ore microscopy. Field trips use digital GIS mapping methods for rock type, structure, mineralization, and wall rock alteration. Integration interpretation of geophysics with geology.
Rules & Requirements

Prerequisites: 101 or 271; 100A-100B; 118 recommended

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Brimhall

Formerly known as: Geology 205

EPS 212 Advanced Stratigraphy and Tectonics 3 Units
Evolution of the earth in response to internal, surficial and extraterrestrial processes.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 212

EPS 216 Active Tectonics 3 Units
This course is a graduate course designed to introduce students in the earth sciences to the geology of earthquakes, including tectonic geomorphology, paleoseismology and the analysis and interpretation of geodetic measurements of active deformation. While the focus will be primarily on seismically active faults, we will also discuss deformation associated with landslides, regional isostatic rebound, and volcanoes, as well as measurements of global plate motions. We will address methods and applications in paleoseismology, tectonic geomorphology, and geodesy. The course will address measurement techniques (e.g,. GPS, leveling, etc.), data analysis and inversion, and subsequent modeling and interpretation of the data. The integration of geodetic measurements with geologic and seismologic data allows an improved understanding of active processes.
Rules & Requirements

Prerequisites: 116 or equivalent, PHYSICS 7A or equivalent, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 207

EPS 217 Fluvial Geomorphology 4 Units
Application of fluid mechanics to sediment transport and development of river morphology. Form and process in river meanders, the pool-riffle sequence, aggradation, grade, and baselevel.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 217

EPS 220 Advanced Concepts in Mineral Physics 3 Units
A combined seminar and lecture course covering advanced topics related to mineral physics. The interface between geophysics with the other physical sciences is emphasized. Topics vary each semester.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 220

EPS 224 Isotopic Geochemistry 4 Units
An overview of the use of natural isotopic variations to study earth, planetary, and environmental problems. Topics include geochronology, cosmogenic isotope studies of surficial processes, radiocarbon and the carbon cycle, water isotopes in the water cycle, and radiogenic and stable isotope studies of planetary evolution, mantle dynamics, volcanoes, groundwater, and geothermal systems. The course begins with a short introduction to nuclear processes and includes simple mathematical models used in isotope geochemistry.
Rules & Requirements

Prerequisites: Chemistry 1A-1B, Mathematics 1A-1B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: DePaolo

EPS 225 Topics in High-Pressure Research 2 Units
Analysis of current developments and techniques in experimental and theoretical high-pressure research, with applications in the physical sciences. Topics vary each semester.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophyics 225

EPS 229 Introduction to Climate Modeling 3 Units
This course emphasizes the fundamentals of the climate system via a hierarchy of climate models. Topics will include energy balance, numerical techniques, climate observations, atmospheric and oceanic circulation and heat transports, and parameterizations of eddy processes. The model hierarchy will also explore nonlinear and stochastic processes, and biogeochemistry. Students will build computational models to investigate climate feedbacks, climate sensitivity, and response times.
Rules & Requirements

Repeat rules: Course may be repeated for credit with consent of instructor. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Fung

Formerly known as: Earth and Planetary Science C229/Integrative Biology C229

EPS 230 Radiation and Its Interactions with Climate 3 Units
Introduction to role of radiative processes in structure and evolution of the climate system. Electromagnetism; solar and terrestrial radiation; interactions of radiation with Earth's atmosphere, ocean, and land surface; greenhouse and runaway greenhouse effects; radiative balance of the climate system; energy-balance climate models; effects of clouds and aerosols; interactions of radiation with atmospheric and oceanic dynamics; radiative processes and paleoclimate; radiative processes and anthropogenic global warming.
Rules & Requirements

Prerequisites: PHYSICS 105, 110A, 110B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Collins

EPS 236 Geological Fluid Mechanics 4 Units
An advanced course in the application of fluid mechanics in the earth sciences, with emphasis on the design and scaling of laboratory and numerical models. Principals of inviscid and viscous fluid flow; dynamic similarity; boundary layers; convection; instabilities; gravity currents; mixing and chaos; porous flow. Applications to mantle convection, magma dynamics, atmosphere and ocean dynamics, sediment/debris flows, and hydrogeology. Topics may vary from year to year.
Rules & Requirements

Prerequisites: Continuum/fluid mechanics at the level of 108 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 238

EPS C241 Stable Isotope Ecology 5 Units
Course focuses on principles and applications of stable isotope chemistry as applied to the broad science of ecology. Lecture topics include principles of isotope behavior and chemistry, and isotope measurements in the context of terrestrial, aquatic, and marine ecological processes and problems. Students participate in a set of laboratory exercises involving preparation of samples of choice for isotopic analyses, the use of the mass spectrometer and optical analysis systems, and the anlaysis of data.
Rules & Requirements

Prerequisites: Graduate standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructors: Amundson, Dawson, Mambelli

Also listed as: ESPM C220/INTEGBI C227

EPS C242 Glaciology 4 Units
A review of the mechanics of glacial systems, including formation of ice masses, glacial flow mechanisms, subglacial hydrology, temperature and heat transport, global flow, and response of ice sheets and glaciers. We will use this knowledge to examine glaciers as geomorphologic agents and as participants in climate change.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Cuffey

Formerly known as: 241

Also listed as: GEOG C241

EPS C249 Solar System Astrophysics 3 Units
The physical foundations of planetary sciences. Topics include planetary interiors and surfaces, planetary atmospheres and magnetospheres, and smaller bodies in our solar system. The physical processes at work are developed in some detail, and an evolutionary picture for our solar system, and each class of objects, is developed. Some discussion of other (potential) planetary systems is also included.
Rules & Requirements

Prerequisites: 149, 169, C160A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructors: Chiang, de Pater

Also listed as: ASTRON C249

EPS 250 Advanced Topics in Earth and Environmental Sciences 3 Units
Review of recent literature and discussion of ongoing research at the interface between earth science and environmental science.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 250

EPS 251 Carbon Cycle Dynamics 3 Units
In this course, we will focus on the (unsolved) puzzle of the contemporary carbon cycle. Why is the concentration of atmospheric CO2 changing at the rate observed? What are the terrestrial and oceanic processes that add and remove carbon from the atmosphere? What are the processes responsible for long-term storage of carbon on land and in the sea? Emphasis will be placed on the observations and modeling needed to evaluate hypotheses about carbon sources and sinks. Past records will be examined for clues about sensitivity of carbon processes to climate variations.
Hours & Format

Fall and/or spring: 15 weeks - 6 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 219

EPS 254 Advanced Topics in Seismology and Geophysics 1 Unit
Lectures on various topics representing current advances in seismology and geophysics, including local crustal and earthquake studies, regional tectonics, structure of the earth’s mantle, and core and global dynamics.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 250

EPS 255 Advanced Topics in Earth and Planetary Science 1 Unit
Lectures on various topics representing current advances in all aspects of earth and planetary science.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

EPS 256 Earthquake of the Week 2 Units
Each week, the seismicity of the previous week, in California and worldwide, is reviewed. Tectonics of the region as well as source parameters and waveforms of interest are discussed and placed in the context of ongoing research in seismology.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geophysics 255

EPS 260 Research in Earth Science 2 Units
Weekly presentations to introduce new graduate students and senior undergraduates to current research conducted in the Department of Earth and Planetary Science.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Geology 260

EPS 271 Field Geology and Digital Mapping 4 Units
Geological mapping, field observation, and problem solving in the Berkeley hills and environs leading to original interpretation of geological processes and history from stratigraphic, structural, and lithological investigations. Integration of the Berkeley hills geology into the tectonic and paleo-climatic record of the Coast Ranges and California as a whole through systematic field mapping in key localities and reading of original literature. Training in digital field mapping, use of digital base maps, and use of global positioning systems.
Rules & Requirements

Prerequisites: 50 or equivalent introductory course for majors

Credit Restrictions: Students will receive no credit for 271 after taking 101.

Hours & Format

Fall and/or spring: 15 weeks - 7 hours of fieldwork and 2 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Brimhall

EPS C276 Seismic Hazard Analysis and Design Ground Motions 3 Units
Deterministic and probabilistic approaches for seismic hazard analysis. Separation of uncertainty into aleatory variability and epistemic uncertainty. Discussion of seismic source and ground motion characterization and hazard computation. Development of time histories for dynamic analyses of structures and seismic risk computation, including selection of ground motion parameters for estimating structural response, development of fragility curves, and methods for risk calculations.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructor: Abrahamson

Also listed as: CIV ENG C276

EPS 280 Research 2 - 12 Units
Individual conferences to be arranged. Provides supervision in the preparation of an original research paper or dissertation.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-12 hours of independent study per week

Summer:
6 weeks - 5-30 hours of independent study per week
8 weeks - 4-23 hours of independent study per week
10 weeks - 3-18 hours of independent study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

EPS 290 Seminar 2 - 6 Units
Topics will be announced each semester.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-6 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Formerly known as: Geology 290

EPS C292 Planetary Science Seminar 1 Unit
The departments of Astronomy and Earth and Planetary Science offer a joint research seminar in advanced topics in planetary science, featuring speakers drawn from graduate students, postdoctoral researchers, faculty, and visiting scholars. Topics will span planetary interiors; surface morphology; atmospheres; dynamics; planet formation; and astrobiology. Speakers will vary from semester to semester. Meetings will be held once a week for 1 hour each, and the schedule of speakers will be determined on the first day of class. To pass the class, participants will be required to give a 30-minute presentation, either on their own research or on recent results from the literature.
Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-1 hours of seminar per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Also listed as: ASTRON C292

EPS C295Z Energy Solutions: Carbon Capture and Sequestration 3 Units
After a brief overview of the chemistry of carbon dioxide in the land, ocean, and atmosphere, the course will survey the capture and sequestration of CO2 from anthropogenic sources. Emphasis will be placed on the integration of materials synthesis and unit operation design, including the chemistry and engineering aspects of sequestration. The course primarily addresses scientific and engineering challenges and aims to engage students in state-of-the-art research in global energy challenges.
Rules & Requirements

Prerequisites: Chemistry 4B or 1B, Mathematics 1B, and PHYSICS 7B, or equivalents

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: Letter grade.

Instructors: Bourg, DePaolo, Long, Reimer, Smit

Also listed as: CHEM C236/CHM ENG C295Z

EPS 298 Directed Group Study for Graduates 1 - 9 Units
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Graduate

Grading: The grading option will be decided by the instructor when the class is offered.

Formerly known as: Geology 298

EPS C301 Communicating Ocean Science 4 Units
For graduate students interested in improving their ability to communicate their scientific knowledge by teaching ocean science in elementary schools or science centers/aquariums. The course will combine instruction in inquiry-based teaching methods and learning pedagogy with six weeks of supervised teaching experience in a local school classroom or the Lawrence Hall of Science with a partner. Thus, students will practice communicating scientific knowledge and receive mentoring on how to improve their presentations.
Rules & Requirements

Prerequisites: One course in introductory biology, geology, chemistry, physics, or marine science required and interest in ocean science,junior, senior, or graduate standing; consent of instructor required for sophomores

Hours & Format

Fall and/or spring: 15 weeks - 2.5 hours of lecture, 1 hour of discussion, and 2 hours of fieldwork per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Professional course for teachers or prospective teachers

Grading: Letter grade.

Instructor: Ingram

Also listed as: GEOG C301/INTEGBI C215

EPS 375 Professional Preparation: Supervised Teaching of Geology and Geophysics 1 - 6 Units
Discussion, curriculum, class observation, and practice teaching in geology, geophysics, and earth science.
Rules & Requirements

Prerequisites: Graduate standing and appointment as graduate student instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of discussion per week

Additional Details

Subject/Course Level: Earth and Planetary Science/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Earth and Planetary Science 300