

THE SCHOOL OF THE ENVIRONMENT

College of Science and Engineering

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Graduate Coordinator: Leora Nanus

Professor

Leonhard Blesius (2007), *Professor in Geography and Environment*. Ph.D. University of Iowa.

Tendai Chitewere (2007), *Professor in Geography and Environment*. Ph.D. Binghamton University.

Jerry D. Davis (1988), *Professor in Geography and Environment*. Ph.D. University of Georgia.

Jason Henderson (2003), *Professor in Geography and Environment*. Ph.D. University of Georgia.

Ellen Hines (2001), *Professor in Geography and Environment*. Ph.D. University of Victoria.

Mary L. Leech (2005), *Professor in Geology*. Ph.D. Stanford University.

Xiaohang Liu (2003), *Professor in Geography and Environment*. Ph.D. University of California, Santa Barbara.

Andrew J. Oliphant (2002), *Professor in Geography and Environment*. Ph.D. University of Canterbury.

Alexander Stine (2013), *Professor in Oceanography*. Ph.D. University of California, Berkeley.

Nancy Lee Wilkinson (1986), *Professor in Geography and Environment*. Ph.D. University of Oregon.

Associate Professor

Jennifer Blecha (2007), *Associate Professor in Geography and Environment*. Ph.D. University of Minnesota.

John Caskey (1998), *Associate Professor in Geology*. Ph.D. University of Nevada.

Courtney Donovan (2007), *Associate Professor in Geography and Environment*. Ph.D. University of Washington.

Glenn E. Fieldman (1990), *Associate Professor in Environmental Studies*. Ph.D. University of Denver.

Qian Guo (1998), *Associate Professor in Geography and Environment*. Ph.D. University of Tennessee, Knoxville.

Yadira Ibarra (2016), *Associate Professor in Earth and Climate Sciences*. Ph.D. University of Southern California.

Leora Nanus (2014), *Associate Professor in Geography and Environment*. Ph.D. University of Colorado Boulder.

Aritree Samanta (2018), *Associate Professor in Environmental Studies*. Ph.D. Cleveland State University.

Autumn Thoyre (2016), *Associate Professor in Environmental Studies*. Ph.D. University of North Carolina at Chapel Hill.

Assistant Professor

Erin Bray (2019), *Assistant Professor in Earth and Climate Sciences*. Ph.D. University of California, Santa Barbara.

Adjunct Professor

Stuart W. Siegel (2016), *Adjunct Professor in Estuarine Science*. Ph.D. University of California, Berkeley.

Leonard Sklar (2003), *Adjunct Professor in Geology*. Ph.D. University of California, Berkeley.

Lisa D. White (1990), *Adjunct Professor in Geology*. Ph.D. University of California, Santa Cruz.

Majors

- Bachelor of Arts in Earth Sciences (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ba-earth-sciences/>)
- Bachelor of Arts in Environmental Studies (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ba-environmental-studies/>)
- Bachelor of Arts in Geography (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ba-geography/>)
- Bachelor of Science in Earth Sciences (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/bs-earth-sciences/>)
- Bachelor of Science in Environmental Science (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/bs-environmental-science/>)
- Bachelor of Science in Environmental Studies: Concentration in Natural Resource Management and Conservation (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/bs-environmental-studies-concentration-natural-resource-management-conservation/>)

Minor

- Minor in Earth Sciences (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/minor-earth-sciences/>)
- Minor in Geography (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/minor-geography/>)

Certificate

- Certificate in Climate Change Causes, Impacts, and Solutions (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ct-climate-change/>)

- Certificate in Weather Study (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/certificate-weather-study/>)

Masters

- Master of Arts in Geography (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ma-geography/>)
- Master of Arts in Geography: Concentration in Resource Management and Environmental Planning (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ma-geography-concentration-resource-management-environmental-planning/>)
- Master of Science in Geographic Information Science (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ms-geographic-information-science/>)
- Master of Science in Geosciences (<http://bulletin.sfsu.edu/colleges/science-engineering/environment/ms-geosciences/>)

Environmental Studies Courses (ENVS) (p. 8)

Geography and Environment Courses (GEOG) (p. 9)

Earth Sciences (ERTH)

ERTH 110 Our Dynamic Earth (Units: 3)

Prerequisite: Not open to students who have completed EARTH 112.

Investigating the geologic processes that are continually shaping our planet, emphasizing the connections between humans and nature and the process of scientific discovery. Designed for non-science majors.

Course Attributes:

- B1: Physical Science
- Environmental Sustainability

ERTH 112 Our Dynamic Earth Lecture and Lab (Units: 4)

Prerequisite: Not open to students who have completed EARTH 110 or EARTH 111.

Investigate the geologic processes that are continually shaping our planet with an emphasis on the connections between humans and nature and the process of scientific discovery. Designed for non-science majors. Lecture, 3 units; laboratory, 1 unit. Extra fee required.

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability

ERTH 115 History of Life (Units: 3)

Origin and early development of life; evolution of life through geologic time; extinction and replacement of organisms.

Course Attributes:

- B2: Life Science
- Environmental Sustainability

ERTH 162 Our Dynamic Weather Lecture and Lab (Units: 3)

Prerequisite: Not open to students who have completed EARTH 160.

The nature of weather, including winds, storms, clouds, and precipitation. How and why weather changes, emphasizing the process of scientific discovery. Weather map interpretation and weather forecasting. Designed for non-science majors. Lecture, 2 units; laboratory, 1 unit. Extra fee required.

Course Attributes:

- B1: Physical Science
- B3: Lab Science

ERTH 170 Our Dynamic Ocean (Units: 3)

Prerequisite: Not open to students who have completed EARTH 172.

Investigating components and operating principles of the ocean system, including ocean basin features, currents, nutrient cycling, and climatic influences, emphasizing the process of scientific discovery. Designed for non-science majors.

Course Attributes:

- B1: Physical Science
- Environmental Sustainability

ERTH 171 Our Dynamic Ocean Lab (Unit: 1)

Prerequisite: EARTH 170 (may be taken concurrently); not open to students who have completed EARTH 172.

Investigating ocean processes that play a dominant role in regulating our climate and environment. Emphasizes nature human connections and the process of scientific discovery through hands-on activities. Extra fee required.

Course Attributes:

- B3: Lab Science

ERTH 172 Our Dynamic Ocean Lecture and Lab (Units: 4)

Prerequisite: Not open to students who have completed EARTH 170 or EARTH 171.

Investigate components and operating principles of the ocean system, including ocean basin features, currents, nutrient cycling, and climatic influences, emphasizing the process of scientific discovery. Designed for non-science majors. Lecture, 3 units; laboratory and fieldwork, 1 unit. Extra fee required.

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability

ERTH 205 Techniques in Earth Sciences (Units: 2)

Prerequisite: An introductory course in one of the earth sciences (geology, meteorology, oceanography) or EARTH 400.

Introduction to field and laboratory techniques in the earth sciences, including scientific writing and library research. Laboratory and fieldwork, 2 units. (Plus-Minus letter grading only)

ERTH 210 Physical Geology (Units: 4)

Composition, structure, and evolution of the earth; earth materials; tectonic and hydrologic systems; landform development; relation of geologic systems to the human environment. Lecture, 3 units; laboratory and fieldwork, 1 unit. Extra fee required. (Plus-minus letter grade only)

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability

ERTH 230 Environmental Geology (Units: 3)

Human interaction with the geologic environment. Social and political implications, resource and energy exploitation, land use planning, waste disposal, and human modification of nature. Lecture, 2 units; laboratory and fieldwork, 1 unit. Intended for non-science majors.

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability

ERTH 240 Environmental Water Resources (Units: 3)

Apply concepts from hydrology, the science of water, to investigate the distribution, flow, and properties (physical, chemical, and biological) of water resources. Characterize the environmental state of freshwater and related food, energy, and ecological resources. Problem-solving related to pollution and prevention, natural disasters, such as droughts and floods, water scarcity, urbanization and stormwater, sustainable groundwater management, engineering solutions, seawater intrusion, and climate variability, with a focus on CA and San Francisco. Experience with hydrologic measurements, testing, data collection, and analysis in the field and using computer models. Lecture, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability

ERTH 260 Physical Processes in the Atmosphere (Units: 4)

Prerequisite: MATH 199 or equivalent or satisfactory score on calculus pretest.

Observed behaviors of the atmosphere and the processes and principles that explain and predict them. Algebra-based problem solving. Lecture, 3 units; laboratory, 1 unit. Extra fee required.

Course Attributes:

- B1: Physical Science
- B3: Lab Science
- Environmental Sustainability
- Global Perspectives

ERTH 310 The Violent Earth (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

The catastrophic geological agents that modify the environment. The significance of processes such as earthquakes and volcanic eruptions in the development of our planet. The concept of time in evaluating the magnitude of these violent events. Designed for non-science majors.

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability

ERTH 325 Geology of the National Parks (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Apply geologic principles to natural environments of North America with a focus on the geologic history, landscape evolution of the National Parks, and the uniqueness of natural regions and questions of preservation. Lecture, 2 units; laboratory, 1 unit. Designed for non-science majors. (Plus-minus letter grade only)

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability

ERTH 330 California Water (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor. Intended for non-science majors.

Human interaction with the hydrologic environment; science and politics of water issues facing California; hydrologic cycle, floods, droughts, groundwater, contamination; water needs of cities, farms, ecosystems; effects of climate change on water resources. (Plus-minus letter grade only)

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability

ERTH 335 Global Warming (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Scientific understanding of global warming. Greenhouse gases, records of past climate change, warming of the recent past, human impact on climate, projections of future climate, and the impact on society. Critical evaluation of popular media coverage of climate change.

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability
- Global Perspectives

ERTH 360 California Weather Events (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Investigation of the basic meteorology of normal and abnormal weather events in California.

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability
- Global Perspectives

ERTH 365 Extreme Weather in a Warming World (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Atmosphere and ocean as agents of catastrophic change. Fluctuations in atmospheric and oceanic circulations and their environmental impacts. Implications of human modification of the ocean-atmosphere system. Weather variability as evidenced by recent floods, droughts, and severe weather. Designed for non-science majors.

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability
- Global Perspectives

ERTH 400 Earth Systems I (Units: 3)

Prerequisites: At least 9 units of coursework in geoscience, earth sciences, chemistry, or physics.

Exploring the components of Earth's systems: atmosphere, hydrosphere, lithosphere, biosphere, and anthroposphere, with focus on the physical and biogeochemical processes through which the components interact. Lecture, 2 units; laboratory, 1 unit.

ERTH 410 Volcanology (Units: 3)

Prerequisite: EARTH 210 or permission of the instructor.

Volcanic processes, landforms, structures, and rocks; origin and differentiation of magma and relation to plate boundaries; case studies of volcanic events on earth and other planets; applications to archaeology and other disciplines. Lecture, 2 units; laboratory and fieldwork, 1 unit. Extra fee required.

ERTH 420 Mineralogy and Petrology I (Units: 4)

Prerequisites: EARTH 210 and CHEM 115 or permission of the instructor.

Minerals: physical properties, crystal chemistry, reactions and stability, and identification of common types, including optical mineralogy. Lecture, 2 units; laboratory and fieldwork, 2 units.

ERTH 425 Geomorphology (Units: 4)

Prerequisites for EARTH 825: Graduate or senior standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; or permission of the instructor.

Prerequisites for EARTH 425: Upper-division standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; or permission of the instructor.

Landscapes, their geologic evolution, and the processes which create and modify them. Lecture, 3 units; laboratory, 1 unit.

(ERTH 825/ERTH 425 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 434 Coastal Processes (Units: 3)

Prerequisites for EARTH 834: Graduate or senior standing; MATH 226 and PHYS 111 or PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

Prerequisites for EARTH 434: Upper-division standing; MATH 226 and PHYS 111 or PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

Dynamics of the nearshore ocean and interactions with the coast and beaches. Topics include tides, coastal waves and currents, sediment transport and beaches, inner shelf processes, and estuarine dynamics. Lecture, 2 units; laboratory, 1 unit.

(ERTH 834/ERTH 434 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 442 Surface Water Hydrology (Units: 4)

Prerequisites: MATH 226 and EARTH 210 or EARTH 505 are recommended; or permission of the instructor.

Introduction to surface water hydrology; exploration of hydrologic processes; how precipitation and snowmelt become streamflow, evapotranspiration, and groundwater; watershed hydrology, streamflow processes, and water quality. Lecture, 3 units; activity, 1 unit. (Plus-minus letter grade only)

(This course is offered as EARTH 442 and GEOG 342. Students may not repeat the course under an alternate prefix.)

ERTH 444 Hydrogeology (Units: 4)

Prerequisites for EARTH 744: Graduate or senior standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222 or an upper-division Engineering course; or permission of the instructor.

Prerequisites for EARTH 444: Upper-division standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; GPA of 3.0 or higher; or permission of the instructor.

Physical and geologic factors controlling the occurrence and dynamics of groundwater. Chemical parameters and distribution. Aquifer testing and analysis. Lecture, 3 units; laboratory, 1 unit.

(ERTH 744/ERTH 444 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 446 Quaternary Geology and Soils (Units: 3)

Prerequisites for EARTH 846: Graduate standing; EARTH 210; or permission of the instructor.

Prerequisites for EARTH 446: Senior standing; EARTH 210; GPA of 3.0 or higher; or permission of the instructor.

Pleistocene and Holocene environments, and their geomorphic and stratigraphic record. Emphasis on landform evolution, soil genesis, soil genesis, climatic history, sea-level changes, neotectonics, and environmental impact. Lecture, 2 units; laboratory, 1 unit.

(ERTH 846/ERTH 446 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 465 Weather Analysis and Forecasting I (Units: 4)

Prerequisites: EARTH 260, EARTH 461, MATH 227, PHYS 111 or (recommended) PHYS 220.

Weather analysis and forecasting as an application of the principles of atmospheric physics and dynamics. Weather satellite analysis techniques. Operational forecasting. Lecture, 2 units; laboratory, 2 units. (Plus-minus letter grade only)

ERTH 470 Physical Oceanography (Units: 4)

Prerequisites for EARTH 870: Graduate or senior standing; EARTH 170 or EARTH 172; and PHYS 220; or permission of the instructor.

Prerequisites for EARTH 470: Upper-division standing; EARTH 170 or EARTH 172; and PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

The dynamic character of the ocean environment with an emphasis on the properties of seawater, surface heat transfer, Coriolis force, surface and deep ocean circulation, deep and shallow wave phenomena, and underwater sound and optics. Designed for both the physical scientist and marine biologist. Lecture, 3 units; laboratory, 1 unit.
(ERTH 870/ERTH 470 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 490 Public Weather Forecasting (Units: 1-3)

Prerequisites: Earth Sciences majors; EARTH 160 or EARTH 162 or EARTH 260.

Weather forecasting tailored for public use. Forecasting and nowcasting in the media. Weather briefing duties of intern forecaster. May be repeated for a total of 3 units. (Plus-minus letter grade only)

ERTH 500 Earth Systems II (Units: 3)

Prerequisite: EARTH 400.

Exploration of how physical and biochemical processes in Earth's systems led to the origin and evolution of the continents, oceans, atmosphere, and life through geologic time. Lecture, 2 units; laboratory and fieldwork, 1 unit.

ERTH 505 Quantitative Methods in Earth Sciences (Units: 3)

Prerequisites: EARTH 400 or MATH 199.

Quantitative reasoning and techniques, including statistics, applied to problems in earth science. Lecture, 2 units; laboratory and fieldwork, 1 unit. Weekend field trip required. (Plus-minus letter grade only)

ERTH 510 Structural Geology (Units: 4)

Prerequisites: EARTH 500 and EARTH 420; EARTH 505 or MATH 199.

Mechanical aspects of rock deformation. Description, classification, and genesis of folds, faults, and other structures of the earth's crust. Evolution of regional structures. Lecture, 2 units; laboratory and fieldwork, 2 units.

ERTH 515 Sedimentology and Stratigraphy (Units: 4)

Prerequisites: EARTH 205, EARTH 420, and EARTH 500.

Sedimentary particles and processes, depositional environments, principles of stratigraphic correlation, and basin analysis. Lecture, 2 units; laboratory and fieldwork, 2 units. (Plus-minus letter grade only)

ERTH 520 Mineralogy and Petrology II (Units: 4)

Prerequisite for EARTH 820: Graduate standing or permission of the instructor.

Prerequisites for EARTH 520: Upper-division standing; EARTH 420; GPA of 3.0 or higher; or permission of the instructor.

Advanced mineralogy and igneous and metamorphic petrology with a focus on physical and chemical processes in the earth. Lecture, 2 units; laboratory, 2 units. Extra fee required.
(ERTH 820/ERTH 520 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 526 Ore Deposits (Units: 4)

Prerequisite for EARTH 826: Graduate standing; EARTH 420; or permission of the instructor.

Prerequisites for EARTH 526: Upper-division standing; EARTH 420; GPA of 3.0 or higher; or permission of the instructor.

The origin of ore deposits emphasizing the mineralogic, petrologic, and plate tectonic environments of major deposits from around the world. Chemical and physical controls on ore transport and deposition. Techniques of mineral exploration and mining. Lecture, 3 units; laboratory, 1 unit.

(ERTH 826/ERTH 526 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 535 Planetary Climate Change (Units: 4)

Prerequisites: At least 9 units of physical sciences coursework.

Interdisciplinary investigation of physical processes, principles, and tools contributing to our understanding of climate and climate change. Lecture, 3 units; laboratory, 1 unit.

ERTH 544 Groundwater Contamination (Units: 3)

Prerequisites for EARTH 844: Graduate or senior standing; EARTH 744.

Prerequisites for EARTH 544: Upper-division standing; EARTH 444; CHEM 115 recommended; GPA of 3.0 or higher; or permission of the instructor.

Application of hydrogeologic principles to the solution of groundwater contamination problems. Seminar, 2 units; laboratory, 1 unit.
(ERTH 844/ERTH 544 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 577 Climate and Ecological Interactions (Units: 4)

Prerequisites: MATH 107 and MATH 108, or MATH 199, or MATH 226; BIOL 230 and BIOL 240 or two 200-level or higher courses in Earth & Climate Sciences; or permission of the instructor.

Theory, observations, and modeling of the two-way interaction between climate and ecology. Lecture, 3 units; laboratory, 1 unit. (Plus-minus letter grade only)

(This course is offered as BIOL 577 and EARTH 577. Students may not repeat the course under an alternate prefix.)

ERTH 600GW Earth's Climate History - GWAR (Units: 3)

Prerequisites: GE Area A2; CHEM 115 and EARTH 500 (may be taken concurrently).

Examination of Earth's climate history over the last 50 million years; analysis of different mechanisms of climate forcing including tectonic changes, greenhouse gas forcing on long and short time scales, orbital forcing, and internal climate feedback. Lecture, 2 units; laboratory, 1 unit. (ABC/NC grading only)

Course Attributes:

- Graduation Writing Assessment

ERTH 610 Neotectonics (Units: 3)

Prerequisites for EARTH 810: Graduate or senior standing; EARTH 510; or permission of the instructor.

Prerequisites for EARTH 610: Senior standing; EARTH 510; GPA of 3.0 or higher; or permission of the instructor.

Principles of earthquake geology including plate tectonics, fault mechanics, basic seismology, geodesy, tectonic geomorphology, seismic hazard analysis, and case studies of large historical earthquakes. Lecture, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)
(ERTH 810/ERTH 610 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 620 Field Methods in Geology (Units: 2)

Prerequisites: EARTH 210, EARTH 510, EARTH 515, satisfactory standing in the major, or permission of the instructor.

Field methods: plotting features on topographic maps and aerial photographs, use of field instruments, mapping, and preparation of geologic reports. Laboratory and fieldwork.

ERTH 642 Watershed Assessment and Restoration (Units: 4)

Prerequisites: GEOG 101 or EARTH 210; GEOG 603 and MATH 199.

Assessing and restoring watersheds and streams. Exploration of hydrologic and watershed processes, variables influencing runoff and erosion, and hillslope and stream restoration techniques. Lecture, 3 units; activity, 1 unit. [CSL may be available]
(This course is offered as GEOG 642 and EARTH 642. Students may not repeat the course under an alternate prefix.)

ERTH 690 Earth Sciences Capstone Presentation (Unit: 1)

Prerequisites: Restricted to senior Earth Sciences majors, EARTH 695 or EARTH 698 (may be taken concurrently).

Principles and best practices of presenting scientific information orally and by poster. Practice presenting senior project or senior thesis research. Presentation of senior project at a poster session or oral thesis defense open to the public. (Plus-minus letter grade only)

ERTH 695 Senior Project (Units: 1-3)

Prerequisites: Senior Earth Sciences majors, 3.0 GPA in major course work, and permission of Earth Sciences faculty adviser.

Directed, original research on an Earth Sciences-related problem.

ERTH 697 Undergraduate Research (Units: 2)

Prerequisites: Senior standing and permission of the instructor.

Research activities, including literature review, project design, data collection, and analysis. (Plus-minus letter grade only)

ERTH 698 Senior Thesis (Units: 2)

Prerequisite: EARTH 697 (may be taken concurrently).

Undergraduate research, to include a written report and oral presentation approved by the thesis committee. (Plus-minus letter grade only)

ERTH 699 Independent Study (Units: 1-3)

Prerequisite: Permission of the instructor.

Independent study in the laboratory, field, or library under the direction of a faculty member. The student must present a written report of the work accomplished to the faculty.

ERTH 700 Graduate Seminar in Geosciences (Units: 2)

Prerequisite: Graduate standing.

Introduction to the graduate program; discussion of interdisciplinary geoscience topics; format to include speakers and assigned readings. (Plus-minus letter grade only)

ERTH 701 Research Methods in Geosciences (Units: 3)

Prerequisite: EARTH 700 or permission of the instructor.

Application of research methods: problem formulation, literature searches, proposal writing, scientific report writing, and oral presentation. Preparation of proposal for master's thesis. (Plus-minus letter grade only)

ERTH 702 Quantitative Methods in Geosciences (Units: 3)

Prerequisites: Courses in basic statistics, calculus, and computer applications, or permission of the instructor.

Quantitative methods and computer techniques necessary for geoscience problem-solving. Lecture, 2 units; laboratory and fieldwork, 1 unit. (Plus-minus letter grade only)

ERTH 741 Electron Microscopy (Units: 4)

Prerequisites: Graduate or senior standing and permission of the instructor.

Introduction to electron microscopy with a focus on instrumentation, image formation and interpretation, x-ray microanalysis, sample preparation, artifacts, and related techniques. Laboratory work includes operation of the electron microscope, x-ray microanalysis, and the preparation of biological and inorganic specimens for scanning and transmission electron microscopy. Seminar, 2 units; laboratory, 2 units. Extra fee required. (Plus-minus letter grade only)
(This course is offered as BIOL 741, CHEM 741, and EARTH 741. Students may not repeat the course under an alternate prefix.)

ERTH 744 Hydrogeology (Units: 4)

Prerequisites for EARTH 744: Graduate or senior standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222 or an upper-division Engineering course; or permission of the instructor.

Prerequisites for EARTH 444: Upper-division standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; GPA of 3.0 or higher; or permission of the instructor.

Physical and geologic factors controlling the occurrence and dynamics of groundwater. Chemical parameters and distribution. Aquifer testing and analysis. Lecture, 3 units; laboratory, 1 unit.

(ERTH 744/ERTH 444 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 790 Advanced Public Weather Forecasting (Units: 1-3)

Prerequisite: EARTH 490 and/or permission of the instructor.

Direction of a forecast office. Students assume lead forecaster responsibilities in administration of the SF State Public Weather Forecast Center. (Plus-minus letter grade only)

ERTH 795 Selected Topics in the Geosciences (Units: 3)

Prerequisite: Graduate standing or permission of the instructor.

Topics to be specified in the Class Schedule. May be repeated for a maximum of 12 units when topics vary. (Plus-minus letter grade only)

Topics:

- a. Rock Mechanics in Geomorphology
- b. Sedimentary Processes & Depositional Environments
- c. Vadose Zone Hydrology
- d. Global Tectonics
- e. Oceanographic Processes in the CA Current System

ERTH 810 Neotectonics (Units: 3)

Prerequisites for EARTH 810: Graduate or senior standing; EARTH 510; or permission of the instructor.

Prerequisites for EARTH 610: Senior standing; EARTH 510; GPA of 3.0 or higher; or permission of the instructor.

Principles of earthquake geology including plate tectonics, fault mechanics, basic seismology, geodesy, tectonic geomorphology, seismic hazard analysis, and case studies of large historical earthquakes. Lecture, 2 units; laboratory, 1 unit. (Plus-minus letter grade only)

(ERTH 810/ERTH 610 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 820 Mineralogy and Petrology II (Units: 4)

Prerequisite for EARTH 820: Graduate standing or permission of the instructor.

Prerequisites for EARTH 520: Upper-division standing; EARTH 420; GPA of 3.0 or higher; or permission of the instructor.

Advanced mineralogy and igneous and metamorphic petrology with a focus on physical and chemical processes in the earth. Lecture, 2 units; laboratory, 2 units. Extra fee required.

(ERTH 820/ERTH 520 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 825 Geomorphology (Units: 2)

Prerequisites for EARTH 825: Graduate or senior standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; or permission of the instructor.

Prerequisites for EARTH 425: Upper-division standing; EARTH 210, EARTH 505 or MATH 226, and PHYS 111 and PHYS 112 or PHYS 220 and PHYS 222; or permission of the instructor.

Landscapes, their geologic evolution, and the processes which create and modify them. Lecture, 3 units; laboratory, 1 unit.

(ERTH 825/ERTH 425 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 826 Ore Deposits (Units: 2)

Prerequisite for EARTH 826: Graduate standing; EARTH 420; or permission of the instructor.

Prerequisites for EARTH 526: Upper-division standing; EARTH 420; GPA of 3.0 or higher; or permission of the instructor.

The origin of ore deposits emphasizing the mineralogic, petrologic, and plate tectonic environments of major deposits from around the world. Chemical and physical controls on ore transport and deposition. Techniques of mineral exploration and mining. Lecture, 3 units; laboratory, 1 unit.

(ERTH 826/ERTH 526 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 834 Coastal Processes (Units: 3)

Prerequisites for EARTH 834: Graduate or senior standing; MATH 226 and PHYS 111 or PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

Prerequisites for EARTH 434: Upper-division standing; MATH 226 and PHYS 111 or PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

Dynamics of the nearshore ocean and interactions with the coast and beaches. Topics include tides, coastal waves and currents, sediment transport and beaches, inner shelf processes, and estuarine dynamics. Lecture, 2 units; laboratory, 1 unit.

(ERTH 834/ERTH 434 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 844 Groundwater Contamination (Units: 3)

Prerequisites for EARTH 844: Graduate or senior standing; EARTH 744.

Prerequisites for EARTH 544: Upper-division standing; EARTH 444; CHEM 115 recommended; GPA of 3.0 or higher; or permission of the instructor.

Application of hydrogeologic principles to the solution of groundwater contamination problems. Seminar, 2 units; laboratory, 1 unit.

(ERTH 844/ERTH 544 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 846 Quaternary Geology and Soils (Units: 3)

Prerequisites for EARTH 846: Graduate standing; EARTH 210; or permission of the instructor.

Prerequisites for EARTH 446: Senior standing; EARTH 210; GPA of 3.0 or higher; or permission of the instructor.

Pleistocene and Holocene environments, and their geomorphic and stratigraphic record. Emphasis on landform evolution, soil genesis, soil genesis, climatic history, sea-level changes, neotectonics, and environmental impact. Lecture, 2 units; laboratory, 1 unit.

(ERTH 846/ERTH 446 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 870 Physical Oceanography (Units: 4)

Prerequisites for EARTH 870: Graduate or senior standing; EARTH 170 or EARTH 172; and PHYS 220; or permission of the instructor.

Prerequisites for EARTH 470: Upper-division standing; EARTH 170 or EARTH 172; and PHYS 220; GPA of 3.0 or higher; or permission of the instructor.

The dynamic character of the ocean environment with an emphasis on the properties of seawater, surface heat transfer, Coriolis force, surface and deep ocean circulation, deep and shallow wave phenomena, and underwater sound and optics. Designed for both the physical scientist and marine biologist. Lecture, 3 units; laboratory, 1 unit.

(ERTH 870/ERTH 470 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ERTH 896 Directed Reading in the Geosciences (Units: 3)

Prerequisite: Graduate status or permission of adviser.

Supervised literature research in a specific area chosen on the basis of individual student need. Readings, tutorial discussion, and research report or creative projects. May be repeated for a total of 6 units. (Plus-minus letter grade, RP grading only)

ERTH 897 Research Project (Units: 1-3)

Prerequisites: Graduate standing, EARTH 700, and EARTH 701.

Thesis research incorporates all aspects of investigative studies from data collection to data analysis. May be repeated for a total of 6 units. (Plus-minus letter grade, RP grading only)

ERTH 898 Master's Thesis (Units: 3)

Prerequisites: Graduate standing, EARTH 700, EARTH 701, EARTH 702, permission of instructor and approval of Advancement to Candidacy (ATC) and Culminating Experience (CE) forms by Graduate Studies.

Advancement to Candidacy (ATC) and Proposal for Culminating Experience Requirement forms must be approved by the Graduate Division before registration. (Plus-minus letter grade, RP grading only)

ERTH 899 Independent Study (Units: 1-3)

Prerequisites: Graduate standing and permission of the adviser.

Independent study in the laboratory or field under the direction of a faculty member. A detailed written report of the work accomplished must be submitted to the department. May be repeated for a total of 6 units. (Plus-minus AB/NC grading only)

Environmental Studies (ENVS)**ENVS 130 Environmental Studies (Units: 3)**

Introduction to environmental studies. An examination of the history of the environmental movement, exploration of strategies to effect constructive change, analysis of environmental fields, and the need for their integration. [Formerly ENVS 300]

Course Attributes:

- Environmental Sustainability

ENVS 224 Research Methods for Environmental Studies (Units: 4)

Prerequisite: Restricted to Environmental Studies majors or permission of the instructor.

Introduction to quantitative and qualitative research methods in environmental studies. The scientific method, field methods in natural and social sciences, and data analysis including descriptive statistics and hypothesis testing. Lecture, 3 units; activity, 1 unit.

ENVS 331 Global Environmental Crisis (Units: 4)

Prerequisite: Upper-division standing.

Describes the impact of a growing world economy and population on biological and physical earth systems, and the potential consequences of environmental destruction for human well-being. Explores the historical and economic reasons for the political divide between developed and less-developed countries with respect to environmental issues and negotiations.

(This course is offered as I R 331 and ENVS 331. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- Environmental Sustainability
- Global Perspectives
- Social Justice

ENVS 450GW Environmental Law and Policy - GVAR (Units: 3)

Prerequisites: GE Area A2 and ENVS 130 or permission of the instructor.

Introduction and overview of environmental policies and the legal system at the national and international level through directed readings, class discussion, and research in the field of environmental law and policy. (ABC/NC grading only.)

Course Attributes:

- Graduation Writing Assessment

ENVS 460 Energy, Justice, and Sustainability (Units: 3)

Prerequisite: Upper-division standing or permission of the instructor.

Interdisciplinary social scientific exploration of energy focusing on environmental justice, sustainability, and political-economic perspectives. Topics include environmental impacts of energy systems and resources, social movements for sustainable energy transitions, and intersections of energy systems with inequalities in race, class, and gender. [CSL may be available]

ENVS 470 Climate Politics and Policy (Units: 3)

Prerequisite: ENVS 130 or permission of the instructor.

Domestic and international politics surrounding both climate change and the requirements of climate policy in the context of a global society dedicated to economic growth and characterized by sharp divisions between rich and poor.

Course Attributes:

- Environmental Sustainability
- Global Perspectives

ENVS 480 Climate Change Adaptation and Justice (Units: 3)

Prerequisite: Upper-division standing or permission of the instructor.

Interdisciplinary examination of the social, economic, political, and ethical aspects of climate change, with a focus on adaptation, justice, and resilience. Discussion of adaptation to climate change in both the developed and the developing world and in different sectors and regions; the role of state, non-state, and community actors; and justice and equity implications of climate change adaptation.

ENVS 530 Environmental Leadership and Organizing (Units: 3)

Prerequisite: ENVS 130 or permission of the instructor.

Theoretical and applied study of leadership and organizing for the environment and environmental justice. Multidisciplinary exploration of social change and democratic action. Topics include gender and race-sensitive leadership, alternative approaches for civic engagement, organizing strategy and tactics, advocacy ethics, and current challenges facing the environmental movement.

ENVS 570 Applied Local Sustainability (Units: 3)

Prerequisite: ENVS 130 or permission of the instructor.

Examination of current sustainability issues and efforts at SF State, local cities, and other institutions across the country. Includes hands-on sustainability research on campus.

Course Attributes:

- Environmental Sustainability

ENVS 600 Environmental Problems and Solutions (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

An ecological approach to nature and the landscape. Human populations, natural resources, and environmental quality in California with particular reference to the San Francisco Bay Area.

(This course is offered as GEOG 600 and ENVS 600. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- UD-D: Social Sciences
- Environmental Sustainability
- Global Perspectives

ENVS 640 Recreational Use of National Parks and Protected Areas (Units: 3)

Prerequisite: Upper-division standing or permission of the instructor.

Introduction to concepts of conservation and preservation of national parks and other ecosystem units, and managing visitor use. Emphasis on history, management principles, and current issues. National parks will be the primary focus and selected international protected areas will be included. [CSL may be available]

(This course is offered as RPT 640 and ENVS 640. Students may not repeat the course under an alternate prefix.)

ENVS 651 Student Managed Fund in Environmental, Social and Governance (ESG) Investments (Units: 3)

Prerequisite: Sophomore standing or higher.

Introduction to the fundamental concepts and principles of Environmental, Social, and Governance (ESG) investments and their application to firm valuation and portfolio selection. Discussion of the topics of financial markets, financial statement analysis, time value of money, asset valuation, risk and return, and portfolio selection within the context of ESG. Survey of critical skills in implementing the ESG principles in investments with a blend of discussions, readings, cases, and presentations.

(This course is offered as FIN 651, ECON 651, and ENVS 651. Students may not repeat the course under an alternate prefix.)

ENVS 657 Natural Resource Management: Biotic Resources (Units: 4)

Prerequisites: GEOG 101, GEOG 205 or ENVS 224, or permission of the instructor.

Basic theories and methodologies of managing forest, wildlife and rangeland resources. Agencies, laws, and policies that govern natural resource management. Emphasis on the urban-wildland interface. Lecture, 3 units; activity, 1 unit.

(This course is offered as GEOG 657 and ENVS 657. Students may not repeat the course under an alternate prefix.)

ENVS 675 Climate Ambassadors Practicum (Units: 4)

Prerequisites: Restricted to upper-division standing; Climate Change: Causes, Impacts, and Solutions Certificate students; two courses in the certificate.

Education and training in ethical, creative, and effective communication and engagement strategies to address climate change and climate justice. Provides a combination of critical reading and discussion with collaborative action to become campus and public Climate Ambassadors.

ENVS 680 Environmental Studies Internship (Units: 1-3)

Prerequisites: Restricted to upper-division standing; ENVS 130; permission of the instructor.

Fieldwork in approved public, private, and non-profit environmental organizations, government and non-government agencies, or local corporations under the supervision of the organization and faculty coordinator. May be repeated for credit on advisement. [CSL may be available]

ENVS 690 Senior Seminar in Environmental Studies (Units: 3)

Prerequisites: Restricted to senior Environmental Studies majors and completion of core courses.

Integration and application of major concentration in Environmental Studies. Trends in Environmental Studies. Group projects working with the community to assist in problem solving or activism; job evaluation. (Plus-minus letter grade only)

ENVS 699 Independent Study (Units: 1-3)

Prerequisites: Upper-division standing, permission of the instructor, major adviser, and department chair.

Supervised study of a particular issue selected by the student. May be repeated for a total of 6 units.

Geography & Environment (GEOG)**GEOG 101 Our Physical Environment (Units: 3)**

Environmental processes; elements of weather and climate; shapes of landforms; formation, distribution of soils and natural vegetation; physiography of oceans. Synergistic relations between the physical and human environments.

Course Attributes:

- B1: Physical Science
- Environmental Sustainability

GEOG 102 The Human Environment (Units: 3)

Nature of cultural geography; interpretation of the cultural elements of the geographic landscape and study of our changing relationship with the environment.

Course Attributes:

- D1: Social Sciences
- Environmental Sustainability
- Global Perspectives

GEOG 107 World Regions and Interrelations (Units: 3)

World culture regions: economic development, paths of cultural evolution, bases for political organization and resource appraisals; the persistence of cultural differentiation in the face of increasing interdependence, cultural transfer, and common threats to humanity.

Course Attributes:

- D1: Social Sciences
- Environmental Sustainability
- Global Perspectives

GEOG 160 Introduction to Environmental Science (Units: 4)

Introduction to ecological and environmental systems, and processes and problems at global, state, and local levels; examination of ecosystems, natural resources and earth processes and their interactions with the human environment. Lecture, 3 units; laboratory, 1 unit.

Course Attributes:

- B2: Life Science
- B3: Lab Science
- Environmental Sustainability
- Global Perspectives

GEOG 180 First-Year Experience: Sustainable City, Sustainable You (Units: 3)

Prerequisite: GE Area A2* with a grade of CR or C- or higher.

The City of San Francisco is striving to meet social and environmental challenges to sustain our communities. Students' actions contribute to The City's sustainability; at the same time, students struggle to sustain their own social, physical, financial, and academic well-being. Sustainability from body scale to city scale, examining identity development, social & environmental justice, and personal & social well-being. Writing, mapping, graphic, and oral communication in ways that support your personal and professional goals, culminating in a multimedia portfolio.

Course Attributes:

- E: Lifelong Learning Develop

GEOG 203 Geographical Measurement (Units: 3)

Prerequisite: First-Year Math Advising Module. For students who elect to take a B4 course without additional support.

Extraction and analysis of qualitative and quantitative information about our environment. Applications of numerical and statistical techniques through the use of maps, geographic information systems, remote sensing, surveying, and GPS. Lecture, 2 units; activity, 1 unit.

Course Attributes:

- B4: Math/QR

GEOG 205 Geographic Techniques (Units: 3)

Prerequisites: Restricted to sophomore standing and above; GEOG 101 or equivalent; and GE Area B4.

Geographical analysis; methodology, tools, and techniques used in geographical research, including data acquisition, classification, descriptive statistics; map reading; introduction to geographic information science and remote sensing. Lecture, 2 units; activity, 1 unit.

GEOG 301 Bay Area Environments (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Introduction to the complex nature of human and environment interaction in the SF Bay Area. Exploration of environmental issues, geologic processes, water, weather, climate and ecosystems, anthropogenic changes across the region, and the future of the Bay Area.

(This course is offered as A U 301 and GEOG 301. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability

GEOG 312 Geography of Landforms (Units: 4)

Prerequisites: GEOG 101 and GEOG 205; or permission of the instructor.

Development of earth's surface landforms through processes involving weathering, hill slopes and flowing water, wind and ice. Structural and climatic control of landforms. Geographic analysis of landform systems. Lecture, 3 units; activity, 1 unit. Extra fee required.

GEOG 313 Earth's Climate System (Units: 4)

Prerequisites: GEOG 101 and GEOG 205; or permission of the instructor.

Physical characteristics and processes of Earth's climate system; atmospheric composition, radiation, energy and water budgets and circulations, interaction with biological, oceanic and cryospheric systems and global climate change. Computer-based analysis using climate measurements and models. Lecture, 3 units; activity, 1 unit.

GEOG 314 Bioclimatology (Units: 4)

Prerequisites: GEOG 101 and GEOG 205; or permission of the instructor.

Interactions between climate and the biosphere including ecosystem-atmosphere exchanges of energy, water and carbon, agricultural and urban climatology, wind transport and energy and measurement techniques. Lecture, 3 units; activity, 1 unit.

GEOG 316 Biogeography (Units: 4)

Prerequisites: GEOG 101, GEOG 205; or permission of the instructor.

Distribution, ranges, and limits of plants and animals and the biogeographical effects of human occupancy. Ecological and historical themes, the changing patterns of biota in space and time under changing environmental and human conditions. Lecture, 3 units; activity, 1 unit.

GEOG 317 Geography of Soils (Units: 4)

Prerequisites: CHEM 115 or CHEM 180; EARTH 110 or GEOG 101; and GEOG 205; or permission of the instructor.

Properties of soils and factors of formation: parent material, climate, organisms, topography, and time. Distribution of taxonomic suborders. Soils as a natural resource. Lecture, 3 units; activity, 1 unit. Extra fee required.

GEOG 342 Surface Water Hydrology (Units: 4)

Prerequisites: MATH 226 and EARTH 210 or EARTH 505 are recommended; or permission of the instructor.

Introduction to surface water hydrology; exploration of hydrologic processes; how precipitation and snowmelt become streamflow, evapotranspiration, and groundwater; watershed hydrology, streamflow processes, and water quality. Lecture, 3 units; activity, 1 unit. (Plus-minus letter grade only)

(This course is offered as EARTH 442 and GEOG 342. Students may not repeat the course under an alternate prefix.)

GEOG 421 Future Environments (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Geography of the future. Programs from an economic point of view and economic development from an ecological point of view, including the potential productivity of various regions. Future environments of North America.

Course Attributes:

- UD-D: Social Sciences
- Environmental Sustainability
- Global Perspectives
- Social Justice

GEOG 423 Geographic Perspectives on Gender (Units: 3)

Prerequisites: Upper-division standing; GE Areas A1, A2, and A3; or permission of the instructor.

This course critically examines the interrelationship between geography and gender. In particular, this course compares and considers the historical and contemporary positions and experiences of men and women throughout the world. As part of this, attention will be given to understanding the differences and commonalities of men and women's experiences in different sectors of society and across geographic scales. (This course is offered as GEOG 423 and WGS 423. Students may not repeat the course under an alternate prefix.)

GEOG 425 Economic Geography (Units: 3)

Prerequisite: Upper-division standing or permission of the instructor.

Location and geographic distribution of the world's major types of production and associated systems of distribution and consumption; interpretation of economic activities in relation to various features of the environment.

GEOG 427 Agriculture and Food Supply (Units: 4)

Prerequisites: Upper-division standing; GEOG 101; or permission of the instructor.

Investigation of the location and distribution of world agricultural production and the environmental forces influencing agricultural organization and food supply. Problems in U.S. and California agriculture are analyzed. Lecture, 3 units; activity, 1 unit.

Course Attributes:

- Environmental Sustainability
- Global Perspectives

GEOG 428 International Political Economy of Food and Hunger (Units: 4)

Prerequisite: Upper-division standing or permission of the instructor.

Exploration of why hunger persists in a world of abundance; food aid, farm policy, and global food trade; whether production can match population growth without environmental harm; crop genetic engineering, international policies and movements for sustainability, and food sovereignty/security.

(This course is offered as I R 428 and GEOG 428. Students may not repeat the course under an alternate prefix.)

GEOG 430 Transforming Food and Agriculture Systems: Local to Global (Units: 4)

Prerequisites: GEOG 101 and GEOG 102, or GEOG 427, or GEOG 428/ I R 428; or permission of the instructor.

Exploration of movements for sustainable and urban agriculture, local and regional food systems, food justice and food sovereignty; consideration of ecological, economic, and political aspects of building alternative food systems locally, nationally, and internationally. Field trips and community service required. Lecture, 3 units; laboratory, 1 unit.

Course Attributes:

- Environmental Sustainability
- Global Perspectives
- Social Justice

GEOG 432 Urban Geography (Units: 4)

Prerequisite: Upper-division standing.

Geographic characteristics of cities in relation to evolution, morphology, and function. The internal and external relationships of diversified urban areas. Lecture, 3 units; activity, 1 unit.

(This course is offered as GEOG 432 and USP 432. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- Environmental Sustainability
- Global Perspectives

GEOG 433 Urban Transportation (Units: 4)

Prerequisite: Upper-division standing or permission of the instructor.

Emphasis on sustainable and green solutions to mitigate transportation greenhouse gas emissions and expand equity in urban transportation; understanding environmental and social impacts of urban transportation; relationship between transportation and urban form; History and politics of urban transportation; Field observations of transportation in San Francisco. Lecture, 3 units; activity, 1 unit.

(This course is offered as GEOG 433 and USP 433. Students may not repeat the course under an alternate prefix.)

GEOG 434 Geographies of Health and Health Care (Units: 3)

Prerequisite: Upper-division standing or permission of the instructor.

Geographies of health; the role place plays in determining the quality of health status, and in shaping access to and use of health care.

(This course is offered as GEOG 434 and PH 434 [Formerly H ED 434]. Students may not repeat the course under an alternate prefix.)

GEOG 435 Geography of Global Transportation (Units: 4)

Prerequisite: Upper-division standing.

Global transportation policies involving rail transit, bicycles, freight movement, airport ground access, and automobile travel. Case studies in the Bay Area, North America, Europe, China, and Africa. Lecture, 3 units; activity, 1 unit.

GEOG 445 Geopolitics and Globalization (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Physical and cultural geographic factors in and between political-territorial units. Effects of resource distribution, political motivations, and ideologies on establishing territorial sovereignty.

(This course is offered as GEOG 445 and I R 445. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- UD-D: Social Sciences

GEOG 455 Geography of Ethnic Communities (Units: 3)

Prerequisite: Upper-division standing.

The spatial structure and organization of ethnic communities as illustrated by reference to San Francisco and other American cities.

Course Attributes:

- Am. Ethnic & Racial Minorities
- Social Justice

GEOG 500GW Physical and Human Dimensions of Climate Change - GWAR (Units: 3)

Prerequisites: GE Area A2; GEOG 101 and GEOG 102.

An interdisciplinary investigation of climate change including the causes, environmental and societal impacts as well as mitigation and adaptation strategies. Bridges traditional human and physical branches of geography and examines a variety of associated writing conventions. (Plus-minus ABC/NC grading only)

Course Attributes:

- Graduation Writing Assessment

GEOG 550 Geography of the United States and Canada (Units: 3)

Prerequisite: Upper-division standing.

Anglo-America's physiography, climates, vegetation, soils, and natural resources and their effect on the development of industry, commerce, and population distribution.

GEOG 552 Geography of California (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Location and description of California's natural resources; the influence of land surface, climate, natural vegetation, soils, and minerals upon economic development, routes of commerce, and population distribution. Current water problems.

Course Attributes:

- UD-D: Social Sciences
- Am. Ethnic & Racial Minorities
- Environmental Sustainability
- Social Justice

GEOG 575 Emerging China (Units: 3)

Prerequisites: Restricted to upper-division standing; GE Areas A1*, A2*, A3*, B4*, and E all with grades of C- or better; or permission of the instructor.

Examination of China's geographical conditions for development focusing on climate change, landforms, and natural resources. Focus on the patterns of human-environmental interactions that engender cultural institutions, economic development, and political changes. Discussion of the environmental sustainability of development strategies and feasible alternatives. Build a geographical framework for critically assessing the impact of China's economic emergence on the environment and natural resources within and beyond its borders.

Course Attributes:

- UD-D: Social Sciences
- Environmental Sustainability
- Global Perspectives
- Social Justice

GEOG 600 Environmental Problems and Solutions (Units: 3)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

An ecological approach to nature and the landscape. Human populations, natural resources, and environmental quality in California with particular reference to the San Francisco Bay Area.

(This course is offered as GEOG 600 and ENVS 600. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- UD-D: Social Sciences
- Environmental Sustainability
- Global Perspectives

GEOG 601 Field Methods in Human Geography (Units: 3)

Prerequisite for GEOG 701: Graduate standing or permission of the instructor.

Prerequisites for GEOG 601: Upper-division standing; GEOG 205; GPA of 3.0 or higher; or permission of the instructor.

Application of field methods in human geography. Research methodologies and design including interviewing, surveying, ethnographic methods, and archival research. Lecture, 2 units; activity, 1 unit.

(GEOG 701/GEOG 601 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 602 Field Methods in Environmental Science & Physical Geography (Units: 4)

Prerequisite for GEOG 702: Graduate standing or permission of the instructor.

Prerequisites for GEOG 602: Upper-division standing; GEOG 205; GPA of 3.0 or higher; or permission of the instructor.

Field methods and monitoring techniques in environmental science and physical geography. Research methods, instrumentation and experimental design in geomorphic surveying, plant sampling and measurement, atmospheric instruments, and monitoring systems. Hands-on experiences provided through weekly field labs and field report writing. Lecture, 2 units; laboratory, 2 units.

(GEOG 702/GEOG 602 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 603 Introduction to Geographic Information Systems (Units: 3)

Prerequisite: GEOG 205 or ENVS 224 or equivalent.

Applications of computers in geographic problem-solving. Investigates the nature of geographic information sources—maps, earth images, and spatial databases—and the application of spatial analysis, mapping, charting, and image display tools. Lecture, 2 units; laboratory, 1 unit.

GEOG 604 Environmental Data Science (Units: 3)

Prerequisite for GEOG 704: Graduate standing or consent of the instructor.

Prerequisites for GEOG 604: Upper-division standing; GEOG 205 and GEOG 603; GPA of 3.0 or better; or consent of the instructor.

Environmental data science is the array of methods for turning raw data into understanding as applied to environmental research. An exploratory data analysis approach is employed where visualization of data in time and space can lead to insight and hypothesis development. Major topics include time-series analysis, geospatial methods employing open-source tools in the R language, and employing innovations in graphics and maps. Lecture, 2 units; laboratory, 1 unit.

(GEOG 704/GEOG 604 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 606 Cartography (Units: 3)

Prerequisite: GEOG 205 or equivalent.

Theory and practice in modern thematic cartography. Compilation and classification of geospatial datasets, the role of scale and projections in thematic maps, and theory and practice in cartographic symbolization, visualization, and communication. Ethics in geospatial visualization and issues in implementing cartographic visualizations in web and GIS environments. Lecture, 2 units; laboratory, 1 unit. Lab fee required.

GEOG 610 Remote Sensing of the Environment I (Units: 4)

Prerequisite: GEOG 205.

Introduction to remote sensing and digital image processing. Image acquisition, physical background, image interpretation. Display and enhancement of digital images, radiometric and geometric corrections. Lecture, 2 units; activity, 2 units. Extra fee required.

GEOG 611 Remote Sensing of the Environment II (Units: 4)

Prerequisite for GEOG 711: Graduate standing; GEOG 610; or permission of the instructor.

Prerequisites for GEOG 611: Upper-division standing; GEOG 610; GPA of 3.0 or higher; or permission of the instructor.

Advanced remote sensing and digital image processing. Selected topics including object-oriented image processing with Definiens Professional. Lecture, 2 units; activity, 2 units. Extra fee required.

(GEOG 711/GEOG 611 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 620 Geographical Information Systems (Units: 4)

Prerequisites for GEOG 720: Graduate standing; GEOG 603 or equivalent; or permission of the instructor.

Prerequisites for GEOG 620: Upper-division standing; GEOG 603 or equivalent; GPA of 3.0 or higher; or permission of the instructor.

Theory and applications of Geographic Information Systems for automating, analyzing, and producing maps from geographic data. Lecture, 2 units; activity, 2 units.

(GEOG 720/GEOG 620 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 621 Geographic Information Systems for Environmental Analysis (Units: 4)

Prerequisite for GEOG 721: Graduate standing or permission of the instructor.

Prerequisites for GEOG 621: Upper-division standing; GEOG 205 and GEOG 603 and MATH 199 or equivalents; GPA of 3.0 or higher; or permission of the instructor.

GIS applied to environmental analysis. Raster surface analysis, spatial analysis of discrete and continuous surfaces, spatial statistics, and the generation of statistical surfaces from environmental samples and contour data. Seminar, 2 units; activity, 2 units.

(GEOG 721/GEOG 621 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 625 Programming for Geographic Information Science (Units: 3)

Prerequisites: GEOG 620 or GEOG 621.

Programming methods for developing new tools for automating existing methods for desktop (Python) and web (ArcGIS API for Python) GIScience environments. Essentials of object-oriented programming methods applied to GIS and remote sensing. Lecture, 2 units; laboratory, 1 unit.

GEOG 642 Watershed Assessment and Restoration (Units: 4)

Prerequisites: GEOG 101 or EARTH 210; GEOG 603 and MATH 199.

Assessing and restoring watersheds and streams. Exploration of hydrologic and watershed processes, variables influencing runoff and erosion, and hillslope and stream restoration techniques. Lecture, 3 units; activity, 1 unit. [CSL may be available]

(This course is offered as GEOG 642 and EARTH 642. Students may not repeat the course under an alternate prefix.)

GEOG 644 Water Quality (Units: 3)

Prerequisites: GEOG 101, GEOG 205, CHEM 180, BIOL 230 or BIOL 240.

Examination of physical and social properties of water quality including pollution testing and mitigation, state and federal regulations, public policy and environmental justice.

GEOG 646 The Geography of Marine Resources (Units: 4)

Prerequisite: GEOG 101 or permission of the instructor.

Character and spatial arrangements of resources of the ocean; analysis of marine biomass, minerals, and energy; examination of maritime policy and economic aspects of the marine environment. Lecture, 3 units; laboratory, 1 unit.

GEOG 647 Geography of Water Resources (Units: 4)

Prerequisite: GEOG 101 or permission of the instructor.

Distribution and development of atmospheric, surface, and groundwater resources; interrelationships between water and human activities in California and the West. Divergent solutions to water-related issues and controversies. Lecture, 3 units; laboratory, 1 unit. Extra fee required.

GEOG 648 Management of National Parks and Protected Areas (Units: 4)

Prerequisite: Upper-division standing or permission of the instructor.

Conservation and preservation of large ecosystem units: national parks, nature and wildlife reserves and equivalent natural areas. History, management, and problems of these tracts of land. Lecture, 3 units; laboratory, 1 unit.

GEOG 651 San Francisco Bay Area Environmental Issues (Units: 4)

Prerequisites: GE Areas A1*, A2*, A3*, and B4* all with grades of C- or better or permission of the instructor.

Mission and work of environmental management organizations. Managing our air, water, soil, wildlife, and aesthetic resources. Land use and transportation concepts. Field projects. Lecture, 3 units; laboratory, 1 unit.

(This course is offered as GEOG 651 and USP 651. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- UD-B: Physical Life Science
- Environmental Sustainability

GEOG 652 Environmental Impact Analysis (Units: 4)

Prerequisite: GEOG 205 or ENVS 224 or permission of the instructor.

Cultural and physical environmental interrelationships. Evaluating impact proposals. Reconciling resource potentials with human needs, problems of social development impact, and environmental quality protection. Lecture, 3 units; activity, 1 unit.

(This course is offered as GEOG 652 and USP 652. Students may not repeat the course under an alternate prefix.)

GEOG 657 Natural Resource Management: Biotic Resources (Units: 4)

Prerequisites: GEOG 101, GEOG 205 or ENVS 224, or permission of the instructor.

Basic theories and methodologies of managing forest, wildlife and rangeland resources. Agencies, laws, and policies that govern natural resource management. Emphasis on the urban-wildland interface. Lecture, 3 units; activity, 1 unit.

(This course is offered as GEOG 657 and ENVS 657. Students may not repeat the course under an alternate prefix.)

GEOG 658 Land-Use Planning (Units: 4)

Prerequisite: Upper-division standing.

The institutions, practice, and methodology of land-use planning. Relationship of planning to socio-economic objectives within the context of market and political forces. The planning process, locational analysis, zoning, and negotiated development. Lecture, 3 units; activity, 1 unit. (This course is offered as GEOG 658 and USP 658. Students may not repeat the course under an alternate prefix.)

GEOG 666 Geography of Garbage: Recycling and Waste Reduction (Units: 3)

Prerequisite: Junior standing.

Geographical analysis of waste. Alternative solutions focusing on the San Francisco Bay Area: development and implementation of resource management programs. Lecture, 2 units; activity, 1 unit.

Course Attributes:

- Environmental Sustainability

GEOG 667 Environmental Justice: Race, Poverty, and the Environment (Units: 4)

Prerequisite: Upper-division standing or permission of the instructor.

Examination of environmental justice concepts, research and policies; understanding how toxins and other environmental assaults differentially affect communities and groups in USA and abroad; focus on research, ethnic, class dynamics; environmental justice movements, public policy and planning.

(This course is offered as USP 515 and GEOG 667. Students may not repeat the course under an alternate prefix.)

Course Attributes:

- Environmental Sustainability
- Global Perspectives
- Social Justice

GEOG 668 Politics, Law, and the Urban Environment (Units: 4)

Prerequisite: Upper-division standing or permission of the instructor.

Law and the legal system as mechanisms for regulating urban development and protecting the environment; intervention in development and land use; environmental decay, conservation of open space, other related resources. Lecture, 3 units; activity, 1 unit.

(This course is offered as USP 513, GEOG 668, and PLSI 513. Students may not repeat the course under an alternate prefix.)

GEOG 685 Projects in Teaching Geography (Units: 1-3)

Prerequisites: Upper-division standing; a grade of B or better in course for training; permission of the Instructor.

Training in the teaching of geography. Responsibilities include working with supervising faculty to review and prepare course materials, tutor students, conduct small discussion groups and give brief lectures/demonstrations. (Students may earn a maximum of 4 units toward the baccalaureate degree for any course(s) numbered 685 regardless of discipline.)

GEOG 688 Geographic Internship (Units: 2-6)

Prerequisites: 15 units in Geography; permission of the instructor.

Practical geographic assignments with sponsoring agencies. May be repeated for a total of 6 units with different internships. [CSL may be available]

GEOG 690 Senior Seminar in Geography and Environmental Science (Units: 3)

Prerequisites: Senior standing in BA Geography or BS Environmental Science; completion of core requirements, GEOG 101, GEOG 102 or GEOG 107, GEOG 205, GEOG 500GW.

Research project formulation and development, writing strategies and conventions in academic and professional contexts, career preparation in Geography.

GEOG 699 Independent Study (Units: 1-3)

Prerequisite: Permission of the instructor, major adviser, and department chair.

Supervised study of a particular problem selected by the student in consultation with the adviser. May be repeated for a total of 3 units.

GEOG 701 Field Methods in Human Geography (Units: 3)

Prerequisite for GEOG 701: Graduate standing or permission of the instructor.

Prerequisites for GEOG 601: Upper-division standing; GEOG 205; GPA of 3.0 or higher; or permission of the instructor.

Application of field methods in human geography. Research methodologies and design including interviewing, surveying, ethnographic methods, and archival research. Lecture, 2 units; activity, 1 unit.

(GEOG 701/GEOG 601 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 702 Field Methods in Environmental Science & Physical Geography (Units: 4)

Prerequisite for GEOG 702: Graduate standing or permission of the instructor.

Prerequisites for GEOG 602: Upper-division standing; GEOG 205; GPA of 3.0 or higher; or permission of the instructor.

Field methods and monitoring techniques in environmental science and physical geography. Research methods, instrumentation and experimental design in geomorphic surveying, plant sampling and measurement, atmospheric instruments, and monitoring systems. Hands-on experiences provided through weekly field labs and field report writing. Lecture, 2 units; laboratory, 2 units.

(GEOG 702/GEOG 602 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 704 Environmental Data Science (Units: 3)

Prerequisite for GEOG 704: Graduate standing or consent of the instructor.

Prerequisites for GEOG 604: Upper-division standing; GEOG 205 and GEOG 603; GPA of 3.0 or better; or consent of the instructor.

Environmental data science is the array of methods for turning raw data into understanding as applied to environmental research. An exploratory data analysis approach is employed where visualization of data in time and space can lead to insight and hypothesis development. Major topics include time-series analysis, geospatial methods employing open-source tools in the R language, and employing innovations in graphics and maps. Lecture, 2 units; laboratory, 1 unit.

(GEOG 704/GEOG 604 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 705 Geographical Analysis (Units: 3)

Prerequisites: Graduate standing in Geography; GEOG 205 or equivalent.

Methods of statistical analysis and review of their use in geographic literature; univariate and multivariate analysis, graphical presentation; statistical software. Lecture, 2 units; laboratory, 1 unit.

GEOG 711 Remote Sensing of the Environment II (Units: 4)

Prerequisite for GEOG 711: Graduate standing; GEOG 610; or permission of the instructor.

Prerequisites for GEOG 611: Upper-division standing; GEOG 610; GPA of 3.0 or higher; or permission of the instructor.

Advanced remote sensing and digital image processing. Selected topics including object-oriented image processing with Definiens Professional. Lecture, 2 units; activity, 2 units. Extra fee required.

(GEOG 711/GEOG 611 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 720 Geographical Information Systems (Units: 4)

Prerequisites for GEOG 720: Graduate standing; GEOG 603 or equivalent; or permission of the instructor.

Prerequisites for GEOG 620: Upper-division standing; GEOG 603 or equivalent; GPA of 3.0 or higher; or permission of the instructor.

Theory and applications of Geographic Information Systems for automating, analyzing, and producing maps from geographic data. Lecture, 2 units; activity, 2 units.

(GEOG 720/GEOG 620 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 721 Geographic Information Systems for Environmental Analysis (Units: 4)

Prerequisite for GEOG 721: Graduate standing or permission of the instructor.

Prerequisites for GEOG 621: Upper-division standing; GEOG 205 and GEOG 603 and MATH 199 or equivalents; GPA of 3.0 or higher; or permission of the instructor.

GIS applied to environmental analysis. Raster surface analysis, spatial analysis of discrete and continuous surfaces, spatial statistics, and the generation of statistical surfaces from environmental samples and contour data. Seminar, 2 units; activity, 2 units.

(GEOG 721/GEOG 621 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

GEOG 735 Seminar in Global Environmental Policy (Units: 3)

Prerequisite: Graduate standing or permission of the instructor.

International/global policy making process and responses to critical environmental problems confronting the world as well as underlying causes such as population explosion and energy consumption. Policy choices, negotiating strategies, and outcomes.

(This course is offered as I R 735 and GEOG 735. Students may not repeat the course under an alternate prefix.)

GEOG 751 Environmental Management (Units: 3)

Prerequisites: Graduate Geography students; GEOG 600 or permission of the instructor.

Management and planning concepts and their application to problems in resource development and environmental protection. History of environmental management and policy, national and international problems in environmental management. (Plus-minus letter grade only)

GEOG 776 Environmental Policy (Units: 3)

Prerequisite: Graduate standing or permission of the instructor.

Covers scope and theories of US and CA environmental policy. (This course is offered as P A 776 and GEOG 776. Students may not repeat the course under an alternate prefix.)

GEOG 785 College Teaching of Geography (Units: 1-3)

Prerequisites: Graduate standing; a grade of B or better in the course of training; permission of the instructor.

Training in the teaching of geography. Work with supervising faculty to review and prepare course materials, tutor students, conduct small discussion groups and give brief lectures/demonstrations. May be repeated for 3 units total of degree credit.

GEOG 789 GIScience Internship (Units: 3)

Prerequisites: Graduate MS GIScience students and permission of the instructor.

Professional work experience: students will work 135 hours with sponsoring agencies or organizations under the supervision of a faculty member and an on-site work supervisor. (Plus-minus letter grade only)

GEOG 801 Scope and Method in Geography (Units: 3)

Prerequisite: Graduate Geography students.

Nature of geography and its historical development with emphasis on geographic literature. Alternative geographic approaches to themes central to the discipline. (Plus-minus letter grade only)

GEOG 810 Seminar in Physical Geography (Units: 3)

Prerequisites: Graduate Geography students; GEOG 801, appropriate upper-division course work.

Field to be specified in Class Schedule. May be repeated when topics vary. (Plus-minus letter grade only)

Topics:

- a. Geomorphology
- b. Climatology
- c. Biogeography

GEOG 815 Seminar in GIScience (Units: 3)

Prerequisites: Graduate Geography and GIScience students; upper-division coursework in GIScience; or permission of the instructor.

Theoretical development of GIScience with emphasis on exploring and discussing research literature in geographic information systems, remote sensing, and spatial analysis. Extra fee required. (Plus-minus letter grade only)

GEOG 820 Human and Social Geography (Units: 3)

Prerequisites: Graduate Geography students; GEOG 801, appropriate upper-division course work; or permission of the instructor.

Investigation of the development of this subfield in human geography with special emphasis on theoretical frameworks, research paradigms and applications to contemporary life. (Plus-minus letter grade only)

GEOG 857 Issues in Marine and Estuarine Conservation (Units: 3)

Prerequisites: Restricted to graduate Geography and Interdisciplinary Marine and Estuarine Science students; GEOG 801 or BIOL 708; or permission of the instructor.

Exploration of issues of marine, wetland, and coastal conservation due to human exploitation of resources. Discussions include critical evaluations of landmark and current research; topics of relevance to individual student research. (Plus-minus letter grade only)

GEOG 895 Research Project (Units: 3)

Prerequisites: Graduate Geography students; permission of the instructor and chair of student's committee; and approval of Advancement to Candidacy (ATC) and Culminating Experience (CE) forms by Graduate Studies. ATC and Proposal for Culminating Experience Requirement forms must be approved by the Graduate Division before registration.

(CR/NC, RP grading only)

GEOG 896 Directed Reading in Geography (Units: 3)

Prerequisites: Graduate Geography students and permission of the adviser.

Intensive supervised research to achieve better understanding of a specific topic, concept, or area chosen on the basis of individual student need. Readings, tutorial discussion, and research report or creative projects required. (Plus-minus AB/NC, RP grading only)

GEOG 897 Research Project Formulation (Units: 2)

Prerequisites: Graduate Geography students and filing of ATC form.

Development of Master's thesis: formulation of research question, literature review and methodology, leading to a written and oral proposal; focus on colloquia, thesis defenses, workshops on grants, publication writing, and research methods. (CR/NC grading only)

GEOG 898 Master's Thesis (Units: 3)

Prerequisites: Graduate Geography students; permission of the instructor and chairperson of candidate's committee; and approval of Advancement to Candidacy (ATC) and Culminating Experience (CE) forms by Graduate Studies. ATC and Proposal for Culminating Experience Requirement forms must be approved by the Graduate Division before registration.

(CR/NC grading only)

GEOG 899 Independent Study (Units: 1-3)

Prerequisites: Graduate Geography students; and permission of the graduate major adviser, supervising faculty member, and department chair.

Study is planned, developed, and completed under the direction of a member of the departmental faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. May be repeated for a total of 3 units.