Earth, Environment, and Sustainability

Chair

- Emily Finzel

Undergraduate majors: earth and environmental sciences (BA, BS); environmental policy and planning (BA); geographical and sustainability sciences (BA, BS)

Undergraduate minors: earth and environmental sciences; environmental policy and planning

Undergraduate certificates: geographic information science; sustainability

Graduate degrees: MA in geography; MS in geoscience; PhD in geography; PhD in geoscience

Website: https://clas.uiowa.edu/earth-environment-sustainability

The School of Earth, Environment, and Sustainability (SEES) offers interdisciplinary education and research focused around three majors: earth and environmental sciences, geographical and sustainability sciences, and environmental policy and planning. To support the growing need for interdisciplinary understanding, SEES uniquely assembles scientists with natural science and human-centered perspectives to investigate the causes, impacts, and solutions to environmental challenges. This combination allows students to understand the breadth and integration of the overall environmental and sustainability fields, and then focus their passion to make an impact in their chosen career.

Programs

Undergraduate Programs of Study

Majors

- Major in Earth and Environmental Sciences (Bachelor of Arts)
- Major in Environmental Policy and Planning (Bachelor of Arts)
- Major in Geographical and Sustainability Sciences (Bachelor of Arts)
- Major in Earth and Environmental Sciences (Bachelor of Science)
- Major in Geographical and Sustainability Sciences (Bachelor of Science)

Minors

- Minor in Earth and Environmental Sciences
- Minor in Environmental Policy and Planning

Certificates

- Certificate in Geographic Information Science
- Certificate in Sustainability

Graduate Programs of Study

- Master of Arts in Geography
- Master of Science in Geoscience
- Doctor of Philosophy in Geography
- Doctor of Philosophy in Geoscience

Facilities

Geographic Information Systems Instructional Lab

Students have access to the Geographic Information Systems Instructional Lab (GISIL), a state-of-the art computer lab used to teach GIS, cartography, and remote sensing. The GISIL also supports field-based educational activities using mobile GIS software, UAVs, and GPS to collect and analyze data. This unique training experience builds future researchers and practitioners with the perspective and strong analytical skillset needed to address today's most pressing challenges head-on.

Earth Science Research Laboratories

The sample preparation and analytical equipment housed in the School of Earth, Environment, and Sustainability are shared facilities co-managed by faculty. Specific research labs include Environmental and Hydrogeology, MicroPaleontology, Petrology, Sedimentary Materials, Thin Section and Sample Preparation, and Mineral Separation. Major analytical instruments for earth science research, including an SEM, electron microprobe, laser ablation ICP-MS, and XRF, are housed in the Iowa MatFab Facility.

Ashton Prairie Living Laboratory

Ashton Prairie Living Laboratory (APLL) is an eight-acre prairie restoration project located within the University of Iowa's Ashton Cross Country Course. APLL was established in 2019 to educate students and the public about ecosystems, and for faculty and students to explore environmental processes and management at a developing prairie restoration site.

The site includes an initial one-acre pilot plot and a recently added seven-acre area, as well as an adjacent stream. The grounds have been instrumented with twelve groundwater wells, a weather station and eddy flux-tower, soil moisture probes, stream discharge gages, and two soil pits. Other equipment available for the site include a soil respiration meter, water quality probes and sondes, infiltrometers, small flumes, a soil camera, GNSS and Total Station, and thermal cameras. Over the last five years, the site has supported over forty undergraduate students, across multiple departments, working directly on management, monitoring, and research projects. Student activities have included seed gathering, thistle management, pollinator and plant distribution studies, groundwater-surface water-macroinvertebrate interactions, and soil health studies. APLL has also hosted a number of academic courses, such as Intro to Environmental Studies, Entomology, Hydrogeology, and Prairie Restoration, as well as community events, including the annual University of Iowa BioBlitz.

UI Paleontology Repository

The University of Iowa Paleontology Repository (UIPR) is a public research facility developed to support and fulfill the mission of teaching, research, and service of the School of Earth, Environment, and Sustainability and the university. The repository is an international resource that houses type specimens of fossils and makes them accessible to

the scientific community as proscribed by the International Code of Zoological Nomenclature. It holds over one million specimens including more than 25,000 type and referred specimens and has been ranked among the top ten collections in North America in terms of size and significance. UIPR is a hub for experiential learning and graduate and faculty research support. Student opportunities include unpaid volunteering and internships, course projects, internally funded Office for Undergraduate Research fellowships or Hawkeye Experience Grants, and externally funded employment (e.g., by Iowa Science Foundation, Historical Research Development Program, U.S. Geological Survey, or National Science Foundation). Projects range from database cataloging, digitization, collection preservation, specimen preparation and conservation (e.g., mastodon bone conservation), and archive management to science education, public outreach, and web development.

Iowa Lakeside Laboratory

Students may have the opportunity to take courses at Iowa Lakeside Laboratory, a field station located on West Lake Okoboji in northwestern Iowa. Run cooperatively by the University of Iowa, Iowa State University, and the University of Northern Iowa, the laboratory offers courses at the undergraduate and graduate levels and provides excellent conditions for summer study in several disciplines. See Iowa Lakeside Laboratory (University College) in the catalog or visit the Lakeside Laboratory website.

Courses

Earth, Environment, and Sustainability Courses

SEES:1000 First-Year Seminar 1-2 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

SEES:1020 The Global Environment 3 s.h.
Underlying processes driving human/environment interaction, including climate change, deforestation, and natural disasters; environmental challenges, including declining biological diversity; human response to more frequent severe climate events; production of a more sustainable future. GE: Sustainability. GE: Natural Sciences without Lab; Sustainability.

SEES:1021 The Global Environment Lab 1 s.h.
Laboratory application of concepts discussed in SEES:1020; computer-based and traditional approaches to the investigation of earth's processes, including earthquakes, water and energy balances, climate and weather, and soil development. Corequisites: SEES:1020, if not taken as a prerequisite. GE: Natural Sciences Lab only.

SEES:1030 Introduction to Earth Science 3-4 s.h.
Relationships between plate tectonics, geologic time, and the rock cycle with volcanoes and igneous, sedimentary, metamorphic rocks; fossils; radioactive isotopes; landscape evolution; mountain building; natural resources; their impacts on civilization. GE: Natural Sciences with Lab; Natural Sciences without Lab. Same as CEE:1030.

SEES:1031 Introduction to Earth Science Laboratory 1 s.h.
Laboratory component of SEES:1030. Requirements: completion of 3 s.h. in SEES:1030 or CEE:1030. GE: Natural Sciences Lab only. Same as CEE:1031.

SEES:1035 Our Digital Earth 3 s.h.
Gain experience working with geospatial technology, such as geographic information systems (GIS) and remote sensing, using geospatial data and analysis to illuminate and improve sustainability issues that face current and future generations. GE: Sustainability. GE: Quantitative or Formal Reasoning; Sustainability.

SEES:1040 Evolution and the History of Life 3-4 s.h.
Fossils over the past 3.5 billion years, origin and evolution of life, evolutionary radiations and mass extinctions, the invasion of land, dinosaurs, the age of mammals, relationship between biological systems and environmental change in earth history. GE: Natural Sciences with Lab; Natural Sciences without Lab.

SEES:1046 Environmental Politics in India 3 s.h.
How resources, commodities, people, and ideas cross borders; examination of globalization through issues of technology, social justice, environment; perspectives from anthropology, gender studies, geography, energy science, and development. GE: Sustainability. GE: International and Global Issues; Sustainability. Same as ANTH:1046, GWSS:1046, SJUS:1046.

SEES:1050 Introduction to Geology 4 s.h.
Minerals, rocks, and rock-forming processes (including volcanoes and sedimentary environments); surface processes (rivers, groundwater, glaciers, deserts, ocean shorelines), major earth processes (continental drift, plate tectonics, earthquakes, mountain building); impact on civilization. Offered fall semesters. GE: Natural Sciences with Lab.

SEES:1060 Big Ideas: Origins of the Universe, Earth, and Life 3 s.h.
Origin of the universe, the biochemistry of life, and the origin of life on Earth; for non-science majors. Recommendations: first-year or sophomore standing. GE: Natural Sciences without Lab. Same as ASTR:1060, BIOL:1060.

SEES:1070 Contemporary Environmental Issues 3 s.h.
Global environmental challenges; ecological, economical, cultural, and geographical causes and effects; underlying science and potential solutions to global issues of sustainability. GE: Sustainability. GE: International and Global Issues; Sustainability.

SEES:1080 Introduction to Environmental Science 3-4 s.h.
Biological and physical character of the Earth; interaction of humans with the environment, including impacts on ecosystems, climate, natural processes, resources; alternative options, including sustainability, waste management, energy, land reform. GE: Sustainability. GE: Natural Sciences with Lab; Natural Sciences without Lab; Sustainability.

SEES:1081 Introduction to Environmental Sciences Laboratory 1 s.h.
Laboratory component of SEES:1080. Requirements: completion of 3 s.h. in SEES:1080 or 3 s.h. of transfer equivalent. GE: Natural Sciences Lab only.

SEES:1085 Fundamentals of Environmental Science 4 s.h.
Interdisciplinary study of how Earth's natural systems interact, how these systems affect society, and how they respond to human activity; how environmental problems can be solved and avoided by drawing upon knowledge in disciplines as diverse as ecology, anthropology, economics, chemistry, and political science; blended instructional environment, including traditional lectures, discussions in TILE classrooms, laboratory, online learning, peer-reviewed writing exercises, and service learning. Offered fall semesters. GE: Sustainability. GE: Natural Sciences with Lab; Sustainability.

SEES:1090 Globalization and Geographic Diversity 3 s.h.
World regions including their physical environment, culture, economy, politics, and relationships with other regions; students learn about conflicts within and between regions. GE: International and Global Issues.

SEES:1100 Age of Dinosaurs 4 s.h.
Origin and evolutionary history of dinosaurs; diversity of dinosaurian groups, their geographic distributions and paleoecology; origins of flight among dinosaurs; environmental context, including other animals and plants that lived alongside dinosaurs; the so-called extinction of dinosaurs and radiation of modern forms; the role dinosaurs play in the interaction between science and the popular media. Offered fall semesters. GE: Natural Sciences with Lab.

SEES:1115 The History of Oil 3 s.h.
Historical perspective on business, science, geology, technology, politics, environment, and culture of the global oil industry; the rise of oil as the most influential international business of the last 150 years, the material foundation of economies, a major force in world politics, a shaper of daily life, and a guide to understanding Earth's deep history. Offered fall semesters. GE: Sustainability. GE: Historical Perspectives; Sustainability. Same as HIST:1115.

SEES:1170 Geology of the U.S. National Parks 2 s.h.
Geologic features, geologic history, important biological and archaeological characteristics, with emphasis on features that caused certain areas to be included in national park system.

SEES:1179 Geology of National Parks: Preparation and Planning 1 s.h.
Preparation for a national park field trip offered in SEES:1180; students learn about locations; basic safety rules; camping skills; administrative work, including defensive driver training; investigation of national parks, national monuments, and protected lands; basic geology.

SEES:1180 Geology of National Parks: Field Trip 2 s.h.
Observation, interpretation of prominent geologic, geomorphic, biological features; semester-break or semester-end visits to different parks or groups of parks each year. Offered spring semesters. Prerequisites: SEES:1179.

SEES:1290 Energy and the Environment 3 s.h.
Scientific concepts related to potentially significant energy sources of the 21st century; environmental impacts, positive and negative, of each energy source as well as geologic and geographical distributions and applications. GE: Natural Sciences without Lab.

SEES:1400 Natural Disasters 3 s.h.
How earth-atmosphere-hydrosphere-space systems produce events catastrophic to humans on the scale of individual lives to civilizations; root causes of earthquakes, landslides, volcanic eruptions, floods, hurricanes, tsunami, tornadoes, and asteroid impact, and their local, national, and global impact; spatial and temporal occurrences of these hazards; methods and processes for hazard preparedness, response, and recovery; social, economic, and policy aspects that affect and compound the magnitude of disasters associated with natural phenomena; case studies drawn from contemporary and ancient societies. GE: Sustainability. GE: Natural Sciences without Lab; Sustainability.

SEES:2001 Second-Year Field Trip for Earth and Environmental Sciences 1 s.h.
Opportunity for students to begin developing an appreciation of earth system and earth history scales; application of classroom learning to field-based inquiry; real-world examples of introductory course material in an outdoor classroom setting. Prerequisites: SEES:1030 or SEES:1050 or SEES:1080. Requirements: geoscience or environmental sciences major.

SEES:2010 Interdisciplinary Environmental Seminar 1 s.h.
Discover research, explore careers, and build connections. Requirements: first- or second-year standing.

SEES:2013 Introduction to Sustainability 3 s.h.
Introduction to sustainability knowledge, skills, and habits as a means to shape one's vision of a sustainable citizen; emphasis on basic skills of literacy, applied math, and finding information; traditional sustainability knowledge areas related to society, economy, and environment; intersecting themes (e.g., informed consumerism, eco-economics, and livable environments). GE: Sustainability. GE: Social Sciences; Sustainability. Same as BUS:2013, URP:2013.

SEES:2050 Foundations of GIS 4 s.h.
Introduction to concepts and methods of geographical information systems (GIS) technology through hands-on lab activities and projects; introduction to map design and spatial analysis.

SEES:2110 Eight Billion and Counting: Introduction to Population Dynamics 3 s.h.
How dramatic changes to the size of population has changed fundamental characteristics of populations and processes, such as food and water scarcity, climate change and biodiversity, rise of megacities, health and disease, migration, social networks, economics, environment, and household structure. GE: Social Sciences. Same as GHS:2110.

SEES:2200 Historical Geology 4 s.h.
Framework of earth history that is essential to understand how the earth system works; investigation of physical, biological, atmospheric, oceanographic, and chemical history of the earth to prepare for further earth and environmental science courses. Prerequisites: SEES:1030 or SEES:1050 or SEES:1080 or SEES:1085.

SEES:2310 Introduction to Climatology 3 s.h.
Introduction to atmospheric processes that determine weather and climate; flow of energy through the atmosphere, distribution and movement of moisture and air, and atmospheric disturbances such as cyclones, hurricanes and tornadoes, and climate change. Recommendations: SEES:1020 or similar earth systems science course.

SEES:2374 Biogeography 3 s.h.
Introduction to processes that lead to the patterns of plant and animal distributions we see across the globe; processes of focus include plate tectonics, climate, and human-ecological interactions; species management and conservation in relationship to climate and change in human patterns of environment. Prerequisites: SEES:1020 or BIOL:1412 or BIOL:1261 or BIOL:1370 or BIOL:1141. Same as BIOL:2374.

SEES:2410 Mineralogy 4 s.h.
Physical, chemical, and optical properties of minerals; phase relations; structures; associations; diagnostic features for identification. Offered fall semesters. Prerequisites: (CHEM:1110 or CHEM:1070) and (SEES:1050 or SEES:1030).

SEES:2673 Ecology 3 s.h.
Adaptations of organisms to their physical and biological environments; organism-environment interactions; population biology; interactions between species; ecology of communities, ecosystems; human impact on ecosystems. Recommendations: a basic statistics or calculus course. Same as BIOL:2673.

SEES:2831 Geologic Field Methods 3 s.h.
Basic methods of geologic fieldwork in southwest Montana using topographic maps and GPS to locate oneself, identifying geologic map units (including superficial deposits), recognizing geologic contacts, constructing stratigraphic sections, measuring planar structures, and making geologic maps complete with a legend and cross-section. Offered summer sessions. Prerequisites: SEES:1080 or SEES:1050 or SEES:1030 or SEES:1400.

SEES:2910 The Global Economy 3 s.h.
Examination of contemporary economic geography; types of national economies, uneven development, role of government in shaping economy, multinational corporations; foundation for understanding national economies and economic statistics; contemporary issues including economic globalization, commodification of nature, de-industrialization. GE: International and Global Issues.

SEES:2930 Water Resources 3 s.h.
Introduction to science and policy issues affecting water resources management in the U.S.; how the intersection of people, climate, technology, and geography affects the quality, availability, and demand for freshwater resources.

SEES:2950 Environmental Conservation 4 s.h.
Scientific foundations of biological conservation; strategies used to better connect conservation practice with needs of a growing human population. Prerequisites: SEES:1020 or SEES:1070 or SEES:1080 or SEES:1085.

SEES:3001 Third-Year Field Trip for Earth and Environmental Sciences 1 s.h.
Opportunity for students to apply their major coursework to real-world problems; field trip to visit parks, mines, and/or quarries in Missouri and Arkansas that illustrate many of the lessons learned in SEES:2410 and SEES:3510. Prerequisites: SEES:1030 or SEES:1050 or SEES:1080 or SEES:2410. Requirements: geoscience or environmental sciences major, and junior standing.

SEES:3003 Natural History Research Collections 3 s.h.
Techniques, methods, and issues specific to natural history research collections; practice in preparing and cleaning specimens; role of natural history specimens in modern scientific research. Recommendations: basic understanding of the diversity of plants and animals and natural history museum collections, MUSM:3001 or MUSM:3200, and BIOL:1411 or BIOL:1412; or other experience. Same as MUSM:3003.

SEES:3020 Earth Surface Processes 3 s.h.
Basic geomorphic and environmental processes that shape the earth's surface; emphasis on erosion, transport, deposition by land mass movement (creep, landslides, earth flow), fluid agents (wind, water, ice); methods used to study these processes. Recommendations: SEES:1050 or SEES:1080 or SEES:1020 or SEES:1085.

SEES:3050 Geospatial Programming 3 s.h.
Introduction to geospatial programming with Python; programming basics, data structures, and algorithms; spatial data models and structures; vector-based and raster-based geoprocessing; automating GIS tasks and models; spatial libraries (e.g., ArcPy, GeoPandas, GDAL, PySAL). Prerequisites: SEES:2050. Same as IGPI:3050.

SEES:3060 Ecology and Natural History of Iowa 3 s.h.
Plant and animal communities, landforms, and geologic history of Iowa; local area fieldwork; students learn identification and survey techniques, and interact with local naturalists.

SEES:3070 Marine Ecosystems and Conservation 3 s.h.
Introduction to ocean ecosystems, including coral reefs, mangroves, estuaries and salt marshes, sandy and rocky shores, seagrass and kelp beds, the deep sea, plankton; biodiversity of each ecosystem; interrelationship of biota and physical/chemical environment; interactions among organisms, including food webs and symbiosis; local and global threats such as overfishing, pollution, ocean acidification, global warming, sea level change; ongoing biodiversity crisis, solutions for conservation problems.

SEES:3080 Introduction to Oceanography 2 s.h.
Descriptive, chemical, physical, biological, geological aspects of oceans; impact on weather, climate, shorelines, food supply, other aspects of civilization. Offered spring semesters. Recommendations: knowledge of basic chemistry, biology, physics, earth science.

SEES:3090 Hungry Planet: Global Geographies of Food 3 s.h.
Societal and environmental implications of past, current, and future global food supply examined from a geographical perspective; focus on questions of who eats what, where, and why; transformative history of agriculture, modern agribusiness and alternative food supplies, geopolitical implications of food production, food scarcity and rising food costs, urban versus rural agriculture, the obesity epidemic versus malnutrition, and the future of food. Same as GHS:3070.

SEES:3095 Field Ecology 4 s.h.
Analysis and interpretation of patterns and underlying physical and biotic basis for regional and local distributions of plants and animals of eastern Iowa; field observation, sampling, and laboratory analysis; conduction of several field research projects requiring collection, statistical analysis, and interpretation of data in short reports; field-oriented course. Prerequisites: BIOL:2673. Recommendations: advanced undergraduate standing or graduate standing in ecology, environmental sciences, or geoscience.

SEES:3096 Winter Ecology 2 s.h.
How seasons occur, thermoregulation, microhabitats, what animals are active, and winter plant identification; local area fieldwork.

SEES:3097 Introduction to Bird Study 2 s.h.
Basic identification skills, bird banding, and bird ecology; Hageboeck Hall of Birds at the UI Museum of Natural History; local field study.

SEES:3100 Earth and Planetary Remote Sensing 4 s.h.
Remote sensing of the earth's surface from aircraft, satellites; aerial photograph interpretation; remote sensing systems, methods, data analysis using electromagnetic spectrum and digital processing techniques, including visible, infrared, microwave radiation; remote sensing applied to geologic and environmental problems. Prerequisites: SEES:1030 or SEES:1050 or SEES:1080 or SEES:1085.

SEES:3110 Geography of Health 3 s.h.
Provision of health care in selected countries, with particular reference to the Third World; focus on problems of geographical, economic, cultural accessibility to health services; disease ecology, prospective payment systems, privatization, medical pluralism. Same as GHS:3111.

SEES:3131 Unnatural Disasters: A Global History 3 s.h.
What is a natural disaster? How do we assess "naturalness" of these events within political, social, and historical contexts in which they occur? Are disasters specific moments of crisis, or rather, are they slow—unraveling across time and space years before and after the moment their pain is most acutely felt? Examination of these questions at a global scale. Same as HIST:3131.

SEES:3150 Sustainability Project arr.
Individual or collective project related to sustainability under the direction and supervision of a faculty member; involves regularly scheduled meetings, data collection and interpretation, and a final project report.

SEES:3160 Field Trip 1-3 s.h.
Field trip to an area of geologic interest, such as localities in the Midwest, Hawaii, Grand Canyon (Arizona), Rio Grande Rift (New Mexico), Death Valley (California, Nevada), Appalachian Mountains (Virginia), as well as international destinations such as the Caribbean and China; preceded by weekly discussions of destination's geology.

SEES:3190 Undergraduate Directed Study arr.
Special topics, independent research.

SEES:3200 Collection Care and Management 3 s.h.
How a museum's management policy relates to its administrative, legal, and ethical obligations to its collections; acquisitions, deaccessions, collection use, data standards, storage environment, health, safety, documentation. Same as MUSM:3200.

SEES:3210 Principles of Paleontology 3 s.h.
Patterns of evolution in fossil record; species and analysis of their evolutionary relationships; paleoecology, paleocommunity evolution; evolutionary radiation and mass extinctions; large-scale relationships between biodiversity and climatic change. Offered fall semesters.

SEES:3220 Evolution of the Vertebrates 4 s.h.
Evolutionary history of vertebrates revealed by fossils and information from living animals; biogeographic, stratigraphic, paleoecological aspects of selected groups, especially mammals and dinosaurs; transitions from aquatic to terrestrial life, origins of flight, major events in vertebrate history (including mass extinctions and explosive radiations). Requirements: introductory course in geoscience, bioscience, or physical anthropology.

SEES:3230 Prairie Restoration 3 s.h.
Actively participate in the ecological reconstruction of a prairie on the University of Iowa campus. Topics include a brief history of tallgrass prairie; aerial photography and plant community analysis; stewardship land planning; native plant seed preparation and planting techniques; botany; invasive plant species identification and management; prescribed fire/controlled burning planning and techniques; erosion control and stormwater mitigation; Native American land management practices; and the tallgrass prairie's role in shaping the American Midwest's landscape.

SEES:3250 Health, Work, and the Environment 3 s.h.
Survey of environmental and occupational health hazards and the associated health risks of exposure; how public health protects society from these hazards; how public health policy can be influenced by science. Same as CPH:3400.

SEES:3300 Envisioning Future Worlds: Sustainable Development and Its Alternatives 3 s.h.
Sociocultural, geopolitical, and environmental implications of sustainable development and its alternatives investigated from a geographic perspective; geopolitical history of sustainable development; measures of sustainability in development; major critiques of sustainable development; alternative visions of development from different geographical contexts including ecofeminism, Buen Vivir, food sovereignty, degrowth, commoning, and the People's Health Movement. Same as GHS:3300.

SEES:3315 Ecosystem Ecology 4 s.h.
Terrestrial ecosystems as integrators of biological, physical, and ecological processes; flows of energy, carbon, water, and nutrients within ecosystems; spatial and temporal patterns and processes of Earth's ecosystems; sustaining ecosystems in the face of global change. Prerequisites: SEES:1020 or SEES:1080 or SEES:1085 or SEES:2374 or SEES:2673 or BIOL:2673.

SEES:3320 Earth's Climate System 3 s.h.
Overview of climate science and how we understand Earth's climate system through interconnected relationships between oceans, atmosphere, biosphere, and geosphere; introduction to climate archives, systems science, climate modeling, and mechanisms responsible for ancient and modern climate change. Recommendations: SEES:1020, SEES:1030, SEES:1050, SEES:1080, or SEES:1085.

SEES:3330 Sedimentary Geology 4 s.h.
Basic concepts of sedimentology, stratigraphy, depositional environments, sedimentary petrology; hands-on analyses of sediments and sedimentary rocks, including thin-section petrography; lecture/laboratory. Offered fall semesters.

SEES:3331 Human Dimensions of Climate 3 s.h.
How climate shapes human societies; focus on how climate and climate variability affects food production, water use, energy use, and human disease systems (e.g., influenza, malaria, air pollution, diarrheal disease); climate change impacts (e.g., sea level rise, droughts, wildfires, famine); societal impact, adaptation and vulnerability, mitigation strategies; policy.

SEES:3340 Ecosystem Services 3 s.h.
Ecosystem services—valuable goods and services produced by ecosystems (e.g., flood control, food production, water purification)—from an interdisciplinary perspective centering on geographic techniques used to measure, map, and model ecosystem services; methods used to incorporate ecosystem services into decision and policy making; how human activities alter these services. Prerequisites: SEES:2050 and (SEES:1020 or SEES:1070 or SEES:1080 or SEES:2374 or SEES:2673 or BIOL:2673 or BIOL:1370).

SEES:3350 Urban Ecology 3 s.h.
Urban ecology as an interdisciplinary field that investigates relationships between natural and the systems in urban environments; students explore urban ecosystems through lecture, discussion of current research, and field-based research projects; and identify how cities can become more sustainable systems. Prerequisites: SEES:2374 or SEES:2673 or BIOL:2673. Requirements: SEES:2374 or SEES:2673 or BIOL:2673 or introductory course in ecology, and junior standing.

SEES:3360 Soil Genesis and Geomorphology 3 s.h.
Introduction to soil genesis, soil geomorphology, and classification including the basics of soil profile description and soil-landscape, soil-vegetation, and soil-climate relationships; emphasis on study of soils as the interface between living and non-living Earth systems and the role of soils in sustaining ecosystems and human societies; short field excursions and a weekend field trip. Requirements: college earth science and chemistry.

SEES:3380 Fluvial Geomorphology 3 s.h.
Hydrologic principles, stream channel processes, and fluvial geomorphology within drainage basin systems; spatial and temporal variations in water distribution, analysis of hydrological data, flow mechanisms, sediment transport, forecasting procedures, hydrograph construction, modeling. Requirements: SEES:3020 or another 3000-level geology or hydraulics course. Same as CEE:3328.

SEES:3390 Integrated Watershed Analysis 3 s.h.
Integration of existing knowledge of physical, hydrological, and environmental processes with management issues and challenges in water resources and environmental management; aspects of water quantity and quality, water use and treatment; basin management issues related to forestry, agriculture, urbanization, floods, droughts.

SEES:3400 Iowa Environmental Policy in Practice 3 s.h.
How Iowa government addresses environmental policy development and implementation; policy process and current environmental issues; students attend meetings with Iowa State legislators and relevant agency personnel in Des Moines, Iowa, to observe how policies move into practice in agency offices. Prerequisites: SEES:1070 or POLI:3111 or SEES:3780. Requirements: junior or higher standing.

SEES:3420 Sustainable and Green Building Concepts 3 s.h.
Green building and sustainable development trends and theories: water policy, ecosystem services, climate change, and public health; LEED certified building process and each of the associated credit categories (i.e., sustainable sites, energy and atmosphere, water efficiency); how knowledge of green building and sustainable development can help lessen the environmental impact of built environments, improve the bottom line, and better plan for great communities.

SEES:3500 Introduction to Environmental Remote Sensing 3 s.h.
Basic concepts and principles of remote sensing; sources of data; georegistration; digital processing and classification of remotely sensed images for extraction of environmental information; linkage of remote sensing techniques with GIS analysis. Same as IGPI:3500.

SEES:3510 Igneous and Metamorphic Petrology 4 s.h.
Nature, origin, and petrography of igneous and metamorphic rocks in hand specimen and thin-section. Offered spring semesters. Prerequisites: (MATH:1010 or MATH:0100 or MATH:1020 or MATH:1850) and (SEES:1050 or SEES:1030) and (CHEM:1110 or CHEM:1070) and SEES:2410.

SEES:3520 GIS for Environmental Applications 3 s.h.
Students learn new, more advanced techniques for the representation and study of human and natural systems using geographic information systems (GIS); application of this new knowledge to environmental management and problem solving. Prerequisites: SEES:2050. Same as IGPI:3520.

SEES:3539 History of Environmental (In)Justice in Latin America 3 s.h.
Introduction to history of environmental change in Latin America; examination of pre-Hispanic cultures and spaces; reshaping of landscapes due to colonialism; commodification of nature in early republics; consolidation of 19th-century agro-economies; land-tenure changes and integration of regional markets due to neoliberalism in 20th century; relationship between environmental problems (e.g., biotic invasions, soil exhaustion, biodiversity loss, pesticide contamination) and imperial domination; scientific racism, state formation, and income inequality. Same as HIST:3539.

SEES:3540 Geographic Visualization 3 s.h.
Concepts and techniques that underlie cartographic representation, interaction, and geovisualization; map symbolization and visual variables; spatiotemporal visualization, multivariate mapping, interactive cartography, animation, geovisual analytics, 3D visualization, virtual and augmented reality. Prerequisites: SEES:2050. Same as IGPI:3540.

SEES:3570 Light Detection and Ranging (LiDAR): Principles and Applications 3 s.h.
Basic principles and applications of Light Detection and Ranging (LiDAR); LiDAR as an essential technology for mapping and analyzing a vast range of topics, including hydrology flooding, transportation planning, and 3D modeling. Recommendations: SEES:2050.

SEES:3608 Planetary Geology 3 s.h.
Introduces geologic processes throughout our solar system from the formation of the solar system to the differentiation of planetary bodies up to current state of planets and exobiology. Prerequisites: SEES:1030 or SEES:1050.

SEES:3610 Ethical Collection and Use of Geospatial Information 3 s.h.
Ethical issues that arise during the collection and use of digital geospatial information; particular emphasis on privacy as well as willful and unintentional introduction of different types of errors of omission (e.g., sampling related errors) and commission (e.g., inappropriate map projections); readings provide theoretical background and illustrative practical examples.

SEES:3760 Hazards and Society 3 s.h.
Examination of the impact and societal responses to natural and technological hazards; using case studies from around the world, students explore relationships between extreme events, human behavior, disaster management, public policy, and technology to understand what makes people and places vulnerable to hazards. Same as GHS:3760.

SEES:3780 U.S. Energy Policy in Global Context 3 s.h.
Historical and contemporary aspects of U.S. governmental planning and policy on a wide range of energy issues in global context. Same as GHS:3780, HIST:3240, POLI:3431.

SEES:3800 Environmental Policy 3 s.h.
Reasons why markets fail in environmental realm (e.g., externalities, common pool resources, club goods, public goods); ecosystem services and techniques used for their valuation; revealed and stated preferences; cost-benefit analysis and role in policy-making process; tools to address environmental market failures, particularly command and control, taxes and subsidies, and mitigation markets; focus on air pollution, climate change, and water-related policies.

SEES:3840 Structural Geology 4 s.h.
Rock deformation; description, classification of geologic structures such as faults and folds; processes that generate geologic structures; solution of structural problems; interpretation of geologic maps. Prerequisites: SEES:1030 or SEES:1050.

SEES:3920 Planning Livable Cities 3 s.h.
Development of livable cities in the United States; economic, physical, environmental, and political forces that shape their growth; impact of planning, how it shapes the future of cities. Same as URP:3001.

SEES:3940 Transportation Economics 3 s.h.
Overview of transportation markets—intercity, rural, urban; transportation modes—rail, highway, air, water, pipeline, transit; issues in finance, policy, planning, management, physical distribution, and environmental, economic, and safety regulation. Recommendations: ECON:1100 and ECON:1200. Same as ECON:3750, URP:3350.

SEES:3992 Undergraduate Research arr.
Opportunity for undergraduate students to participate in faculty-led research projects.

SEES:4000 The United Nations Sustainable Development Goals: A Blueprint for a Sustainable Future 3 s.h.
Establishment of baseline competencies among students from diverse backgrounds; introduction to the United Nations sustainable development goals framework; foundational concepts for sustainable development (e.g., life-cycle analysis, systems thinking, data processing, visualization). Same as SDG:4000.

SEES:4001 Fourth-Year Field Trip for Earth and Environmental Sciences 2 s.h.
Application of core course learning to real-world examples; students develop a broader understanding of interrelated aspects of earth and environmental sciences as truly integrated scientific endeavors; multi-day fieldtrip to highlight a wide range of geoscience and environmental science studies and provide students an opportunity to apply all aspects of their training to the amazing geologic landscape; capstone field experience for students in their senior year. Prerequisites: SEES:2831. Requirements: geographical and sustainability sciences (GSS) or earth and environmental sciences (EES) major, and senior standing.

SEES:4010 Field Methods in Physical Geography 3 s.h.
Introduction to basic approaches to research design and of sampling environmental variables commonly used in environmental sciences; basic methods of sampling and lab analyses of vegetation, land cover, soils, and more.

SEES:4030 Senior Project Seminar 3 s.h.
Development of an independent research project, preparation of a research report, and presentation of the associated outcomes. Offered spring semesters.

SEES:4110 Global Biogeochemical Cycles 3 s.h.
Investigation of various physicochemical states oceans have assumed over the past 4 billion years of Earth history; use of isotope geochemistry as a proxy for ancient ocean conditions; focus on integrated Earth system science, paleoceanographic and paleoclimate modeling, role of chemical stratigraphy in deciphering past climate states of ocean-atmosphere system; relationship between chemical changes in ocean/atmosphere and biological systems of the Earth.

SEES:4150 Health and Environment: GIS Applications 3 s.h.
Introduction to how geographic information systems (GIS) and spatial statistics are used in the study of patterns of health and disease in space and time. Same as GHS:4150, IGPI:4150.

SEES:4200 Museum Object Preservation 3 s.h.
Detailed study of specific types of museum objects, their materials, and care; topics include care, storage, and preservation of paper, books, photographs, works of art, electronic media, textiles, furniture, archaeological artifacts, and natural history specimens; students complete a curatorial project and gain hands-on practice in basic object cleaning and making enclosures and supports; for students planning museum careers or taking care of collections as part of their professional responsibilities. Same as MUSM:4200.

SEES:4210 Sustainability as a System Science 3 s.h.
Investigation of social, environmental, and economic sustainability in systems across the planet with a focus on food, energy, and water nexus; geographical and temporal trade-offs, unintended consequences, impacts quantification, role of public and private sectors, conceptual modeling of key system drivers and their interactions, nested systems, and system relations.

SEES:4230 Special Topics 1-3 s.h.
Contemporary issues in School of Earth, Environment, and Sustainability research areas.

SEES:4310 Climate Change 3 s.h.
Physical science of climate change; impacts on human and natural systems; mitigation of and adaptation to climate change. Prerequisites: SEES:1020 or SEES:1080 or SEES:2013.

SEES:4410 Analytical Methods Seminar 2 s.h.
Theory and practice of analyzing chemical, isotopic, and mineralogical compositions of rocks, inorganic materials, and waters; use of modern analytical instruments. Offered spring semesters. Prerequisites: CHEM:1070 or CHEM:1110.

SEES:4470 Ecological Climatology 3 s.h.
Introduction to global energy, water, and carbon cycles; biosphere-atmosphere interactions across scales ranging from leaf to globe. Prerequisites: SEES:2310 or SEES:2374.

SEES:4490 Elements of Geochemistry 3 s.h.
Introduction to application of chemical principles to solution of geologic problems concerning earth and environmental processes; origin of elements, chemical differentiation of Earth and the solar system, geochronology, application of radiogenic and stable isotopes, chemical equilibrium, elementary thermodynamics and kinetics, carbonate and silicate stability relationships, chemical weathering, adsorption, trace element behavior, oxidation-reduction reactions, characterization of surface and ground waters, and ocean chemistry. Prerequisites: (SEES:1030 or SEES:1050) and (CHEM:1070 or CHEM:1110).

SEES:4500 Advanced Remote Sensing 4 s.h.
Theory and practice of remote sensing and digital image processing; practical applications to human-environment interactions. Requirements: SEES:3100 or SEES:3500 or CEE:3783. Same as IGPI:4500.

SEES:4520 GIS for Environmental Studies: Applications 3 s.h.
Project-driven course to advance student knowledge of geographic information systems (GIS); application of GIS to environmental change analysis, environmental assessment, hazard/risk analysis, and environmental decision-making. Prerequisites: SEES:3520. Same as IGPI:4520.

SEES:4540 Isotope Geochemistry 3 s.h.
Radiogenic and stable isotope systematics, applications to geological, cosmological, and environmental problems. Prerequisites: (SEES:1030 or SEES:1050) and (CHEM:1070 or CHEM:1110). Recommendations: SEES:2410.

SEES:4580 Introduction to Geographic Databases 3 s.h.
Introduction to basic building blocks of spatial database design, spatial data models, structures, relationships, queries (SQL), indexing, and geoprocessing; design and construction of various types of spatial databases, including relational and big data approaches such as ArcGIS geodatabase, PostGIS/PostgreSQL, and MongoDB. Prerequisites: SEES:2050. Same as IGPI:4581.

SEES:4600 Biogeography, Ecology, and Conservation of Mammals 4 s.h.
An overview of the class Mammalia. Topics include the evolution, diversity, functional morphology, behavior, ecology, biogeography, and conservation of mammals. Course follows a lecture/lab format and includes both field and classroom labs. Prerequisites: BIOL:1412 or SEES:2374.

SEES:4630 Hydrogeology 4 s.h.
Foundational concepts of physical hydrogeology including water cycle and hydrologic balance, hydrogeologic properties of porous media and fractured rock, Darcy's law, flow systems, and hydrogeologic characterization methods; students practice quantitatively evaluating groundwater flow problems through regular problem sets and hands-on labs. Prerequisites: MATH:1850 or MATH:1550.

SEES:4640 Contaminant Hydrogeology 3 s.h.
Introduction to controls on contaminant transport in groundwater systems (e.g., advection, dispersion, diffusion, reaction/transformation); variety of models used to practice quantitatively evaluating contaminant behavior; survey of common contaminants in groundwater through discussion of published case studies; overview of standard and leading edge characterization and remediation methods. Recommendations: SEES:4630 or CEE:4102.

SEES:4660 Groundwater Modeling 3 s.h.
Groundwater flow and contaminant transport modeling; numerical methods, applications of groundwater modeling to water supply, groundwater resources evaluation, remediation design using software; GMS (MODFLOW, MODPATH, and MT3D). Prerequisites: MATH:1860 and SEES:4630. Same as CEE:4104.

SEES:4680 Field Methods in Hydrologic Science 3 s.h.
Collection and interpretation of physical hydrology and hydraulics field measurements; basic data quality assurance and quality control; hands-on experience with field equipment and data collection. Prerequisites: SEES:4720 or SEES:2831 or SEES:3020 or SEES:3360 or SEES:3330 or SEES:3380 or ENGR:2510 or SEES:4800 or SEES:4630 or CEE:3371 or SEES:4790 or SEES:3390.

SEES:4720 Paleoclimatology 3 s.h.
Introduction to glaciers and glacial and interglacial Earth systems; linkages among glacial, oceanic, and atmospheric systems and their effects on landscapes and biota over the past 2 million years; how oceans, atmosphere, and glaciers interact and landscape effects of past glacial and interglacial cycles. Requirements: physical geology or physical geography or anthropology.

SEES:4750 Environmental Impact Analysis 3 s.h.
In-depth exposure to the history and evolution of the U.S. Environmental Impact Assessment (EIA) process; discussion of major court cases; ecological, economic, and political aspects of current environmental controversies; exposure to real-world scenarios that are crucial to understanding the EIA process in action; field trips to six or seven environmental control facilities in Iowa City and neighboring areas. Prerequisites: SEES:1070. Same as URP:4750.

SEES:4760 Mineral and Petroleum Exploration Geology 3 s.h.
Fundamentals of resource exploration philosophy and methods, with project-based presentation of techniques and strategies for mineral exploration and petroleum exploration; integration and evaluation of geological, geochemical, and geophysical techniques for mineral exploration; hydrocarbon systems and seismic interpretation for petroleum exploration. Corequisites: SEES:3510 and SEES:3840.

SEES:4770 Environmental Justice 3 s.h.
Introduction to the field of environmental justice; understanding and addressing the processes that lead poor and marginalized communities to face a disproportionate degree of environmental risks and hazards. Same as AFAM:4770, GHS:4770.

SEES:4780 Global Stratigraphy 3 s.h.
Types of stratigraphy (e.g., biostratigraphy, lithostratigraphy, sequence stratigraphy, chemostratigraphy, magnetostratigraphy, cyclostratigraphy, chronostratigraphy) that share a number of procedures and practices and how differences cloud understanding of Earth history; central role of stratigraphy in modern geoscience pursuits; issue of time in stratigraphic record as an organizing theme for investigation of comparative stratigraphy.

SEES:4790 Applied Environmental Geology 3 s.h.
Application of geology, water, and earth processes to civil and environmental engineering practice; physical properties of rock and soil, geologic mapping and surveying, groundwater supplies and wells, stream engineering, watershed management, site investigations for environmental assessment, and geologic hazards. Prerequisites: SEES:1050 or SEES:1080 or SEES:1030.

SEES:4800 Global Geophysics 3 s.h.
Geophysics is the broad geoscience field interested in discovering the unseen characteristics of the Earth and other planets, including the internal structure of the Earth, the current motions of tectonic plates, the sources and causes of geological disasters, and the locations of economic resources; methods to accomplish these goals include seismology, gravity and magnetic studies, geodesy, and measurements of heat; course offers a broad introduction to these topics that is rooted in current and growing fields of active research. Requirements: introductory geology or physics.

SEES:4820 Tectonics and Basin Analysis 3 s.h.
Dynamic processes responsible for crustal genesis, plate movements, mountain building; plate boundary zones; sedimentologic, structural, petrologic, geophysical characteristics of major tectonic settings; multidisciplinary approach; week-long field trip. Corequisites: SEES:3840.

SEES:4832 Geologic Field Analysis 3 s.h.
Structural, stratigraphic, and regional analysis of geology in the Rocky Mountains of Montana; emphasis on making reasonable geologic interpretations from field relationships; mapping projects in vicinity of Dillon, Montana that build on experience gained in SEES:2831; capstone experience dedicated to synthesizing the geology of a fold-and-thrust belt near Glacier National Park. Offered summer session. Prerequisites: SEES:3840 and SEES:2831.

SEES:4990 Senior Thesis 3 s.h.
Original research. Requirements: senior standing.

SEES:4995 Honors Thesis arr.
Original research. Requirements: honors standing.

SEES:5010 School of Earth, Environment, and Sustainability Foundations 3 s.h.
Overview of research in the School of Earth, Environment, and Sustainability (SEES).

SEES:5015 American Association of Petroleum Geologists Fall Field Trip 1 s.h.
Resource-related topics in mineral and hydrocarbon exploration; tectonic settings for resources. Requirements: AAPG student chapter member or graduate standing, and basic understanding of mineralogy, petrology, and structural geology.

SEES:5020 Research Resources 1 s.h.
Develop literature review skills; identify and synthesize key works in areas of study.

SEES:5050 Research and Writing 3 s.h.
Identification of research areas; research questions and hypotheses; methodological decisions; research proposal and paper writing.

SEES:5380 Process Geomorphology Seminar 1-3 s.h.
Topics in process geomorphology ranging from fluvial dynamics to mass movement to sediment transport and related environmental processes.

SEES:5530 Geochronology 3 s.h.
How to evaluate published ages, and assumptions/errors involved; how to select and sample suitable materials for dating, and choose a suitable dating method and analytical technique; opportunity to develop skills for research and professional careers. Prerequisites: SEES:4490 or SEES:4540.

SEES:5800 Environmental Policy: Theory and Practice 3 s.h.
Various types of approaches to environmental policy, with a focus on the differences between market-based (taxes and regulatory markets) and command and control (regulations and bans); assessment of approaches in terms of efficacy, efficiency, and equity; key United States and international environmental policies such as the Clean Water Act, the Endangered Species Act, and the Paris Agreement; role of technology, research, and development in addressing environmental problems. Same as PBAF:5800, URP:5800.

SEES:6100 Seminar in Health and Environment 3 s.h.
Research on health and environment.

SEES:6190 Graduate Directed Study arr.
Independent research.

SEES:6230 Special Topics 1-3 s.h.
Contemporary issues in School of Earth, Environment, and Sustainability research areas.

SEES:6250 Paleontology Seminar 1-3 s.h.
Current controversial issues in paleontology. Recommendations: SEES:3210.

SEES:6300 Seminar in Environment, Conservation, and Land Use 1-3 s.h.
Research on land use, water resources, conservation.

SEES:6390 Advanced Watershed Analysis Seminar 1-3 s.h.
Integration of existing knowledge of physical, hydrological, and environmental processes with management issues and challenges in water resources and environmental management; aspects of water quantity and quality, water use and treatment, and basin management issues related to forestry, agriculture, urbanization, floods, droughts.

SEES:6500 Seminar in Spatial Analysis and Modeling 1-3 s.h.
Research themes in spatial analysis, GIScience, simulation, remote sensing. Same as IGPI:6501.

SEES:6570 Earth and Planetary Science Seminar 1-2 s.h.
Topics in earth and planetary science.

SEES:7000 School of Earth, Environment, and Sustainability Research Colloquium 1 s.h.

SEES:7270 Orientation, Scholarly Integrity, and Responsible Conduct of Research 1 s.h.
Introduction to the School of Earth, Environment, and Sustainability (SEES) and provides training in the responsible conduct of research (RCR) in the earth and environmental sciences. Introduction to degree requirements, departmental programs, departmental and university facilities, and local geology; overview of research and scholarship, funding mechanisms, publication process, professional and industry considerations, conflict of interest, and intellectual property. Review and explore a broad spectrum of ethics and scholarly integrity in SEES during formulation, performance, and reporting of both basic and applied research.

SEES:7559 Race, Science, and Nature in Latin America **arr.**
Analysis of the history of United States and Latin America relations in the 20th century through the lens of scientific and agricultural change; how plant breeding, agrochemicals, heavy machinery, and irrigation systems set in motion trends that made the 20th century exceptional; possibility of feeding an unprecedented growing global population and transition of human species from being primarily rural to primarily urban in less than a hundred years; analysis of how a network of scientists, businesses, and governments made proliferation of agribusinesses possible to emphasize Indigenous and Mestizo peasants' role in that process. Same as AMST:7559, HIST:7559.

SEES:7604 Principles of Scholarly Integrity **0 s.h.**
Training in responsible conduct of research and scholarly activities; student/mentor responsibilities, authorship, plagiarism/falsification/fabrication of data, intellectual property, conflict of interest; fiscal, institutional, and societal; data handling. Requirements: postdoctoral standing in geoscience.

SEES:7990 Graduate Research **arr.**
Independent research related to theses or dissertations.

SEES:7999 Graduate Thesis **arr.**