

Environmental Studies

Students interested in studying the environment can choose among three majors in the following academic departments: Biology; Earth and Planetary Sciences; and Political Science. The curriculum for these majors is integrated and interdisciplinary, drawing from many disciplines across Arts & Sciences and the university as a whole, and the majors thus capture the strengths of both the traditional academic departments and the interdisciplinary innovation necessary to explore fully the multiple issues and questions posed in the study of the environment. Please visit the Environmental Studies website (<http://enst.wustl.edu>) for more information.

Please visit the following *Bulletin* pages for more information on these majors:

Environmental Biology (<http://bulletin.wustl.edu/undergrad/artsci/biology/#majors>)

Environmental Earth Sciences (<http://bulletin.wustl.edu/undergrad/artsci/earthplanetarysciences/#majors>)

Environmental Policy (<http://bulletin.wustl.edu/undergrad/artsci/politicalscience/#majors>)

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Majors

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Environmental Biology (<http://bulletin.wustl.edu/undergrad/artsci/biology/#majors>)

Environmental Earth Sciences (<http://bulletin.wustl.edu/undergrad/artsci/earthplanetarysciences/#majors>)

Environmental Policy (<http://bulletin.wustl.edu/undergrad/artsci/politicalscience/#majors>)

Minors

The Minor in Environmental Studies

Required Units: 19

Required Courses:

Code	Title	Units
EPSc 201	Earth and the Environment	4
Biol 2950	Introduction to Environmental Biology	3
Pol Sci 2010	Introduction to Environmental Policy	3
Total Units		10

Elective Courses: 9 units — one course from each of the three categories below

One advanced science course:

Code	Title	Units
Biol 372	Behavioral Ecology	4
Biol 381	Introduction to Ecology	3
EnSt 375	Urban Ecology	3
EPSc 323	Biogeochemistry	3
EPSc 401	Earth Systems Science	3
EPSc 413	Introduction to Soil Science	3

One advanced political science or law course:

Code	Title	Units
Pol Sci 3240	The Political Economy of Public Goods	3
Pol Sci 331	Topics in Politics	3
Pol Sci 332B	Environmental and Energy Issues	3
Pol Sci 3752	Topics in American Politics: Globalization, Urbanization and Environment	3
Pol Sci 4043	Public Policy Analysis, Assessment and Practical Wisdom	3
EnSt 539	Interdisciplinary Environmental Clinic	var.; max 6

One advanced anthropology or ethics course:

Code	Title	Units
Anthro 3322	Brave New Crops	3
Anthro 3472	Global Energy and the American Dream	3
Anthro 361	Culture and Environment	3
Anthro 4211	Paleoethnobotany and Ethnobotany	3

EnSt 335F Introduction to Environmental Ethics 3

Courses that are offered less frequently or have more prerequisites but that are preapproved substitutions for these requirement categories include:

Advanced science:

Code	Title	Units
Biol 4170		3
EPSc 408	Earth's Atmosphere and Global Climate	3
EPSc 429	Environmental Hydrogeology	3
EPSc 444	Environmental Geochemistry	3
EPSc 484	Paleoenvironmental Reconstruction	3

Advanced political science or law:

Code	Title	Units
Econ 451	Environmental Policy	3

Advanced anthropology or ethics:

Code	Title	Units
Anthro 3612	Population and Society	3
Anthro 4215	Anthropology of Food	3

Other advanced courses:

Code	Title	Units
EnSt 405	Sustainability Exchange: Community and University Practicums	3
EnSt 406	Urban Ecosystem Principles Integration	3

The Minor in Interdisciplinary Environmental Analysis

Required Units: 18

Required Courses:

Code	Title	Units
EnSt 350W	Environmental Issues: Writing	3
EnSt 357	Environmental Problem Solving	3
EnSt 380	Applications in GIS	3
Total Units		9

One interdisciplinary environmental capstone course:

Code	Title	Units
EnSt 405	Sustainability Exchange: Community and University Practicums	3
EnSt 406	Urban Ecosystem Principles Integration	3

EnSt 452	International Climate Negotiation Seminar	var.; max 6
EnSt 539	Interdisciplinary Environmental Clinic	var.; max 6

One advanced elective in natural science:

Code	Title	Units
EnSt 365	Applied Conservation Biology	3
EnSt 481	Advanced GIS	3
EPSc 454	Exploration and Environmental Geophysics	4

One advanced elective in social science and humanities:

Code	Title	Units
Econ 451	Environmental Policy	3
EnSt 310	Ecological Economics	3
EnSt 315	Fallout: Analyzing Texts and Narratives of the Nuclear Era	3
EnSt 335F	Introduction to Environmental Ethics	3
EnSt 461	Intro to Environmental Law and Policy	3
History 3068	The Human History of Climate Change	3
Pol Sci 4043	Public Policy Analysis, Assessment and Practical Wisdom	3

Courses

Visit online course listings to view semester offerings for L82 EnSt (<https://courses.wustl.edu/CourseInfo.aspx?sch=L&dept=L82&crslvl=1:4>).

L82 EnSt 109A Quantitative Reasoning in Environmental Science

Introduction to practical mathematical methods for understanding environmental aspects of our planet, particularly how the environment changes with time through human interactions. Emphasis on intuitive approaches in devising simple relationships for understanding quantitative outcomes of natural processes. Introduction to basic statistical methods, including hypothesis testing, and how statistics can be applied to environmental problems.

Same as L19 EPSc 109A

Credit 3 units. A&S: NS, QA A&S IQ: NSM, AN Art: NSM BU: SCI

L82 EnSt 110 Environmental Issues

This course examines the science behind current environmental issues, with emphasis on ecology and Earth science. Students gain an understanding about the consequences of the way that humans currently interact with the natural environment and potential solutions that would allow long-term sustainability of the Earth. Topics include: human population growth, global climate change, energy use, challenges to feeding the world,

the interaction between the environment and human health, sustainable design, and the relationship between biodiversity and ecosystem functioning.

Credit 3 units. A&S: NS A&S IQ: NSM BU: SCI

L82 EnSt 115 Introduction to Conservation Biology

This course is introductory level and appropriate for both non-science majors as well as potential science majors who may be investigating their interests. Conservation Biology will focus on biodiversity, its preservation and current threats, as well as obstacles to its preservation for the future. We will examine the different levels of biodiversity present in nature as well as highlighting its importance, and why it matters to the human population. In studying Conservation Biology, students will also learn key concepts from related fields such as evolution and ecology that are necessary to understand concepts and concerns. Course topics include species and ecosystem management, restoration, strategies to combat threats, and past successes and failures relating to biodiversity conservation.

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

L82 EnSt 122 A&S Freshman Seminar: A Sense of Place: Discovering the Environment of St. Louis

Students go exploring in and around St. Louis. Rivers, prairies, urban landscapes and more. They'll learn about the St. Louis backyard and their "home" for the next four years. Through field trips, readings, interviews and discussion, they'll see first-hand what challenges face the environment and the people who live here. They will learn how to examine multiple perspectives, how to think critically and how to approach problems from an interdisciplinary and holistic approach. Students also learn why it is important to know a community at the local level if they're going to affect change on any level — state, national or international. In addition to weekly readings and discussion, this class includes several field trips.

Credit 3 units. A&S: NS A&S IQ: NSM BU: SCI

L82 EnSt 201 Earth and the Environment

Introduction to the study of the Earth as a dynamic, evolving planet. Emphasis on how internal and surface processes combine to shape the environment. Themes: Earth's interior as revealed by seismic waves; Earth history and global tectonics shown by changes to ocean floors, mountain-building, formation of continents, earthquakes and volcanism; climate history and global biogeochemical cycles, influenced by circulation of atmosphere and oceans, ice ages and human activity. Composition and structure of rocks and minerals. Part of the introductory sequence of courses for all Earth and planetary sciences and environmental studies majors. Three class hours and one two-hour lab a week.

Same as L19 EPSc 201

Credit 4 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L82 EnSt 210 Undergraduate Teaching Assistant

Credit 3 units.

L82 EnSt 221A Human Use of the Earth

Examination of the impacts of a growing population on the Earth, including habitat destruction, resource depletion, and air and water pollution. Population growth, landscape change, and the distribution and uses of the water, mineral, and energy-producing resources of the Earth.

Same as L19 EPSc 221A

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L82 EnSt 222 Topics in Japanese Literature and Culture: Environmental Consciousness in Modern Japanese Literature

A topics course on Japanese literature and culture; topics vary by semester.

Same as L05 Japan 221

Credit 3 units. A&S: TH A&S IQ: HUM, LCD BU: IS EN: H

L82 EnSt 2431 Focus: Missouri's Natural Heritage, Part 1

Missouri's Natural Heritage is a multidisciplinary two-semester freshman Focus course. The first semester of the sequence focuses on Missouri geology, climate, archaeology and native megafauna. This provides a foundation on which to examine the ecology, restoration and management of our diverse habitats (prairie, forest, glade and stream) and the biology of our diverse plant and animal wildlife (arthropods, mollusks, fish, salamanders, lizards, birds and mammals) in the second semester. We also introduce basic concepts in biodiversity and resource management with attention to resolution of conflicts of interest. In addition to weekly lecture and discussion, students in this class visit sites across the state during three weekend camping trips and a longer camping trip during winter break. Attendance on field trips is an essential component of the course and grade. Lab fee covers transportation and meals for all field trips.

Same as L61 Focus 2431

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

L82 EnSt 272A Physics and Society

Introduction to physics: its goals, methods, and relevance for society. Topics include energy as a unifying principle of physics and society's use of energy: resources and costs. Nuclear energy: history, technology, radiation, waste, weapons. Global climate change: the greenhouse effect, the hole in the ozone layer. Science and government. Bad science, pseudoscience, antiscience. Intended for science and nonscience majors. Must be taken for a letter grade.

Same as L31 Physics 171A

Credit 3 units. A&S: NS, QA A&S IQ: NSM, AN Art: NSM BU: SCI

L82 EnSt 290 Sophomore Seminar in Sustainability and the Environment

This course will provide an opportunity for students to evaluate and explore potential paths in environmental studies, and learn presentation skills to carry forward in their careers. Students will also get the opportunity to get out of the classroom and participate in environmental field trips and activities.

Credit 3 units. A&S: NS A&S IQ: NSM

L82 EnSt 299 Directed Internship

Internship with an environmental organization (commercial, not-for-profit, governmental, etc.) where the primary objective is to obtain professional experience outside of the classroom. Student must have a faculty sponsor and must file a Learning Agreement with the Career Center, the faculty sponsor and the site supervisor. A final written project is agreed upon between the student and faculty sponsor before work begins, and is evaluated by the faculty sponsor at the end of the internship.

Detailed supervision of the intern is the responsibility of the site supervisor.

Credit variable, maximum 3 units.

L82 EnSt 3068 The Human History of Climate Change

While climate change has become a hot-button issue in recent decades, it is by no means a new concern. Advisers to the king of France were warning against deforestation in the 18th century and 19th century. Scientific experiments revealed the arrival of acid rain in the industrial centers of Great Britain. This course will examine the longer history of climate change and how it has been addressed as a scientific, political and environmental issue. Students will be introduced to the field of environmental history and explore how the methods of this field of inquiry challenge traditional historical categories.

Same as L22 History 3068

Credit 3 units. A&S: SS BU: HUM EN: S

L82 EnSt 306B Africa: Peoples and Cultures

An anthropological survey of Africa from the classic ethnographies to contemporary studies of development. Emphasis on the numerous social and economic changes African peoples have experienced from precolonial times to the present.

Same as L48 Anthro 306B

Credit 3 units. A&S: SS, CD A&S IQ: LCD, SSC Arch: SSC Art: SSC BU: HUM, IS

L82 EnSt 310 Ecological Economics

This course is designed to give students an appropriately advanced understanding of the fundamental assumptions, the conceptual novelties, and the distinctive tools of analysis that comprise the emerging discipline of ecological economics. Often the value of tools is best illustrated through use, so the course also aims to acquaint students with how the conceptual frame of Ecological Economics offers a distinctive approach to some of the most pressing problems our culture faces — problems that have their origin in our perpetual-growth economy which now strains against (and in many places has far transgressed) environmental limits to growth.

Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L82 EnSt 315 Fallout: Analyzing Texts and Narratives of the Nuclear Era

In this course we will pursue diverse texts and narratives through which Americans have developed a complex relationship to this technology and think critically about nuclear energy. Topics will include, but not be limited to: history of nuclear technology development (Manhattan Project); debates surrounding nuclear waste management, environmental and human health, a natural history of irradiated landscapes; literary journalism; and atomic travelogues. This course requires two field visits, including the Ameren Callaway Energy Center (Callaway Nuclear Power Plant) and Weldon Springs Interpretive Center.

Credit 3 units. A&S IQ: HUM Arch: HUM Art: HUM EN: H

L82 EnSt 323 Biogeochemistry

Survey of biogeochemical interactions among Earth's crust, oceans and atmosphere, including perturbations due to human activities. Carbon, nitrogen, phosphorus and sulfur

biogeochemical cycles. Greenhouse warming of atmosphere from carbon dioxide and chlorofluorocarbons: effects of inorganic and organic wastes in groundwater systems. Introductory course for students of environmental science and nonscience majors.

Prerequisite: permission of instructor.

Same as L19 EPSc 323

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L82 EnSt 335F Introduction to Environmental Ethics

A general survey of current issues in environmental ethics, focusing on problems such as the obligation to future generations, protection of endangered species, animal rights, problems of energy and pollution, wilderness, global justice, and business obligations. Students also learn some ethical and political theory.

Same as L30 Phil 235F

Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM BU: ETH

L82 EnSt 350W Environmental Issues: Writing

For students interested in environmental issues — natural science, social science and policy. This course aims to provide students with the writing skills they need to be successful in the environmental field once they graduate. In doing so, students examine environmental issues and decision-making processes by examining data and facts underlying positions and decisions. They explore the role of audience, purpose and author angle of vision as they examine the role of multiple stakeholders in environmental issues and processes. Students also are exposed to different types of writing used in environmental studies professions. When the course includes a service learning component, students are exposed to the types of writing that are necessary in environmental careers and in environmental non-profits and governmental agencies in particular.

Credit 3 units. A&S: NS, WI A&S IQ: NSM, WI BU: SCI

L82 EnSt 357 Environmental Problem Solving

This course aims to provide students with the opportunity to develop and apply problem-solving skills in the context of environmental challenges. Students will learn basic frameworks of decision-making through readings and role-play. Through the role-play, students will grapple with the perspectives of multiple stakeholders, the interplay of science and policy, and the ambiguity and uncertainty inherent in decision-making processes.

Credit 3 units. A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L82 EnSt 374 Social Landscapes in Global View

From the beginning of the human campaign, societies have socialized the spaces and places where they live. This socialization comes in many forms, including the generation of sacred natural places (e.g., Mt. Fuji) to the construction of planned urban settings where culture is writ large in overt and subtle contexts. Over the past two decades or so, anthropologists, archaeologists and geographers have developed a wide body of research concerning these socially constructed and perceived settings — commonly known as "landscapes." This course takes a tour through time and across the globe to trace the formation of diverse social landscapes, starting in prehistoric times and ending in modern times. We cover various urban landscapes, rural landscapes, nomadic landscapes (and others) and the intersection of the natural environment, the built environments and the symbolism that weaves them together. Chronologically, we range from 3000 BCE to 2009 CE and we cover all the continents. This course

also traces the intellectual history of the study of landscape as a social phenomenon and investigates the current methods used to recover and describe social landscapes around the world and through time. Join in situating your own social map alongside the most famous and the most obscure landscapes of the world and trace the global currents of your social landscape!

Same as L48 Anthro 374

Credit 3 units. A&S: SS A&S IQ: LCD, SSC Art: SSC BU: BA EN:

S UColl: NW

L82 EnSt 375 Urban Ecology

Urban Ecology is a field of study within ecology that focuses on the urban environment as an ecosystem and attempts to understand how humans and nature can better coexist in these highly modified environments. The ultimate goal is to aid efforts for more sustainable cities through better urban planning and practices. It is a multidisciplinary study including topics from ecology, evolution and conservation biology, as well as architecture, economics and business. The class format will include both lectures and discussions.

Credit 3 units. A&S: NS A&S IQ: NSM Arch: NSM Art: NSM BU:

SCI

L82 EnSt 380 Applications in GIS

This introductory course in Geographic Information Systems (GIS) is designed to provide basic knowledge of GIS theory and applications using the existing state-of-the-art GIS software. The course is taught using a combination of lectures, demonstrations and hands-on, interactive tutorials in the classroom. The first week of the course provides a broad view of how students can display and query spatial data and produce map products. The remainder of the course focuses on applying spatial analytical tools to address questions and solve problems. As the semester develops, more tools are added to students' GIS toolbox so that they can complete a final independent project that integrates material learned during the course. Students are encouraged to design individualized final projects using their own or other available data; however, some already-prepared final projects also are available.

Credit 3 units. A&S: NS A&S IQ: NSM

L82 EnSt 381 Introduction to Ecology

This course explores the science of ecology, including factors that control the distribution and population dynamics of organisms, the structure and function of biological communities, how energy and nutrients flow across ecosystems, and what principles govern ecological responses to global climatic and other environmental changes. The class format includes lectures, discussions and small group exercises. Assignments include quantitative data analysis, ecological modeling and scientific writing.

Same as L41 Biol 381

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L82 EnSt 390 Independent Study

Independent study for undergraduates, supervised by a faculty member. Prerequisite: permission of instructor.

Credit variable, maximum 6 units.

L82 EnSt 391 Directed Research in Environmental Studies

Research activities or project in environmental studies done under the direction of an instructor in the program. Permission of an instructor and the chair of the program is required.

Credit variable, maximum 6 units.

L82 EnSt 392 Directed Fieldwork in Environmental Studies

Fieldwork carried out under the direction or supervision of an instructor in the Program. Permission of an instructor and of the chair of the program is required.

Credit variable, maximum 6 units.

L82 EnSt 405 Sustainability Exchange: Community and University Practicums

The Sustainability Exchange will bring together students working in transdisciplinary teams to tackle real-world energy, environmental, and sustainability problems through an experiential form of education. Students will participate in projects with clients and partners on- or off-campus, developed with and guided by faculty advisers drawn from across the university, with the intention of delivering an applicable end-product that explores "wicked" problems requiring innovative methods and solutions. These projects matter to the client or partner. The team-based project will be complemented by a seminar that will explore the field of design and design thinking through problem-solving strategies and methodologies drawn from a wide range of creative practices, including design, engineering and science, as well as contemporary topics in energy, environment and sustainability. Students will draw on these topics to influence their projects. This course is open to all undergraduate juniors and seniors. An application is required; students will be accepted off the wait list following the application process. CET (<https://gephardt.institute.wustl.edu/cec/college-of-arts-sciences>) course.

Same as I50 InterD 405

Credit 3 units. A&S IQ: SSC EN: S

L82 EnSt 406 Urban Ecosystem Principles Integration

In today's world, your discipline has grand challenges whose solutions often lay in other realms. How will you train yourself to leverage the interdisciplinary partnerships required to innovatively solve and evolve in a rapidly changing world? The mission of this interdisciplinary course is to "Advance the interrelationships of ecological and human systems toward creating a healthy, resilient, and biodiverse urban environment," and bring together experts and students in ecology, urban design, architecture/landscape architecture, economics, social work and engineering, drawing from inside and outside the Washington University community. Building from our knowledge of ecosystem principles and function, a diverse group of leaders in their fields provides lectures, readings and student project leadership to understand and test Healthy Urban Ecosystems Principles among human and ecological (nonhuman) systems and the range of sociopolitical processes entailed with their implementation. Class content is developed by Washington University leaders in their disciplines as well as external organizations such as the Missouri Botanical Garden, the Field Museum in Chicago and others. This course builds upon a 1-unit fall seminar (not a prerequisite) that introduces challenges and solutions to achieving healthy urban ecosystems, and provides students an opportunity to more deeply engage and manipulate the interrelationships of symbiotic urban systems, and apply those concepts in multidisciplinary project applications. Projects leverage student-defined challenges in the evolving laboratory of urban St. Louis using Healthy Urban Ecosystems Principles to develop multidisciplinary integrated solutions to challenges encountered in urban areas such as climate change and resilience, security of ecosystem services, social inequity,

economic strife, and community vitality. Students present their work in a public forum at semester's end. CET (<https://gephardt.institute.wustl.edu/cec/college-of-arts-sciences>) course. Same as I50 InterD 406

Credit 3 units. A&S IQ: SSC EN: S

L82 EnSt 408 Earth's Atmosphere & Global Climate

Structure and dynamics of Earth's atmosphere. Basic factors controlling global climate of Earth. Quantitative aspects of remote sensing of atmosphere. Remote sensing instrumentation. Prerequisites: Math 233 and Phys 117A (or Phys 197); or permission of instructor.

Same as L19 EPSc 408

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM

L82 EnSt 413 Introduction to Soil Science

Physical, chemical and biological processes that occur within soil systems. Types of soils and how these relate to soil formation. Major components of soil, including soil water, minerals, organic matter and microorganisms. Soils in wetlands and arid regions. Cycling of nutrients and contaminants in soils. Soil quality, conservation and sustainability. Two one-day field trips required. Prerequisites: EPSc 323 or Chem 112A (or AP Chem score of 4) or permission of instructor.

Same as L19 EPSc 413

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM

L82 EnSt 419 Community Ecology

Basic principles of community ecology, including species interactions, spatial and temporal patterns of biodiversity, and ecosystem functioning. Analytical theory, statistical patterns, and experimental approaches are emphasized. Intended for students wanting a rigorous overview of ecological principles. Prerequisite: at least one of the following courses: Biol 3501, 372, 381, 4170, 4193, EnSt 370 or permission of instructor.

Same as L41 Biol 419

Credit 4 units. A&S: NS A&S IQ: NSM Art: NSM

L82 EnSt 4193 Experimental Ecology Laboratory

Design and interpretation of ecological experiments, with an emphasis on hypothesis testing, sampling methodology, and data analyses. Sessions address fundamental ecological questions and include field, greenhouse, and laboratory (microcosm) studies on a variety of taxa and ecosystems. Generally work is done before dark (5-6 p.m.), although occasionally goes later (7 p.m.). Includes occasional required Saturday field trips to local sites (e.g., forests, wetlands, prairies, streams) for in-depth study. Assignments are primarily several written assignments, including final projects and in-class participation. Fulfills the upper-level laboratory requirement for the Biology major. One hour of lecture and 4 hours of laboratory per week. Prerequisites: permission of instructor and at least one of the following: Introduction to Ecology (Biol 381), Behavioral Ecology (Biol 372), Biological Conservation (EnSt 370), Population Ecology (Biol 4170), Community Ecology (Biol 419), or Evolution (Biol 3501). Credit will not be awarded for both 4191 and 4193. Enrollment is limited to 15 students.

Same as L41 Biol 4193

Credit 4 units. A&S: NS, WI A&S IQ: NSM, WI Art: NSM

L82 EnSt 428 Hydrology

Survey of principles that govern the flow of water in river and groundwater systems in deep geologic environments. Basic

equations of fluid flow, dynamics, and the characteristics of drainage basins, rivers, floods, and important aquifers. Exploitation of ground water systems. Prerequisite: EPSc 353; or permission of instructor.

Same as L19 EPSc 428

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM

L82 EnSt 432 Environmental Mineralogy

Topics connected with environmental mineralogy, some selected by students. Topics may include: mineral dust such as asbestos, containment materials for nuclear waste disposal, environmental ramifications of the processing and use of phosphate fertilizers, lead in the environment, acid mine drainage, microbial mediation of sulfide oxidation, minerals in the human body, weathering of building materials, materials engineering, and engineering of materials for more effective recycling. Three class hours and one two-hour laboratory a week. Participation in discussions, term paper, two field trips required. Most readings from primary sources. Prerequisite: EPSc 352 or permission of instructor.

Same as L19 EPSc 430

Credit 4 units. A&S: NS A&S IQ: NSM Art: NSM

L82 EnSt 444 Environmental Geochemistry

Introduction to the geochemistry of natural waters and the processes that alter their composition. Key principles of aqueous geochemistry and their application to describe the main controls on the chemistry of pristine and polluted soil, surface, and ground water environments. Acids and bases, mineral solubility, carbonate chemistry, chemical speciation, redox reactions, adsorption and ion exchange, and the speciation, mobility and toxicity of metals. Prerequisites: EPSc 201 and Chem 112A (or AP Chem score of 4); or permission of instructor.

Same as L19 EPSc 444

Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L82 EnSt 451 Environmental Policy

This course examines the relationship between environmental economics and environmental policy. The course focuses on air pollution, water pollution, and hazardous wastes, with some attention given to biodiversity and global climate change. The course examines critically two prescriptions that economics usually endorses: (1) "balancing" of benefits against costs (e.g., benefit-cost analysis) and the use of risk analysis in evaluating policy alternatives; (2) use of market incentives (e.g., prices, taxes or charges) or "property rights" instead of traditional command-and-control regulations to implement environmental policy. Prerequisite: Econ 1011.

Same as L11 Econ 451

Credit 3 units. A&S: SS A&S IQ: SSC Art: SSC BU: BA, ETH

L82 EnSt 452 International Climate Negotiation Seminar

This course is a 3-credit advanced seminar for students who will represent Washington University at the annual United Nations Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). COP22 will be held in Marrakech, Morocco, in November of 2017.

Credit variable, maximum 6 units. A&S IQ: SSC EN: S

L82 EnSt 461 Intro to Environmental Law and Policy

Survey of the most prominent federal laws governing environmental compliance and pollution control. Examines laws applicable to environmental impact statements, air pollution, water pollution, and hazardous waste. Addresses policy

concerning the relative merits of using technological capabilities as compared with health risks in setting environmental standards. Discusses the need for environmental regulation to protect societal resources.

Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L82 EnSt 481 Advanced GIS

This course is designed to move beyond tools and skills learned in Applications in GIS (EnSt 380/580). Classes will feature hands-on exercises selected to help students master advanced GIS analysis tools and techniques, while providing experience in the planning and execution of real-world projects. Primary emphasis will be on applying fundamental GIS concepts, performing spatial analysis, developing proficiency with core ArcGIS software (e.g., Network Analyst extension), resolution of problems, and efficient delivery of results. Readings from books and scientific literature will introduce key concepts and provide real-world examples that will be reinforced in the hands-on exercises, assignments and projects. As the semester develops, students will gain a variety of new tools and techniques that will allow them to complete a final independent project that integrates the material learned during the course.

Credit 3 units. A&S IQ: NSM

L82 EnSt 498 Undergraduate Research Seminar

Provides an opportunity for advanced undergraduates to synthesize many of the diverse subdisciplines of Earth and Planetary Sciences while focusing on a research topic. Subject changes each offering. Each subject is unique and timely, but broad enough to encompass wide-ranging interests among students. Students conduct original research, make written reports of the results, and make oral presentations of their projects in class. Prerequisite: senior standing or permission of instructor.

Same as L19 EPSc 498

Credit 3 units. A&S: NS, WI A&S IQ: NSM, WI Art: NSM