Environmental Studies

Students interested in studying the environment can choose from 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. 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 by the study of the environment. Please visit the Environmental Studies website (http://enst.wustl.edu) for more information.

Environmental Studies offers two minors. The environmental studies minor (https://enst.wustl.edu/academic-requirements/#anchor-group-9799) includes core course work in biology, earth science and political science. Students may choose upper-level elective courses in a variety of natural and social science disciplines.

The interdisciplinary environmental analysis minor (https://enst.wustl.edu/academic-requirements/#anchor-group-9814) prepares students to tackle real-world environmental challenges by providing more robust opportunities for interdisciplinary knowledge and skill development. In particular, the minor is structured to provide students with opportunities to strengthen their critical analysis and problem-solving skills through participation in team-based learning experiences and, where possible, by engaging on real-world issues.

For more information about the related majors, please visit the following Bulletin pages:

- 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)

Phone: 314-935-7047
Email: bowinston@wustl.edu
Website: http://enst.wustl.edu

Faculty

Director

David Fike (https://eps.wustl.edu/people/david-like)
Professor, Department of Earth & Planetary Sciences
Associate Director, International Center for Energy, Environment and Sustainability (InCEES)
Director, Environmental Studies Program
PhD, Massachusetts Institute of Technology
(Earth and Planetary Sciences)

Associate Director

Eleanor Pardini (http://wubio.wustl.edu/people/eleanor-pardini)
Senior Lecturer and Research Scientist, and Associate Director of Environmental Studies and Contact for Environmental Biology
PhD, University of Georgia
(Biology)

Professor

William R. Lowry (http://polisci.wustl.edu/William_Lowry)
Contact for Environmental Policy
PhD, Stanford University
(Political Science)

Additional Faculty

Solny Adalsteinsson (https://tyson.wustl.edu/solny-adalsteinsson)
Staff Scientist, Tyson Research Center
(Environmental Studies)

Sharon Deem (https://www.researchgate.net/profile/Sharon_Deem)
DVM, PhD, DACZM
(Environmental Studies; Saint Louis Zoo)

Karen DeMatteo (https://enst.wustl.edu/people/karen-dematteo)
Lecturer
PhD, Saint Louis University
(Environmental Studies; GIS)

Elizabeth Hubertz (http://law.wustl.edu/faculty_profiles/profiles.aspx?id=6728)
Lecturer in Law
Assistant Director, Interdisciplinary Environmental Clinic
JD, University of Virginia
(Law; Interdisciplinary Environmental Clinic)

Scott Krummenacher (http://polisci.wustl.edu/faculty/scott-krummenacher)
Lecturer
PhD, Saint Louis University
(Political Science)
Students interested in studying the environment can choose from among three majors in the following academic departments: Biology, Earth and Planetary Sciences, and Political Science. Please visit the following Bulletin pages for more information about 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)

**Minors**

**The Minor in Environmental Studies**

**Required Units: 19**

**Required Courses:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSc 201</td>
<td>Earth and the Environment</td>
<td>4</td>
</tr>
<tr>
<td>Biol 2950</td>
<td>Introduction to Environmental Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

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

**One advanced science course:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol 372</td>
<td>Behavioral Ecology</td>
<td>4</td>
</tr>
<tr>
<td>Biol 381</td>
<td>Introduction to Ecology</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 375</td>
<td>Urban Ecology</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 323</td>
<td>Biogeochemistry</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 401</td>
<td>Earth Systems Science</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 413</td>
<td>Introduction to Soil Science</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 364</td>
<td>Field Methods for Environmental Science</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 365</td>
<td>Applied Conservation Biology</td>
<td>3</td>
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</table>

**One advanced political science or law course:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Pol Sci 3240</td>
<td>The Political Economy of Public Goods</td>
<td>3</td>
</tr>
<tr>
<td>Pol Sci 331</td>
<td>Topics in Politics: Theories of Social Justice</td>
<td>3</td>
</tr>
<tr>
<td>Pol Sci 332B</td>
<td>Environmental and Energy Issues</td>
<td>3</td>
</tr>
<tr>
<td>Pol Sci 340</td>
<td>Topics: Environmental Justice</td>
<td>3</td>
</tr>
<tr>
<td>Pol Sci 3752</td>
<td>Topics in American Politics: Globalization, Urbanization and Environment</td>
<td>3</td>
</tr>
<tr>
<td>Pol Sci 4043</td>
<td>Public Policy Analysis, Assessment and Practical Wisdom</td>
<td>3</td>
</tr>
<tr>
<td>L82 EnSt 539</td>
<td>Interdisciplinary Environmental Clinic</td>
<td>var.; max 6</td>
</tr>
</tbody>
</table>

**EnSt 461** | Intro to Environmental Law | 3     |

**One advanced anthropology or ethics course:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 3053</td>
<td>Nomadic Strategies and Extreme Ecologies</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 3322</td>
<td>Brave New Crops</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 3472</td>
<td>Global Energy and the American Dream</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 361</td>
<td>Culture and Environment</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 3615</td>
<td>Environmental Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 4211</td>
<td>Paleoenvironment and Ethnobotany</td>
<td>3</td>
</tr>
<tr>
<td>History 3068</td>
<td>An Inconvenient Truth: The Human History of Climate Change</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 405</td>
<td>Sustainability Exchange: Community and University Practicums</td>
<td>3</td>
</tr>
</tbody>
</table>
EnSt 406 Urban Ecosystem Principles Integration 3

Additional Course Options: Courses that are offered less frequently or that have more prerequisites but that are preapproved substitutions for these requirement categories include the following:

Advanced science:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSc 408</td>
<td>Earth's Atmosphere and Global Climate</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 429</td>
<td>Environmental Hydrogeology</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 444</td>
<td>Environmental Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 484</td>
<td>Paleoenvironmental Reconstruction</td>
<td>3</td>
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</table>

Advanced political science or law:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Econ 451</td>
<td>Environmental Policy</td>
<td>3</td>
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</table>

Advanced anthropology or ethics:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 3612</td>
<td>Population and Society</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 4215</td>
<td>Anthropology of Food</td>
<td>3</td>
</tr>
<tr>
<td>Anthro 379</td>
<td>Archaeology and Climate Change</td>
<td>3</td>
</tr>
</tbody>
</table>

The Minor in Interdisciplinary Environmental Analysis

Required Units: 18

Required Courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnSt 350W</td>
<td>Environmental Issues: Writing</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 357</td>
<td>Environmental Problem Solving</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 380</td>
<td>Applications in GIS</td>
<td>3</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

One interdisciplinary environmental capstone course:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnSt 405</td>
<td>Sustainability Exchange: Community and University Practicum</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 406</td>
<td>Urban Ecosystem Principles Integration</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 452</td>
<td>International Climate Negotiation Seminar</td>
<td>var.; max 6</td>
</tr>
<tr>
<td>L82 EnSt 539</td>
<td>Interdisciplinary Environmental Clinic</td>
<td>var.; max 6</td>
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</table>

One advanced elective in natural science:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnSt 365</td>
<td>Applied Conservation Biology</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 481</td>
<td>Advanced GIS</td>
<td>3</td>
</tr>
<tr>
<td>EPSc 454</td>
<td>Exploration and Environmental Geophysics</td>
<td>4</td>
</tr>
<tr>
<td>EnSt 364</td>
<td>Field Methods for Environmental Science</td>
<td>3</td>
</tr>
</tbody>
</table>

One advanced elective in social science and humanities:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ 451</td>
<td>Environmental Policy</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 310</td>
<td>Ecological Economics</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 315</td>
<td>Fallout: Analyzing Texts and Narratives of the Nuclear Era</td>
<td>3</td>
</tr>
<tr>
<td>EnSt 461</td>
<td>Intro to Environmental Law</td>
<td>3</td>
</tr>
<tr>
<td>History 3068</td>
<td>An Inconvenient Truth: The Human History of Climate Change</td>
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<td>Pol Sci 4043</td>
<td>Public Policy Analysis, Assessment and Practical Wisdom</td>
<td>3</td>
</tr>
</tbody>
</table>

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 101 Earth's Future: Causes and Consequences of Global Climate Change

Earth's Future: Causes and Consequences of Global Climate Change examines 1) the physical basis for climate change; 2) how climates are changing and how we know and assess that climates are changing; and 3) the effects of climate change on natural and human systems. The course is team-taught and will involve participation by scholars across the university with expertise in specific subjects. This is a broad, introductory course for first year students and presumes no special subject matter knowledge on the part of the student. Same as I50 INTER D 101 Credit 3 units. A&S: FYBB A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

L82 EnSt 105 Sustainability in Business

In today's complex business environment, organizations are constantly challenged to develop and execute innovative policies and processes that ensure profitable growth. Some leaders believe that the sole purpose of business is to maximize shareholder wealth and that profitability (or fiscal sustainability) is not compatible with environmental responsibility. In reality, ecological and economic performance need not and should not be mutually exclusive. Fortunately, the outmoded mindset of "profit-at-any-cost" is beginning to shift as organizations recognize the importance of adopting balanced business practices that promote economic prosperity, social equity, and environmental quality. Organizations that embed sustainability into their corporate strategies increase operational efficiency by using resources more responsibly and minimizing waste. In an increasingly crowded and competitive marketplace,
sustainability has become a source of competitive advantage through which an organization can have a positive impact not only on the "bottom line" but also on the environment and society. In this course, we explore key concepts, debates, and issues driving sustainability in business. We will also look at various sustainability tools, principles, and frameworks that business can use to better understand the natural systems from which sustainability is derived and upon which all organisms and organizations rely to sustain their own existence.

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

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 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 conservation. Students will 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 will include: human population growth, ecosystem structure and diversity, types and origin of pollution, global climate change, energy resources and use, challenges to feeding the world, and the interaction between the environment and human health.

Credit 3 units. A&S IQ: NSM Arch: NSM Art: 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 121 Ampersand: Pathfinder — A Sense of Place: Discovering Missouri's Natural Heritage
Discovering Missouri's Natural Heritage is the first course in the Pathfinder program, and it will introduce students to their new home for the next four years. This interdisciplinary course will cover Missouri geology, climate, archaeology, and native megafauna. We will explore many of the habitats found in Missouri (e.g., prairie, forest, glade, stream) as well as the biology of the state's diverse plant and animal wildlife (e.g., arthropods, mollusks, fish, salamanders, lizards, birds, mammals). This will provide a foundation that will inform each student's study of ecology, policy, and management in other courses. In addition to weekly lectures and discussions, students in this class will visit sites across the state during three weekend camping trips and two one-day trips. Attendance on field trips is an essential component of the course. Course enrollment is open only to students admitted into the Pathfinder Fellowship program.

Same as L61 FYP 121
Credit 3 units. A&S: AMP BU: SCI

L82 EnSt 122 Ampersand: Pathfinder — A Sense of Place: Discovering the Environment of St. Louis
As the second course in the Pathfinder program, this course turns students' attention to the environment of the greater St. Louis area as they explore in and around St. Louis. Students will learn about their St. Louis backyard and their "home" for the next four years. Through field trips, readings, and discussion, they will see firsthand the challenges that face the St. Louis 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. They will also learn why it is important to know a community at the local level when trying to affect change on any level, be it state, national, or international. In addition to weekly readings and discussions, this class includes several field trips.

Same as L61 FYP 122
Credit 3 units. A&S: AMP

L82 EnSt 181 Ampersand: Pathfinder — Environmental Seminar
A survey of pressing environmental issues, both local and global, as well as an introduction to the breadth of environmental work occurring on campus. Credit/no credit only.

Same as L61 FYP 181P
Credit 1 unit. A&S: AMP

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 IQ: NSM Arch: NSM Art: NSM BU: SCI

L82 EnSt 210 Undergraduate Teaching Assistant
Credit 3 units.

L82 EnSt 215 Introduction to Environmental Humanities
In this environmental humanities seminar, we will consider texts illustrating how American citizens evolved in their perception, use, and expectations of the natural world during the 19th and early 20th centuries, especially with regard to (but not limited to) the practice of agriculture. How did the mandatory short-term goals of health and economic security sought so eagerly by citizens and supported by evolving technologies foreshadow
the unintended consequences of long-term environmental damage that would contribute to climate change, and how can we understand this using a critical and hopeful lens? Considering contemporary writings on our perception of "environmentalism" will help us nuance our analysis. Topics will include agrarian democracy; settlement of the Great Plains by immigrant farmers; the Dust Bowl; and fragmentation of the Sioux ecosystem. This cultural research will frame our visits to the Tyson Research Center, Washington University's field laboratory in west St. Louis County. The Tyson Research Center's mission is to provide a living landscape for environmental research and education as a component of Washington University's International Center for Energy, Environment and Sustainability (InCEES). As a class, we will meet with faculty researchers from both science and the humanities and hear about their work on ecosystem sustainability (i.e., thinking long-term for human and environmental health). We will use texts such as government reports, history, literature, environmental policy, and autobiography. This course is for first-year and sophomore students only.

Credit 3 units. A&S: FYS A&S IQ: HUM BU: HUM EN: H

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 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 IQ: HUM, LCD BU: IS EN: H

L82 EnSt 250 One Health: Linking the Health of Humans, Animals, and the Environment
This course will provide an introduction to One Health. One Health is a collaborative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. The student will learn about the challenges threatening environmental, animal, and human health. More importantly, they will learn about the transdisciplinary and holistic One Health approach that is necessary if we are to develop the solutions to these challenges. After learning about the loss of biodiversity, climate change, and environmental pollutants, students will participate in project-based learning modules to understand the how and why of these challenges as well as the mechanisms to study the current threats to conservation and public health. Class lessons will consist of lectures, clicker-based discussions, and case-study discussions. Assignments will include regular readings, quizzes, three exams, the creation of an infographic to convey a concept to a lay audience, and one short final reflection essay. This course will be limited to first- and second-year students.
Credit 3 units. A&S IQ: SSC BU: BA EN: S

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 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 306B An Inconvenient Truth: 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 about 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 306B
Credit 3 units. A&S IQ: HUM Arch: HUM Art: HUM BU: HUM, IS EN: H

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 IQ: LCD, SSC Arch: SSC Art: SSC BU: HUM, IS

L82 EnSt 310 Ecological Economics
Our planet is finite but our economic theories and practices assume that our economy can grow forever. The paradoxical pursuit of infinite growth on a finite planet has real-world consequences: from climate change to increasing income inequality to stagnant and declining quality of life for most of us to the ongoing mass extinction of species that are not economically useful to us, but whose loss simplifies ecosystems to the point of collapse. If these trends continue we will face some very difficult times ecologically and socio-politically. One alternative to infinite-planet economic theory is Ecological Economics, which can be described as economics as if the laws of thermodynamics are true and apply to us. Alone among disciplines with any aspiration to analytic rigor, the field of economics has remained unaffected by the thermodynamic

L82 EnSt 310 Ecological Economics
An introduction to ecological economics. This course will cover the fundamentals of the discipline, including the integration of ecological and economic concepts, the role of economic systems in natural resource management, and the relationship between economic activities and environmental impacts. Students will learn how to apply ecological economics principles to real-world problems, such as climate change, biodiversity loss, and pollution.
Credit 3 units. A&S IQ: NSM Arch: HUM, IS

Environmental Studies (10/14/19)
revolution that transformed such fields as biology, chemistry, physics, even history in the late 19th and early 20th centuries. This failure to take physical law into account is one great source of our society’s environmental (and social and political) problems. Ecological economics thus represents the continuation of the thermodynamic revolution begun in the 1880s. This course is designed to give you an appropriate grounding in the fundamental assumptions, the conceptual novelties, and the distinctive tools of analysis that comprise this emergent school of economic theory, while placing this theorizing in historical (and ecological) context. We’ll pay particular attention to how the precepts and practice of Ecological Economics illuminate the largest challenge facing humans today, the necessity of developing an ecologically sustainable society, one that is sized to the limits of our finite planet.

Credit 3 units. 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 environmental humanities course we will compare and integrate diverse texts and narratives through which Americans have developed a complex relationship to nuclear technology. Nuclear technology has long been developed, used and debated. Capable of both healing and harm, it challenges our notions of risk versus benefit at every level. It is also poised to potentially play a significant environmental role in climate mitigation by delivering large amounts of nearly carbon-free energy. Using texts such as literary nonfiction, history, environmental anthropology, natural history and public health, we will explore aspects of the Manhattan Project, the Chernobyl Nuclear Reactor accident, the presence of fear in the public perception of nuclear technology, and debates regarding the current and future use of nuclear energy. Two or three Saturday field site visits will be required, one to Weldon Springs Interpretive Center.

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

L82 EnSt 323 Biogeochemistry

This course covers basic concepts of how elements cycle among the Earth’s crust, the oceans, and the atmosphere, including perturbations due to human activities. Carbon, nitrogen, phosphorus, sulfur, and water cycles. Isotopic tracers. Feedbacks, forcings, and residence times. Redox cycling and thermodynamics. Biogeochemical box models and changes in biogeochemical cycles over Earth’s history. Biogeochemistry of greenhouse gases; biogeochemical feedbacks in the climate system. This course is appropriate for EPS students, engineering students, environmental science majors, and other students with interest in the environmental or geological sciences.

Same as L19 EPSc 323

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

L82 EnSt 341 International Energy Politics

What determines the global price of oil? What is the relationship between oil, democracy, poverty, and war? Can renewable energy ever fully replace fossil fuels? In this course, we will analyze long-term trends in the international energy markets while focusing on the political, economic, and security considerations that influence them. We first review the effects of fossil fuels (oil, natural gas, coal) on peace and conflict in the international system and on the stability and well-being of regimes that are rich with such resources. We discuss the major role that energy plays in regional and interstate politics by examining the energy policy of various actors in the international system, including the United States, the European Union, Saudi Arabia, China, Russia, Nigeria, Venezuela, and Iran. The course will also deal with various issues in global environmental politics as well as global trends in the use of renewable and nuclear energy. Grades are based on a short research paper, a class presentation, and a mid-term exam.

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

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 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 3615 Environmental Anthropology

This course will provide students with a working knowledge of how the study of humans across space and time has fundamentally impacted the way we understand the idea of nature, the environment and what it means to be human. The course will ground students in both historical and cutting-edge anthropological theories with units on subsistence, transformative nature, imagining wilds in the Anthropocene and pluralizing environmentalisms. Same as L48 Anthro 3615

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

L82 EnSt 364 Field Methods for Environmental Science

This course provides a broad survey of practical and applied methods for environmental field work for site assessments, ecological studies, conservation land management, habitat monitoring, and ecological restoration. A primary focus will be sources and techniques for obtaining and interpreting field data across a range of abiotic, organismal and system/community parameters, with emphasis on hands-on field experience providing students with direct knowledge highlighting the advantages and limitations of various methods. In the process, students will learn about multiple taxonomic and organismal groups and natural community types, and the relationships among these and the physical environment in functional natural systems. Course topics include theory and practice of methods
for sampling biotic and abiotic resources, including vegetation, fauna, aquatic systems, stream geomorphology, and soils, as well as using these data for assessments, habitat monitoring, land management decisions, and developing ecological restorations. Students will gain familiarity with responding to issues driving applied environmental science and related fields today, including data quality, sampling design, field techniques, viability and threat analyses, and incorporating field data into multi-scale conservation planning and design work. The course consists of instructor presentations, guest lectures, readings and written response papers, student projects and presentations, classroom discussions, and extensive field exercises and hands-on training. Class logistics: one lecture (1.5 hours) and one lab (5 hours) per week, plus 2-3 all day Saturday field trips (see policy on absences for back-up plan regarding field trips).

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

**L82 EnSt 365 Applied Conservation Biology**

A hands-on introduction to the concepts of conservation biology and applied conservation practice, including designing and implementing conservation projects. Readings, lectures, classroom exercises, and field projects will immerse students in all aspects of conservation in the contemporary landscape, and the tools and techniques needed for successful and sustainable conservation outcomes will be introduced. Three Saturday field trips are required.

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

**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 current currents of your social landscape!

Same as L48 Anthro 374

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

**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 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 IQ: NSM Arch: NSM Art: 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 and the structure and function of biological communities. It regularly touches on applications of these principles, such as ecological responses to global climate change, consequences of habitat fragmentation, and disease ecology/conservation medicine. Principles of experimental design, quantitative data analysis and interpretation, and mathematical models are critical to the field of ecology and are emphasized throughout the course. The class meetings have an active learning format that includes lectures, regular student interaction during small-group activities, discussions, and computer simulation labs. Assignments include regular homework reading, occasional problem sets, and computer pre- and post-lab activities. Prerequisite: Biol 2970, Biol 2950, or permission of instructor. Same as L82 EnSt 381.

Same as L41 Biol 381

Credit 3 units. A&S IQ: NSM Arch: 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 projects 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 Practicum
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 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://gephardtinstitute.wustl.edu/for-faculty-and-staff/community-engaged-teaching) course.
Same as I50 INTER D 405
Credit 3 units. A&S IQ: SSC Arch: SSC Art: CPSC, 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 biocentric 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://gephardtinstitute.wustl.edu/for-faculty-and-staff/community-engaged-teaching) course.
Same as I50 INTER D 406
Credit 3 units. A&S IQ: SSC Arch: SSP 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 IQ: NSM Arch: 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 IQ: NSM Arch: NSM Art: NSM

L82 EnSt 419 Community Ecology
Community ecology is an interdisciplinary field that bridges concepts in biodiversity science, biogeography, evolution and conservation. This course provides an introduction to the study of pattern and process in ecological communities, with an emphasis on theoretical, statistical and experimental approaches. Topics include ecological and evolutionary processes that create and maintain patterns of biodiversity; biodiversity and ecosystem function; island biogeography, metacommunity dynamics, niche and neutral theory; species coexistence; and environmental change. The class format includes lectures, discussions, and computer labs focused on the analysis, modeling, and presentation of ecological data using the statistical program R. Prerequisite: Bio 2970, Bio 381 (recommended), or permission of instructor.
Same as L41 Biol 419
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

L82 EnSt 4193 Experimental Ecology Laboratory
The goal of this course is to provide skills in the design, interpretation, and written presentation of results of ecological experiments, with emphasis on hypothesis testing, sampling methodology, and data analysis. Students have opportunities to address a variety of ecological questions using field, greenhouse, or laboratory (microcosm) studies. The course is divided into a five-hour lab period (generally held at the Tyson Research Center) and a 1.5-hour lecture/discussion period held on campus. Occasional Saturday field trips to local sites (e.g., forests, wetlands, prairies, streams) for in-depth study may also be scheduled. This is a writing-intensive course, and grades are based on written assignments, including final projects, as well as in-class participation. This course fulfills the upper-level laboratory requirement for the Biology major. Prerequisites: permission of instructor and at least one of the following: Biol 3501, Biol 372, Biol 381, Biol 419, or Biol 472. Enrollment limited to 15 students.
Same as L41 Biol 4193
Credit 4 units. A&S IQ: NSM, WI Arch: NSM 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 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 3 units. 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 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 IQ: SSC Art: SSC BU: BA, ETH EN: S

L82 EnSt 452 International Climate Negotiation Seminar
This variable-credit course (all students will register for 3 credits) is designed to prepare students to attend and observe annual meetings associated with the United Nations Framework Convention on Climate Change (UNFCCC) as a delegate of Washington University. The course and meetings provide student delegates with a unique educational experience to observe the development of international climate policy through interdisciplinary negotiations and interactions inside the negotiating space. Students see the interaction between climate policy, science, and technology as they identify and analyze policy decisions across the international climate regime. The number of students who can attend meetings is limited by the United Nations. We will do our best to have course participants attend either the COP or Subsidiary Body meetings. Students attend one week. The COP 25 meeting will be held in Santiago, Chile, from December 2 to December 13, 2019. The Subsidiary Body meetings will be in Bonn, Germany, in June 2020. Enrollment is limited. Students should indicate their interest by placing themselves on the waitlist (registering for 3 credits) and completing an application. All students will be placed on the waitlist upon registration, and students will be selected to enroll from the waitlist after all the applications are reviewed. The application will be open March 1 and will be available on the course website (https://sites.wustl.edu/wustlcop). Application review will begin April 12. Interviews will take place between April 16 and April 25, and enrollment decisions will be made by April 26. Participation in the course is possible without traveling to the meetings. The course is currently scheduled for Tuesdays and Thursdays from 11:30 to 1:00. Contact the instructor with questions at martin@wustl.edu.

Credit variable, maximum 6 units. A&S IQ: NSM Art: S

L82 EnSt 461 Intro to Environmental Law
Survey of the most prominent federal laws designed to control pollution and protect human health and the environment. Examines laws applicable to environmental impact statements, biodiversity, air pollution, water pollution, and hazardous waste. Discusses the role of state law and cooperative federalism, as well as the roles of the courts, the legislature, and the administrative state in protecting the environment.

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

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 Art: NSM

L82 EnSt 4980 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 IQ: NSM, WI Art: NSM