

Earth System Science and Policy (ESSP)

Courses

ESSP 160. Sustainability & Society. 3 Credits.

Human interactions with the natural environment are often perceived as conflicts between environmental protection and socio-economics. Sustainability attempts to redefine that world view by seeking balance between the 'three Es' -environment, economy, equity. This course examines the concept of sustainability, the theory behind it, and what it means for society. F.

ESSP 200. Sustainability Science. 3 Credits.

This course will provide an integrated, system-oriented introduction on the concepts, theories and issues surrounding a sustainable future for humans and the Planet Earth. The course will address the concept of sustainability, the concept of a system, explore human world views, provide an introduction to energy, complexity and ecosystems, and examine resources use, food production, industrial development and the prospects for a sustainable future. S.

ESSP 310. Sustainable Food Systems. 3 Credits.

This course will examine the need for development of sustainable food production systems. The course will introduce the concept of an integrated agro-ecosystem. Students will learn how food production systems work, how they impact natural ecosystems, how fragile the human food resource has become, and gain an appreciation of the complexity of relationships between humans and food. F, even years.

ESSP 320. Land and Water Sustainability. 3 Credits.

This course covers topics of sustainability of physical landscapes and water on the Earth. Class lectures will introduce concepts related to landscape use, perception of landscape and water use as a resource, and most importantly how to use the physical landscape and freshwater as a resource in a manner to which it will be viable for future generations (i.e. landscape and water resource sustainability). Topics include, but are not limited to snow and glacier melt water, ground water, mountain environment resources, river flood plain land use, and water use in desert environments. F, odd years.

ESSP 330. Environmental Change: Adaptation & Mitigation. 3 Credits.

The objective is to introduce the varieties of adaptation and mitigation strategies to address four main sustainability challenges: land use/land cover change, climate change, water security, and biodiversity loss. The major physical processes of the Earth systems will be examined, together with the natural and anthropogenic changes in these processes; then, the societal impacts from modifications to the Earth systems will be described; finally, the strategies of adaptation and mitigation will be compared, using a variety of regional case studies as examples. S, odd years.

ESSP 333. Oceanography. 3 Credits.

Oceanography introduces the ocean and the study of the ocean, which regulates our climate, maintains our atmosphere, and serves as an enormous resource. The course explores all aspects of the oceans- their physics, chemistry and biology, as well as the structure of the basins that contain them. Students will learn how the oceans interact with the atmosphere and the solid Earth, understand the role played by the oceans, not only as a producer of food and source of recreation, but as a transporter of heat energy, sink for greenhouse gases, and moderator of the climate. In the end, students will come away with a deeper understanding of how the ocean works and greater appreciation for the benefits we derive from it. F, odd years.

ESSP 410. Why Cry for the Cryosphere?. 3 Credits.

This course will provide an integrated, system-oriented perspective on the concepts, processes, and issues surrounding all of the cold environment locations on Earth (i.e. the Arctic, Antarctic, Sub-Arctic, high elevations, and seasonally cold regions of the planet) also known as the cryosphere. The course focuses on how human-environmental relationships have an impact on, as well as are impacted by the cryosphere. Topics include, but are not limited to, climate change impacts on snow, glaciers, permafrost, and sea ice; changes in the cryosphere impacting human's living on the landscape; and the importance of the cryosphere in relation to sustainability of the Earth and human systems. S, odd years.

ESSP 420. Sustainable Energy. 3 Credits.

This course is an interdisciplinary exploration of Sustainable Energy. The interdisciplinary exploration includes the analysis of renewable energy systems as well as the socio-economical, political, and environmental aspects of renewable energy. The course will specifically analyze the origin and dimensions of global energy issues and identify how renewable energy issues and policies are critical to the sustainable future of global environmental quality, economic growth, social justice, and democracy. S, even years.

ESSP 450. Environmental and Natural Resource Economics. 3 Credits.

This course will cover the general topics in the field of environmental and natural resource economics: market failure, pollution regulation, the valuation of environmental amenities, renewable and non-renewable resources management, and the economics of biodiversity conservation, climate change and sustainability. The course has a strong focus on the interaction between human society and natural environmental systems and the connection between market equilibrium and social sustainability. F, odd years.

ESSP 460. Global Environmental Policy. 3 Credits.

Governance and policy are the most common strategies used to address environmental problems. This course introduces students to the foundation, development, actors, process, challenges, and future outlook of global environmental policy. By navigating various levels of US and global governance, students will explore a variety of concepts and principles in the development and implementation of environmental policies. S, odd years.

ESSP 499. Special Topics in Sustainability. 1-4 Credits.

Investigation and detailed study of special topics related to sustainability issues. The course may include a lab if applicable. Repeatable once with different topic. Maximum of 8 credits. Repeatable to 8.00 credits. On demand.

ESSP 501. Earth System Science and Policy I. 5 Credits.

An overview of the fundamental issues from five research areas: Biodiversity and Ecosystem Functioning; Climate and Environmental Change; Land and Resource Management; Environmental Policy, Management, and Communication; and Human Health and the Environment. Material will be presented "situationally" in a problem-based learning environment. ESSP faculty and guest lecturers will present background information relevant to the topics. Students are expected to engage actively in the learning process by 1) determining what further information they need to understand the problem, 2) researching the questions, 3) clearly and concisely presenting the findings of their research to one another. Prerequisite: Graduate standing in ESSP. Corequisite: ESSP 501R and ESSP 501L.

ESSP 501L. Earth System Science and Policy Laboratory I. 2 Credits.

Laboratory session. Will require one or more full day field trips; may require one or more weekend field trips. Prerequisite: Graduate standing in ESSP. Corequisite: ESSP 501 and ESSP 501R. S/U grading.

ESSP 501R. Earth System Science and Policy Recitation. 3 Credits.

Small group discussions to include many parties to an environmental issue. Prerequisite: Graduate standing in ESSP. Corequisite: ESSP 501 and ESSP 501L. S/U grading.

ESSP 502. Earth System Science and Policy II. 5 Credits.

Course follows the design of ESSP 501 but with more emphasis on written reports and team projects. At the beginning of the semester, students will either select or be assigned a topic for an interdisciplinary team project for completion by the end of the semester. The team project helps students acquire an interdisciplinary outlook, and fosters communication and cooperation within a positive multi-disciplinary work environment. This will provide students with skills that are integral to the management of complex environmental problems they will face in the world beyond academia. Prerequisite: ESSP 501, 501R and 501L. Corequisite: ESSP 502R and ESSP 502L.

ESSP 502L. Earth System Science and Policy Laboratory II. 2 Credits.

Laboratory session. Prerequisite: ESSP 501, 501R and 501L. Corequisite: ESSP 502 and 502R. S/U grading.

ESSP 502R. Earth System Science and Policy Recitation II. 3 Credits.

Small group discussion. Prerequisite: ESSP 501, 501R and 501L. Corequisite: ESSP 502 and 502L. S/U grading.

ESSP 503. Environmental Policy & Science. 3 Credits.

Human interactions with the Earth system are often managed through policy and science. This course will introduce students to concepts, ideas, practices, and challenges at the nexus of policy, science, and the environment. Students will examine the human dimensions of environmental problems and the different roles of policy and science in helping us address them. F.

ESSP 504. The Biosphere. 3 Credits.

The Biosphere (ESSP 504) introduces students to the concept of the biosphere as articulated by Vladimir Vernadsky in the 1920s and 1930s, and examines the concepts and roles of nutrient cycling, biodiversity, evolution, ecology, and ecosystem productivity on Earth. The overall course is framed around the Drake equation and walks students through critical steps in the formation of the solar system, habitable zones around stars, evolution and proliferation of life on Earth, the interconnected nature of inorganic nutrient cycling and ecosystem function, and human's impact on all these systems, culminating with the final variable of the Drake equation--the longevity of civilizations--and humanity's active role in the Anthropocene. F.

ESSP 505. Energy Issues and Earth Systems. 3 Credits.

This course is about contemporary complex energy issues. It gives an overview of energy history, the last century trends and the achievement in energy production. It also discusses energy systems and energy "linkages" with society. It then examines the pros and the cons of both fossil fuels and alternative fuels. Finally it considers the future of energy in low-carbon energy systems. F.

ESSP 506. Ecosystem Services: Valuing Nature in a Market Society. 3 Credits.

Analyzes the services and goods provided by natural and human-made ecosystems with a primary focus on the agroecosystems and grasslands of the northern Great Plains. Explores the scientific framework of ecosystem services, their disruption or disturbance, economic and ecological values, methods of analyzing these values, and policy implications. S.

ESSP 507. Earth Systems Processes and Vulnerability Analysis. 3 Credits.

Earth Systems Processes and Vulnerability Analysis (ESSP 507) will explore how humans exist on an active landscape. The course focuses on an understanding of the integration of the processes of physical Earth systems and the human vulnerability to hazards and Earth system syndromes related to these processes. The course also explores human vulnerability by analyzing spatial, numerical, and historical data, through spatial and statistical techniques. S.

ESSP 508. Hydrological Cycle in Earth Systems. 3 Credits.

Hydrological Cycle in Earth Systems (ESSP 508) will introduce the processes of the hydrological cycle in the Earth system. The course focuses on an understanding of fundamental chemical and physical properties of water and processes of water movement within the Earth system through physical, biological and human controls. The course also aims to help students develop an understanding of how the hydrological cycle interacts and affects the energy balance and biogeochemical cycle in the Earth system. S.

ESSP 520. Earth Systems Modeling. 3 Credits.

Introduction to statistical and deterministic approaches for modeling earth systems, including use of modeling to support management and policymaking. Develops systems thinking skills and emphasizes modeling as a framework for environmental analysis and problem solving. Students will learn how different classes and scales of models are used to explore different type of environmental questions. Emphasis will be on the dynamic, interdependent and interactive relationships between human activities and ecosystem function and structure as well as the effects of these activities on biogeochemical cycles, energy flow, and biodiversity. Students will use these analyses to evaluate opportunities to shift toward more sustainable human behavior. Prerequisite: Graduate standing in ESSP or consent of instructor.

ESSP 530. Principles of Environmental Science. 3 Credits.

Provides a basis for understanding the complex responses of plants and animals to environmental change and presents clear explanations and analysis of interactions between organisms and their physical environment. Students will learn the physical principles that explain key Earth system processes, such as water cycle and energy cycle, and key interactions, such as radiative forcing. More importantly, students will learn principles that apply in conducting research and in the interpretation of measurements. Even though this graduate level course is intended for students who are expected to conduct research toward their degree, non-thesis graduate students are also encouraged to enroll as it covers a wide range of physical topics associated with Earth System Science. Corequisite: Statistics, Calculus, College Physics, and permission of the instructor.

ESSP 540. Advanced Topics in Geospatial Technologies. 3 Credits.

The course's intent is to stay abreast of technological developments in a rapidly evolving field. Course contents will vary according to where the advances have the most immediate impact. The goal is to provide students exposure and hands-on experience needed to apply technologies to significant Earth System problems. Among technologies to be discussed are sensors for satellites and aircraft, data acquisition and image processing tools, verification and validation techniques, precision navigation by Global Positioning Satellites, and advanced uses of Geographic Information Systems. Prerequisite: Consent of instructor.

ESSP 562. Environmental Economics, Policy and Management. 3 Credits.

Examines the principles of economics, natural resource limitations and management, and the role of science in public policy decision-making with the intent of preserving Earth's vital life-support systems while meeting human needs and aspirations. Through case studies, guest speakers, and personal experience, studies how science does or does not inform environmental policymaking. Students apply economic theory and analysis to evaluate environmental problems and policies and apply ecological principles to shape economic policy. Particular emphasis will be on wetland habitats and agroecosystems. F.

ESSP 570. Communicating Environmental Information. 3 Credits.

The focus of this class is on communication of scientific information to non-science audiences. Students will 1) probe the role of communication in the public perceptions of environmental issues, 2) examine the effectiveness of different tools in raising environmental awareness, 3) explore the barriers that hinder effective communication and subsequent motivation to action, and 4) profile a variety of environmental outreach activities. Ways to convert polarization among differing parties into consensus by communicating accurate, timely information will be explored. Prerequisite: Consent of instructor.

ESSP 590. Colloquium Series. 1 Credit.

Speaker series and student led discussions on interdisciplinary topics and research related to the graduate core courses in ESSP. Prerequisite: Consent of Instructor. S/U grading. F,S.

ESSP 594. Directed Study. 1-5 Credits.

Directed reading or investigations tailored to the needs of individual students for advanced knowledge in specific areas. Typically requires weekly meetings with the assigned faculty member. Usually culminates in a paper on the specific topical area. Doctoral candidates may repeat once. Prerequisite: Permission of an ESSP faculty member who agrees to serve as supervisor. Repeatable to 10.00 credits.

ESSP 596. Doctoral Research. 1-9 Credits.

Arranged with student's advisory committee. May be repeated for credit. Prerequisite: Graduate standing in ESSP or consent of instructor. Repeatable. S/U grading. F,S,SS.

ESSP 597. Internship. 3-9 Credits.

Practical experience for ESSP students in a professional environment. Repeatable to 9 credits. Prerequisite: Graduate standing in ESSP. Repeatable to 9.00 credits. S/U grading.

ESSP 599. Special Topics. 1-6 Credits.

Topics of current interest. May be provided by program or visiting ESSP faculty. May be repeated for credit. Prerequisite: Graduate standing in ESSP or consent of instructor. Repeatable.

ESSP 996. Continuing Enrollment. 1-12 Credits.

Repeatable. S/U grading.

ESSP 997. Independent Study. 2 Credits.

Independent study and preparation of written and oral reports describing internships. Prerequisite: Approval by student's advisor of written proposal describing internship to be completed.

ESSP 998. Thesis. 1-9 Credits.

Academic credit for thesis research that has been approved in advance by a student's advisory committee. May be repeated, but no more than 9 credits will be allowed in a master's degree program. Prerequisite: Graduate standing in ESSP or consent of instructor. Repeatable to 9.00 credits. F,S,SS.

ESSP 999. Dissertation. 1-9 Credits.

Academic credit for ESSP doctoral dissertation research that has been approved in advance by a student's advisory committee. May be repeated but no more than 18 credits will be allowed in the degree program. Prerequisite: Consent of instructor. Repeatable to 18.00 credits. F,S,SS.