

ENVIRONMENTAL STUDIES

(AS) {ENVS}

150. (COML151, GRMN150) WATER WORLDS.

SM 543. (COML544, ENGL584, GRMN543, SPAN543) ENVIRONMENTAL HUMANITIES.

SM 073. (PHIL073) Topics in Ethics. (M) Meyer, M..

Topics vary each semester.

169. (STSC169) ENGINEERING PLANET EARTH.

181. (GRMN181) Comparative Cultures of Sustainability. (L) Simon Richter.

Sustainability is more than science, engineering, policy, and design. Surveying the world, we see that the politics and practice of sustainability play out in different ways depending on cultural factors. Some cultures are more prone to pursue ecological goals than others. Why? Do the environmental history and experience of a nation affect policy? Do nature and the environment play a crucial role in the cultural memory of a nation? Can cultural components be effectively leveraged in order to win approval for a politics of sustainability? And what can we, as residents of a country where climate change and global warming are flashpoints in an enduring culture war, learn from other cultures? This course is designed to equip undergraduate students with the historical and cultural tools necessary to understand the cultural aspects of sustainability in two countries noted for their ecological leadership and cultural innovation, Germany and the Netherlands.

L/R 200. Introduction to Environmental Earth Science. (C) Physical World Sector. All classes. Plante.

This course will expose students to the principles that underlie our understanding of how the Earth works. The goal of Earth Systems Science is to obtain a scientific understanding of the entire Earth system by describing its component parts (lithosphere, hydrosphere, atmosphere, biosphere) and their interactions, and describe how they have evolved, how they function, and how they may be expected to respond to human activity. The challenge to Earth Systems Science is to develop the capability to predict those changes that will occur in the next decade to century, both naturally and in response to human activity. Energy, both natural and human-generated, will be used as a unifying principle. Knowledge gained through this course will help students make informed decisions in all spheres of human activity: science, policy, economics, etc.

204. Global Climate Change. (A) Physical World Sector. All classes. Irina Marinov. Prerequisite(s): Any of the following courses: ENVS 200 or GEOL 100 or GEOL 130 or GEOL 125 or GEOL 103 or Instructor Permission.

Public perceptions and attitudes concerning the causes and importance of global warming have changed. Global Climate Change provides a sound theoretical understanding of global warming through an appreciation of the Earth's climate system and how and why this has changed through time. We will describe progress in understanding of the human and natural drivers of climate change, climate processes and attribution, and estimates of projected future climate change. We will assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation.

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SM 279. (STSC279) Nature's Nation: Americans and Their Environment. (M) Greene.

The United States has been described as "nature's nation. The presence of enormous, resource-rich and sparsely settled continent has been a component of American identity, prosperity and pride--it has even been described as the source of the democratic political system. From the beginning, Americans transformed their natural environment, even as, over time, they grew to value environmental preservation and protection. This course traces the interaction of Americans and the natural world in, studying how Americans changes the natural environment over time, in order to understand why environmental change occurred and occurred in the manner it did. What have Americans believed about the nature of the nation's nature, and what attitudes and policies have followed from these ideas? After surveying American environmental history from the 17th to the 20th century, we will examine specific topics and problems in the long relationship between Americans and their environment. (Possible topics: national parks and wilderness preservation, environmental politics, chemical pollution, invasive species). This seminar fulfills the research requirement for the History major because students will complete a 20-page paper of original research.

295. Maritime Science and Technology: Woods Hole Sea Semester. (C) Andrews. Prerequisite(s): Laboratory course in physical or biological science or its equivalent; college algebra or its equivalent. This set of courses requires special application procedures. Contact Maria Andrews for information and an application. Only the "SEA semester: Ocean Exploration" and "SEA Semester: Oceans and Climates" can be taken for Penn credit without taking a leave, and all students must have permission from Maria Andrews before registering at SEA.

A rigorous semester-length academic and practical experience leading to an understanding of the oceans. The Sea Semester is composed of two intensive six-week components taken off-campus. The Shore Component is six weeks at Woods Hole, Massachusetts, with formal study in: Oceanography, Maritime Studies, and Nautical Science. This is followed by six weeks aboard a sailing research vessel, during which students conduct oceanographic research projects as part of the courses, Practical Oceanography I and II.

Maritime Studies. A multidisciplinary study of the history, literature, and art of our maritime heritage, and the political and economic problems of contemporary maritime affairs.

Nautical Science. The technologies of operation at sea. Concepts of navigation, naval architecture, ship construction, marine engineering systems, and ship management are taught from their bases in physics, mathematics, and astronomy.

Practical Oceanography I. Taken aboard SSV Westward or SSV Corwith Cramer. Theories and problems raised in the shore component are tested in the practice of oceanography at sea. Students are introduced to the tools and techniques of the practicing oceanographer. During two lectures daily and while standing watch, students learn the operation of basic oceanographic equipment, the methodologies involved in the collection, reduction, and analysis of oceanographic data, and the attendant operations of a sailing oceanographic research vessel. **Practical Oceanography II.** Taken aboard SSV Westward or SSV Corwith Cramer. Students assume increasing responsibility for conducting oceanographic research and the attendant operations of the vessel. The individual student is responsible directly to the chief scientist and the master of the vessel for the safe and orderly conduct of research activities and related operation of the vessel. Each student completes an individual oceanographic research project designed during the shore component.

299. Independent Study. (C) Staff. Prerequisite(s): Permission of department. May be repeated for credit

Directed study for individuals or small groups under supervision of a faculty member.

301. Environmental Case Studies. (A) dmochowski. Prerequisite(s): ENVS 200.

A detailed, comprehensive investigation of selected environmental problems. Guest speakers from the government and industry will give their accounts of various environmental cases. Students will then present information on a case study of their choosing.

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L/R 312. (ENVS640, PHYS314) Ocean-Atmosphere Dynamics and Implications for Future Climate Change. (B) Marinov. Prerequisite(s): MATH 114 or permission of the instructor.

This course covers the fundamentals of atmosphere and ocean dynamics, and aims to put these in the context of climate change in the 21st century. Large-scale atmospheric and oceanic circulation, the global energy balance, and the global hydrological cycle. We will introduce concepts of fluid dynamics and we will apply these to the vertical and horizontal motions in the atmosphere and ocean. Concepts covered include: hydrostatic law, buoyancy and convection, basic equations of fluid motions, Hadley and Ferrel cells in the atmosphere, thermohaline circulation, Sverdrup ocean flow, modes of climate variability (El-Nino, North Atlantic Oscillation, Southern Annular Mode). The course will incorporate student led discussions based on readings of the 2007 Intergovernmental Panel on Climate Change (IPCC) report and recent literature on climate change. Aimed at undergraduate or graduate students who have no prior knowledge of meteorology or oceanography or training in fluid mechanics. Previous background in calculus and/or introductory physics is helpful. This is a general course which spans many subdisciplines (fluid mechanics, atmospheric science, oceanography, hydrology).

SM 399. (GEOL399) Environmental Studies Research Seminar for Juniors. (B) Dmochowski. Prerequisite(s): ENVS 200.

This seminar is designed to help Juniors prepare for the Senior Thesis research. Topic selection, advisor identification, funding options, and basic research methods will be discussed.

325. Sustainable Goods. Hagan.

The study of sustainability-the long term viability of humans in harmony with the environment-has been identified as a critical issue for society and industry and is evolving to examine how society should conduct itself in order to survive. This issue impacts the consumer goods that we use in our lives, the processes that are designed to make these goods, and the raw materials that we obtain to create these goods. The questions that we will examine will be: can these goods be obtained, made, and consumed in a fashion that allows the current quality of life to be maintained (or enhanced) for future generations? Can these processes be sustainable? A review of consumer goods is necessary as the starting point in order to understand the basic needs of people in society and why people consume goods as they do. Subsequently, each student will choose a product to examine in detail and will research the product for its impact with respect to natural resource selection, production, use, and disposal/reuse.

326. GIS: Mapping Places & Analyzing Spaces. KRISTA HEINLEN.

This course is a hands-on introduction to the concepts and capabilities of geographic information systems (GIS). Students will develop the skills necessary for carrying out basic GIS projects and for advanced GIS coursework. The class will focus on a broad range of functional and practical applications, ranging from environmental science and planning to land use history, social demography, and public health. By the end of the course, students will be able to find, organize, map, and analyze data using both vector (i.e. drawing-based) and raster (i.e. image-based) GIS tools, while developing an appreciation for basic cartographic principles relating to map presentation. This course fulfills the spatial analysis requirement for ENVS and EASC Majors. Previous experience in the use of GIS is not required.

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327. Principles of Sustainability. Alain Plante.

What is sustainability? Can any fundamental concepts, principles or framework be constructed that adequately describes the search for sustainability? Is there a meaningful methodology? Sustainability science is a trans-disciplinary approach in which the quantitative and qualitative, natural and social, and theory and practice are reconciled and creatively combined. The objective of this course is to provide an in-depth analysis of the foundational concepts, principles, processes and practices of sustainability science. The course will explore three foundational laws governing sustainability: the law of limits to growth, the second law of thermodynamics, and the law of self-organization. Students will examine how these laws operate in biological, ecological, and physical systems, and then apply them to social, economic and political systems.

SM 400. Environmental Studies Seminar. (B) Plante. May be repeated for credit

Application of student and faculty expertise to a specific environmental problem, chosen expressly for the seminar.

SM 404. (HSOC404) Urban Environments: Speaking About Lead in West Philadelphia. (B) Natural Science & Mathematics Sector. Class of 2010 and beyond. Pepino. ABCS Course. Requires community service in addition to class time.

Lead poisoning can cause learning disabilities, impaired hearing, behavioral problems, and at very high levels, seizures, coma and even death. Children up to the age of six are especially at risk because of their developing systems; they often ingest lead chips and dust while playing in their home and yards.

In ENVS 404, Penn undergraduates learn about the epidemiology of lead poisoning, the pathways of exposure, and methods for community outreach and education. Penn students collaborate with middle school and high school teachers in West Philadelphia to engage middle school children in exercises that apply environmental research relating to lead poisoning to their homes and neighborhoods.

SM 407. (HSOC407) Urban Environments: Prevention of Tobacco Smoking in Adolescents. (B) Pepino. ABCS Course. Requires community service in addition to class time.

Cigarette smoking is a major public health problem. The Centers for Disease Control and Prevention Control reports that more than 80% of current adult tobacco users started smoking before age 18. The National Youth Tobacco Survey indicated that 12.8% of middle school students and 34.8% of high school students in their study used some form of tobacco products.

In ENVS 407, Penn undergraduates learn about the short and long term physiological consequences of smoking, social influences and peer norms regarding tobacco use, the effectiveness of cessation programs, tobacco advocacy and the impact of the tobacco settlement. Penn students will collaborate with teachers in West Philadelphia to prepare and deliver lessons to middle school students. The undergraduates will survey and evaluate middle school and Penn student smoking. One of the course goals is to raise awareness of the middle school children to prevent addiction to tobacco smoke during adolescence. Collaboration with the middle schools gives Penn students the opportunity to apply their study of the prevention of tobacco smoking to real world situations.

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SM 406. (HSOC406) Community Based Environmental Health. (A) Pepino. ABCS Course. Requires community service in addition to class time.

From the fall of the Roman Empire to Love Canal to the epidemics of asthma, childhood obesity and lead poisoning in West Philadelphia, the impact of the environment on health has been a continuous challenge to society. The environment can affect people's health more strongly than biological factors, medical care and lifestyle. The water we drink, the food we eat, the air we breathe, and the neighborhood we live in are all components of the environment that impact our health. Some estimates, based on morbidity and mortality statistics, indicate that the impact of the environment on health is as high as 80%. These impacts are particularly significant in urban areas like West Philadelphia. Over the last 20 years, the field of environmental health has matured and expanded to become one of the most comprehensive and humanly relevant disciplines in science.

This course will examine not only the toxicity of physical agents, but also the effects on human health of lifestyle, social and economic factors, and the built environment. Topics include cancer clusters, water borne diseases, radon and lung cancer, lead poisoning, environmental tobacco smoke, respiratory diseases and obesity. Students will research the health impacts of classic industrial pollution case studies in the US. Class discussions will also include risk communication, community outreach and education, access to health care and impact on vulnerable populations. Each student will have the opportunity to focus on Public Health, Environmental Protection, Public Policy, and Environmental Education issues as they discuss approaches to mitigating environmental health risks.

This honors seminar will consist of lectures, guest speakers, readings, student presentations, discussions, research, and community service. The students will have two small research assignments including an Environmental and Health Policy Analysis and an Industrial Pollution Case Study Analysis. Both assignments will include class presentations. The major research assignment for the course will be a problem-oriented research paper and presentation on a topic related to community-based environmental health selected by the student. In this paper, the student must also devise practical recommendations for the problem based on their research.

SM 408. (HSOC408) Urban Environments: The Urban Asthma Epidemic. (B) Pepino. ABCS Course. Requires community service in addition to class time.

Asthma as a pediatric chronic disease is undergoing a dramatic and unexplained increase. It has become the number one cause of public school absenteeism and now accounts for a significant number of childhood deaths each year in the USA. The Surgeon General of the United States has characterized childhood asthma as an epidemic. In ENVS 408, Penn undergraduates learn about the epidemiology of urban asthma, the debate about the probable causes of the current asthma crisis, and the nature and distribution of environmental factors that modern medicine describes as potential triggers of asthma episodes.

Penn students will collaborate with the Childrens Hospital of Philadelphia (CHOP) on a clinical research study entitled the Community Asthma Prevention Program. The Penn undergraduates will co-teach with CHOP parent educators asthma classes offered at community centers in Southwest, West, and North Philadelphia. The CHOP study gives the Penn students the opportunity to apply their study of the urban asthma epidemic to real world situations.

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SM 410. Clean Water - Green Cities. (M) Neukrug. Prerequisite(s): ENVS 200, GEOL 100 or equivalent. An academically-based curriculum service learning approach to using water, science and politics to create a sustainable Philadelphia.

This course will provide an overview of the cross-disciplinary fields of civil engineering, environmental sciences, urban hydrology, landscape architecture, green building, public outreach and politics. Students will be expected to conduct field investigations, review scientific data and create indicator reports, working with stakeholders and presenting the results at an annual symposium. There is no metaphor like water itself to describe the cumulative effects of our practices, with every upstream action having an impact downstream. In our urban environment, too often we find degraded streams filled with trash, silt, weeds and dilapidated structures. The water may look clean, but is it? We blame others, but the condition of the creeks is directly related to how we manage our water resources and our land. In cities, these resources are often our homes, our streets and our communities. This course will define the current issues of the urban ecosystem and how we move toward managing this system in a sustainable manner. We will gain an understanding of the dynamic, reciprocal relationship between practices in a watershed and its waterfront. Topics discussed include: drinking water quality and protection, green infrastructure, urban impacts of climate change, watershed monitoring, public education, creating strategies and more.

498. (GEOL498) Senior Thesis. (F) Giegengack. Prerequisite(s): ENVS 400-level course and declaration of the ENVS major. The Environmental Studies major, as of the fall of 2008, requires 1 semester of ENVS399 and two semesters of ENVS498.

The culmination of the Environmental Studies major. Students, while working with an advisor in their concentration, conduct research and write a thesis.

SM 411. Air Pollution: Sources & Effects in Urban Environments. (A) Andrews and Howarth.

This is an ABCS course designed to provide the student with an understanding of air pollution at the local, regional and global levels. The nature, composition, and properties of air pollutants in the atmosphere will also be studied. The course will focus on Philadelphia's air quality and how air pollutants have an adverse effect on the health of the residents. The recent designation by IARC of Air Pollution as a known carcinogen will be explored. How the community is exposed to air pollutants with consideration of vulnerable populations will be considered. Through a partnership with Philadelphia Air Management Service (AMS) agency the science of air monitoring and trends over time will be explored. Philadelphia's current non-attainment status for PM_{2.5} and ozone will be studied. Philadelphia's current initiatives to improve the air quality of the city will be discussed. Students will learn to measure PM_{2.5} in outdoor and indoor settings and develop community-based outreach tools to effectively inform the community of Philadelphia regarding air pollution. The outreach tools developed by students may be presentations, written materials, apps, websites or other strategies for enhancing environmental health literacy of the community. A project based approach will be used to include student monitoring of area

schools, school bus routes, and the community at large. The data collected will be presented to students in the partner elementary school in West Philadelphia. Upon completion of this course, students should expect to have attained a broad understanding of and familiarity with the sources, fate, and the environmental impacts and health effects of air pollutants.

416. (BIOL415) Freshwater Ecology. (M) Bott. Prerequisite(s): BIOL 101 or 121 and one semester of college chemistry.

Survey of the physical, chemical and biological properties of freshwater ecosystems, both riverine and lentic, natural and polluted.

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SM 463. (ENVS643, URBS463, URBS663) The Historical, Scientific, & Policy Dimensions of "Brownfields". (M) Keene. Offered through LPS - See current timetable

This course gives an overview of the genesis of the so-called "Brownfield" problem and of the various efforts that our society is taking to try to solve, or at least ameliorate it. The course will place the "Brownfield" problem in the broader context of the growth and decline of industrial base cities like Philadelphia. Students will study the general constitutional and statutory framework within which we approach the problems of orphan, polluted sites and the disposal of contemporary solid wastes. They will also analyze the principal actions that have been taken by federal and state governments to address remediation and redevelopment of abandoned industrial sites. In addition, the course will explore environmental equity issues.

507. Wetlands. (M) Willig. Offered through LPS - See current timetable

The course focuses on the natural history of different wetland types including climate, geology, and hydrology factors that influence wetland development. Associated soil, vegetation, and wildlife characteristics and key ecological processes will be covered as well. Lectures will be supplemented with weekend wetland types, ranging from tidal salt marshes to non-tidal marshes, swamps, and glacial bogs in order to provide field experience in wetland identification, characterization, and functional assessment. Outside speakers will discuss issues in wetland seed bank ecology, federal regulation, and mitigation. Students will present a short paper on the ecology of a wetland animal and a longer term paper on a selected wetland topic. Readings from the text, assorted journal papers, government technical documents, and book excerpts will provide a broad overview of the multifaceted field of wetland study.

530. Rocky Mountain Field Geology and Ecology. (L) Giegengack/Bordeaux. Field work is done in and around Red Lodge, Montana. An additional fee for Room and Board applies. Permission of the Instructor is required for non-MES students.

Designed for the MES program (open to non-MES students by permission of the instructor). This is a two-week intensive field course in the geology, natural history, and ecology of the Greater Yellowstone Ecosystem, which comprises a range of environments from the mile-high semi-deserts of intermontane basins to the alpine tundra of the Beartooth Plateau above 12,000 feet. The program is based at the Yellowstone-Bighorn Research Association (YBRA) field station on the northeast flank of the Beartooth Mountains near Red Lodge, Montana. The course includes day trips from the field station as well as overnight visits to sites within Yellowstone National Park. Pre-trip classes will be held online before the trip to ensure that all students are adequately familiar with basic principles of field-based natural science.

SM 533. Research Methods in Environmental Studies. (M) Kulik.

This course is designed to prepare Master of Environmental Studies students to undertake their Capstone exercises. In this course, we discuss how to identify an appropriate research project, how to design a research plan, and how to prepare a detailed proposal. Each student should enter the course with a preliminary research plan and should have identified an advisor. By the end of the course, each student is expected to have a completed Capstone proposal that has been reviewed and approved by his/her advisor.

541. Modeling Geographical Objects. (M) Tomlin.

This course offers a broad and practical introduction to the acquisition, storage, retrieval, maintenance, use, and presentation of digital cartographic data with both image and drawing based geographic information systems (GIS) for a variety of environmental science, planning, and management applications. Its major objectives are to provide the training necessary to make productive use of at least two well known software packages, and to establish the conceptual foundation on which to build further skills and knowledge in late practice.

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SM 601. Proseminar: Contemporary Issues in Environmental Studies. (M) Pfefferkorn/Bordeaux/Scatena. Offered through LPS - See current timetable

A detailed, comprehensive investigation of selected environmental problems. This is the first course taken by students entering the Master of Environmental Studies Program.

604. Conservation and Land Management. (M) Harper. Some Saturday field trips will be required.

Using protected lands in the Delaware Valley, this field-based course will explore various strategies for open-space conservation and protection. In addition, students will be introduced to land management techniques used on such sites to restore or preserve land trust properties in accordance with goals set for their use or protection. Sustainable land uses such as community supported agriculture, ecovillages, and permaculture design will be covered. Emphasis will be placed on developing skills in "Reading the Landscape" to determine conservation and restoration priorities. Students will produce a site assessment report on sites that they visit.

SM 606. Ornithology. (A) McGraw.

This class will explore the foundations of avifaunal biology and ecology using a combination of hands-on classroom and in-the-field experiences. Classroom content includes physiology, anatomy, and morphology of birds. The fall migration of birds in North America is an epic and often tragic event. Sampling birds in migration has resulted in foundational understandings about stopover habitats, species-specific energy budgets and has helped realize the complete life cycle of hundreds of species. We will enter the field and participate in actual ornithological research, explore avifaunal ecology through birdwatching, and meet with regional leaders in the ornithological field.

610. Regional Field Ecology. (L) Willig. Offered through LPS - See current timetable. Some Sunday field trips required.

Over the course of six Sunday field trips, we will travel from the barrier islands along the Atlantic Ocean in southern New Jersey to the Pocono Mountains in northeastern Pennsylvania, visiting representative sites of the diverse landscapes in the region along the way. At each site we will study and consider interactions between geology, topography, hydrology, soils, vegetation, wildlife, and disturbance. Students will summarize field trip data in a weekly site report. Evening class meetings will provide the opportunity to review field trips and reports and preview upcoming trips. Six all-day Sunday field trips are required.

SM 611. Environmental Law. (B) Keene.

This course will provide an introduction to environmental law and the legal process by which environmental laws are implemented and enforced. The course will examine the common law roots of environmental regulation in tort principles such as nuisance, negligence and trespass. We will examine important Constitutional principles in substantive and procedural law as well as significant environmental laws and approaches. Finally, we will examine emerging theories of citizen's rights and the government's role in environmental law and regulation. Students will learn how to read and analyze court decisions and apply some of the elements of legal thinking to actual cases and current problems.

612. Economics and the Environment. (M) Handy.

This course provides a comprehensive introduction to basic economic tools and methods, as they are applied to environmental issues -- including pollution control, resource depletion, the global commons, intergenerational equity, and policy decision-making. The course is designed for those with little or no prior economics background; disciplined sceptics are welcome.

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SM 613. (ENVS413) Business and the Natural Environment. (B) Heller. Offered through LPS - See current timetable

This course explores dramatic changes taking place at the interface of business, society, and the natural environment. Previously, business and environmental interests were believed to be adversarial. Now, some contemporary thinkers are suggesting that environmental capabilities can be a source of competitive advantage for corporations. A recent Harvard Business Review article refers to the sum of these changes as "The Next Industrial Revolution." In this course we will study examples on the cutting edge of these developments. We will look at corporations that are creating a "double bottom line" by strategizing about the ecological impact of their decisions, as well as the economic impact. We will learn about industrial designers who are rethinking everything from tennis shoes to corporate headquarters' buildings with the environment in mind. We will consider new alliances among business, environmental activists and government regulators -- all stakeholders in a sustainable society.

615. Professional Case Studies in Environmental Analysis and Management. (M) Laskowski.

This course is designed for students nearing the end of their MES program. It will provide students with hands-on experience working with local environmental professionals on projects in the Delaware Valley region. Each student will select a project made available by a local public or private agency. Among the tasks that students will perform are data collection and analysis, project planning, and documentation. Each student will prepare a detailed report under the direction of the agency representative that can be the basis for a Capstone project. Those interested in continuing on to the Capstone phase will use the report as the basis for a publishable document to be prepared in conjunction with the participating agency.

SM 617. Innovative Environmental Management Strategies. (M) Laskowski. Offered through LPS - See current timetable

This course will evaluate innovative environmental management strategies used by corporations, governments, the public, and NGOs including approaches such as the concept of pollution prevention, environmental management systems, green buildings, green product design, product labeling, environmental education, the power of information, market-based techniques, and industrial ecology. Some professionals believe that these innovative approaches have the potential to result in more environmental improvement than will be realized by additional regulatory requirements. This course will address which approaches work best and identify critical elements needed to ensure the best approaches to specific problems. Students will be exposed to real-life situations through expert guest lecturers, case studies, and "hands on" projects.

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SM 616. (ENVS426) Risk Assessment: Science & Policy Challenges. (L) Pepino.

How do government policy-makers make decisions about potential threats to human health and the environment in the face of scientific uncertainty? The course develops the concept of Risk Assessment from the publication of the 1983 National Research Council (NRC) report commonly known as the "Red Book" which was used to rank the initial hazardous waste sites under the Superfund program. Using a variety of teaching tools, including lectures, panel discussions, and case studies, the course examines how public policy decisions regarding environmental risk are made and how effective those decisions are at reducing risks to affected populations. The course focuses on the complex interaction of science, economics, politics, laws, and regulations in dealing with environmental and public health risks. The course will begin with a review of the policy process and methods used in evaluating human health and environmental risks, including the traditional steps in the risk assessment process, including quantitative and qualitative aspects of hazard identification, dose-response assessment, exposure assessment, and risk characterization.

The course will then focus on how scientific uncertainty, risk perceptions, socio-economic disparities, risk communication, and politics influence environmental risk-based decision-making. Issues such as special populations (e.g., children, elderly, immune-compromised, woman of pregnancy age, etc.) must be considered when developing risk reduction strategies. The use of the "precautionary principle" will be discussed in the context of different types of environmental stressors (e.g., pesticides, chemicals, climate change, air pollution, water quality, and land use) and how this important controversial principle is applied differently in contrasting national and European risk management policies.

SM 619. Environmental Leadership in Philadelphia. (C) Laskowski.

Philadelphia-area individuals and organizations have provided progressive leadership on many local, national, and international issues. These leaders come from government, business, NGOs, and academia. This course, given over a two week period, provides students with an opportunity to meet with these leaders at their place of employment. These experts will discuss their organization, their environmental priorities, and their thoughts on career opportunities. Each expert will also provide an in-depth explanation one or two of their progressive, sometimes cutting-edge, approaches to environmental management and science.

SM 620. How to Quantify Sustainable Practices in Business and Manufacturing. (B) Baer.

This course is designed to survey the various sustainability tools currently available to evaluate business performance. We will concentrate on the Triple Bottom line views of sustainability. Emphasis will be on Data driven approaches to Life Cycle Assessment, Environmental Product Declarations, ISO standards, and Green Construction. Special sessions will review the business drivers and market pull for sustainable products and practices. We will focus on US Green Building Council LEED requirements as well as the expectations of retailers for environmental information with regard to consumer packaged goods.

SM 621. Comparative Environmental Regulation. (B) Hagan.

In order to guide organizations and companies in an aligned fashion on environmental and sustainability issues, we need to understand the specific approaches that governments take in regulating environmental issues and the underpinning philosophies that drive these regulatory frameworks. This course will therefore require an evaluation of the different tools that governments have to influence, guide and command environmental outcomes from different segments of society. We will specifically examine the environmental regulatory approaches in a number of countries such as the United States, the European Union, China, India and Brazil.

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SM 622. Environmental Enforcement. (A) Lisa.

The goal of the course is to provide students with an introduction to the role of enforcement in federal, state and local environmental regulatory programs. Emphasis will be placed on federal enforcement actions initiated by the U.S. Environmental Protection Agency and U.S. Department of Justice. The course will provide students with an introduction to the American Legal System and legal concepts, like standing, jurisdiction, and burden of proof. A number of case studies and classroom exercises will be utilized as part of the discussion of civil and criminal enforcement actions. For example, a detailed case study will be presented concerning a successful prosecution by the federal government of a wastewater treatment plant operator (from the receipt of the initial tip through the sentencing of the defendant). A theme of all classes, presentations and assignments will be the role of the environmental professional in the enforcement context (e.g., the environmental professional who testifies as an expert in a judicial proceeding, or performs an audit that becomes the subject of a self-disclosure to EPA).

SM 629. The US Water Industry in the 21st Century. (A) Neukrug.

The course will explore all 4 sectors of the water business in the United States: The Drinking Water Industry, The Stormwater Utility, Water Resources (rivers, streams, reservoirs) Management and the Water Pollution Control Industry. The course will have 2 primary foci: 1. The influences on the industry from new technologies and infrastructure, acceptable levels of risk, public and private sector competition, climate change, the bottled water industry, resource recovery, rates and affordability and other influences will be investigated. 2. The management of a 21st century utility will be explored, including topics of organization and leadership, the role of environmentalism, infrastructure financing, water / wastewater treatment facility operations, public affairs and media, and designing a capital improvement program are examples of topic areas.

SM 623. Climate Change and Security. (A) Thomas.

Climate change is increasingly presented as posing significant security risks, but the relationship is much more complex than such a simple cause-effect statement might suggest. Researchers from diverse fields including geography, climatology, and political science are actively engaging questions about what kinds of security are threatened by climate change and through what mechanisms. For example, will severe drought lead to violent conflict? Who is vulnerable to reduced soil moisture or increased coastal erosion and why? What are the consequences of viewing a problem as a livelihood versus national security risk? Who are the winners and losers of climate change-based security interventions? This course will orient students to the evolving debate on the relationship between climate change and its impacts on national, human, and environmental security.

625. Overview of Environmental Justice: Issues, Actions and Visions for the Future. (B) Harris and Thompson. Offered through LPS-See current Timetable.

Many people refer to the Environmental Justice Movement as the most significant social rights movement to occur in this country since the Civil Rights Movement. Communities around the United States have expressed concerns related to the siting, permitting and clean up of hazardous waste sites in minority and low-income areas. Beginning with the protests in Warren County, North Carolina, Environmental Justice has become a most critical and controversial issue in this country. This course will provide an overview of the history, guiding principles, and issues of concern regarding Environmental Justice and will examine the approaches taken by communities, EPA, state and local government over the years to address these concerns. Students will be expected to evaluate and assess the various issues and case studies presented to them in a critical fashion, discuss these case studies, and make recommendations for appropriate action.

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SM 627. The Politics of Water. (B) Thomas.

Despite decades of scientific research and policy action aimed at managing water resources equitably and sustainably, it remains that the world's water resources continue to be severely polluted, pose grave hazards to lives and infrastructure, and be obstinately unevenly distributed in space and time. Moreover, a growing number of people (currently estimated at over 700 million) lack sufficient quantities of clean water. Although such challenges have long been approached with technical expertise (e.g. hydro-engineering, economic models), this course examines the social and political dynamics that underpin these problems. Organized as a survey of problems and responses, this seminar examines key concepts, major approaches, and current debates regarding water governance in various regions of the world. Course topics include the privatization of water, water as a human right, and human vulnerability to water hazards. In viewing water provision and management as not solely a technical concern but as inherently political, the course seeks to provide a set of analytical tools that is both critical and constructive.

SM 631. Current EPA Regulatory Practices and Future Directions. (A) Laskowski.

The regulatory approach continues to be the foundation of environmental protection in the US. This course provides an overview of key environmental laws and regulations, and the processes used to write permits, conduct inspections and take enforcement actions. It is taught mainly from the perspective of the federal government and will also include perspectives from the states, NGOs, and the regulated community. Techniques used to set priorities, ensure fairness, and encourage compliance are included. Current issues in major regulatory programs will be reviewed and future directions will be discussed.

SM 634. Closing the Loop on Climate Change. (C) Chu.

Historical consumption of materials and land resources has resulted in increasing per capita waste and greenhouse gas emissions. This course will explore opportunities to address the challenges of climate change through sustainable closed-loop approaches for materials and land. Alternative views of the drivers of climate changing greenhouse gases and the relative contributions of various sectors of the U.S. economy will be presented. The implications of climate change, economic costs of climate change mitigation and adaptation, rising energy prices, land use, and waste management issues will be discussed. The course will identify policy needs at all levels (international, national, state, and local) as well as practical solutions for greenhouse gas reductions. The course will explore in depth local policies and actions (e.g., recycling efforts and land use planning) that complement national and international efforts (e.g., cap and trade system and carbon tax).

639. Policy to Practical in Environmental Management: Water Issues. (C) Laskowski. Offered through LPS - See current timetable

This course explores some of the most challenging national and global water-related topics and includes guest lectures by and trips to meet representatives from several of the leading organizations addressing these these issues. Examples of these topics include meeting the UN Millennium Development Goal of halving the number of people worldwide who do not have adequate drinking water and sanitation; the control of polluted runoff from farms and urban areas; the management of multi-state water pollution programs; and assessment of the impacts of low-level toxics in water. In addition to learning about the environmental issues, students will also visit regional and global experts in such places as the Philadelphia, Washington DC, and New York City. Students must attend two full-day field trips and one afternoon trip.

ENVIRONMENTAL STUDIES

(AS) {ENVS}

SM 635. Major Global Environmental Problems of Today and How We Must Deal With Them Tomorrow.. (B) Laskowski. Offered through LPS - See current timetable

Global environmental problems of today are some of the greatest challenges of the new millennium. Almost everyone is in some way part of the problem and increasingly will be asked to be a part of the solution. The problems that we face today often differ from those of the past because it is sometimes difficult for the international community to agree on the extent, causes, and impacts of the problem and how to allocate responsibility for the resolution of the problem. Governments, businesses and NGOs around the world have recognized the need to take the initiative and address these issues through regulation, voluntary approaches, and cooperation on an international level. How best to manage these problems is the constant challenge. This course will provide an overview of several of the major global environmental problems facing the world today, and how they are connected by common causes, underlying themes and concepts critical to the understanding and management of these issues. It will examine the over-arching concepts of sustainability and globalization as well as frameworks for assessing and managing the issues.

The course will also consider the role of the major players/stakeholders in the situation, including governments, non-government organizations, and private sector individuals/participants, and where appropriate, touch on such issues as intergenerational aspects and the potential long-term irreversibility. With the assistance of regional and national experts, we will address specific problems, such as: human populations and their environmental impact; issues surrounding resources such as food, water, habitats, and energy; global climate change; the ozone layer; and problems of international/environmental terrorism, catastrophes, and disease. Each student will prepare a report and presentation on some aspect of a topic discussed during the term.

637. Global Water Issues. (A) Laskowski. Offered through LPS - See current timetable

Water- related illnesses are estimated by some to kill up to 5000 people per day worldwide and many of these casualties are children. This course will explore the causes of this global crisis and what is being done to address the issue. It will provide an overview of international agreements, wastewater and water supply issues, technological advances, political/financial/cultural and other barriers to success, and what students can do to become involved in resolving the issues. Guest lecturers and case studies will provide insights to problems in problem areas around the world. Students will be asked to evaluate specific problems and suggest improved approaches to improving access to clean water.

SM 638. Global Water Policy and Governance. (A) Laskowski.

At the turn of the 21st century the United Nations established a series of goals to assist developing countries. These Millennium Development Goals [MDG] include targets for water and sanitation: " by the year 2015 to reduce by one half the percent of the world's population that does not have access to safe water and adequate sanitation". This course explores the policies and actions being taken by the world community, the United States, and NGOs to meet these targets. It will also address water governance issues such as financing, community leadership, and capacity building for water/sanitation in developing countries. Two mandatory full-day field trips are included [one to the United Nations in New York City; another to US Government leaders in Washington, DC].

ENVIRONMENTAL STUDIES

(AS) {ENVS}

SM 642. Global Water Conference in Stockholm, Sweden. (L) Laskowski.

The global water and sanitation crisis kills over 4,000 children each day and represents one of the biggest health problems in the world. At the University of Pennsylvania school year 2010-2011 was declared the "Year of Water" in recognition of the many challenges that lie ahead as global increases in population and affluence and the influences of climate change will stress limited water resources. Each year the Stockholm International Water Institute convenes a Conference with experts from around the globe to exchange the latest water research findings and develop new networks. Students will attend the Conference, present research by presentations/posters, document a key issue, interview experts, and meet colleagues with common interests. They will also help other organizations at the Conference.

SM 647. Urban Ecology. (C) Bathala.

Urban Ecology provides an examination of the ways in which humans and other animals interact in shared and contiguous environments. A focus of the course will be the impact of urbanization on our natural resources. Topics covered include historical and ethical perspectives of wildlife, general ecological principles, biodiversity and endangered species management, eco-tourism and environmental sustainability. Students will be required to keep a weekly journal of current news articles and responses in lieu of a textbook. Additionally, a museum trip or evening lecture series event may be incorporated. Students will have the opportunity to collect data for an Urban Bird Watch project. Laboratory exercises will also be required which demonstrate various ecological measures.

SM 643. (ENVS463, URBS463, URBS663) The Historical, Scientific, & Policy Dimensions of "Brownfields". (M) Keene. Offered through LPS - See current timetable

This course is intended to give students an overview of the genesis of the so-called "Brownfield" problem and of the various efforts our society is taking to solve or, at least, ameliorate it. The course will place the "Brownfield" problem in the broader context of the growth and decline of the industrial base of cities like Philadelphia. Students will study the general constitutional and statutory framework within which we approach the problems of orphan, polluted sites and the disposal of contemporary solid wastes. They will also analyze the principal actions that have been taken by Federal and state government to address remediation and redevelopment of abandoned industrial sites. The course will also explore environmental equity issues.

The students will collaborate with high school students at the West Philadelphia High School to identify sites in their neighborhoods and to learn how to determine the sites ownership and land use history. The students will study ways of determining environmental risk and the various options that are available for remediation in light of community ideas about re-use. Students will be expected to participate actively in the seminar and the sessions with high school students. Students in the course are required to prepare and present a term paper on a topic in the general area of "Brownfield" analysis and remediation.

SM 644. Energy, Waste and the Environment. (B) Giere.

The aim of this course is to provide an incentive to use geochemical and mineralogical principles to address and solve major environmental problems. The students identify the problems that are associated with different types of waste. This course covers a wide range of problems associated with the waste arising from the generation of electricity. The main topics will be the uranium cycle, characterization of nuclear waste, and the containment and disposal of nuclear waste. Based on insights from the nuclear fuel cycle, solutions are presented that diminish the environmental impacts of coal and biomass combustion products, incineration of municipal solid waste, toxic waste due to refuse incineration, and landfills and landfill gases.

SM 645. Water Environment Federation Conference. (A) Neukrug.

ENVIRONMENTAL STUDIES

(AS) {ENVS}

652. God, Gold & Green: Themes and Classics in American Environmental Thought. (C) Blaine. Offered through LPS - See current Timetable

Through an exploration of enduring themes and classics, this course traces environmental thought in America from the first European settlements to the present. We begin by considering the preconceptions that Europeans brought to the New World and the realities they found when they arrived. We look at the issues raised by the unprecedented industrial and urban expansion of the 19th century and the accompanying westward migration that filled the continent. We examine how the conflict between economic growth and environmental limits created competing models of prosperity, equality and justice. And finally, we look at ways to transcend those divides and build a sustainable and equitable future. The primary vehicles for understanding the evolution of environmental thinking across several centuries are some of the classic texts of environmental thought - from *The Book of Genesis* to Henry Thoreau's *Walden* to Rachel Carson's *Silent Spring* to Al Gore's *An Inconvenient Truth*. The course seeks to provide a theoretical and historical framework that will help students understand current issues and address real problems.

SM 656. Environmental Futures. (B) Laskowski.

As global population and affluence increases in the 21st century, the world is faced with many environmental challenges. Global climate change, declines in fisheries, water supply shortages, limited fossil fuels, habitat destruction, species extinction, and low-level toxins are a few concerns. Many studies of these issues have projected disastrous impacts on the environment, human health, and the economy. But, how accurate are those projections? And, what needs to happen to make these projections more optimistic? In this course students will select one of the many global environmental problems of the 21st century, research projections made about the impact of the problem to the year 2050, assess the accuracy of the assumptions behind these projections, and apply creative thinking to what needs to happen to make these projections more optimistic (eg, could there be technological breakthroughs?; better international agreements?; improved monitoring?; shifts in cultural attitudes?; regulation and market-based solutions?). Environmental management topics such as strategic planning, environmental indicators, pollution prevention, innovative technologies, and the importance of quality science will be addressed.

678. Advanced Biogeochemistry. (B) Vann. A soils course would be helpful, but not required

The course will cover nature of the field of biogeochemistry and its application. Topics include, elemental cycling at various scales, from global to watershed level, the interaction between geology and biology in controlling how these relationships have changed over the Earth's history and man's influence on these cycles.

The course will include an examination of the CENTURY computer model, a popular model for examining nutrient cycling in terrestrial ecosystems. Students will submit a term paper on a related subject, such as comparing the functioning of two watersheds or summarizing current understanding of a particular cycle, etc.

ENVIRONMENTAL STUDIES

(AS) {ENVS}

SM 662. Green Design and the City. (B) Berman. Offered through LPS - See current timetable

Can our cities become examples of sustainable design? Does inner city revitalization tie into sustainability? Are there successful examples to learn from? This seminar will focus on how existing cities attempt to integrate green design principles within them. It will look at case studies, both in the US and abroad.

Urban design and transportation will be examined within this context, including how to create pedestrian friendly spaces. Infill construction and the adaptive use of existing buildings will be discussed, as well as the reuse of brownfield sites. We will also look at what types of construction actually constitute green buildings.

We will take advantage of our local resources within Philadelphia, and include visits to nearby sites, along with talks by local experts. There will be a series of short projects given throughout the term. They will usually include both a written component and a presentation to the class. The energetic execution of these projects, their presentations and the subsequent discussions, will be a key part of this seminar.

SM 664. Sustainable Design. (C) Berman. Offered through LPS - See current timetable

This seminar will focus on how physical design can improve sustainability. It will be broken down into 3 parts: Green Buildings, Green Urbanism, and Smart Growth Planning. Starting small, we will begin by looking at which types of construction actually constitute Green Buildings and which of these are the most effective. Our look at Green Urbanism will focus on existing cities and towns. They will be examined in terms of how urban design and transportation can promote sustainability. Finally, Smart Growth planning concepts for new developments will be discussed. This will include a survey of New Urbanism. Both these closely allied approaches are recent attempts to guide new growth in a more sensitive manner. We will also take advantage of local resources within our region, and include visits to nearby sites, along with talks by local experts.

SM 674. Life Cycle Assessment. (A) Hagan.

681. Modeling Geographical Space. (M) Tomlin. Offered through LPS - See current timetable

This course explores the nature and use of digital geographic information systems (GIS) for the analysis and synthesis of spatial patterns and processes through 'cartographic modeling'. Cartographic modeling is a general but well defined methodology that can be used to address a wide variety of analytical mapping applications in a clear and consistent manner. It does so by decomposing both data and data-processing tasks into elemental components that can then be recomposed with relative ease and with great flexibility.

699. (GEOL699) Masters of Environmental Studies Capstone Seminar. (C) Bordeaux. Permission of instructor required. Offered through LPS - See current timetable

999. Independent Study. (C) Staff. Permission of instructor required

Directed study for individuals or small groups under supervision of a faculty member.