

## Environmental Studies

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### Program Description

Environmental Studies is an interdisciplinary department designed to provide students with the knowledge and skills to **analyze complex environmental issues from a variety of perspectives** --natural sciences, social sciences, and humanities. With six core faculty, all with active research programs involving students, and contributions from faculty in twelve additional departments, **Environmental Studies is one of the most comprehensive small-college environmental programs in the nation.**

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The department offers an **extraordinary range of opportunities for hands-on learning**. Many courses immerse students in local terrestrial, fresh-water, and marine habitats. Other programs lead abroad for a first-hand investigation of environmental problems in Africa, Asia, Europe, and Latin America.

Field trips are a component of most environmental studies courses. Students travel from campus to the deep, underground mines in Pennsylvania coal country, the nearby forests on the battlefields of the world-famous Gettysburg National Military Park, and the beaches on the Maryland and North Carolina Outer Banks. **Students routinely visit Washington, D.C., to participate in the annual Environmental Film Festival or discuss environmental policy with decision makers**, including representatives of federal agencies such as the National Park Service or EPA, environmental NGOs (e.g., the National Wildlife Federation or the Sierra Club), and members of Congress. In the summer students may enroll in departmental field courses that examine ecology in coastal Maine or the [geography of the Rocky Mountains in Colorado](#), or they may pursue environmentally oriented internships and research opportunities with faculty on campus or across the country.

In the classroom or laboratory, at an internship or on a service-learning project, in the comfort of the library or under demanding field conditions, students are taught to approach environmental issues with an open mind, to examine alternatives carefully, and to write and speak effectively about their work. The program prepares students for graduate study and careers in environmental science, environmental management, law, public policy, urban planning, positions with nonprofit organizations, and other related fields.

### Program Requirements

#### The Environmental Studies Major

The Environmental Studies major is interdisciplinary with a set of core courses that draw from the natural sciences, humanities, and social sciences. Along with the six courses in this interdisciplinary core, students choose an Area of Concentration. The **Bachelor of Arts** degree comprises a minimum of 11 courses. The **Bachelor of Science** degree comprises a minimum of 14 courses. In addition to the specific areas of concentration listed here as models, students may design their own unique area of concentration in consultation with their Environmental Studies faculty advisor.

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## Core Requirements

### Bachelor of Arts

*The core requirements for the **Bachelor of Arts** degree consist of **six** courses. Students usually complete the first five Environmental Studies core courses (ES 196, 211, 223, 225, and 230) by the end of the sophomore year, although the department recognizes that students enter the major from a variety of backgrounds and may take longer. The 400-level capstone requirement is met in the senior year.*

- ES 196 Environmental Science and Society
- ES 211 Principles of Ecology
- ES 223 Earth System Science
- ES 225 Introduction to Environmental Humanities
- ES 230 Introduction to Geographic Information Systems
- ES 400 Environmental Studies Seminar *OR* ES 460 Individualized Study: Research

### Bachelor of Science

*In addition to the six core requirements listed above, students pursuing the **Bachelor of Science** degree must complete two additional two-course sequences in the natural sciences and fulfill a mathematics/statistics requirement. **Students planning to attend graduate school in natural science related areas should choose the Bachelor of Science degree and speak with their advisor about additional natural science and math courses.***

- Natural Sciences (choose at least two **two-course** sequences)  
*Bio 111 Introduction to Ecology & Evolution and Bio 112 Form & Function of Living Organisms (preferred) *OR**  
*Bio 113 Introduction to Phage Biology and Bio 114 Phage Genomics*  
*Chem 105 *OR* Chem 107 Chemical Structure and Bonding and Chem 108 Chemical Reactivity*  
*Phy 103 Elementary Physics I and Phy 104 Elementary Physics II *OR**  
*Phy 109 Introductory Physics I and Phy 110 Introductory Physics II *OR**  
*Phy 111 Introductory Modern Physics I and Phy 112 Introductory Modern Physics II*
- Mathematics and Statistics (choose at least **one** option)  
*Math 105-106 Calculus w/Precalculus*  
*Math 111 Calculus I*  
*Math 112 Calculus II*

*Bio 260 Biostatistics*

*Econ 241 Intro. Econ. & Business Statistics*

*Pol 215 Political Science Research Methods*

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## **Area of Concentration**

In addition to the core requirements, majors pursue advanced course-work within a particular topical area of concentration. Students complete at least **five** courses within an area of concentration, three of which must be ES courses at or above the 240-level unless alternative arrangements are made with the Department Chair. Some courses have prerequisites. Courses may count more than once in the major, as long as the minimum number of courses is met for the Bachelor of Arts degree (11) and Bachelor of Science degree (14) respectively.

## **Suggested Areas of Concentration**

### **Earth System Science**

- ES 318 Glaciers and Records of Climate Change
- ES 322 Geomorphology OR ES 323 Geologic Disasters & Global Change
- One two-course sequence: choose from Chem 107-108 OR Phy 103-104 OR Phy 109-110 OR Phy 111-112

### **Energy and the Environment**

- ES 240: Energy Production and Use
- One two-course sequence: Phy 103-104 OR Phy 109-110 OR Phy 111-112

### **Environmental Policy and Management**

- ES 333 Environmental Policy
- Pol 101 American Government OR Pol 103 Intro. to International Relations OR Pol 104 Intro. to Comparative Politics

### **Environmental Science**

Note: At least **three** courses should be chosen from the list of electives.

- One mathematical/statistics course (see list under BS core requirements)
- **Two** two-course sequences in natural science (see list under BS core requirements)

### **Environmental Writing**

- ES 241 Environmental Writing
- Eng 201: Writing the Public Essay

### **GIS and Spatial Analysis**

- ES 263 Remote Sensing
- ES 312 Environmental Applications of GIS

- One statistics course (see list under BS core requirements)

### **Landscape Ecology and Land-Use**

- ES 312 Environmental Applications of GIS OR ES 304: Landscape Ecology
- ES 245 Terrestrial Ecosystems OR ES 315 Land: Ecology, History, and Culture

### **Marine and Freshwater Ecology**

- ES/Bio 306 Marine Ecology OR Bio 307 Freshwater Ecology (whichever is chosen, the other may be used as an elective)
- Bio 111 Introduction to Ecology & Evolution
- Bio 112 Form & Function of Living Organisms

### **Nature and Human Culture**

- ES 252 The Rocky Mountain West: Cultural Geography
- ES 319 Environmental Film

### **Sustainable Development**

- One course from: Econ 104, Pol 102, or Pol 103 (to be taken prior to ES 334 or ES 333)
- ES 333 Environmental Policy
- ES 334 Global Environment and Development

### **Conservation Biology**

- ES 316 Conservation Biology
- Bio 111 Introduction to Ecology & Evolution
- Bio 112 Form & Function of Living Organisms

### **Self-designed Area of Concentration**

A Self-designed Area of Concentration is one that combines courses from existing areas of concentration and elsewhere in the Gettysburg College curriculum in consultation with your advisor. Students submit a plan of study including a list of courses, which must be approved by the Chair of the Environmental Studies Department.

The self-designed area of concentration is meant to allow you to take advantage of special circumstances, such as courses offered by visiting faculty, study abroad, or to combine courses in a unique and logical way to help you achieve your career goals. Recent examples include areas such as Environmental Education or Environmental Health.

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### **Electives**

#### **Environmental Studies**

- ES 240 Energy: Production, Use, and Environmental Impact
- ES 245 Terrestrial Ecosystems
- ES 251 The Rocky Mountain West: Physical Geography

- ES 252 The Rocky Mountain West: Cultural Geography
- ES 263 Remote Sensing
- ES 304 Landscape Ecology
- ES/Bio 306 Marine Ecology
- ES 312 Environmental Applications of GIS
- ES 315 Land: Ecology, History, and Culture
- ES 316 Conservation Biology
- ES 317 Chesapeake Bay
- ES 318 Glaciers and Records of Climate Change
- ES 319 Environmental Film
- ES 322 Geomorphology
- ES 323 Geologic Disasters and Global Change
- ES 324 Soils, Water and the Environment
- ES 333 Environmental Policy
- ES 334 Global Environment and Development
- ES 350 Coastal Ecology of Maine
- One course among ES 122, 127, 128, 130, 162 or FYS 105, 120, 139, 148 or 156 as entry to the major by permission of the Department.

### **Samples from other Departments**

- Anth 223 Indigenous Peoples, the Environment, and the Global Economy
- Ast 208 Topics in Astronomy
- Bio 200 Physiology of Plant Adaptations
- Bio 204 Biology of Flowering Plants
- Bio 211 Genetics
- Bio 218 Biology of Algae and Fungi
- Bio 227 Invertebrate Zoology
- Bio 230 Biostatistics
- Bio 307 Freshwater Ecology
- Bio 314 Evolution
- Chem 203 Organic Chemistry
- Chem 204 Organic Chemistry
- Chem 317 Instrumental Analysis
- CS 103 Introduction to Computing
- CS 111 Computer Science I
- Econ 208: Energy Economics
- Econ 216: Political Economy of Oil
- Econ 222: Issues in Environment and Resource Economics
- Econ 250 Economic Development
- Econ 341 Environmental Economics

- Eng 201: Writing the Public Essay
- Hist 103 Europe, Asia, and Africa: 1750-1930
- Hist 230 Native American-European Encounter in North America
- Hist 236 Urbanism in American History
- Hist 371 Modern African Environments: History, Ecology, and People
- IDS 255 Science, Technology, and Nuclear Weapons
- IDS 268 The Arts, Environment, and Religions of Indonesia
- Math 212 Linear Algebra
- OMS 406: Business, Ethics, and Civic Life (in American Watersheds)
- Phil 333 Philosophy and Science
- Pol 252 North-South Dialogue
- Pol 327: State Politics and Policy
- Pol 363 Politics of Developing Areas
- Phy 310 Atomic and Nuclear Physics
- Phy 325 Advanced Physics Laboratory
- Phy 352 Optics and Laser Physics
- Rel 226 Native American Religions

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### **The ES Major Plan**

It is strongly recommended that upon declaration of the ES Major, in consultation with one's Environmental Studies faculty advisor, students develop an ES major plan: a written statement explaining one's choice of an Area of Concentration in light of one's academic and career goals. It includes a brief outline of plans for future courses, internships, off-campus study, and independent research. While the plan may change, it encourages students to think intentionally about their academic careers and be better prepared to take full advantage of the learning opportunities available both on and off campus.

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### **The Environmental Studies Minor**

*The Environmental Studies minor consists of **six** courses:*

- ES 196 Environmental Science and Society
- ES 211 Principles of Ecology *OR* ES 223 Earth System Science (May take both and use second course as elective)
- ES 225 Introduction to Environmental Humanities
- ES 230 Introduction to Geographic Information Systems
- Two electives from the other ES courses (*Note: only one course among ES 122, 123, 124, 126, 127, 128, 130, and 162 or FYS 105, 120, 139, 148, or 156 can be counted towards the minor.*)

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### **Additional Opportunities**

#### **Environmental Education Certificate**

The Department of Environmental Studies and the Department of Education are pleased to offer an Environmental Education Certificate. Students interested in this teaching certificate complete either the BA or BS in Environmental Studies and the **Education Minor**. It is important to begin the education coursework as early as possible along with your ES courses, and we recommend that students discuss their plans with their ES advisor, as well as consult with Dr. Rinke in the Education Department.

### **Public Policy**

Students interested in Environmental Policy have the option of participating in a second Public Policy major. The public policy major at Gettysburg College offers a flexible, rigorous, multidisciplinary curriculum that provides training for students interested in problem-solving in domestic or international public arenas.

### **Dual Degree Programs in Environmental Engineering and Environmental Management**

Students spend 3 years at Gettysburg College and 2 years at a graduate institution in order to earn both their BS and either MS or MEM in five years total.

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#### **For additional information...**

Contact the Department Chair, Rud Platt at [rplatt@gettysburg.edu](mailto:rplatt@gettysburg.edu).

*Revised September 2012/smp*

## **Course Listing**

Course level:

**100 | 200 | 300 | 400**

### ***ES-121 Environmental Issues***

Introduction to national and global environmental issues. Students learn the basic concepts of ecology, including population growth models, species interactions, and ecosystem and biosphere processes. Building on this scientific base, students use an interdisciplinary approach to analyze economic, ethical, political, and social aspects of environmental issues. Topics include human population dynamics, air and water pollution, toxic wastes, food production, land use, and energy utilization.

### ***ES-122 Natural Catastrophes and Geologic Hazards***

Investigation of natural disasters and the fundamental geologic principles that cause them. Topics include earthquakes, volcanoes, landslides, floods, and tsunamis. The importance of geologic information to land-use planning is discussed. Preparation for these hazards and establishing prediction methods are also evaluated.

### ***ES-123 The Biodiversity Crisis***

Exploration of the causes and consequences of the current species extinction crisis. The focus is on why and how the loss of biodiversity is an important environmental threat. Topics will include the importance of biodiversity and healthy ecosystems, the intrinsic and utilitarian values of biodiversity, the social and political issues associated with this issue. Topics will be explored through active engagement in service learning activities and through reading of diverse sources.

### ***ES-124 Meteorology***

Study of the atmosphere and atmospheric phenomena, as well as associated interactions with the oceans and the Earth's surface and its organisms. Topics include composition and energy budgets of the atmosphere, cloud development and precipitation, air pressure, winds and fronts, and atmospheric circulation patterns. Destruction of the ozone layer and ultraviolet radiation, the greenhouse effect, pollution, and global warming are also examined.

### ***ES-126 Climatology***

Study of the localized weather of a region. Influencing factors of climate are examined, including continental vs. oceanic/lake effects, temperature and precipitation, the role of cyclones and anticyclones, and topographic and organismic alterations. Also analyzed are specific climatological disturbances, such as thunderstorm formation, tornado development and occurrence, hurricane structure and movement, El Nino, and the Southern Oscillation (ENSO), and La Nina.

### ***ES-127 Plants, People and the Environment***

Our lives depend on, are enhanced by, and at times even threatened by plants. From the oxygen we breathe to the carbon dioxide we release, our lives (biological, cultural and spiritual) are thoroughly integrated with plants. In this course "Plants, People and the Environment" we examine the biology of plants including the traditional botanical disciplines of anatomy, evolution, ecology, physiology as well as the cultural uses of plants from agriculture to religion. Further, we consider the developing applications of plants in human well-being like pollution remediation, food production and pharmaceuticals.

### ***ES-128 Oceanography***

Introduction to our planet's oceans, beginning with the history of oceanography and focusing on the fundamental concepts of chemical, physical, geological, and biological oceanography. Important environmental problems in marine habitats are also explored. Topics include ocean exploration, plate tectonics, hydrothermal vents, currents, tides, upwelling, waves, tsunamis, ocean-climate interactions, El Nino, global nutrient cycles, primary production, biodiversity, pollution, overfishing, and the law of the sea.

### ***ES-130 The Chesapeake Bay Ecosystem***

Introduction to the physical, chemical, and biological components of the Chesapeake Bay ecosystem. Emphasis is placed on the history of the Bay, primary production dynamics, habitat types, and pelagic and bottom-dwelling organisms. Human impacts on the Bay and its watershed are discussed, including contemporary issues such as crab and oyster fisheries, aquaculture, nutrient inputs, toxic chemicals, exotic species invasions, and the management goals of the Chesapeake Bay Program

### ***ES-161 Physical & Human Geography***

Studies of human activities in its locational context. Topics include basic place name geography, weather and climate, population trends and characteristics, health and human development, culture and language, technology and economic development, human ecology, and environmental problems.

### ***ES-162 World Regional Geography***

An introduction to geography through the study of world regions. This course serves to broaden and diversify students' worldviews on contemporary issues while providing powerful conceptual tools for clearer understanding. Geographic applications emphasize the importance of region, place, spatial scale, and diffusion. Course focuses on the interaction within and between regional cultures, environments, politics, and processes of globalization from a variety of scales. Topics include: human-induced environmental change, population and migration, culture change, international development, regional conflict, and global inequality.

### ***ES-196 Environmental Science and Society***

Introduction to the methods and assumptions underlying environmental science as applied to current environmental problems and their intersection with modern society. Building from a foundation in the natural sciences, an interdisciplinary approach is used to investigate the social causes and consequences of air and water pollution, human population, food production, energy, natural resource use, toxic waste, endangered species, land conservation, and environmental health.

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### ***ES-211 Principles of Ecology***

Introduction to current ideas in theoretical and empirical ecology. A quantitative approach is used to examine population dynamics, competition, predator-prey interactions, life-history strategies, species diversity patterns, community structure, energy flow, biogeochemical cycling, and the biosphere. Course

provides a foundation for further work in environmental studies. Three class hours and laboratory.

Prerequisite: ES 196 or one year of college science.

### ***ES-223 Earth System Science***

Introduction to the natural environment and human interaction with it. Course examines the physical processes of the Earth's atmosphere, hydrosphere, lithosphere, and biosphere. Topics include geological processes and hazards, water resources, waste management, energy and mineral resources, and human impact on global climate change. Lab sessions provide practical exercises on basic earth systems principles and environmental applications. Local field trips to environmental and geological sites are included. Prerequisite: ES 196 or one year of college science.

### ***ES-225 Environmental Humanities***

Introduction to environmental humanities. Using the interdisciplinary lenses of literary studies, history, philosophy, and communication studies, students consider how human beings imagine nature, how they communicate ideas about nature, and the ways in which these understandings affect the material environment. Discussions and assignments emphasize humanities research methods and explore topics such as wilderness, environmental justice, and consumerism, highlighting how language and media shape (and are shaped by) cultural perceptions of the environment. Prerequisite: ES 196.

### ***ES-230 Introduction to Geographic Information Systems***

Introduction to geographic information systems and science, and applications to environmental studies. Topics include GPS and spatial data input, cartography and map projections, data models and database development, spatial analysis, and evaluation of uncertainty. Laboratory exercises use ArcGIS software to provide hands-on experience in the use and analysis of geographic data. Prerequisites: Sophomore status.

### ***ES-240 Energy: Production and Use***

Conventional and alternative energy sources are examined with respect to supply, price, technology, and environmental impact. U.S. consumption patterns are studied and the potential of conservation is addressed. Topics include nuclear reactors, fossil fuel supply, photovoltaics, air pollution, greenhouse effect, and energy efficient architecture. Prerequisite: One year of college science.

### ***ES-241 Environmental Writing***

Exploration of environmental issues through the reading and writing of journalistic prose. Highlighting the historical roots of environmental journalism and contemporary practices, the course focuses on

reporting and writing stories for the public in formats typical to newspapers, magazines, and online media such as blogs. Fundamentals to such writing include developing: 1) basic techniques for organizing stories that evoke interest and convey scientific and technical information accurately; 2) newsgathering techniques like researching credible sources and interviewing; 3) clean, crisp writing through attention to the iterative process of drafting, peer reviewing, and revising. Prerequisite: ES 125 or 225, or ES 196 and English writing class at level 110 or higher, or permission of the instructor.

### ***ES-245 Terrestrial Ecosystem Dynamics***

Examination of patterns and processes in the terrestrial ecosystems of the world. Topics include the physical structure of ecosystems; the cycling of carbon, water, and mineral nutrients; soil development; and interactions among plants, animals, and decomposers. Similarities and differences in the ecosystems of Earth's nine major biomes are examined. Course investigates threats posed by human activities to terrestrial ecosystems worldwide, as well as approaches for minimizing those threats in order to conserve biodiversity and ecosystem function

### ***ES-251 The Rocky Mountain West: Physical Geography***

Intensive two-week field-based examination of the physical and cultural geography of the Rocky Mountain West. Focusing on the San Juan Mountain Range in Southwest Colorado, students participate in home stays, service-learning activities, and other field-based projects to examine regional social-environmental relations from diverse multi-cultural, institutional, and political-economic perspectives. In this way, students develop a critical place-based understanding of how recent "New West" socio-economic changes are impacting these relations, including new efforts to achieve ecologically sustainable and socially just solutions to land management problems

### ***ES-252 The Rocky Mountain West: Cultural Geography***

Intensive two-week field-based examination of the physical and cultural geography of the Rocky Mountain West. Focusing on the San Juan Mountain Range in Southwest Colorado, students participate in home stays, service-learning activities, and other field-based projects to examine regional social-environmental relations from diverse multi-cultural, institutional, and political-economic perspectives. In this way, students develop a critical place-based understanding of how recent "New West" socio-economic changes are impacting these relations, including new efforts to achieve ecologically sustainable and socially just solutions to land management problems

### ***ES-263 Remote Sensing***

An introduction to the theory and practice of remote sensing, the science of acquiring information about

the earth from air or space borne sensors. The first part of the course focuses on principles of remote sensing, sensor technology, and basic image processing. The course culminates in a change detection project where students acquire, process, and analyze image pairs to map an environmental change such as deforestation, urbanization, or flooding. Prerequisite: Sophomore Status. Alternate Years.

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### ***ES-302 Wildlife Ecology***

Wildlife Ecology. Study of ecological applications for managing terrestrial vertebrate populations and their habitats. Building on topics in Principles of Ecology (ES211), this lecture and laboratory develops an in-depth understanding of wildlife ecology, management techniques, ecological survey techniques, and data analysis. Emphasis is on application through the use of current field protocols and analytical techniques. The class draws on literature and examples from around the world. Prerequisite: ES 211.

### ***ES-304 Landscape Ecology***

Analysis of ecological patterns and processes at the landscape scale. Lecture and laboratory provide a comprehensive introduction to this rapidly developing field in ecology. Studying ecological processes at large spatial scales has been facilitated by the development of Geographical Information Systems (GIS) and more specialized computer programs. This course provides an opportunity to develop GIS skills and gain experience in analysis of spatial environmental and ecological data. Emphasis on practical learning through laboratory exercises and coursework. Prerequisite: ES 211 and ES 230.

### ***ES-306 Marine Ecology***

Analysis of the ecology of marine systems. The open ocean, estuaries, salt marshes, beaches, mud and sand flats, seagrass beds, rocky shores, coral reefs, and deep sea are examined. Problems of pollution, beach erosion, and the management of declining fisheries is also presented. Quantitative field work in a variety of coastal habitats is conducted on a required field trip to Duke University Marine Laboratory and the Outer Banks barrier island chain. Three class hours and laboratory-field work. Alternate years. Prerequisite: ES 211.

### ***ES-312 Environmental Application of Geographic Information Systems***

Application of geographic information systems and spatial analytic methods to selected environmental problems. Students will solidify their existing GIS skills, as well as learn new analytic strategies such as exploratory spatial data analysis, quantitative landscape analysis, and spatial interpolation. Lab exercises focus on environmental applications such as constructing habitat suitability models, quantifying habitat fragmentation, mapping wilderness, and identifying environmental health "hot spots". Each student will

also complete a final project related to an environmental issue, where they will define project needs, develop a GIS database, conduct spatial analyses, and present results. Prerequisite: Environmental Studies 230. Alternate Years.

### ***ES-315 Land: Ecological, Historical and Cultural Synthesis***

Investigation of land as the foundation upon which human and natural communities exist. A mode of analysis of land mosaics is presented using landscape ecology. The history of land ownership is explored as it has led to the contemporary American systems of land tenure. Investigations are made of the cultural significance of conservation and development forces on land. Ultimately, a synthetic look at land will lead to an investigation of the environmental and social implications of changing landscapes.

### ***ES-316 Conservation Biology***

A discipline comprising pure and applied science, which focuses on the preservation of biological diversity. Focus implicitly recognizes that preserving the genetic and ecological features of a species requires preservation of that species' niche. Topics include food web organization, spatial heterogeneity and disturbance, consequences of small population size and inbreeding, captive propagation, demographics of population growth, and species reintroduction and management. Prerequisite: Environmental Studies 211.

### ***ES-317 Chesapeake Bay: Science, Policy and Environmental Issues***

Examines the ecology of the Chesapeake Bay region in the context of society's exploitation of a natural system. We will trace the settlement of the region with an emphasis on how the Bay affected the society that developed along its shores and, in turn, how the Bay was affected by this human development. Readings from the scientific literature will be combined with those from history, sociology, and economics to form a coherent portrait of the interplay between society and the environment. Prerequisite: Environmental Studies 211. Alternate Years

### ***ES-318 Glaciers and Record of Climate Change***

Introduction to glacial geology and records of climate change over the last 2 million years. Course examines basic glaciology, glacial erosion and depositional processes. Analysis of landforms is used to make interpretations of climatic variability. Climate records from ice cores and sediment cores are evaluated. Natural and human induced climate change is discussed. Prerequisite: Environmental Studies 223 or permission of instructor.

***ES-319 Environmental Film***

Study of environmental films and their role in shaping environmental imaginations and actions in contemporary life. Applies fundamentals of film analysis to critical stylistic, textual and contextual (historical and political-economic) investigations of both fictional and documentary environmental films. Topics include Hollywood films about wildlife, wilderness, land use, technology and pollution, and documentaries on wildlife conservation, wilderness-adventure, and socio-nature themes. Prerequisite: ES 125 or 225 and any 200 level Environmental Studies course or permission of the instructor.

***ES-322 Geomorphology***

Introduction to earth surface processes and landform analysis. Course examines basic geomorphologic processes including weathering and erosion, soil formation, mass movements, river processes, eolian systems, and glacial environments. Analysis of landforms from aerial photographs and topographic maps is used to make interpretations of climatic variability. Investigations of the interaction between natural surface processes and human modification of landscapes are discussed.

***ES-323 Geologic Disasters and Global Change***

Investigation of geologic disasters and their relationship to global change. Course focuses on natural disasters that affect the surface of the Earth, including landslides, floods, El Nino, coastal erosion, sea level rise, droughts and desertification. The interaction between natural surface processes and human modification of landscapes are discussed. Prerequisite: Environmental Studies 223 or permission of instructor. Alternate Years

***ES-324 Soil, Water & the Environment***

Examination of the flows of elements and energy through rocks, soils, fresh water, oceans, the atmosphere, and the biosphere. Course considers the transformations and movement of water, carbon, and nutrients at various scales, from individual organisms up to the entire planet. Special emphasis is given to the effects of global climate change, acid rain, nitrogen deposition, and the conversion of natural ecosystems to agricultural and development uses.

***ES-333 Environmental Policy***

Analysis of the policies that guide the use, control and management of natural resources. Students examine the laws, bureaucracies, economics, politics and ideologies underlying policy making processes in order to understand how and why certain policies emerge as well as their social and ecological effects. The primary focus is on the United States, but the growing international dimension of environmental policies and the ambiguous role of the US in these efforts is also considered. Prerequisite: Any 100-level

Environmental Studies course or POL 101. Cross-listed: Political Science 333 and ES 333

***ES-334 Global Environment and Development***

Examination of the cultural, political, and economic processes driving uneven environmental change and socioeconomic development from an interdisciplinary political ecology perspective. Course focuses on sustainable development issues in the developing world, but includes discussion of the industrialized countries to a lesser extent. Topics covered include: population, poverty, and the environment; cultural adaptation to environmental change; conservation-development dilemmas; environmental justice; role of non-governmental organizations; international environmental policy. Prerequisite: Environmental Studies 196 and Sophomore Status. Alternate Years

***ES-350 Coastal Ecology of Maine***

Intensive two-week field and laboratory experience to investigate marine and terrestrial environments in Maine. Students collect and analyze data, using quantitative sampling techniques to test hypotheses on the ecology of major habitats. Field sites include rocky and soft-sediment shores, open beaches, spruce-fir forests, blueberry barrens, and peat bogs. Emphasis is on the geological phenomena that created North America's glaciated landscape. Relationships between environment and human activities in this rural area with its natural resource-based economy are explored. Prerequisite: Environmental Studies 211.

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***ES-400 Seminar***

Advanced study of an important national or global environmental issue. Interdisciplinary approach is used to analyze the problem from a variety of viewpoints in the humanities, social sciences, and natural sciences. Students are responsible for a major term paper involving independent research. Topics differ each semester. Prerequisite: Senior standing as a minor or major in environmental studies or permission of instructor.

***ES-450 Individualized Study***

Individualized tutorial counting toward the minimum requirements in a major or minor, graded A-F

***ES-451 Individualized Study-Tutorial***

Individualized tutorial counting toward the minimum requirements in a major or minor, graded S/U

***ES-452 Individualized Study-Tutorial***

Individualized tutorial not counting in the minimum requirements in a major or minor, graded A-F

***ES-453 Individualized Study-Tutorial***

Individualized tutorial not counting in the minimum requirements in a major or minor, graded S/U

***ES-460 Individualized Study-Research***

Independent investigation of an environmental topic of interest to the student. In conjunction with a faculty member, the student writes a research proposal due the tenth week of the spring semester of the junior year for a project to be conducted in the senior year. Student usually defines a research question and collects data to test a hypothesis. Such work may be done in the laboratory or field or with a computer database. A substantial paper is written and presented orally. Studio, performance, and writing projects may also be appropriate individualized study activities. Prerequisite: Senior standing as a major or minor in environmental studies and a GPA of at least 3.3, or permission of instructor.

***ES-461 Individualized Study-Research***

Individualized research counting toward the minimum requirements in a major or minor, graded S/U

***ES-462 Individualized Study-Research***

Individualized research not counting in the minimum requirements in a major or minor, graded A-F

***ES-463 Individualized Study-Research***

Individualized research not counting in the minimum requirements in a major or minor graded S/U

***ES-472 Individualized Study-Internship***

Internship not counting in the minimum requirements in a major or minor, graded A-F

***ES-473 Individualized Study-Intern***

Internship not counting in the minimum requirements in a major or minor, graded S/U

***ES-474 Summer Internship***

Summer Internship graded A-F, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office.

***ES-475 Summer Internship***

Summer Internship graded S/U, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office

***ES-477 Half Credit Internship***

Half credit internship, graded S/U.

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