Colby

ENVIRONMENTAL STUDIES

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The Environmental Studies Program at Colby recently celebrated its 41st anniversary. The program has received national recognition for developing an innovative, project-based curriculum and for challenging students to engage hands-on with environmental issues at Colby, in Maine, and around the world. From understanding the impacts of climate change to preventing biodiversity loss and unsustainable use of natural resources, environmental challenges are a national and international priority. Our students and faculty are active locally, nationally, and internationally in studying and helping to solve these challenges. The program encourages and supports student environmental initiatives and activism. Colby was one of the first colleges in the nation to use 100-percent renewable-source electricity, recently opened a biomass boiler facility that will reduce fossil fuel use for heating and hot water by roughly 90 percent, and is committed to becoming carbon neutral by 2015. The U.S. Environmental Protection Agency, the state of Maine, and other organizations have recognized Colby for its commitment to environmental academics and sustainability. Recent examples of student-led environmental initiatives include establishing an organic garden, organizing activities to reduce carbon emissions on campus, developing a climate change action plan in the local community, raising awareness about the dangers of using hazardous chemicals in personal care products and children's toys at the state and federal levels, and reducing bottled water use on campus.

A strategic partnership between Colby and the Bigelow Laboratory for Ocean Sciences has expanded educational and research opportunities in marine sciences for students. The partnership includes an expansion of the program's marine sciences curriculum, including Jan Plan courses taught by Bigelow research scientists, an increase in student research opportunities, a semester-long in-residence study at Bigelow beginning fall 2012, and curricular innovations that combine scientific research with economic and social policy analysis.

The Environmental Studies Program offers interdisciplinary majors in environmental policy, in environmental science, and in environmental studies-interdisciplinary computation as well as a minor that can be elected by majors in any discipline. Each major provides a broad-based course of study and prepares graduates to understand and to address the many complex environmental challenges facing society. Our science and policy curriculum benefits from our Maine location, including access to diverse natural areas and unique access to government, nonprofit, and business institutions. Our graduates are prepared to take leadership positions in businesses, nonprofits, consulting firms, educational institutions, and government agencies. Many of our graduates complete postgraduate work in environmental sciences/studies, ecology, urban/rural planning, natural resource conservation and management, law, environmental and public policy, and other related areas.

A student may elect only one of the majors offered by the Environmental Studies Program.

The interdisciplinary **environmental policy major** provides an extensive introduction to the study of domestic and international environmental policy. Students combine a foundation course in environmental studies with courses in environmental economics, domestic environmental policy and law, international environmental policy and politics, and courses in environmental science. Diverse electives allow students to explore topics from introductory geographic information systems (GIS) to endangered species policy to environmental and human health. Students complete the Environmental Policy Practicum capstone seminar in the senior year.

Environmental policy majors are encouraged to take Environmental Studies 118 (spring) in their first year and Environmental Studies 233 and 271 (fall) and Environmental Studies 234 (spring) in their sophomore year. Students enrolled in "The Green Cluster" who are interested in this major should enroll in Environmental Studies 118 as well as Economics 133 in the spring semester.

Students pursuing this major must complete at least one course at the 300-level or above selected from category III below. No more than one course at the 100-level may be used to fulfill category III. No requirement for the major may be taken satisfactory/unsatisfactory. AP credit can fulfill core course requirements based on exam performance and coverage. Exemption from Environmental Studies 118 is granted with an AP test score of 5, allowing advanced placement into other courses. Courses not listed below, such as those offered by some off-campus study programs, may count toward the major pending prior approval by the program director.

Requirements for the Major in Environmental Policy

I. Required Environmental Studies Core Courses

Biology	131 Biodiversity or
	164 Evolution and Diversity
Environmental Studies	118 Environment and Society
	271 Introduction to Ecology
Economics	133 Principles of Microeconomics
	231 Environmental and Natural Resource Economics

II. All of the Following Courses

Environmental Studies	233 Environmental Policy
	234 International Environmental Policy
Mathematics	212 Introduction to Statistical Methods *or*
	231 Applied Statistics and Regression Analysis

III. Humans and the Environment (Four courses, at least two from environmental studies)

Anthropology	256 Land, Food, Culture, and Power
Economics	341 Natural Resource Economics
Environmental Studies	126 Environmental Activism
	120 Losing Ground: Community Responses to Environmental Hazards
	212 Introduction to GIS and Remote Sensing (if not used to satisfy IV below) *or*
	214 Introduction to GIS and Spatial Analysis (if not used to satisfy IV below)
	265 Global Public Health
	268 Hazardous Waste and Environmental Justice
	319 Conservation Biology (if not used to satisfy IV below)
	336 Endangered Species Conservation
	340 Conflict, Negotiation, and Environmental Justice
	342 Marine Conservation and Policy
	343 Environmental Change
	344 Marine Fisheries Management
	346 Global Food Policy
	347 Tropical Forests and Rural Livelihoods
	358j Ecological Field Study (if not used to satisfy IV below)
	366 Environment and Human Health (if not used to satisfy IV below)
History	364 Environmental and Health History in Africa
	394 Ecological History
	445 Nuclear Madness
	446 Global Health History
Philosophy	328 Radical Ecologies
STS	215 Weather, Climate, and Society
	253 Energy, Power, and the American Century, 1901-2001
	358 Climbing the Oil Peak

IV. Three of the Following Courses

Biology	211 Taxonomy of Flowering Plants
	237 Woody Plants
	257j Winter Ecology
	259j Plants of the Tropics
	334 Ornithology
	354 Marine Ecology
	452 Behavioral and Physiological Ecology
Chemistry	141 General Chemistry
	142 General Chemistry
	217 Environmental Chemistry

Environmental Studies

Environmental Studies	212 Introduction to GIS and Remote Sensing *or*
	214j Introduction to GIS and Spatial Analysis
	319 Conservation Biology
	352 Advanced and Applied Ecology
	356 Aquatic Ecology
	358j Ecological Field Study
	366 Environment and Human Health
Geology	141 Earth and Environment *or*
	146 Deciphering Earth History
	397 Geologic Environments in the Marine Realm
Physics	141 Foundations of Mechanics *or*
	143 Honors Physics
	145 Foundations of Electromagnetism and Optics

V. One of the Following Capstone Courses

Environmental Studies	493 Environmental Policy Practicum *or*
	494 Problems in Environmental Science (open only to double majors in biology)

VI. Senior Colloquia

Environmental Studies	401, 402 Senior Colloquium (one credit for the year)

Environmental Studies 401 and 402 provide one credit for the senior year and typically are taken in addition to a normal four-course semester.

The interdisciplinary **environmental science major** also begins with the foundation course in environmental studies and is followed by core courses in environmental economics, biology and ecology, chemistry or physics, geology or GIS, and mathematics. Students select a focus area to explore in depth. Current focus areas include conservation biology, applied ecology, marine science, environment and human health, environmental chemistry, and environmental geology. Students can also propose well-structured alternative focus areas. The senior capstone seminar provides a hands-on approach to environmental science research. Colby's four science buildings have excellent teaching and research laboratories furnished with the necessary equipment to undertake sophisticated environmental investigations.

Environmental science majors are encouraged to enroll in Biology 163 (fall) and Environmental Studies 118 (spring) in their first year and Environmental Science 271 (fall) in their sophomore year. Students enrolled in "The Green Cluster" who are interested in this major should also enroll in Chemistry 141 in the fall; in the spring they should enroll in Chemistry 142, Environmental Studies 118, and Mathematics 121.

Majors must complete at least two courses at the 300-level or above selected from categories III and IV below. No more than one course at the 100 level may be used to fulfill category III. No requirement for the major may be taken satisfactory/unsatisfactory. AP credits can fulfill core course requirements based on exam performance and coverage. Exemption from Environmental Studies 118 is granted with an AP test score of 5, allowing advanced placement into other courses. AP credits also can provide advanced placement in focus areas, but in no case can AP credits reduce the number of required focus area courses below five. Environmental studies majors electing the science concentration should consult with the program director or the advisor for their selected focus area as early as their first year at Colby to identify any courses beyond the major requirements that may be desirable to meet their postgraduate goals, especially graduate or professional school.

Requirements for the Major in Environmental Science

I. Required Environmental Studies Core Courses

Environmental Studies	118 Environment and Society
	271 Introduction to Ecology
Economics	133 Principles of Microeconomics
	231 Environmental and Natural Resource Economics

II. Required Science and Mathematics Courses

Biology	164 Evolution and Diversity
Chemistry	141 and 142 General Chemistry *or*
	145 Honors Chemistry *or*
Physics	141 Foundations of Mechanics and 145 Foundations in Electromagnetism and Optics
Geology	141 Earth and Environment *or*
	146 Deciphering Earth History *or*
Environmental Studies	212 Introduction to GIS and Remote Sensing *or*
	214 Introduction to GIS and Spatial Analysis

For students electing the conservation biology, applied ecology, environment and human health, or marine science focus area:

Mathematics	121 Single-variable Calculus *and* either Mathematics 212 Elementary Statistics *or* 231 Applied Statistics and Regression Analysis

For students electing the environmental geology or environmental chemistry focus area:

Mathematics	121 Single-variable Calculus *and* 122 Series and Multi-variable Calculus

III. Humans and the Environment (Two courses, not taken from the same discipline unless that discipline is environmental studies)

Anthropology	256 Land, Food, Culture, and Power
Economics	341 Natural Resource Economics
Environmental Studies	126 Environmental Activism
	120 Losing Ground: Community Responses to Environmental Hazards
	212 Introduction to GIS and Remote Sensing Studies (if not used to satisfy II above) *or*
	214 Introduction to GIS and Spatial Analysis (if not used to satisfy II above)
	233 Environmental Policy
	234 International Environmental Policy
	265 Global Public Health
	268 Hazardous Waste and Environmental Justice
	319 Conservation Biology
	336 Endangered Species Conservation
	340 Conflict, Negotiation, and Environmental Justice
	342 Marine Conservation and Policy
	344 Marine Fisheries Management
	346 Global Food Policy
	347 Tropical Forests and Rural Livelihoods
	358j Ecological Field Study
	366 Environment and Human Health
History	364 Environmental and Health History in Africa
	394 Ecological History
	445 Nuclear Madness
	446 Global Health History
Philosophy	328 Radical Ecologies
STS	215 Weather, Climate, and Society
	253 Energy, Power, and the American Century, 1901-2001
	358 Climbing the Oil Peak

IV. Focus Area (Five courses from one of the following focus areas and an additional culminating experience chosen in consultation with advisor. The Environmental Studies Program will consider well-structured proposals for additional focus areas.) Advanced Placement credits can provide advanced placement in focus areas but cannot reduce the number of required focus-area courses below five.

A. Conservation Biology

Biology	163 The Cellular Basis of Life
Environmental Studies	319 Conservation Biology *or*
	336 Endangered Species Conservation
	352 Advanced and Applied Ecology

Two Courses from the Following:

Biology	211 Taxonomy of Flowering Plants
	237 Woody Plants
	254 Marine Invertebrate Zoology
	257j Winter Ecology
	259j Plants of the Tropics
	334 Ornithology
	354 Marine Ecology
	452 Behavioral and Physiological Ecology

Environmental Studies	212 Introduction to GIS and Remote Sensing *or*
	214 Introduction to GIS and Spatial Analysis (if not used to satisfy II above)
	319 Conservation Biology *or*
	336 Endangered Species Conservation
	342 Marine Conservation and Policy
	358j Ecological Field Study

Culminating Experience:

Environmental Studies	494 Problems in Environmental Science

B. Applied Ecology

Biology	163 The Cellular Basis of Life
Environmental Studies	343 Environmental Change
	352 Advanced and Applied Ecology

Two Courses from the Following:

Biology	211 Taxonomy of Flowering Plants
	237 Woody Plants
	257j Winter Ecology
	354 Marine Ecology
	452 Behavioral and Physiological Ecology
Environmental Studies	212 Introduction to GIS and Remote Sensing *or*
	214j Introduction to GIS and Spatial Analysis (if not used to satisfy II above)
	356 Aquatic Ecology
	358j Ecological Field Study

Culminating Experience:

Environmental Studies	494 Problems in Environmental Science

C. Marine Science

Biology	163 The Cellular Basis of Life
	354 Marine Ecology
Environmental Studies	352 Advanced and Applied Ecology

Two courses from the following:

Biology	254 Marine Invertebrate Zoology
	452 Behavioral and Physiological Ecology
Chemistry	217 Environmental Chemistry
Environmental Studies	342 Marine Conservation and Policy
	344 Marine Fisheries Management
	356 Aquatic Ecology
	358j Ecological Field Study

Courses offered by Bigelow Laboratory scientists may help fulfill this focus area requirement. The Bigelow Laboratory semester program will fulfill three focus area courses.

Biology	285 Reefs to Red Tides: Ocean Diversity, Function, and Management
Environmental Studies	281 Marine Microbiology: From Viruses to Whales
	287 Oceans in a Changing Climate

Culminating Experience:

Environmental Studies	494 Problems in Environmental Science

D. Environment and Human Health

Biology	163 The Cellular Basis of Life
Environmental Studies	366 Environment and Human Health

Three Courses from the Following:

Biochemistry	362 Medical Biochemistry

Biology	275 Mammalian Physiology 348 Pathogenic Bacteriology 368 Biological Basis of Metabolism
Chemistry	241, 242 Organic Chemistry 368 Chemical Basis of Metabolism
Environmental Studies	265 Global Public Health
History	364 Environmental and Health History in Africa 446 Global Health History
Mathematics	306 Topics in Epidemiology

Culminating Experience:

Environmental Studies	494 Problems in Environmental Science or 491/492 Independent Study

E. Environmental Geology

Geology	225 Mineralogy 231 Structural Geology 251 The Record of Life on Earth 254 Principles of Geomorphology

One Course from the Following:

Geology	279j Geology of Bermuda 354 Glacial and Quaternary Geology 356 Sedimentation and Stratigraphy 361 Topics in Geochemistry 372 Quaternary Paleoecology 397 Geological Environments in the Marine Realm
Environmental Studies	358j Ecological Field Study

Culminating Experience:

Geology	491/492 Independent Study

F. Environmental Chemistry

Chemistry	217 Environmental Chemistry 241, 242 Organic Chemistry 331 Chemical Methods of Analysis

One course from the following:

Biochemistry	367 Biochemistry of the Cell
Chemistry	332 Instrumental Methods of Analysis 341 Physical Chemistry 411 Inorganic Chemistry

Culminating Experience:

Chemistry	481/482 Special Topics in Environmental Chemistry

V. Senior Colloquium

Environmental Studies	401, 402 Senior Colloquium (one credit for the year)

Environmental Studies 401 and 402 provide one credit for the senior year and typically are taken in addition to a normal four-course semester.

Students are encouraged to consider field courses offered by Colby or other approved programs such as: Biology 257j, 259j, Environmental Studies 358j, Geology 279j, and the Semester in Environmental Science at the Marine Biological Laboratory, Woods Hole. Students electing the marine science focus area are strongly encouraged to consider a semester of off-campus study through programs offered by the Bigelow Laboratory for Ocean Sciences, School for Field Studies, the Duke University Marine Laboratory, the Marine Biological Laboratory, and other approved programs. An internship or research project in the discipline is strongly recommended. Students are strongly encouraged to participate in research projects, relevant field study, or internships to complement their academic work. Limited financial assistance is available to help environmental studies majors participate in research or internship opportunities.

The major in **environmental studies–interdisciplinary computation** provides an introduction to environmental studies as a discipline as well as training in computational techniques used in environmental policy and science. Students will become familiar with quantitative tools used to investigate environmental problems, especially GIS and remote sensing. No requirement for the major may be taken satisfactory/unsatisfactory. Advanced Placement credits can fulfill core course requirements based on exam

performance and coverage. Students interested in this major should try to take Computer Science 151 in their first year (fall or spring) and Computer Science 231 (fall) and 251 (spring) in their second year. Students should consult with the Environmental Studies Program director or their computer science advisor when planning their capstone independent-study project.

Requirements for the Major in Environmental Studies-Interdisciplinary Computation

I. Required Environmental Studies Core Courses

Biology	131 Biodiversity *or*
	164 Evolution and Diversity
Environmental Studies	118 Environment and Society
	233 Environmental Policy
	234 International Environmental Policy
	271 Introduction to Ecology

II. Required Environmental Studies Courses

Environmental Studies	212 Introduction to GIS and Remote Sensing *or*
	214j Introduction to GIS and Spatial Analysis
	352 Advanced and Applied Ecology
	343 Environmental Change

III. One Course Selected from the Following:

Environmental Studies	319 Conservation Biology
	336 Endangered Species Conservation
	342 Marine Conservation and Policy
	344 Marine Fisheries Management
	346 Global Food Policy
	366 The Environment and Human Health

IV. Required Computer Science Courses:

Computer Science	151 Computational Thinking
	231 Data Structures and Algorithms
	251 Data Analysis and Visualization
	341 Systems Biology I *or* 361 Object-Oriented Design
	365 Computer Vision

V. Capstone Courses

Environmental Studies	491 or 492 Independent Study

VI. Senior Colloquia

Environmental Studies	401, 402 Senior Colloquium

Environmental Studies 401 and 402 provide one credit for the senior year and typically are taken in addition to a normal four-course semester.

Honors in Environmental Studies

Environmental studies majors with a minimum cumulative grade point average of 3.5 at the end of the January term of the junior year or with special program approval are eligible to apply for the Environmental Studies Honors Research Program. Interested students should contact a faculty sponsor during the spring semester of the junior year to discuss a project. Before the end of spring registration, students should secure a faculty sponsor for their research project. Students who are studying abroad in the spring should try to make initial contact with a potential sponsor in the spring via e-mail, but may complete their proposal in the fall at the beginning of the academic year. The student must then petition the program for permission to undertake honors work. With approval from the program, students can register for Environmental Studies 491. Students wishing to change their honors project topic must petition the program for approval of the new topic. Honors research projects will be a total of six to eight credits and will be conducted during the student's last two academic semesters (and may include Jan Plan). Also, students enrolled in Environmental Studies 493 or 494 may petition the program to expand their independent study for these courses into an honors project to be conducted in January and the spring semester.

Successful completion of the honors program will include an approved thesis, an oral presentation at the Colby Undergraduate

Research Symposium, and a successful thesis defense as well as the completion of the required course work for the major. The student fulfilling these requirements will graduate “With Honors in Environmental Studies.” The decision whether or not the student will be approved to convert her or his seminar or independent study project to an honors project in the spring semester and continue in the Environmental Studies Honors Program by enrolling in Environmental Studies 484 will be made at the end of the first semester. In cases where requirements for honors have not been fulfilled at the end of the spring semester, Environmental Studies 484 (Honors Research) will revert to a graded Environmental Studies 492 (Independent Study).

The **environmental studies minor** is designed to introduce students to environmental issues and their ramifications in the context of the social and natural sciences. Course requirements provide flexibility, allowing students to study in areas of most interest to them. Courses not listed below, such as those offered by some off-campus study programs, may count toward the minor pending prior approval by the program director.

Requirements for the Minor in Environmental Studies

1. Environmental Studies 118
2. Either Economics 133 and 231, or Anthropology 112 and 256, or Environmental Studies 233 and 234
3. Either Biology 131 or 164, and Environmental Studies 271; or Geology 141 or 146, and one additional geology course; or Chemistry 141 and 142
4. Two courses, including one numbered 300 or above, selected from the following group(s):
   Group 1: At least one course selected from environmental studies core courses:

Environmental Studies	212 Introduction to GIS and Remote Sensing *or* 214 Introduction to GIS and Spatial Analysis
	233 Environmental Policy 234 International Environmental Policy 241 Environment and Social Inequality 265 Global Public Health
	268 Hazardous Waste and Environmental Justice
	319 Conservation Biology 336 Endangered Species Conservation 340 Conflict, Negotiation, and Environmental Justice 342 Marine Conservation and Policy 343 Environmental Change 344 Marine Fisheries Management 346 Global Food Policy 347 Tropical Forests and Rural Livelihoods
	352 Advanced and Applied Ecology 356 Aquatic Ecology
	358j Ecological Field Study
	366 Environment and Human Health

Group 2: If only one course is chosen from the environmental studies core group, then one additional course from:

Biology	211 Taxonomy of Flowering Plants
	237 Woody Plants
	254 Marine Invertebrate Zoology
	257j Winter Ecology
	259j Plants of the Tropics
	354 Marine Ecology
	452 Behavioral and Physiological Ecology
Chemistry	217 Environmental Chemistry
Economics	341 Natural Resource Economics
Geology	254 Principles of Geomorphology 397 Geological Environments in the Marine Realm
Philosophy	328 Radical Ecologies
STS	215 Weather, Climate, and Society 253 Energy, Power, and the American Century, 1901-2001
	358 Climbing the Oil Peak

If not used to satisfy the social science couplet:

Anthropology	256 Land, Food, Culture, and Power

Economics	231 Environmental and Resource Economics
Environmental Studies	233 Environmental Policy 234 International Environmental Policy

Minors also are encouraged to have a hands-on environmental activity either of an experiential nature (internship) or an academic nature (research project). In many, if not most cases, at least one of these activities may be required by one of the courses selected and thus satisfied automatically.

No requirement for the minor may be taken satisfactory/unsatisfactory. AP credit in a subject allows advanced placement but does not reduce the number of courses required for the minor.

Students with a major in biology, geology, or global studies considering a minor in environmental studies should consider electing a double major in biology and environmental studies, geology and environmental studies, or global studies and environmental studies because of the overlap in required courses. Interested students should discuss these possibilities with the Environmental Studies Program director.

A student cannot elect both the chemistry: environmental science concentration and the environmental studies: science concentration.

Course Offerings

ES118s Environment and Society An interdisciplinary study of the human relationship with and impact on the environment. Examination of important local, national, and global environmental issues by exploring causes and methods for investigating these problems, as well as possible solutions, from scientific and public-policy perspectives. Students explore important literature and ideas in the field to complement the lectures, conduct an original, semester-long, group research project, and complete a variety of writing assignments. *Four credit hours.* COLE, MCCLENACHAN, NYHUS

ES120f Losing Ground: Community Responses to Environmental Hazards An introduction to community-level environmental problems related to hazardous waste and the impacts on and responses of affected communities. Explores the concept of environmental justice and how the risk of hazardous exposures is related to race, ethnicity, class, and gender. We discuss U.S. policy debates on hazardous waste regulation and environmental injustice claims, and we consider the evidence for the inequitable distribution of environmental quality and adverse health impacts, the mechanisms for environmental and public health decision-making, and community access to informational resources and empowerment. *Four credit hours.* **W1, U** CARLSON

ES126f Environmental Activism An introduction to the history, theory, and practice of environmental activism, incorporating both global and local perspectives. Students explore the social phenomena that underlay human action in the environmental arena, taking an interdisciplinary approach that encompasses history, social movement and political theory, media studies, gender studies, psychology, and first-person narratives. Goals include 1) developing effective skills in critical reading, analysis, and communication; 2) developing an appreciation for the vastness and diversity of human responses to environmental challenges; and 3) providing the opportunity for students to apply their emerging leadership and organizing skills to the design of a student environmental group. Part of the three-course Integrated Studies 126, "The Green Cluster." *Prerequisite:* Concurrent enrollment in Biology 131 (lab section B) and English 126. (Elect IS126.) *Four credit hours.* **S** CARLSON

ES131f Biodiversity Listed as Biology 131. *Four credit hours.* **N,Lb** BEVIER

ES197Aj Sustainable and Socially Responsible Business Provides students with a broad overview of sustainable and socially-responsible business principles and the ways in which companies have incorporated them into their organizations. Through a series of readings, lectures, guest speakers, and real-world case studies, students will be exposed to the issues and opportunities facing "green businesses". Includes small group and individual presentations. *Three credit hours.* PENNEY

ES197Cj Landscapes and Meaning: An Exploration of Environmental Writing An exploration of the works of selected 20th-century environmental writers and how their life experiences contribute to a sense of connection with and action on behalf of the Earth. Through readings, film, writing assignments, group discussion, and journaling, students will develop critical thinking and communication skills while reflecting on their own personal relationship with nature. *Three credit hours.* **L** MACKENZIE

ES212s Introduction to GIS and Remote Sensing A comprehensive theoretical and practical introduction to the fundamental principles of geographic information systems and remote sensing digital image processing. Topics include data sources and models, map scales and projections, spatial analysis, elementary satellite image interpretation and manipulation, and global positioning systems. Current issues and applications of GIS, with emphasis on environmental topics. Students develop and carry out independent projects using GIS. *Prerequisite:* Sophomore standing. Not open to students who have completed Environmental Studies 214. *Four credit hours.* NYHUS

ES214f Introduction to GIS and Spatial Analysis An introduction to geographic information systems' (GIS) data management and visualization capabilities as well as the theory and application of spatial analysis techniques. Topics covered

include spatial data representation in a GIS, effective map making, coordinate systems and projections, exploratory spatial data analysis (ESDA), and spatial statistical analysis. *Prerequisite:* Not open to students who have completed Environmental Studies 212. *Four credit hours.* GIMOND

ES214Jj Introduction to GIS and Spatial Analysis An introduction to geographic information systems' (GIS) data management and visualization capabilities as well as the theory and application of spatial analysis techniques. Topics covered include spatial data representation in a GIS, effective map making, coordinate systems and projections, exploratory spatial data analysis (ESDA), and spatial statistical analysis. *Prerequisite:* Not open to students who have completed Environmental Studies 212. *Three credit hours.* GIMOND

[ES215] Weather, Climate, and Society Listed as Science, Technology, and Society 215. *Four credit hours.* **N**

ES217s Environmental Chemistry Listed as Chemistry 217. *Three credit hours.* KING

ES231s Environmental and Natural Resource Economics Listed as Economics 231. *Three credit hours.* DISSANAYAKE

ES233f Environmental Policy A comprehensive and interdisciplinary introduction to the process and challenges of developing, implementing, and evaluating environmental policy. The roles of costs and benefits, uncertainty and risks, science and technology, and attitudes and ethics are explored. Historic and contemporary case studies are used to examine major institutions and actors, laws and regulations, incentives and enforcement approaches, and their role in addressing our nation's most pressing environmental problems. Students complete a semester-long research assignment. *Prerequisite:* Environmental Studies 118. *Four credit hours.* REYNOLDS

ES234s International Environmental Policy Examines how communities, nations, and international organizations govern the use of natural resources including water, land, forests, fisheries, and the global climate. Through case studies and international environmental treaty analyses we will develop an understanding of global environmental issues, explore complementarities and tradeoffs among local, national, and global approaches to environmental governance, highlight the environmental justice implications of various resource management regimes, and assess the effectiveness of policies to address major environmental problems. *Prerequisite:* Environmental Studies 118. *Four credit hours.* **I** REYNOLDS

[ES259] Plants of the Tropics Listed as Biology 259. *Three credit hours.*

ES265j Global Public Health An introduction to the principles and measures of global health, disease burdens, and environmental determinants of health, including poverty, climate change, pollution, population, violence, and lack of safe food, clean water, and fuels. We will also study international health institutions, key actors, and environmental regimes for the regulation of environmental health hazards. Through small-group presentations and discussion we will explore global case studies that highlight the complex relationship between human health and the environment. *Prerequisite:* Environmental Studies 118 or one course in the natural sciences. *Three credit hours.* **I** CARLSON

[ES268] Hazardous Waste and Environmental Justice An interdisciplinary exploration of environmental justice as it relates to hazardous waste in the United States. Covers the production, disposal, tracking, and regulation of waste, and how race, class, ethnicity, and gender affect the risk of exposure. Methods used to measure inequities and responses by governments and civil society to environmental justice claims are discussed. Case studies emphasize the experiences of minority groups. Students will develop an understanding of the key factors that put groups at disproportionate risk of environmental burdens and the proximal and ultimate causes of these inequities. *Prerequisite:* Environmental Studies 118. *Four credit hours.* **U**

ES271f Introduction to Ecology An introduction to ecological concepts and theory applied to ecosystems, communities, populations, and individuals. Concepts related to ecosystem structure and function, patterns of plant and animal diversity, population dynamics, and adaptations of organisms to their physical environment are studied and applied to current environmental problems. Ecological sampling techniques are practiced during field trips taken to local terrestrial, freshwater, and marine ecosystems. Identification of common plant and animal species, and investigation of ecological relationships are emphasized. A research assignment helps enhance writing skills. *Prerequisite:* Biology 131 or 164. Not open to students who have completed Biology 263. *Four credit hours.* **N,Lb** COLE

ES279j Geology of Bermuda Listed as Geology 279. *Three credit hours.* RUEGER

[ES281] Marine Microbiology: From Viruses to Whales Introduction to marine microbiology. The diversity of marine microbes, including single-celled algae, protozoa, archaea, viruses, with special focus on bacteria. The relationship of oceans with microbial communities, which are the basis of the marine food web. How tools of science, including genomics, are used to study this invisible world and its evolution. Effects of climate change on marine microbes and effects of microbes on oceans and human health. Biotechnological potential of marine microbes. The essentiality of microbes to planetary health. *Prerequisite:* Biology 131 or 163 or Environmental Studies 271. *Three credit hours.* **N**

ES285j Reefs to Red Tides: Ocean Diversity, Function, and Management Listed as Biology 285. *Three credit hours.* **N** HEIL

ES287j Oceans in a Changing Climate Oceans provide important ecosystem services that humans depend upon, and they play critical roles in Earth's climate. They are changing in response to human activity and natural cycles. We examine causes and consequences of these changes and how the ocean will mediate them. Topics include cycling of chemical elements necessary for life, rising sea level, melting icecaps, changing ocean pH, changing circulation, the impact on ecosystems and fisheries, and possible climate change mitigation strategies. How humans might respond on global scales and in a timely manner through policy, politics, and social and cultural means. Includes lectures, student-led presentations, and discussions. *Prerequisite:* Biology 131 or 163 or Environmental Studies 271. *Three credit hours.* **N** SIERACKI

[ES319] Conservation Biology Concepts of conservation biology are examined in detail. Topics include patterns of diversity and rarity, sensitive habitats, extinction, captive propagation, preserve design, and reclamation of degraded or destroyed ecosystems. Interdisciplinary solutions to the challenges of protecting, maintaining, and restoring biological diversity are discussed. Offered in alternate years. *Prerequisite:* Environmental Studies 118 or 271, and sophomore or higher standing. *Four credit hours.*

[ES328] Radical Ecologies Listed as Philosophy 328. *Four credit hours.*

ES331f Natural Resource Economics Listed as Economics 341. *Prerequisite:* Economics 223. *Four credit hours.* DISSANAYAKE

ES336f Endangered Species Conservation An interdisciplinary course that uses biological, social, and policy approaches to understand the causes of and solutions to species extinction. Students are introduced to influential literature and ideas in endangered species conservation, policy, and management, including strategies for and constraints to implementing effective conservation. Case studies, assignments, and a research paper allow students to explore the role of interdisciplinary research and analyses and to ask questions, think critically, and communicate effectively about these issues. *Prerequisite:* Environmental Studies 118 or 271, and sophomore or higher standing. *Four credit hours.* NYHUS

[ES340] Conflict, Negotiation, and Environmental Justice Examines the opportunities and challenges of using alternative dispute resolution processes to manage environmental justice conflicts. Through the use of negotiation simulations, case studies, films, and independent research projects, we will discuss the important social functions of conflicts, identify and explore the unique dimensions of environmental justice conflicts, examine how these unique dimensions impact collaborative problem-solving processes, and develop our own abilities to assess conflicts and effectively negotiate. *Prerequisite:* Environmental Studies 118 or Sociology 131. *Four credit hours.* **U**

[ES342] Marine Conservation and Policy Human activities and effects including overfishing, water pollution, climate change, and benthic habitat destruction have all had major impacts on ocean ecosystems. Through lectures and discussions we will investigate global, regional, and local threats to marine biodiversity and ecosystem function. Potential conservation solutions will be considered. Independent and group research projects will investigate the science and policy of marine conservation issues and will evaluate and synthesize information from scientific literature, popular media, and online discussions. *Prerequisite:* Environmental Studies 118 and sophomore or higher standing. *Four credit hours.*

ES343f Environmental Change Investigation of the relationship between past environmental history and current ecosystem condition. Landscape change and ecological restoration across a range of Maine ecosystems including forests, wetlands, rivers, marine environments, with an emphasis on ecological theory. The impacts of past and present human activities including forestry, fishing, and industrial and residential development. Students will read scientific literature, practice ecological field and laboratory methods, enhance data analysis and writing skills, and complete a research project designed to evaluate environmental change and recovery potential in a local landscape, riverscape, or seascape. Lecture and laboratory. *Prerequisite:* Environmental Studies 271 and sophomore or higher standing. *Four credit hours.* MCCLENACHAN

ES344s Marine Fisheries Management Managing marine fisheries represents one of the most significant challenges in the conservation of global resources. We explore political, cultural, and ecological factors essential for successful management. Through lectures, discussions, and readings, students become familiar with global fisheries issues, including high seas management, initiatives to protect the food security and biodiversity of tropical island nations, and management of marine and anadromous fish in the United States. Through a field-based, group research project, students will investigate challenges involved with managing marine fish populations in Maine. *Prerequisite:* Environmental Studies 118 or Biology 164, and sophomore or higher standing. *Four credit hours.* MCCLENACHAN

ES346s Global Food Policy Examines the emergence and development of global food systems and food policies starting with the earliest agricultural societies and continuing to the present day. We explore the economic, nutritional, and environmental justice implications of agricultural systems and critically analyze the intended and actual outcomes of food policies for nations and agricultural communities. Case studies, films, and independent research further highlight the role of food and food policy in degrading the environment, exacerbating ethnic tensions and social inequities, and even spurring conflict. *Prerequisite:* Environmental Studies 118 and sophomore or higher standing. *Four credit hours.* **I** REYNOLDS

ES347s Tropical Forests and Rural Livelihoods Examines the environmental, economic, and cultural roles of tropical forests in rural communities. Lectures and readings underscore the environmental justice implications of global, national, and

local forest management regimes, emphasizing benefits and costs of deforestation, afforestation, reforestation, restoration, and conservation in tropical regions. Through case studies and independent research we critically analyze current tropical forest issues, contrasting traditional, private-sector, state-based, and international approaches to contemporary forest management problems. *Prerequisite:* Environmental Studies 118 and sophomore or higher standing. *Four credit hours.* **I** REYNOLDS

ES352s Advanced and Applied Ecology An examination of theoretical and applied aspects of ecology at the organism, population, and community levels. Study of environmental tolerance and adaptation of plant and animal species; population dynamics; population competition, trophic relationships, and coevolutionary interactions; community structure and organization; succession; and biogeography. Emphasis on the relevance of theory and concepts to solving environmental problems. Laboratory exercises explore principles of experimental design and ecological sampling techniques. A research assignment helps to enhance writing and presentation skills. Lecture and laboratory. *Prerequisite:* Environmental Studies 271 and sophomore or higher standing. *Four credit hours.* COLE

ES354f Marine Ecology Listed as Biology 354. *Three or four credit hours.* WILSON

ES356s Aquatic Ecology Concern over the impact of human activities on aquatic communities and ecosystems has brought aquatic ecology to the forefront of public attention. Through lecture, discussion, writing assignments, and laboratory work, students will explore the major ecological principles that influence aquatic ecosystems. Experimental approaches and sampling techniques used by limnologists will be employed in local lakes, streams, and rivers, as well as in the laboratory to investigate topics of concern in freshwater ecosystems, including eutrophication, pollution, biomagnification and bioaccumulation, invasive species, and the impact of climate change. *Prerequisite:* Environmental Studies 271, and sophomore or higher standing. *Four credit hours.* BRUESEWITZ

[ES357] Physiological Ecology Listed as Biology 357. *Three credit hours.*

ES358j Ecological Field Study The biological diversity, ecology, and conservation of marine ecosystems in Moorea, French Polynesia. Involves qualitative and quantitative field studies of the biological diversity and ecology of coral reef ecosystems; field-based investigation of the environmental challenges facing these ecosystems; discussions with conservation practitioners about innovative conservation solutions and the efficacy of local marine protected areas; exposure to the culture and history of Polynesian Islanders, including pre-European ecosystem management practices and traditional ecological knowledge of marine biodiversity and ecosystem function. Lectures, films, and discussions of assigned readings during the first week followed by a 20-day field trip. Cost: $3,475. Financial aid available for qualified students. *Prerequisite:* Biology 131 or 164 or Environmental Studies 118, and permission of the instructor. *Three credit hours.* MCCLENACHAN

ES366s The Environment and Human Health How human health is affected by physical, chemical, biological, and social environments; how we use science to measure effects of these determinants at the level of cell, tissue, individual, and population; how we assess these determinants to make regulatory decisions. Topics include introductions to toxicology, epidemiology, and risk assessment; health effects of pollution, synthetic chemicals, consumer products, climate change, and the built environment; the etiology of health outcomes including cancer, obesity, endocrine disruption, and respiratory diseases. Students use primary scientific literature for independent research and, when appropriate, engage in environmental health policy debates in Congress and/or the Maine legislature. *Prerequisite:* Environmental Studies 118 or Biology 131 or 164, and sophomore or higher standing. *Four credit hours.* **N** CARLSON

ES397f Geologic Environments in the Marine Realm Listed as Geology 397. *Three credit hours.* RUEGER

ES398s Conservation Paleobiology Listed as Geology 398. *Four credit hours.* **N,Lb** KOSLOSKI

ES401f, 402s Environmental Studies Colloquium Attendance at selected program colloquia during the fall and spring semesters; written evaluations to be submitted. Required of all senior environmental studies majors. Typically taken in addition to a normal four-course semester. *One credit hour for the year.* *Prerequisite:* Senior standing in environmental studies. COLE

ES484s Honors in Environmental Studies Majors approved for admission into the Environmental Studies Honors Program may elect this for the January Program or the spring semester. Requires research conducted under the guidance of a faculty member and focused on an approved topic leading to the writing of a thesis. A maximum of eight credits (including Environmental Studies 491 in the fall semester) may be earned in honors work. Upon successful completion of the thesis, an oral presentation, and all requirements for the major, the student will graduate "With Honors in Environmental Studies." *Prerequisite:* Senior standing and a 3.50 grade point average in the major at the end of the junior year or permission of the program. *One to four credit hours.* FACULTY

ES491f, 492s Independent Study Independent study devoted to a topic chosen by the student with the approval of the program committee. *Prerequisite:* Senior standing as environmental studies major or minor. *One to four credit hours.* FACULTY

ES493f Environmental Policy Practicum An in-depth analysis of current issues and policies affecting the environment. Students work individually and collaboratively on a project with a common theme and are assigned unique roles as researchers, editors, and technical coordinators. Reading and discussion of primary literature is augmented with invited speakers, field trips,

and student presentations. Section A has an international emphasis while section B focuses on domestic issues. *Prerequisite:* Senior standing as an environmental studies policy major. *Four credit hours.* NYHUS, REYNOLDS

ES494f Problems in Environmental Science Causes of and solutions to selected environmental problems are investigated through lectures, laboratory and fieldwork, discussions, and guest presentations. Focuses on completion of a group research project with methods used by private consulting firms and governmental agencies to investigate aquatic environmental problems such as eutrophication or the spread of invasive species. Research results are presented in a public forum at the end of the semester. Civic engagement component provides useful information to the community and the state, and gives students experience interacting with interested stakeholders. Skill development includes research, communication (both oral and written), and collaborative work skills. *Prerequisite:* Environmental Studies 271 and senior standing as a biology or environmental science major. *Five credit hours.* BRUESEWITZ