ENVIRONMENTAL STUDIES

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Affiliated Faculty: Professors Paul Josephson (History), Whitney King (Chemistry), James Webb (History), and W. Herbert Wilson (Biology); Associate Professor Catherine Bevier (Biology); Assistant Professors Nathan Chan (Economics), Sahan Dissanayake (Economics), and Keith Peterson (Philosophy); Visiting Assistant Professor Bruce Rueger (Geology)

The Environmental Studies Program at Colby was founded in 1971. 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 achieve carbon neutrality and uses 100-percent renewable-source electricity. Colby also seeks LEED certification of all new construction and major renovations, and uses sustainably harvested wood biomass instead of oil as its primary fuel for heat and hot water, reducing fossil fuel use by approximately 90 percent. 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, and curricular innovations that combine scientific research with economic and social policy analysis.

The Environmental Studies Program offers interdisciplinary majors in environmental policy, environmental science, and environmental studies-interdisciplinary computation as well as a minor that can be elected by majors in any discipline. The curriculum emphasizes inquiry-based learning and original research opportunities. Our majors are flexible and enable students to pursue their individual academic goals and interests. Each major provides a broad-based course of study and prepares graduates to understand and to address the many complex environmental challenges facing society. The interdisciplinary nature of our curriculum is enhanced by close ties to many departments and programs in the natural sciences, social sciences, and humanities. 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, marine science, 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. A student cannot elect both the chemistry: environmental science concentration and the environmental science major with an environmental chemistry focus.

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.

Requirements for the Major in Environmental Policy

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 such as introductory geographic information systems (GIS), conservation biology, global food policy, and environmental and human health. Students complete the Environmental Policy Practicum capstone seminar (domestic or international emphasis) in the senior year.

Environmental policy majors are encouraged to take Environmental Studies 118 (spring) in their first year at Colby. Students enrolled in “The Green Cluster” (fall) who are interested in this major should enroll in Economics 133 as well as Environmental Studies 118 in the spring semester of their first year.

Students pursuing this major should elect Environmental Studies 233 and 271 (if possible) in the fall and 234 in the spring of their sophomore year. Students 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 4 or 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.

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

Statistics
- 212 Introduction to Statistical Methods

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

Anthropology
- 256 Land, Food, Culture, and Power

Economics
- 341 Natural Resource Economics
- 472 Seminar: Third Wave of Environmental Management
- 476 Seminar: Economics of Ecosystem Services and Biodiversity

Environmental Studies
- 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)
- 242 Marine Conservation and Policy
- 244 Marine Communities (if not used to satisfy IV below)
- 265 Global Public Health
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems (if not used to satisfy IV below)
- 297A Marine Wildlife Conservation and Management
- 297B Resource Conservation, Equity, and Environmental Regulations
- 297C Climate Change Policy
- 298 Our Earth: Governing the Commons
- 319 Conservation Biology (if not used to satisfy IV below)
- 343 Environmental Change
- 344 Marine Fisheries Management
- 346 Global Food Policy
- 347 Tropical Forests and Rural Livelihoods
- 358 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

Philosophy
- 216 Philosophy of Nature
- 243 Environmental Ethics
- 328 Radical Ecologies
STS

- 215 Weather, Climate, and Society

IV. Three of the Following Courses (at least one from environmental studies)

Biology

- 237 Woody Plants
- 259 Plants of the Tropics
- 334 Ornithology
- 354 Marine Ecology

Chemistry

- 131 General Chemistry Principles or
- 141/142 General Chemistry
- 217 Environmental Chemistry

Environmental Studies

- 212 Introduction to GIS and Remote Sensing or
- 214 Introduction to GIS and Spatial Analysis
- 244 Marine Communities
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 319 Conservation Biology
- 343 Environmental Change
- 352 Advanced and Applied Ecology
- 356 Aquatic Ecology
- 358 Ecological Field Study
- 366 Environment and Human Health

Geology

- 141 Earth and Environment or
- 142 Deep Time Planet Earth
- 378 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

- 493A Environmental Policy Practicum (international emphasis) or
- 494B Environmental Policy Practicum (domestic emphasis)

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.

Requirements for the Major in Environmental Science

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 seminars provide a hands-on approach to environmental science research in freshwater or marine ecosystems. Colby’s four science buildings have excellent teaching and research laboratories furnished with the necessary equipment and instrumentation 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 of their first year; in the spring they should enroll in Chemistry 142, Environmental Studies 118, and
Mathematics 121. Students interested in the environmental science major with a marine science focus should consider the Bigelow Laboratory Changing Oceans semester program in their junior year.

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 4 or 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 four or five depending on the focus area. Environmental science majors should consult with the program director 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.

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. Required Science and Mathematics Courses

**Chemistry**
- 131 General Chemistry Principles or
- 141/142 General Chemistry

or

**Physics**
- 141 Foundations of Mechanics and 145 Foundations in Electromagnetism and Optics

**Geology**
- 141 Earth and Environment or
- 142 Deep Time Planet Earth or
- 378 Geologic Environments in the Marine Realm

or

**Environmental Studies**
- 212 Introduction to GIS and Remote Sensing or
- 214 Introduction to GIS and Spatial Analysis

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

**Mathematics and Statistics**
- 121 Single-variable Calculus and Statistics 212 Elementary Statistics

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
- 472 Seminar: Third Wave of Environmental Management
- 476 Seminar: Economics of Ecosystem Services and Biodiversity
Environmental Studies

- 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
- 242 Marine Conservation and Policy
- 244 Marine Communities
- 265 Global Public Health
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 297A Marine Wildlife Conservation and Management
- 297B Resource Conservation, Equity, and Environmental Regulations
- 297C Climate Change Policy
- 298 Our Earth: Governing the Commons
- 319 Conservation Biology
- 343 Environmental Change
- 344 Marine Fisheries Management
- 346 Global Food Policy
- 347 Tropical Forests and Rural Livelihoods
- 358 Ecological Field Study
- 366 Environment and Human Health

History

- 364 Environmental and Health History in Africa
- 394 Ecological History

Philosophy

- 216 Philosophy of Nature
- 243 Environmental Ethics
- 328 Radical Ecologies

STS

- 215 Weather, Climate, and Society

IV. Focus Area (Four or five courses, depending on the focus area chosen, 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 four or five depending on the focus area.

A. Conservation Biology (Four courses)

Environmental Studies

- 319 Conservation Biology
- 352 Advanced and Applied Ecology

Two Courses from the Following:

Biology

- 237 Woody Plants
- 259 Plants of the Tropics
- 334 Ornithology
- 354 Marine 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)
- 242 Marine Conservation and Policy
- 244 Marine Communities
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 358 Ecological Field Study

Culminating Experience:

Environmental Studies

- 494 Problems in Environmental Science
B. Applied Ecology (Four Courses)

*Environmental Studies*
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 352 Advanced and Applied Ecology
- 356 Aquatic Ecology

One Course from the Following:

*Biology*
- 237 Woody Plants
- 354 Marine Ecology
- 382 Ecological Modeling

*Environmental Studies*
- 212 Introduction to GIS and Remote Sensing or
- 214 Introduction to GIS and Spatial Analysis (if not used to satisfy II above)
- 343 Environmental Change
- 358 Ecological Field Study

Culminating Experience:

*Environmental Studies*
- 494 Problems in Environmental Science

C. Marine Science (Four Courses)

*Environmental Studies*
- 242 Marine Conservation and Policy
- 244 Marine Communities
- 352 Advanced and Applied Ecology

One course from the following:

*Biology*
- 254 Marine Invertebrate Zoology
- 354 Marine Ecology

*Chemistry*
- 217 Environmental Chemistry

*Environmental Studies*
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 344 Marine Fisheries Management
- 356 Aquatic Ecology
- 358 Ecological Field Study

Courses offered during Jan Plan by research scientists from Bigelow Laboratory may help fulfill this focus area requirement. The Bigelow Laboratory *Changing Oceans* semester program will fulfill three focus area courses.

Culminating Experience:

*Environmental Studies*
- 494 Problems in Environmental Science

D. Environment and Human Health (Four Courses)

*Environmental Studies*
- 366 Environment and Human Health

Three Courses from the Following:

*Biochemistry*
- 362 Medical Biochemistry
- 368 Biochemistry of the Cell II

*Biology*
• 275 Mammalian Physiology
• 348 Pathogenic Bacteriology

Chemistry
• 241, 242 Organic Chemistry

Environmental Studies
• 265 Global Public Health

History
• 364 Environmental and Health History in Africa

Mathematics
• 306 Topics in Epidemiology

Culminating Experience:

Environmental Studies
• 494 Problems in Environmental Science

E. Environmental Geology (Five Courses)

Geology
• 225 Mineralogy
• 231 Structural Geology
• 254 Principles in Geomorphology

Two Courses from the Following:

Geology
• 251 The Record of Life on Earth
• 256 Sedimentation and Stratigraphy
• 279 Geology of Bermuda
• 354 Glacial and Quaternary Geology

Environmental Studies
• 358 Ecological Field Study

Culminating Experience:

Environmental Studies
• 494 Problems in Environmental Science

F. Environmental Chemistry (Five Courses)

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:

Environmental Studies
• 494 Problems in Environmental Science or

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 259, Environmental Studies 358, Geology 279, the Bigelow Laboratory Changing Oceans Semester, the Semester in Environmental Science at the Marine Biological Laboratory, and School for Field Studies. An internship or research project in the discipline is strongly recommended. Students are strongly encouraged to participate in research projects, relevant field studies, or internships to complement their academic work. Limited financial assistance is available to help environmental studies majors participate in research or internship opportunities.

Requirements for the Major in Environmental Studies-Interdisciplinary Computation

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.

I. 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
• 214 Introduction to GIS and Spatial Analysis
• 343 Environmental Change
• 352 Advanced and Applied Ecology

III. One Course Selected from the Following:

Environmental Studies

• 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
• 319 Conservation Biology
• 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 1 or 361 Object-Oriented Design
• 365 Computer Vision

V. Capstone Courses
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.

Requirements for 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 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 Liberal Arts Symposium, a successful thesis defense, and 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 (or in Jan Plan and 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).

Requirements for the Minor in Environmental Studies

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.

1. Environmental Studies 118.
2. AP credit in a subject allows advanced placement but does not reduce the number of courses required for the minor.
3. Either Economics 133 and 231, or Anthropology 112 and 256, or Environmental Studies 233 and 234
4. Either Biology 131 or 164, and Environmental Studies 271; or Geology 141 or 142, and one additional geology course; or Chemistry 141 and 142
5. Two courses, including one numbered 300 or above, selected from the following group(s):

Group 1: At least one course selected from the 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
- 242 Marine Conservation and Policy
- 244 Marine Communities
- 265 Global Public Health
- 276 Exploring the Anthropocene: Human Impacts on Global Ecosystems
- 297A Marine Wildlife Conservation and Management
- 297B Resource Conservation, Equity, and Environmental Regulations
- 297C Climate Change Policy
- 298 Our Earth: Governing the Commons
- 319 Conservation Biology
- 343 Environmental Change
- 344 Marine Fisheries Management
- 346 Global Food 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 satisfied automatically. No requirement for the minor may be taken satisfactory/unsatisfactory.

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.

Course Offerings

**ES118s Environment and Society** An interdisciplinary study of human relationships with and impacts on the environment. Examination of important local, national, and global environmental issues by exploring causes and methods for investigating these pressing 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 several writing assignments. **Four credit hours.** MCDOWELL, NYHUS, REYNOLDS

**ES120f 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.  CARLSON

ES120f  From Darwin to Dillard: Nature Writing through Time  Focusing on broad themes such as observing and exploring, encountering animals, working the land, and dwelling in place, we thoughtfully and critically engage a century of excellent nature writing by authors worldwide.  Students learn about and practice nature writing using the personal journal, the essay, word pictures and figurative language, story telling, poetry, and activism.  Through reading, writing, art, music, video, and time outdoors, students encounter nature using all their senses, and gain an appreciation of the content and process of nature writing.  Four credit hours.  W1.  MACKENZIE

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 to apply 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 Philosophy 126.  (Elect IS126.)  Four credit hours.  S.  CARLSON

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

ES141j  Green Building Design: Making the Case for Change  Presents the theory and practice of green building design through lectures, discussions, presentations, guest speakers, and field trips.  Studies the processes used to quantify the environmental impacts of building construction and introduces effective mitigation strategies.  Concepts include integrated design techniques, site and landscape considerations, passive design techniques, water efficiency, materials and resource mitigation, occupant health and engagement programs, energy efficiency and reduction, construction best practices, commissioning, and knowledge management.  Students will also undertake group projects using Colby as a case study.  Three credit hours.  BRIGHT

ES143j  Sustainable and Socially Responsible Business  Provides a broad overview of sustainable and socially-responsible business principles and the ways in which companies incorporate them.  Also introduces sustainable and socially-responsible investment strategies and reviews their potential impact and effectiveness.  Through a series of readings, lectures, guest speakers, and real-world case studies, students are exposed to the issues and opportunities facing "green businesses".  Includes small group and individual presentations.  Previously offered as Environmental Studies 197A (2013).  Three credit hours.  PENNEY

ES151j  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.  Previously offered as Environmental Studies 197C (2010, 2013).  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:  Concurrent enrollment in Biology 131 (lab section B) and Philosophy 126.  (Elect IS126.)  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:  Sophomore or higher standing.  Not open to students who have completed Environmental Studies 212 or 214J.  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:  Sophomore or higher standing.  Not open to students who have completed Environmental Studies 212 or 214.  Three credit hours.  GIMOND
ES215  Weather, Climate, and Society  Listed as Science, Technology, and Society 215.  Four credit hours.  N.

ES216s  Philosophy of Nature  Listed as Philosophy 216.  Four credit hours.  PETERSON

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

ES218s  Exploratory Data Analysis in R  Exploratory data analysis employs methods such as robust data summaries and data visualization to isolate important patterns and features in the data to shed light on the phenomena being investigated. Students will learn the building blocks of effective graphic design for data exploration and for publication using the R programming environment. They will also learn how to manipulate and restructure complex data sets (including spatial data) for data analysis. Students will use R and RStudio to generate dynamic reports that will integrate both analysis and presentation with a strong emphasis on reproducible research. Prerequisite: Sophomore standing.  Four credit hours.  GIMOND

ES218s  Nature and the Built Environment  Listed as American Studies 228.  Four credit hours.  H.  LISLE

ES219s  Environmental and Natural Resource Economics  Listed as Economics 231.  Three credit hours.  CHAN

ES220s  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

ES221s  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.  REYNOLDS

ES222s  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. Previously listed as Environmental Studies 342. Prerequisite: Environmental Studies 118.  Four credit hours.  NEAL

ES223s  Microbes in the Environment  Listed as Biology 240.  Three credit hours.  N.  CHILDERS

ES224s  Environmental Ethics  Listed as Philosophy 243.  Four credit hours.

ES225j  Plants of the Tropics  Listed as Biology 259.  Three credit hours.  JOHNSON

ES226j  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 a course in the natural sciences.  Three credit hours.  CARLSON
ES271f  Introduction to Ecology  An examination of ecological concepts applied to individuals, populations, and communities of plants and animals in terrestrial, freshwater, and marine environments. Concepts and theories related to adaptations of organisms to their physical environment, patterns of plant and animal diversity, population dynamics and interactions, and the structure and diversity of ecological communities are explored 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: Environmental Studies 118, and Biology 131 or 164. Not open to students who have completed Biology 263.  Four credit hours.  N, Lb.  MCDOWELL

[ES276]  Exploring the Anthropocene: Human Impacts on Global Ecosystems  Human activities are changing the environment in ways so numerous and extensive that some scientists have proposed we are in a new geological epoch, the "Anthropocene," defined by human impacts on the landscape and ecosystem function. Through lectures, discussions, group projects, and laboratory exercises students will examine key elements of global ecosystem function, investigate how human activities have altered global ecosystems since the Industrial Revolution, and critically assess scientific evidence for anthropogenic changes. Global climate change will be investigated and placed in a broader context of anthropogenic change. We will also examine the concepts of tipping points to navigate future life in the Anthropocene.  Prerequisite: Environmental Studies 118 and one college-level science course.  Four credit hours.  N, Lb.

[ES277]  Vertebrate Natural History  Listed as Biology 277.  Four credit hours.

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

[ES287]  Impact of Climate Change on Ocean Life  The concentration of carbon dioxide (CO2) in the atmosphere recently passed 400 parts per million, the highest level seen in three million years. Increased CO2 is causing the oceans to warm and become more acidic. We will explore the connections, past and present, between the oceans and climate and will examine how current changes impact marine life. Emphasis is on microbial ecosystems that form the base of marine food webs and have a major impact on ocean health. Students will explore the primary scientific literature and work on written and oral presentation skills. Can be repeated once for additional credit.  Prerequisite: One semester of mathematics or science; a biology course is highly recommended.  Three credit hours.  N.

ES297Aj  Biological Oceanography: Microbial Denizens of the Living Ocean  Listed as Biology 297A.  Three credit hours.  N. MARTINEZ

ES297Bj  Extreme Climate Change in the Gulf of Maine  Listed as Biology 297B.  Three credit hours.  COUNTWAY, RECORD

ES319f  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.  NYHUS

ES328f  Radical Ecologies  Listed as Philosophy 328.  Four credit hours.  PETERSON

[ES331]  Natural Resource Economics  Listed as Economics 341.  Prerequisite: Economics 223.  Four credit hours.

[ES343]  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, and 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.

ES344f  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 271, 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  

**ES347** 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.

**ES352s** Advanced and Applied Ecology  
An examination of theoretical and applied aspects of ecology at the organism, population, and community levels. Through lectures, discussions, and reading of primary literature, students will acquire a conceptual and theoretical understanding of environmental tolerance and adaptation of plant and animal species; population dynamics; competition, trophic relationships, and coevolutionary interactions; community structure and organization; succession; and biogeography. The relevance of theory and concepts to solving environmental problems will be explored. 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.**  
MCDOWELL

**ES354** Marine Ecology  
Listed as Biology 354.  
**Three or four credit hours.**

**ES356f** 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 the physical, chemical, and biological organization of 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, land use change, invasive species, and the impact of climate change. **Prerequisite:** Environmental Studies 271, a W1 course, and sophomore or higher standing.  
**Four credit hours.**  
W2. BRUESEWITZ

**ES358** Ecological Field Study in Moorea  
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: TBD. Financial aid available for qualified students. **Prerequisite:** Biology 131 or 164 or Environmental Studies 118, and permission of the instructor.  
**Three credit hours.**

**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 126, and sophomore or higher standing.  
**Four credit hours.**  
N. CARLSON

**ES378s** Geologic Environments in the Marine Realm  
Listed as Geology 378.  
**Three credit hours.**  
N. RUEGER

**ES401f, ES402s** Environmental Studies Colloquium  
Attendance at selected program colloquia during the fall and spring semesters; written reflections 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.  
**Noncredit.** NYHUS

**ES476** Seminar: Economics of Ecosystem Services and Biodiversity  
Listed as Economics 476.  
**Four credit hours.**

**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: Junior or senior standing as an 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. Prerequisite: Environmental Studies 233 (for domestic emphasis) or 234 (for international emphasis), and 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 field work, discussions, and guest presentations. Focuses on completion of a group research project with methods used by private consulting firms and governmental agencies to investigate freshwater (section A) or marine (section B) environmental problems. Research results are presented in a public forum at the end of the semester. The 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 an environmental science major. Five credit hours. BRUESEWITZ, MCCLENACHAN