ENVIRONMENTAL STUDIES PROGRAM

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The Environmental Studies Program offers interdisciplinary majors in environmental policy, environmental science, and environmental computation as well as a minor that can be elected by majors in any discipline.

The Environmental Studies Program at Colby was founded in 1971 and has received national recognition for developing an innovative, research-based curriculum and for challenging students to engage hands-on with environmental issues at Colby, in Maine, and around the world. Our students and faculty are active locally, nationally, and internationally in studying and helping to solve diverse environmental challenges. The program encourages and supports student environmental initiatives and activism. Resources are available to support student internships and research projects, and a majority of students study abroad at some point. We are committed to incorporating learning about environmental justice and environmental racism in our curriculum, and listening, responding to, and amplifying perspectives from vulnerable and marginalized communities. We greatly value diversity among our students, and we are committed to strengthening diversity in environmental studies.

Colby was one of the first colleges in the nation to achieve carbon neutrality and uses 100-percent renewable source electricity. The College 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, and installed 5,300 solar panels to supply 16 percent of the College's electricity. Colby seeks LEED silver certification of all new construction and major renovations. The U.S. Environmental Protection Agency, the Association for the Advancement of Sustainability in Higher Education, the state of Maine, and others have recognized Colby for its commitment to environmental academics and sustainability. Examples of student-led environmental initiatives include establishing an organic garden and beekeeping club, 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 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 a semester of study in residence at Bigelow, on-campus courses taught by Bigelow research scientists, student research opportunities, and curricular innovations that combine scientific research with economic and social policy analysis.

The Environmental Studies Program curriculum emphasizes inquiry-based learning and original research. Each major is flexible and enables students to pursue their individual academic goals and interests. Each major provides a broad-based course of study that combines interdisciplinary breadth and focus-area depth to prepare graduates to understand and to address 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, humanities, and other interdisciplinary programs. Our science and policy curricula benefit 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 and professional study in environmental sciences/studies/management, ecology, limnology, international development, law, marine science and oceanography, medicine, natural resource conservation and management, planning, public health, 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.

Requirements for the Major in Environmental Policy

The interdisciplinary environmental policy major provides an extensive introduction to the study of U.S. and international environmental policy. Students combine a foundation course in environmental studies with core courses in environmental economics, U.S. environmental policy and law, international environmental policy and politics, statistics, and ecology. Diverse electives allow students to explore topics such as introductory geographic information systems (GIS), conservation biology, climate change adaptation, energy, environmental justice, marine and freshwater conservation, forest ecology, public health, and the environmental humanities.
Environmental policy majors are encouraged to take Environmental Studies 118 (spring) and Biology 163 (fall) and 164 (spring) in their first year at Colby. 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 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. Up to two courses may be counted toward the major from approved off-campus study programs.

Environmental policy majors are encouraged to work with their advisor to develop a curricular pathway that includes both depth and breadth of study. Recommended thematic groupings selected from electives in category III and category IV below include: conservation and resources, energy and climate, environmental humanities, environmental justice, food and agriculture, public health, and water resources (marine and freshwater). See the Environmental Studies Program website for details on suggested courses for these groupings. Students are welcome to develop additional thematic pathways (e.g., green building, urban and regional planning).

I. Required Environmental Studies Core Courses

Biology
- 163 Cellular Basis of Life
- 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

East Asian Studies
- 242 Development and Environmental Issues in Contemporary China

English
- 120 Inventing Nature in New England
- 337 Climate Fiction

Environmental Studies
- 151 Landscape and Meaning: An Exploration of Environmental Writing
- 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)
- 239 Seafood Forensics
- 242 Marine Conservation and Policy
- 265 Global Public Health
- 276 Global Change Ecology (if not used to satisfy IV below)
- 283 Environmental Humanities: Stories of Crisis & Resilience
- 297 Sustainable Business Seminar
- 2xx Renewable Energy Systems
- 319 Conservation Biology (if not used to satisfy IV below)
- 341 Community, Economics, and Conservation
- 344 Marine Fisheries Management
• 346 Global Food Policy
• 397 Environmental Justice
• 3xx Sustainability Science: From Theory to Practice

History
• 248 Nuclear Visions, Environmental Realities
• 348 U.S. Environmental History

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

Religious Studies
• 298 American Spirituality and the Environment

Science, Technology, and Society
• 215 Weather, Climate, and Society

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

Biology
• 198 Biochemistry of Food
• 211 Taxonomy of Flowering Plants
• 225 Immunology
• 237 Woody Plants
• 246 Parasitology
• 259 Plants of the Tropics
• 275 Human Physiology
• 277 Vertebrate Natural History
• 334 Ornithology
• 354 Marine Ecology
• 382 Ecological Modeling

Chemistry
• 121 and 122 Earth System Chemistry I and II or
• 141 and 142 General Chemistry I and II or
• 147 Comprehensive General Chemistry (cannot be counted with Chemistry 141 and 142)
• 217 Environmental Chemistry
• 331 Chemical Methods of Analysis

Economics
• 278 Joules to Dollars

Environmental Studies
• 212 Introduction to GIS and Remote Sensing or
• 214 Introduction to GIS and Spatial Analysis
• 218 Exploratory Data Analysis in R
• 244 Marine Communities
• 276 Global Change Ecology
• 2xx Renewable Energy Systems
• 319 Conservation Biology
• 338 Forest Ecosystems
• 356 Aquatic Ecology
• 358 Ecological Field Study
• 366 Environment and Human Health
• 371 Current Topics in Environmental Science
• 398 Conservation Paleobiology
• 3xx Sustainability Science: From Theory to Practice

Geology
• 141 Earth and Environment or
- 262 Earth's Climate: Past, Present, and Future
- 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**
- 493 Environmental Policy Practicum or
- 494 Problems in Environmental Science (with permission of director)

**VI. Senior Colloquia**

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

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

Students are strongly encouraged to participate in relevant on- and off-campus opportunities, including research projects, public policy and/or humanities experiences, field studies, civic engagement, or internships in the discipline to complement their academic work. Environmental studies majors may apply for Environmental Studies Program financial assistance to participate in relevant research or internship opportunities.

**Requirements for the Major in Environmental Science**

The interdisciplinary environmental science major includes foundation courses and 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 aquatic sciences (freshwater and marine), conservation biology, ecosystem ecology, energy and climate, and public health. Students may also petition the Environmental Studies Program director to propose well-structured alternative focus areas. The senior capstone seminars provide a hands-on approach to environmental science research in freshwater or marine ecosystems.

Environmental science majors are encouraged to enroll in Biology 163 (fall) and 164 (spring) and Environmental Studies 118 (spring) in their first year, and Environmental Science 271 (fall) in their sophomore year. 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 may also provide advanced placement in biology, chemistry, physics, calculus, and microeconomics. Environmental science majors should consult with their advisor 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**
- 163 Cellular Basis of Life
- 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**
- 121 and 122 Earth System Chemistry I and II or
- 141 and 142 General Chemistry I and II or
- 147 Comprehensive General Chemistry

OR
Physics

- 141 Foundations of Mechanics or 143 Honors Physics and
- 145 Foundations in Electromagnetism and Optics

Geology

- 121 and 122 Earth System Chemistry I and II or
- 141 Earth and Environment

Note: The two-semester Chemistry/Geology 121 and 122 sequence can replace the requirement to take two chemistry and one geology/GIS course.

OR

Environmental Studies

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

Mathematics and Statistics

- Mathematics 121 Single-Variable Calculus and
- Statistics 212 Elementary Statistics

Students electing the energy and climate focus area are encouraged to also take Mathematics 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, at least one course from Environmental Studies)

Anthropology

- 256 Land, Food, Culture, and Power

East Asian Studies

- 242 Development and Environmental Issues in Contemporary China

English

- 337 Climate Fiction

Environmental Studies

- 151 Landscape and Meaning
- 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
- 239 Seafood Forensics
- 242 Marine Conservation and Policy
- 265 Global Public Health
- 276 Global Change Ecology
- 283 Environmental Humanities: Stories of Crisis & Resilience
- 297: Sustainable Business Seminar
- 2xx Renewable Energy Systems
- 319 Conservation Biology
- 341 Community, Economics, and Conservation
- 344 Marine Fisheries Management
- 346 Global Food Policy
- 358 Ecological Field Study
- 364 Climate Change, Justice, and Health
- 366 Environment and Human Health
- 397B Community, Economics, and Conservation
- 397 Environmental Justice
- 3xx Sustainability Science: From Theory to Practice

History

- 248 Nuclear Visions, Environmental Realities
- 348 U.S. Environmental History

Philosophy
IV. Focus Area (four 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.

A. Aquatic Sciences (Freshwater and Marine) (four courses)

Environmental Studies
- 244 Marine Communities
- 356 Aquatic Ecology

Two Courses from the following:

Biology
- 354 Marine Ecology

Chemistry
- 217 Environmental Chemistry
- 331 Chemical Methods of Analysis

Environmental Studies
- 212 Introduction to GIS and Remote Sensing or 214 Introduction to GIS and Spatial Analysis or 218 Exploratory Data Analysis in R
- 239 Seafood Forensics (if not used to satisfy II above)
- 276 Global Change Ecology
- 344 Marine Fisheries Management
- 358 Ecological Field Study

The Bigelow Laboratory Changing Oceans semester program will fulfill three courses in the Aquatic Sciences focus area.

B. Climate and Energy (four courses)

Environmental Studies
- 276 Global Change Ecology
- 2xx Renewable Energy Systems
- 3xx Sustainability Science: From Theory to Practice

Chemistry
- 217 Environmental Chemistry

OR

Economics
- 278 Joules to Dollars

Two Courses from the following:

Biology
- 382 Ecological Modeling

Chemistry
- 241 Organic Chemistry I
- 242 Organic Chemistry II
- 217 Environmental Chemistry (if not used above)
- 278 Joules to Dollars (if not used above)
- 331 Chemical Methods of Analysis
- 341 Physical Chemistry: Thermodynamics and Kinetics
• 342 Physical Chemistry: Quantum and Statistical Mechanics

Environmental Studies
• 218 Exploratory Data Analysis in R
• 364 Climate Change, Justice and Health

Geology
• 252 Earth’s Climate: Past, Present, and Future
• 363 Paleoceanography

Physics
• 312 Physics of Fluids

The Bigelow Laboratory Changing Oceans semester program will fulfill up to two courses in the Climate and Energy focus area.

C. Conservation Biology (four courses)

Environmental Studies
• 319 Conservation Biology
• 338 Forest Ecosystems

Two Courses from the following:

Biology
• 211 Taxonomy of Flowering Plants
• 237 Woody Plants
• 259 Plants of the Tropics
• 277 Vertebrate Natural History
• 334 Ornithology
• 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)
• 218 Exploratory Data Analysis in R
• 242 Marine Conservation and Policy
• 244 Marine Communities
• 356 Aquatic Ecology
• 358 Ecological Field Study
• 398 Conservation Paleobiology

D. Ecosystem Ecology (four courses)

Environmental Studies
• 276 Global Change Ecology
• 338 Forest Ecosystems

Two Courses from the following:

Biology
• 382 Ecological Modeling

Chemistry
• 217 Environmental Chemistry
• 331 Chemical Methods of Analysis

Economics
• 278 Joules to Dollars

Environmental Studies
• 218 Exploratory Data Analysis in R
• 244 Marine Communities
• 356 Aquatic Ecology
Geology
• 262 Earth’s Climate: Past, Present, and Future
• 363 Paleoceanography

E. Public Health (four courses)

Environmental Studies
• 265 Global Public Health
• 366 Environment and Human Health

Two Courses from the following:

Biochemistry
• 362 Medical Biochemistry or
• 367 Biochemistry of the Cell I

Biology
• 225 Immunology
• 246 Parasitology
• 275 Mammalian Physiology
• 278 Biomedical Genomics and Bioinformatics
• 348 Pathogenic Bacteriology

Chemistry
• 241 Organic Chemistry I

Environmental Studies
• 212 Introduction to GIS and Remote Sensing or 214 Introduction to GIS and Spatial Analysis (if not used to satisfy II above) or 218 Exploratory Data Analysis in R
• 364 Climate Change, Justice and Health

Statistics
• 306 Topics in Epidemiology

V. One of the following Capstone Courses

Environmental Studies
• 494 Problems in Environmental Science or
• 493 Environmental Policy Practicum (with permission of director)

For students selecting the Aquatic Science Focus Area, the capstone requirement can be filled using one course from the Bigelow Laboratory Changing Oceans semester and evidence of a writing project with a Bigelow faculty research advisor submitted to the ES program director. This course cannot also count toward the focus area.

Guidelines for Counting Bigelow Courses toward major requirements

Environmental Science majors with a focus area in aquatic sciences or energy and climate who successfully complete the Bigelow semester program may apply three courses from the Bigelow semester toward the major as follows:

• Three of the four courses towards the focus area OR
• Two courses toward the focus area and one as a replacement for ES494. If this option is selected, students must submit a scientific paper on their independent research project with the guidance of their Bigelow research advisor to their Environmental Studies Program academic advisor and the Environmental Studies Program director for approval at least one week prior to registration for fall classes in the prior spring semester.

1. 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.

Students are encouraged to consider field courses offered by Colby or other approved programs. Students are strongly encouraged to participate in research projects, relevant field studies, or internships in the discipline to complement their academic work. Environmental studies majors may apply for Environmental Studies Program financial assistance to participate in relevant research or internship opportunities.
Requirements for the Major in Environmental Studies Computation

The interdisciplinary major in environmental computation provides an introduction to environmental studies as a discipline as well as training in computational techniques used in environmental policy and science. Students become familiar with quantitative tools used to investigate environmental problems. The major is designed to provide students with proficiency in computational thinking, the analysis and understanding of environmental systems, challenges, and solutions, and in the design and implementation of algorithms for modeling and analysis. Students gain experience applying computational thinking and statistical methods to a diverse spectrum of topics in environmental studies and are introduced to the complexity and inter-relatedness of coupled human and natural systems and diverse computational environments. Diverse electives allow students to explore environmental topics in depth, including agriculture and food, conservation science, energy and climate, environmental humanities, marine and freshwater conservation, and public health.

Students interested in this major are encouraged to take Environmental Studies 118 (spring) in their first year, Computer Science 151 or 152 or 153, and 231 (fall or spring), and 251 or 252 (spring) in their first year, and one or more Environmental Studies electives in their second year. No requirement for the major may be taken satisfactory/unsatisfactory. Advanced Placement 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. Courses not listed below, such as those offered by some off-campus study programs, may count toward the major pending approval of the program director. Up to two courses may be counted toward the major from approved off-campus study programs. Courses counted in one section cannot also be counted in another section (e.g., a 200-level Environmental Studies courses used as a Foundational Course cannot also be counted as an Application Course).

Students should consult with the Environmental Studies Program director or their Computer Science advisor when planning their course of study, including capstone experience.

I. Required Foundational Courses (four courses)

Computer Science
- 151 Computational Thinking: Visual Media or
- 152 Computational Thinking: Science (recommended) or
- 153 Computational Thinking: Smart Systems and
- 231 Data Structures and Algorithms

Environmental Studies
- 118 Environment and Society and
- One 200-level course (e.g., 233, 234, 242, 244, 265, 271, 276, 283)

II. Required Modeling and Analysis Courses (four courses)

Computer Science
- 251 Data Analysis and Visualization or 252 Mathematical Data Analysis and Visualization and one from the following:
- 341 Systems Biology or
- 343 Neural Networks or
- 346 Modeling and Simulation or
- 365 Computer Vision
- or other course approved by advisor

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

Mathematics and Statistics
- Statistics 212 Introduction to Statistical Methods or
- Mathematics 122 Multivariable Calculus

III. Application Courses (five courses)

Five courses selected from the following:

Computer Science
At least one and up to two courses at the 300 level or above

Environmental Studies
At least three and up to four courses not also counted elsewhere to provide depth in an application area. Recommended application groupings include: conservation and resources (e.g., 319, 338, 344), ecosystem ecology (e.g., 276, 366), energy and climate (e.g., 217, 276, 3XX), environmental justice (e.g., 364, 3XX), public health (e.g., 265, 364, 366), and water resources (marine and freshwater) (e.g., 242, 244, 356). Courses from the Bigelow Semester can count toward this requirement; up to two courses from study abroad can be counted toward this requirement with prior approval from the director of the Environmental Studies Program. At least one course must be at
the 300 level.

Mathematics and Statistics

One course selected from the following

- Statistics
  - 321 Statistical Modeling
- Mathematics
  - 253 Linear Algebra
  - 262 Vector Calculus
  - 311 Ordinary Differential Equations
  - 332 Numerical Analysis

IV. Culminating Experience

Environmental Studies

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

One capstone selected from the following determined in consultation with the student’s advisor:

- Computer Science 4xx or
- Environmental Studies 493 Environmental Policy Practicum or
- Environmental Studies 494 Problems in Environmental Science

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 strongly encouraged to participate in relevant on- and off-campus opportunities, including research projects, civic engagement, internships, field studies, and other opportunities to complement their academic work. Environmental Studies majors may apply for Environmental Studies Program financial assistant to participate in relevant research or internship opportunities.

Environmental Studies 401 and 402 provide one credit for the senior year and typically are taken in addition to a normal four-course semester. Environmental studies majors may apply for Environmental Studies Program financial assistance to participate in relevant research or internship opportunities.

Requirements for Honors in Environmental Studies

Environmental studies majors with a minimum cumulative grade point average of 3.7 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. Students who are studying abroad in the spring should try to make initial contact with a potential sponsor in the spring via email, but may complete their proposal in the fall at the beginning of the academic year. If the faculty sponsor and the program director approve a proposed project, students will register for ES483 (Honors Project) in the fall semester and Jan Plan. During the fall, students must write a thesis proposal, have it approved by the environmental studies faculty, and make progress on their research. Students approved by the environmental studies program will continue their research during the spring semester in Environmental Studies 484 (Honors Project). A maximum of eight credits for honors research is allowed for the entire year. Additional details are provided on the Environmental Studies Program web page.

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. Students fulfilling these requirements will graduate with “Honors in Environmental Studies.” In cases where requirements for honors have not been fulfilled at the end of the spring semester, Environmental Studies 483 and 484 (Honors Research) will revert to a graded Environmental Studies 491/291/492 (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. AP credit in a subject allows advanced placement, but it does not reduce the number of courses required for the minor. Students who receive an AP 4 or 5 for environmental science do not have to take Environmental Studies 118 but must take an additional course from Group 1 below. 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 include

- 118 Environment and Society

and
1. Either Economics 133 and 231; or Anthropology 112 and one of 256 or 253 or Global Studies 255; or Environmental Studies 233 and 234; or Environmental Studies 265 and either 364 or 366; or Philosophy 243 and either 216 or 328;
2. Either Biology 163 or 164; or one of Geology 122, 123, 125, or 141 and one additional 200-level geology course; or Chemistry 141 and 142, or 147 and one additional chemistry course; or Chemistry 121 and 122; or two courses from Bigelow Ocean Science Semester
3. Two additional 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**
- 151 Landscape and Meaning
- 212 Introduction to GIS and Remote Sensing or 214 Introduction to GIS and Spatial Analysis
- 218 Exploratory Data Analysis in R
- 233 Environmental Policy
- 234 International Environmental Policy
- 239 Seafood Forensics
- 242 Marine Conservation and Policy
- 244 Marine Communities
- 265 Global Public Health
- 276 Global Change Ecology
- 283 Env Humanities: Stories of Crisis & Resilience
- 297: Sustainable Business Seminar
- 2xx Renewable Energy Systems
- 319 Conservation Biology
- 337: Climate Fiction
- 338 Forest Ecosystems
- 341 Community, Economics, and Conservation
- 343 Environmental Change
- 344 Marine Fisheries Management
- 346 Global Food Policy
- 356 Aquatic Ecology
- 358 Ecological Field Study
- 364 Climate Change, Justice and Health
- 366 Environment and Human Health
- 371 Current Topics in Environmental Science
- 368 Global Climate Policy
- 3xx Scientific Communication
- 397 Environmental Justice
- 398 Conservation Paleobiology
- 3xx Sustainability Science: From Theory to Practice

**Group 2: If only one course is chosen from the environmental studies core group (Group 1), then one additional course from:**

**American Studies**
- 228 Nature and the Built Environment

**Anthropology**
- 256 Land, Food, Culture, and Power

**Art**
- 218 Architectural Design Workshop

**Biology**
- 237 Woody Plants
- 259 Plants of the Tropics
- 277 Vertebrate Natural History
- 354 Marine Ecology
- 382 Ecological Modeling

**Chemistry**
- 217 Environmental Chemistry
- 331 Chemical Methods of Analysis
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.

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. BRUESEWITZ, SULLIVAN, WALKER

[ES122] Environmental Impacts of Pandemics on Human and Natural Systems Investigates the environmental impacts of pandemics, on scales ranging from the personal to global, and will place students' personal experiences with the recent coronavirus crisis into a larger perspective. This recent crisis has affected the entire planet, precipitating changes in mobility, resource use, and government, with lasting impacts on human and natural environments for decades to come. Changes in fossil fuel use, personal consumption of manufactured goods, the structure of government, and social integration across groups and nations could change the way we live across the planet, with significant lasting impacts on the environment. This course will investigate the scope of those changes. Three credit hours.

[ES126] Environmental Activism An introduction to the history, theory, and practice of environmental activism, incorporating both global and local perspectives. We focus on individual activists, grassroots groups, indigenous people, and large environmental organizations, analyze their motivations, strategies, and experiences, and determine how their actions have sparked effective social, political, and environmental change. We explore the social phenomena that underlay environmental activism, taking an interdisciplinary approach that encompasses history, environmental justice, social movement theory, political theory, public policy, and communications. We make significant use of primary source narratives by activists and communities on the front-lines of environmental struggles. We will place particular emphasis on climate and energy activism. Energy/Exhaustion humanities theme course. Prerequisite: First-year standing. Four credit hours. S.

[ES143] 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. Three credit hours.

[ES151] 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.  

[ES211] Taxonomy of Flowering Plants  Listed as Biology 211.  

[ES212] 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 or higher standing.  

Not open to students who have completed Environmental Studies 214 or 214J.  

Four credit hours.  

GIMOND

[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


Four credit hours.  

N.

[ES216] Philosophy of Nature  Listed as Philosophy 216.  

Four credit hours.  


Three credit hours.  

[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


Three credit hours.  

[ES224j Creative Environmental Storytelling  Explores the roles of awe, mindfulness, and active imagination in environmental writing. Students will be encouraged to access their “inner hermit” and explore how, as biological beings, we can create effective storytelling to envision a future where all life thrives. Students will explore the writings of others and practice writing their own stories. Introduces the idea of the evolutionary body and how it can relate to effective engagement for positive environmental change. Previously offered as Environmental Studies 297C (Jan Plan 2019).  

Three credit hours.  

WILLIAMS


Four credit hours.  

H.

[ES231s Environmental and Natural Resource Economics  Listed as Economics 231.  

Four credit hours.  

MEREDITH

[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 or 126.  

Four credit hours.  

SULLIVAN

[ES234] 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 or 126.  
**Four credit hours.**  

**ES237**  
**Advocating for the Environment**  
Listed as Jan Plan 237.  
**Three credit hours.**  

**ES238s**  
**Renewable Energy Systems**  
Introduces students to major themes of renewable energy systems. Students will analyze alternative energy solutions for a sustainable future. Emphasis will be on the different forms of renewable energy, within the context of the existing energy mix, energy policy, resource potential, and institutional opportunities and barriers. We will explore renewable energy potential and solutions through textbook and supplemental readings, current event briefings, group work and activities. 

**Prerequisite:** Environmental Studies 118.  
**Four credit hours.**  

**ES239f**  
**Seafood Forensics: Uncovering Fraud in Ocean Food Systems**  
Seafood is a critical component of the global food system. However, the sustainability of ocean resources hinges on the veracity with which seafood is labeled, and mislabeling is on the rise. We will explore the varied impacts of fraud in ocean food systems. Students will learn how mislabeling affects the management and conservation of marine resources, supply chain economics, and risks to human health. Students will study how new molecular tools are being used to combat fraud, and explore the broader policy implications of forensic science. Students will grow their scientific literacy and enhance their writing and presentation skills. Previously offered as Environmental Sciences 298 (Spring 2019). 

**Prerequisite:** Biology 163.  
**Four credit hours.**  

**ES240**  
**Microbes in the Environment**  
Listed as Biology 240.  
**Three credit hours.**  

**ES241s**  
**Development and Environmental Issues in Contemporary China**  
Listed as East Asian Studies 242.  
**Four credit hours.**  

**ES242f**  
**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 or 126.  
**Four credit hours.**  

**ES243f**  
**Environmental Ethics**  
Listed as Philosophy 243.  
**Four credit hours.**  

**ES244s**  
**Marine Communities**  
Introduces students to key ecological interactions in marine communities around the world, including kelp forests, coral reefs, sea grasses, and the open ocean. A key learning goal is improved scientific literacy through in-depth reading and synthesis of scientific papers and the development of a research proposal. 

**Prerequisite:** Biology 271 or Environmental Studies 271.  
**Four credit hours.**  

**ES245f**  
**Land, Sovereignty, and Art**  
Listed as American Studies 245.  
**Noncredit.**  

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

**ES261s**  
**Chemistry of Aqueous Environments**  
Listed as Chemistry 261.  
**Four credit hours.**  

**ES263f**  
**Atmospheric Chemistry**  
Listed as Chemistry 263.  
**Four credit hours.**  

**ES265**  
**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, 126 or a course in the natural sciences.  
**Four credit hours.**  

**ES271f**  
**Introduction to Ecology**  
Listed as Biology 271.  
**Four credit hours.**  

**ES276s**  
**Global Change Ecology**  
Provides an interdisciplinary introduction to the principles of climate, ecosystems, and biogeochemistry needed to understand human impacts on the natural environment. Students will study the impacts of climate warming, our changing...
atmosphere, land-use change, altered hydrologic and nutrient cycles, and other global changes. We will examine key elements of global ecosystem function and investigate how human activities have altered global ecosystems since the Industrial Revolution. We will critically assess scientific evidence for anthropogenic changes, and consider both impacts and solutions to the challenges of global changes. Relies heavily on reading of primary scientific literature and group participation and discussion. Prerequisite: Environmental Studies 118 or 126, and one college-level science course. Four credit hours. NEAL

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

[ES279] Geology of Bermuda Listed as Geology 279. Three credit hours.

[ES282] Extreme Climate Change in the Gulf of Maine Listed as Biology 282. Three credit hours.

ES283f Environmental Humanities: Stories of Crisis and Resilience Listed as English 283. Four credit hours. L. WALKER

ES297] Conserving the Western Maine Mountains Conserving the Western Maine Mountains (WMM) is a multi-disciplinary seminar that will engage students in solving real-life problems confronting a region of global ecological significance that is struggling to reach its economic potential. The class will examine the biological, economic, social, and cultural dimensions of conserving the WMMs landscape and way of life. Each student will conduct a research project that analyzes a challenge facing the region and proposes a policy or economic solution. Examples might include: recognition of the regions Indigenous People and culture, benefits and costs of motorized recreation, forest carbon credits in land conservation, and the future of the ski industry in a changing climate. Prerequisite: Environmental Science 118. Three credit hours. GAUVIN

ES297B Climate Geoengineering: Evaluating Strategies to Sequester CO2 Human emissions of CO2 are changing Earth's climate. Increased attention is focusing on ways to actively remove and sequester atmospheric CO2. Such approaches carry ethical and technical risks, as well as costs and benefits that must be carefully evaluated if we are to make informed decisions about their potential use. We will review geoengineering approaches to atmosphere CO2 removal, including technical and biogeochemical bases and potential financial costs. We will consider the risks of action and inaction, as well as governance structures that could regulate geoengineering activities. Discussion and presentation of primary literature will be the focus of the course, culminating in a final paper advocating for a specific course of climate action. Prerequisite: Chemistry 121, 141 or 147 and a 100-level biology, environmental studies, or geology course. Three credit hours. EMERSON, TWining

ES297C Fate and Effects of Organic Pollutants in the Ocean Listed as Chemistry 297. Three credit hours. AEPPLI

ES319s 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, 126 or 271 or Biology 263, and sophomore or higher standing. Four credit hours. SULLIVAN

ES323s Sustainability Science: From Theory to Practice Focuses on interdisciplinary aspects of the field of sustainability science, drawing on multiple disciplines to address current societal challenges. The course provides a foundation in historical and modern thinkers in the field; an introduction to sectors that are commonly pursued by sustainability professionals (food systems, water, energy, urban environment, transportation, waste systems). The course will provide students with skills and tools to create positive change in society. We will develop skills through several hands-on projects that build on one another throughout the semester, using real world examples in various sectors as the basis for our learning. Prerequisite: Environmental Studies 118. Four credit hours. S. BATES

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

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

[ES332] Chemical Methods of Analysis Listed as Chemistry 331. Four credit hours.

ES333s Environmental Revolutions in American Literature and Culture Listed as English 333. Four credit hours. L. SIBARA

ES337s Climate Fiction Listed as English 337. Four credit hours. L. WALKER

ES338s Forest Ecosystems Forest ecosystems regulate climate, store and filter water, provide food and fiber, and serve as recreational...
areas and sacred spaces. These ecosystems are undergoing dramatic changes with important ecological, economic, and social consequences. We will examine these changes through the lenses of terrestrial ecosystem ecology, forest ecology, and ecosystem management. Using primary scientific literature as our guide, we will examine the status of forests around the world and how forest composition drives forest ecosystem processes. We will discuss how forest management and restoration can be used to increase the resilience of forest ecosystems and harness their productivity to mitigate carbon emissions and climate change. **Prerequisite:** Biology 271 or Environmental Studies 271.  **Four credit hours.**  

[ES341] Community, Economics, and Conservation  An interdisciplinary examination of sustainability through the intersection of communities, economics, and conservation. Students will gain critical thinking and leadership skills by examining strategies, policy frameworks, and decision support tools for evaluating trade-offs between economic interests and the environment. Case studies will focus on providing tools in land conservation, finance, recreational planning, GIS, and ecosystem services, with an eye towards application in a student project. **Prerequisite:** Environmental Studies 118, 126, or Economics 231.  **Four credit hours.**  

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. **Prerequisite:** Biology 263 or Environmental Studies 118, 126, or 271, and sophomore or higher standing.  **Four credit hours.**  

[ES346] 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 or 126 and sophomore or higher standing.  **Four credit hours.**  

ES348s U.S. Environmental History  Listed as History 348.  **Four credit hours.**  

[ES354] Marine Ecology  Listed as Biology 354.  **Four credit hours.**  

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 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, PEARSON  

[ES358] Ecological Field Study: Belize  Ecology, and conservation of the meso-American barrier reef. Involves qualitative and quantitative field studies of the biological diversity and ecology of local ecosystems; field-based investigation of the environmental challenges facing these ecosystems; discussions with conservation practitioners about innovative conservation solutions and the efficacy of conservation activities; and exposure to regional culture and history. Lectures, pool-based field technique training, and student research prior to departure followed by an off-campus field trip. Cost: $3100. Financial aid available for qualified students. **Prerequisite:** Biology 164 or Environmental Studies 118 or 126, and permission of the instructor.  **Three credit hours.**  

[ES362] Energy and Utopia  Listed as English 362.  **Four credit hours.**  

ES363f Paleocanography  Listed as Geology GE363.  **Four credit hours.**  

KOFFMAN  

ES364s Climate Change, Justice, and Health  Examines the impacts of changing climate dynamics on human livelihoods, rights, health, and well-being. Through interdisciplinary readings, class discussions, research projects, and innovative communications, students will engage deeply with data from the natural and social sciences about human impacts, adaptations, and vulnerabilities, as well as explore climate justice activism. Key learning goals include improved information literacy and written and oral communication skills and increased understanding of the ways climate change is impacting the world in which we live. **Prerequisite:** Environmental Studies 118 or 126.  **Four credit hours.**  

CARLSON  

[ES366] 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.

**ES368s** Global Climate Policy  Climate change is a global problem. How and whether a world of sovereign states can cooperate to reduce climate change risks to manageable levels are critical questions, but there is no political or expert consensus around the best way forward. This course will study global climate politics and policy, particularly within the context of the United Nations Framework Convention on Climate Change. Students will work individually and in groups to critically assess the complexities and effectiveness of international governance responses relating to climate mitigation, adaptation, finance provision, technology transfer and capacity-building. Prerequisite: Environmental Studies 118 or 126. Four credit hours. S. ROBINSON

**[ES371]** Current Topics in Environmental Science: Corals  Explores emerging and cutting-edge topics in the field of environmental science, with a focus on the global crisis in coral reef systems. Students will focus on contemporary scientific literature reviewing emerging topics from leading journals in environmental science and ecology journals, as well as engaging a variety of experimental designs, laboratory methods, and statistical approaches to investigate and understand environmental processes and human impacts in these ecosystems. An independent research assignment will enhance writing skills. Prerequisite: Biology 271 or Environmental Studies 271. Four credit hours.

**ES371Jj** Current Topics in Environmental Science: Corals  Explores emerging and cutting-edge topics in the field of environmental science, with a focus on the global crisis in coral reef systems. Students will focus on contemporary scientific literature reviewing emerging topics from leading journals in environmental science and ecology journals, as well as engaging a variety of experimental designs, laboratory methods, and statistical approaches to investigate and understand environmental processes and human impacts in these ecosystems. An independent research assignment will enhance writing skills. Prerequisite: Biology 271 or Environmental Studies 271. Three credit hours. NEAL

**[ES373]** Life in Times of Extinction  Listed as English 373. Four credit hours. L.

**[ES378]** Geologic Environments in the Marine Realm  Listed as Geology 378. Three credit hours. N.

**[ES382]** Ecological Modeling  Listed as Biology 382. Four credit hours.

**ES397f** Environmental Justice  An examination of the historical and contemporary roots of the unequal distribution of environmental benefits and harms, focusing on the broad social and political processes that perpetuate inequity. Throughout this course, we explore how issues like race, gender, and wealth influence the allocation of the world's natural resources and how those inequities have resulted in the rampant environmental destruction and health disparities we see today. This course is designed to help students foster a nuanced understanding of environmental conditions and, through the analysis and development of case studies, encourage creative and impactful storytelling about the causes and consequences of environmental injustice. Prerequisite: Environmental Studies 118 or equivalent. Four credit hours. SULLIVAN

**ES398As** Conservation Paleobiology  Managing for a changing climate challenges conservation in the Anthropocene and requires practitioners and ecologists to think beyond static historic baselines. Conservation paleobiology seeks to fill the gap between the short-term nature of most ecological studies and the long-term goals of conservation to bring long temporal perspectives to conservation practitioners. Students will explore primary literature from paleobiology, conservation, and their intersection. After reading broadly in foundational to modern literature, we will focus on the place-based local case study of alpine plant communities in the northeastern United States and the conservation challenges of managing small, disjunct populations with assumed high vulnerability, but unknown paleo-histories. Prerequisite: Biology 271 or Environmental Studies 271. Four credit hours. MCDONOUGH MACKENZIE

**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. BRUESEWITZ

**ES483J** Honors in Environmental Studies  Noncredit. BATES

**ES484s** Honors in Environmental Studies  Intended for majors approved for admission into the Environmental Studies Honors Program. 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 may be earned in honors work. Upon successful completion of the thesis, an oral presentation, defense
and all requirements for the major, the student will graduate with "Honors in Environmental Studies." **Prerequisite:** Senior standing and a 3.70 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.** BATES, ROBINSON

**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:** Biology/Environmental Studies 271, and senior standing as an environmental science major. **Five credit hours.** BRUESEWITZ, NEAL