ENVIRONMENTAL SCIENCE

404 Altschul Hall
212-854-5618
Department Assistant: Catherine Cook

The Department of Environmental Science
Mission
Barnard College’s Environmental Science Department provides highly motivated young women with challenging and rewarding programs in Environmental Science, Environmental Biology, and Environmental Policy. High academic standards, multidisciplinary courses, and training in methodologies such as field work, measurements, and data analysis, ready our students with the tools needed to think critically, evaluate and solve problems, and understand and communicate science to address the needs of society. Faculty members are nationally and internationally recognized scholars and educators, active in research and curriculum development. Courses are innovative, featuring multimedia and technologically advanced resources. The urban setting, the proximity to the Hudson River, and the numerous affiliations we maintain with Columbia University through Lamont#Doherty Earth Observatory, the Earth Institute, and the School of Public Health, as well as Black Rock Forest, the American Museum of Natural History and other institutions, allow us to offer undergraduates unparalleled opportunities for student research and educational experiences. Upon successful completion of our program, our students are well prepared to continue their academic studies as graduate students or to pursue successful careers in a wide range of fields.

Student Learning Outcomes
We expect that students graduating with an environmental major will learn to:

• recognize the history, structure, function, interactions, and trends of key environmental systems: climate, earth, life, socio/political;
• assemble a logical chain of reasoning ranging from observation to inference and action, not only to identify and characterize a problem, but also to find solutions:
  • design an independent scientific inquiry, from methods to interpretation;
  • locate, organize, analyze, integrate, synthesize, and evaluate complex information from multiple and disparate sources;
• apply appropriate analytical and quantitative approaches:
  • organize, visualize, and statistically analyze environmental data, and interpret relationships, trends and make predictions about future changes;
• handle uncertain, complex, real-world problems in the lab, field, community, and workplace:
  • observe analytically and integrate diverse information from variable sources outside of the classroom;
  • think critically, creatively, resourcefully, and strategically, including identifying steps needed to reach goals, manage projects, evaluate progress, and adapt approaches, developing both self-reliance, and civic-mindedness;
• develop spatial literacy, understand the role of maps and 2-3 dimensional spatial systems; effectively process, reason, problem solve and communicate issues within a spacial context;
  • utilize advances in environmental sciences and technology to resolve issues and anticipate implications;
• clearly communicate complex analyses, interpretations and significance through variable media (oral presentation, poster, proposal, research article, report), to audiences ranging from scientific to policy, and the general public;
• collaborate in teams, with peers and mentors, and work with others in diverse group settings, developing flexibility and leadership skills.

Environmental Science provides a scientific basis for management of earth systems. It focuses on the interaction between human activities, resources, and the environment. As human population grows and technology advances, pressures on earth's natural systems are becoming increasingly intense and complex. Environmental Science is an exciting field where science is used to best serve society. The department offers two majors, Environmental Science and Environmental Policy. A third major, Environmental Biology, is offered in conjunction with the Department of Biological Sciences.

The curriculum recognizes the need for well-trained scientists to cope with balancing human requirements and environmental conservation. Majors acquire an understanding of earth systems by taking courses in the natural sciences, as well as courses investigating environmental stress. Students learn to critically evaluate the diverse information necessary for sound environmental analysis. Our courses foster an interdisciplinary approach to environmental problem-solving.

Internships or some type of work or field experience are extremely valuable in preparing students for a career in Environmental Science. We strongly encourage students to consider an internship in the summer before the senior year because it may lay the foundation for the senior thesis. Studies have shown that students who have had related work experience are more attractive to employers and graduate schools.

Students interested in environmental science might want to consider a semester or summer program at the SEE-U (http://www.cerc.columbia.edu/?id=see-u/), SEA Semester at Woods Hole (http://www.sea.edu/home/), the School for Field Studies (http://www.fieldstudies.org/), the Organization for Tropical Studies (http://www.ots.ac.cr/), or some other field program. In addition, we recommend that those students planning to go abroad in the junior year elect to do so in the Fall Semester rather than the Spring Semester in order to take best advantage of senior seminar research planning and programming.

Students wishing to go on to graduate school or careers in earth science and the physical sciences should take at least two semesters each of calculus, physics, and chemistry. Those considering graduate school or careers in biological/chemical fields are recommended to take calculus as well as upper-level courses in biology and chemistry, and may wish to consider enrolling in an Environmental Biology major or minors in these fields. Students interested in pursuing further work in environmental policy, economics, environmental law, journalism, or teaching may consider enrolling in an Environmental Policy major or pursuing a double major, a special major, or a major/minor combination in relevant fields.

Co-Chairs: Martin Stute (Professor), Brian Mailloux (Professor)
Assistant Professors: Logan Brenner, Elizabeth Cook
Senior Lecturers: Peter Bower, Terryanne Maenza-Gmelch (Laboratory Director)
Lecturer: Sedelia Rodriguez (Laboratory Instructor)
Adjunct Professors: Elena Dana Neascu, Christian Braneon, Cynthia Rosenzweig, Jenna Lawrence
Environmental Science Major

Environmental Science provides a scientific basis for management of earth systems. It focuses on the interaction between human activities, resources, and the environment. As human population grows and technology advances, pressures on earth’s natural systems are becoming increasingly intense and complex. Environmental Science is an exciting field where science is used to best serve society.

Requirements for the Environmental Science Major

For requirement details, see Environmental Science Major Worksheet, envsciworksheet.doc (http://envsci.barnard.edu/sites/default/files/envsciworksheet_revised_073014_3.doc).

Part A

The following four courses with labs:

- EESC UN2100 Earth's Environmental Systems: The Climate System 4.5
- EESC UN2200 Earth's Environmental Systems: The Solid Earth System 4.5
- CHEM BC2001 General Chemistry I 5
- BIOL BC1500 Introduction to Organismal and Evolutionary Biology 4.5
  - BIOL BC1501 and Introductory Lab in Organismal and Evolutionary Biology
  - or EESC UN2300 Earth's Environmental Systems: The Life System

*Students may NOT receive credit for BOTH BIOL BC1500, 1501 AND EESC UN2300.

Part B

Select two courses:

- CHEM BC3230 Organic Chemistry I 3
- CHEM BC3238 Introductory Organic Chemistry Laboratory (recommended)
- CHEM BC2002 General Chemistry II 5
- CHEM BC3231 Organic Chemistry II 3
- BIOL BC1502 Introduction to Cell and Molecular Biology 3
- BIOL BC1503 Introductory Lab in Cell and Molecular Biology (recommended)
- PHYS V1201 General Physics I 3
- PHYS V1202 General Physics II 3
- PHYS BC2001 Physics I: Mechanics 4.5
- PHYS BC2002 Physics II: Electricity and Magnetism 4.5
- PHYS BC3001 Physics III: Classical Waves & Optics 5

Part C

Select two courses in calculus, statistics, data analysis, and/or economics:

- MATH UN1101 CALCULUS I (or other Calculus class) 3
- MATH UN1102 Calculus II (or other Calculus class) 3
- EESC BC3017 Environmental Data Analysis (or other statistical or data analysis class) 3
- ECON BC1003 or ECON UN1105 Introduction to Economic Reasoning Principles of Economics 3

Part D

Select four electives courses. For details, see Environmental Science Major Worksheet on the departmental website (link above).

Part E

- EESC BC3800 - EESC BC3801 Senior Research Seminar Senior Research Seminar (provide credit for the senior thesis) 6

Advice for the Environmental Science Major

Advisor: Co-Chair, Brian Mailloux

Students with a strong science background who are interested in majoring in Environmental Science are advised to take EESC UN2100 Earth's Environmental Systems: The Climate System early on, followed by EESC UN2200 Earth's Environmental Systems: The Solid Earth System. These two courses are required for all Environmental Science majors.

If you are interested in exploring Environmental Science or are concerned about your science background, you could take EESC BC1001 Environmental Science I in the fall. In the spring, you can shift into the major sequence of EESC UN2100 Earth’s Environmental Systems: The Climate System.

EESC BC1001 Environmental Science I may be taken as a major elective*, however, the course must be completed prior to taking EESC UN2100, UN2200 or UN2300.

We recommend that Environmental Science majors take CHEM BC2001 General Chemistry I and BIOL BC1500 Introduction to Organismal and Evolutionary Biology, plus the corresponding lab, BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology, early in their academic career at Barnard in order to prepare for upper level courses with prerequisites. Students with concerns about their science preparation should not take both at the same time. If you want advice on taking an Introductory Biology course, visit Biology (http://physics.barnard.edu/academics/introductory-sequence/), and for advice on taking an Introductory Physics course, visit Physics (http://physics.barnard.edu/department-astronomy-physics/).

Students should check the catalogue and the department for additional information on the major, minor and courses offered by Barnard and Columbia. Classes with grades less than C- or taken pass/fail can not be counted towards the major.

See also Senior Research Seminar for information on senior thesis requirements.

Requirements for the Environmental Science Minor

Students wishing to minor in Environmental Science must have a plan approved by the Environmental Science Department Co-Chair, Martin Stute. For requirement details see Environmental Science Minor Worksheet (http://envsci.barnard.edu/sites/default/files/minorworksheet__040214.doc) for a list of qualifying electives. In some cases, courses in other sciences can be substituted with the approval of the chair. Five courses are required including:

Select two laboratory science courses (with corresponding labs):

- EESC BC1001 Environmental Science I 4.5
- EESC UN2100 Earth’s Environmental Systems: The Climate System 4.5
- EESC UN2200 Earth’s Environmental Systems: The Solid Earth System 4.5
- EESC UN2300 Earth’s Environmental Systems: The Life System (students must enroll in the corresponding LAB course, EESC UN2310.) 4.5

Select three electives (two of which are at the 3000-level or higher) that form a coherent program. (For Electives for the Environmental Science Minor, please see link for Minor Requirements Worksheet above.) 9

Students wishing to minor in Environmental Science who are interested in field programs and seek minor credit must contact the department.
Co-Chair, Martin Stute. The only current field program within Columbia University is SEE-U.

There is no minor in Environmental Biology or Environment and Sustainability.

**Environment and Sustainability Major**

Sustainability is a growing field focusing on finding solutions in an ever-changing environment. Majors develop an understanding of the processes and stresses of earth’s systems, handle environmental data and make reasoned assessments, and engage in collaborative and interdisciplinary work required for developing approaches to maintain a sustainable environment.

The Environment and Sustainability major is designed to equip students to play effective roles as citizens or career professionals who can actively engage in environmental decision-making and policy in a rapidly changing environment. Majors learn to analyze and evaluate environmental, political, and economic systems and public policies in the context of environmental concerns, and to use these interdisciplinary skills to navigate development with the environment in mind. The major begins with foundations in the natural sciences, social sciences, and quantitative analysis, followed by upper level electives in both the natural and social sciences, as is a required hands-on, client-based collaborative workshop at the junior level is required. Many exciting opportunities for student research exist on this campus and in the greater metropolitan community.

Environment and Sustainability as did Policy graduates will go on to a variety of careers, including national and international environmental policy, law, economics, journalism, business, public administration, government agencies, corporations, multilateral institutions, nongovernmental organizations, academia, and consulting firms. There is no minor in Environment and Sustainability.

**Requirements for the Environment and Sustainability Major**

For requirement details, see Environment and Sustainability Major Requirement Worksheet, envsustworksheet.doc (http://bulletin.columbia.edu/barnard-college/courses-instruction/environmental-science/EnvsustainWorksheet_Revised_011017.doc)

<table>
<thead>
<tr>
<th>Part A-1. Natural Science Foundation (all 3 required)</th>
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<tbody>
<tr>
<td>EESC UN2100 Earth's Environmental Systems: The Climate System</td>
<td>4.5</td>
</tr>
<tr>
<td>CHEM BC2001 General Chemistry I (plus Lab)</td>
<td>5</td>
</tr>
<tr>
<td>or EESC BC3016 Environmental Measurements</td>
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... * Majors can replace General Chemistry with EESC BC3016, Environmental Measurements, but must complement this with either an A-2 or a B-2 course, not also being used for those requirements.

| BIOL BC1500 Introduction to Organismal and Evolutionary Biology and Introductory Lab in Organismal and Evolutionary Biology | 5 |
| or EEBE UN2002 Environmental Biology II: Organisms to the Biosphere |  |
| or EESC UN2300 Earth’s Environmental Systems: The Life System |  |
| or Columbia’s SEE-U summer Program (only for those who did not receive credit for EESC BC1001) |  |

<table>
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<tr>
<th>Part A-2. Additional Science Foundation Course (choose 1)</th>
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<tr>
<td>CHEM BC3230 Organic Chemistry I</td>
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<tr>
<td>CHEM BC2002 General Chemistry II</td>
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| EESC UN2200 Earth's Environmental Systems: The Solid Earth System | 4.5 |
| BIOL BC1502 - BIOL BC1503 Introduction to Cell and Molecular Biology and Introductory Lab in Cell and Molecular Biology | 5 |
| EESC BC1001 Environmental Science I | 4.5 |
| EESC UN1011 Earth: Origin, Evolution, Processes, Future | 4 |

**Part B. Quantitative Foundations (1 from each grouping, choose 2 total)**

| SDEV UN3390 GIS for Sustainable Development | 3 |
| or SDEV UN3450 Spatial Analysis and Modeling for Sustainable Development |  |
| or EAAE E4009 Geographic information systems (GIS) for resource, environmental and infrastructure management |  |
| or EESC BC3016 Environmental Measurements |  |
| or EESC BC3050 Big Data with Python: Python for Environmental Analysis and Visualisation |  |
| or EESC GU4050 Global Assessment and Monitoring Using Remote Sensing |  |
| or URBS UN3200 Spatial Analysis: GIS Methods and Urban Case Studies |  |

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<tr>
<th>Part C. Social Science Foundation (choose 2)</th>
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<tr>
<td>ECON BC1003 Introduction to Economic Reasoning</td>
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<tr>
<td>or ECON UN1105 Principles of Economics</td>
<td></td>
</tr>
<tr>
<td>POLS UN1601 INTERNATIONAL POLITICS</td>
<td>4</td>
</tr>
<tr>
<td>SDEV UN2300 Challenges of Sustainable Development</td>
<td>3</td>
</tr>
<tr>
<td>SDEV UN2320 Economic and Financial Methods for Sustainable Development</td>
<td>3</td>
</tr>
<tr>
<td>ANTH UN1002 The Interpretation of Culture</td>
<td>3</td>
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</table>

**Part D. Electives (choose 3, at least 1 from each grouping of upper level courses) D1. Natural Science Elective (See Worksheet for full list of courses)**

| EESC BC3000 Workshop in Sustainable Development | 4 |
| Part F. Senior Research/Thesis (2 courses) |  |
| EESC BC3800 Senior Research Seminar | 3 |
| EESC BC3801 Senior Research Seminar | 3 |

**Advice for the Environment and Sustainability Major**

**Advisers:** Co-Chair, Martin Stute

Because this Major was approved by the Faculty in Fall 2017 as a updated replacement for the Environmental Policy, any student may elect the Environment and Sustainability major, but only students in the Class of 2019 or 2018 can graduate with a major in Environmental Policy because it is being phased out.

Students with a strong science background who are interested in majoring in Environment and Sustainability are advised to take Earth’s Environmental Systems: Climate (EESC UN2100 Earth’s Environmental Systems: The Climate System).

If you are interested in exploring Environment and Sustainability or are concerned about your science background, you could take EESC BC1001 Environmental Science I in the fall. In the spring, you would need to find another introductory level Environmental Science course such as EESC UN1011, Earth, Origin, Evolution, Processes, Future (with Lab) or shift into the major sequence of EESC UN2100 Earth’s Environmental Systems: The
Climate System which is a Natural Science Foundation course. Please also note the following:
For the second Natural Science Foundation course requirement can be fulfilled by Majors in Environment and Sustainability with either CHEM BC2001, General Chemistry or EESC BC3016x, Environmental Measurements along with either another Additional Science Foundations Course or a Quantitative Foundations Analysis/Skills course. There are a few options to fulfill the 3rd Natural Foundation course requirements, so see above or the Environment and Sustainability Major Requirement Worksheet, envsustworksheet.doc (http://bulletin.columbia.edu/barnard-college/courses-instruction/environmental-science/EnvSustWorksheet_Revised_011017.doc) for more specifics.

We recommend that Environment and Sustainability majors take CHEM BC2001 General Chemistry I and BIOL BC1500 Introduction to Organismal and Evolutionary Biology plus the corresponding lab, BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology, early in their academic career at Barnard in order to prepare for upper level courses with prerequisites, but it is not recommended that they be taken concurrently. Students with concerns about their science preparation should realize the option of taking EESC BC2016, Environmental Measurements (plus the additional course). If you want advice on taking an Introductory Biology course, visit Biology (http://bulletin.columbia.edu/barnard-college/courses-instruction/biological-sciences/), and for advice on taking an Introductory Physics course, visit Physics (http://bulletin.columbia.edu/barnard-college/courses-instruction/physics-astronomy/).

Students should check the catalogue and the department for additional information on the major, minor and courses offered by Barnard and Columbia. Classes with grades less than C- or taken pass/fail can not be counted towards the major.

See also Senior Research Seminar for information on senior thesis requirements.

Part A-1. Natural Science Foundation (3 courses with corresponding labs)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>EESC UN2100</td>
<td>Earth's Environmental Systems: The Climate System</td>
<td>4.5</td>
</tr>
<tr>
<td>CHEM BC2001</td>
<td>General Chemistry I (plus Lab)</td>
<td>5</td>
</tr>
<tr>
<td>BIOL BC1500</td>
<td>Introduction to Organismal and Evolutionary Biology and Introductory Lab in Organismal and Evolutionary Biology</td>
<td>5</td>
</tr>
<tr>
<td>or EEEB UN2002</td>
<td>Environmental Biology II: Organisms to the Biosphere</td>
<td>5</td>
</tr>
<tr>
<td>or EESC UN2300</td>
<td>Earth's Environmental Systems: The Life System</td>
<td>5</td>
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Part A-2. Additional Science Foundation Course (1 course with corresponding lab)

<table>
<thead>
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<th>Credits</th>
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<tbody>
<tr>
<td>CHEM BC3230</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM BC2002</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>or EESC UN2200</td>
<td>Earth's Environmental Systems: The Solid Earth System</td>
<td>3</td>
</tr>
<tr>
<td>BIOL BC1502</td>
<td>Introduction to Cell and Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>or EESC BC1001</td>
<td>Environmental Science I</td>
<td>3</td>
</tr>
<tr>
<td>or EESC BC1002</td>
<td>Environmental Science II</td>
<td>3</td>
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Part B. Quantitative Assessment (2 courses)

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<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>EESC BC3017</td>
<td>Environmental Data Analysis</td>
<td>3</td>
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<tr>
<td>SDEV UN3390</td>
<td>GIS for Sustainable Development</td>
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Part C. Decision-Making Foundation (one for each grouping, 3 courses total)

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<tr>
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<tbody>
<tr>
<td>ECON BC1003</td>
<td>Introduction to Economic Reasoning</td>
<td>3</td>
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<tr>
<td>or ECON UN1105</td>
<td>Principles of Economics</td>
<td>3</td>
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<tr>
<td>ANTH UN1002</td>
<td>The Interpretation of Culture (with discussion section)</td>
<td>3</td>
</tr>
<tr>
<td>or EEEB UN1010</td>
<td>Human Origins and Evolution</td>
<td>3</td>
</tr>
<tr>
<td>or ANTH V3004</td>
<td>Introduction to Environmental Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>or SDEV UN2300</td>
<td>Challenges of Sustainable Development</td>
<td>3</td>
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Part D. Natural Science Elective (1 course) See link for Environmental Policy Major Worksheet above.

Part E. Social Science Elective (1 course) See link for Environmental Policy Major Worksheet above.

Part F. Junior Research (1 course) See link for Environmental Policy Major Worksheet above.

Part G. Senior Research/Thesis (2 courses)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tr>
<td>EESC BC3800</td>
<td>Senior Research Seminar</td>
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<tr>
<td>EESC BC3801</td>
<td>Senior Research Seminar</td>
<td>3</td>
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</table>

Advisers: Martin Stute (Environmental Science Department), Kimberly Marten (Political Science), Alan Dye (Economics), Paige West (Anthropology), David Weiman (Urban Studies).

Students with a strong science background who are interested in majoring in Environmental Policy are advised to take Earth’s Environmental Systems: Climate (EESC UN2100 Earth’s Environmental Systems: The Climate System).

If you are interested in exploring Environmental Policy or are concerned about your science background, you could take EESC BC1001 Environmental Science I in the fall. In the spring, you would need to find another introductory level Environmental Science course such as EESC UN1011 Earth, Origin, Evolution, Processes, Future (with Lab) or shift into the major sequence of EESC V2100 Earth’s Environmental Systems: Climate which is a Natural Science Foundation course. Please also note the following:

EESC BC1001 Environmental Science I must be taken prior to taking EESC UN2100, UN2200 or UN2300.

We recommend that Environmental Policy majors take CHEM BC2001 General Chemistry I and BIOL BC1500 Introduction to Organismal and Evolutionary Biology plus the corresponding lab, BIOL BC1501 Introductory Lab in Organismal and Evolutionary Biology, early in their academic career at Barnard in order to prepare for upper level courses with prerequisites. Students with concerns about their science preparation should not take both at the same time. If you want advice on taking an Introductory Biology course, visit Biology (http://bulletin.columbia.edu/barnard-college/courses-instruction/biological-sciences/), and for advice on taking an Introductory Physics course,
visit Physics (http://bulletin.columbia.edu/barnard-college/courses-instruction/physics-astronomy/).

Students should check the catalogue and the department for additional information on the major, minor and courses offered by Barnard and Columbia. Classes with grades less than C- or taken pass/fail can not be counted towards the major.

See also Senior Research Seminar for information on senior thesis requirements.

EESC BC1001 Environmental Science I. 4.5 points.
Prerequisites: Prerequisites: Enrollment limited. Students must also sign up for the corresponding lab course, EESC BC1011 to receive credit. Note BC1001 is not required for an environmental policy major. This class examines the basic principles of environmental science using current local and global environmental news as case studies. Issues covered are climate change, invasive species, water resources, sustainability, etc. A major goal is for students to understand the science behind environmental issues. Readings from the scientific literature, various newspaper articles, magazines and an online textbook are carefully coordinated with the topics. Because of our location, the lab curriculum features studies of the Hudson River and its forested shorelines. The lab is closely paired with the lecture and features hands-on and inquiry-based lab and field studies of statistics, data presentation, writing in the format of a scientific paper, data collection (on land and on the Hudson River), water chemistry, microbiology, microscopic and macroscopic life in the river, birds and plants in Riverside Park, biodiversity on a green roof, local geology, topographical maps, compass use, and museum studies. Students must also register for one of the eight lab sections EESCX1011. Students must take both lecture and lab.

EESC UN2100 Earth's Environmental Systems: The Climate System. 4.5 points.
CC/GS: Partial Fulfillment of Science Requirement, BC: Partial Fulfillment of General Education Requirement: Laboratory Science (SCI), BC: Fulfillment of General Education Requirement: Quantitative and Deductive Reasoning (QUA)., Lab Required Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be reinstated.

Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics; and one semester of college science. Origin and development of the atmosphere and oceans, formation of winds, storms and ocean currents, reasons for changes through geologic time. Recent influence of human activity: the ozone hole, global warming, water pollution. Laboratory exploration of topics through demonstrations, experimentation, computer data analysis, and modeling. Students majoring in Earth and Environmental Sciences should plan to take EESC W2100 before their senior year to avoid conflicts with Senior Seminar.

EESC BC1011 Environmental Science I Lab. 0 points.
Corequisites: EESC BC1001
Students enrolled in EESC BC1001 must enroll in this required lab course. Students cannot enroll in this course unless also enrolled in BC1001.
EESC UN2200 Earth’s Environmental Systems: The Solid Earth System. 4.5 points.

CC/GS: Partial Fulfillment of Science Requirement
Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be necessary.

Prerequisites: high school algebra and chemistry. Recommended preparation: high school physics.
Prerequisites: high school algebra, chemistry, and physics. Exploration of how the solid Earth works, today and in the past, focusing on Earth in the Solar system, continents and oceans, the Earth’s history, mountain systems on land and sea, minerals and rocks, weathering and erosion, glaciers and ice sheets, the hydrological cycle and rivers, geochronology, plate tectonics, earthquakes, volcanoes, energy resources. Laboratory exploration of topics through examination of rock samples, experimentation, computer data analysis, field exercises, and modeling. Columbia and Barnard majors should plan to take W2200 before their senior year to avoid conflicts with the Senior Seminar.

Fall 2020: EESC UN2200

<table>
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<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 2200</td>
<td>001/12443</td>
<td>T 1:10pm - 2:25pm</td>
<td>Maria Tolstoy, Jonathan Kingslake</td>
<td>4.5</td>
<td>51/60</td>
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<tr>
<td>EESC 2200</td>
<td>001/12443</td>
<td>T 4:10pm - 7:00pm</td>
<td>Maria Tolstoy, Jonathan Kingslake</td>
<td>4.5</td>
<td>51/60</td>
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Spring 2021: EESC UN2200

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<td>EESC 2200</td>
<td>001/10400</td>
<td>Online Only</td>
<td>Steven Goldstein, Sidney Hemming</td>
<td>4.5</td>
<td>0/50</td>
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</table>

EESC UN2300 Earth’s Environmental Systems: The Life System. 4.5 points.

CC/GS: Partial Fulfillment of Science Requirement
Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be reinstated.

Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics.
Role of life in biogeochemical cycles, relationship of biodiversity and evolution to the physical Earth, vulnerability of ecosystems to environmental change; causes and effects of extinctions through geologic time (dinosaurs and mammoths) and today. Exploration of topics through laboratories, demonstrations, computer data analysis and modeling. REQUIRED LAB: EESC UN2310. Students should see the Directory of Classes for lab sessions being offered and select one.

Co-meets with EEEB 2002

Spring 2021: EESC UN2300

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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 2300</td>
<td>001/10401</td>
<td>Online Only</td>
<td>Paul Olsen, Matthew Palmer, Kevin Griffin</td>
<td>4.5</td>
<td>0/50</td>
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Conservation and preservation is an interdisciplinary study of earth materials, their transformation into art objects and architectural structures, and the philosophy and analytical techniques required to prepare conservation and preservation strategies for these objects and structures. The course is Beyond Barnard being hands-on and field trip oriented with a focus on the Metropolitan Museum of Art and local geology and infrastructure.

EESC BC3012 Brownfields. 3 points.

Prerequisites: One college level science course or permission of the instructor. Anyone who has taken EESC BC1002 Introduction to Environmental Science cannot take this course.

Brownfields considers interconnections between groundwater contamination, toxics, human health, government, economics, and law using the award-winning interactive learning simulation Brownfield Action, Through a semester-long, laboratory exploration of a simulated brownfield, students engage in an environmental site assessment and development of a plan for remediation and revitalization.

EESC BC3013 Shorelines and Streams. 3 points.

Prerequisites: Enrollment limited. Four required field trips that take a substantial portion of the day. An interdisciplinary study of shoreline processes, the larger ecosystems of which they are a part, and the geologic events and human impacts that have brought them through time to their current state. A problem-oriented, field-methods course, providing hands-on experience with tools and observational methods in a variety of outdoor environments. Involves sampling and measurement techniques for rocks and minerals, fossils, water, soil, flora, and fauna, as well as field and laboratory work, data interpretation and analysis, and the creation of a sample collection. Emphasis on the writing process through the reading of Rachel Carson’s The Edge of the Sea, a daylong field trip to Montauk Point, and the writing of a term essay on the natural history and origin of a grain of garnet found at the top of the dune at Napeague Bay.

EESC BC3014 Field Methods in Environmental Science. 3 points.

Prerequisites: Enrollment limited. Five required field trips that take a substantial portion of the day. Problem-oriented, hands-on approach emphasizing the tools, techniques, and observational skills necessary for the understanding of forest ecology and deer management. Field and laboratory work as well as data analysis and interpretation. Field Methods utilizes the outdoor resources of the Hudson River Valley, especially the forest environment at Black Rock Forest, a 4,000-acre preserve near Cornwall, N.Y.

Fall 2020: EESC BC3014

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<tr>
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<tr>
<td>EESC 3014</td>
<td>001/00579</td>
<td>F 8:40am - 11:30am</td>
<td>Peter Bower</td>
<td>3</td>
<td>12/11</td>
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EESC BC3016 Environmental Measurements. 3 points.

Prerequisites: Enrollment limited. Required field trip on first Friday of the semester. Hands-on approach to learning environmental methods. Students take a one-day cruise on the Hudson River to collect environmental samples. These samples are then analyzed throughout the semester to characterize the Hudson River estuary. Standard and advanced techniques to analyze water and sediment samples for nutrients and contaminants are taught.
EESC BC3017 Environmental Data Analysis. 3 points.
Prerequisites: One year of college science or EESC V2100 or permission of the instructor.
Acquisition, analysis, interpretation, and presentation of environmental data, assessment of spatial and temporal variability. Focus on water quality issues and storm surges. Uses existing and student-generated data sets. Basic principles of statistics and GIS, uses standard software packages including EXCEL and ArcGIS. Includes a half-day field trip on a Saturday or Sunday. General Education Requirement: Quantitative and Deductive Reasoning (QUA).

EESC BC3019 Energy Resources. 3 points.
Energy Resources utilizes the physical plant of Barnard and Columbia to involve students in a semester long real-life policy study that explores the interconnections between energy resources and sustainable energy efficiency. Students work collaboratively as a team and interface with college faculty, administration, staff and student organizations to produce and disseminate a professional level policy report describing existing usage of energy, analyzing where change is needed.

EESC BC3021 Forests and Environmental Change. 4 points.
Not offered during 2020-21 academic year.
Prerequisites: Enrollment limited to 12 students. One year of college science or permission of instructor. Alternate years.
Seminar on forests in global change framework: forest distribution and link to climate, forest ecology, paleoecology, role of forests in global ecosystem, biological invasions, habitat fragmentation, biodiversity, conservation and management strategies. Format: class discussion of readings, student presentations on scientific papers, field trips, data collection and analysis.

EESC BC3023 The Hudson: The Estuary, The River, and Our Environment. 3 points.
An interdisciplinary study of the relationship between ecosystem function and sustainable human habitation for one of the great rivers of the world. Topics include: geological origins, the watershed, basic hydrology, and estuarine dynamics; habitats and plants, energy flow, and nutrient dynamics; the invertebrates; fishes, fisheries, and other animals; water quality, water supply, and sewage treatment; sediment dynamics and PCBs; colonization and revolution; industrialization and transformation of the landscape; the Storm King controversy, conservation and environmentalism

EESC BC3025 Hydrology. 3 points.
Prerequisites: EESC V2100, physics, or permission of instructor. Includes a weekend field trip. Alternate years.
Hands-on study and discussion of the basic physical principles of the water cycle (evaporation, condensation, precipitation, runoff, and subsurface flow), as well as environmentally relevant applications based on case studies. Special focus on the New York City area, the arid Southwest, and the developing world. Coverage of contemporary global water resources issues, including pollution control, sustainable development, and climate change. General Education Requirement: Quantitative and Deductive Reasoning (QUA).

EESC BC3026 Bird, Plant and Land-use Dynamics. 3 points.
Prerequisites: Enrollment limited to 12 students. Permission of the instructor required.
This class looks at the response of wildlife (birds and plants) to climate change and land-use issues from the end of the last glaciation to the present. We visit wildlife refuges along a rural-suburban-urban gradient in order to observe and measure the role refuges play in conservation. Case study topics are: (1) land-use change over time: a paleoenvironmental perspective, (2) environmental transformations: impact of exotic and invasive plants and birds on local environments and (3) migration of Neotropical songbirds between their wintering and breeding grounds: land-use, crisis and conservation. Format: lecture, student presentations, field trips and data collection/analysis.

EESC BC3032 Agricultural and Urban Land Use: Human-Environment Interactions. 4 points.
BC: Fulfillment of General Education Requirement: Cultures in Comparison (CUL).
Not offered during 2020-21 academic year.
Prerequisites: One year of college science or permission of instructor. Alternate years.

EESC BC3033 Waste Management. 3 points.
Alternate years.

EESC BC3040 Environmental Law. 3 points.
Process-oriented introduction to the law and its use in environmental policy and decision-making. Origins and structure of the U.S. legal system. Emphasis on litigation process and specific cases that elucidate the common law and toxic torts, environmental administrative law, and environmental regulation through application and testing of statutory law in the courts. Emphasis also on the development of legal literacy, research skills, and writing.
EESC BC3043 Water, Sanitation, and Health. 3 points.
This course focuses on understanding water, sanitation and health in the developing world and how these factors interact to affect people's lives. Specifically, what are the options for providing cleaner water and improved sanitation in order to reduce the incidence of waterborne diseases in the developing world?

EESC BC3045 Responding to Climate Change. 3 points.
Prerequisites: One of the following courses that introduces the structure and functioning of the climate system and processes underlying climate change: EESC V1002, Climate and Society; Case Studies; EESC V2100 Earth's Environmental Systems: Climate; EESC W2330, Science of Sustainable Development; or EAE E1100, A Better Plant by Design. Analysis of climate change adaptations, responses, and mitigation options. Consideration of impacts of projected climate changes including global water, food and health complemented by regional case studies. Scientific, technologic, economic, political, and behavioral aspects of potential solutions.

EESC BC3050 Big Data with Python: Python for Environmental Analysis and Visualization. 3 points.
Big Data is changing how we interact with and understand the environment. Yet analyzing Big Data requires new tools and methods. Students will learn to use Python programming to analyze and visualize large environmental and earth's systems data sets in ways that Excel is not equipped to do. This will include both time series and spatial analyses with programming occurring interactively during class and assignments designed to strengthen methods and results. Students will learn to write code in Python, plot, map, sub-select, clean, organize, and perform statistical analyses on large global scale data sets, using the data in analysis, and take any data set no matter how large or complicated.

EESC BC3800 Senior Research Seminar. 3 points.
Enrollment limited to senior majors (juniors with the instructor's permission). Provides credit for the senior thesis. The Senior Research Seminar can be taken Spring/Fall or Fall/Spring sequence.

Guided, independent, in-depth research culminating in the senior thesis in the spring. Includes discussion about scientific presentations and posters, data analysis, library research methods and scientific writing. Students review work in progress and share results through oral reports. Weekly seminar to review work in progress and share results through oral and written reports. Prerequisite to EESC W3901.

EESC BC3040 Workshop in Sustainable Development. 4 points.
Students address real-world issues in sustainable development by working in groups for an external client agency. Instruction in communication, collaboration, and management; meetings with and presentations to clients and academic community. Projects vary from year to year. Readings in the course are project-specific and are identified by the student research teams.

Cross-Listed Courses
There are no cross-listed courses for your department.