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Office of Academic and Research Programs

# A Guide to Educational Programs in Environment and Sustainable Development at Columbia University



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**PLEASE NOTE: This information may be subject to change. For the most up-to-date information, please contact the program staff directly.**

**A GUIDE TO EDUCATIONAL PROGRAMS IN ENVIROMENT AND SUSTAINABLE  
DEVELOPMENT AT COLUMBIA UNIVERSITY**

**OFFICE OF ACADEMIC AND RESEARCH PROGRAMS  
THE EARTH INSTITUTE, COLUMBIA UNIVERSITY  
FALL 2010**

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## **Overview**

Columbia University and its affiliates offer an array of varied undergraduate, masters, and doctoral programs in the field of environmental studies and sustainable development. Currently, there are over twenty academic programs that are associated with the Earth Institute that represent one of the largest collections of environmental education programs in the world. This guide provides a brief overview of all the educational programs at Columbia that address environmental and sustainable development issues. The overview of each program contains a brief description of the program, information about its admission and/or academic requirements, and a list of connected faculty. All of the information about the academic programs was obtained from departmental Websites and/or from program view books.

Columbia undergraduates who are interested in sustainable development and environmental studies have the option of pursuing a:

- Special Concentration in Sustainable Development
- Concentration in Environmental Biology
- Majors in:
  - Sustainable Development
  - Earth Sciences
  - Environmental Sciences
  - Earth and Environmental Engineering
- Summer Ecosystem Experiences for Undergraduates (SEE-U)

Students who already have a Bachelors degree can pursue a:

- Postbaccalaureate in Environmental Biology
- Postbaccalaureate in Ecology, Evolution and Environmental Biology

Barnard undergraduates can obtain a major in:

- Environmental Science
- Environmental Biology
- Environmental Policy

Graduate students interested in continuing their education in environment or sustainable development may choose from eleven master degrees:

- M.S. in Sustainability Management
- M.A. in Conservation Biology
- M.A./M.S. Earth and Environmental Science Journalism
- M.S. Earth Resources Engineering
- M.A. Climate and Society
- M.P.H. Environmental Health Sciences
- M.P.A. Environmental Science and Policy
- M.P.A. in Development Practice
- M.I.A./M.P.A. Energy and Environment

Graduate Students may also obtain a certificate in Environmental Policy or Conservation Biology.

Those interested in pursuing a doctoral degree in Earth and Environmental Science or sustainable development will find a series of multidisciplinary Ph.D. program options offered by the university.

Doctoral Programs currently offered include:

- Ph.D. in Sustainable Development
- Ph.D. or Eng.Sc.D in Earth and Environmental Engineering
- Ph.D. in Earth and Environmental Sciences
- Ph.D. in Atmospheric and Planetary Science
- Dr.P.H., Ph.D. in Environmental Health Sciences
- Ph.D. in Ecology and Evolutionary Biology
- Ph.D. in Evolutionary Primatology

The Earth Institute, through its Office of Academic and Research Programs, works to assist these schools and departments, as well as to stimulate interaction among students and faculty.

This is accomplished through the following activities:

- A campus-wide student advisory council and research assistant program
- An intern program in units of the Earth Institute
- A small research project travel grant program
- A program to support field trips in environmental courses
- Annual meeting of academic program directors and department chairs
- Environmental career fairs
- Open Houses for prospective students
- Co-curricular programming
- Administrative support for start-up programs
- Maintaining the education pages of the Earth Institute Website
- A year-long Earth Institute Practicum

Columbia University is in the process of building new environmental and sustainable development education programs and adding environmental and sustainable development education to existing programs. Through the Earth Institute, a wide range of conferences, lectures, and seminars are presented each year on issues related to environmental science, policy, and sustainable development.

## **UNDERGRADUATE PROGRAMS**

### **Undergraduate Program in Sustainable Development**

Ruth DeFries, Co-Program Director – [rd2402@columbia.edu](mailto:rd2402@columbia.edu) – (212) 851-1647

Kevin Griffin, Co-Program Director – [griff@ldeo.columbia.edu](mailto:griff@ldeo.columbia.edu) – (845) 365-8371

Natalie Unwin-Kuruner, Senior Program Manager – [natalie@ei.columbia.edu](mailto:natalie@ei.columbia.edu) – (212) 854-8536

The Earth Institute, in collaboration with Columbia College; School of General Studies; and the Departments of Earth and Environmental Science; Ecology, Evolution, and Environmental Biology; International and Public Affairs; and Earth Engineering, offers both a Major and a Special Concentration in Sustainable Development. The broadest definition of sustainable development is that each generation should be able to meet its material needs without compromising the ability of future generations to meet their own needs. Sustainable development signifies the ability of the world to narrow the gap between the rich and the poor, and the ability of all to pursue further progress in overall human well-being. The world as a whole, and each major sub-region, ought to be able to accomplish these goals without causing irreparable harm to ecosystems and the vital services they provide, depleting essential resources, or posing unjustifiable risks to future generations.

### **Undergraduate Major in Sustainable Development**

#### **Courses of Instruction**

For courses of instruction, please see:

<http://www.college.columbia.edu/bulletin/depts/sustdev.php?tab=courses>

[http://www.gs.columbia.edu/index\\_majors.htm](http://www.gs.columbia.edu/index_majors.htm)

**Program of Study:** The major in sustainable development extends from the philosophical, ideological and structural traditions of the Columbia Core. Students who wish to complete the major in sustainable development will work with their program adviser to decide on course selection and sequencing. Study abroad and internships are strongly encouraged, particularly to act as a basis for thesis research and to provide students with practical experience early on in their professional development.

The program benefits from the support of Earth Institute researchers—many of whom have helped design classes in the degree—and their pioneering work in the field. Drawing on cutting-edge research and practical work at the Earth Institute, graduates of the program will be uniquely prepared to approach issues of sustainable development from all angles in the public, private, and non-profit sectors.

### **Undergraduate Requirements for the Major in Sustainable Development**

Students wishing to complete the major in sustainable development should work with the program adviser to decide on course selection and sequencing. A minimum of 15 courses and a practicum are required for the major as follows:

#### **I. Sustainable Development Foundation (three courses):**

- SDEV W1900 Introduction to Sustainable Development Seminar
- SDEV W2300 Challenges of Sustainable Development
- EESC W2330 Science for Sustainable Development

## II. **Basic Disciplinary Foundation (five courses):**

- One of the following science sequences:
  - EEEB W2001 and W2002 Environmental Biology I and II
  - CHEM C1403 and C1404 General Chemistry
  - PHYS V1201 and V1202 General Physics
  - EESC V2100 and V2300 Earth Science
  - EAEE E1100 and E2002 Engineering Science
- Two social science courses to be chosen from an approved list in conjunction with the program adviser:
  - ECON W1105 Principles of Economics
  - SDEV W3400 Demography of Human Populations
  - POLS V1501 Introduction to Comparative Politics or V1601 International Politics
  - SOCI W1000 The Social World
  - ANTH V1002 The Interpretation of Culture
- One of the following Quantitative Foundations courses:
  - **Statistics**
    - STAT W1211 Introduction to Statistics (with calculus)
    - STAT W3105 Introduction to Probability Models
    - STAT W3107 Introduction to Statistical Inference
    - STAT W4105 Introduction to Probability
    - STAT W4107 Statistical Inference
    - STAT W4315 Linear Regression Models
    - STAT W4606 Elementary Stochastic Processes
  - **Linear Algebra**
    - MATH V2010 Linear Algebra

## III. **Analysis and Solutions to Complex Problems (two courses):**

- EAIA W4200 Alternative Energy Resources
- SDEV W3330 Ecological and Social Systems for Sustainable Development
- PUBH W3100 Fundamentals of Global Health
- SDEV W3200 Global Food Systems
- SDEV W3360 Disasters and Development
- SDEV W3410 Urbanization and Sustainability
- The Summer Ecosystems Experience for Undergraduates (SEE-U) Summer Program

## IV. **Skills/Actions (two courses):**

- SDEV W3390 GIS for Sustainable Development
- SCNC W3010 Science, Technology and Society
- SDEV W3450 Spatial Analysis and Modeling for Sustainable Development
- EESC W4050 Global Assessment Remote Sensing
- SDEV W3320 Economic and Financial Methods for Sustainable Development
- SDEV W3355 Climate Change and Law

**V. Electives (a practicum and two courses):**

- One of the following practicums:
  - SDEV W3500 EI-Lamont Sustainable Development Practicum
  - SUMA K4734 EI Practicum on Environment and Sustainable Development
- Two of the following:
  - Additional courses from Analysis and Solutions to Complex Problems
  - Additional courses from Skills/Actions
  - Senior Thesis Seminar (two-semester sequence, to be developed)
  - Upper division courses from the list below as approved by program adviser

**VI. Capstone Workshop (one course):**

- SDEV W3280 Workshop in Sustainable Development

**Undergraduate Special Concentration in Sustainable Development**

**Courses of Instruction**

For courses of instruction, please see:

<http://www.college.columbia.edu/bulletin/depts/sustdev.php?tab=courses>

[http://www.gs.columbia.edu/index\\_majors.htm](http://www.gs.columbia.edu/index_majors.htm)

**Program of study:** The Special Concentration in Sustainable Development is not a stand-alone concentration; it is intended to serve as a complement to the disciplinary specialization and methodological training inherent in a concentration or major.

Students wishing to complete a special concentration in sustainable development will work with a program adviser to decide upon course selection and sequencing.

The special concentration will allow students to draw upon classes in a wide range of disciplines including political science, anthropology, environmental science, and economics. The courses required for the special concentration are designed to provide Columbia students with an understanding of the theory and practice of sustainable development, provide experience with complex development challenges through direct engagement, and help students imagine and create alternative futures for our rapidly changing world.

**Undergraduate Requirements for a Special Concentration in Sustainable Development**

Students wishing to complete the special concentration in sustainable development should work with the program adviser to decide on course selection and sequencing. A minimum of **nine** courses and a practicum are required for the concentration as follows:

**I. Sustainable Development Foundation (three courses):**

- SDEV W1900 Introduction to Sustainable Development
- SDEV W2300 Challenges of Sustainable Development
- EESC W2330 Science for Sustainable Development

**II. Natural Science Systems (one course):**

- One of the following natural science courses:
  - PHYS V1201 General Physics I
  - CHEM C1403 Chemistry I
  - EAEE E1100 A Better Planet by Design
  - EEEB W1001 Biodiversity
  - EEEB W2002 Environmental Biology II
  - EESC V1201 Environment Risks and Disasters
  - EESC V2100 Earth's Environment Systems: Climate
  - EESC 1011/1411 Earth: Origin, Evolution, Processes, Future
  - EESC V1003 Climate and Society: Case Studies

### **III. Human Science Systems (one course):**

- One human science courses to be chosen from an approved list in conjunction with the program adviser:
  - ECON W1105 Principles of Economics
  - SDEV W3400 Demography of Human Populations
  - POLS V1501 Introduction to Comparative Politics or POLS V1601 International Politics
  - SOCI W1000 The Social World
  - ANTH V1002 The Interpretation of Culture

### **IV. Analysis and Solutions to Complex Problems (two courses):**

- EAIA W4200 Alternative Energy Resources
- SDEV W3330 Ecological and Social Systems for Sustainable Development
- PUBH W3100 Fundamentals of Global Health
- SDEV W3200 Global Food Systems
- SDEV W3360 Disasters and Development
- SDEV W3410 Urbanization and Sustainability
- The Summer Ecosystem Experiences for Undergraduates (SEE-U) Program

### **V. Skills/Actions (one course):**

- SDEV W3390 GIS for Sustainable Development
- SCNC W3010 Science, Technology and Society
- SDEV W3450 Spatial Analysis and Modeling for Sustainable Development
- EESC W4050 Global Assessment Remote Sensing
- SDEV W3320 Economic and Financial Methods for Sustainable Development
- SDEV W3355 Climate Change and Law

### **VI. Practicum:**

- One of the following practicums:
  - SDEV W3500 EI-Lamont Sustainable Development Practicum
  - SUMA K4734 EI Practicum on Environment and Sustainable Development

### **VII. Capstone Workshop (1 course)**

- SDEV W3280 Workshop in Sustainable Development

## **Program Faculty**

*Susana Adamo*, Adjunct Associate Professor, Center for International Earth Science Information Network

*Alastair Ager*, Professor of Clinical Population and Family Health, Mailman School of Public Health

*Mark Becker*, Adjunct Associate Professor of International and Public Affairs, School of International and Public Affairs

*Satyajit Bose*, Lecturer in Discipline of International and Public Affairs, School of International and Public Affairs

*Peter Coleman*, Associate Professor of Psychology and Education and Director, International Center for Cooperation and Conflict Resolution, *Teachers College*

*Patricia Culligan*, Professor, Civil Engineering & Engineering Mechanics, Department of Civil Engineering and Engineering Mechanics, Fu Foundation School of Engineering and Applied Science

*Ruth DeFries*, Denning Family Professor of Sustainable Development; Professor, Department of Ecology, Evolution and Environmental Biology

*Peter deMenocal*, Professor, Department of Earth and Environmental Sciences

*Glenn Denning*, Professor of Professional Practice, School of International and Public Affairs

*Stuart Gaffin*, Associate Research Scientist, *Center for Climate Systems Research*

*Joe Graziano*, Professor of Environmental Health Sciences, Professor of Pharmacology, Mailman School of Public Health

*Kevin Griffin*, Associate Professor, Department of Earth and Environmental Sciences

*Klaus Lackner*, Maurice Ewing and J. Lamar Worzel Professor of Geophysics, Fu Foundation School of Engineering and Applied Science

*Upmanu Lall*, Alan and Carol Silberstein Professor of Engineering, Fu Foundation School of Engineering and Applied Science

*Edward Lloyd*, Evan M. Frankel Clinical Professor in Environmental Law, Columbia Law School

*John Mutter*, Professor, Department of Earth and Environmental Sciences and School of International and Public Affairs

*Shahid Naeem*, Professor of Ecology and Department Chair of the Department of Ecology, Evolution, and Environmental Biology

*Anne Paxton*, Associate Professor of Clinical Epidemiology, Population and Family Health, Mailman School of Public Health

*Stephanie Pfirman*, Hirschorn Professor and Department Chair, Department of Environmental Science, Barnard College

*Louise Rosen*, Lecturer, School of International and Public Affairs

*Jeffrey D. Sachs*, Quetelet Professor of Sustainable Development, School of International and Public Affairs; Professor of Health Policy and Management

*Wolfram Schlenker*, Assistant Professor, Department of Economics, School of International and Public Affairs

*Peter Schlosser*, Vinton Professor of Earth and Environmental Engineering, School of Engineering and Applied Science; Professor of Earth and Environmental Sciences

*Elliot Sclar*, Professor of Urban Planning, Graduate School of Architecture, Planning and Preservation; Professor of International Affairs, School of International and Public Affairs

*Sam Sia*, Assistant Professor, Department of Biomedical Engineering, Fu Foundation School of Engineering and Applied Science

*Sara Tjossem*, Lecturer in Discipline of International and Public Affairs, School of International and Public Affairs

## **B.A. Earth and Environmental Sciences**

Walter C. Pitman III, Program Director – [pitman@ldeo.columbia.edu](mailto:pitman@ldeo.columbia.edu) – (845) 365-8397

Nicholas Christie-Blick, Program Director – [ncb@ldeo.columbia.edu](mailto:ncb@ldeo.columbia.edu) – (845) 365-8821

Mia Leo, Academic Department Administrator – [mia@ldeo.columbia.edu](mailto:mia@ldeo.columbia.edu) – (845) 365-8633

Carol S. Mountain, Undergraduate Program Coordinator – [carolm@ldeo.columbia.edu](mailto:carolm@ldeo.columbia.edu) – (845) 365-8551 / (212) 854-9705

Admission Deadline Must apply to Columbia College or the School of General Studies: Check application deadlines at their Websites.

Program Website: <http://eesc.columbia.edu/undergraduate/index.html>

### **Mission**

The undergraduate program in Earth and Environmental Sciences offers both a major and a concentration in either Earth science or environmental science, and a special concentration in environmental science for environmental biology majors. A comparable special concentration in environmental biology is available to environmental science majors in the Department of Ecology, Evolution and Environmental Biology.

Our program for majors aims to convey an understanding of how the complex Earth system works at a level that will encourage students to think creatively about Earth system processes and how to address problems in Earth and environmental science from a multidisciplinary perspective. The breadth of material covered provides an excellent background for those planning to enter the professions of law, business, diplomacy, public policy, teaching, journalism, etc. At the same time, the program provides sufficient depth so that our graduates will be prepared for graduate school in one of the Earth sciences. The program can be adjusted to accommodate students with particular career goals in mind.

### **Environmental Science Major**

The curriculum for the environmental science major provides an introduction to a variety of environmentally related fields. Environmental science majors are required to take three semesters of introductory courses and to obtain grounding in basic physics, chemistry, biology, and mathematics. Here, students are allowed some choice depending on interest. With this introduction to the Earth's environment, and equipped with a knowledge of the basic sciences, students are prepared to choose a set of upper-level courses in consultation with an undergraduate adviser. All environmental science majors are required to complete a research project, providing a practical application of mastered course work. This research culminates in the writing of a senior thesis. The research and the thesis are commonly done at Lamont-Doherty Earth Observatory with guidance from a faculty member or research scientist (there is a free shuttle bus between Morningside and Lamont). However, other options are also possible. Environmental science majors have an option to complete the special concentration in environmental biology for environmental science majors.

## **Earth Science Major**

The major in Earth science follows a similar rationale and requires the same introductory courses with a focus on the solid Earth and less emphasis on the ocean, atmosphere, and biosphere. Field experience, normally between the junior and senior year, is required but with two options. One is a six- to eight-week summer course, for which arrangements are made through another university. Few programs have sufficient students to mount such a course on their own. A second option is to select the senior thesis/research project.

## **Concentration**

Our program for concentrators serves students who want more exposure to science than is provided by introductory-level courses, and who are contemplating professional careers rather than planning to pursue graduate-level work in science. The program aims to provide concentrators with experience in data analysis and a thorough introduction to the Earth's systems.

The concentration in environmental science and the concentration in Earth science are designed to give students an understanding of "how the Earth works" and an introduction to the methods used to investigate Earth processes, including their capabilities and limitations. Concentrators often join the social professions (e.g., business, law, medicine, etc.) and take with them a stronger scientific background than is normally required of Columbia undergraduates. They take the same introductory courses as the majors, but fewer basic science and upper-level courses are required.

In addition to the environmental science and Earth science concentrations, the department sponsors a special concentration which must be done in conjunction with the environmental biology major. Students should be aware that they must complete the environmental biology major in order to receive credit for the special concentration. There is also a special concentration in environmental biology for environmental science majors sponsored by the Department of Ecology, Evolution, and Environmental Biology.

All majors and concentrators, when planning their programs of study, should regularly consult the directors of undergraduate studies, who can be contacted directly or through the department office on the fifth floor of Schermerhorn. The requirements listed for the different majors and concentrations are special to this department and must be read in conjunction with the general requirements for the bachelor's degree. Declaration of the major must be approved by the department and filed in the departmental office.

## **Major in Earth Science Requirements (47 credits)**

### **I. Introductory Earth Science (two courses):**

- One of the following:
  - V2200 Solid Earth
  - V1011 Earth: Origin, Evolution, Processes, and Future
- AND one of the following:
  - V2100 Climate

- V2300 Life

**II. Introductory Science (two courses):**

- One of the following Chemistry courses:
  - C1403 General Chemistry 1
  - BC2001 Chemistry 1
- One of the following Physics courses:
  - V1201 General Physics 1
  - C1401 Mechanics and Thermodynamics
  - C1601 Mechanics and Relativity
  - C2801 Accelerated Physics 1

**III. The following Mathematics course: V1101 Calculus 1**

**IV. Advanced Science (two from the choices listed):**

- One of the following Chemistry courses:
  - C1404 General Chemistry 2
  - C3071 Inorganic Chemistry
  - BC3230 Organic Chemistry
  - BC2002 Chemistry 2
- AND/OR one of the following Physics courses:
  - V1202 General Physics 2
  - C1402 Electricity, Magnetism, & Optics
  - C1602 Electricity, Magnetism, & Thermodynamics
  - C2802 Accelerated Physics 2
- AND/OR one of the following Mathematics courses:
  - V1102 Calculus 2
  - W1211 Introduction to Statistics (with Calculus)
  - BC3017 Data Analysis
- AND/OR EEEB W2001 Environmental Biology I

**V. Field Research (six credits):**

- Field Course\*
- OR\*\* one of the following:
  - BC3800 Research, BC3801 Research
  - AND W4076 Geologic Mapping
  - AND W3901 Senior Seminar

*\*A 6-8 week long summer field course, arranged through another University.*

*\*\*Students taking Research Seminar option must also take W4076 Geological Mapping as one of their five advanced courses.*

**VI. Advanced Courses (five of the following totaling at least seventeen credits. Substitutions allowed at discretion of adviser):**

- W3010 Field Geology
- W3015 Carbon Cycle
- W3018 Weapons of Mass Destruction
- W3101 Design and Maintenance of a Habitable Planet
- W3201 Solid Earth Dynamics

- W4050 Remote Sensing
- W4085 Geodynamics
- W4090 Geochronology and Thermochronology
- W4113 Mineralogy
- W4223 Sedimentary Geology
- W4230 Crustal Deformation
- W4300 Earth's Deep Interior
- W4330 Terrestrial Paleoclimate
- W4480 Paleobiology & Earth Systems History
- W4701 Petrology
- W4835 Wetlands and Climate Change
- W4886 Isotope Hydrology
- W4887 Isotope Geology I
- W4888 Isotope Geology II
- W4937 Cenozoic Paleooceanography
- W4941 Prin. Geophysics
- W4947 Plate Tectonics
- W4949 Seismology
- BC3019 Energy Resources
- BC3025 Hydrology
- E2002 Alternate Energy Resources
- E3321 Env. Geophys.

### **Earth Science Concentration Requirements (25.5 credits)**

#### **I. Introductory Earth Science (two courses):**

- One of the following:
  - V2200 Earth's Environmental Systems: Solid Earth
  - V1011 Earth: Origin, Evolution, Processes, Future
- AND one of the following:
  - V2100 Earth's Environmental Systems: Climate
  - V2300 Earth's Environmental Systems: Life

#### **II. Introductory Science (six credits):** Two courses in Chemistry, Physics, Mathematics and/or Biology chosen from the Introductory Science list for the Earth Science Major (need not be two in the same subject).

#### **III. Advanced Courses:** Three courses, but at least eleven credits chosen from the list of Advanced Courses for the Major in Earth Science. (Substitutions allowed at discretion of adviser.)

## **Major in Environmental Science Requirements (47 credits)**

### **I. Introductory Environmental Science (ALL of the following):**

- V2100 Earth's Environmental Systems: Climate
- V2200 Earth's Environmental Systems: Solid Earth
- V2300 Earth's Environmental Systems: Life

### **II. Introductory Science (two courses):**

- One of the following Chemistry courses:
  - C1403 Gen. Chemistry 1
  - BC2001 Chemistry 1
- One of the following Physics courses:
  - V1201 General Physics 1
  - C1401 Mechanics & Thermodynamics
  - C1601 Mechanics and Relativity
  - C2801 Accelerated Physics 1

### **III. The following Mathematics courses: V1101 Calculus 1**

### **IV. Advanced Science (two courses from the following course groups listed):**

- One of the following Chemistry courses:
  - C1404 General Chemistry 2
  - C3071 Inorganic Chemistry
  - BC3230 Organic Chemistry
  - BC2002 Chemistry 2
- AND/OR one of the following Physics courses:
  - V1202 General Physics 2
  - C1402 Electricity, Magnetism and Optics
  - C1602 Electricity, Magnetism and Thermodynamics
  - C2802 Accelerated Physics 2
- AND/OR one of the following Mathematics courses:
  - MATH V1102 Calculus 2
  - W1211 Statistics
  - BC3017 Data Analysis
- AND/OR EEEB W2001 Environmental Biology I

### **V. Research/Thesis (two courses):**

- One of the following:
  - BC3800 Research
  - BC3801 Research
- AND W3901 Senior Seminar

### **VI. Advanced Environmental Science (four of the following, at least two within the Department. Substitutions allowed at adviser's discretion. Non-science or engineering courses by approval of adviser):**

- W3015 Carbon Cycle
- W3018 Weapons of Mass Destruction

- W3101 Design and Maintenance of a Habitable Planet
- W3201 Solid Earth Dynamics
- W4008 Atmospheric Science
- W4030 Climate Change
- W4050 Remote Sensing
- W4090 Geochronology and Thermochronology
- W4223 Sedimentary Geology
- W4330 Terrestrial Paleoclimate
- W4550 Ecophysiology
- W4835 Wetlands and Climate Change
- W4885 Chemistry of Continental Waters
- W4886 Isotope Hydrology
- W4887 Isotope Geology I
- W4888 Isotope Geology II
- W4917 Earth/Human Interactions
- W4920 Paleoceanography
- W4925 Physical Oceanography
- W4926 Chemical Oceanography
- W4937 Cenozoic Paleoceanography
- W4947 Plate Tectonics
- BC3016 Environmental Measurements
- BC 3017 Environmental Data Analysis
- BC3019 Energy Resources
- BC3025 Hydrology
- BC3200 Ecotoxicology
- E2002 Alternate Energy Resources

### **Environmental Science Concentration Requirements (25.5 credits)**

- I. Introductory Environmental Science (ALL of the following):**
  - V2100 Earth's Environmental Systems: Climate
  - V2200 Earth's Environmental Systems: Solid Earth
  - V2300 Earth's Environmental Systems: Life
  
- II. Introductory Science:** Two courses in Chemistry, Physics, Mathematics and/or Biology from the Introductory Science list for the Major in Environmental Science. (Need not to be two in the same subject.)
  
- III. Advanced Courses:** Two courses chosen from the list of Advanced Courses for the Major in Environmental Science. Substitutions allowed at discretion of adviser.

### **Special Concentration in Environmental Science for Majors in Environmental Biology (31.5 credits)**

- I. Introductory Environmental Science (ALL of the following):**
  - EESC V2100 Earth's Environmental Systems: Climate
  - EESC V2200 Earth's Environmental Systems: Solid Earth

- EESC V2300 Earth's Environmental Systems: Life

**II. Introductory Science:** One year of Chemistry, Physics, Mathematics and/or Biology chosen from the Introductory Science list for the Environmental Science Major.

**III. Advanced Courses:** Four additional courses from those recommended for the Environmental Science Major (3000 level and above).

\*Advanced courses that fulfill the major in Environmental Biology cannot also count towards fulfillment of the special concentration in Environmental Science.

### **Special Concentration in Environmental Biology for Majors in Environmental Science**

Requirements: 39 points, distributed as described below.

**I. All students must take:**

- EEEB W2001 Environmental Biology I
- EEEB W2002 Environmental Biology II (equivalent to EESC V2300)
- EESC V2100 Earth's Environmental Systems: Climate
- EESC V2200 Earth's Environmental Systems: Solid Earth

**II. Introductory Science:**

- CHEM C1403 and C1404 (General Chemistry 1 & 2) OR
- CHEM C2407 and C2507 (Advanced General Chemistry and Lab) AND
- STAT V1111, V1211 (Intro to Statistics) or BIOL BC2286 (Statistics & Research Design)
- EEEB W3087 (Conservation Biology)

**III. Three additional advanced EEEB courses** (3000 level and above), each chosen from a different curricular area (evolution, genetics ecology, behavior, conservation; anatomy, physiology, diversity; biology laboratory courses)

\*Advanced courses that fulfill the major in environmental science cannot also count towards fulfillment of the special concentration in environmental biology.

### **Faculty**

*Geoffrey A. Abers*, Adjunct Professor, Earthquakes, Earth structure, and their relationship to active tectonic processes

*Mark H. Anders*, Associate Professor, Structural geology

*Robert F. Anderson*, Adjunct Professor, Role of ocean circulation and ocean biology in regulating the concentration of CO<sub>2</sub> in the atmosphere; sensitivity of these processes to climate change

*Roger N. Anderson*, Lecturer, Marine geophysics, energy

*Anthony G. Barnston*, Associate, Forecasting climate variability and change, ENSO, statistical prediction methods

*Natalie T. Boelman*, Storke-Doherty Lecturer, Terrestrial ecology, hyperspectral remote sensing, bioacoustics

*Wallace S. Broecker*, Newberry Professor, Paleoclimate, ocean chemistry, radiocarbon dating

*W. Roger Buck IV*, Adjunct Professor, Marine geophysics, geodynamics, tectonics

*Mark A. Cane*, G. Unger Vetlesen Professor (Joint with APAM), Climate physics, climate prediction, social impacts of climate; paleoclimate; oceanography

*Nicholas Christie-Blick*, Professor, Sedimentation processes, crustal deformation, deep-time Earth history

*James R. Cochran*, Lecturer, Marine geophysics, gravity, geodesy, isostasy

*Joel E. Cohen*, Adjunct Professor, Population science

*Anthony D. Del Genio*, Adjunct Professor, Role of clouds and water vapor in climate, dynamics of planetary atmospheres

*Peter B. deMenocal*, Professor, Paleoclimatology, ocean circulation variability, tropical-extratropical paleoclimate linkages, Pliocene-Pleistocene evolution of tropical climates, African climate and human evolution

*Peter M. Eisenberger*, Professor, Earth/human systems and interactions

*Göran Ekström*, Professor, Seismology

*John J. Flynn*, Adjunct Professor, Vertebrate paleontology

*Lisa M. Goddard*, Adjunct Associate Professor, Climate science

*Steven L. Goldstein*, Professor, Isotope geology, climate change, mantle geochemistry, Earth evolution

*Arnold L. Gordon*, Professor, Physical oceanography

*Kevin L. Griffin*, Associate Professor, Plant ecophysiology

*James E. Hansen*, Adjunct Professor, Unraveling the mechanisms of climate change, and projecting the climatic impact of human activity

*Sidney R. Hemming*, Associate Professor, Geochronology and the sedimentary record of changes through Earth history

*Bärbel Hönisch*, Assistant Professor, Validation of paleo-proxies in living foraminifers and application of knowledge to reconstruct past climate change

*Andrew Juhl*, Adjunct Associate Professor, Biological Oceanography

*Kim A. Kastens*, Adjunct Professor, Research on thinking & learning in geosciences; spatial cognition in geosciences; public understanding of the Earth & environment; marine geology

*Peter B. Kelemen*, Arthur D. Storke Memorial Professor, Carbonation of peridotite for CO<sub>2</sub> storage, melt transport in the mantle and lower crust, mantle shear zones and intermediate depth earthquakes

*Andrew A. Lacis*, Lecturer, Radiative transfer, climate change, remote sensing

*Arthur L. Lerner-Lam*, Adjunct Professor, Seismology, natural hazards

*Douglas G. Martinson*, Adjunct Professor, Physical oceanography, polar studies

*Jerry F. McManus*, Professor, Paleoclimate

*William H. Menke*, Professor, Seismology, solid Earth geophysics, tomography

*John C. Mutter*, Professor, Marine seismic studies of mid-ocean ridges, natural disasters, sustainable development

*Meredith Nettles*, Assistant Professor, Glacial seismology

*Mark A. Norell*, Adjunct Professor, Vertebrate paleontology

*Paul E. Olsen*, Arthur D. Storke Memorial Professor, Paleoecology, ecosystem evolution, vertebrate paleontology

*Hsien Wang Ou*, Adjunct Professor, Ocean dynamics, planetary circulation, climate theories

*Dorothy M. Peteet*, Adjunct Professor, Paleoecology, palynology

*Stephanie L. Pfirman*, Hirschorn Professor, Environmental Science, Barnard College, Arctic oceanography

*Walter C. Pitman III*, Adjunct Professor, Marine magnetics

*Terry A. Plank*, Professor, Igneous geochemistry, magma generation, crustal recycling, magmatic water

*Lorenzo M. Polvani*, Professor (Joint with APAM), atmosphere, ocean and climate dynamics, geophysical fluid dynamics, planetary atmospheres

*G. Michael Purdy*, Professor, Marine seismology

*Paul G. Richards*, Mellon Professor Emeritus & Special Lecturer, Theoretical Seismology, Arms Control/Nuclear disarmament

*Joerg M. Schaeferi*, Adjunct Associate Professor, Climate Science Cosmogenic Dating

*Peter Schlosser*, Vinton Professor, Aqueous geochemistry, hydrology

*Christopher H. Scholz*, Professor (Joint with APAM), Experimental and theoretical rock mechanics, especially friction, fracture, hydraulic transport properties, nonlinear systems, mechanics of earthquakes and faulting

*Christopher Small*, Adjunct Professor, Imaging spatio-temporal dynamics of the Earth surface with light, sound & gravity

*Jason E. Smerdon*, Storke-Doherty Lecturer, Late-Holocene paleoclimate, statistical methods, geothermal climate signals

*Adam H. Sobel*, Professor (Joint with APAM), Atmospheric and climate dynamics, tropical meteorology

*Marc W. Spiegelman*, Arthur D. Storks Memorial Professor (Joint with APAM), Coupled fluid/solid mechanics, reactive fluid flow, solid Earth and magma dynamics, scientific computation/modeling

*Martin Stute*, Ann Olin Whitney Professor, Barnard College, Aqueous geochemistry, hydrology

*Taro Takahashi*, Adjunct Professor, Carbon cycle in the oceans, atmosphere and biosphere

*Andreas M. Thurnherr*, Lecturer, Physical Oceanography

*Mingfang Ting*, Adjunct Professor, Climate dynamics

*Maria Tolstoy*, Associate Professor, Marine Seismology

*David Walker*, Higgins Professor, Experimental petrology, geology, materials science, alternate energy

*Spahr C. Webb*, Adjunct Professor, Marine geophysics, seismology, ocean bottom seismometry/instrumentation

## **B.A. Concentration and Post-Baccalaureate – Environmental Biology**

Matthew Palmer, Director of Undergraduate Studies and Post-Baccalaureate Program Director – [mp2434@columbia.edu](mailto:mp2434@columbia.edu) – (212) 854-4767

Jill Shapiro, Major Adviser for Evolutionary Biology of the Human Species – [jss19@columbia.edu](mailto:jss19@columbia.edu) – (212) 854-5819

Lourdes Gautier, Academic Department Administrator – [lq2019@columbia.edu](mailto:lq2019@columbia.edu) – (212) 854-8665

Admission Deadlines: major declaration early-mid spring; post-baccalaureate students can enter in any semester through rolling admission.

Program Website: <http://www.columbia.edu/cu/e3b/undergrad.html>

### **Mission**

Our mission is to educate a new generation of scientists and practitioners in the theory and methods of ecology, evolution, and environmental biology. Our educational programs emphasize a multi-disciplinary perspective on the Earth's declining biodiversity, integrating an understanding from the biological sciences with insights from relevant fields in the physical and social sciences.

### **Academic Programs**

The Department of Ecology, Evolution, and Environmental Biology runs two undergraduate majors/concentrations. The primary major is in Environmental Biology and the second is Evolutionary Biology of the Human Species. The foci and requirements vary substantially and are intended for students with different academic interests. The department also offers a post-baccalaureate program in conjunction with School of Continuing Education for students who have already completed a bachelor's degree.

### **Bachelor of Arts in Environmental Biology**

The Environmental Biology major is offered by the Department of Ecology, Evolution, and Environmental Biology (E3B). It provides students with a strong foundation in areas of organismal biology, including evolution, systematics, ecology, population biology, behavior, and biodiversity conservation, as well as an exposure to social sciences such as economics and environmental policy. All majors complete an environmental biology research internship that serves as the basis for the senior thesis. The major provides the solid academic training required to either enter the rapidly evolving environmental work force or to pursue graduate studies.

### **Concentration in Environmental Biology**

While students intending to pursue graduate education are advised to undertake the Environmental Biology major, E3B also offers a concentration in Environmental Biology for students whose main academic focus is elsewhere (e.g. law, economics, chemistry), but who wish to pursue some organized study in our field. The concentration includes fewer

introductory and upper division courses, no internship, and no research seminar. Details on the Concentration are available from the Columbia College Bulletin.

## **Environmental Biology Major Requirements**

### **I. Lower division requirements: 33 credits**

- EEEB W2001 *and* W2002 Environmental Biology I and II
- EESC V2100 Climate System *and* V2200 Solid Earth System
- CHEM C1403 & C1404, *or* C2407 & C2507
- PHYS V1201
- MATH V1101, V1102, V1105 *or* V1106
- STAT W1111, W1211, EEEB W3020, *or* BIOL BC3386

### **II. Upper division requirements: 18 credits**

*Note: The course offerings that satisfy these requirements vary between semesters and years. A list of approved courses is available on the E3B Website or from the Director of Undergraduate Studies.*

- **Environmental policy/economics (one of the following):**
  - ANTH V3004 Introduction to environmental anthropology
  - ANTH W3973 Environment and development
  - ANTH W4022 Political ecology
  - ANTH W4124 People and their environment
  - ECON BC3039 Environmental and natural resource economics
  - EEEB G4184 Plant conservation in theory and practice
  - EESC BC3032 Agricultural and urban land use
  - EESC BC3035 Environmental hazards and disasters
  - EESC BC3040 Environmental law
  - EESC W3018 Weapons of mass destruction
  - EESC W4917 The earth/human system
  - INAF U4729 Alternative energy resources
  - INAF U4737 Economics of the environment
  - INAF U4740 Introduction to environmental sociology
  - SOCI W3290 Environmental sociology
  - SUSD W3300 Challenges of sustainable development
- **Evolution/genetics (one of following):**
  - ANEB W3204 Dynamics of human evolution
  - ANEB W3970 Biological basis of human variation
  - ANEB G4146 Human brain evolving
  - ANEB W4200 Fossil evidence of human evolution
  - BIOL BC3200 Genetics
  - BIOL BC3240 Plant evolution
  - BIOL BC3260 Vertebrate evolution
  - BIOL BC3278 Evolution
  - BIOL W3031 Genetics
  - BIOL W3032 Genetics
  - BIOL W3208 Introduction to evolutionary biology
  - BIOL W4205 Origins of life

- EEEB G4789 Biogeography
- EEEB G4126 Conservation genetics
- EEEB G4020 Population genetics
- EEEB G4210 Herpetology
- EEEB G4601 Biological systematic
- EEEB G4910 Field Botany and Plant Systematics
- **Ecology, behavior, and conservation biology (one of the following):**
  - BIOL BC3280 Animal behavior
  - BIOL BC3372 Population and community ecology
  - EEEB W3940 Current controversies in primate behavior and ecology
  - EEEB G4060 Invasion biology
  - EEEB G4086 Ethnobotany
  - EEEB G4100 Forest ecology
  - EEEB G4120 Islands: ecology, evolution and conservation
  - EEEB G4127 Disease ecology and conservation
  - EEEB G4130 Restoration and urban ecology
  - EEEB G4150 Modeling populations and communities
  - EEEB G4184 Plant conservation in theory and practice
  - EEEB G4185 Insect ecology and conservation
  - EEEB G4205 Extinction science
  - EEEB G4650 Biodiversity and ecosystem function
  - EEEB G4126 Conservation genetics
  - EEEB W3011 Behavioral biology of the living primates
  - EEEB W3087 Conservation biology
  - EESC BC3021 Forests and environmental change
  - EESC W4550 Plant ecophysiology
  - EESC W4835 Wetlands and climate change
- **Morphology, Physiology, and Diversity (one of the following):**
  - ANEB G4147 Human skeletal biology I
  - ANEB G4148 Human skeletal biology II
  - BIOL BC3240 Plant evolution
  - BIOL BC3250 Invertebrate zoology
  - BIOL BC3260 Vertebrate evolution
  - BIOL BC3340 Plant physiology
  - BIOL BC3360 Animal physiology
  - BIOL W3002 Animal structure and function
  - BIOL W3006 Physiology
  - BIOL W3022 Developmental Biology
  - BIOL W3041 Cell Biology
  - EEEB W3030 Biology, systematics, and evolutionary history of the apes
  - EEEB W3204 Primate skeletal anatomy
  - EEEB W3215 Forensic osteology
  - EEEB G4140 Ornithology
  - EEEB G4200 Ecotoxicology
  - EEEB G4210 Herpetology
  - EEEB G4650 Biodiversity and ecosystem processes
  - EEEB G4660 Fish biodiversity, systematics, and evolution
  - EEEB W4666 Insect biodiversity
  - EEEB W4668 Diversity in fungi

- EEEB W4910 Field Botany and Plant Systematics
- EESC W4550 Plant ecophysiology

*Environmental Biology majors must also complete one additional course from the preceding four categories (i.e., five total courses which cover the four distributional requirements). At least one of these courses must include a laboratory component. Consult with the Director of Undergraduate Studies for further details.*

- III. Thesis Research Seminar:** EEEB W3991 & W3992 (three credits required, six credits strongly recommended).
- IV. Internship requirement:** Each student is required to complete an environmental biology research internship after the junior year. This research serves as the basis for the senior thesis, which is developed during the required thesis research seminars (EEEEB 3391 and/or 3392). Students develop research projects in consultation with a research mentor (often associated with the consortium institutions of the Center for Environmental Research and Conservation) and faculty thesis adviser.

## **Evolutionary Biology of the Human Species**

The major in Evolutionary Biology of the Human Species provides students with a foundation in the interrelated spheres of behavior, ecology, genetics, evolution, and morphology, patterns of growth, adaptation and forensics. Using the framework of evolution and with attention to the interplay between biology and culture, research in these areas is applied to our own species and to our closest relatives to understand who we are and where we came from. This integrated biological study of the human species is also known as biological anthropology. As an interdisciplinary major students are also encouraged to draw on courses in related fields including biology, anthropology, geology and psychology as part of their studies.

## **Degree Requirements**

### **Major in the Evolutionary Biology of the Human Species**

36 points distributed as described below. Students must take a minimum of 20 points from EEEB or ANEB biological anthropology courses. Other points may be taken either within or outside of EEEB with adviser approval.

## **Required Courses**

### **I. Introductory Level:**

- EEEB V1010 The Human Species: Its Place in Nature
- EEEB V1011 Behavioral Biology of Living Primates
- Alternatively, in place of Behavioral Biology of Living Primates students may take Environmental Biology II (EEEEB W2002) as long as they take the 3000 level version of the former course (EEEEB W3011) as well.

### **II. Advanced Level (nine points) :**

- EEEB V3087 Conservation Biology

**III. Theoretical Foundation from Related Fields (one course from each subset, six points):**

- Cultural Anthropology
  - ANTH V1002 The Interpretation of Culture
  - ANTH V2004 Introduction to Social and Cultural Anthropology
  - ANTH V3041 Theories of Culture: Past and Present
- Archeology
  - ANTH V3280 Archeological Theory and Method
  - ACLG V2028 Introduction to 21<sup>st</sup> Century Archeology
  - ANTH V1007 Origins of Human Society

**IV. Breadth Requirement (nine points, one course from each subset, can overlap seminar requirement:**

- Genetics/Human Variation
  - Population Genetics (EEEEB W4020)
  - Genetics (BIOL W3031/C3032 or BIOL BC3200)
  - Biological Basis of Human Variation (ANEB V3970)
  - Race: The Tangled History of a Biological Concept (EEEEB W4700)
- Primate Behavioral Biology and Ecology
  - Current Controversies in Primate Behavior and Ecology (EEEEB V3940)
  - Animal Behavior (BIOL BC3280)
  - The Evolution of Behavior (PSYC W3540)
  - Behavioral Neuroscience (PSYC BC1119) ["Apes" EEEB W3030 may be applied here if needed]
- Human Evolution/Morphology
  - Human Skeletal Biology (ANEB G4147, G4148)
  - Explorations in Primate Anatomy (EEEEB W3208)
  - Fossil Evidence for Human Evolution (ANEB W4200)
  - Dynamics of Human Evolution (EEEEBW3204 ANEB 3204)
  - The Biology, Systematics and Evolutionary History of "The Apes" (EEEEB V3030)
  - Vertebrate Zoology (BIOL BC3260)
  - Animal Structure and Function (BIOL W3002)
  - Physiology (BIOL 3006), any of the BME Anatomy Courses
  - Forensic Osteology (EEEEB 3215)

**V. At least one seminar:** Current Controversies in Primate Behavior, Dynamics of Human Evolution, Controversial Topics in Human Evolution, Biological Basis of Human Variation (four points). May overlap breadth requirement.

**VI. EBHS Senior Thesis Seminar EEEB W3993-3994 (four points):** While students are not required to complete a thesis, all are encouraged to undertake this year long course in which they undertake independent original research

It is strongly suggested that students intending to pursue graduate study in this field broaden their foundation by taking an introductory biology course (optimally Environmental Biology I), a 3000-level genetics course and a quantitative methods course. The Major Adviser will make additional recommendations dependent on the student's area of focus.

## **Post-baccalaureate Program in Ecology, Evolution, and Environmental Biology**

For students who have recently completed a degree in a field other than environmental science or biology, but would like to further their education in this field, E3B offers a post-baccalaureate program through the School of Continuing Education. The program is geared toward students who expect to apply to graduate programs in an environmental discipline. The curriculum includes the core sciences of biology, chemistry, statistics, and environmental science in addition to conservation biology and two upper-division electives. We also welcome those who simply desire to learn about environmental biology through a rigorous curriculum. The program requirements are described in detail at: <http://ce.columbia.edu/Postbaccalaureate-Studies/Ecology-Evolution-and-Environmental-Biology-Certificate-Program-1>.

### **Core Faculty**

*Marina Cords*, Professor

*Ruth DeFries*, Denning Professor of Sustainable Development

*Don Melnick*, Thomas Hunt Morgan Professor of Conservation Biology

*Shahid Naeem*, Professor and Chair

*Dustin Rubenstein*, Assistant Professor

*Maria Uriarte*, Assistant Professor

*Fabio Corsi*, Lecturer in Discipline

*Matthew Palmer*, Lecturer in Discipline

*Jill Shapiro*, Lecturer in Discipline

### **Affiliated Faculty**

*Philip Ammirato*, Professor Emeritus of Biological Sciences, Barnard College

*Walter Bock*, Professor of Biological Sciences

*John Glendinning*, Professor of Biological Sciences, Barnard College

*Paul Hertz*, Professor of Biological Sciences, Barnard College

*Ralph Holloway*, Professor of Anthropology

*Darcy Kelley*, Professor of Biological Sciences

*Paul Olsen*, Professor of Earth and Environmental Sciences

*Robert Pollack*, Professor of Biological Sciences

*Jeanne Poindexter*, Professor of Biological Sciences, Barnard College

*Steve Cohen*, Associate Professor of SIPA

*Kevin Griffin*, Associate Professor of Earth and Environmental Sciences

*Brian Morton*, Associate Professor of Biological Sciences, Barnard College

*Paige West*, Associate Professor of Anthropology, Barnard College

*Hillary Callahan*, Assistant Professor of Biological Sciences, Barnard College

**Adjunct Faculty:**

The Department of E3B also has a large adjunct faculty (see [http://www.columbia.edu/cu/e3b/faculty\\_adjunct.html](http://www.columbia.edu/cu/e3b/faculty_adjunct.html)), most of who are senior scientists at one of the following institutions: American Museum of Natural History, New York Botanical Garden, Wildlife Conservation Society, and Wildlife Trust. These faculty members teach courses and advise student research.

## **B.S. Earth and Environmental Engineering**

Tuncel M. Yegulalp, Program Director - [yegulalp@columbia.edu](mailto:yegulalp@columbia.edu) – (212) 854-2984

Gary Hill, Program Coordinator – [gh2206@columbia.edu](mailto:gh2206@columbia.edu) - (212) 854-2926

Peter Rennée, Department Administrator - [pr99@columbia.edu](mailto:pr99@columbia.edu) – (212) 854-7065

Admission Deadlines: Early – November 1, Regular – January 2

Program Website: <http://www.engineering.columbia.edu/bulletin/dept/earth.php>

### **Mission**

The Bachelor of Science (B.S.) degree in Earth and Environmental Engineering (EEE) prepares students for careers in the public and private sector concerned with primary materials (minerals, fuels, water) and the environment. Graduates are also prepared to continue with further studies in Earth/environmental sciences and engineering, business, public policy, international studies, law, and medicine. The EEE program is accredited as an environmental engineering program by the Accreditation Board for Engineering and Technology (ABET).

### **Undergraduate Program Objectives**

1. Graduates equipped with the necessary tools (mathematics, chemistry, physics, Earth sciences, and engineering science) will understand and implement the underlying principles used in the engineering of processes and systems.
2. Graduates will be able to pursue careers in industry, government agencies, and other organizations concerned with the environment and the provision of primary and secondary materials and energy, as well continue their education as graduate students in related disciplines.
3. Graduates will possess the basic concepts and skills needed for the practice of earth and environmental engineering, including measurement and control of material flows through the environment; assessment of environmental impacts of past, present, and future industrial activities; and analysis and design of processes for remediation, recycling, and disposal of used materials.
4. Graduates will practice their profession with excellent written and communication skills and with professional ethics and responsibilities.

### **The Curriculum**

Earth and environmental engineering is an inherently broad and multidisciplinary field. Therefore the approach of the EEE curriculum is to expose students to multiple facets within this engineering specialty, while focusing in-depth on one of three particular problem areas that are of critical importance in the 21st century. A strong foundation in basic math/sciences and liberal arts is also an important part of the EEE curriculum, since these fundamentals are needed to understand and address the technical and socioeconomic aspects of all environmental problems.

The EEE curriculum also spans a broad spectrum of educational methods and research/professional experiences. Traditional lecture classes are complemented with physical laboratory and computer modeling components, and specific classes are devoted to

laboratory and field methods relevant to EEE. A number of introductory and upper-level elective courses are taught using a project-team-oriented approach, with student groups working semester-long on a problem, or components of a larger problem in a studio setting. Service learning (i.e., learning by doing) is also strongly emphasized, via course projects, summer internships with local companies, undergraduate research opportunities, and the EEE senior design project.

### **First- and Second-Year Curriculum**

Our first- and second-year curriculum is consistent with the Columbia SEAS and liberal arts core requirements. In addition, there are a number of EEE-specific math and science courses. More importantly, there are two courses taught by EEE faculty, which provide an early introduction to Earth and environmental engineering and continuity throughout the four-year EEE curriculum:

- E1100: A Better Planet by Design. Scheduled for first-year spring semester. This is EEE's professional-level course, so it is not required by the EEE program but highly recommended.
- EAEE E2002: Alternative Energy Resources. Scheduled for second-year fall semester. This course is required by the EEE program.

### **Junior/Senior Curriculum**

Our junior- and senior-year curriculum consists of an intensive set of technical engineering courses, with the following objectives:

- Build fundamental skills in applied math and sciences such as fluid mechanics, thermodynamics, and statistics.
- Understand traditional environmental engineering topics related to pollution control, transport, and remediation.
- Introduce emerging 21st-century environmental engineering problems related to all three EEE concentration areas: **Water Resources and Climate Risks**, **Sustainable Energy and Materials**, and **Environmental Health Engineering**.
- In-depth focus on one concentration area to be selected by the student through technical electives.

### **Faculty**

*William Becker*, Adjunct Professor of Earth and Environmental Engineering

*Marco Castaldi*, Assistant Professor of Earth and Environmental Engineering

*Kartik Chandran*, Assistant Professor of Earth and Environmental Engineering

*X Chen*, Associate Professor

*Paul F. Duby*, Professor of Mineral Engineering

*Raymond Farinato*, Adjunct Professor of Earth and Environmental Engineering

*Robert Farrauto*, Adjunct Professor of Earth and Environmental Engineering

*Vasilis Fthenakis*, Senior Research Scientist, Earth and Environmental Engineering

*Yuri Gorokovich*, Adjunct Professor of Earth and Environmental Engineering

*Klaus Lackner*, Chair, Maurice Ewing and J. Lamar Worzel Professor of Geophysics

*Upmanu Lall*, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics

*Wade McGillis*, Doherty Research Scientist, Earth and Environmental Engineering

*Ismail Cevdet Noyan*, Professor of Materials Science

*Ah-Hyung (Alissa) Park*, Lenfest Junior Professor in Applied Climate Science

*Sri Rangarajan*, Adjunct Assistant Professor of Earth and Environmental Engineering

*Peter Schlosser*, Vinton Professor of Earth and Environmental Engineering

*Ponisseril Somasundaran*, LaVon Duddleson Krumb Professor of Earth and Environmental Engineering

*Nickolas J. Themelis*, Stanley-Thompson Professor Emeritus of Chemical Metallurgy

*Nicholas J. Turro*, William B. Schweitzer Professor of Chemistry

*Tuncel M. Yegulalp*, Professor of Mining Engineering

## **B.A. Environmental Biology (Barnard)**

Stephanie Pfirman, Program Co-Chair – [spfirman@barnard.edu](mailto:spfirman@barnard.edu) – (212) 854-5120

Martin Stute, Program Co-Chair – [mstute@barnard.edu](mailto:mstute@barnard.edu) – (212) 854-8110

Paul Hertz, Program Co-Chair – [phertz@barnard.edu](mailto:phertz@barnard.edu) – (212) 854-2151

Hilary Callahan, Program Co-Chair – [hcallahan@barnard.edu](mailto:hcallahan@barnard.edu) – (212) 854-5405

Catherine Cook, Administrator – [ccook@barnard.edu](mailto:ccook@barnard.edu) – (212) 854-5618

Program Website: <http://www.barnard.edu/envsci/programs/envbiomajor.htm>

### **Mission**

The Environmental Biology major is designed to provide a student with a broad education in the field as well as an opportunity to cover a specific aspect of biology in depth if she desires. The major is suitable for students who intend to pursue a research career in conservation biology, ecology, or environmental biology as well as for students interested in environmental law or policy. Career opportunities are possible in: natural history museums and parks, environmental education, environmental advocacy, and government agencies.

The departments of Environmental Science and Biology jointly administer the Environmental Biology program. Majors take courses in both departments, and should maintain contact with advisers in each. The senior thesis requirement for the Environmental Biology major can be completed by enrolling in a senior seminar in either the Environmental Science or Biology departments or by completing guided research in Biology.

### **Major Requirements**

- I. **Biology** (One year of introductory Biology with lab at the 1500-level sequence; one lecture course in Ecology with lab; one lecture course in Organismal Biology, one additional lecture course in Biology—not including Organismal Biology.)
  - Molecular and Cellular Biology, BIOL BC1502y
  - Physiology, Ecology, and Evolutionary Biology, BIOL BC 1500x
  - Biodiversity Laboratory, BIOL BC1501x
  - Biological Experimentation Laboratory, BIOL BC1503y
  - Ecology, BIOL BC2272y or Applied Ecology and Evolution, BC3380, or other Ecology course
  - Laboratory in Ecology, BIOL BC2873y.
  
- II. **Organismal Biology (one of the following):**
  - Plant Biology, BIOL BC2240x
  - Invertebrate Zoology, BIOL BC2250
  - Vertebrate Biology, BIOL BC2262y
  - Microbiology, BIOL BC3320x
  - One additional lecture course in Biology (not listed above)
  
- III. **Environmental Science (three courses):**
  - One year of introduction Environmental Science with lab:
    - Climate with lab EESC V2100x,y

- Solid Earth with lab, EESC V2200x
- One of the following in methodology:
  - Field Methods, EESC BC3014x
  - Environmental Measurements, EESC BC3016y
  - Hydrology, EESC BC3025y
  - Global Assessment Remote Sensing, EESC NO36x
  - GIS-Remote Sensing, Environmental Infrastructure Management, EAEE E4009
- One additional lecture course in Environmental Science (please see the electives listed under the Environmental Science major)

**IV. Introductory Chemistry with Lab (including one semester of Organic Chemistry)**

- General Chemistry I with lab, CHEM BC2001x
- Organic Chemistry I, CHEM BC3230y with Organic Lab, CHEM BC3328y.

**V. Data Handling (one of the following):**

- Research Design and Analysis, BIOL BC2286
- Data Analysis, EESC BC3017
- Statistics for Ecology and Evolutionary Biology, EEEB W3020.

**VI. Senior Thesis (completed in either Biology or Environmental Science) from the following courses:**

- Senior Seminar in Biology, BIOL BC3590x, y
- Senior Thesis Research and Seminar, BIOL BC3593x, 3594y
- Senior Research Seminar, EESC BC3800x and Senior Research Seminar, EESC BC3801y

**Core Faculty**

*Stephanie Pfirman*, Professor and Chair, Environmental Science.

*Brian Mailloux*, Assistant Professor, Environmental Science

*Paul Hertz*, Professor, Biology

*Hilary Callahan*, Assistant Professor, Ecological Genetics

**Affiliated Faculty**

*Philip V. Ammirato*, Professor Emeritus, Plant Development and Physiology

*Elizabeth S. Boylan*, Provost

*James Danoff-Burg*, Part-time Faculty, Ecology

*John Glendinning*, Assistant Professor and Chair, Physiology and Behavior

*Brian Morton*, Associate Professor, Molecular Evolution

*Jeanne S. Poindexter*, Professor Emeritus, Microbial Physiology and Ecology

*Kristen Shepard*, Assistant Professor, Plant Development & Physiology

*Martin Stute*, Associate Professor, Environmental Science

*Jennifer Mansfield*, Assistant Professor, Developmental Genetics

*Matthew Wallenfang*, Assistant Professor, Cell Biology

## **B.A. Environmental Science (Barnard)**

Stephanie Pfirman, Program Co-Chair – [spfirman@barnard.edu](mailto:spfirman@barnard.edu) – (212) 854-5120

Martin Stute, Program Co-Chair – [mstute@barnard.edu](mailto:mstute@barnard.edu) – (212) 854-8110

Catherine Cook, Administrator – [ccook@barnard.edu](mailto:ccook@barnard.edu) – (212) 854-5618

Program Website: <http://www.barnard.edu/envsci/programs/envscimajor.htm>

### **Mission**

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 Environmental Science 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. The program aims to teach our students to critically evaluate the diverse information necessary for sound environmental analysis. Courses foster an interdisciplinary approach to environmental problem-solving. Internships, research, or field experience often form the basis for the Senior Thesis and are extremely valuable in preparing students for a variety of careers in environmental science.

### **Major Requirements**

#### **I. Part A – Core Sciences (the following four courses with labs):**

- Earth's Environmental Systems: Climate with lab, EESC V2100x,y
- Earth's Environmental Systems: Solid Earth with lab, EESC V2200x
- General Chemistry I with lab, CHEM BC2001x
- Physiology, Ecology, and Evolutionary Biology, BIOL BC1500x with Biodiversity Laboratory, BIOL BC1501x
- Earth's Environmental Systems: Life with lab (for students not planning on taking upper level courses in Biology), EESC V2300y

#### **II. Part B – Basic Sciences (two of the following):**

- Organic Chemistry I, CHEM BC3230y
- Organic laboratory (recommended) CHEM BC3328y
- General Chemistry II with lab, CHEM BC2002
- Organic Chemistry II, CHEM BC3231x
- Molecular, Cellular and Developmental Biology, BIOL BC1502y
- Biological Exp. laboratory (recommended), BIOL BC1503y
- General Physics, PHYS V1201x
- General Physics, PHYS V1202y
- Physics I: Mechanics, PHYS BC2001x
- Physics II: Electricity and Magnetism, PHYS BC2002y
- Physics III: Waves and Optics, PHYS BC3001x

**III. Part C – Quantitative Methods (two of the following):**

- Calculus I
- Calculus II
- Statistics/Data Analysis (e.g., EESC BC3017)
- Economics (ECON BC1002, 1003, or 1105)

**IV. Part D – Environmental Electives (four of the following):**

- Introduction to Environmental Anthropology, ANTH V3004
- Environment and Cultural Behavior ANTH V3971
- A Better Planet by Design, EAEE E1100y
- Introduction to Environmental Science I or II, EESC BC1001x EESC BC1002y (if taken before Earth's Environmental Systems)
- Earth's Environmental Systems: Life + lab, EESC V2300x; (cannot count for both Part A and Part D)
- Science for Sustainable Development, EESC W2330y
- Shorelines and Streams, EESC BC3013
- Field Methods in Environmental Science, EESC BC3014x
- \*Earth's Carbon Cycle, EESC V3015y;
- Environmental Measurements, EESC BC3016x, or Quantitative and Instrumental Techniques, CHEM BC3338y
- Environmental Data Analysis, EESC BC3017x (cannot count for both Part C and Part D)
- Weapons of Mass Destruction, EESC W3018
- \*Energy Resources, EESC BC3019x
- \*Forests and Environmental Change, EESC BC3021x
- \*Hydrology, EESC BC3025y
- \*Case Studies in Land Use Dynamics, EESC BC3026y
- \*Agricultural and Urban Land Use, EESC BC3032y
- \*Waste Management, EESC BC3033y
- Natural Resources and Environmental Economics, ECON BC3039x
- Environmental Risks and Disasters, EESC V1201y
- Environmental Law, EESC BC3040y
- \*Ecotoxicology, EESC BC3200x
- \*Principles of Geomorphology, EESC V3327x
- \*Chemistry of Continental Waters, EESC W4885y
- \*Global Assessment and Monitoring Using Remote Systems, EESC W4050x, or GIS Applications to Environmental Problems, EAEE W4009

- Economics of the Environment, ECON W4625y
- Microbiology, BIOL BC3320x
- Plant Physiology, BIOL BC3340y
- General Ecology, BIOL BC2272x, or Applied Ecology and Evolution, BIOL BC3279x
- Conservation Biology, EEEB W3087
- Restoration Ecology, BIOL G4130
- \*International Politics and the Environment, INAF U4727.

*Check with the Environmental Science Department for other electives*

*\* Course taught alternate years.*

**V.**

**Part E – Senior Thesis:**

- Senior Research Seminar, EESC BC3800x
- Senior Research Seminar, EESC BC3801y

*\*\*Note Major Requirements may change, please consult the department for more detailed information.*

**Requirements for the Minor**

Students wishing to minor in Environmental Science must have a plan approved by the Environmental Science Department chair. Five courses are required including two laboratory science courses (such as EESC BC1001, EESC BC1002, EESC V2100, EESC V2200, EESC V2300) and three electives that form a coherent program. (Please see elective courses listed in the Environmental Science Major.) In some cases, courses in other sciences can be substituted with the approval of the chair.

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

**Core Faculty**

*Stephanie Pfirman*, Department Co-Chair and Professor, Environmental Science

*Martin Stute*, Department Co-Chair and Professor, Environmental Science

*Brian Mailloux*, Assistant Professor, Environmental Science

*Peter Bower*, Senior Lecturer, Environmental Science

*Terryanne Maenza-Gmelch*, Lecturer and Laboratory Director, Environmental Science

*Diane Dittrick*, Laboratory Director, Environmental Science

## **Affiliated Faculty**

*Cynthia Rosenzweig*, Adjunct Professor, Goddard Institute for Space Studies and Center for Climate Systems Research

## **B.A. Environmental Policy (Barnard)**

Stephanie Pfirman, Program Co-Chair – [spfirman@barnard.edu](mailto:spfirman@barnard.edu) – (212) 854-5120

Martin Stute, Program Co-Chair – [mstute@barnard.edu](mailto:mstute@barnard.edu) – (212) 854-8110

Catherine Cook, Administrator – [ccook@barnard.edu](mailto:ccook@barnard.edu) – (212) 854-5618

Program Website: <http://www.barnard.edu/envsci/programs/envaffmajor.htm>

### **Mission**

Environmental Policy is a growing field at the intersection of science and society. It focuses on political institutions, societal processes, and individual choices that lead to environmental stress, along with the impact of environmental stress on institutions, processes, and individuals and the development of approaches to reduce environmental impact.

The Environmental Policy program is designed to equip students to play effective roles as citizens or career professionals who can actively engage in environmental decision-making and policy. Majors learn to analyze and evaluate environmental, political, and economic systems and public policies in the context of environmental concerns. While students have their primary affiliation with the Environmental Science Department, they choose a second adviser from the departments of Political Science, Economics, or Anthropology. A required senior thesis is completed in the Senior Research Seminar.

### **Major Requirements:**

#### **I. Part A1 – Natural Science Foundation (three of the following):**

- Earth's Environmental Systems: Climate with lab, EESC V2100x,y
- General Chemistry I with lab, CHEM BC 2001x
- Physiology, Ecology, and Evolutionary Biology, BIOL BC1500x with Biodiversity Laboratory, BIOL BC1501x
- Environmental Biology II with lab, BIOL W2002
- Earth's Environmental Systems: Life with Lab, EESC V2300y
- Columbia's SEE-U summer program

#### **II. Part A2 – Natural Science Foundation (one of the following):**

- Organic Chemistry, CHEM BC3230 (for students who intend to pursue advanced coursework in natural sciences)
- General Chemistry II with lab, CHEM BC2002 (for students who prefer a general introduction to chemistry and do not intend to pursue advanced coursework in natural sciences)
- Earth's Environmental Systems: Solid Earth with lab, EESC V2200
- Molecular, Cellular and Developmental Biology, BIOL BC1502y with Biological Exp. Lab, BIOL BC1503y
- Introduction to Environmental Science I with Lab, EESC BC1001 or 1002

#### **III. Part B – Quantitative Assessment (two of the following):**

- Data Analysis, EESC BC3017
- GIS Applications to Environmental Problems, EAEE E4009

- Environmental Measurements, EESC BC3016
- Global Assessment and Monitoring Using Remote Systems, EESC W4050
- GIS Methods and Case Studies, URBS V3200.

**IV. Part C – Decision-making Foundation (one course from each grouping, three courses total):**

- Economics
  - Introduction to Economic Reasoning, ECON BC1003x,y
  - Principles of Economics, ECON W1105
- Politics
  - Environmental Politics, POS V3212y
  - International Politics, POLS V1601
  - Comparative Politics, POSL V1501y
  - International Relations of the Environment, POLS 3616y/ INAF U6243y
  - Urban Planning in Developing Countries, URBS V3565x
  - Politics of the American Environment, HIST W342
- Culture
  - Interpretation of Culture, ANTH V1002x,y with Discussion Section, ANTH V1112x,y
  - Human Species-Place in Nature, EEEB V1010x
  - Introduction to Environmental Anthropology, ANTH V3004 (no longer offered)
  - Challenges to Sustainable Development, SDEV3300x

**V. Part D – Natural Science Elective (one of the following):**

- Alternate Energy Resources is EAEE E2002
- Science for Sustainable Development, EESC W2330y
- Environmental Measurements, EESC BC3016x (Counts only for Part B or D)
- Weapons of Mass Destruction, EESC W3018y
- \*Energy Resources EESC BC3019x
- \*Forests and Environmental Change, EESC BC3021
- \*Hydrology, EESC BC3025y
- \*Case Studies in Land-use Dynamics, EESC BC3026
- \*Agricultural and Urban Land Use, EESC BC3032y
- \*Waste Management, EESC BC3033x
- \*Ecotoxicology, EESC BC3200x
- A Better Planet by Design, EEAE E1100y
- Applied Industrial Ecology, EAEE E4001x
- Restoration and Urban Ecology, EEEB G4130x

*\*course taught alternate years*

**VI. Part E – Social Science Elective (one of the following):**

- Anthropology of Disaster, ANTH V3924y
- Anthropology of Consumption, ANTH V3950
- Environmental and Cultural Behavior, ANTH V3971x
- International Relations of the Environment, INAF U6243
- Environmental Politics/Policy Management, INAF U4727
- The Global Economy, ECON W2257
- Environmental Law, EESC BC3040y

- Environmental Sociology, SOCI W3290
- Americans in the Natural World, HIST W4400y
- Making of the Modern American Landscape, HIST W3441
- Looking at Nature in the US 1835 to Present, HIST W4582
- 20th Century Urbanization in Comparative Perspectives, URBS V3525/HIST BC 3525y
- Environmental and Natural Resource Economics, ECON BC3039

**VII. Part F – Junior Research (one of the following):**

- Junior research colloquium or other research experience in the social sciences (building on Decision-making Foundation and Social Science Elective) selected from the following:
  - Political Ecology, ANTH W4022
  - Environment and Development, ANTH V3973y
  - Ethnographic Field Work, ANTH BC3868
  - \*Science, Technology, and Modernity, HIST BC3305x
  - \*History of Environmental Thought, HIST BC4909y
  - Colloquium on American Political Decision-making, POLS BC3331
  - Colloquium on International Political Economy, POLS BC3800y
  - International Organizations, POLS BC3805y
  - American Politics Seminar: Executive Leadership, POLS W3922
  - International Politics Seminar: National Security Policy, POLS W3961
  - Environmental Politics/Policy Management, INAF U4727y
  - Urban Planning in Developing Countries, URBS V3565 (counts only for F or C)
  - Urban Studies Junior Colloquia: Contemporary Urban Issues, URBS V3546y
  - Urban Studies Junior Colloquia: Shaping Up the Modern City, URBS V3546y

**VIII. Part G: Senior Research/Thesis**

- Senior Research Seminar, EESC BC3800x
- Senior Research Seminar, EESC BC3801y

\*\*Note Major Requirements may change, please consult the department for more detailed information.

**Core Faculty**

*Stephanie Pfirman*, Department Chair and Professor, Environmental Science

*Paige West*, Associate Professor, Anthropology

*Rajiv Sethi*, Associate Professor, Economics

*David Weiman*, Professor, Economics

*Kimberly Marten*, Professor, Political Science

**Affiliated Faculty**

*Cynthia Rosenzweig*, Research Scientist, Goddard Institute for Space Studies and Center for Climate Systems Research

*Martin Stute*, Department Co-Chair and Professor, Environmental Science

*Brian Mailloux*, Assistant Professor, Environmental Science

*Peter Bower*, Senior Lecturer, Environmental Science

*Timothy Kenna*, Adjunct Assistant Professor, Environmental Science

### **Summer Ecosystem Experiences for Undergraduates (SEE-U)**

Center for Environmental Research and Conservation (CERC) Staff:

Desmond Beirne – [djb2104@columbia.edu](mailto:djb2104@columbia.edu) – (212) 854-0149

Admission Deadlines: November 15 for early application with fellowship consideration. December 15 for early application without fellowship consideration. February 1 spring semester deadline.

Program Website: [http://www.cerc.columbia.edu/education\\_seeu.html](http://www.cerc.columbia.edu/education_seeu.html)

CERC's Summer Ecosystem Experiences for Undergraduates (SEE-U) program consists of field methods and research courses that provide undergraduate students of all majors with a global understanding of ecology and environmental sustainability.

The five-week, six credit SEE-U programs are held in three distinct ecosystems sites: in the endangered Mata Atlantica Forest of Brazil; in the tropical ecosystem of the Caribbean including the Dominican Republic and Puerto Rico, which is significantly impacted by human activity; and in the temperate forest ecosystem of Black Rock Forest in Upstate New York.

SEE-U is working to develop a site in Amman, Jordan for the summer 2011. Updates can be found on the Website above.

The SEE-U program is designed to expose students to ecological fieldwork in unique and interesting natural settings. The "real world" laboratories of tropical, temperate, and endangered ecosystems allow for firsthand knowledge and understanding that could be elusive in the more traditional classroom setting. SEE-U instructors engage students in thinking about the broader implications of the experience in relation to issues of biodiversity, climate change, and sustainability.

Upon completion of the program, students receive **six credits** from Columbia University. At Columbia, these credits fulfill core science requirements.

### **SEE-U and the Undergraduate Special Concentration in Sustainable Development**

In addition to receiving six points of credit toward required science coursework, students who are concentrators in Sustainable Development can use course credit from the SEE-U program to fulfill requirements/electives in the concentration.

Sustainable development is most commonly defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” It addresses the limited capacity of an ecosystem to absorb the impact of human activities.

CERC believes that sustainable development requires us to have a keen understanding of ecology and a sense of place in the natural world as a core component of the sustainability framework. This understanding is relatively new within the more “traditional” approach to sustainability that is focused on political, social, and economic factors alone.

Thus, SEE-U is a unique academic opportunity that allows students to work alongside scientists and their fellow students to develop an understanding of ecological processes and systems and relation of these systems to Sustainable Development. SEE-U is a thorough and robust introduction to field conservation ecology. It highlights major threats to biodiversity and equips students with tools useful in combating those threats. Students come away from the program with an appreciation of the scientific method and how to apply it, as well as an informed perspective on the role of nature, its conservation, and its connection to genuine sustainable development.

The SEE-U program fulfills courses in the *Skills* and *Systems* area of the concentration as well as in the *Practicum*. Students should speak with their Sustainable Development adviser if they have any questions.

## **MASTERS PROGRAMS**

### **M.S. in Sustainability Management**

Steven Cohen, Program Director – [sc32@columbia.edu](mailto:sc32@columbia.edu) – (212) 854-4445

Louise Rosen, Program Associate Director – [lar46@columbia.edu](mailto:lar46@columbia.edu) – (212) 854-3142

Admission Deadline: April 15 for September admission, October 15 for January admission

Program Website: <http://ce.columbia.edu/Sustainability-Management>

The M.S. in Sustainability Management (MSSM) is co-sponsored by The Earth Institute and the School of Continuing Education. It includes new and existing courses at the University, taught by faculty and researchers who are leaders in the fields of earth science, engineering, architecture, and environmental policy and management. The program utilizes environmental and sustainable development research to provide practical training to a new generation of professionals who will address critical interdisciplinary issues.

This program builds upon years of experience in bridging research and practice in the field of sustainability. In response to the increasing global challenges all organizations face, from limiting their carbon emissions to managing their water resources, the program melds academic leadership, scientific rigor, and professional practice to form a unique interdisciplinary community dedicated to making lasting advances in global sustainability practice. Taking a bold and innovative approach to sustainability that prioritizes the protection of the Earth's systems and resources as well as the spread of social and economic opportunities for all people, the MSSM is training a new generation of problem solvers. Graduates should be able to appreciate complex systems of water, environmental services, climate, water, and energy to be able to maximize efficient usage and minimize their negative impacts.

The MSSM is a 36-point program that includes five required areas of study—Integrative Courses in Sustainability Management, Economics and Quantitative Analysis, The Physical Dimensions of Sustainability Management, The Public Policy Environment of Sustainability Management, and General and Financial Management.

The degree may be completed on a full or part-time schedule. Full-time students will complete the degree in three intensive semesters (Fall, Spring, and Summer). Part-time students, taking 2-3 courses per semester, can complete the program over two academic years. All students must complete all requirements within three years with an overall grade point average of 3.0 (B) or better. Graduates receive a unique Master of Science degree, an essential set of skills and knowledge, as well as access to the placement services and networking opportunities presented by Columbia University, The School of Continuing Education, and the Earth Institute.

### **Admissions Requirements**

- Bachelor's Degree
- College level science, math, and economics are preferred but not essential if familiarity with these subjects has been developed by other means
- Practitioner experience is greatly valued and accomplishments in the fields of sustainability management will be considered

## Program Requirements (Full-Time schedule)\*

### I. Integrative Courses in Sustainability Management (nine points)

- One required introductory course
- One capstone course
- One elective course
  - **Fall**
    - SUMA K4100 Sustainability Management (3 points)
    - SUMA K4734 Earth Institute Practicum (3 points)
  - **Spring**
    - SUMA K6090. Workshop in Sustainability Management (3 points)
    - PLAN A4381.001 Sustainable Urban Development: International Perspective (3 points)
    - PLAN A6010.001 Ecosystem Approaches to Urban Management (3 points)

### II. Economics and Quantitative Analysis

- Two courses in general and sustainability economics (6 points)
- One course in statistics (3 points)
- Fall (choice of):
  - SUMA K 4190 Economics of Sustainability Management (3 points)
  - ENVP U8213.001 Microeconomics & Policy Analysis I
  - ENVP U6310.001 Resolution Methods & Quantitative Technology Management
  - STAT W4105.001 Probability
  - EAEE E6210.001 Quantitative Environmental Risk Analysis
- Spring (choice of):
  - SUMA K 4190 Economics of Sustainability Management
  - ECON W4329.001 Economics of Sustainable Development
  - ENVP U8216.001 Microeconomics & Policy Analysis II
  - INAF U4737.001 Economics of the Environment
  - STAT W4105.001 Probability
  - ENVP U6311.001 Quantitative Techniques & Systems Analysis in Policymaking & Management II

### III. The Physical Dimensions of Sustainability Management

- Three courses (nine points total) are to be taken out of the following categories although all three courses may not come from only one category:
  - One or two courses in Earth and Environmental Engineering
  - One or two courses in Environmental Planning, Design or Architecture
  - One or two courses in Ecology or Earth and Environmental Sciences
- Fall (choice of):
  - SUMA K4140 Sustainability Science
  - ARCH A4623 Architecture and the Sustainable Built Environment
  - ARCH A4623 Sustainable Futures
  - INAF U4729 Alternative Energy Resources
  - PLAN A4579.001 Introduction to Environmental Planning
  - INAF U6236.001 History of American Ecology & Environment
- Spring (choice of):
  - SUMA XXXX The Earth's Climate System
  - EEGB G4127.001 Disease Ecology & Conservation

- EEEB G6020.001 Fundamentals of GIS In Ecology & Conservation
- PLAN A6232.001 Advanced GIS
- PLAN A4008.001 History & Theory of Planning
- Summer (choice of):
  - ENVP U6115.001 Climatology
  - ENVP U6116.001 Hydrology

**IV. The Public Policy Environment of Sustainability Management:** one course in environmental or sustainability policy or law (3 points)

- Fall (choice of):
  - SUMA The Policy and Legal Context of Sustainability Management
  - ENVP U6225.001 Ethics, Values and Justice
  - INAF U6017.001 International Trade
  - PUAF U4260.001 Critical Issues in Urban Public Policy
- Spring (choice of):
  - K4260 The Dynamics of Energy Efficiency
  - ENVP U6320.001 Political Context of Public & Private Environmental Management
  - INAF U4409.001 Political, Social & Economic Development of Brazil I
  - INAF U4710.001 Extractive Industry: Rights & Development
  - INAF U6017.001 International Trade
  - INAF U6063.002 The Geopolitics of Energy
  - INAF U6063.002 The Geopolitics of Energy
  - INAF U6242.001 Energy Policy
- Summer
  - ENVP U6241.001 Earth Systems, Environmental Politics, Policy & Management

**V. General and Financial Management:** Two courses in public, private or nonprofit general or financial management (6 points)

- Fall (choice of):
  - SUMA 4197 Financing the Green Economy; Markets, Business and Politics
  - ENVP U8200.001 Public Management
  - IEOR E4000.001 Production Management
  - INAF U6045.001 International Capital Markets
  - INAF U6060.001 International Energy Systems & Business Structures
  - PUAF U6033.001 Decision Models & Management
- Spring (choice of):
  - SUMA 4175 Global Environmental Markets
  - ENVP U6235.001 Environmental Finance
  - ENVP U8201.001 Colloquium on Financial Management in Government
  - INAF U6045.001 International Capital Markets
  - PUAF U6033.001 Decision Models & Management

\*Part-time students will take the same courses over a period of two academic years, including summer sessions.

## Faculty

*Upmanu Lall*, Director of the Columbia Water Center and the Alan and Carol Silberstein Professor of Earth and Environmental Engineering and Civil Engineering and Engineering Mechanics at The School of Engineering and Applied Sciences (SEAS)

*Moshe Adler*, Associate Adjunct Professor of Urban planning at the Graduate School of Architecture, Planning and Preservation

*Alonso Aguirre*, Adjunct Professor of Ecology, Evolution, and Environmental Biology (E3B) at Columbia University

Howard Apsan , Adjunct Professor of International and Public Affairs

*Eron Bloomgarden*, President, Environmental Markets, Equator, LLC

*Satyajit Bose*, Lecturer, School of International and Public Affairs (SIPA)

*Wallace S. Broecker*, Newberry Professor of Earth and Environmental Sciences at Columbia University

*Andrea Bubula*, Lecturer in Discipline of International and Public Affairs

*Stephen Cameron*, Adjunct Associate Professor, School of International and Public Affairs

*Mark A. Cane*, the G. Unger Vetlesen Professor of Earth and Climate Sciences in the department of earth and environmental sciences and the department of applied physics and applied mathematics

*Carol A. Clark*, Adjunct Associate Professor at the Graduate School of Architecture, Planning and Preservation at Columbia University

*Steven A. Cohen*, Director of the M.S. in Sustainability Management and the Director of the Master of Public Administration program in Environmental Science and Policy at Columbia University's School of International and Public Affairs (SIPA). He is also Executive Director of the Earth Institute, Columbia University

*Fabio Corsi*, M.A. Program Adviser and Lecturer in Ecology, Evolution, and Environmental Biology at Columbia University

*Padma Desai*, Gladys and Roland Harriman Professor of Comparative Economic Systems in the economics department at Columbia University

*David N. Dinkins*, Professor in the practice of public affairs

*Luke Falk*, Project Manager, New York State Energy Research and Development Authority

*Greg A. Freyer*, Associate Professor of clinical environmental health sciences

*Guillermo M. Gallego*, Industrial Engineering and Operations Research Department

*Alessandra Giannini*, Associate Research Scientist at the International Research Institute for Climate and Society

*Lisa Goddard*, Research Scientist at the International Research Institute for Climate and Society (IRI), Adjunct Associate Professor in Department of earth and environmental sciences

*Adela J. Gondek*, Adjunct Professor of Public Affairs

*Joseph Graziano*, Professor of environmental health sciences and pharmacology; Chair of environmental health sciences

*Carol Casazza Herman*, Practicing attorney in environmental policy and sustainability programs for business, public interest and academic organizations

*Urvashi Kaul*, Adjunct Assistant Professor of International and Public Affairs in SIPA at Columbia University

*Klaus Lackner*, Ewing-Worzel Professor of Geophysics in the Department of Earth and Environmental Engineering

*Jingchen Liu*, Assistant Professor at the statistics department

*Peter J. Marcotullio*, Adjunct Professor at the Graduate School of Architecture, Planning and Preservation at Columbia University

*Brannen C. McElmurray*, Senior Associate at Evolution Markets

*Kate McFadden*, Researcher at the Earth Institute

*Lalith Munasinghe*, Associate Professor of economics at Barnard College  
*Davidson Norris*, Adjunct Associate Professor at the Graduate School of Architecture, Planning and Preservation at Columbia University

*Kate Orff*, Assistant Professor, Graduate School of Architecture, Planning and Preservation at Columbia University

*Liam M. Paninski*, Associate Professor in the Department of Statistics

*Libor Pospisil*, Assistant Professor in the Department of Statistics

*Sri Rangarajan*, Adjunct Assistant Professor in the Department of Earth and Environmental Engineering in the School of Engineering and Applied Sciences

*Richard Robb*, Professor in professional practice of international finance at the School of International and Public Affairs (SIPA)

*Louise A. Rosen*, Director of the Office of Academic and Research Programs for The Earth Institute, Columbia University and the Associate Director of the M.P.A. program in Environmental Science and Policy

*Michael Shnaidman*, Adjunct Assistant Professor in the Department of Statistics

*Adam Louis Shrier*, Adjunct Professor of international business at American University, international business developer and a management consultant to the energy and chemical industries

*Christopher Small*, Lecturer at Lamont-Doherty Earth Observatory-Marine Geology & Geophysics

*Jason Smerdon*, Doherty Associate Research Scientist in the Lamont-Doherty Earth Observatory and Storke-Doherty Lecturer in earth and environmental sciences

*Sara Tjossem*, Lecturer and Researcher at Columbia University's School of International and Public Affairs (SIPA) and the Earth Institute, Columbia University

*Thomas Trebat*, Executive Director of the Institute of Latin American Studies (ILAS) and of the Institute's Center for Brazilian Studies; Adjunct Lecturer of international and public affairs at the School of International and Public Affairs

*Bogdan Vasi*, Assistant Professor of International and Public Affairs, and Department of Sociology at Columbia University

*David Walker*, Higgins Professor at Earth and Environmental Sciences

*M. Neil Ward*, head forecast operations at the International Research Institute for Climate and Society (IRI) at the Lamont-Doherty Earth Observatory (LDEO); Director for Decision Systems Research

*Sarah Williams*, Director of Columbia University's Spatial Information Design Lab (SIDL); Adjunct Assistant Professor at the Graduate School of Architecture, Planning and Preservation at Columbia University (GSAPP)

*Tuncel M. Yegulalp*, Professor in the Department of Earth and Environmental Engineering in the School of Engineering and Applied Science (SEAS)

*Zhiliang Ying*, Professor in the Department of Statistics

## **M.A. Conservation Biology**

Fabio Corsi, M.A. Program Adviser – [fc2257@columbia.edu](mailto:fc2257@columbia.edu) – (212) 854-7807

Lourdes Gautier, Academic Department Administrator – [lg2019@columbia.edu](mailto:lg2019@columbia.edu) – (212) 854-8665

Admission Deadline: January 15

Program Website: <http://www.columbia.edu/cu/e3b/ma.html>

The Master of Arts in Conservation Biology focuses on biological sciences, and integrates environmental policy and economics concepts. The interdisciplinary approach provides students with a range of options for building their careers. Graduates may continue their education in a Ph.D. program or enter the job market directly as scientific researchers, teachers, or administrators in a non-governmental organization or government agency dedicated to the conservation of natural resources. Students have the option of tailoring their course work to follow the academic, the professional, or the educational track. The academic track focuses on research and emphasizes the scientific aspects of conservation biology; the professional track focuses on applied conservation and emphasizes the policy aspects of conservation biology; and the educational track focuses on engaging the broader public on conservation biology issues.

### **Admission Requirements**

- A background in ecology and evolutionary biology, including undergraduate courses in introductory biology and upper-division ecology, evolution, and genetics (or equivalents).
- GRE general test. Biology Subject test strongly recommended.
- Applicants interested in the thesis-based program are strongly encouraged to contact potential faculty mentors before applying although this is not a requirement for admission.

### **Program Requirements**

The M.A. in Conservation Biology is a two-year program. The M.A. program requires two full-time residence units (a residence unit equals one full-time semester). Part-time options are also available. Students may choose between a thesis-based or course-based program. The total number of points in the course-based option is 47, while the total number of points for the thesis-based M.A. is 49 (the 2 points difference results from the different course requirements for the two options).

Students following the thesis-based program will register for directed research and will spend a considerable portion of their registered time working on a research project that leads to a final thesis. Students following the course-based program will register for two additional required classes beyond those currently required for the M.A. (either in conservation science or environmental policy). To complete their requirements, students write a take-home essay over a period of two weeks during the spring semester of their second year.

### **Core Courses**

All M.A. students take the following core courses:

- Fundamentals of Ecology and Evolution (EEEEB G4122) in year 1;
- 2-semester sequence in Conservation Biology (EEEEB 6905 in the Fall semester and EEEB 6990 in the Spring semester of year 1);
- Environmental policy, politics, and management (INAF U6241, in year 1);
- 4 semesters of the CERC seminar (EEEEB G6300, taken in both years);

### Other Required Courses

Students in all tracks take 8 additional courses. Students in the academic track take 2 additional courses in conservation biology, plus 4 electives in conservation science and 2 electives in environmental policy. Students in the professional tracks take 2 additional policy courses, plus 3 electives in conservation science and 3 electives in environmental policy. Students in the education track take 2 courses in conservation and education, plus 2 electives in conservation science, 2 electives in environmental policy, and 2 electives in education and communication.

Students have the option of replacing elective courses with Directed Reading or Directed Research to get credits for internships and/or research experience conducted outside of the normal coursework.

Students in all tracks enrolled in the course-based degree program add 2 more electives (for a total of 10): these 2 electives can be in either conservation science or environmental policy (or in education and communication for students in the educational track).

Students in all tracks enrolled in the thesis-based degree program are required to register for the thesis development seminar in the first semester of the first year. The goal of the seminar is to produce a thesis research proposal by the end of the semester.

(For a complete outline of the various options, refer to the E3B Student Handbook available on the E3B Website: [http://www.columbia.edu/cu/e3b/resources\\_handbook.html](http://www.columbia.edu/cu/e3b/resources_handbook.html))

### Possible Electives:

<b>Conservation Science:</b>	<b>Environmental Policy:</b>	<b>Conservation Education</b>
Forest Ecology	Economics of the Environment	Science in secondary school
Disease Ecology and Conservation	Environmental Science for Sustainable Development	Science in childhood education
Restoration and Urban Ecology	The Geopolitics of Energy	Science in the environment
Race: Tangled Historical-Biological Concept	Game Theory	Structure of science knowledge and curriculum design
Evolution I	Alternative Energy Resources	Middle School Living Environment Methods Laboratory
Intro to Conservation Genetics	The Economics of Energy	Introduction to science education practice
Understanding Nature-	History of American Ecology	Neurobiology of

obs/exper	& Environmentalism	consciousness, constructivism, and information processing
Teaching Conservation Biology	Quantitative Methods-Energy/Policy Analysis	Science curriculum improvement in the elementary school
Fundamentals of GIS in Ecology and Conservation	Urban Energy Systems & Policy	The nature and practice of science
Dynamics of Climate Variability and Climate Change	Law, Economics and Development	Science, Technology & Society
Managing and adapting climate	Environmental Science for Sustainable Development	Selected topics and issues in science education
Global Assessment and Monitoring Using Remote Sensing	Human Ecology and Sustainable Development	Science teacher education
Paleoceanography	Community Development Policy	Curriculum and pedagogy in science education
Environmental data analysis and modeling	Environment, Conflict and Resolution Strategies	
Statistics		

\* Note all of the above courses are only examples of the courses that may be used to fulfill the elective requirements; other courses may also be available and eligible for the MA program. Note that not all courses are offered every year. If you would like more information about elective courses please contact the MA program adviser.

### **M.A. Thesis/M.A. Essay**

Students in the thesis-based program prepare an M.A. thesis based on original research, which is evaluated by a 3-member thesis committee tailored to the student's interests. The thesis research is presented to the entire department before graduation. During their fourth semester, students in the course-based program prepare an M.A. essay as a take-home assignment which is evaluated by a faculty committee.

### **Core Faculty**

*Marina Cords*, Professor

*Ruth DeFries*, Denning Professor of Sustainable Development

*Don Melnick*, Thomas Hunt Morgan Professor of Conservation Biology

*Shahid Naeem*, Professor and Chair

*Katherine McFadden*, Assistant Professor

*Maria Uriarte*, Assistant Professor

*Dustin Rubenstein*, Assistant Professor

*Fabio Corsi*, Lecturer

*Matthew Palmer*, Lecturer

*Jill Shapiro*, Lecturer

**Affiliated Faculty:**

*Philip Ammirato*, Professor Emeritus of Biological Sciences, Barnard College

*Walter Bock*, Professor of Biological Sciences

*John Glendinning*, Professor of Biological Sciences, Barnard College

*Paul Hertz*, Professor of Biological Sciences, Barnard College

*Ralph Holloway*, Professor of Anthropology

*Darcy Kelley*, Professor of Biological Sciences

*Paul Olsen*, Professor of Earth and Environmental Sciences

*Robert Pollack*, Professor of Biological Sciences

*Jeanne Poindexter*, Professor of Biological Sciences, Barnard College

*Steve Cohen*, Associate Professor of SIPA

*Kevin Griffin*, Associate Professor of Earth and Environmental Sciences

*Brian Morton*, Associate Professor of Biological Sciences, Barnard College

*Paige West*, Associate Professor of Anthropology, Barnard College

*Hillary Callahan*, Assistant Professor of Biological Sciences, Barnard College

**Adjunct Faculty:**

The Department of E3B also has a large adjunct faculty (see [http://www.columbia.edu/cu/e3b/faculty\\_adjunct.html](http://www.columbia.edu/cu/e3b/faculty_adjunct.html)), most of whom are senior scientists at one of the following institutions: American Museum of Natural History, New York Botanical Garden, Wildlife Conservation Society, and Wildlife Trust. These faculty members teach courses and advise student research.

## **M.S. Earth Resources Engineering**

Marco Castaldi, Program Director – [mc2352@columbia.edu](mailto:mc2352@columbia.edu) – (212) 854-6390

Gary Hill, Program Coordinator – [gh2206@columbia.edu](mailto:gh2206@columbia.edu) – (212) 854-2926

Peter Rennée, Department Administrator – [pr99@columbia.edu](mailto:pr99@columbia.edu) – (212) 854-7065

Admission Deadline: Fall – February 15, Spring – October 1

Program Website: <http://www.engineering.columbia.edu/bulletin/dept/earth.php>

### **Mission**

The M.S. ERE program is designed for engineers and scientists who plan to pursue, or are already engaged in, environmental management/development careers. The focus of the program is the environmentally sound development and processing of resources (minerals, energy, and water) and the recycling or proper disposal of used materials. The program also includes technologies for assessment and remediation of past damage to the environment. Students can choose a pace that allows them to complete the M.S. ERE requirements while being employed.

M.S. ERE graduates are specially qualified to work for engineering, financial, and operating companies engaged in mining and mineral processing ventures, the environmental industry, environmental groups in all industries, and for city, state, and federal agencies responsible for the environment and energy/resource conservation.

Details of these concentrations, including suggested and required classes for each concentration, are available from the department.

### **Admission Requirements**

- Official B.S./B.A. transcript
- Personal Statement
- Resume or Curriculum Vitae
- Three letters of recommendation
- The Graduate Record Examination (GRE)
- TOEFL test (for students who received their bachelor's degree in a country where English is not the spoken language)

### **Program Requirements**

For students with a B.S. in engineering, at least 30 points (ten courses) are required. For students with a B.S. or a B.A., preferably with a science major, up to 48 points (total of sixteen courses) may be required for make-up courses. A number of concentrations are available for the M.S.E. ERE, and students may choose courses that match their interests and career plans. These areas include:

- environmental health engineering
- integrated waste management
- sustainable energy
- water resources and climate risks

### **Other Required Courses**

Depending on the student's background, other courses will be required upon recommendation of the adviser.

### **M.S. Thesis/M.S. Essay**

M.S. candidates are required to carry out a research project and write a master's thesis worth 3-6 points.

### **Faculty**

*William Becker*, Adjunct Professor

*Marco Castaldi*, Assistant Professor

*Kartik Chandran*, Assistant Professor

*Xi Chen*, Associate Professor

*Paul F. Duby*, Professor of Mineral Engineering

*Raymond Farinato*, Adjunct Professor

*Robert Farrauto*, Adjunct Professor

*Vasilis Fthenakis*, Senior Research Scientist

*Gavin Gong*, Assistant Professor

*Yuri Gorokovich*, Adjunct Professor

*Scott Kaufman*, Adjunct Assistant Professor

*Klaus Lackner*, Chair, Maurice Ewing and J. Lamar Worzel Professor of Geophysics

*Upmanu Lall*, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics

*Wade McGillis*, Doherty Research Scientist

*Cevdet Noyan*, Professor

*Ah-Hyung (Alissa) Park*, Lenfest Junior Professor in Applied Climate Science

*Sri Rangarajan*, Adjunct Assistant Professor

*Peter Schlosser*, Vinton Professor of Earth and Environmental Engineering

*Ponisseril Somasundaran*, LaVon Duddleson Krumb Professor of Earth and Environmental Engineering

*Nickolas J. Themelis*, Stanely-Tompson Professor Emeritus of Chemical Metallurgy

*Nicholas J. Turro*, William B. Schweitzer Professor of Chemistry

*Tuncel Yegulalp*, Professor of Mining Engineering

*Gregory Yetman*, Adjunct Assistant Professor

## **M.A. Climate and Society**

Mark A. Cane, Program Director – [mcane@ldeo.columbia.edu](mailto:mcane@ldeo.columbia.edu) – (845) 365-8344

Mingfang Ting, Associate Director, Lamont Research Professor, Lamont-Doherty Earth Observatory; Adjunct Professor, Department of Earth and Environmental Sciences – [ting@ldeo.columbia.edu](mailto:ting@ldeo.columbia.edu) – (845) 365-8374

Arezou Paksima, Assistant Director – [arezou@ei.columbia.edu](mailto:arezou@ei.columbia.edu) – (212) 854-9896

Application Priority Deadline: March 1

Admissions Decisions: April 15

Program Website: <http://www.columbia.edu/cu/climatesociety/>

### **Mission**

The twelve-month M.A. Program in Climate and Society trains professionals and academics to understand and cope with the impacts of climate variability and climate change on society and the environment. This rigorous program emphasizes the problems of developing societies. Students complete the program in three semesters: autumn, spring, and summer.

Columbia is at the forefront of research on climate and climate applications, and is supported by an extensive network of research units and faculty. Drawing on the educational and research facilities of Columbia University, the M.A. Program in Climate and Society combines elements of established programs in Earth sciences, Earth engineering, international relations, political science, sociology, and economics with unique classes in interdisciplinary applications specially designed for the program's students.

A set of tailor-made core courses provide a scientific basis for inquiry and stress interdisciplinary problem solving.

At the end of twelve intensive and rewarding months, graduates are prepared to address environmental issues from positions in government, business, teaching, and non-governmental organizations. Others continue their academic careers in the social or natural sciences.

### **Admission Requirements**

- A completed bachelor's degree in physical sciences, engineering, social sciences, or planning and policy studies.
- Work experience in a related field is considered desirable.
- The General Test of the Graduate Record Examination (GRE) is required. Students who live in countries where the GRE test is not available must include a note requesting a waiver for the exam.
- The Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) exam is required for non-native speakers of English. Students who have completed their bachelor's degree in a country where English is the primary language may have this requirement waived.

Note: Earlier submission of applications is encouraged for full consideration for financial aid.

## Program Requirements

This is a twelve-month program: students begin study as a cohort in the fall semester.

To provide a common set of skills and a shared professional working knowledge, there is a significant component of core courses.

All students in the program take part in the core courses. Electives are chosen in consultation with an academic adviser. All students participate in the Summer Seminar and have a choice between a local internship and a thesis. Thirty points of credits are required for the M.A.

### Core Courses

W4400: Dynamics of Climate Variability and Change; 3 points	W4404: Regional Climate and Climate Impacts; 3 points
W4401: Quantitative Models of Climate-Sensitive Natural and Human Systems; 4 points	A professional development seminar
G4402-G4403: Managing Climate Variability and Adapting to Climate Change; two-semester course; 3 points each semester	A choice between a summer internship or research thesis
Summer Seminar	

### Possible Electives

Students have a wide variety of electives from which to choose; below are just a few. After consulting with the faculty adviser, each student selects one social science elective in the fall semester and three electives from any relevant discipline in the spring semester.

Political Ecology Anthropology W4022	The Anthropology of Science Anthropology W4204
Economics of the Environment Economics W4625	Economics of Sustainable Development Economics U6230
Alternative Energy Resources International Affairs INAF U4729	Management and Development of Water Systems Earth and Environmental Engineering W4100
Physical Hydrology Earth and Environmental Engineering E6240	Atmospheric Dynamics Earth and Environmental Sciences G6921
Climatic Change Earth and Environmental Sciences W4030	Global Assessment and Monitoring Using Remote Sensing Earth and Environmental Sciences W4050
Advanced Applications of Remote Sensing and Image Processing Earth and Environmental Sciences W4051	Wetlands and Climate Change Earth and Environmental Sciences W4835
Introduction to Atmospheric Chemistry Earth and Environmental Sciences W4924	Principles of Physical Oceanography Earth and Environmental Sciences W4925
Carbon Sequestration Earth and Environmental Sciences E6212	Invasion Biology Ecology, Evolution, and Environmental

	Biology W4060
Tropical Field Ecology Ecology, Evolution, and Environmental Biology G4101	Disease Ecology and Conservation Ecology, Evolution, and Environmental Biology G4127
Case Studies in Risk Assessment and Environmental Policy Environmental Health Sciences P9317	Water and Infectious Diseases Environmental Health Sciences P9320
Looking at Nature History W4582	International Relations of the Environment International Affairs U6243
Environmental Science for Sustainable Development International Affairs U6240	Project Management for Economic and Political Development International Affairs U6827
Local Level Development International Affairs U8143	Climate Change, Rights, and Development International Affairs U6235
Multidisciplinary Approaches to Human Decision Making Psychology W4285	Energy, Business, and Economic Development International Affairs U6042
Environmental Law Law School L6242	Climate Change Law Law School L6038

### **Associated Faculty**

*Tony Barnston*, Lead Forecaster, IRI

*Wallace S. Broecker*, Newberry Professor of Earth and Environmental Sciences

*Mark A. Cane*, Director of M.A. Climate and Society and G. Unger Vetlesen Professor of Earth and Climate Sciences

*Steven A. Cohen*, Director, Master of Public Administration Program in Environmental Science and Policy

*Peter B. DeMenocal*, Associate Professor, Earth and Environmental Sciences

*Anthony Del Genio*, Adjunct Professor, Goddard Institute for Space Studies

*Lisa Goddard*, Research Scientist, Forecasting and Prediction Research, IRI; Adjunct Associate Professor, Department of Earth and Environmental Sciences

*Upmanu Lall*, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics

*Douglas Martinson*, Senior Research Scientist, Climate Modeling and Diagnostics Groups, Lamont-Doherty Earth Observatory

*Vijay Modi*, Professor, Department of Mechanical Engineering

*John C. Mutter*, Professor of Earth and Environmental Sciences and of International and Public Affairs

Benjamin Orlove, Professor, Department of International and Public Affairs

*Dorothy Peteet*, Adjunct Senior Research Scientist, NASA/ Goddard Institute for Space Studies/Lamont-Doherty Earth Observatory

*David Rind*, Adjunct Professor in the Department of Earth and Environmental Sciences

*Cynthia Rosenzweig*, Research Scientist at the Goddard Institute for Space Studies

*Christopher Small*, Associate Research Scientist, Marine Geology and Geophysics, Lamont-Doherty Earth Observatory

*Shiv Someshwar*, Research Scientist, IRI

*Awash Teklehaimonot*, Senior Staff member of the World Health Organization

*Mingfang Ting*, Doherty Senior Research Scientist, Lamont-Doherty Earth Observatory; Adjunct Professor, Department of Earth and Environmental Sciences

## **M.P.H. Environmental Health Sciences**

Tomás R. Guilarte, Department Chair – [trguilarte@columbia.edu](mailto:trguilarte@columbia.edu) – (212) 305-3959

Greg Freyer, Program Director of Educational Affairs – [gaf1@columbia.edu](mailto:gaf1@columbia.edu) – (212) 342-0457

Admission Deadlines: Fall and Summer – January 5

Program Website: <http://www.mailman.hs.columbia.edu/ehs/index.html>

Environmental Health Sciences (EHS) is a rapidly expanding field which requires a broad range of basic and applied scientific skills. The program at the Mailman School of Public Health is primarily oriented towards understanding and predicting the health effects of environmental and occupational exposure to chemicals and radiation. Research activities of the faculty aim to generate scientific data which ultimately serve as the underpinnings of environmental policy decisions. Because EHS is a broad field, students choose a concentration by enrolling in one of the following tracks: environmental and molecular epidemiology, environmental and molecular toxicology, environmental policy, global health, or medical/health physics. Each of these tracks considers national, international, and global environmental policy issues.

Our students find employment in varied settings including chemical and pharmaceutical industries, federal or local environmental protection agencies, domestic and international health departments, hospitals, environmental consulting firms, international organizations, and public interest groups. Some of our students also go on to pursue doctoral and other advanced degree programs.

### **Admission Requirements**

- Mailman School of Public Health requirement: One year of Math (Algebra or Calculus)
- One year of undergraduate Biology
- One year each of General and Organic Chemistry (exception: Policy Track)
- One year of Physics for Medical/Health Physics Track only

Note: Qualified students who demonstrate high potential but are lacking required science coursework will be considered on a case by case basis and will be expected to address the deficiency through additional coursework.

### **Program Requirements**

Course requirements for the M.P.H. vary among tracks. For example, students interested in Environmental and Molecular Epidemiology are expected to take some toxicology coursework and additional requirements in epidemiology and biostatistics; those pursuing the Environmental and Molecular Toxicology track take classes in toxicology and then have the flexibility to take appropriate electives in molecular epidemiology or genetics. The Policy track is a unique one-year (14 months) track that begins in the summer and ends with a six-week practicum experience that takes place in the second summer. Students within this track take courses that provide them with the scientific background necessary to develop sound environmental policies along with relevant courses in policy. Finally, students in the Global Health Track are required to complete a six course global public health-specific core in addition to the general departmental requirements. Some flexibility in required courses may be allowed, depending upon each student's background and career goals.

For a closer review of the coursework pertaining to each track, please view our Website at: <http://www.mailman.hs.columbia.edu/academic-departments/environmental-health/academic-programs/mph-program>

### Practicum Requirement

All students in the department are required to fulfill a practicum experience. The practicum experience varies from laboratory research to governmental agency involvement to relevant summer or part-time corporate or interest group employment. Global Health Track students in the department must carry out a structured, overseas practicum project. Students in the Environmental Policy Track complete a structured practicum/capstone during their 2<sup>nd</sup> summer.

### Capstone Requirement

The capstone requirement in EHS is satisfied by either writing a Master's Essay or successfully completing P9300: Topics in Environmental Health Sciences. However, the Master's Essay is required for students in the Global Health Track. Completion of a Master's Essay is also strongly recommended for students who are considering the pursuit of a doctoral degree.

### Core Courses

All M.P.H. students take the following core courses:

- P6104 Introduction to Biostatistics<sup>1</sup>
- P6300 Environmental Health Sciences
- P6400 Principles of Epidemiology I
- P6530 Issues and Approaches in Health Policy and Management
- P6700 Introduction to Sociomedical Sciences

### Other Required Courses and Possible Electives

For additional course information, please select Environmental Health Sciences from the Course Description drop down menu: <http://www.mailman.hs.columbia.edu/academics/courses?dept=Environmental%20Health%20Sciences>

Course Number	Environmental Sciences and Relevant Electives	Required	Courses
<b><u>P6300</u></b>	Environmental Health Sciences		
<b><u>P6301</u></b>	Environmental Health Science Applications		
<b><u>P6330</u></b>	Radiobiology for Medical Physicists		
<b><u>P6385</u></b>	Principles of Genetics and the Environment I		
<b><u>P6390</u></b>	Tutorial in Environmental Health Sciences		

<sup>1</sup> The department recommends that all EHS students take the placement exam for P6104. Students may only take P6103 if they do not pass the advanced placement exam for P6104.

<b><u>P8304</u></b>	Public Health Impacts of Climate Change
<b><u>P8306</u></b>	Occupational and Environmental Hygiene
<b><u>P8307</u></b>	Molecular Epidemiology
<b><u>P8308</u></b>	Molecular Toxicology
<b><u>P8309</u></b>	Air Pollution
<b>P8310</b>	Health Physics
<b>P8311</b>	Basic and Applied Nutritional Science: Emerging Global Issues
<b><u>P8312</u></b>	Fundamentals of Toxicology
<b><u>P8313</u></b>	Toxicokinetics
<b>P8317</b>	Frameworks for Environmental Policy
<b>P8318</b>	Science Basic to Public Health Practice
<b><u>P8319</u></b>	Biological Markers of Chemical Exposure
<b>P8320</b>	Applied Environmental and Industrial Hygiene
<b><u>P8325</u></b>	Risk Assessment, Communication and Management
<b>P8330</b>	Radiation Physics
<b>P8333</b>	Radiation Oncology Practical Experience
<b>P8340</b>	Diagnostic Radiology Applications
<b>P8360</b>	Basic Experimental Methods and Nuclear Instrumentation
<b>P8365</b>	Nuclear Medicine Applications
<b>P8371</b>	GIS for Public Health
<b>P8380</b>	Health Physic Applications
<b>P8390</b>	Tutorial Environmental Health Sciences
<b>P8475</b>	Topics in Emerging Infectious Diseases
<b><u>P9300</u></b>	Topics in Environmental Health Sciences
<b><u>P9303</u></b>	Hazardous Waste and Public Health
<b><u>P9317</u></b>	Case Studies in Risk Assessment & Environmental Policy
<b>P9319</b>	Clinical Nuclear Medicine Physics
<b><u>P9320</u></b>	Water and Infectious Disease
<b>P9330</b>	Diagnostic Radiological Physics
<b>P9335</b>	Radiation Therapy Physics
<b>P9350</b>	Global Master's Essay I
<b>P9351</b>	Global Master's Essay II
<b><u>P9360</u></b>	Master's Essay: Critical Literature Review
<b><u>P9361</u></b>	Research Master's Essay I in Environmental Health Sciences

<b>P9362</b>	Research Master's Essay II in Environmental Health Sciences
<b>P9370</b>	Journal Club in Environmental Health Sciences
<b>P9390</b>	Tutorial in Environmental Health Sciences

## **EHS Faculty**

### **Full-Time Faculty and Areas of Interest**

#### **Professors**

*David Brenner*, Ph.D. – radiation, health physics

*Dickson Despommier*, Ph.D. – infectious disease, ecology

*Joseph Graziano*, Ph.D. – metal toxicology and metabolism

*Tomás R. Guilarte*, Ph.D. – mechanism based neurotoxicology, neuroscience

*Tom Hei*, Ph.D. – cancer, radiation, fiber toxicology

*Patrick Kinney*, Sc.D. – respiratory disease, climate change and health

*Howard Lieberman*, Ph.D. – radiation biology

*Frederica Perera*, Dr.P.H. – cancer, children's health

*Regina Santella*, Ph.D. – cancer, biomarkers of chemical exposure

*Neil Schluger*, M.D. – respiratory disease

*Robin Whyatt*, Dr.P.H. – pesticides, children's health, reproductive health

*Cheng-Shie Wu*, Ph.D. – radiation, health physics

#### **Associate Professors**

*Greg Freyer*, Ph.D. – DNA repair, cancer

*Mary Gamble*, Ph.D. – nutritional biochemistry, epigenetics, metal toxicology

*Rachel Miller*, M.D. – respiratory disease

*Matthew Perzanowski*, Ph.D. – respiratory disease, asthma and allergens

*Deliang Tang*, Dr.P.H. – cancer

*John Whysner*, M.D., Ph.D. – toxicology, carcinogenesis

#### **Assistant Professors**

*Edward Christman*, Ph.D. – radiation safety

*Darby Jack*, Ph.D. - environmental health policy; environmental health in developing countries

*Manuela Orjuela*, M.D. – cancer, retinoblastoma, pediatrics

*Jing Shen*, M.D., Ph.D. – cancer

**Research Scientists**

*Yu-Jing Zhang*, M.D. – cancer

**Associate Research Scientists**

*Norman Kleiman*, Ph.D. – DNA damage and repair, oxidative stress, cataracts

*Nancy Loiacono*, M.P.H. – metal toxicology, environmental epidemiology

*Faruque Parvez*, M.S., M.P.H. – metal toxicology, indoor air pollution

*Vesna Slavkovic*, M.S. – metal toxicology, analytical chemistry

**For review of EHS Joint and Adjunct Faculty Members please see the link via our Department Website:**

<http://www.mailman.hs.columbia.edu/academic-departments/environmental-health/faculty>

## **M.P.A. Environmental Science & Policy**

Steve Cohen, Program Director – [sc32@columbia.edu](mailto:sc32@columbia.edu) – (212) 854-4445

Louise Rosen, Associate Director – [lar46@columbia.edu](mailto:lar46@columbia.edu) – (212) 854-3142

Sara Tjossem, Associate Director – [sft2101@columbia.edu](mailto:sft2101@columbia.edu) – (212) 854-0424

Mariel Kessel, Program Manager – [msk2156@columbia.edu](mailto:msk2156@columbia.edu) – (212) 851-0261

Admission Deadline: Early Admission – November 1; Admission with fellowship consideration – January 15; Regular Admission – February 15

Program Website: <http://www.columbia.edu/cu/mpaenvironment/>

The Master of Public Administration in Environmental Science and Policy trains public managers and policymakers, who apply innovative, systems-based thinking to environmental issues. The program challenges students to think systemically and act pragmatically. To meet this challenge, we offer a high-quality graduate program in management and policy analysis that emphasizes practical skills and is enriched by ecological and planetary science.

Graduates are creating a new profession of earth systems problem-solvers: individuals who are prepared for leadership positions in local, state, and federal government agencies, as well as in nonprofit organizations and the environmental divisions of private corporations. They are also well suited for designing cost-effective programs and implementing policies. Most importantly, a deep understanding of Earth systems guides their work, allowing them to craft the kinds of solutions necessary for our increasingly complex environmental problems.

This twelve-month program takes place at Columbia University's Morningside Heights campus in New York City in coordination with the Lamont-Doherty Earth Observatory.

### **Admission Requirements**

- Bachelor's degree or evidence of equivalent preparation
- Background in biology, chemistry, and economics

### **Program Requirements**

Students enrolled in the Environmental M.P.A. Program are awarded a Master of Public Administration degree from Columbia University's School of International and Public Affairs after a single year of intensive study. The curriculum, outlined below, provides a management and policy analytic core and a natural and social science earth systems concentration. Students complete a total of 54 credits over three semesters.

The intensive course of study begins in late May or early June with an orientation program. The summer term begins immediately afterward, followed by the autumn and spring terms. The summer term features the fundamental science of earth systems and conservation biology, as well as an introduction to environmental policy and management issues. In the autumn and spring, students delve deeper into the formulation and management of public policy. The physical and social sciences are linked throughout the program so that students gain an integrated understanding of Earth systems.

**Required Courses:**

ENVP U8200: Public Management; 3 credits	ENVP U8201: Financial Management; 3 credits
ENVP U8213-U8216: Microeconomics and Policy Analysis I and II; 3 credits	ENVP U6310: Quantitative Techniques and Systems Analysis in Policymaking and Management ; 3 credits
ENVP U6220 Environmental Chemistry; 2 credits	ENVP U6221: Risk Assessment and Environmental Toxicology; 2 credits
ENVP U6115 Climatology	ENVP U6116 Hydrology; 2 credits
ENVP U6111: Principles of Ecology; 2 credits	ENVP U6112: Urban Ecology; 2 credits
ENVP U6225 Ethics, Values, and Justice; 3 credits	ENVP U6241 Earth Systems and Environmental Politics, Policy, and Management; 3 credits
ENVP U9229 The Workshop in Applied Earth Systems Management I; 3 credits	ENVP U9230 The Workshop in Applied Earth Systems Management II; 3 credits
ENVP U9232 The Workshop in Applied Earth Systems Policy Analysis; 6 credits	

**Recommended but non-required courses:**

ENVP U6320: Political Context of Public and Private Management; 3 credits	ENVP U6230 The Economics of Sustainable Development; 3 credits
ENVP U6224 Environmental Data Analysis; 3 credits	

**Faculty**

*Howard N. Apsan*, Adjunct Professor of Public Affairs

Irene Boland, Lecturer, School of International and Public Affairs, Columbia University

*Kathy Callahan*, Adjunct Lecturer, School of International and Public Affairs

*Steven A. Cohen*, Director, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs; Executive Director and Chief Operating Officer, The Earth Institute

*Nancy Degnan*, Executive Director of the Center for Environmental Research and Conservation (CERC) and Lecturer, School of International and Public Affairs

*Adela Gondek*, Adjunct Professor of Public Affairs

*Juerg Matter*, Assistant Professor; Science Coordinator, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs and Lamont Associate Research Professor, Lamont-Doherty Earth Observatory

*Michael Musso*, Adjunct Lecturer, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs and Environmental Health Sciences, Mailman School of Public Health

*Suresh Naidu*, Assistant Professor, Master of Public Administration in Environmental Science and Policy and of International and Public Affairs and Economics, School of International and Public Affairs

*Matthew I. Palmer*, Adjunct Faculty, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs; Lecturer and Director of Undergraduate Studies, Department of Ecology, Evolution, and Environmental Biology

*Louise Rosen*, Adjunct Lecturer, Associate Director, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs; Director, Office of Educational Programs, The Earth Institute

*Jason E. Smerdon*, Adjunct Assistant Professor of Public Affairs, School of International and Public Affairs; Storke-Doherty Lecturer, Lamont-Doherty Earth Observatory and the Department of Earth and Environmental Sciences

*Gail Suchman*, Adjunct Professor, School of International and Public Affairs

*Sara Tjossem*, Associate Director of Curriculum, MPA in Environmental Science and Policy, Lecturer of International and Public Affairs

*Bogdan Vasi*, Assistant Professor of International and Public Affairs and Sociology

## **M.P.A. in Development Practice**

Glenn Denning, Program Director – [gd2147@columbia.edu](mailto:gd2147@columbia.edu)

Admission Deadline: January 5 for fall admission only. All materials, including GRE test scores and letters of reference, must be received by SIPA's Office of Admissions by this date. Applications completed after this date will be reviewed on a space available basis only.

**Previous work experience in a developing country setting is required. Two years of relevant work experience is strongly recommended.**

Program Website: [www.sipa.columbia.edu/mdp](http://www.sipa.columbia.edu/mdp).

The 22-month MPA degree in Development Practice (MPA DP) is designed to train practitioners to understand, plan, and manage integrated approaches to sustainable development. This rigorous cross-disciplinary academic program, complemented by a structured three-month field internship, emphasizes the development of critical knowledge, skills, and attributes of an effective development professional.

### **Practitioners of a Cross-Disciplinary Approach**

Drawing on the educational and research facilities and global experience of Columbia University, the MDP combines elements of core courses in the social sciences, health sciences, natural sciences and engineering, and management.

- Health Sciences—nutrition, population sciences, and reproductive health; basic epidemiology of infectious and non-infectious disease; health policy; and health system design and management.
- Natural Sciences and Engineering—agriculture, forestry and fishery management; water management, energy, engineering, environment, and climate science; and information management systems and design.
- Social Sciences—anthropology, economics, education, politics and international political economies, statistics.
- Management—project design and management, budget planning and financial management, commodities management, communication and negotiations, critical self-reflection, geographic information systems and decision making tools, institutional resource and human resource management, monitoring and evaluation.

In addition, students gain a solid understanding of a range of areas including: the political and socio-cultural context of development; data collection methods and statistical analysis used for the planning, monitoring, and evaluation of development interventions. The study of policy and management would also be explored within the context of the technical fields.

### **Program Requirements**

All students in the program take part in the core and elective courses, complemented by a three-month structured field internship in integrated rural development.

The four main components are:

- core and elective courses (45-points minimum);
- global course (3-points);
- language requirement (3-points minimum);
- field internship (3 months).

*Pre-Masters Program Seminar “Getting Started”*: Students take an intensive refresher course before their first fall term that will include communications, math, and statistic. **The content and duration of “Getting Started” is currently under review.**

## Coursework

- **Core and Elective Courses:** Students must take a minimum of 45 credits in the core and elective courses of health sciences, natural sciences and engineering, social sciences, and management over four semesters of courses. Core courses are determined annually by the program director. Elective courses must relate to the program goals and also require the approval of the program director.
- **Global Course:** Students must take the 3-point “*Global Classroom: Integrated Approaches to Sustainable Development Practice*” course. This is an information technology based interactive course that fosters cross-border and cross-disciplinary collaboration and allows students and teachers to participate in collective assignments and learning experiences.
- **Language:** Student must take 3 or more points in a foreign language, unless demonstrated proficiency in second language is met. Exempted students can take additional points in a core or elective course or to learn another language.
- **Field Internship:** Students undertake a 3-month structured field internship during the summer between first and second years of study. The internship will normally involve teams of students working on integrated rural development projects in developing countries. All summer internships require the approval of the program director. Additional internships during the semesters are encouraged.

## Core and Affiliated Faculty

Faculty members for the MPA DP *may* include:

*Steve Cohen*, Executive Director and Chief Operating Officer, the Earth Institute; Director, Master of Public Administration in Environmental Science and Policy, School of International and Public Affairs and the Earth Institute; Director, Environmental Policy Studies Concentration, School of International and Public Affairs; Director, Master of Science in Sustainability Management, School of Continuing Education and the Earth Institute

*Ruth DeFries*, Denning Family Chair in Sustainable Development; Professor, Ecology, Evolution and Environmental Biology

*Glenn Denning*, Professor of Professional Practice, School for International and Public Affairs; Program Director, MPA in Development Practice, School of International and Public Affairs and the Earth Institute

*Geoffrey Heal*, Paul Garrett Professor of Public Policy and Business Responsibility, Graduate School of Business; Professor, Finance and Economics; Co-Director, Center for Economy Environment and Society; Co-Director, Center on Globalization and Sustainable Development

*Macartan Humphreys*, Associate Professor, Political Science; Director, Columbia Center for the Study of Development Strategies

*Robert Lieberman*, Vice Dean for Academic Affairs, School for International and Public Affairs; Associate Professor, Political Science and Public Affairs, School for International and Public Affairs

*John W. McArthur*, CEO and Executive Director, Millennium Promise

*Cheryl Palm*, Senior Research Scientist, International Research Institute for Climate and Society (IRI), Tropical Agriculture Program; Associate Director, Center on Globalization and Sustainable Development

*Vijay Modi*, Professor of Mechanical Engineering, School of Engineering and Applied Sciences

*John Mutter*, Professor, Earth and Environmental Sciences; Professor, School of International and Public Affairs

*Shahid Naeem*, Professor and Chair, Ecology, Evolution and Environmental Biology; Director of Science, Center for Environmental Research and Conservation (CERC)

*José Antonio Ocampo*, Professor of Professional Practice; Director, Program in Economic and Political Development, School of International and Public Affairs

*Anne Paxton*, Associate Professor of Clinical Population & Family Health, Mailman School of Public Health; Associate Professor of Clinical Epidemiology, Mailman School of Public Health; Director, Masters Program in Epidemiology; Director, Global Health Track, Mailman School of Public Health

*Paul Pronyk*, Director of Monitoring and Evaluation, Millennium Villages Project, Center for Global Health and Economic Development (CGHED), HIV/AIDS Technical Adviser, Millennium Villages Project, CGHED

*Cynthia Rosenzweig*, Senior Research Scientist, NASA Goddard Institute for Space Studies

*Jeffrey Sachs*, Director, the Earth Institute; Quetelet Professor of Sustainable Development; Professor, Health Policy and Management

*Pedro Sanchez*, Director, Tropical Agriculture and Rural Environment Program, the Earth Institute; Director, Millennium Villages Project, the Earth Institute

*Peter Schlosser*, Vinton Professor of Earth and Environmental Sciences; Associate Director and Director of Research, the Earth Institute

*Elliott Sclar*, Professor of Urban Planning, School of International and Public Affairs and Graduate School of Architecture, Planning and Preservation; Director, Center for Sustainable Urban Development

*Awash Teklehaimanot*, Professor, Clinical Epidemiology, Mailman School of Public Health; Director, Center for Global Health and Economic Development

## **M.I.A. / M.P.A. Energy & Environmental Policy (EEP)**

Steve Cohen, Concentration Director – [sc32@columbia.edu](mailto:sc32@columbia.edu) – (212) 854-4445

Admission Deadlines: Fall (with fellowship consideration) – January 5, Fall (regular admission) – February 15, Spring – October 1

Program Website: <http://sipa.columbia.edu/academics/concentrations/eep/index.html>

The Energy and Environment Concentration provides students with the analytical tools and substantive knowledge to address the key economic and environmental challenges of the 21st Century and to pursue leadership careers in the fields of energy and environment in the public, private, or nonprofit sectors.

While shortages in many finite resources such as water and food must be addressed to create a truly sustainable economy, no single resource issue is more problematic than the need for energy to power the developed and developing nations of the world. Because energy and the environment are intimately connected to society's productivity and sustainability, our ability to properly protect, develop, and manage our natural assets requires well-trained leaders. Energy and environmental leaders need a solid background in earth sciences, politics, management, economics, quantitative techniques, business, enterprise development, market and regulatory structures, and policy analysis. The Energy and Environment Concentration incorporates this interdisciplinary approach to the study of energy and environmental issues so its graduates are well-equipped to prove themselves as the leaders and policy-makers of their generation.

There are three tracks within the Energy and Environment concentration: the International Energy Policy and Management Track (IEMP), the Sustainable Energy Policy track (SEP) and the Environmental Policy and Management track (EPM). The IEMP track focuses on energy development and production, particularly large-scale infrastructure projects that involve extensive interaction between the private and public sectors for energy management and policy. The sustainable energy policy track, which was launched in the Fall 2010, focuses on the national and international policies and practices aimed at ensuring a sustainable energy future, including policies and practices that support small-scale energy production and enterprise development. The environmental policy track focuses on the policy and management knowledge required to address the most pressing environmental sustainability issues. Each track consists of a carefully developed sequence of courses. Energy students are required to enroll in one environmental course and environmental students must take a course focused on energy policy or management. The environment track recommends but does not require enrollment in the applied science specialization. Given the complexity and many facets of the Energy and Environment concentration, students have some flexibility to design the track to include courses that will be tailored to their particular interest. It is encouraged that students meet with their track director to discuss the various options.

### **Admission Requirements**

- Bachelor's degree or evidence of equivalent preparation
- At least two prior courses in economics (macro and micro economics)
- The study of at least one foreign language (for M.I.A applicants only)
- Deadlines: Fall (with fellowship consideration) – January 5

Fall (regular admission) – February 15  
Spring – October 1

## **Program Requirements**

To prepare students to seize these opportunities, the EEP concentration ensures that all students gain the essential background and tools for energy and environmental analysis, while offering them the flexibility to choose a track. As part of the requirements of the M.I.A. or M.P.A. degree, each student is required to take a “capstone workshop” where hands-on experience in environmental or energy policy analysis is gained by working with clients from industry and the public sector. Students have substantial opportunity to be involved in choosing the issue and client agency for the workshop.

## **Internships**

All SIPA students are required to fulfill a minimum of 3 credits in an internship. Internships may be performed both during the academic year and in the summer between the first and second years. Although the summer break is an ideal period to do an internship, students may also wish to consider the possibility to combining internships with classes during school semesters.

Internships provide an opportunity not only to test your value in the job market, but also are excellent ways to explore and better define areas of professional interest. Students should commence investigating internship possibilities through the Office of Career Services (OCS) as soon as possible, and may also wish to consult the EEP alumni list, EEP faculty, and the Program Assistant for further suggestions. It is important to be aware that in the past, many EEP students have found the contacts made through internships extremely helpful in the job search.

## **Environmental Policy and Management Track**

Steve Cohen, Program Director – [sc32@columbia.edu](mailto:sc32@columbia.edu) – (212) 854-4445  
Admission Deadline: Fall (with fellowship consideration) – January 5  
Fall (Regular admission) – February 15  
Spring – October 1

Environmental issues arise today in almost every policy field, and Columbia University in the City of New York provides an unmatched setting in which to undertake professional study in environmental policy. This track is designed for students interested in national and international environmental policy, law, economics, journalism, and business. This interdisciplinary program provides a rigorous academic background and practical experience in environmental policy. In classes and outside activities, Environmental Policy and Management students mingle with future environmental professionals pursuing degrees in Business, Conservation Biology, Earth & Environmental Engineering, Law, and Columbia's innovative program in Environmental Journalism. Given the diversity of backgrounds and career goals of program participants, students learn from each other as well as from faculty, and build life-long connections that enrich their careers.

## **Environmental Policy and Management Requirements**

This track requires 15 credits, consisting of 1 core course listed below, plus 1 workshop, and 1 elective in each of the various clusters of classes: environmental policy, environmental economics, and energy policy.

- SDEV U6240 Environmental Science for Sustainable Development (3 credits)
- Environmental Policy Cluster (One of the following):
  - INAF U4727 Environmental Politics and Policy Management (3 credits)
  - INAF U6243 International Relations of the Environment (3 credits)
  - ENVP U6320 Political Context of Public and Private Management (3 credits)
  - INAF U6034 Integrated Development Practice (3 credits)
  - INAF U6236 History of American Ecology & Environmentalism (3 credits)
  - INAF U8909 Environment, Conflict & Resolution Strategies (3 credits)
  - SDEV U6240 Environmental Science for Sustainable Development (3 credits)
- Environmental Economics Cluster (One of the following):
  - INAF U4737 Economics of the Environment (3 credits)
  - INAF U6233 Environmental Finance Prep (3 credits)
  - INAF W4329 or ENVP U6230 Economics of Sustainable Development (3 credits)
  - ENVP U6250 Poverty, Inequality & the Environment (3 credits)
  - ENVP U6275 GIS for International Studies (3 credits)
  - INAF U6016 Cost-Benefit Analysis (3 credits)
  - INAF U6068 Economic Analysis of Environmental Policies (3 credits)
  - SDEV U9245 Environment & Resource Economics (3 credits)
- Energy Policy Cluster (One of the following):
  - INAF U6242 Energy Policy (3 credits)
  - INAF U8778 Urban Energy Systems and Policy (3 credits)
  - INAF U6063 The Geopolitics of Energy (3 credits)
  - INAF U4729 Alternative Energy Resources (3 credits)
  - LAW L8452 Seminar: Energy Law (3 credits)
  - INAF U6060 International Energy Systems & Business Structures (3 credits)
  - INAF U6235 Quantitative Methods-Energy/Policy Analysis (3 credits)
  - INAF U8562 Marine Transportation, Law & Public Policy (3 credits)
- A capstone workshop (3 credits) is required for all MIA and MPA students in the second year. Each year, several workshops are organized by faculty affiliated with the EEP program. One of the workshops offered by another concentration may be substituted provided that its topic contains a significant environmental element, as determined by the EEP Director.

Note: A course may simultaneously fulfill a M.I.A requirement and an EEP concentration requirement. This is known as 'double-counting'. By double counting, students can free-up more course slots for desired electives while continuing to fulfill all the requirements for the M.I.A degree. Please note however, that while a course may double-count toward two requirements it still counts as only one course with regard to credit hours.

## **International Energy Management and Policy Track**

Ellen Morris, Track Director – [em2507@columbia.edu](mailto:em2507@columbia.edu)

Admission Deadlines: Spring – October 15, Fall – January 15, February 15

This track is designed for students interested in international energy resource management and related public policy issues. The curriculum provides a thorough understanding of energy industry fundamentals, including the structure and operation of international energy systems and of the business organizations involved in the producing, transporting, and marketing of energy products. It examines economic, environmental, and social policies applicable to energy development and consumption; political and strategic issues arising from the unequal distribution of global energy resources; and the impact of technological change on the future role of energy in the global economy. Electives are available to permit students to pursue detailed study in such areas as energy project finance, petroleum markets and trading, electricity markets, alternative energies, the geopolitics of oil, and marine transportation systems.

### **IEMP Requirements Summary**

This track requires 18 credits, consisting of 3 core courses listed below, plus 1 workshop, 1 elective in the IEMP Track, and 1 elective in the Environment Track.

IEMP track concentrators must also satisfy their SIPA economics requirement with Economic Analysis for International Affairs (U6400/U6401), and must take Accounting (U6200) in the Fall 1<sup>st</sup> year to prepare for the IEMP required Corporate Finance (U6301) in the Spring 1st year and Economics of Energy (U6065) in the Fall 2<sup>nd</sup> year.

As part of the SIPA core, IEMP requirements include: Economic Analysis for International Affairs, INAF U6400/6401, and Accounting for International and Public Affairs, INAF U620, can count for Functional Specialization in Management requirements.

- International Energy Systems and Business Structures, INAF U6060.  
Corporate Finance, INAF U6031
- Economics of Energy, INAF U6065
- Capstone Workshop, INAF U9000
- IEMP Electives (Select at least one of the following):  
Alternative Energy Resources, INAF U4729  
Energy Business and Economic Development, INAF U6042  
Maritime Transportation, Law & Public Policy, INAF U8562  
Quantitative Methods in Energy Business and Policy Analysis, INAFU6325.  
Urban Energy Systems and Policy, INAF U8778  
US Energy Security: The Geopolitics of Oil and Natural Gas, INAF U6680  
Petroleum Markets and Trading, INAF U6615  
Electricity Markets – Design and Policy, INAF U6057  
International Energy Project Development & Finance, INAF U6040  
Marine Energy Transportation Technology, Economics & Policy, INAF U6657  
Risk and Scenario Analysis across the Energy Value Chain, INAF U6048  
Energy Policy, INAF U6242  
Energy Industry in the Middle East and Africa, INAF U6080  
International Energy Policy: Growth, Energy, Technology and the Environment, INAF U6061
- Environmental Policy and Management Electives (Select at least one of the following):  
Environmental Science for Decision Makers, INAF U4735  
Environmental Science for Sustainable Development, SDEV U6240

Economics of the Environment, INAF U4737  
Environmental Finance, INAF U6238  
Economics of Sustainable Development INAF W4329  
Economics of Sustainable Development ENVP U6230

## **Sustainable Energy Policy Track**

Ellen Morris, Track Director – [em2507@columbia.edu](mailto:em2507@columbia.edu)

Admission Deadlines: Spring – October 15, Fall – January 15, February 15

The sustainable energy track is designed for students interested in renewable energy, energy efficiency and the relationship of energy to sustainable economic development. The curriculum provides a thorough understanding of the challenges facing the formulation and implementation of sustainable energy policy including the connection of energy systems to business and political structures. This track permits the study of sustainable energy policy on a global, national and local scale. It permits the study of urban energy systems, alternative energy resources, governmental energy policy, energy industry fundamentals, and the business organizations involved in all aspects of energy production, distribution and consumption. Courses are available to permit students to pursue detailed study in sustainable energy policy, energy development and consumption; energy law, climate policy, carbon management, political and strategic issues arising from the unequal distribution of global energy resources; and the impact of technological change on the environmental impacts of energy use and development.

## **SEP Requirements Summary**

This track requires 18 credits, consisting of 2 core courses listed below, 2 electives in the Sustainable Energy Policy Track, and 1 elective in the Environment Track. All MIA and MPA students also are required to take a Capstone Workshop.

Sustainable Energy Policy track concentrators are provided with a great deal of flexibility in their study of sustainable energy policy. Possible areas of focus include energy efficiency, energy and economic development, energy and climate policy and renewable energy policy.. If a student does not wish to develop an area of focus, she or he may organize their studies more broadly and enroll in courses that cover a range of energy policy issues.

Students in the Sustainable Energy Policy track must also satisfy their SIPA economics requirement with Economic Analysis for International Affairs (U6400/U6401).

- Economics of Energy, INAF U6065
- Energy Policy, INAF U6242
- Capstone Workshop, INAF U9000
- Sustainable Energy Policy Electives (Select at least two of the following):
  - Alternative Energy Resources, INAF U4729
  - Energy Business and Economic Development, INAF U6042
  - International Energy Policy: Growth, Energy, Technology & Environment, INAF U6061
  - Energy Industry in the Middle East, INAF U6080
  - Energy Industry in the Asia, INAF U6082

Climate Change Policy, INAF U8537

Urban Energy Systems and Policy, INAF U8778

Climate Change, Development and Human Rights, SDEV U6235

- Environmental Policy and Management Electives (Select at least one of the following):  
Environmental Science for Decision Makers, INAF U4735  
Environmental Science for Sustainable Development, SDEV U6240  
Economics of the Environment, INAF U4737  
Environmental Finance, INAF U6238  
Economics of Sustainable Development INAF W4329  
Economics of Sustainable Development ENVP U6230

## **EEP Faculty**

*Daniel Ahn*, Adjunct Assistant Professor of International and Public Affairs, SIPA

*Douglass Almond*, PhD, Assistant Professor of International and Public Affairs and Economics, SIPA

*Scott Barrett*, PhD, Lenfest-Earth Institute Professor of Natural Resource Economics, SIPA

*Albert Bressand*, PhD, Professor of Professional Practice, SIPA, Director, Center for Energy, Marine Transportation, and Public Policy

*Louise Burke*, Adjunct Professor

*Steven Cohen*, Director of the M.P.A. in Environmental Science and Policy; Director, Environmental Policy Studies, School of International and Public Affairs, Executive Director and Chief Operating Officer, The Earth Institute

*Joshua R. Ginsberg*, PhD, Adjunct Professor, SIPA

*AJ Goulding*, Adjunct Assistant Professor, SIPA

*Antoine Halff*, Adjunct Professor, SIPA

*Steven A. Hammer*, PhD, Director, CEMTPP Urban Energy Program, Adjunct Professor, SIPA

*Klaus Jacob*, PhD, Adjunct Professor of International and Public Affairs; Special Research Scientist, Lamont-Doherty Earth Observatory

*Urvashi Kaul*, Adjunct Assistant Professor of International and Public Affairs

*Irene King*, Assistant Adjunct Professor, SIPA

*Linda Krueger*, Adjunct Professor, SIPA

*Phillip J. LaRocco*, Adjunct Professor, SIPA

*Marc Levy*, Adjunct Professor, SIPA, Deputy Director, Center for International Earth Science Information Network

*John McArthur*, Adjunct Assistant Professor of International and Public Affairs, SIPA

*Ellen Morris*, PhD, Adjunct Professor and Director of the International Energy Management and Policy track and the Sustainable Energy Policy track, SIPA

*David Nissen*, Adjunct Senior Research Scholar, Center for Energy, Marine Transportation and Public Policy

*Roy Nersesian*, Associate Professor of Professional Practice, SIPA

*Jeffrey Potent*, Adjunct Professor, SIPA

*Neil Quartaro*, Esq., Adjunct Associate Professor, SIPA

*Louise Rosen*, Associate Director of the M.P.A. in Environmental Science and Policy, Director of the Office of Academic and Research Programs at the Earth Institute, Adjunct Lecturer of International and Public Affairs, SIPA

*Wolfram Schlencker*, PhD, Assistant Professor, International and Public Affairs and Economics, SIPA

*Adam Shrier*, Adjunct Professor of International and Public Affairs, SIPA

*Gail Suchman*, Adjunct Lecturer of International and Public Affairs, SIPA

*Sara Tjossem*, Lecturer of International and Public Affairs, SIPA

*Bogdan Vasi*, Assistant Professor of International and Public Affairs and Sociology, SIPA

*Gernot Wagner*, Adjunct Assistant Professor of International and Public Affairs, SIPA

## **DOCTORAL PROGRAMS**

### **Ph.D. Program in Sustainable Development**

John Mutter, Director of Graduate Studies – [jcm7@columbia.edu](mailto:jcm7@columbia.edu)

Jeffrey Sachs, Program Co-Director – [sachs@columbia.edu](mailto:sachs@columbia.edu)

Joseph Stiglitz, Program Co-Director – [jes322@columbia.edu](mailto:jes322@columbia.edu)

Mona Khalidi, Assistant Director of Graduate Studies – [mk2388@columbia.edu](mailto:mk2388@columbia.edu)

Admission Deadline: December 15

Program Website: <http://www.sipa.columbia.edu/phd/index.html>

The interdisciplinary Ph.D. in Sustainable Development is designed to train future researchers, university teachers, and world leaders in the social and natural science disciplines germane to sustainable development. By combining elements of a traditional graduate education in social science, particularly economics, with graduate level training in the natural sciences, the program's graduates will be uniquely situated to undertake serious quantitative analytical research and policy assessments with the goal of sustainable development. There are a wide variety of potential employers for the program's graduates. Many graduates will pursue academic careers in interdisciplinary graduate and undergraduate programs with foci that could include policy and the environment, development economics, and energy policy as well as in the more traditional disciplines. Others will choose nonacademic positions, taking leadership roles in government ministries in the United States and throughout the world, working on environmental protection and sustainable development programs; as well as in a variety of international and non-governmental organizations, such as the UN, the IMF and the World Bank; in private firms engaged in large-scale development projects; or in consulting firms analyzing development issues for private and public clients.

Any additional questions about the program can be emailed to Assistant Director of Graduate Studies, Mona Khalidi at: [sipa\\_phd@columbia.edu](mailto:sipa_phd@columbia.edu).

#### **Admission Requirements**

- Four semesters of college-level social science, including two semesters of economics, and six semesters of college-level math and science
- Two semesters of college-level calculus
- Understanding of multivariate calculus and linear algebra
- Submission of scores from the GRE General test
- The English Placement Test and submission of TOEFL scores (only for non-native English speakers)

#### **Program Requirements**

The curriculum consists of twelve core courses including three semesters of economics; three quantitative methods (econometrics) courses; Environmental Economics; Human Ecology; Comparative Development; Politics of Sustainable Development; Environmental Science for Sustainable Development; and Science and Technology Policy for Development. Students must also complete two social science electives and a coherent sequence of four natural science courses. In addition to this course work, students will participate in mandatory integrative seminars; complete an MA thesis by the end of the second year; successfully complete the M Phil Qualifying Exams and submit the dissertation prospectus before the end

of the fourth year; and finally write a Ph.D. dissertation. Students are expected to complete their studies in five years. A sixth year is permitted but normally cannot be funded by the School.

### **The Ph.D. Dissertation**

The Ph.D. dissertation will be on a topic in sustainable development. Social science research toward the degree will be matched with a deep understanding of physical and natural systems influencing economic development.

Students should possess at least two research tools before starting the dissertation portion of this program. Among these is an advanced understanding of quantitative methods, to be gained through the mandatory core courses. The other research tool should be appropriate to the student's dissertation work. In consultation with the student's academic advisers, this second tool could be a two-course sequence in GIS or other analytic modeling systems, or a proficiency exam in a language other than English.

Students with a regional area of interest to their dissertation may wish to conduct research abroad, either for the use of archives, to improve language skills, or to confer with local experts. In order to ensure that students complete the Ph.D. program without delay, it is preferred that they make use of summers to conduct such research. Students may not receive extended residence credit for study or research away from Columbia before the completion of all coursework requirements and comprehensive examinations.

### **Teaching Requirements**

Students have to fulfill a teaching and research requirement by working six semesters as a Teaching or Research Assistant as assigned by the Director of the Program. Students who secure external funding may reduce this requirement, but in all cases every student must teach at least two semesters.

### **Faculty**

*Douglas Almond*, Assistant Professor of International and Public Affairs and Economics

*Lisa Anderson*, James T. Shotwell Professor of International Relations

*Scott Barrett*, Professor of Natural Resource Economics

*Guillermo Calvo*, Professor of International and Public Affairs

*Mark Cane*, G. Unger Vetlesen Professor, Earth and Environmental Sciences and Professor of Applied Physics and Applied Mathematics, School of Engineering and Applied Sciences

*Pierre Andre Chiappori*, E. Rowan and Barbara Steinschneider Professor of Economics

*John Coatsworth*, Professor of International and Public Affairs and of History; Dean, School of International and Public Affairs

*Geoffrey Heal*, Paul Garrett Professor of Public Policy and Business Responsibility, Business School

*Macartan Humphreys*, Associate Professor Political Science

*Patrick Kinney*, Professor of Environmental Health Sciences, Mailman School of Public Health

*Klaus Lackner*, Maurice Ewing and J. Lamar Worzel Professor of Geophysics

*Upmanu Lall*, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics; Department Chair, Earth and Environmental Engineering

*Leigh Linden*, Assistant Professor International and Public Affairs, and Economics

*W. Bentley MacLeod*, Professor of International and Public Affairs and Economics

*Vijay Modi*, Professor of Mechanical Engineering

*John C. Mutter*, Professor of Earth and Environmental Sciences and of International and Public Affairs; Director of Graduate Studies

*Shahid Naeem*, Professor of Ecology, Evolution, and Environmental Biology

*Jose Antonio Ocampo*, Professor in the Professional Practice of International and Public Affairs

*Sharyn O'Halloran*, George Blumenthal Professor of International and Public Affairs and of Political Science

*Arvind Panagariya*, Jagdish Bhagwati Professor of Indian Political Economy, International and Public Affairs and of Economics

*Christian Pop-Eleches*, Assistant Professor International and Public Affairs, and Economics

*Jeffrey D. Sachs*, Director of The Earth Institute; Quetelet Professor of Sustainable Development; Professor of Health Policy and Management; Co-Director of PhD Program in Sustainable Development

*Bernard Salanie*, Professor of Economics

*Bhaven Sampat*, Assistant Professor of Health Policy and Management

*Pedro Sanchez*, Senior Research Scholar, Tropical Agriculture and Rural Environment Program, The Earth Institute

*Wolfram Schlenker*, Assistant Professor of International and Public Affairs, and Economics

*Joseph E. Stiglitz*, University Professor; Co-Director of PhD Program, SDEV.

*Miguel Urquiola*, Assistant Professor of International and Public Affairs

*Bogdan Vasi*, Assistant Professor of International and Public Affairs And Sociology

*Eric Verhoogen*, Assistant Professor of International and Public Affairs, and Economics

*Paige West*, Assistant Professor of Anthropology, Barnard College

## Ph.D. Earth and Environmental Engineering

Marco Castaldi, Program Director – [mc2352@columbia.edu](mailto:mc2352@columbia.edu) – (212) 854-6390

Gary Hill, Program Director – [gh2206@columbia.edu](mailto:gh2206@columbia.edu) – (212) 854-2926

Peter Rennée, Department Administrator – [pr99@columbia.edu](mailto:pr99@columbia.edu) – (212) 854-7065

Admission Deadline: Fall – December 1, Spring – October 1

Program Website: <http://www.engineering.columbia.edu/bulletin/dept/earth.php>

The Department of Earth and Environmental Engineering offers two doctoral degrees: (1) the Eng.Sc.D. degree administered by The Fu Foundation School of Engineering and Applied Science; and (2) the Ph.D. degree, administered by the Graduate School of Arts and Science. Qualifying examinations and all other intellectual and performance requirements for these degrees are the same. The scope includes the design and use of sensors for measurement at molecular scale; the understanding of surface, colloid, aqueous, and high-temperature phenomena; the integrated management of multiple resource and the mitigation of natural and environmental hazards at regional to global scales. The management of the interaction between human activities, Earth resources and ecosystems is of primary interest.

### **Admission Requirements**

- Official B.S./B.A. transcript
- Official M.S./M.A. transcript
- Personal statement
- Resume or Curriculum Vitae
- Three letters of recommendation
- Submission of the Graduate Record Examination (general) scores
- Submission of TOEFL scores (only for students whose Bachelor's degree was received in a non-English speaking country)

The engineering objectives of EEE research and education include:

- **Provision and disposal of materials:** environmentally sustainable extraction and processing of primary materials; manufacturing of derivative products; recycling of used materials; management of industrial residues and used products; materials-related application of industrial ecology.
- **Management of water resources:** understanding, prediction, and management of the processes that govern the quantity and quality of water resources, including the role of climate; development/operation of water resource facilities; management of water-related hazards.
- **Energy resources and carbon management:** mitigation of environmental impacts of energy production; energy recovery from waste materials; advancement of energy efficient systems; new energy sources; development of carbon sequestration strategies.
- **Sensing and remediation:** understanding of transport processes at different scales and in different media; containment systems; modeling flow and transport in surface and subsurface systems; soil/water decontamination and bioremediation.

## **Faculty**

*William Becker*, Adjunct Professor

*Marco Castaldi*, Assistant Professor

*Kartik Chandran*, Assistant Professor

*Xi Chen*, Associate Professor

*Paul F. Duby*, Professor of Mineral Engineering

*Raymond Farinato*, Adjunct Professor

*Robert Farrauto*, Adjunct Professor

*Vasilis Fthenakis*, Senior Research Scientist

*Yuri Gorokovich*, Adjunct Professor

*Scott Kaufman*, Adjunct Assistant Professor

*Klaus Lackner*, Chair, Maurice Ewing and J. Lamar Worzel Professor of Geophysics

*Upmanu Lall*, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics

*Wade McGillis*, Doherty Research Scientist

*Cevdet Noyan*, Professor of Materials Science

*Ah-Hyung (Alissa) Park*, Lenfest Junior Professor in Applied Climate Science

*Sri Rangarajan*, Adjunct Assistant Professor

*Peter Schlosser*, Vinton Professor of Earth and Environmental Engineering

*Ponisseril Somasundaran*, LaVon Duddleson Krumb Professor of Earth and Environmental Engineering

*Nickolas J. Themelis*, Stanley-Thompson Professor Emeritus of Chemical Metallurgy

*Nicholas J. Turro*, William B. Schweitzer Professor of Chemistry

*Tuncel M. Yegulalp*, Professor of Mining Engineering

*Gregory Yetman*, Adjunct Assistant Professor

## **Ph.D. Earth and Environmental Sciences**

Steven L. Goldstein, Program Director – [steveg@ldeo.columbia.edu](mailto:steveg@ldeo.columbia.edu) – (845) 365-8787

Mia Leo, Administrator – [mia@ldeo.columbia.edu](mailto:mia@ldeo.columbia.edu) - (845) 365-8633

Admission Deadline: January 1

Program Website: <http://eesc.columbia.edu/graduate/phdrequirements.html>

The Ph.D. program aims to train broadly educated Earth scientists for careers in academia, research, government, and industry; along the way, our students move swiftly from receiving knowledge to creating it. All the facilities and equipment necessary for modern studies in the Earth sciences are available for the use of students in the department whose research is conducted at one of three affiliated institutions: the Lamont-Doherty Earth Observatory, the American Museum of Natural History, or the Goddard Institute for Space Studies.

### **Admission Requirements**

Ours is a full-time Ph.D. program; students who can attend classes only in the late afternoons and evenings and on Saturdays or during the Summer Session may not matriculate in this Department. With the exception of our two terminal masters programs (Climate and Society & Earth and Environmental Science Journalism), a terminal M.A. is not offered. All students must sign on for the full Ph.D. program (and will acquire the M.A. degree along the way). Applicants for the Ph.D. program must have completed at least a Bachelor's degree.

#### **Requirements:**

- We require applicants to have an undergraduate major in one of the following disciplines:

Biology	Environmental Sciences/Policy
Chemistry	Mathematics/Engineering
Geoscience	Physics

- At least one college year with a high record in chemistry, mathematics, and physics is strongly recommended. Additional competence is required for graduate work in certain disciplines.
- GRE Aptitude Test
- GRE Advanced Tests are welcomed, but not required.

### **Degree Requirements for the Ph.D. in Earth and Environmental Sciences**

A student may not become a candidate for the Ph.D. degree without first fulfilling the requirements for the M.A. and M.Phil. degrees. Specific course requirements will vary depending on the student's chosen area of research.

#### **Requirements for the M.A. Degree**

This degree is prerequisite to the M.Phil. and Ph.D. degrees unless the student has been awarded two Residence Units of advanced standing.

- **Program of study:** To be approved by an advisory committee designated by the department.

- **Length of program:** No fewer than two Residence Units.
- **Points of E-credit:** Twenty approved course points; removal of admissions deficiencies.
- **Field requirement:** Students in terrestrial and marine geology, solid earth geophysics, and planetary science programs are advised to take a field course.
- **Languages:** None.
- **Examination:** Written submission of the results of two research projects, and successful oral presentation of these results to the student's advisory committee.

### Requirements for the M. Phil. Degree

This degree is prerequisite to the Ph.D. degree.

- **Length of program:** The degree is to be completed by the end of the fourth year of study, except for those students granted advanced standing, who must complete the degree by the end of the third year of study.
- **Residence Units:** Six full-time, including those earned for the MA degree.
- **Points of E-credit:** Minimum of forty-five approved course points (including those earned for the MA degree), including seminar courses but excluding research points.
- **Required courses:**
  1. At least 10 points outside the student's program of study and in a major subdivision within the department (geology/petrology/mineralogy; marine geology and geophysics; solid earth geophysics; terrestrial geology/paleontology; oceanography; atmospheric science).
  2. An approved field course is required of candidates in the first four subdivisions listed above.
  3. Courses prescribed by the department subdivision.
- **Languages:** No formal requirement; students in certain disciplines may be asked to show proficiency in a foreign language if their adviser or their research requires it.
- **Apprenticeship:** To be served in laboratory or field research and approved by the student's advisory committee.
- **Examination:** A two-hour oral certifying examination, which must be taken by the end of the third academic year, consisting of questioning and discussion centered on the student's major and minor fields and research, but also in general Earth sciences. Performance in the certifying examination determines whether or not the student may continue in residence toward the Ph.D. degree upon completion of the M. Phil. Degree
- **Thesis Proposal:** Within six months of successfully completing the certifying exam, students must present a thesis proposal to their advisory committee (and invited guests, if any).

### Requirements for the Ph.D. Degree

The M.A. and M.Phil. degrees are prerequisite to the Ph.D. degree.

- **Recommended length of program:** Five years, including the earning of the M.A. and M.Phil. degrees, at least one year of which should be spent in preparing the dissertation.
- **For certification to the Ph.D. examination:** Dissertation must have been approved by the candidate's advisory committee.

## Faculty

*Geoffrey A. Abers*, Adjunct Professor, Earthquakes, Earth structure, and their relationship to active tectonic processes

*Mark H. Anders*, Associate Professor, Structural geology

*Robert F. Anderson*, Lecturer, Role of ocean circulation and ocean biology in regulating the concentration of CO<sub>2</sub> in the atmosphere; sensitivity of these processes to climate change

*Roger N. Anderson*, Adjunct Professor, Marine geophysics, energy

*Anthony G. Barnston*, Associate, Forecasting climate variability and change, ENSO, statistical prediction methods

*Natalie T. Boelman*, Storke-Doherty Lecturer, Terrestrial ecology, hyperspectral remote sensing, bioacoustics

*Wallace S. Broecker*, Newberry Professor, Paleoclimate, ocean chemistry, radiocarbon dating

*W. Roger Buck IV*, Adjunct Professor, Marine geophysics, geodynamics, tectonics

*Mark A. Cane*, G. Unger Vetlesen Professor (Joint with APAM), Climate physics, climate prediction, social impacts of climate; paleoclimate; oceanography

*Nicholas Christie-Blick*, Professor, Sedimentation processes, crustal deformation, deep-time Earth history

*James R. Cochran*, Lecturer, Marine geophysics, gravity, geodesy, isostasy

*Joel E. Cohen*, Adjunct Professor, Population science

*Anthony D. Del Genio*, Adjunct Professor, Role of clouds and water vapor in climate, dynamics of planetary atmospheres

*Peter B. deMenocal*, Professor, Paleoclimatology, ocean circulation variability, tropical-extratropical paleoclimate linkages, Pliocene-Pleistocene evolution of tropical climates, African climate and human evolution

*Peter M. Eisenberger*, Professor, Earth/human systems and interactions

*Göran Ekström*, Professor, Seismology

*John J. Flynn*, Adjunct Professor, Vertebrate paleontology

*Lisa M. Goddard*, Adjunct Associate Professor, Climate science

*Steven L. Goldstein*, Professor, Isotope geology, climate change, mantle geochemistry, Earth evolution

*Arnold L. Gordon*, Professor, Physical oceanography

*Kevin L. Griffin*, Associate Professor, Plant ecophysiology

*James E. Hansen*, Adjunct Professor, Unraveling the mechanisms of climate change, and projecting the climatic impact of human activity

*Sidney R. Hemming*, Associate Professor, Geochronology and the sedimentary record of changes through Earth history

*Bärbel Hönlisch*, Assistant Professor, Validation of paleo-proxies in living foraminifers and application of knowledge to reconstruct past climate change

*Andrew Juhl*, Adjunct Associate Professor, Biological Oceanography

*Kim A. Kastens*, Adjunct Professor, Research on thinking & learning in geosciences; spatial cognition in geosciences; public understanding of the Earth & environment; marine geology

*Peter B. Kelemen*, Arthur D. Storke Memorial Professor, Carbonation of peridotite for CO<sub>2</sub> storage, melt transport in the mantle and lower crust, mantle shear zones and intermediate depth earthquakes

*Andrew A. Lacis*, Lecturer, Radiative transfer, climate change, remote sensing

*Arthur L. Lerner-Lam*, Adjunct Professor, Seismology, natural hazards

*Douglas G. Martinson*, Adjunct Professor, Physical oceanography, polar studies

*Jerry F. McManus*, Professor, Paleoclimate

*William H. Menke*, Professor, Seismology, solid Earth geophysics, tomography

*John C. Mutter*, Professor (Joint with SIPA), Marine seismic studies of mid-ocean ridges, natural disasters, sustainable development

*Meredith Nettles*, Assistant Professor, Glacial seismology

*Mark A. Norell*, Adjunct Professor, Vertebrate paleontology

*Paul E. Olsen*, Arthur D. Storke Memorial Professor, Paleoecology, ecosystem evolution, vertebrate paleontology

*Hsien Wang Ou*, Adjunct Professor, Ocean dynamics, planetary circulation, climate theories

*Dorothy M. Peteet*, Adjunct Professor, Paleoecology, palynology

*Stephanie L. Pfirman*, Hirschorn Professor, Environmental Science, Barnard College, Arctic oceanography

*Walter C. Pitman III*, Adjunct Professor, Marine magnetism

*Terry A. Plank*, Professor, Igneous geochemistry, magma generation, crustal recycling, magmatic water

*Lorenzo M. Polvani*, Professor (Joint with APAM), atmosphere, ocean and climate dynamics, geophysical fluid dynamics, planetary atmospheres

*G. Michael Purdy*, Professor, Marine seismology

*Paul G Richards*, Mellon Professor Emeritus and Special Lecturer, Theoretical Seismology, Arms Control/Nuclear Disarmament

*Joerg M. Schaefer*, Adjunct Associate Professor, Climate Science, Cosmogenic Dating

*Peter Schlosser*, Vinton Professor (Joint with DEEE), Aqueous geochemistry, hydrology

*Christopher H. Scholz*, Professor (Joint with APAM), Experimental and theoretical rock mechanics, especially friction, fracture, hydraulic transport properties, nonlinear systems, mechanics of earthquakes and faulting

*Christopher Small*, Adjunct Professor, Imaging spatio-temporal dynamics of the Earth surface with light, sound & gravity

*Jason E. Smerdon*, Storke-Doherty Lecturer, Late-Holocene paleoclimate, statistical methods, geothermal climate signals

*Adam H. Sobel*, Professor (Joint with APAM), Atmospheric and climate dynamics, tropical meteorology

*Marc W. Spiegelman*, Arthur D. Storke Memorial Professor (Joint with APAM), Coupled fluid/solid mechanics, reactive fluid flow, solid Earth and magma dynamics, scientific computation/modeling

*Martin Stute*, Ann Olin Whitney Professor, Barnard College, Aqueous geochemistry, hydrology

*Taro Takahashi*, Adjunct Professor, Carbon cycle in the oceans, atmosphere and biosphere

*Andreas Thurnherr*, Lecturer, Physical Oceanography

*Mingfang Ting*, Adjunct Professor, Climate dynamics

*Maria Tolstoy*, Associate Professor, Marine Seismology

*David Walker*, Higgins Professor, Experimental petrology, geology, materials science, alternate energy

*Spahr C. Webb*, Adjunct Professor, Marine geophysics, seismology, ocean bottom seismometry/instrumentation

*Gisela Winckler*, Adjunct Associate Professor Marine Geochemistry

## **Ph.D. Atmospheric and Planetary Science (APS)**

Wallace S. Broecker, Program Director – [broecker@ldeo.columbia.edu](mailto:broecker@ldeo.columbia.edu) – (845) 365-8413

Anthony D. Del Genio, Contact – [Adelgenio@giss.nasa.gov](mailto:Adelgenio@giss.nasa.gov) – (212) 678-5588

Admission Deadline: January 1

Program Website: <http://www.giss.nasa.gov/edu/grad/>

### **Mission**

The NASA Goddard Institute for Space Studies/Columbia University graduate program in Atmospheric and Planetary Science is jointly offered by the Department of Earth and Environmental Sciences and the Department of Applied Physics and Applied Mathematics at Columbia University. The program is different from a standard meteorology curriculum, emphasizing global climate change, Earth observation, planetary atmospheres, and interdisciplinary studies over such traditional subjects as weather forecasting, although the focus in all cases is on basic physical processes.

### **Admission Requirements**

A strong background in physics and mathematics, including advanced undergraduate courses in mechanics, electromagnetism, advanced calculus and differential equations.

### **Program of Study**

The Departments of Earth and Environmental Sciences; Astronomy; Physics; and Applied Physics and Applied Mathematics at Columbia University jointly offer a graduate program in atmospheric and planetary science leading to the Ph.D. degree. Four to six years are generally required to complete the Ph.D., including the earning of M.A. and M. Phil. degrees. The program is conducted in cooperation with the NASA Goddard Space Flight Center's Institute for Space Studies, which is adjacent to Columbia University. Members of the Institute hold adjunct faculty appointments, offer courses, and supervise the research of graduate students in the program. The Institute holds colloquia and scientific conferences in which the University community participates. Opportunities for visiting scientists to conduct research at the Institute are provided by postdoctoral research programs administered by the National Academy of Sciences-National Research Council and Columbia and supported by NASA.

Research at the Institute focuses on broad studies of natural and anthropogenic global changes. Areas of study include global climate, earth observations, biochemical cycles, astrobiology, planetary atmospheres, and related interdisciplinary studies. The global climate program involves basic research on climatic variations and climate processes, including the development of global numerical models to study the climate effects of increasing carbon dioxide and other trace gases, aerosols, solar variability and changing surface conditions. The earth observations program entails research in the retrieval of aerosol radiative properties from global satellite polarimetry data to further understanding of their effects on climate. Biogeochemical cycles research utilizes three-dimensional models to study the distribution of trace gases in the troposphere and stratosphere and to examine the role of the biosphere in the global carbon cycle. The planetary atmospheres program focuses on studies of the

dynamics of Titan and the Jovian planets, using Cassini spacecraft data. Interdisciplinary research includes studies of turbulence and astrobiology.

## **Faculty**

*Brian Cairns*, Adjunct Associate Professor, Applied Physics & Applied Mathematics

*Vittorio M. Canuto*, Adjunct Professor, Applied Physics and Applied Mathematics

*Barbara E. Carlson*, Adjunct Professor, Applied Physics and Applied Mathematics

*Mark A. Chandler*, Associate Research Scientist, Center for Climate Systems Research

*Anthony D. Del Genio*, Adjunct Professor, Earth and Environmental Sciences, Applied Physics and Applied Mathematics

*Leonard M. Druryan*, Senior Research Scientist, Applied Physics and Applied Mathematics

*Timothy M. Hall*, Adjunct Professor, Applied Physics and Applied Mathematics

*James E. Hansen*, Adjunct Professor, Earth and Environmental Sciences; Head of the Institute for Space Studies

*Nancy Kiang*, Adjunct Associate Research Scientist, Center for Climate Systems Research

*Andrew A. Lacis*, Lecturer, Earth and Environmental Sciences

*Ron L. Miller*, Adjunct Professor, Applied Physics and Applied Mathematics

*Michael I. Mishchenko*, Research Scientist, NASA Goddard Institute for Space Studies

*Jan Perlwitz*, Associate Research Scientist, Applied Physics and Applied Mathematics

*Dorothy M. Peteet*, Adjunct Professor, Earth and Environmental Sciences

*Cynthia Rosenzweig*, Senior Scientist, NASA Goddard Institute for Space Studies, Center for Climate Systems Research

*Gary L. Russell*, Senior Scientist, NASA Goddard Institute for Space Studies

*Gavin A. Schmidt*, Research Scientist, Center for Climate Systems Research

*Drew T. Shindell*, Adjunct Associate Research Scientist, Center for Climate Systems Research

*Linda E. Sohl*, Associate Director, Research and Proposal Development, Center for Climate Systems Research.

*Larry D. Travis*, Associate Chief of the Institute for Space Studies

## **Ph.D. Environmental Health Sciences**

Greg A. Freyer, Ph.D.  
Program Director of Educational Affairs, M.A. Adviser  
60 Haven Avenue, B-1 New York, NY 10032  
Tel: 212.342.0457  
Fax: 212.781.4993

### **Ph.D. — Overview**

Our program seeks to integrate skills in basic biomedical sciences and public health into an interdisciplinary training experience for the next generation of environmental health scientists. PhD candidates will acquire skills in modern scientific methods and techniques to enable them to solve problems related to environmental exposures and their effects on human health. This includes understanding of the physiological, cellular, and molecular mechanisms of environmental agents on various disease processes, as well as an appreciation for environmental health risk assessment and policy. The program is designed specifically to develop scientists who can establish successful research careers in academia; however, the skills they acquire through their training can also be applied to careers in government and/or private research sectors.

Each candidate's research is focused on one of the following themes in environmental health sciences: environmental cancer, environmental respiratory disease, environmental neurodegenerative disease, radiation biology, or environmental neurotoxicology. Trainees choose from one of two possible tracks: molecular epidemiology or molecular toxicology. The former encompasses research in human populations, while the latter is generally more mechanistic and laboratory-based. The PhD program utilizes classroom instruction, a journal club, seminars, qualifying exams, and most importantly, research to train candidates as independent authorities in environmental health sciences. Candidates are also encouraged to enhance their educational experience by taking elective courses related to their thesis topic at the main Columbia campus, as well as the Medical Center campus.

### **Requirements**

As a minimum requirement, applicants must have completed one year of the following courses: general chemistry, organic chemistry, biology and mathematics.

### **Careers**

**Potential Career Paths:** Graduates are qualified to obtain junior and senior positions within health-related organizations. Our graduates also obtain employment in research programs in academic settings. The following is a sampling of career opportunities available to graduates:

- Academic positions within universities and hospitals as faculty members and senior-level researchers.
- Senior roles in research, management, or data analysis with governmental regulatory agencies at the local, state, national, and international levels.
- Researchers within private industry, including pharmaceutical companies.

- Leadership/senior roles at government organizations involved in environment and health protection, such as the Environmental Protection Agency (EPA) health departments and the Center for Disease Control and Prevention (CDC).
- Consulting roles, such as within pharmaceutical and healthcare companies.
- Community-based organizations concerned with health issues related to environmental exposures.

For more information about our PhD program, please review our Website:

<http://www.mailman.hs.columbia.edu/academic-departments/environmental-health/academic-programs/phd-program>

## **Dr.P.H. — Overview**

The Dr.P.H. program is designed for professionals interested in advancing their careers particularly in research, advocacy, policy, and administrative positions in an area of specialization within the field of environmental health. The Dr.P.H. program shares the learning objectives of the PhD program, but is better suited for students interested in a focus on applied, practical, or real world research problems in a subspecialty area within environmental health sciences. Our students pursue work in government agencies such as those responsible for developing environmental policy, roles within private and public institutions in the area of health and safety, or non-government organizations whose interests are in the effects of environmental exposure to human health. These students are well prepared for leadership roles within the specialty areas of the field of environmental health sciences.

## **Requirements**

M.P.H. or its equivalent (defined as another master's degree appropriate to the public health field).

## **Careers**

- Senior roles in research, management, or data analysis at governmental regulatory agencies at the local, state, national, and international level
- Researchers within industries including pharmaceutical companies
- Leadership/senior roles at government organizations involved in environmental and health protection, such as the Environmental Protection Agency (EPA), health departments, and the Center for Disease Control (CDC).
- Consulting firms
- Community based organizations concerned with health issues related to environmental pollutants
- Non-government organizations involved in developing and advocating for sound environmental policy

For more information about our DrPH program, please review our Website:

<http://www.mailman.hs.columbia.edu/academic-departments/environmental-health/academic-programs/drph-program>

## **EHS Faculty**

### **Full-Time Faculty and Areas of Interest**

#### **Professors**

*David Brenner*, Ph.D. – radiation, health physics

*Dickson Despommier*, Ph.D. – infectious disease, ecology

*Joseph Graziano*, Ph.D. - metal toxicology and metabolism

*Tomás R. Guilarte*, Ph.D. – mechanism based neurotoxicology, neuroscience

*Tom Hei*, Ph.D. – cancer, radiation, fiber toxicology, DNA damage and mutagenesis

*Patrick Kinney*, Sc.D. – respiratory disease, climate change and health, pollution epidemiology

*Howard Lieberman*, Ph.D. – radiation biology

*Frederica Perera*, Dr.P.H. - cancer, children's health, molecular epidemiology

*Regina Santella*, Ph.D. – cancer, biomarkers of chemical exposure

*Robin Whyatt*, Dr.P.H. – pesticides, children's health, reproductive health

*Chen Shie Wu*, Ph.D. – radiation, health physics

*Neil Schluger*, M.D. – respiratory disease, epidemiology, tuberculosis

#### **Associate Professors**

*Greg Freyer*, Ph.D. – DNA repair, cancer

*Mary Gamble*, Ph.D. – nutritional biochemistry, epigenetics, metal toxicology, arsenic exposure, nutritional status and cancer

*Rachel Miller*, M.D. – respiratory disease

*Matthew Perzanowski*, Ph.D. – respiratory disease, asthma and allergens

*Deliang Tang*, Dr. P.H. – environmental carcinogenesis, epigenetics

*John Whysner*, M.D., Ph.D. – toxicology, carcinogenesis

#### **Assistant Professors**

*Edward Christman*, Ph.D. – radiation safety

*Jing Shen*, M.D., Ph.D. – cancer

*Manuela Orjuela*, M.D. – cancer, retinoblastoma, pediatrics

*Darby Jack*, Ph.D. – environmental health policy; Environmental health in developing countries

#### **Research Scientists**

*Yu-Jing Zhang*, M.D. – cancer

**Associate Research Scientists**

*Norman Kleiman*, Ph.D. – DNA damage and repair, oxidative stress, cataracts

*Nancy Loiacono*, M.P.H – metal toxicology, environmental epidemiology

*Faruque Parvez*, M.S., M.P.H. – metal toxicology, indoor air pollution

*Vesna Slavkovic*, M.S. – metal toxicology, analytical chemistry

## **Ph.D. Programs, Department of Ecology, Evolution and Environmental Biology (E3B)**

Eleanor Sterling, Director of Graduate Studies – [es443@columbia.edu](mailto:es443@columbia.edu) – (212) 854-9987

Lourdes Gautier, Academic Department Administrator – [lg2019@columbia.edu](mailto:lg2019@columbia.edu) –

(212) 854-8665

Program Website: <http://www.columbia.edu/cu/e3b/phd.html>

E3B offers two Ph.D. programs: one in Ecology and Evolutionary Biology and one in Evolutionary Primatology.

The Ecology and Evolutionary Biology (EEB) program is designed to provide the broad education needed to describe, understand, and conserve the Earth's biological diversity in all its forms. Matriculating students will develop the skills needed to conduct ecological, behavioral, systematic, molecular, and other evolutionary biological research and develop the ability to formulate and implement environmental policy. Graduates often pursue academic careers as researchers and teachers, or professional positions in national or international conservation, environmental and multilateral aid organizations. All Ph.D. students in EEB must complete the Environmental Policy Certificate program, for which they receive a separate degree.

Columbia has offered a Ph.D. program in Evolutionary Primatology for over a decade. Many aspects of this program are coordinated with the New York Consortium of Evolutionary Primatology (NYCEP). NYCEP, a consortium of the City University of New York, New York University, the American Museum of Natural History, and the Wildlife Conservation Society, provides a multi-institutional venue for graduate training leading to the Ph.D., which emphasizes all aspects of the behavioral, ecological, morphological, and evolutionary biology of primates. Course offerings in this program are coordinated across the NYCEP institutions. While in the past this Ph.D. program was administered by the Anthropology Department, it is now housed within E3B, and is funded by a multi-institutional NSF IGERT grant.

### **Core Faculty (E3B)**

*Marina Cords*, Professor

*Ruth DeFries*, Denning Professor of Sustainable Development

*Don Melnick*, Thomas Hunt Morgan Professor of Conservation Biology

*Shahid Naeem*, Professor and Chair

*Katherine McFadden*, Assistant Professor

*Dustin Rubenstein*, Assistant Professor

*Maria Uriarte*, Assistant Professor

*Fabio Corsi*, Lecturer

*Matthew Palmer*, Lecturer

*Jill Shapiro*, Lecturer

## **Affiliated Faculty**

*Philip Ammirato*, Professor Emeritus of Biological Sciences, Barnard College

*Walter Bock*, Professor of Biological Sciences

*John Glendinning*, Professor of Biological Sciences, Barnard College

*Paul Hertz*, Professor of Biological Sciences, Barnard College

*Ralph Holloway*, Professor of Anthropology

*Darcy Kelley*, Professor of Biological Sciences

*Paul Olsen*, Professor of Earth and Environmental Sciences

*Robert Pollack*, Professor of Biological Sciences

*Jeanne Poindexter*, Professor of Biological Sciences, Barnard College

*Steve Cohen*, Associate Professor of SIPA

*Kevin Griffin*, Associate Professor of Earth and Environmental Sciences

*Brian Morton*, Associate Professor of Biological Sciences, Barnard College

*Paige West*, Associate Professor of Anthropology, Barnard College

*Hillary Callahan*, Assistant Professor of Biological Sciences, Barnard College

## **Adjunct Faculty**

The Department of E3B also has a large adjunct faculty (see [http://www.columbia.edu/cu/e3b/faculty\\_adjunct.html](http://www.columbia.edu/cu/e3b/faculty_adjunct.html)), most of whom are senior scientists at one of the following institutions: American Museum of Natural History, New York Botanical Garden, Wildlife Conservation Society, and Wildlife Trust. These faculty members teach courses and advise student research.

## **NYCEP Faculty**

Students in the Evolutionary Primatology Program also have the larger NYCEP (New York Consortium in Evolutionary Primatology) faculty to serve as internship and research advisers, instructors, and committee members. This faculty includes full-time faculty members at City University of New York and New York University, as well as research scientists at the American Museum of Natural History and the Wildlife Conservation Society. For a full listing see <http://www.nycep.org/pages/faculty/index.php>.

## **Ph.D. Ecology and Evolutionary Biology**

Eleanor Sterling, Director of Graduate Studies – [es443@columbia.edu](mailto:es443@columbia.edu) – (212) 854-9987

Lourdes Gautier, Academic Department Administrator – [lg2019@columbia.edu](mailto:lg2019@columbia.edu) – (212) 854-8665

Admission Deadline: January 3

Full-time Residence Units (RU)

Six units of full-time residency are required by the Graduate School of Arts and Sciences (4-5 for students with advanced standing). These RUs include the two that make up the linked Environmental Policy Certificate.

### **Admission Requirements**

- An undergraduate major in one of the natural sciences
- It is desirable that students have had course work in calculus, physics, chemistry, statistics, genetics, evolution, ecology, and organismal biology
- Prior field biology experience is strongly recommended

### **Advisers**

Students are admitted to the program with a primary research adviser already identified. By the end of the second semester, each EEB student, in consultation with the adviser and Director of Graduate Studies (DGS), will select a 3-member advisory committee from the faculty associated with the EEB program. This committee has primary responsibility for student supervision and designing the student's individual program. In most cases, the committee members become part of the 5-member dissertation committee.

### **Core Courses**

All first-year students must take the following core courses:

- EEEB 4122 Fundamentals of Ecology and Evolution (4 credits)
- EEEB G6990 Conservation Biology (3 credits)

*Note: Students receiving a grade of less than B+ in any of these courses will be required to take a written exam at the end of the first summer based on the core course material.*

### **Other Required Courses**

- Enrollment in the CERC Seminar (EEEEB G6300) is required for the first 4 years (3 years for those with advanced standing), and attendance is expected thereafter for students in residence in New York.
- Students in the Ecology and Evolution Ph.D. program are required to complete a Certificate in Environmental Policy, which is a separate but linked degree. The EPC requires 24 points of coursework, including one course each in the areas of Environmental Policy/Politics, Environmental Law, Environmental Economics and Anthropology/Public Health. In addition, students must take a workshop in Environmental Policy, and complete two elective courses.

## **Elective Courses**

Elective courses provide highly specialized training in one or more of the areas of program specialization, e.g. evolution, ecology, population biology, systematics, behavior, and ethnobiology. Students choose elective courses in consultation with the DGS and their advisory committees. Most students take 5-6 elective courses.

## **Biology Internships**

Two internships are required, either with the student's adviser, or in different areas. Sponsors should be from different institutions. The internships may be outside of the CERC consortium if a CERC/E3B faculty member takes official and serious responsibility for approving the internship proposal and its successful completion.

## **Scholarly Language Requirement**

Students will be required to demonstrate proficiency in foreign languages as needed for their specific fieldwork locations. Proficiency will be assessed by university examination.

## **Teaching Assistantship**

All Ph.D. students will serve as teaching assistants, usually a combination of undergraduate and graduate courses, for 2-4 semesters. This experience provides students an opportunity to develop skills related to many professional directions they may eventually follow. Service as a TA is a component of all fellowships. Students may not register for courses for which they are the TA.

## **Advanced Examinations**

The purpose of the advanced exams is to test a student's ability to think like a professional. Each student takes two advanced exams, normally during the third year. Advanced exams are taken in a 3-day take-home format, and the student prepares an essay similar to a short article that might appear in a publication like *TREE (Trends in Ecology and Evolution)*.

## **Literature Review**

One in-depth review of the scholarly literature most relevant to the proposed dissertation research, written in the style of an article submitted to a scholarly journal or an introductory chapter of a dissertation, will be submitted for committee approval in the third year of study.

## **Oral Examination of the Dissertation Proposal**

A well-developed written research proposal, in a style for submission to a specific major granting agency (e.g. NSF), will be defended orally before the student's dissertation committee, normally during the second semester of the third year (second year for students with advanced standing). Final revisions to the proposal will be discussed, and the committee may then recommend advancement to Ph.D. candidacy.

## **Advancing to Candidacy**

Students advance to candidacy if they pass their oral exam (proposal defense), and have completed all other requirements of the Ph.D. degree other than the dissertation. Completion of the Environmental Policy certificate is not required for advancement to candidacy. A student advanced to candidacy is eligible for the M. Phil. degree (see below).

## **Dissertation Research**

Once a student is advanced to Ph.D. candidacy, s/he is expected to submit the proposal to granting agencies for outside funding.

## **M.A., M. Phil., and Ph.D.**

The sequential M.A. degree is awarded to Ph.D. students who have completed all M.A. degree requirements (usually lasting one full year in the program).

The M. Phil. degree is awarded upon successful completion of all the Ph.D. requirements other than the preparation and defense of the dissertation. This degree is to be completed by the end of the fourth year of study, except for those students granted advanced standing, who must complete the degree by the end of the third year of study. Six units of residency and 40 E credits approved by the DGS and the student's advisory committee are required for this degree.

The Ph.D. degree is earned after the defense and final deposition of the dissertation. The written dissertation is first submitted to the student's sponsor and other readers as recommended. After revisions, the dissertation is submitted to the full five-member dissertation committee, and the students defend the dissertation orally. Students are required to present a seminar to the department around the time of their dissertation defense.

## **Ph.D. Evolutionary Primatology**

Eleanor Sterling, Director of Graduate Studies – [es443@columbia.edu](mailto:es443@columbia.edu) – (212) 854-9987  
Lourdes Gautier, Academic Department Administrator – [lg2019@columbia.edu](mailto:lg2019@columbia.edu) – (212) 854-8665

The Evolutionary Primatology program is part of a consortium graduate program, the New York Consortium in Evolutionary Primatology (NYCEP), which includes City University of New York, New York University, the American Museum of Natural History, and the Wildlife Conservation Society as members. This program is currently funded by an NSF IGERT grant. To find out more about the consortium, please see <http://www.nycep.org/>. Graduates of this program have gone on to positions in academia and research, as well as conservation organizations.

Six units of full-time residency (4-5 for students with advanced standing) are required by the Graduate School of Arts and Sciences.

### **Advisers**

Students are admitted to the program to work with a particular research adviser. During the first 2 years, they develop a 5 member dissertation committee, which normally includes the readers of their advanced exams and literature review, as well as the research adviser. Some committee members may be members of institutions other than Columbia, but three must be on the GSAS list of approved advisers, and preferably faculty at Columbia.

### **Core Courses**

Students are required in their first two years to take a set of 3 core courses in the following areas:

- Evolutionary morphology
- Genetics
- Primate behavior, ecology and conservation

*Note: Students receiving a grade of less than B+ in any of these courses are required to take a written exam at the end of the first summer based on the core course material.*

### **Other Required Courses**

Students must take the NYCEP seminar in both semesters of the first two years of study, and attendance is expected thereafter if the student is a resident of New York.

### **Advanced Courses**

Advanced courses provide highly specialized training in one or more of the major subdivisions of evolutionary primatology, e.g. behavior/ecology/conservation, evolutionary morphology, genetics. Students will select at least 3 such courses from an approved list, which includes courses in other departments at Columbia, as well as through the consortium with CUNY and NYU. Students are expected to take advanced statistics courses to gain the proficiency they will need for their research.

## **Internships**

Three research internships are required. They must focus on three distinct topics. One must be outside of Columbia, and one must be outside the student's chosen area of expertise. Internship sponsors are usually faculty members of the NYCEP consortium.

## **Scholarly Language Requirement**

Students are required to demonstrate proficiency in foreign languages as needed for their specific fieldwork locations. Proficiency is assessed by university examination or the department.

## **Teaching Assistantship**

All Ph.D. students will serve as teaching assistants, for undergraduate or graduate courses, for 2-4 semesters. This experience provides students an opportunity to develop skills related to many professional directions they may eventually follow. Service as a TA is a component of all fellowships. Students may not register for courses for which they are a TA.

## **Financial Aid**

A comprehensive program of financial aid, including fellowships and appointments in teaching is available to Ph.D. students. All Ph.D. students admitted to the program receive annually the prevailing stipend and appropriate tuition and health fees through the fifth year, provided that they remain in good academic standing.

## **Advanced Examinations**

Two advanced written examinations on general topics relevant to the dissertation research must be taken by the end of the third year of study (second for those with advanced standing), and normally by the end of the fifth semester. Each exam is read by two faculty members of the student's committee.

## **Literature Review**

One in-depth review of the scholarly literature most relevant to the proposed dissertation research, written in the style of an article submitted to a scholarly journal or an introductory chapter of a dissertation, will be submitted for approval by two faculty readers by the end of the third year of study (second for those with advanced standing).

## **Oral Examination of the Dissertation Proposal**

Development of a high-level research proposal in a style necessary for submission to a specific granting agency (e.g. NSF), is required. Once completed, the proposal is submitted for provisional approval by two faculty members on the student's dissertation committee. After receiving faculty approval, and before the end of the third year of study (or second for students

with advanced standing), students defend their dissertation proposal orally before a five-member dissertation committee. Final revisions to the dissertation proposal are discussed and the committee may then recommend advancement to Ph.D. candidacy.

### **Advancing to Candidacy**

Students advance to candidacy if they pass their oral exam (proposal defense) and have completed all other requirements of the Ph.D. degree beside the dissertation. A student advanced to candidacy is eligible for the M. Phil. degree (see below).

### **Dissertation Research**

Once a student is advanced to Ph.D. candidacy, s/he is expected to submit the proposal to granting agencies for outside funding.

### **M.A., M. Phil., and Ph.D.**

The sequential M.A. degree is awarded to Ph.D. students who have completed all MA degree requirements (usually lasting one full year in the program).

The M. Phil. degree is awarded upon successful completion of all the Ph.D. requirements other than the preparation and defense of the dissertation. This degree is to be completed by the end of the fourth year of study, except for those students granted advanced standing, who must complete the degree by the end of the third year of study. Six units of residency and forty E credits approved by the DGS and the student's advisory committee are required for this degree.

The Ph.D. degree is earned after the defense and final deposition of the dissertation. The written dissertation is first submitted to the student's sponsor and other readers as recommended. After revisions, the dissertation is submitted to the full five-member dissertation committee, and the student defends the dissertation orally. An oral presentation of the research is also made to the entire department in the form of a departmental seminar.

## **CERTIFICATE PROGRAMS**

### **Environmental Policy Certificate**

This certificate program is designed to provide EEB Ph.D. candidates and students in other GSAS natural or social science programs with a strong foundation in the social sciences that will best enable them to contribute, as scientists, to creating dynamic environmental policy. All Ecology and Evolutionary Biology Ph.D. students are required to complete this program, for which they receive a separate degree. Additional certificate candidates are expected to declare their candidacy as soon as possible after admission to one of the University's graduate degree programs. Students admitted to the certificate program must discuss their course of certificate study with the Environmental Policy Certificate director (currently, Steven Cohen, Director, Master of Public Administration Program in Environmental Science and Policy) at the beginning of each semester.

### **Program Requirements**

At least two Residence Units and 24 points taken for E credit are required for the certificate. One course is required in each of the following four areas (a few example courses are included here):

- Environmental Politics and Policy (U6243. International relations of the environment).
- Environmental Law (L6242. Environmental Law; L8036. Seminar: environmentalism and the protection of natural resources; L9056. Seminar in Hazardous Waste Law; L9379. Seminar in International Environmental Law).
- Economics (W4329. Economics of Sustainable Development; W4625, Economics of the Environment).
- Cultural Anthropology or Public Health (G4124. People and Their Environment; G4086. Ethnobotany; U4740. Introduction to Environmental Sociology).

In addition to these courses, students must complete three electives. Upon recommendation of the Environmental Policy Certificate director, up to six points of advanced standing credit for similar courses taken at another university may be accepted, and students may be able to substitute some of the above course work with internships. All students must enroll in the problem solving workshop (G6103 Environmental Policy Workshop, U8903 Workshop in Cross National Environmental Problems) at Columbia. The workshop is usually taken with an associated Directed Readings course, which counts as one of the three required electives. The certificate is awarded on the recommendation of the Environmental Policy Certificate director.

## **Conservation Biology Certificate**

Social science students enrolled in a post-graduate degree program at SIPA, the Law School, the Graduate School of Arts and Sciences or other professional schools at Columbia, who wish to obtain a stronger background in biology, may pursue a Certificate in Conservation Biology.

Candidates for the certificate are expected to declare their candidacy as soon as possible after admission to one of the University's recognized graduate departments or programs. The Certificate Committee will review the admissions packet of candidates to verify whether they have a strong enough background in biology to successfully follow the program.

Admitted students will then be assigned a Committee member as an adviser. They will be expected to discuss their program of certificate study with their adviser at the beginning of each semester and obtain written course approval from them.

### **Program Requirements**

At least two Residence Units and 24 points taken for a letter grade (E credit) are required for the certificate. Advanced standing credit is permissible for up to six points in Population Biology or an approved elective only; all other courses must be taken during residence at Columbia University. The following courses are required:

- Two semesters graduate sequence in Conservation Biology (EEEEB G6905, EEEB G6990)
- Environmental Politics, Policy and Management, (INAF U6241)
- Two additional advance courses in conservation biology.
- One elective (chosen in consultation with adviser)
- Environmental policy workshop (offered either through SIPA or through E3B)

In addition, an interdisciplinary paper must be written for one of the aforementioned courses. It must be read by the course's instructor and by a second reader from the Certificate Committee. A grade of B+ or better is required. The certificate is granted by the Graduate School of Arts and Sciences on the recommendation of the EEB Certificate Committee.

## **The Certificate in Conservation and Environmental Sustainability**

Center for Environmental Research and Conservation (CERC) Staff:  
Rita Ricobelli – [rricobelli@ei.columbia.edu](mailto:rricobelli@ei.columbia.edu) – (212) 854-6005  
Desmond Beirne – [djb2104@columbia.edu](mailto:djb2104@columbia.edu) – (212) 854-0149  
Program Website: <http://www.cerc.columbia.edu/?id=certificate>

CERC believes that one of the most important ways to build environmental leadership and solve complex problems of environmental sustainability is to engage with professionals in the public, private, and not-for-profit sectors. CERC understands that environmental issues are complex and that finding solutions are equally complex. Training professionals to think critically about the environment and its intersection with public policy, the economy, and society starts with teaching *the science* behind the issues to figure out how to move from environmental problems to environmental problem-solving.

The Program is comprised of 120 hours of coursework that is delivered as foundational (or required) courses in ecology, environmental economics, biodiversity, and environmental law as well as electives in either case studies or policy, management, and finance tracks.

Taught by faculty, researchers, and scientists from the CERC consortium institutions (Columbia University, American Museum of Natural History, The New York Botanical Garden, Wildlife Conservation Society, and Wildlife Trust) as well as public and private sector practitioners, Certificate students typically begin with the Fundamentals (required) and advance to topical courses. CERC presents these Fundamentals so that students can gain a background in the complexities of the issues, a science vocabulary, a way of thinking, and cutting-edge research on current issues.

In addition to the required Fundamental courses, electives cover a wide range of important topics such as energy, climate change, coral reef restoration, water, and other natural resources management, sustainable investing, and environmental entrepreneurship, to name a few.

Finally, the Certificate Program also offers courses in field methods and ecology in places like the Caribbean and Upstate New York as well as our own urban ecosystem in New York City.

The Certificate Program is flexible in its design. Classes are held Monday through Thursday, 6-8 pm at CERC on Columbia University's Morningside Campus. Courses are only five weeks long, with opportunities to start the program three times each semester. The typical student completes the CERC program in one to two years.

*Beginning in fall 2010, successful completion of the CERC Certificate science courses is recognized as preparation for two Columbia University graduate programs: the M.P.A. in Environmental Science and Policy and the M.S. in Sustainability Management.*

## **FELLOWSHIPS**

### **The Marie Tharp Visiting Fellowship**

Kuheli Dutt, Program Director, Assistant Director for Academic Affairs & Diversity –  
[kuheli.dutt@columbia.edu](mailto:kuheli.dutt@columbia.edu) – (845) 365-8603

The Marie Tharp Fellowships are three-month fellowships that can be taken at any of the research units of departments affiliated with the Earth Institute. These fellowships are awarded to earth scientists outside of Columbia University to collaborate with researchers at Columbia. This fellowship was started with an NSF-ADVANCE grant with the goal of promoting the cause of women in science. The fellowship is named after Marie Tharp, who was the first to map the details of the ocean floor on a global scale. She published the pivotal interpretation of mid-ocean ridges that was crucial to the eventual acceptance of theories of plate tectonics and continental drift. Tharp based her work on data from sonar readings obtained by Maurice Ewing and his team. Piecing together data from the late 1940s and early 1950s, she and colleague Bruce Heezen discovered a 40,999-mile underwater ridge girdling the globe and established the foundation for the conclusion that the sea floor spreads from central ridges and that the continents are in motion with respect to one another—a revolutionary geological theory at the time. Years later, satellite images proved Tharp's maps to be accurate. Tharp came to the Lamont Geological Observatory (now the Lamont-Doherty Earth Observatory) in 1948, where she began work on contributions by the Library of Congress, the Woods Hole Oceanographic Institution, and the Lamont-Doherty Earth Observatory. Her map of the ocean floor is still a key foundation for research and education in the ocean sciences.

Application Deadline: Application materials may be submitted by e-mail by January 2011. For additional information please contact Kuheli Dutt at [kdutt@ldeo.columbia.edu](mailto:kdutt@ldeo.columbia.edu)

## **OTHER GRADUATE CREDIT-BEARING PROGRAMS**

### **The Inquire Institute**

Center for Environmental Research and Conservation (CERC)  
Minosca Alcantara – [mva2107@columbia.edu](mailto:mva2107@columbia.edu) – (212) 854-2992  
Desmond Beirne – [djb2104@columbia.edu](mailto:djb2104@columbia.edu) – (212) 854-0149  
Program Website: <http://www.cerc.columbia.edu/?id=tt>

CERC's Inquire Institute provides six graduate credits in conservation biology and human ecology and is designed to support teachers in increasing their own exposure to and understanding of the inquiry process as well as how to translate this to the classroom. The graduate credits meet the New York State Department of Education's certification requirements in science.

Participants can earn up to **six graduate** credits that meet NYS certification requirements and that can be applied to a Master's degree or to the "30 points above" requirement for a salary increase in NYC.

The Institute focuses on urban ecosystems of New York City and the areas of water, biodiversity, and energy. It is a combination of lectures, fieldwork, labs, and curriculum development. Participants work collaboratively on projects to develop basic skills and understandings of the inquiry process and the scientific methods. Projects form the basis of an inquiry-driven curriculum unit with accompanying teacher resource plan, designed to be used in the classroom in the upcoming academic year. For public school teachers, this unit(s) coincides with the *New York City Science Scope and Sequence*, Pre-K-High school.

Inquire Institute is designed so that educators and CERC faculty work together in inquire-based education, experiential learning, and the use of "living laboratories" all within the required framework of formative and summative assessment.

Now entering its seventh year, the Institute welcomes educators from both the public and private school systems. Moreover, because we also approach our curriculum and the Institute's mission from a perspective of inquiry, teachers from all disciplines can benefit. Thus, past participants have included Math, Social Studies, Literacy, Art, and Special Education teachers.

Finally, students currently enrolled in graduate schools of education or in graduate programs in conservation education are encouraged to attend.

## **Faculty**

*Nancy Degnan*, Executive Director, CERC

*Jenna Lawrence*, Lecturer in Discipline, E3B (Department of Ecology, Evolution and Environmental Biology)

*Matthew Palmer*, Lecturer in Discipline, E3B

*Robert Newton*, Research Scientist, LDEO, Geochemistry

*Ellen Meier*, Associate Professor of Computing and Education, Mathematics, Science and Technology, Teachers College