



NICHOLAS SCHOOL OF THE  
ENVIRONMENT AND EARTH SCIENCES  
DUKE UNIVERSITY

## **ENVIRONMENTAL HEALTH AND SECURITY**

(Master of Environmental Management)

**August 2007**

The **Environmental Health and Security Program (EHS)** emphasizes interactions among human/environmental health and ecological processes. The **EHS** recognizes that vulnerability can arise by human actions affecting ecological processes; and, in turn, by altered ecological processes affecting human well being. Of concern are anthropogenic and natural phenomena. Examples of the former include over exploitation of resources, introduction of exotic species, residential, industrial, and agricultural pollution, as well as direct acts of terror. Natural phenomena include earthquakes, fire, volcanic action, floods, drought, and global warming. The above lead to questions of the security of ecological processes essential for the sustainable life of plants, man, fish and wildlife, and food web organisms. Recognizing that freedom from danger is unrealistic, this program stresses risk assessment attendant to actions/processes that affect human/environmental health and provides a scientific approach to environmental management.

Duke University, in close proximity to North Carolina's Research Triangle Park, with the National Institute of Environmental Health Sciences, the United States Environmental Protection Agency, and two major state universities, is strategically sited for this area of study.

Important areas of strength are: watershed management; air-shed management; toxics, including mechanisms of toxicity, fate and transport of toxics in air and water and at their interface; risk assessment; environmental epidemiology; occupational and environmental health; and global change, including climate and land use.

The **EHS** seeks to instill in the student a science-based approach combining integrated assessment for humans, biota, and natural resources. The program instills risk assessment approaches that weigh assessment uncertainties against costs associated with decisions and the costs of gathering and employing increasingly realistic and accurate data and models.

Graduates of the program have the skills to become analysts or consultants for private industry and public agencies that deal with health effects and environmental issues including: international aid organizations, public health departments, federal agencies managing disaster relief, departments of agriculture, nuclear regulatory councils, and state and federal environmental protection agencies.

During the first year of study, students enrolled in the **EHS** will work with a faculty member on course selection and in determining an area of study for the Master's Project. By the end of the first year, the student will choose an advisor who will work with the student on developing a project, as well as advising on courses to be taken during the second year. In the second year, the student will complete the course requirements and devote time to the completion of the Master's Project. A paper and presentation will be made at the end of the second semester of the second year.

This program relies largely on faculty and courses taught at the Durham campus, but it is possible for a student to take appropriate classes for one semester at the Duke University Marine Laboratory. This approach would be desirable if the student is interested in developing a project dealing with coastal environmental change.

### **PREREQUISITES**

School-wide prerequisites: one semester of college calculus; an introductory applied statistics course covering descriptive statistics, probability distributions, hypothesis testing, confidence intervals, correlation, simple linear regression, and simple ANOVAs; one semester of college biology (including animal or human physiology); one semester of college chemistry; and, one semester of organic chemistry.

### **CURRICULUM**

The curriculum consists of 4 core courses, 3 specialization courses, 4 analytical tools courses, and the Master's Project.

#### **CORE COURSES (4 courses, at least 12 credits)**

- 1) ENV 240                      Chem Fate Org Compounds
- 2) ENV 298.02                Environmental Epidemiology
- 3) ENV 246                      Survey of Environmental and Occupational Health
  
- 4) Core course in ecology or global change (choose one from the list below)
  - BIOLOGY 203L                Marine Ecology (Beaufort)
  - BIOLOGY 217                 Ecology/Global Change
  - BIOLOGY 267L                Community Ecology
  - BIOLOGY 304                 Plant/Ecological Responses To Global Change
  - BIOLOGY 309                 Ecological Forecasting
  - ENV 203                        Conservation Biology Theory/Practice
  - ENV 208                        Estuarine Ecosystem Processes (Beaufort)
  - ENV 209                        Conservation Biology/Policy (Beaufort)
  - ENV 217                        Tropical Ecology
  - EOS 272                        Biogeochemistry
  - EOS 2XX                        Climate Change

### **SPECIALIZATION**

**Three courses totaling at least 9 credits are required. Courses listed here and in the core listing (above) only count for one category.**

This set of 3 courses is chosen to demonstrate a depth of expertise in a particular combination of human health concerns and ecological/environmental processes. At least one course has to be human health emphasis. At least one course has to be ecological/environmental. It is possible to have one course that combines the two.

Examples of human health concerns include: (1) human health effects of pollutants or toxicants (e.g., organ systems affected, mechanisms of toxicity, pharmacokinetics); (2) risk of human-caused or natural disasters (e.g., flood, earthquake, hurricane, terrorist actions); and (3) human disease risk.

Examples of ecological and environmental processes include: land use changes (e.g., urbanization, coastal development, deforestation), climate change, routes of pollutant/toxicant transport and transformation (e.g., soil processes, water quality, air quality, hydrology).

**(1) Combined Emphasis (i.e., courses that bridge human and environmental health issues)**

ENV 212	Environmental Toxicology
ENV 235	Air Quality Management
ENV 298.56	Water Quality
ENV 239	Human and Ecological Risk Assessment
ENV 298.13	Seeing the Big Picture: Lessons from Watershed Management in California
ENV 319	Mechanisms in Environmental Toxicology

**(2) Environmental Emphasis**

BIOLOGY 309	Ecological Forecasting
CE 139L	Introduction to Soil Mechanics
CE 208	Environmental Transport
ENV 221	Soil Resources
ENV 233	Soil Chemistry and Contamination
ENV 234	Watershed Hydrology
ENV 240	Chemical Fate of Organic Compounds
ENV 243 CBI 243	Environmental Biochemistry
ENV 256S	Life in Variable and Polluted Coastal Environments
ENV 270	Resource and Environmental Economics
ENV 271	Economic Analysis of Resource and Environmental Policies
ENV 279	Atmospheric Chemistry
ENV 298.14	Biogeochemical Cycle Modeling
ENV 307	Ecophysiology of Productivity and Stress
ENV 309	Wetland Restoration Ecology
ENV 312	Wetlands Ecology and Management

ENV 313	Advanced Topics in Environmental Toxicology
ENV 335	Water Quality Modeling
EOS 202	Beach and Island Geological Processes
EOS 215	Introduction to Physical Coastal Processes
EOS 278	Tropical Climate and Paleoclimate
EOS 2XX	Climate Change (new course to be taught by Gabi Hegerl)

**(3) Human Emphasis**

CE 123L	Water Resources Engineering
CE 124L	Environmental Engineering
CE 241	Physical Chemical Treatment Processes
CE 248	Solid Waste Engineering
CE 249	Hazardous/Toxic Waste
CFM 240	Epidemiological Methods in Primary Care Research
ENV 298.03	Air from the Molecule to the Clinic
ENV 298.60	Comparative & Integrative Pathobiology
ENV 298.71	Natural Catastrophes
ENVR 130	Health Effects of Environmental Agents (UNC)
ENVR 232	Health Effects of Outdoor and Indoor Air Pollution (UNC)
EPID 160	Principles of Epidemiology (UNC)
PAP 255	Introduction to Epidemiological Principles
Pharmacology 233	Essentials of Pharmacology, Toxicology and Drug Discovery
Pharmacology 254	Mammalian Toxicology

**APPROACHES (4 courses, at least 12 credits)**

**One statistics course (either introductory level or, if qualified, second level course) is required.**

BAA 250	Biometry
BIOS 170	Demographic Techniques I (UNC)
CRM 212	Design of Etiological, Clinical and Experimental Studies
ENV 210	Applied Data Analysis for Environmental Science
ENV 255	Applied Regression Analysis
Pharmacology 333	Statistics for Basic Biomedical Scientists

**Two courses in a focal area are required.** Examples of Focal Areas are provided below.

Focal Area in Statistical/Mathematical Modeling

ENV 210	Applied Data Analysis
ENV 255	Applied Regression Analysis
ENV 298.14	Biogeochemical Cycle Modeling

ENV 236 Water Quality Modeling  
ENVR 279 Modeling for Environmental Risk Analysis (UNC)

Focal Area in Risk Analysis

ENV 239 Human Health and Environmental Risk Assessment  
ENV 385 Environmental Decision Analysis  
BA 510 Bayesian Inference and Decision  
CEE 221 Engineering Systems Reliability  
ENVR 175 Risk Assessment  
ENVR 176 Quantitative Risk Assessment in Environmental Health (UNC)

Focal Area in Geospatial analysis

ENV 259 Fundamental of GIS and Geospatial Analysis  
ENV 359 Advanced Geospatial Analysis

Focal Area in Field studies

BIO 222 Entomology  
ENV 298.17 Wetlands Field Skills  
ENV 201 Forest Resources Field Skills  
ENV 298.xx Field Ornithology

**A single course in law, policy, economics or other social science relevant to the chosen specialization, is required.**

LAW 590.01 Risk Regulation  
ENV 281 Environmental Law  
LAW 235 Environmental Law  
PPS 255S Health Policy Analysis  
PPS 263S Public Health Issues: Prevention and Management  
SOCIO 227BS Social Behavior/Health  
PLAN 219 Water Policy in Lesser Developed Countries (UNC)  
PLCY 184 Environment & Development (UNC)

**Master's Project (5-7 credits)**

ENV 398.07S MP Seminar (1 credit)  
ENV 399.xx: Master's Project (4-6 credits)

**Electives (8-10 credits)**

**Participating Faculty**

Faculty members who are participating in this program and will serve as advisors are listed below with contact information. Additional information can be found at individual web sites at [www.nicholas.duke.edu](http://www.nicholas.duke.edu)

David E. Hinton	<a href="mailto:dhinton@duke.edu">dhinton@duke.edu</a>	(Program Chair)
Celia Bonaventura	<a href="mailto:bona@duke.edu">bona@duke.edu</a>	
Richard DiGiulio	<a href="mailto:richd@duke.edu">richd@duke.edu</a>	
Peter Haff	<a href="mailto:haff@duke.edu">haff@duke.edu</a>	
Prasad Kasibhatla	<a href="mailto:psk9@duke.edu">psk9@duke.edu</a>	
Randall Kramer	<a href="mailto:kramer@duke.edu">kramer@duke.edu</a>	
Seth Kullman	<a href="mailto:swkull@duke.edu">swkull@duke.edu</a>	
Richard Kwok	<a href="mailto:rkwok@rti.org">rkwok@rti.org</a>	
Marie Lynn Miranda	<a href="mailto:mmiranda@duke.edu">mmiranda@duke.edu</a>	
Daniel Richter	<a href="mailto:drichter@duke.edu">drichter@duke.edu</a>	
Heather Stapleton	<a href="mailto:heather.stapleton@duke.edu">heather.stapleton@duke.edu</a>	
Wayne Thomann	<a href="mailto:thoma010@mc.duke.edu">thoma010@mc.duke.edu</a>	
Jonathan Wiener	<a href="mailto:WIENER@law.duke.edu">WIENER@law.duke.edu</a>	

[This list of Participating Faculty is expected to expand.]