Environmental Science for Sustainable Development
SDEV U6240
Fall 2006

Class Time and Location:
M 09:00A-10:50A
SIPA IAB: Room 413

Instructor Information:

Earth Science: Dr. John Colin Mutter (jcm@ldeo.columbia.edu)

Climatology: Dr. Yochanan Kushnir (kushnir@ldeo.columbia.edu)

Hydrology: Dr. Tobias Siegfried (ts2392@columbia.edu)

Ecology: Dr. Kate McFadden (kwm6@columbia.edu)

Human Health & Epidemiology: Dr. Paul Brandt

Course Description:

The Earth's physical and natural systems are experiencing dramatic changes that bring into question the sustainability of our planet. Essential to addressing these changes is an understanding of the functioning of the earth and natural systems. This course provides fundamental knowledge of the topics within the natural sciences that are critical to address the issues of sustainable development. The interactions between the natural and human environment are complex and interconnected. A strong understanding of the functioning of the earth's processes is essential to addressing sustainable development challenges.

Course Objectives:
This course provides a rigorous survey of the key areas of natural science that are critical to understanding sustainable development. The goal of the course is to provide students with a fundamental understanding of natural science topics that are essential to addressing issues of sustainable development. The course will provide the theories, methodological techniques and applications associated with each natural science unit presented. The teaching is designed to ensure that students have the natural science basis to properly appreciate the co-dependencies of natural and human systems, which are central to understanding sustainable development. Students will learn the complexities of the interaction between the natural and human environment. After completing the course, students should be able to incorporate scholarly scientific work into their research or policy decisions and be able to use scientific methods of data analysis.

This is a modular course that will cover core thematic areas specifically, climate, natural hazards, water management, public health/epidemiology, and ecology/biodiversity. To achieve coherence across lectures this course will emphasize how each topic is critical to studies of sustainable development and conclude with a place-based case study lecture that integrates various topics covered. In the lectures and particularly the seminar sections this course will emphasize key scientific concepts such as uncertainty, experimental versus observational approaches, prediction and predictability, the use of models and other essential methodological aspects.

Course Organization:
The Environmental Science for Sustainable Development course will provide an in-depth analysis of five core natural science topics that are a fundamental part of understanding sustainable development issues. The core natural science topics include: Earth Systems Science, Climate, Water Resource Management, Ecology/Biodiversity and Public Health/Epidemiology. The course is designed to provide students with a thorough examination of key natural science areas and the depth of subject matter essential to environmental decision making. This course will expose students to the complex interactions between the natural and human environment. A multidisciplinary study of these areas will provide an integrative view of the core natural science topics and the relation to sustainable development. A series of lectures will be given on each topic with a required seminar session to accompany.

Lectures:
The lectures are designed to provide a basic understanding of the core natural sciences with an emphasis on key scientific concepts such as uncertainty, experimental versus observational approaches, prediction and predictability, the use of models and other essential methodological aspects, which will provide commonality throughout each of the units. There will be a framework for all the lectures to provide consistency throughout the course. The framework for each unit will consist of three general areas, which will include theories, methodology and applications.

The course lectures will be divided into the following lecture topics:

Earth Systems Science
The earth systems science unit will provide an overview of how the earth works by analyzing geo-physical properties and feedback mechanisms. This section will focus on understanding disasters and development by examining the natural hazards in connection with human vulnerabilities.

Climate
The climate systems unit will provide a multidisciplinary study of the climate cycles over long and short term intervals as well as the hydrological cycling both globally and regionally. The climate system segment will provide an understanding of the Earth's energy budget, the interaction between the oceans and atmospheres and climate variability and change.

Water Resource Management

The water resource management unit will examine basic physical principles and complexities of resource management. The basic physical principles of the hydrological cycles and water storage will be discussed coupled with a focus on river basin development and management, groundwater management, water pricing and quality issues.

Ecology/Biodiversity
The ecology and biodiversity unit will develop an understanding of the evolution and functional importance of biodiversity. This section will examine population dynamics and carrying capacities in relation to biodiversity loss and stability.

Public Health/Epidemiology
The public health unit will provide students with an understanding of the local and global environmental health problems and examine how those problems intersect with health disparities and government policies.

Seminar Sessions:
The seminar sessions are designed to delve deeper into the topics covered in the lectures through case studies and discussion. The seminar sections are designed to emphasize key scientific concepts such as uncertainty, experimental versus observational approaches, prediction and predictability, the use of models and other essential methodological aspects.

The seminar sessions will be sub-divided into group A and group B. Students in group A (Master's students) will work to integrate the natural science topics into decision making with an emphasis on understanding the interconnectivity between science and policy. Session A will focus on examining case studies and scholarly publications with the aim of understanding the interaction between science and policy with respect to sustainable development issues.

Students in group B (PhD students) will concentrate on the methodology, data analysis and interpretation of natural science topics. Session B will have a quantitative and technical orientation focused on understanding how to generate research questions and proposals and develop and design scientific experimentation. The students in session B will create their own research agenda for additional areas of study within the focus of their PhD research.

Seminar: The seminar session for the class meets once a week for 2 hours.

Session A
- Discussion will focus on the role of natural science in public policy decision making.
- Focus on case studies and integrating the natural science into the application towards policy making.

Session B
- Focus on methodology and analysis of the natural science information.
- Some topics that could be covered include:
    - Integrating science into research for the sustainable development PhD
    - Developing an individualized research agenda

- Developing and designing scientific experimentation
- Uncertainty in science and probability
- Limits to predictability and inference
- Geo-spatial mapping
- Experimentation vs. observation
- Distinguishing between advocacy, applied, and fundamental science
- Scale of study vs. scale of inference
- Modeling - its power and its limitations

Course Project

The course project is designed for students to integrate the topics covered in the lectures and seminar session into a case-study of term paper length.

Course Grading

Course project	**40%**
Section assignments/Quizzes	**40%**
Class participation	**20%**

Policy on Late Submission/Attendance Policy

Late assignments will be penalized one grade category (A to A-) per day of lateness.

Attendance of lectures and seminar sessions are required.