Princeton

Survey
PU Perspectives on Envir

ENVIRONMENTAL STUDIES 301:
PERSPECTIVES ON ENVIRONMENTAL ISSUES - SCIENCE AND ENGINEERING

FALL 1994

Time: Mondays and Wednesdays, 10:00- 10:50

Place: McCosh 62

Instructors:

Harold Feiveson George Philander

Objectives of the Course

We have four large objectives in this course.

(1) To examine several critical features of the "earth system", to understand how human activities are disrupting global ecosystems and the global commons; and to assess the current debate about global environmental problems.

(2) To sort out why experts often contradict each other and to explain that there will always be uncertainty and disagreement among scientists concerning any real environmental problem. To what extent do the disagreements stem from specious scientific arguments and to what extent from tendencies to suppress uncertainties in scientific results for cultural, emotional, or ideological reasons?

(3) To understand how policymakers can cope with scientific uncertainy and disagreement -- more generally, to understand how policymakers and scientists interact -- and to stress the importance of technological innovation in coping with environmental problems.

(4) To illuminate how scientists deal with environmental problems, by discussing features common to many such problems, including: the use of models; the importance of measurement; stability and feedback; stocks, flows, and equilibrium; exponential growth; orders of magnitude and scale; fluctuations; dispersion; and uncertainty.

We intend that the course be accessible to students in science and engineering, the social sciences, and humanities alike. This means that we will not use much mathematical apparatus or expect students to do complicated calculations. We will, however, include a few problem sets to help fix some basic ideas. For many of the topics, also, we will draw attention to more mathematical treatments than will be presented in the lectures for science and engineering students or others who might wish to pursue the topics independently and in more detail.

Connection to Env Studies 302

Env Studies 301 and 302 are independent courses and may be taken in any order. The logic of the division of the courses is as follows:

Environmental impacts may be roughly divided into two categories: disruption of ecosystems and of the global commons, and direct assaults on human well-being. Illustrative of the first category are global climate change, ozone depletion, disruptions of ocean circulation, disruptions of nutrient flows, large-scale deforestation, and large-scale species extinctions. These will be the subjects of 301. The focus will be mostly on global change.

Direct assaults on human well-being include local and regional air and water pollution, acid rain, toxics and other pollutants in solid waste, and use of pesticides. These will be the subjects of 302. The 302 course will also look at regional land-use conflicts such as those affecting forestry, irrigation, and development in the western United States. Attention will be on local and regional issues, with focus mostly on the United States. The course emphasizes various frameworks of policy analysis that may be brought to bear on environmental problems: ethics, literature, history, politics and sociology, diplomacy, law, economics, risk analysis, and science and technology.

Requirements and Such

The class will meet each Monday and Wednesday, 10-10:50 a.m. Precepts will be organized during the first class and students will be expected to participate in the precepts. We expect each precept will include both science and non-science students.

A midterm and final examination will be required. There will be no term paper requirement. Students will be responsible for material in the readings, lectures, and precepts. Lectures will include material not in the readings; and the readings will include material not covered in lectures.

Grades will be determined roughly as follows: midterm (30%), final examination (50%), precept participation (20%).

Books

The following books have been ordered from the University Store:

T.E. Graedel and Paul J. Crutzen, Atmospheric Change: An Earth System Perspective, W.H. Freeman, 1993

John Gribbin, Hothouse Earth, Grove Weidenfeld, 1991 [book is out of print; but a large number of used copies are available for purchase].

Richard Benedick, Ozone Diplomacy, Harvard University Press, 1991

Edward O. Wilson, Diversity of Life, Norton, 1992

Paul Waggoner, How Much Land Can Ten Billion People Spare for Nature?, Council for Agricultural Science and Technology, 1994

John Harte, Consider a Spherical Cow: A Course in Environmental Problem Solving, William Kaufmann, 1985. [This book will be useful to students interested in undertaking more quantitative analyses. We have only ordered a limited number of copies.]

Parts of the Graedel/Crutzen book will be used as the text for the course. We will skip some chapters dealing with detailed chemistry of the atmosphere and most of the technical sections set off as boxes in the text. These sections, however, will be of interest to students wanting more technical detail and mathematical treatment of the topics covered.

Other readings for the course have been collected into a reader, which will be available for purchase at Pequod, 6 Nassau St. Below, articles which have been included in the reader are noted with an asterisk (*).

All of the assigned syllabus readings, including the above-mentioned books and course reader, will be on reserve at Firestone Library. We have also put on reserve four useful reference works:

Robert Kates, B.L. Turner, and William Clark, The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years, Cambridge University Press, 1990.

World Resources Institute, World Resources 1992-93, Oxford Press, 1992

The World Bank, World Development Report 1992: Development and the Environment, Oxford Press, 1992

Paul Ehrlich, Anne Ehrlich, and John Holdren, Ecoscience: Population, Resources, Environment, W.H. Freeman, 1977. Copies of selected chapters.

COURSE OUTLINE

I. INTRODUCTION TO GLOBAL CHANGE AND TO EARTH SCIENCE

1. The Earth Transformed -- Was Malthus Right?

Many environmentalists see growing population and economic output pushing the planet to environmental ruin. Skeptics attack the alarmists. What do policymakers have to understand of the science of global change to enable them to make sensible decisions?

*Garrett Hardin, "Tragedy of the Commons", Science, V. 162, 1968, pp 1243-48; also reprinted in Robert and Nancy Dorfman, eds., Economics of the Environment, 3rd Edition, Norton, 1993, pp 5-19.

*Paul Kennedy, Preparing for the Twenty-first Century, Random House, 1993, pp 3-13; 21-46; 95-121.

*Julian L. Simon, "There Is No Crisis of Sustainability", in G. Tyler Miller, Jr., Environmental Science, Working with the Earth, Fifth Edition, 1993.

*Paul R. Ehrlich and Anne H. Ehrlich, "Simple Simon Environmental Analysis", in G. Tyler Miller, Jr., Environmental Science, Working with the Earth, Fifth Edition, 1993.

2. The Earth Transformed -- An Overview

How is human action transforming the planet? Is population explosion the essential environmental problem?

*John Bongaarts, "Population Policy Options in the Developing World", Science, 11 February 1994.

*Nathan Keyfitz, "Population Growth Can Prevent the Development that Would Slow Population Growth", in Jessica Tuchman Mathews, Preserving the Global Environment, Norton, 1991.

Additional Readings:

Donella Meadows, Dennis Meadows, and Jorgen Randers, Beyond the Limits, Chelsea Green Publishing, 1992, Chapters 2 and 3

3. The Earth System I

Light, air, water, and soil, and the complex interplay between these elements determine the planet's temperature and climate and make earth habitable. Impact of solar radiation, albedo, greenhouse gases on atmospheric and oceanic circulations explained.

Atmospheric Change, Chapters 1, 2, 3.

4. The Earth System II

The sensitivity of the earth system to perturbations can be judged by studying other places (our closest neighbors, Venus and Mars) and other times (past climates on earth including the Ice Ages).

Atmospheric Change, Chapter 6, 10, 14.

Hothouse Earth, Chapters 2, 3, and 4.

II. CASE STUDIES

5. The Ozone Problem, Controversy, and the Montreal Protocol

The science of ozone formation and depletion, evidence of the role of CFCs and other man-made chemicals in the destruction of ozone, and the negotiation of the Montreal Protocol and its aftermath.

Atmospheric Change, pp 139-148, 371-374.

Ozone Diplomacy.

6. Scientific Uncertainty and Policy Formation

Uncertainties in the extent, causes, and effects of ozone loss. The attack on the Montreal Protocol by skeptics. Is the Protocol too draconian?

*Paula Zurer, "Ozone Depletion's Recurring Surprises Challenge Atmospheric Scientists", Chemical and Engineering News, May 24, 1993.

Midterm Exam

7. Global Warming -- The Scientific Basis for Concern

Atmospheric Change, Chapters 12, 13, pp 374-390.

Hothouse Earth, Chapters 6, 7, and 8.

*George Philander, "El Nino and La Nina", American Scientist, 77: 451-459.

8. Global Warming -- The Economics of Global Warming, the Climate Convention, and Strategies to Reduce the Emissions of Greenhouse Gases

*Thomas Schelling, "Some Economics of Global Warming", Robert and Nancy Dorfman, eds., Economics of the Environment, pp 464-483.

Hothouse Earth, Chapters 9 and 10.

*United Nations, United Nations Framework Convention on Climate Change (Article 1-5).

9. Transition from Fossil Fuels to other Energy Sources: renewable energy and nuclear energy

Through what technological strategies and at what economic cost can renewable energy technologies replace fossil fuels? What are the constraints to the growth of nuclear power worldwide?

*Robert Williams, "Toward an Energy Industrial Renaissance", prepared for the Institute for Environmental Management-Siemens/KWU Workshop, 16-18 June 1994.

*Bette Hileman, "U.S. and Russia Face Urgent Decisions on Weapons Plutonium", Chemical & Engineering News, June 13, 1994, pp 12-25.

10. Biodiversity Loss and Disruptions of Nutrient Flows

*E.O. Wilson, Diversity of Life, Chapters 10, 11, 12.

*Ann Kinzig and Robert Socolow, "Human Impacts on the Nitrogen Cycle"

Guest Lecturers: Steven Pacala and Ann Kinzig/Robert Socolow

Additional Readings:

World Wildlife Fund, Some Like It Hot, WWF International, June 1993.

11. Global Change and Food Production

The traditional Malthusian challenge: Is it possible to produce food for a doubled population without destroying habitats and ecosystems on a grand scale?

Paul E. Waggoner, "How Much Land Can Ten Billion People Spare for Nature?", Council for Agricultural Science and Technology, February 1994.

Visiting Lecturer, Paul Waggoner (Monday)

12. Wrap-up: Global change, scientific uncertainty, and policy.

Atmospheric Change, Chapters 18 and 19.