Biology 209 Bevington
Humans and the Global Ecosystem Fall Term, 2012

COURSE SYLLABUS

TEXTS:
Brown, Lester R. 2009. Plan B 4.0: Mobilizing to Save Civilization. W.W. Norton. ISBN: 978-0-393-33087-8

Colburn, Theo, Dianne Dumanoski, and John P. Myers. 1997. Our Stolen Future. Penguin Books. ISBN: 0-452-27414-1

Diamond, Jared. 2005. Collapse: How Societies Choose to Fail or Succeed. Viking Penguin. ISBN: 0-670-033375-5

Leopold, Aldo. 1949. A Sand County Almanac. Oxford University Press. Reprinted 1966. ISBN: 0-345-34505-3

Oreskes, Naomi and Erik M. Conway. 2010. Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming. Bloomsbury Press. ISBN: 978-1-59691-610-4

In the end, our society will be defined not only by what we create, but by what we refuse to destroy.

John Sawhill
President, The Nature Conservancy (1990-2000)

Socialism collapsed because it did not allow the market to tell the economic truth. Capitalism may collapse because it does not allow the market to tell the ecological truth.

Oystein Dahle
Former Vice President of Exxon for Norway and the North Sea

COURSE OBJECTIVES:

In this course we will explore the relationship between humans and nature. In the short period since their evolutionary origin humans have become the single, dominant species on Earth. Because of our technology and our population we are now changing global ecosystems in a manner that would have been unimaginable 100 years ago. Humans are destroying or modifying ecosystems and consuming resources at an unprecedented rate, a rate which is unsustainable. We will examine the current trends associated with this environmental change. We will also look at how past societies responded to environmental problems and how their decisions led to failures or successes. Using principles of ecology we will try to understand what environmental change may mean for us and for other species with which we share the biosphere. Growth of the human population and our increasing dependence on technology have reached a scale where we are changing the climate of the planet. Special attention will be given to global climate change and to the loss of biological diversity. We will examine the forces which cause these phenomena, and our attitudes toward them.

A central theme of the course will be the interconnection between human activities in one part of the biosphere and the effects of these activities elsewhere. We will examine how industrialized countries, especially the United States, have disproportionate effects on the global ecosystem. In short, we will try to understand how our life-style influences our environment. We

will examine the contribution of human population growth to environmental change. Unbridled population growth and the development which goes with it are tied to most of the environmental trends that are changing global ecosystems. For this reason continued growth of the human population represents a threat not only to the stability of global ecosystems but also to the well-being of humankind. The highest human growth rates are in developing countries. In this context we will examine the conundrum of how wealthy, industrialized countries can help poor nations stabilize human population growth and improve their standard of living to an acceptable level in the 21st century.

Another theme which runs through the course is that human well-being depends on essential services of nature (ecosystem functions). In conservation ecology there has been a shift in focus from preserving species and ecosystems for their own sake to managing ecosystems for the sustainability of ecosystem functions that support humankind. Sustainable development of natural resources is required for our way of life, yet today we are living on our "ecological capital" rather than the "interest" that it generates. Many ecologists now feel that the human impact on global ecosystems has begun to deteriorate the capacity of those ecosystems to provide essential services of nature.

Sustainable resource use and the preservation of species are no longer limited by management techniques, rather man's social institutions are key. For this reason we will look at environmental issues through several lenses: economics, culture, and politics. For example, in economics the market prices of most resources do not reflect their total value and utility, and so they are not used efficiently. We will look at ways to incorporate valuation for services of nature into our economic system. Development and conservation are sustainable only in the context of culture, and we will examine how some forms of development may be culturally appropriate while others are not.

GRADING:

Grades are based on three hour exams, quizzes and homework, and a final exam. Hour exams will cover lecture materials. Quizzes will generally be on outside reading assignments (e.g. a scientific paper from the literature, a Web assignment, library readings in a reserve reference book, etc.). However, quizzes may also include material from lecture. For those who wish to do so, there is an option for a limited amount of extra credit. See page 11.

	Point Value	Percentage of Final Grade
Three hour exams (200 points each)	600	60%
Quizzes and/or homework assignments [1] (probably 3-4, each worth about 30-50 points)	100	10%
Final exam	300	30%
	1000	100%

Letter grades are assigned using 10-point intervals:

90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, < 60% = F

ACADEMIC HONESTY:

[1] I don't really know how many quizzes and homework assignments we will have, but you can figure on three or four during the semester. In any case, their contribution to the total grade will be no more than 5-10 %.

- The instructor adheres to the policy statement on academic integrity outlined in the current Student Handbook.
- Cheating on an exam or a laboratory quiz will result in a grade of zero for the exam or quiz.
- Do **not** bring cell phones to class on days when exams are scheduled.

Students who wish to request accommodations in this class for a disability should contact Elaine Mara, Assistant Director of Learning Services for academic and disability support at 1307 Main Street, or by calling 610-861-1510. Accommodations cannot be provided until authorization is received from the Academic Support Center.

LECTURE TOPICS

Introduction

Scope and purpose of the course
What is your standard of living? What is your ecological footprint?
Comparing your ecological footprint to other peoples in the world

Historical perspectives

Man's relation to nature and how it has changed
How are we connected to the land? The story of Bob Hart.
What can we learn from the past?
What societies in the past collapsed, and how did environmental degradation contribute to their demise?
Why did some societies collapse while others did not?
How have past societies responded to environmental problems?
Origins of the modern conservation movement

Environmental trends and the concept of the commons

What do the data show about environmental trends?
Emerging water shortages
Eroding soils, shrinking cropland, food production, and air quality
Biological diversity and tropical forests
Global climate change
Why do so many Americans doubt that global warming is real and that human activity is responsible for it?
Human population growth
Was Malthus right?
The problem of lag time in environmental issues
Does world population growth justify the alarms sounded by environmental Cassandras?
What are the connections between environmental degradation and violent conflict?

The concept of the commons
Garrett Hardin and the tragedy of the commons
The essence of environmentalism

Societies which collapsed

Easter Island and deforestation
Pitcairn and Henderson Islands - interdependency

The Anasazi: population growth and climate change
Maya: environmental damage, population growth, hostile neighbors and climate change
Mesopotamia: Sumerian City States
The Greenland Norse – a long way from home and could not get along with the neighbors

Societies that succeeded

Tikopia, Highland New Guinea
Tokugawa Japan

Why do some societies make disastrous decisions

Haiti and the Dominican Republic
The world as a polder

The science of ecology

How ecologists look at the world
General principles
Ecosystem functions; energy flow, biogeochemical cycles
Relationships among species
Generalizations about ecosystems
Succession and community development.
How ecosystems respond to disturbance
Ripple effects and ecological interdependencies
Biogeography

Biodiversity

How many species are there on earth, and how fast are they being lost?
An inordinate fondness for beetles !
Important misconceptions about the loss of biodiversity
Man as a planetary, serial killer
Services of nature: what the earth does for us, and what we do to the earth.
Biodiversity "hotspots" - geographic regions of exceptional species diversity
Causes for the loss of biological diversity
Why are small populations at risk?
Amphibian decline: What are the frogs telling us?
Are we entering the "*Homogenocene*?" The "*Anthropocene*?"
Why are we detached? Most of us, scientists included, refuse even to mourn.

Environmental ethics

What is an ethic? How do ethics develop?
Do humans have a responsibility to nature? To future generations?
Leopold's *land ethic*
Eastern and western views of the relationship between humans and nature
Population control: the central issue in environmental ethics
How many people do we want? How do we arrive at that number?
"Lifeboat ethics"
Hardin's dilemma in helping poor nations

Ecological economics

The market: How is value determined?
Total utilitarian values of most natural resources and the services of nature are not reflected in the market place, and so they are not used efficiently.
Externalities
Common property

Nonsubstitutability of the services of nature
Cost-benefit analysis
Natural resources as capital
Toward sustainability
How do we account for natural resources and services of nature in the economic system?
Shifting taxes from income to environmentally destructive activities
An attitude shift: From "economizing ecology" to "ecologizing the economy"

Policies and strategies for conservation

Why both market forces and government action are required to manage resources of the commons
Can the drive for profit which has done so much environmental damage be harnessed to save important ecosystems?
Incentives and disincentives
Removing outdated and perverse incentives, tradeable permits
Environmental legislation
Targeting loans and international aid for development, debt-for-nature swaps, ecotourism
Raising the productivity of water and land
Cutting carbon emissions. Should we institute a carbon tax?
International aid for population control

Lecture Target Dates

Mon.	27 Aug.	Introduction
Wed.	29 Aug.	Our standard of living and our ecological footprint
Fri.	31 Aug.	Historical perspectives
Mon.	3 Sept.	No class (Labor Day)
Wed.	5 Sept.	Historical perspectives
Fri.	7 Sept.	Historical perspectives

Mon.	10 Sept.	Environmental trends: oil, water, soil, and croplands
Wed.	12 Sept.	Environmental trends: air quality, biodiversity, tropical forests
Fri.	14 Sept.	Environmental trends: global climate change
Mon.	17 Sept.	Climate change
Wed.	19 Sept.	Climate change
Fri.	21 Sept.	Why do so many Americans doubt that global warming is real?
Mon.	24 Sept.	**First Hour Exam**
Wed.	26 Sept.	Population growth
Fri.	28 Sept.	Population growth
Mon.	1 Oct.	The concept of the commons
Wed.	3 Oct.	Hardin's Tragedy of the commons
Fri.	5 Oct.	Societies which collapsed: Easter Island, Pitcairn, Henderson, Anasazi (Mid Term)
Sat.	6 Oct. - Tue. 9 Oct.	**Fall Recess**
Wed.	10 Oct.	Societal collapse: the Maya, Sumer, Greenland Norse
Fri.	12 Oct.	*Natural Connections*
Mon.	15 Oct.	Why some societies make disastrous decisions. The world as a polder.
Wed.	17 Oct.	Ecology
Fri.	19 Oct.	Ecology
Mon.	22 Oct.	Ecology
Wed.	24 Oct.	**Second Hour Exam**
Fri.	26 Oct.	Ecology
Mon.	29 Oct.	Ecology
Wed.	31 Oct.	Biodiversity
Fri.	2 Nov.	Biodiversity
Mon.	5 Nov.	Biodiversity
Wed.	7 Nov.	Biodiversity
Fri.	9 Nov.	Biodiversity
Mon.	12 Nov.	Biodiversity
Wed.	14 Nov.	Environmental ethics
Fri.	16 Nov.	Environmental ethics
Mon.	19 Nov.	Environmental ethics
Wed.	21 Nov. - Sun. 25 Nov.	**Thanksgiving Vacation**
Mon.	26 Nov.	**Third Hour Exam**

Wed.	28 Nov.	Environmental ethics	
Fri.	30 Nov.	Environmental economics	
Mon.	3 Dec.	Environmental economics	
Wed.	5 Dec.	Environmental economics	
Fri.	7 Dec.		(Last day of classes)
Tue.	11 Dec.	**Final Exam (**1:30 pm)	

TIME LINE FOR READING ASSIGNMENTS [2]

Lecture Topic	Reading Assignment		Due Date for Completion	
Introduction				
	Leopold, Preface and Foreword	xiii – xix	Wed.	29 Aug.
	Part I: A Sand County Almanac	pp. 3-100	Thur.	30 Aug.
	Part II: Quality of Landscape	pp. 101-176	Mon.	3 Sept.
	Part III: A Taste for Country	pp. 177-236	Wed.	5 Sept.
	Part IV: The Upshot	pp. 237-295	Fri.	7 Sept.
	Homework exercises on ecological footprint		Mon.	10 Sept.

[2] Scientific papers in the reading assignments are listed by lecture topic on page 12. Copies of these will supplied in class, so you need not ferret them out in the library.

Historical Perspectives

Diamond, Prologue: A Tale of Two Farms	Wed.	5 Sept.
Chapter 1: Under Montana's Big Sky	Fri.	7 Sept.
Ponting, C. 1990. *Environment* 32: 4-33	Mon.	10 Sept.

Environmental Trends

Brown, Preface & Chapters 1 & 2, pp. 3-54	Mon.	10 Sept.
Chapter 3, pp 55-76	Wed.	12 Sept.

Global Climate Change

Oreskes & Conway [3]	Introduction, Chapters 1 & 2, pp. 1-65	Mon.	17 Sept.
	Chapter 5 & 6, pp.136-215	Wed.	19 Sept.
	Conclusions, Epilogue, pp. 240-274	Fri.	21 Sept.

Tragedy of the commons

Papers by:	Hardin, G. 1968. *Science* 162: 1243-1248	Mon.	1 Oct.
	Homer-Dixon et al. 1993. *Sci. Amer.* 286: 38	Mon.	1 Oct.

Societies which collapsed

Diamond, Chapters 2,3 and 4	Fri.	5 Oct.
Diamond, Chapters 5, 6-8	Wed.	10 Oct.

Societal decisions

Diamond, Chapter 14	Mon.	15 Oct.

The world as a polder

Diamond, Chapter 16	Mon.	15 Oct.

The science of ecology

ESA booklets:	Mon.	22 Oct.
Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems		
Biodiversity and Ecosystem Functioning: Maintaining Natural Life Support Processes		
Vitousek, P.M. et al. 1986. *BioScience* 36: 368-373	Mon.	29 Oct.
Colburn et al, Prologue, Preface, & pp. 1-121 [4]	Wed.	7 Nov
Colburn et al, pp. 122-266	Mon.	19 Nov
Visit the following website [5] (It's important.): http://www.ourstolenfuture.org/		

Biodiversity

Papers by:	Gentry, A. 1988. *Proc. Natl. Acad. Sci.* 85: 156-57	Fri.	9 Nov.

[3] In the book by Oreskes and Conway these are the required readings. Conclusions and the Epilogue are particularly important. I encourage you to also read chapters 3, 4 and 7 - especially chapter 4.

[4] I would suggest that you start Colburn's book after the second hour exam. Her message is important, although as you will see when you read the book it is also rather unsettling. Try to finish the book before Thanksgiving recess, in any event before the third hour exam (28 November) since it will be included on the last exam.

[5] Colburn's book was published in 1977. Much more is known now about the issue of endocrine disrupers, why they are important, and where they come from. The website is updated regularly.

	Erwin, T.L. 1991. *Conservation Biology* 5: 330-333	Fri.	9 Nov.
	Erwin, T.L. 1988. In: E.O. Wilson, *Biodiversity*. Nat. Acad. Press. pp. 13-18	Mon.	12 Nov.
Environmental Ethics			
Paper:	Hardin, G. 1974. *BioScience*. 24: 561-568	Wed.	14 Nov.
Ecological Economics			
	Brown, Chapter 5. Stabilizing Climate. pp. 109-142	Fri.	30 Nov.
	Brown, Chapter 10. Can We Mobilize Fast Enough? pp. 241-268	Mon.	3 Dec.
	Diamond, Chapter 12, Chapter 15	Wed.	5 Dec.
	Papers by:		
	Bhagwati, J. 1993. *Sci. Amer*. Nov. 42-49	Fri.	7 Dec.
	Daly, H.E. 1993. *Sci. Amer*. Nov. 50-57	Fri.	7 Dec.
	Pimentel, D. et al. 1992. *BioScience*. 42: 750-760	Fri.	7 Dec.

Note: The last three readings may be eliminated depending on time.

JOURNAL ARTICLES BY TOPIC

Even though you may not be a science major, I think it is important for you to read a few scientific papers. This is to give you a sense for how scientists think, how they write, and how they communicate with each other. So, from time to time I will give you journal articles (scientific papers) which relate to lecture topics. A few of these are classic articles in ecology or conservation biology. Others are related to historical, economic, or cultural topics in the course. They will be distributed in class several days before they are to be discussed.

<u>Historical perspectives</u>

Ponting, Clive. 1990. Historical perspectives on sustainable development. *Environment* 32: 4-33

<u>Environmental trends and the commons</u>

Diamond, Jared. 1995. Easter's End. *Discover*. August. pp. 63-69

Diamond, Jared. 1997. Paradises Lost. *Discover*. November. pp. 69-78

Hardin, G. 1968. The tragedy of the commons. *Science* 162: 1243-1248

Homer-Dixon, T.F., J.H. Boutwell, and G.W. Rathjens. 1993. Environmental change and violent conflict. *Scientific American*. 268: 38-45

Odum, W.E. 1982. Environmental degradation and the tyranny of small decisions. *BioScience*. 32: 728-729

Ecology

Vitousek, P.M., P.R. Ehrlich, A.H. Ehrlich and P.A. Matson. 1986. Human appropriation of the products of photosynthesis. *BioScience* 36: 368-373

Biodiversity

Erwin, T.L. 1991. How many species are there?: Revisited. *Conservation Biology*. 5: 330-333

Erwin, T.L. 1988. The tropical forest canopy: The heart of biotic diversity. In: E.O. Wilson. *Biodiversity*. National Academy Press. pp. 13-18 ISBN: 0-309-03739-5

Gentry, A. 1988. Tree species richness of upper Amazonian forests. *Proc. Natl. Acad. Sci. US*. 85: 156-157.

Myers, Norman et al. 2000. Biodiversity hotspots for conservation priorities. *Nature*. 403: 853-858

Environmental ethics

Hardin, G. 1974. Living on a Lifeboat. *BioScience*. 24: 561-568

Ecological economics

Bhagwati, J. 1993. The case for free trade. *Scientific American* Nov. 42-49

Daly, H.E. 1993. The perils of free trade. *Scientific American* Nov. 50-57

Pimentel, D. et al. 1992. Environmental and economic costs of pesticide use. *BioScience*. 42: 750-760

EXTRA CREDIT READINGS AND VIDEOS

For those who wish to do so, there are outside readings on reserve and extra credit videos and DVDs in Reeves Library. The outside readings come from John McPhee's book:

McPhee, John. 1971. Encounters with the Archdruid. Farrar, Straus and Giroux

There are three chapters in the book: *A Mountain*, *An Island*, and *A River*. The narratives of the chapters set in three wilderness areas are between David Brower, a militant conservationist (the

"archdruid")[6] and three of his antagonists who seek to develop land or extract resources. The book brings into sharp focus the philosophical divide between men of integrity who hold different views about their environment. McPhee captures the essence of each man's arguments revealing the complex and difficult nature of many environmental decisions. Each chapter is worth 20 points; you may read <u>two</u> of them for extra credit. If you elect to do this, you must advise the instructor in advance. To receive credit you need to turn in a one-page abstract (more if you simply can't control yourself) summarizing the central ideas of the chapter(s) you read.

The video and DVD titles on the following page are on reserve in Reeves Library. Each is worth <u>10 points</u>. You may select up to <u>three</u> of them. They can be viewed in the library, or you can check them out. To receive credit you need to advise the instructor of your intent and turn in a one-page abstract summarizing the central ideas of each film you view. Your summary should be turned in within one week of viewing the film as a paper copy (<u>not</u> via email).

<u>The maximum extra credit is 40 points (reading two chapters in McPhee's book)</u>. All reading and video summaries must be turned in to the instructor on or before **Friday 7 December**. Extra credit summaries are not accepted during final exam week. Videos are listed on page 12. The ones marked with an asterisk may be on reserve for Biology 119 as well as for this course, so look both places if you are interested in them.

RESERVE VIDEOS

The items marked with an asterisk (*) are especially well done and most of these have high quality cinematography.

Historical perspectives
- Wilderness - An American Ideal*

Environmental trends
- Race to Save the Planet 5: Remnants of Eden
- What's Up with the Weather (NOVA)

The science of ecology
- Amazon, Land of the Flooded Forest*
- Manu: Peru's Hidden Rainforest*
- The Queen of Trees* [7]

Biodiversity
- Alien Invaders: Exotic Species in the Food Web of the Great Lakes
- Rain Forest (National Geographic)
- Rain Forest: Heroes of the High Frontier (National Geographic) [8]

[6] Charles Frazer, a resort developer, regards all conservationists as druids, "religious figures who sacrifice people and worship trees."

[7] The is a beautiful movie set along a river in Africa. It is not in Reeves Library. If you want to watch it, see the instructor for his personal copy.

Nomads of the Rain Forest (NOVA)
Spirits of the Rainforest (Discovery channel video)* [9]

Environmental ethics
Aldo Leopold's Wilderness* [10]
From the Heart of the World: The Elder Brother's Warning [11]

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[8] Do you like high places?

[9] The film is set in the rainforests of Manu Park in southeastern Peru. The theme of the movie revolves around the Machiguenga Indians and their role in the forest.

[10] Based on Leopold's book A Sand County Almanac the film is set in southern Wisconsin near Madison where Leopold's thinking evolved the land ethic.

[11] The Kofan of the high mountain forests of Columbia are the elder brothers of the world. This is their warning to the rest of us in the world family.