Bates

Survey
BC Hydrosphere

GEOLOGY 106 - The Hydrosphere

WINTER 1997

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Lecture: MWF 9:00 - 9:55. a.m., Carnegie Science 225 (?)

Lab Group A: M 1:00 - 4:00 p.m., Carnegie Science 219
Lab Group B: T 1:00 - 4:00 p.m., Carnegie Science 219

Text: *Environmental Geology*, Murck, Skinner, and Porter, 1996, John Wiley and Sons.
The good news: this text is an up-to-date guide to the subject of environmental geology--the science is accurate, the writing is comprehensive, and the illustrations are excellent.
The bad news: this is not an environmental geology course--it is a course on the hydrosphere, which is one area of environmental geology. Although the sections on water reources and pollution are very good, much of the book contains background material on geology that you may or may not want to read.

Course Content and Objectives: This is a course about water from a geologist's perspective. We will examine water in five different contexts: Water in Global Earth Processes, Water as a Geologic Force, Water and Weather, Water as a Resource, and Water in Society. My objectives are to help you better understand the scientific aspects of water-related issues. Hopefully when you leave this class you will be able to ask intelligent questions about the subject as a voter, homeowner, government official, business leader, etc. wherever life takes you.

Grading: Journal: 30%
Lab: 25%
Exams: 45%

Journal: I believe that it is important for you to relate the material you learn in this class to your daily life, hobbies, and interests, as well as your academic major. In this class you will have the opportunity to express yourself via a journal of water-related entries that may include such diverse topics as current news articles, water as portrayed in art, music, and literature, environmental law, water and global economics, etc. The journal is worth 30% of your grade, which is more than either of the individual exams. This is your chance to communicate what you are learning in a creative, thoughtful, and unstressed manner. There are some minimum requirements, but beyond that the journal is yours to develop however you wish. I will collect the journal for grading before winter recess and at the end of the semester.

Lab: The laboratory portion of the course is mandatory--all labs must be completed in order to pass the course. Laboratories are the best part of science classes, especially in geology where we get to go outside and take trips to fun places. Unfortunately you are taking a geology class in Maine in the winter. We will nevertheless try to have fun by doing a combination of laboratory experiments, computer exercises, and field work. We will generally be either in Carnegie Science Rooms 219 or The two field labs will depart from Carnegie Science Hall promptly at the scheduled lab time.

Exams: There will be two exams in this class--a midterm (20% of your grade) and a comprehensive final (25% of your grade). The exams will be a combination of multiple choice and short answer questions.

Extra Credit: Create your own Web page! An important aspect of science is communicating your findings and ideas to other people. The extra credit project for this semester will be to create a web page which is in some way an extension of your journal. It might include your opinions and the latest news on a particular hot topic in water resources, or it might show the results of a small project you did, such as a survey of the Bates community's water-use habits. There will be a help session to learn how to make web pages, and when your "water page" is completed it will be attached to the geology department's homepage. Satisfactory web pages will be worth about 2-3 points added to your final average. In other words, if you are at the high end of a grade level the extra credit project will boost you to the higher grade (for example, from a B to a B+).

Reserve Readings: Reserve readings at the library will be a primary resource for more detailed discussions of water-related issues. You will be provided with a list of the readings for each week. You are required to read at least one article and make a journal entry concerning that reading. It is recommended that you read all of the articles. In addition to the weekly articles there are several books on the general subject of water available at the library:

Books at the **Reserve** Desk:

Broecker, W. S., 1985, How to build a habitable planet, Palisades, NY: Eldigio Press, 291 p.

Leopold, L., 1974, Water; a primer, San Francisco, W. H. Freeman, 172 p.

Outwater, A. B., 1996, Water: a natural history, New York, NY: BasicBooks, 212 p.

Powledge, F., 1982, Water: the nature, uses, and future of our most precious and abused resource, New York, Farrar, Straus Giroux, 423 p.

Speidel, D., 1988, Perspectives on water: uses and abuses, New York: Oxford University Press, 388 p.

Books at the **Reference** Desk:

Gleick, P.H. (editor), 1993, Water in crisis : a guide to the world's fresh water resources, New York: Oxford University Press, 473 p.
(call number TD345 .W264 1993)

Van der Leeden, F., 1990, The water encyclopedia, 2nd edition, Chelsea, Mich.: Lewis Publishers.
(call number TD351 .V36 1990)

Attendance: Regular attendance is expected. Missing classes diminishes your education and seriously affects your performance in a course. Students who miss class sessions on a regular basis consistently receive lower grades than those who attend regularly. I cannot stress this enough. Above all else, strive to make it to every class.

Academic Honesty: Any violation of the Bates College Code of Academic Honesty will not be tolerated. Students are expected to collect data in teams during field trips and labs, but students are expected to complete their lab reports on their own unless told otherwise. All journal entries must be your own.

COURSE SCHEDULE

	DATE	TOPIC	TEXT
M	Jan 6	Introduction to Course and Highlights	p. 1-17
		WATER IN GLOBAL EARTH PROCESSES	
W	Jan 8	Planet Ocean	p. 19-39
F	Jan 10	Origin of water *Lab*: Water Resources on the WWW	
M	Jan 13	Reservoirs and cycling	p. 19-26
W	Jan 15	Solar radiation and the earth's energy balance	p. 27-38
F	Jan 17	Circulation of the atmosphere and oceans *Lab*: The hydrologic cycle	p. 217-226
M	Jan 20	No class - Martin Luther King Day	
W	Jan 22	The global water budget	
		WATER AS A GEOLOGIC FORCE	
F	Jan 24	Weathering and erosion *Lab:* HTML Help sessions	p. 351-374
M	Jan 27	Water and the shape of the land	
	Jan 29	Water as a clue to geology	
W	Jan 31	Mass wasting (or where did my house go?) *Lab:* Landforms	p. 145-170
M	Feb 3	Subsidence and collapse	p. 173-187
		WATER AND WEATHER	
W	Feb 5	Everybody talks about the weather...	
F	Feb 7	Formation of rain and snow *Lab*: Weather prediction on the WWW	
M	Feb 10	**Mid-term Exam**	
W	Feb 12	Watersheds	
F	Feb 14	Extreme weather events - **Journals Due** *Lab*: Snow depths and watersheds	p. 238-246
M-F	17-21	WINTER RECESS	
		WATER AS A RESOURCE	
M	Feb 24	Water use and abuse	
W	Feb 26	Flooding - Too much of a good thing	p. 191-214
F	Feb 28	The control of rivers - dam it! Optional Film - "The Milagro Beanfield Wars" *Lab*: Floods!	
M	Mar 3	The hidden resource - ground water	p. 377-385
W	Mar 5	What is an aquifer anyway?	p. 385-389
F	Mar 7	Ground-water flow *Lab Group A*: Water quality	p. 382-385

M	Mar 10	Water chemistry - yes, this will be on the test	
W	Mar 12	Water quality	p. 441-449
F	Mar 14	Where is your tap connected to? *Lab Group B*: Water quality	
M	Mar 17	Guest lecture - TBA	
W	Mar 19	Groundwater pollution	p. 449-454
F	Mar 21	Groundwater cleanup - does it really work? *Homework*: Ground-water flow	
M	Mar 24	Drinking water treatment	
W	Mar 26	Wastewater treatment	p. 418-420
F	Mar 28	Drinking water and health *Field trip*: Wastewater treatment facility	
		WATER AND SOCIETY	
M	Mar 31	Global perspectives on water	
W	Apr 2	Who decides who gets how much??	p. 389-399
F	Apr 4	The Future of Water - **Journals Due**	

106. The Hydrosphere. This course focuses on the three water regimes of the planet earth: the atmosphere, the surface waters, and ground water. This portion of the earth, the hydrosphere, is studied in the light of both natural biogeochemical processes and anthropogenic perturbations, such as water and air pollution. Laboratory study of the hydrologic and geochemical cycles in each regime are integrated with field trips to water treatment facilities and nearby water systems. Enrollment is limited to 52.

Short term unit description.

s.35 Geologic Processes of Global Change on the Hawaiian Islands.

Our planet is a dynamic system characterized by complex interactions among the solid earth, atmosphere, hydrosphere, and biosphere. The physical, chemical, and biological processes occurring at various temporal and spatial scales must be understood to evaluate and predict future global change. This unit examines geologic processes that contribute to global change--volcanism, plate motion, and landscape development--through intensive field studies in Hawaii. Students engage in a variety of field projects, keep a field notebook, and complete a case study of the human dimensions of geologic processes.

Bates

Senior
BC Geologic processes

Short-Term Unit Proposal for 1997
Sharon Locke, Dept. of Geology

Geologic Processes of Global Change on the Hawaiian Islands

Background:

The earth is a dynamic system composed of closely linked and interacting subparts, including the atmosphere, hydrosphere, solid earth, biosphere, and humans (society). This field of study is referred to as earth system science, and is partly the result of technological advances which have allowed scientists to view the earth from space. The view from space has shown that earth processes affect each other on a global scale in a very complex manner that is not well understood. One of the central organizing principles is that earth processes occur on a variety of spatial and temporal time scales, and that we must understand these complex interactions if we hope to understand global change and the increasing demands of human activity. I am proposing a short term unit that will introduce to Bates students the concepts of earth systems science from a geologic perspective. I believe the students will benefit tremendously from exposure to this emerging, relevant approach to the study of the earth.

Objectives:

The objective of the course is to demonstrate the importance of the earth system science perspective by giving students intensive exposure to global change processes. Through case studies and field projects students will learn the geologic aspects of global change, which occur on much longer time scales and at much larger spatial scales compared to many other earth system processes. The Hawaiian Islands are one of the primary places in the world for viewing active volcanism and evaluating how the movement of the earth's crust contributes to global change. The ages of the islands increase systematically as one moves northward in the chain, thus providing a unique opportunity to look at the effect of time on landscape development. In addition, the societal pressures of living on oceanic islands characterized by significant natural hazards and increasing human activity allow an opportunity for case studies on the links between global change and humans.

Evaluation:

1. Field notebooks and field exercises (40%)

2. Local case study on the human component of global change- field project and final report Possible topics include Pacific marine resources, geologic hazards (earthquakes, tsunamis, lava flows), and tropical climatic events (El Nino) (40%)

3. Remote sensing exercise: ground-truthing of a site picked prior to arrival in Hawaii (20%)

Unit outline:
The unit will be developed around five subtopics of global change relevant to the Hawaiian Islands. For each topic I have chosen 3-4 general principles that I would like the students to learn. Field exercises and projects will be designed to demonstrate one or more of these principles. I propose the following modules:

1. Remote sensing
   a. The earth can now be viewed from space and as such our understanding of global-scale processes has increased dramatically.
   b. Remotely-sensed data must be ground-truthed for it to be meaningful.
   c. Earth observations from space are necessary to properly assess global change and predict future change.

2. Plate tectonics
   a. Patterns of mountain building, volcanism, and earthquake activity fit consistently within the plate tectonics model of the earth.
   b. The Hawaiian islands are an example of intraplate activity and as such their existence must be explained within the context of plate tectonic theory.
   c. Plate motion is the result of internal earth dynamics, and contributes to global change on time scales of thousands to millions of years.
   d. The subduction and recycling of oceanic sediments is a primary pathway in the biogeochemical cycling of carbon.

3. Volcanism
   a. The gas and heat output of volcanoes must be monitored to assess the likelihood of eruption and potential resultant hazards.
   b. Particles and gases from volcanoes have a net cooling effect on the earth's climate.
   c. The influence of tropical volcanoes is more important than those in temperate zones because of global atmospheric circulation patterns.

4. Landscape development
   a. Landscape development is a function of climate, geology, and time.
   b. Ages of the Hawaiian Islands increase as one moves northward in the chain, allowing a comparative study of landscape development as a function of time.
   b. Vegetation distribution on the islands is the result of local weather patterns (dominated by the tradewinds) and elevational differences.
   c. Rainfall and the wave action of the ocean are the dominant erosional forces influencing topography and drainage patterns.

5. Society and global change
   a. Humans are an integral part of the earth system because they now have the ability to affect the earth on a global scale.
   b. Human-induced rates of change are generally much faster than those of natural processes.
   c. Basic earth systems must be understood in order for global society to progress towards sustainable development, in terms of both the environment and the economy.