

Water: Disease, Sanitation, and Sustainability – A Comparison of the Ancient and Modern World

By

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Water use has been a critical aspect of sustaining human societies since the advent of settled agriculture and urban centers. The Sumerian civilization collapsed after salinization of its' fields due to unsustainable irrigation practices. Poor water utilization and irrigation practices also played a role in the collapse of the Mayan and Hohokum civilizations. Water has also been a focal point in warfare throughout history. The Goths destroyed the main aqueducts to the city of Rome in the early 6th century, causing its' already declining population to plummet from hundreds of thousands of inhabitants to an estimated 50,000 people. Lessons from the past are relevant to our global civilization today. Water is still a source of conflict, for example in sub-Saharan Africa. Likewise sharing of water resources must be a component of trying to achieve lasting peace, such as in the Arab-Israeli conflict. Water usage in the ancient and medieval worlds will be compared to unsustainable practices that confront us today such as the disappearance of the Aral Sea, and the over-utilization of the Colorado River to the point where its' once vibrant delta has all but ceased to exist. The role of water use practices and basic sanitation in transmitting disease will be viewed throughout history. Even in peace time most ancient societies were ravaged by water and vector borne diseases. Modern sanitation and disinfection of water have radically altered that landscape, but only developed countries such as the USA, Europe, and Japan enjoy these successes. Water and vector borne disease in developing countries still cause high infant mortality rates and reduce longevity for adults. The presentation will look at water related impacts throughout history and how it impacts us today, and, using examples from previous societies, how it may impact us in the future.

Tentative Syllabus for Water: Disease, Sanitation, and Sustainability

Objective:	The objective of this course is to view water as it affected/affects the sustainability and quality of life for both ancient and modern societies.
Prerequisites:	<i>None</i>
Credit:	Three semester hours
Time & Place:	<i>Lecture:</i> TBD
Instructor:	Professor: A. A. Randall, Ph.D., P.E. Office: Engineering II 409 Tel: 407-823-6429, Fax: 407-823-3315, E-mail: randall@mail.ucf.edu Office hours: T 9-11, W 9 to 11, H 9-11 or by appointment Home Page : http://people.cecs.ucf.edu/randall/
Texts:	Water Resources Sustainability by Larry W. Mays (Ed.), McGraw-Hill and WEF Press, New York, New York, and Alexandria, Va., 2007. Collapse: How Societies Choose to Fail or Succeed by Jared Diamond, Viking Penguin, New York, New York, 2005.
Reading List (students will read one chapter or one paper and summarize it each week):	Book chapters or excerpts: Beyond Growth: The Economics of Sustainable Development by Herman E. Daly, Beacon Press, Boston, MA, 2005. Rats, Lice and History by Hans Zinsser, Black Dog & Leventhal Publishers, Inc, New York, New York, 1963. The World's Water, The Biennial Report on Freshwater Resources by Peter H. Gleik, Island Press, Washington D.C., 2004 or 2006. Floods, Famines, and Emperors by Brian Fagan, Basic Books, New York, New York, 1999. Sustainable Water Resources Management by I.G. Malkina-Pykh and Y.A. Pykh, WIT Press, Southampton, Boston, 2003. Papers: Marshall, J.D., Toffel, M.W. (2005) Framing the Elusive Concept of Sustainability: A Sustainability Hierarchy, <i>Environmental Science and Technology</i> , 39(5), 673-682. O'Hara, Sarah L., Metcalfe, S.E., Street-Perrott, F.A. (1994) On the Arid Margin: The Relationship Between Climate, Humans and the Environment. A Review of Evidence from the Highlands of Central Mexico. <i>Chemosphere</i> , 29(5), 965-981. Perz, S.G. (2007) Reformulating Modernization-Based Environmental Social Theories: Challenges on the Road to an Interdisciplinary Environmental Science, <i>Society and Natural Resources</i> , 20, 415-430. Lowdermilk, W.C., Conquest of the Land Through Seven Thousand Years, http://acwi.gov/swrr/conquest-of-the-land-jul28.pdf found at the Sustainable Water Resources Roundtable web site for the Advisory Committee on Water Information (2007). Deng, H., Zheng, B., Wu, G., Liu, G., Ma, K., Zhao, J. (2007) Demand & Supply Analysis of China's Water Resources and its Sustainable Utilization in the First Half of the 21st Century, Proceedings of Energy, Environment, Ecosystems and Sustainable Development '07, Agios Nikolaos, Crete, Greece, July 24-26, 2007.

Evaluation:	1. 10 weekly summaries of papers or chapters from reading list = 15% of final grade 2. 1 Term paper & presentation = 25% of final grade 3. 2 exams = 15% each = 30% of final grade 4. 1 comprehensive final exam = 30% of final grade			
Grading System:	The plus and minus grading system will be utilized to determine the final grade.			
	Grade	Grade Point Value	Grade	Grade Point Value
	A	4.00	C	2.00
	A-	3.75	C-	1.75
	B+	3.25	D+	1.25
	B	3.00	D	1.00
	B-	2.75	D-	0.75
	C+	2.25	F	0.00

Lecture #	Topic	Reading (see list)	Due Dates
1	Water Sustainability	Chap 1 text	
2	Parallels of Past and Present Civilizations With Respect to Water Utilization	Chap 2 of text and Collapse	
3	Ancient hydraulics: Not as primitive as you might think; Information fluency – introduction to literature searches in data bases from the UCF library and on-line search engines for technical literature	“	Students to begin literature search to search for a Term Project topic 1st weekly summary
4	Potable water delivery and wastewater disposal: Ancient Rome; Ancient Irrigation practices and the collapse of the Mayan and Hohokum civilizations	“	
5	Modern Water Practices: Water treatment/sanitation in the demographic transitions of developed countries vs the 3 rd world; also Ecology and Economics	Chap 3 of text and excerpts from Beyond Growth	Weekly summary
6	Modern Infrastructure for Water Treatment: coagulation and softening; also a case study of Arizona – managing for sustainability	Chap 4 of text	
7	Element cycles: C, N, S cycles and P; the role of bacteria and fungi in natural and engineered systems and element cycles	Handouts by Instructor on lecture topic	Weekly summary
8	Modern Infrastructure for Wastewater Treatment	Handouts	
9	The priority list for water and wastewater treatment: disinfection, disinfection, disinfection, but what about carcinogens and ecosystems?; Also - the flush toilet and the story of Thomas Crapper	Handouts	Deadline for students to discuss proposed Term Project with instructor by appointment Weekly summary
10	EXAM 1		
11	The basics of microorganisms and disease: viruses,	Handouts	

	bacteria, and protozoal pathogens, opportunistic pathogens		
12	Water and vector borne disease in the ancient and medieval worlds	Handouts	
13	Water and vector borne disease in Developed Countries: why don't Americans worry about typhoid epidemics and malaria any more?	Handouts	Written proposal for Term Project due with 5+ journal references, 2+ texts, 2+ web sites
14	Water and vector borne disease in developing countries: Diarrhea as a killer; DDT and malaria – save the birds and sacrifice the children?	Handouts	Weekly summary
15	Appropriate technologies for the developing world: Potable water delivery and disinfection Community management of rural water systems in Ghana & other appropriate technology models	Chap 13 of text; Handouts	
16	Appropriate technologies for the developing world: Basic sanitation or selling sanitation - is that a latrine or a shed?	Handouts	Weekly summary
17	Appropriate technologies for the developing world: The failure of single link strategies and the necessity of 3 point attacks (disinfection, sanitation, and medical treatment) in breaking the chain of transmission of water and vector borne disease; Also the response of the developed world - market forces or morality?	Handouts; Excerpts from Beyond Growth	
18	EXAM 2		
19	The water cycle: all water is recycled, even wastewater; also the water cycle and climate change effects	Chap 8 of text	
20	The potential impact of climate change on water sustainability and other possible implications of global climate change for the modern world	Chap 9 of text	Weekly summary
21	Global climate change throughout history and examples of societal collapse concurrent with climate change: The Greenland Vikings and the “Little Ice Age”	Collapse Handouts	
22	Sustainable Integrated Regional Development	Chap 12 of text	Weekly summary
23	Which model for water supply and sanitation is more sustainable – privatization or government?	Chap 14 of text	
24	Case Studies: Groundwater mining and the limits of the concept of sustainability, The Ogallala aquifer and the economy of the American Midwest.	Collapse	Weekly summary
25	Case Studies: South Korea	Chap 11 of text	
26	Case Studies: Easter Island	Collapse	Weekly summary
27	Water for the future: Desalination and reuse and their limitations; If you solve energy limitations, you solve water limitations?	Handouts	
28	Students Term Project presentations		
29	Students Term Project presentations		
30	Students Term Project presentations		
31	Students Term Project presentations		
32	Review for Final Exam		Term Project paper due
	Comprehensive Final Exam		

Statement of the Innovative Nature of the Course

The course brings together separate streams of information from several distinct areas of knowledge. The experience of ancient societies who failed or succeeded in their management of water is gleaned for the lessons that are relevant to the present. In addition information from microbiology and epidemiology is distilled such that an educated layman, or a college student from any academic background, can follow it. Appropriate technologies are also distilled and simplified in this lightly technical manner. This holistic approach which brings together seemingly disparate threads of information should benefit students from many disciplines who may go into the medical field, the sciences, the arts, engineering, public health, or who may become policy makers in the arenas of water allocation, foreign aid, environmental regulation, and public health. In addition this information would be useful to any educated person in a democracy who needs basic knowledge of the plight of the majority of the worlds population, and also the historical mistakes of previous societies that our developed society does not want to repeat.

Information Fluency Statement

Information fluency (IF) is a term used by educational institutions and has several slightly different definitions. At Macalester University IF is defined in this way, "students should develop the ability to use information and communication resources effectively, be adept at critical, analytical and logical thinking, and express themselves well in both oral and written forms." The Associated Colleges of the South define IF as "Information Fluency may be envisioned as the optimal outcome when critical thinking skills are combined with information literacy and relevant computing skills."

In this course IF is addressed in multiple ways but the cornerstone of this effort is the Term Project required of each student. The students will conduct literature searches of a minimum of three separate sources of information: the library texts (LUIS), multiple data bases such as Compendex, Applied Science & Technology, etc., that the UCF library subscribes to (and they may have to use interlibrary loan also), and web search engines specific such as Google or Scholar, and also those which are specific to technical literature such as the Scirus search engine. From the initial literature search the students will have to define their proposed Term Project and then orally communicate it to the course instructor. Then they will have to prepare a written proposal for the project, along with references from all three sources of information. Once approved, or revised and approved, the student will have to research the topic thoroughly and develop a) a Power Point presentation which will be formally presented to his or her fellow students, and b) a term paper handed into the instructor for evaluation and grading. This semester long effort will insure that each student is adept at literature searches in the age of personal computers and on-line journals, and oral communication both to the instructor and then as a formal presentation to the entire class. In addition a technical paper will be developed and handed in which must conform to consistent format guidelines given by the instructor. Thus the students will gain experience in both oral and written communication concerning both technical and historical issues.

Course Summary for Students

EES3930H: The objective of this course is to view water as it affected/affects the sustainability and quality of life for both ancient and modern societies. Water, and the means of conveying and treating it, has been a critical aspect of sustaining human societies since the advent of settled agriculture and urban centers. The Sumerian civilization collapsed after salinization (accumulation of salt) of its' fields due to unsustainable irrigation practices. In the modern world unsustainable practices confront us today: e.g. the disappearance of the Aral Sea, and the disappearance of the Colorado River delta. The role of water use practices and basic sanitation in transmitting disease or in sustaining disease vectors (e.g. mosquitoes, rats) will be viewed throughout history. The historical transition of developed countries from domination by contagious diseases to relatively rarity will be studied as well as the still unfolding path of developing countries which still struggle with water borne disease. Appropriate technologies for developing countries will also be discussed in a lightly technical manner suitable for students of any major. The potentially complicating factors of global climate change and population growth will also be discussed.