

Biology of Water and Health
MPH-241
Cross-listed in Nutrition and Engineering
SYLLABUS-2007 Version 1.0

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- Mark Pokras, D.V.M.
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- Class Time: Monday evenings, 5:30-8:30PM + Two field trips (In-class poll to determine day and time.
- Class Location: Boston Health Sciences Campus
Sackler 204

Required Reading: 1. The Blue Death: Disease, Disaster and the Water We Drink. Harper Collins: New York 2007.
Robert D. Morris. (Available from Amazon.com @ \$16.50)
ISBN 978-0-006-073089-5 (Hereafter cited as Morris).

2. Hygiene Evaluation Procedures. Approaches and methods for Assessing Water- and Sanitation-Related Hygiene Practices Almedom, Astier M., Blumenthal, Ursula, Manderson, Lenore. International Nutrition Foundation for developing Countries. 1997. Distributed by Prof. Griffiths.

Additional material to be posted on TUSK
<http://tusk.tufts.edu/>

Additional Resources: Environment and Health Affinity Group. 1:30 PM on Monday September 17 @ Anderson Hall, MEDFORD

WSSS Seminars Friday afternoons 4:00-5:30 in Mugar 231, Fletcher School, MEDFORD

Course Objectives:

1. Emphasis is placed on participants understanding the biology of water and health.
2. Participants will demonstrate knowledge of the central role of water in health, including adequate hydration.
3. Detailed coverage of selected prototypic or model diseases which include schistosomiasis, cryptosporidiosis, cholera, and others will be presented.
4. Participants will understand animal/human interactions and ecological factors that affect human host susceptibility.
5. Participants will become familiar with widespread chemical agents and their interactions with pathogens.
6. Participants will demonstrate a familiarity with the appropriate methods of assessing the occurrence of water borne disease.
7. Participants will become knowledgeable about the principal methods of controlling the propagation of water-borne diseases.
8. Participants will become knowledgeable about the social and institutional factors influencing sanitation and water treatment decisions and the subsequent impacts on a variety of health indices

This is a required core course for all Water: Systems, Science and Society (WSSS) students but graduate students in other programs are more than welcome.

All course notes and announcements will be posted on TUSK.

Course content:

Week 1
Sept 10

Overview of the course: content, expectations

The biological cycle of water and a brief distillation of human costs/risks/benefits as determined by quality and supply.

Relevance to both domestic and international settings

Time and capital involved in procurement of water at the level of the household

Social and institutional factors influencing water and health

Connection between sanitation, potable water and other health

indices: Case material from Stockholm, Chicago, Malaysia,

Presentation of the basic vocabulary and concepts of the participating disciplines:

Clinical medicine

Environmental epidemiology

Environmental engineering

Ecology

Veterinary medicine

READINGS:

1. [http://www.water-](http://www.water-2001.de/outcome/BonnRecommendations/Bonn_Recommendations.pdf)

[2001.de/outcome/BonnRecommendations/Bonn_Recommendations.pdf](http://www.water-2001.de/outcome/BonnRecommendations/Bonn_Recommendations.pdf)

2. Gute, D.M. and Hanes, N.B. An applied approach to epidemiology and toxicology for engineers. U.S. Department of Health and Human Services. National Institute for Occupational Safety and Health. June, 1993. Units 1+2.

3. Set of materials obtained from the World Health Organization Library.

<http://www.who.int/library>

LNK@who.int

4. Environmental Water Flows. Social Impact. World Bank, 2003.

5. Equitable Child Health Interventions: The Impact of Improved Water and Sanitation Bo Burström; Gloria Macassa; Lisa Öberg; Eva Bernhardt; Lars Smedman. American Journal of Public Health; Feb 2005; 95, 2; ABI/INFORM Global pg. 208

6. Performance of the rural health improvement scheme in reducing the incidence of waterborne diseases in rural Sarawak, Malaysia. K.B. Liewa, M. Lepesteurb,* Transactions of the Royal Society of Tropical Medicine and Hygiene (2006) 100, 949— 955.

7. Public health investments and the infant mortality gap: Evidence from federal sanitation interventions on U.S. Indian reservations. Tara Watson. Journal of Public Economics 90 (2006) 1537– 1560.

Week 2 Griffiths
Sept 17
Homework Set # 1 Assigned

Waterborne Disease

Who is at risk, what are the methods of transmission...
Overview of waterborne transmission
What makes infectious diseases epidemiology different from other fields of epidemiology?
Introduction of reproductive rate as a concept along with infectious dose; differences in clinical expression.

Surveillance for waterborne diseases: the good, the bad, and the ugly

Contrasting models of “simple” cycle infectious diseases (Crypto) versus complex, vector borne diseases such as Schistosomiasis

Introduction to water borne diseases including:
 Hepatitis A
 Polio and other Enteroviruses
 Others such as Rotavirus
Cryptosporidium
 Zoonotic and human origins, Control strategies and engineering solutions
Schistosomiasis
 A model parasitic disease
Overlap of social and environmental factors
 Role of mining and irrigation
 Schisto as a “perfect infectious disease”
Cholera
 History
 Role of human and animal sanitation
 Sanitation methods to control
 Need for molecular techniques for non-culturable pathogens

READINGS:

Required: Morris Part I pp.1-108.

Supplemental:

1. Bica, Ioana, Hamer, Davidson, Stadecker, Miguel J. Hepatic Schistosomiasis. Infections of the Liver. 14:583-604, 2000.

2. Danso-Appiah, A. Vlas, S.J. De, Bosompem, K.M. and Habbema, J.D.F.. Determinants of health-seeking behaviour for schistosomiasis-related symptoms in the context of integrating schistosomiasis control within the regular health services in Ghana. Tropical Medicine and International Health. 9:784-794. 2004.
3. Sack, D.A, Sack, R.B., Balakrish, R. and Siddique, A.K. Cholera. *Lancet*. 363: 223-233. 2004.
4. Naumova EN, Christodouleas J, Hunter PR. Temporal and spatial variability in cryptosporidiosis recorded by the surveillance system in North West England in 1990 - 1999. *Water and Health*. (in press.)
5. Luby et al., Effect of handwashing on child health: a randomized controlled trial. *Lancet* 2005; 366:225-33.
6. Naumova, Egorov, Morris, & Griffiths. The Elderly and Waterborne Cryptosporidium Infection. *Emerging Infectious Disease*. Vol 9, No. 4. April 2003
7. Thapar and Sanderson. Diarrhoea in children: an interface between developing and developed countries. *Lancet* 2004; 363: 641-653.
8. Black, Morris, Bryce. Where and why are 10 million children dying every year? *Lancet* 2003; 361:2226-2234

Week 3 Gute
Sept 24

Homework Set # 1 Due

Tools of environmental epidemiology

Surveillance and monitoring – classical and emerging techniques

Identifying outbreaks

Assessment and analysis

How do you make judgments about nature of the problem?

What sorts of assays are available?

Spatial analysis

Determining cause and effect

READINGS:

1. David A. Savitz and Christine L. Moe. Water: Chlorinated Hydrocarbons and Infectious Agents. Topics in Environmental Epidemiology. Steenland, K. and Savitz, D. (Eds.) Oxford University Press: New York, 1997. pp.64-118.

Week 4 Gute and Durant
Oct 1

Homework Set # 1 Returned

Homework Set # 2 Assigned

Waterborne chemical agents

Lead

Arsenic

Endocrine disrupters

Pesticides
Antibiotics
Woburn case
EPA priority pollutants
Emerging contaminants
Sources, environmental fate and transport

READINGS:

1. Rogers, Catriona, Tomita, Avoy, et al. Hair Analysis Does Not Support Hypothesized Arsenic and Chromium Exposure to Drinking Water in Woburn. *Environmental Health Perspectives*. 105: 1997
2. Aurelio et al. Sources and Distribution of Arsenic in the Aberjona Watershed, Eastern Massachusetts. *Water, Air and Soil Pollution*. 1995. 81:265-282.
3. Davis et al. Groundwater transport of arsenic and chromium at a historical tannery, Woburn, Massachusetts. *Applied Geochemistry*. 1994. Vol 9; 569-582. 1994.
4. Industri-Plex Superfund Site remediation plan. 2005 US EPA

**October 08- Columbus Day Holiday Observed- NO CLASS
THIS CLASS SHIFTED TO OCTOBER 9**

Week 5 Guest lecturer: Bela T. Matyas. M.D., M.P.H. Medical Director,
Epidemiology Program. Massachusetts Department of Public
Health

<http://www.mass.gov/dph/>

Oct 9: **NOTE: THIS IS A TUESDAY!**

Homework #2 Due

Outbreak Investigation Exercise

This will be a hands-on exercise dealing with analysis of a waterborne disease outbreak, using information on possible routes of transmission, incubation time and host behaviors to deduce cause and propose control strategies.

READINGS:

1. Part II Morris pp. 111-214.
2. Additional readings to be assigned.

Week 6

Gute and Water Treatment Plant staff

Oct 15

Homework #2 Returned

Field Trip #1 Water Treatment Technology and Operations.

Cambridge Water Treatment Plant Tour OR Deer Island Treatment Plant NOTE: These activities will either be held during regular class hours BUT at the Fresh pond Water Treatment Facility in Cambridge, Massachusetts or outside of class footprint at Deer Island, Winthrop, MA.

Transportation and other logistics to be specified after class discussion.

Modern evidence that waterborne diseases occur in the US despite water treatment

Exploration of conditions that allow for this.

Sanitation, Primary Prevention and Control Strategies - Overview

- History of water treatment
- Techniques of control
- Land use and related issues
- Sanitation, history,
- Sanitation as a cultural construct
- Case of schistosomiasis control in Puerto Rico

READINGS:

1. Halliday, Stephen. The Great Stink of London. Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis. London: Sutton. 2001. pp. 1-15.
2. Melosi, Martin. The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present. Baltimore: Johns Hopkins Press. 2000. pp. 1-57.

Friday October 19 NOTE: This is outside normal class meeting time!
Alternative time Thursday October 18 in the afternoon.

Field Trip #2 Mystic River water sampling acquisition.

Participants will receive instruction and practice field sampling techniques while on the Mystic River in Medford, MA. These samples will be processed and analyzed and the results discussed. Logistics and transportation to be specified. Approximate duration of field trip = 12:00 Noon – 4:00 PM. Please meet on the front steps of Anderson Hall (Intersection of Boston and College Avenues) on the Medford Campus.

Week 7 Guest lecturers: Susan Murcott, M.S.
Senior Lecturer
Department of Civil and Environmental Engineering
Massachusetts Institute of Technology

<http://cee.mit.edu/index.pl?id=2700>

Astier M. Almedom, D. Phil.

Professor of Practice in Humanitarian Policy and Global
Public Health

Fletcher School, Tufts University

<http://fletcher.tufts.edu/faculty/almedom/profile.asp>

Take-Home Mid-Term Examination Distributed

READINGS:

Selections from: Almedom, Astier, Blumenthal, Ursuala, Manderson, Lenore.
Hygiene Evaluation Procedures: Approaches and Methods for Assessing Water-
and Sanitation-Related Hygiene Practices. International Nutrition Foundation for
Developing Countries, London: 1997.

Week 8 Rioux, Gute

Oct 29

Tap water vs. bottled water – risk comparisons and life cycle analysis
Is it safe, and what about all that plastic?
Science, market forces and consumer demand – is there a disconnect?

Take-Home Mid-Term Due

Week 9

Gute, Griffiths. Guest lecturers: Eric Nelson, M.D./Ph.D. Candidate
Georgia Kaiser, Fletcher School, Ph.D, student, Jamie DeLemos, Civil and
Environmental Engineering Ph.D. candidate.

Nov. 5

Five Page Term Paper Scope Due

Reports from the Field and Around the World

Point of use treatment techniques
Appropriate for pathogens or chemical contaminants
Criteria: Low cost
 Safe and effective
 ‘Trainable’
 Use locally available materials

READINGS:

1. <http://www.designthatmatters.org/>
2. R Dillingham and RL. Guerrant, Childhood stunting: measuring and stemming the staggering costs of inadequate water and sanitation. *Lancet* **363** (2004), p. 94.

Nov 12 NO CLASS

Week 10

November 19

Mid-term Examination Returned via hard copy
Ungraded Term Paper Scope Returned via email

Week 11 Nov 26 Guest lecture: Mark Pokras , D.V.M.
Associate Professor
Cummings School of Veterinary Medicine
Tufts University
<http://www.tufts.edu/home/feature/?p=pokras>

Homework #3 Distributed

Zoonoses, Eco-health, and conservation medicine

Animal to human disease transmission
Environmental overlap with animal health
Food webs and non human systems

READINGS: to be posted on TUSK as suggested by Dr. Pokras.

Add readings for bottled/tap lecture

1. Patz *et al.* Effects of environmental change on emerging parasitic diseases. *International Journal for Parasitology*. 2000; 30: 1395-1405.
2. Norris, Douglas E. Mosquito-borne disease as a consequence of land use change. *Ecohealth*. 2004 1: 19-24.
3. Daszak *et al.* Infectious disease and amphibian population declines. *Diversity and Distributions*. 2003. 9: 141-150.

Week 12

Dec 3 Wrap-up: Major Themes of Course Revisited

Homework # 3 Due

Poster boards distributed

Week 13 All participating instructors

Dec 10

Homework #3 Returned

Poster session/presentations
Evaluation Criteria

1. Term paper: pick a health outcome related to water and pick one or two global geographic areas (nations or regions) where it is public health problem, or one or two contrasting interventions and discuss: nature of the problem, choice of solution, pros and cons (technical feasibility, operational, financial, political, social feasibility) and your own recommendations*.
2. Based on the term paper, a poster session summarizing results
3. Midterm (take home)
4. Homework exercises
5. Class participation

Term paper due December 13, 2007

Term paper:	30%
Poster:	20%
Midterm:	20%
Homework Exercises:	25%
HW #1	10%
HW#2	10%
HW#3	5%
Class participation:	5%