

ENV 6510
Sustainable Development Engineering
&
PHC 6301
Water Pollution and Treatment
3 credits, Spring 2012
Monday, 2 pm-4:45 pm
SOC 160, Social Sciences Building

Course Description. Study of applying appropriate and sustainable engineering solutions and technology to control environmental pollutants found in a developing world setting and smaller communities in North America. Concepts of sustainable development are covered. Topics are drawn from several areas of engineering, including water supply, water treatment, water storage, wastewater treatment, materials, solid waste management, construction, and watersheds.

Note that for class, there may be different reading material for students enrolled in ENV6510 and PHC6301.

Course Objectives. Students taking this course will: 1) apply engineering fundamentals and appropriate technology in design, construction, operation, and maintenance of engineering projects that serve people living in the developing world and smaller communities in the U.S., 2) learn how community-based engineering projects fit into larger, global issues of sustainable development, 3) develop an understanding of the important inter-relationship of public health and engineering; 4) incorporate environmental, societal, and economic considerations and community participation into engineering practice.

Required Textbook

Mihelcic, J.R., L.M. Fry, E.A. Myre, B.D. Barkdoll, L.D. Phillips, *Field Guide in Environmental Engineering for Development Workers: Water, Sanitation, Indoor Air*, ASCE Press, Reston, VA, 2009.

For future Peace Corps Volunteers enrolled in the Master's International Program

Chambers, R. *Rural Development: Putting the Last First*. Longman, 1983.

Peace Corps volunteers should take this book to their field sites. It covers several important topics that are invaluable to grassroots community development work in developing countries.

Waterlines

Waterlines is an international journal of appropriate technologies for water supply and sanitation. Practical Action Publishing. Published quarterly. Available on-line at USF Library. Note: The *Waterlines* editorial by Richard Carter from the June 2008 "re-launch" issue provides a good summary of *Waterlines* and the type of articles that they publish.

RWSN (Rural Water Supply Network) Website: www.rwsn.ch

RWSN focuses on the following four flagship themes, with an emphasis on sub-Saharan Africa: 1) Self Supply, 2) Cost-effective Boreholes, 3) Sustainable rural water supplies, 4) Handpump Technologies

Other Sources of Information for students in the Master's International Program

- *Living Poor*, Moritz Thomson, 1990.
- Davis, J. and R. Lambert. *Engineering in Emergencies*-Second Edition, ITDG Publishing, 2002.

- Crites, R. and Tchobanoglous, G. *Small and Decentralized Wastewater Management Systems*. McGraw-Hill, New York, 1998.

For students enrolled in PHC 6301.

- Students enrolled in PHC 6301 will note there are several chapters from the following book posted on Blackboard. These students should consider purchasing the following book: Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).
- PHC 6301 students must become familiar with the various resources available at: National Small Flows Clearinghouse and the U.S. Environmental Protection Agency (www.epa.gov). This includes becoming regular readers of *Small Flows Magazine* <http://www.nesc.wvu.edu/index.cfm>.
- Reference books for PHC 6301 PHC students should be interested in the following two references (Crites, R. and Tchobanoglous, G. *Small and Decentralized Wastewater Management Systems*. McGraw-Hill, New York, 1998) (Septic Systems – A Practical Alternative for Small Communities, *Pipelines*, 15(3), 2004. http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_SU95.pdf)

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Graduate Doctoral Student Assistants:

Michael MacCarthy & Ryan Schweitzer

Grading: *Class participation/preparation and group projects are a very important aspect of this class. It is expected that you have read all assigned reading materials before arriving to class. Several assignments and one large semester project are required. The large project will be worth approximately 50% of your grade. The remainder of your grade will consist of approximately seven assignments (28%) and course preparedness and in-class participation (22%). Missed work is not allowed to be made up unless the student receives prior approval from the instructor.*

Attendance Policy: Attendance is required. Students who anticipate being absent from class due to a pre-scheduled professional conflict or religious observance should inform the instructor by the second class meeting.

Class Presentations: to be determined at a later date

Semester Project: Class members will work individually to develop a high quality critical literature review on a topic selected from a list provided by the instructors. You are expected to work on this project throughout the semester. The instructor is allowed to request at any time starting in February to immediately see a draft of your semester project for review and provide a mid-progress grade.

Additional Sources of Information: (see <http://cee.eng.usf.edu/peacecorps> for additional sources of technical information that includes student research reports, technical briefs, and links to other sources of information).

Class Schedule & Reading Material (Spring, 2012)
ENV 6510, Sustainable Development Engineering:

Week 1. January 9. Class introduction, what experiences do people have in small community setting and developed/developing world

Global look at sustainable development and link between engineering and health. Global need for safe water and sanitation, issues of global change, chronology of modern world events related to sustainability, and Millennium Development Goals. Importance of public health, hygiene, and community participation to successful engineering practice. Water supply and relationship to health, role of women in issues of water and sanitation, water demand and access.

Students are expected to read the following material before coming to first class

Chapter 1: Introduction: Engineering a Better World

Chapter 2: (not covered in class, students are to read) Project Motivation: Public health and the role of environmental engineers

- For students enrolled in ENV6510 and PHC6301, How Can We Avoid the Coming Power Struggle for Water? Frederick Bloetscher, *Upflow Magazine*, December, 2011.
- For students enrolled in PHC 6301: Chapter 1 Engineering & Sustainable Development," from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).
- For students enrolled in PHC 6301: Chapter 11, Wastewater Treatment, pages 461-465, Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

In class

Defining sustainability and sustainable development, five pillars of sustainable development

Chapter 9: Water Use, Access, and Health

Chapter 19: Wastewater Composition and Generation

Introduction of LogFrame.

Assignment 1: (due January 12 by electronic submission, cut and paste your response into an email to Dr. Mihelcic; subject heading should read "Assignment_1_Full_Name")

- For students enrolled in PHC 6301, provide an overview of information available at the National Small Flows Clearinghouse. Provide detailed review of "Protecting Your Community's Assets: A Guide for Small Wastewater Systems" http://www.nesc.wvu.edu/subpages/WW_manage_plan.cfm
- For students enrolled in ENV6510, provide Dr. Mihelcic detailed overview of "2010, Progress on Sanitation and Drinking-water: 2010 Update" WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Geneva, 60 pgs

Assignment 2: Development of a LogFrame (due January 20, email to Michael MacCarthy)

Week 2. January 16. (out of class effort, Martin Luther King Day) Prepare for Week 3, Project Management/Sustainability Readings that need completed before Week 3 class.

- Chapter 3: Participatory Approaches and Community Management in Engrg. Projects
- Chapter 5: Project Management.
- Schweitzer, R.W., J.R. Mihelcic, "Sustainability Analysis of Community Managed Water Systems in the Developing World," *Journal of Water, Sanitation and Hygiene for Development*, in press, 2012
- RWSN (2010) Myths of the Rural Water Supply Sector. Rural Water Supply Network, Perspectives No 4. May 2010. St. Gallen, Switzerland: <http://www.rwsn.ch/documentation/skatdocumentation.2009-07-27.8158674790/file>
- McConville, J.R., and J.R. Mihelcic, "Adapting Life Cycle Thinking Tools to Evaluate Project Sustainability in International Water and Sanitation Development Work," *Environmental Engineering Science*, 24(7):937-948, 2007.

Week 3. January 23. Project Management and Project Sustainability

Besides the key five readings that you were to complete during Week 2, below are additional readings

- For students enrolled in PHC6301, read EPA's "A New Approach to Protecting Drinking Water and Public Health" (<http://water.epa.gov/lawsregs/rulesregs/sdwa/dwstrategy/index.cfm>).
- For students enrolled in PHC6301, read Climate Change: Effects on Community Water and Wastewater Systems, Caigan McKenzie, *Small Flows Quarterly*, 10(2), 2009.
Systems http://www.nesc.wvu.edu/pdf/ww/publications/smallflows/magazine/SFQ_SPSU09.pdf
- For students enrolled in PHC 6301, read water supply information from: Chapter 9. Water Supply, Distribution, and Wastewater Collection," from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

Week 4. January 30

Latrines (pit, ventilated improved, composting), Wash areas and soak pits, Septic Tank Design and Maintenance

Chapter 20: Wash Areas and Soak Pits

Chapter 21: Latrines

- For students in PHC6301, read Septic Systems – A Practical Alternative for Small Communities, *Pipelines*, 15(3), 2004.
- For students enrolled in PHC 6301: Chapter 11. Wastewater Treatment," from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

Assignment 3: Septic Tank Design

Week 5. February 6. Wastewater Lagoons

Chapter 22: Wastewater Lagoons

- For students enrolled in PHC6301, Lagoon Systems Can Provide Low-Cost Wastewater Treatment (PIPELINE, Spring 1997; 8(2), http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_SP97.pdf
- For students enrolled in ENV6510, The Need for Wastewater Treatment in Latin America: A Case Study of the Use of Wastewater Stabilization Ponds in Honduras, Stewart Oakley, *Small Flows Quarterly*, 6(2), 2005. http://www.nesc.wvu.edu/nsfc/Articles/SFO/SFO_sp05/SFO_Sp05_juried.pdf

Week 6. February 13. Gravity Fed Water Supply Systems, Flow through Pipes

Required Reading _ Chapter 11: Gravity Fed Water Supply Systems

Chapter 14: Water Storage Tanks

Chapter 15: Development of Natural springs

Additional Reading _ Chapter 12: Increasing Capacity of Existing Gravity Fed Water Systems

- For students enrolled in PHC 6301, read section on "water distribution" (pages 355-385): Chapter 9. Water Supply, Distribution, and Wastewater Collection," from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

Week 7. February 20. Water Supply Continued, Demonstration of Gravity Flow Water Systems

Chapter 17: Rainwater Harvesting

- For students in PHV6301 read about EPA's Rainwater Harvesting Policies (EPA_833-F-08-010)-
http://www.epa.gov/npdes/pubs/gi_munichandbook_harvesting.pdf

In class Pre-test: Groundwater Development

Assignment 4: Calculating Storage Requirements for Rainwater Harvesting

Week 8. February 27. Hand Dug Wells and Manually Drilled Wells

- a. Overview of groundwater development
- b. Hand Dug Wells
- c. Hand-drilled wells
 - a. Hand-augering
 - b. Percussion Drilling
 - c. Sludging
 - d. Jetting / Washboring

- For students in PHC6301, read about Groundwater Basics

(<http://www.nesc.wvu.edu/ndwc/articles/OT/FA03/GW101.html>) & Wellhead Protection,

(<http://www.nesc.wvu.edu/ndwc/articles/OT/FA03/wellhead.html>)

Required Reading

Chapter 15: Manually Constructed and Operated Water Wells

Danert, K. 2008. *Realizing the potential of hand-drilled wells for rural water supply*. Waterlines, Vol. 28. No. 2 (April 2009): 108-129

Supplemental Resource:

MacDonald, A., Davies J., Calow R., and J. Chilton. *Developing Groundwater: A Guide for Rural Water Supply*, Practical Action Publishing, 2005.

Week 9. March 5.

Manual Drilling Laboratories (to be held at USF Geopark)

Required Reading

Naugle, J. *Hand Augered Garden Wells*, Lutheran World Relief, 1996. PDF available on-line at:

<http://www.enterpriseworks.org/pubs/Hand%20Augered%20Wells-color.pdf>

Assignment 5: Groundwater Development (lab write-up)

March 12. Spring Break

Week 10. March 19. Water-Lifting Devices; Follow-up to manual drilling labs

Week 11. March 26. Water Treatment

Important contaminants found in sources of drinking water, conventional treatment processes used to treat surface water and groundwater, point of use versus community treatment; slow-sand filtration, cloth filtration, ceramic filters, UV disinfection, chemical disinfection with bleach, boiling of water

Chapter 18: Water Treatment

- For students enrolled in PHC 6301: Chapter 10. Water Treatment," (pages 397-409, 453-453) from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

Assignment 6: Calculating Point-of-use Water Treatment

Week 12. April 2. Construction Materials

Engineering Materials: Stone; block & brick; cement, concrete, and mortar; steel reinforcement (application of, size, spacing).

Construction techniques for foundations, slabs, floors, roofs, walls, & tanks,

Chapter 6: Engineering Materials

Chapter 7: Construction Techniques

Week 13. April 9. TBA (optional laboratory construction session over the weekend).

Review pages 134-143.

Assignment 7: TBA

Week 14. April 16. Solid Waste Management

solid waste production & composition, collection, processing, disposal, source reduction, community survey techniques

Chapter 24: Solid Waste Management

- For students enrolled in PHC 6301: Chapter 13. "Solid Waste Management," from Mihelcic, J.R., J.B. Zimmerman, *Environmental Engineering: Fundamentals, Sustainability, Design*, John Wiley & Sons, 2010).

Additional Reading

- Troschinetz, A.M. and J.R. Mihelcic, "Sustainable Recycling of Municipal Solid Waste in Developing Countries," *Waste Management*, 29(2): 915-923, 2009.
- Post, J.L. and J.R. Mihelcic "Waste Reduction Strategies for Improved Management of Household Solid Waste in Jamaica," *International Journal of Environment and Waste Management*, 2010.
- Owens, E.L., Mihelcic, J.R., Zhang, Q. "Material Flow Analysis to Improve Solid Waste Management in Small Island Developing States," *Journal of Environmental Engineering*, 137(10): 937-944, 2011.

Week 15. April 23. Indoor Air Pollutants and Stove and Ventilation Controls

Chapter 25. Indoor Air Quality

- For students enrolled in PHC6301, Indoor Air Pollution: An Introduction for Health Professionals (U.S. Government Printing Office Publication No. 1994-523-217/81322, 1994)
[http://www.epa.gov/iaq/pdfs/indoor air pollution.pdf](http://www.epa.gov/iaq/pdfs/indoor_air_pollution.pdf)

Week 16. April 30. Final Exam Week

No final examination is given in this course.

Semester Project

All students will work during the semester on a major research project about a topic of your choosing which is relevant to the course and your research and/or professional interests. Final papers should be 15-20 pages (single spacing) in length, not including references and appendices. References are to be applied and referenced as outlined at: <http://www.writetrack.net/aiaa/documents/ReferenceFormat.pdf>. You MUST obtain permission to use any copyrighted material (e.g., figures, photos) BEFORE you submit your final report. Permissions should be included in an Appendix. Your final project grade will be given for the entire research project (title/objectives, outline, draft and final paper) at the end of the semester.

Deadlines for Semester Project:

Week 2, January 20: You must select your topic and have approved by Dr. Mihelcic January 20. By this time, you will need to provide Dr. Mihelcic a title, one-sentence objective of what you plan to cover, and a minimum of 5 references in proper format.

Week 4 Detailed outline due, include your approved title & objective, and minimum of 10 references

Week 7 (end of week) Draft Report is due and undergoes graded peer review

Week 14 (end of week) Final report is due. Your initial graded outline and draft should be included in an Appendix.