July 30, 2015
BVK

ENCE 637 Biological Principles of Environmental Engineering

Meeting times and Location:
Room: PLS 1111
Time: Tuesdays and Thursdays 11.00 am -12.15 pm

Instructor:
Name: Birthe V. Kjellerup, Ph.D.
Phone: 301-314-1535.
Email: bvk@umd.edu
Office hours: Tu/Th: 2-3 pm; Or contact me to schedule an appointment.

Course Description:
This course seeks to provide an examination of biological principles directly affecting humans and the environment, with particular emphasis on microbiological interactions in environmental engineering related to air, water and land systems; microbiology and biochemistry of aerobic and anaerobic treatment processes for aqueous wastes.

Course Objectives:
After completing this course, you will be able to:
1) Identify structures and their functions for biological cells in the environment
2) Understand culture and molecular based methods applied for the study of environmental microbiology
3) Discuss the importance of microbiological processes in environmental engineering applications
4) Discuss the importance of environmental sustainability in environmental engineering
5) Evaluate environmental sustainability aspects of existing and proposed environmental engineering processes and designs
6) Read, understand, present and lead discussions of peer reviewed papers
7) Formulate a well-defined research proposal

Textbooks and Materials:
Michael Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley and David A. Stahl, (2015). Brock Biology of Microorganisms 14th Edition. Pearson (Strongly recommended).

The textbook will be supplemented with peer reviewed literature. Students will be responsible for reading the literature and leading discussions on each topic.
- Suggestions from students are ENCOURAGED and WELCOME.

Notes and Blackboard
Notes will be posted on the Blackboard site. Students are encouraged to read and review the supplements prior to class. These notes will be the basis for exam material and homework (HW). It is also highly recommended that students visit the Blackboard site regularly to be current with notes.

Attendance/Quizzes: Attendance is highly recommended as material covered in class will be the backbone of HW and exam material. It is also recommended that students read the assigned textbook material before class. Assigned papers for discussion must be read. Weekly

home work (HW) assignments or online quizzes will be made available on the Course website and will need to be completed before the listed deadline.

Journal club
As part of this class, students will be responsible for reading peer reviewed papers related to the class topic and prepare class and/or group discussions on the paper. Each paper discussion will last approximately 30 minutes and should aim to dissect the articles and relay the content to the class. Short powerpoint presentations can be used to introduce the main concepts of the paper and get the discussion started.

Homework:
HW sets (web site information, data analysis, theoretical consideration, empirical relationship, analytical solution, library search, mass balance, nutrient requirements, organic gross parameters, data for N and S cycles, stoichiometric relationship, and kinetic data etc.) will be presented each week. They are due each Tuesday before class – submit electronically via email. Some might be tedious calculations and others of conceptual nature. Please use graphic solutions, be neat and logic, so it is easy to follow. HWs and the solution will be posted at Course website. No credit for late HWs.

Exams:
One take home exams will provided at the time designated in the course schedule. One week will be allowed for completion of the exam. The exam is due before class on Tuesday March 31.

Semester Project:
You will be working on a project all semester, where the concepts taught in class and discussions can be related and incorporated. The outcomes of this semester project will be: an extended proposal outline, a NSF pre-proposal and a final presentation. The topic of the semester project will be related to applied environmental microbiology and must be different from your graduate research project.

The topic will need to be finalized by the 3rd week of class (February 12, 2015) and further refined with a two-page extended proposal outline due by the end of the 7th week (March 12, 2015). This pre-proposal should list the title of the proposed research, the major hypothesis being tested, list of objectives to test this hypothesis, and a preliminary list of articles reviewed. The final proposal will follow the guidelines from NSF and will be discussed in class. The last class period will be designated for project presentations, where each student will need to prepare a 10-15 min powerpoint presentation on the research idea, and proposed work. Deadline for submission of NSF proposal: April 30, 2015, 5 pm EST.

Overall Grading Outline:

Presentations (ind/group)	10%
Midterm Exam (take home)	20%
Journal club/discussions	20%
Homework/quizzes	15%
NSF Pre-proposal	20%
Project presentation	15%
Total = 100%	

Disability Statement:
Reasonable accommodations are available for students who have a disability. Students should contact the Disability Support Service Office (DSS) for assistance, 0106 Shoemaker Building,

301.314.7682 (V), Dissup@umd.edu, http://www.counseling.umd.edu/DSS/. Once the DSS prepares an Accommodation Letter regarding needed accommodations, it is the student's responsibility to bring it my attention by the end of the drop/add period.

Student Paper presentations/journal club:
1. Find title - Names
2.
3.
4.
5.
6.
7.

Main ideas tested in Fa15:

1. Do not lecture from PPT. Make ppt available on Canvas 2 days before class, require reading and study of ppt, go through most important topics in class, answer specific questions, discuss paper, protocols etc. in class, relate to research and real life experiences.
2. More involvement of laboratory aspects such as protocols, design of experiments and in silico or wet lab activity.
3. Involvement of guest lectures and topics bordering environmental microbiology, but not specific to the topic.

These content topics are in focus for the Fall 2015 semester:

1. Not enough basic introduction to DNA, RNA, Central Dogma and basic microbiology. Result: week 1 will be covering this with chapters in textbook, videos etc.
2. Too much disease/epidemiology. Result: Disease speed talks will be converted to "Frontiers in Environmental microbiology/engineering", still speed talks. Drop the epidemiology HW.
3. Add a lecture on LCA based and sustainability of env eng solutions - after the "build environment" lectures. Are we using more energy on solving a solution than we recover – by use of microbiology? (Example: Will use of thermal hydrolysis improve the overall energy consumption in a LCA or will it be a sustainable solution?
4. Cover all sections of Env eng / build environment chapter with papers.
5. Student paper pres – start earlier on.
6. Presentation graduation: Keep a) Group pres, b) Short ind pres, c) Long ind pres.
7. Include guest lectures.
8. Include in silico or wet lab demonstration
9. Place deadline for proposal after the final presentation to benefit from peer comments.
10. Include sustainability (LCA) in the broader impact section of the proposal, include a discussion about the environmental sustainability of your solution/proposal with regards to water, energy or other resources. Are we overall solving problems or causing new ones?

Proposal:
Propose
1. A solution to a problem caused by Biofilms such as biofouling, biocorrosion, pathogens harbored, non-working monitoring equipment etc.
OR
2. A biofilm based solution to an environmental problem.

Approximate Course Schedule – may be revised during the semester

Week	Date	Topic	Chapters/readings	Assignments
1	Sept. 1	Introduction to course and microbiology – overview Microbial Cell structure	• Chapter 1 • Syllabus • 1 min pres on research topic and course expectations • Chapter 2	
	Sept. 3	Microbial cell structure and function & Microbial metabolism How to culture aerobic and anaerobic bacteria	Ch2-3 Protocols for aerobic and anaerobic media	
2	Sept. 8	Consider topic for term project	Self study	
	Sept. 10	HW1: Ch 1 & 4	Self study	HW1-answers due
3	Sept. 15	Basic principles of molecular microbiology & Discussion: Extraction of DNA, RNA, Proteins from environmental samples	Ch4 Papers: Methods explained Kit instructions	
	Sept. 17	Microbial growth and control Discussion: How to disinfect drinking water/treated ww	Ch5 Student paper Pres1	HW1-report due Proposal topic due
4	Sept. 22	Biofilms (Basics, problems, beneficial) Paper1: Biocorrosion, biofouling Paper2: Remediation	Ch19 Paper: Biofilms	
	Sept. 24	Microbial genomics Paper: AR resistance genes	Ch6 Student paper Pres2	HW2-answers due
5	Sept. 29	Microbial evolution & Diversity of microorganisms Papers: Hydro-thermal vents,	Ch12-13	
	Oct. 1	Nutrient cycles & Diversity of bacteria-Archaea Paper: Aerobic and anaerobic processes in soil Paper: Archaea and extreme env	Ch 14-15-16 Student paper Pres3	HW2-reports due
6	Oct. 6	Sustainability in Environmental Engineering – Discussion	Paper: LCA of biofuels Paper: LCA of wwtp energy	
	Oct. 8	Methods in Microbial Ecology, How to do – discuss protocols. Paper: MAR-FISH paper	Ch 18 Student paper Pres4	HW3-answers due Proposal outline (2 pg) due
7	Oct. 13	Group Pres	Group Pres	
	Oct. 15	Group Pres	Group Pres	HW3-reports due
8	Oct. 20	The built environment – overview Paper: Acid mine drainage Paper: PAH bioremediation	Ch 21	

	Oct. 22	Microbial processes in sewers and WWTP Paper: Anamox in WWTP Paper: Anaerobic digestion	Ch 21 Student paper Pres5	HW4-answers due
9	Oct. 27	In silico lab/lab demonstration	Omics, Blast etc.	
	Oct. 29	Take home exam (Bioremediation)	Take Home Exam	HW4-reports due
10	Nov. 3	Microbial processes in drinking water and reclaimed water Paper: Helicobacter paper Paper: Reclaimed water	Ch 21 Student paper Pres6	**Take Home Exam due**
	Nov. 5	Guest Lecture: Environmental sustainability, policy and engineering	Paper	
11	Nov. 10	Speed talks: Frontiers in Env. Micro	Individual Pres	Experimental approach due
12	Nov. 17	Speed talks: Frontiers in Env. Micro	Individual Pres	HW5-answers due
	Nov. 19	Symbiosis - Biotechnology: Microbial processes and Biofuels Paper: Bioethanol (Ryan paper) Paper: Bio-diesel from algae	Ch 21-22 Student paper7	
13	Nov. 24	Sustainability in Environmental Engineering – Revisited	Papers	HW5-reports due
	Nov. 26	Thanksgiving		
14	Dec. 1	Vector, Person, Water, Food borne diseases – climate change Paper:	Ch 29-30-31	Proposal Due
	Dec. 3	Ind Pres		Ind Proposal Pres
15	Dec. 8	Ind pres		Ind Proposal Pres
	Dec. 12	Ind pres		Ind Proposal Pres