E N V I R O N M E N T A L B I O T E C H N O L O G Y

Microbio562 – FALL 2017, 3 credits – Class Nr. 40619

Schedule: TuTh 2:30 – 5:30 in N303 Morrill Sci. Ctr. IV North

Instructors: Dr. Klaus **Nüsslein**, Office N326 Morrill I (nusslein@microbio.umass.edu)
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Textbook: I, Microbiologist: a Discovery-Based Course in Microbial Ecology and Molecular Evolution. Author: Erin R. Sanders, University of California, Los Angeles; Jeffrey H. Miller, University of California, Los Angeles. All editions.

COURSE DESCRIPTION

Microbial Biotechnology is a laboratory course supported by lectures and demonstrations. This advanced course is designed to introduce upper undergraduate and graduate students to traditional and molecular methods strategically applied to problems related to microbial biotechnology and environmental microbiology. Course topics cover a wide range from the diversity of microbial life to biodegradation. Seven general areas are emphasized:

(1) Statistical sampling and chemical and physical site characterization,
(2) biomass determination and cell counts,
(3) enrichment techniques,
(4) microbial activity measurements,
(5) single cell detection in situ,
(6) sequence analysis followed by taxonomic and phylogenetic analysis, and
(7) other modern techniques of environmental microbiology.

Instruction will be primarily through lectures, handouts, and informal discussions based upon materials provided and experimental observations, as well as current primary research literature or topics in the news. The class begins with broad sampling concepts and quickly moves to practical applications.

GOALS FOR THIS COURSE

- To establish a broad understanding of microbial ecology and environmental microbiology
- To learn techniques related to these subjects
- To learn best practices, such as lab reports, and how to write a scientific manuscript

ACTIVITIES

Lab Notebook. All students are required to keep an up to date lab notebook (bound pages), which will be signed at the end of each lab meeting by the TA.

Lab Reports for each of the four units are due within one week after the last class meeting related to the unit. All lab reports are to be submitted on Moodle. Word limit is 2000, including figure legends, tables, and references. Total points per lab report are 12.5, and the penalty is -1 pt for over 2000 words, and -0.5 points for each additional 500 words. Late lab reports are penalized 1 pt per day late.

Expectations detailing what each lab module should cover will be posted on Moodle. The Teaching Assistant will be available to review at the end of each module and before the lab reports are due.

Quizzes will be administered in class at the beginning of each week to gauge students' preparedness for lab and progress with the material. Quizzes will be short, concerning both technical and conceptual aspects of the labs. There will be 11 quizzes; the lowest grade will be dropped.

Each module will be summarized in a **final presentations** at the end of each module by an assigned group. The topic of the presentation will be one of the four modules, or another topic approved by the instructors in advance, as long as it includes presentation of data collected by every class member class during the course module, not just the data of your group. Presentations will last half an hour, followed by a brief discussion lead by the presenters for an additional 10 minutes. Grades for final presentations will be on an individual basis, based on a combination of instructor grade (50%) and group grade (50%). Presentation grades will be evaluated based on the student's presentation content and how well the student answers questions at the end of the presentation (see guidelines below).

Readings include lab handouts plus additional assigned reading, as described in the syllabus.

There will be two **field trips**, where attendance will be mandatory.

GRADING AND COURSE REQUIREMENTS

Grades will be based on all activities. There will be no final exam. Grade components weight in points:

Lab Reports..... 4 x 12.5% = 50%
Weekly quizzes.....10 x 2% = 20% (Drop the lowest of 11 quizzes)
Attendance and participation.....15%
Group presentations.....15%

Dates of labs are firm. Makeup labs will not be given.

Grades will be calculated to the nearest whole percent. The grade cut-offs may be lowered on the basis of the point distribution. Please, contact the instructor with any problems regarding course materials immediately. All materials will be discarded 30 days after the end of the semester. Grades will be weighted in computing a final letter grade.

Regrades for lab reports will be considered. Students who choose to may submit a revised version of their lab reports no later than 7 days after the corrected lab reports have been handed back. Additional points will be administered at the discretion of the instructor, and students should prioritize incorporation of comments on the corrected first version, though instructor comments should be considered a minimum for revising. A lab report may only be resubmitted once. No re-grading will be done after 7 days. Regrading does not remove a late submission penalty.

DISABILITY SERVICES

If you would like to request accommodation because of a documented disability, please discuss your situation and possible needs with the instructors within the first week of class. The instructors are available and willing to answer any questions and to give individual help on any portion of the course during class or outside of class by appointment. Students can only use the notes (or in-class recordings) they take from class for their own personal use, and not share (or sell) these notes via an outside vendor or entity without instructor's permission. This does not pertain to accommodations under the Americans with Disabilities Act (ADA), although recordings or sharing of Notes for ADA accommodations should not pertain to distribution beyond the students in the class receiving the accommodations. If you have any questions or need help, please ask.

SCHEDULE

Date	Due	Module	Topics	Instructor	Reading
5 Sept			Intro to course, field prep, basic techniques, Safety Demonstration	Nüsslein, DeAngelis	Sanders, Unit 1
A. Is the campus pond a reservoir for human pathogens?					
7 Sept		A.1	Sampling Strategy; Sample Campus pond; Filter for future DNA extraction; keep filtrate	Nüsslein	Sanders, Unit 2
12 Sept	Quiz #1	A.2	DNA isolation from pond water	Nüsslein	[1]
14 Sept		A.3	Gel electrophoresis; Nanodrop	Nüsslein	Sanders, Unit 3
19 Sept	Quiz #2	A.4	Culturing: serial dilution and plating	Nüsslein	Sanders, Unit 4
21 Sept		A.5	Phenotype cultures by PCR of 16S rRNA from Isolates and from pond community DNA (PCR1 for clone libraries to determine community structure for B.1); API strips	Nüsslein	
B. Who is there? Characterizing natural microbial communities					
26 Sept	Quiz #3	B.1	**Group presentation, Module A** Run PCR results on gel (A.5 and B.1); ligation of 16S amplicons from pond community DNA	Nüsslein	Sanders, Unit 5
28 Sept		B.2	Cloning	Nüsslein	Sanders, Unit 5
3 Oct	**Lab Report A Due;** Quiz #4	B.3	Pick clones; Restriction mapping; run PCR 2	Nüsslein	Sanders, Unit 6
5 Oct		B.4	Gel for PCR 2; prep submit for sequencing	Nüsslein	Sanders, Unit 7
10 Oct	-----		Monday class schedule – no class		
12 Oct		B.5	Sequence analysis and phylogenetic trees	Nüsslein	[2]
17 Oct	Quiz #5	B.6	**Guest lecture Dr. Chul Park**; Phylogenetic trees, continued	Nüsslein	
19 Oct	Field trip		**Field trip** – Waste water treatment facility	Nüsslein	
C. Modeling microbial communities					
24 Oct	Quiz #6	C.1	**Group presentation, Module B**; Temperature effect on microbial growth	DeAngelis	[3]
26 Oct		C.2	Temperature effect on microbial enzyme activities	DeAngelis	[4]

Continued…

Date	Due	Module	Topics	Instructor	Reading
31 Oct	**Lab Report B Due;** Quiz #7	C.3	Modeling temperature effects	DeAngelis	TBD
2 Nov		C.4	Water quality testing	DeAngelis	[6]
7 Nov	Quiz #8	C.5	Data analysis	DeAngelis	
9 Nov		C.6	**Guest lecture Dr. Sue Leschine**, **Group presentation, Module C**	DeAngelis	
D. Batch Fermentation					
14 Nov	Quiz #9	D.1	Set up primary batch fermentation	DeAngelis	[7]
16 Nov	**Lab Report C Due**	D.2	Batch fermentation media preparation, **Guest lecture Dr. Sue Leschine**	DeAngelis	[8]
21,23 Nov			Thanksgiving - no class		
28 Nov	Quiz #10	D.3	Batch fermentation priming and conditioning	DeAngelis	
30 Nov		D.4	Bioinformatics Lab: Omics and the analysis of biofuels fermentation	DeAngelis	[9]
5 Dec	Quiz #11	D.5	Microbial contamination of batch fermentation	DeAngelis	
7 Dec	Field trip	D.6.	Batch fermentation sensory analysis and **Field trip** to BBC Brewery	Nüsslein, DeAngelis	
12 Dec			**Group Presentation, Module D**	Nüsslein	
15 Dec	**Lab Report D Due**		*No class during finals week*		

ATTENDANCE AND PARTICIPATION

Attendance at all scheduled lectures and labs is expected except in cases of emergency (death in family), the advent of religious holidays (the observance of which requires restriction of daily activity) or when participating in official College functions (e.g., field trips and athletic events). When determining whether to consider an absence as excused, the instructors may require such evidence as seems fit.

GROUP PRESENTATIONS

All students will give one **group presentation** at the end of one of the modules. The topic of the presentation will be one of the four modules, assigned randomly. Each group will have 20 minutes to present and 10 minutes to answer questions. Each student is expected to speak for about 5 minutes and answer at least one question from class members or instructors.

GUIDELINES for PRESENTATIONS

- Presentation must include data collected by every class member class during the module, not just the data of your group.
- The format of the presentation is the same as format for lab reports, and you will be graded for including all the pertinent parts:
    - Introduction
        - Why did we do this experiment?
        - What is the hypothesis?
        - What are the expected results?
    - Methods
        - What methods did we use to test the hypothesis?
        - How does that method work?
        - What controls were necessary to form our conclusions?
    - Results
        - What did we find with our experiment?
        - How were the data analyzed?
        - Were we able to use all the data? Why or why not?
    - Discussion
        - Did we find what we expected?
        - Were you able to disprove our hypothesis?
        - If anything went wrong, how could it be improved?
- Other points you will be graded on include, but may not be limited to:
    - Quality of presentation, including lack of typos and effectiveness of message.
    - How well you speak and how long you speak for; points will be deducted for poor speaking and/or not speaking enough.
    - Each student should bring in one outside source, meaning one peer-reviewed article that helps to illuminate the data.
    - Each student should answer at least one question from someone in the class, as part of your grade will be based on how well you answer questions.
    - Each student will also be required to ask a question of his or her classmates. This will count towards your participation grade.
    - At the end of class, you will be required to turn in an evaluation of each member of your group, which will count for half of your presentation grade.

HINTS ON DOING WELL IN THIS COURSE

- **Form study groups and lecture to each other. This is MOST effective, and it is interesting too (*in recent years there was a strong direct correlation between good grades and participation in study groups!!!)***
- Never miss a class.
- Always read the assigned material before class, don't wait until after the material is covered in class. Add that reading time as a work block in your weekly schedule.
- Take good notes during lecture and labs, maybe even photographs.
- If you have a question speak up in class, don't wait until after class.
- Rewrite your notes promptly after class using your text for more explanation.

While none of these guarantee a good grade, if you do them all your chances are greatly improved.

BIBLIOGRAPHY OF ADDITIONAL REQUIRED READING

[1] Kit literature for DNA extraction: PowerWater® SterivexTM DNA Isolation Kit

[2] Nicholas H. Barton, Derek E.G. Briggs, Jonathan A. Eisen, David B. Goldstein, Nipam H. Patel. *Chapter 27: Phylogenetic Reconstruction*. (Cold Spring Harbor Press, 2007). http://www.evolution-textbook.org/content/free/contents/ch27.html

[3] Davidson, E. A. & Janssens, I. A. Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. Nature 440, 165–173 (2006).

[4] Wallenstein, M., Allison, S. D., Ernakovich, J., Steinweg, J. M. & Sinsabaugh, R. *Soil Biology Chapter 13 Controls on the Temperature Sensitivity of Soil Enzymes: A Key Driver of In Situ Enzyme Activity Rates*. **22,** 245–258 (Springer Berlin Heidelberg, 2010).

[5] Lemarchand et al. Molecular Biology and DNA Microarray Technology for Microbial Quality Monitoring of Water. Critical Reviews in Microbiology, 30:145–172, 2004

[6] Handout by instructor; EPA chapter on water quality at http://water.epa.gov/type/rsl/monitoring/vms511.cfm

[7] Nicholas A. Bokulich and Charles W. Bamforth. (2013) The Microbiology of Malting and Brewing. Microbiol. Mol. Biol. Rev. 77(2):157-172. http://mmbr.asm.org/content/77/2/157.short

[8] Desai, N., Antonopoulos, D., Gilbert, J. A., Glass, E. M., & Meyer, F. (2012). From genomics to metagenomics. Current Opinion in Biotechnology, 23(1), 72–76. doi:10.1016/j.copbio.2011.12.017

[9] Alger MT, CM Spirito, JG Usack, JJ Werner, LT Angenent."Chain elongation with reactor microbiomes: upgrading dilute ethanol to medium-chain carboxylates." Energy Environ. Sci., 2012,5, 8189-8192. doi: 10.1039/C2EE22101B.