BIOLOGY 4PP3 - Environmental Microbiology and Biotechnology

Term I: 2014-2015

Instructor: Dr. Jianping Xu
Teaching Assistant: Aaron Vogan

Course description:
This course introduces students to both the fundamentals of environmental microbiology and the advanced research results on major topics of environmental microbiology and biotechnology. The fundamentals include the environmental microbial diversity, major metabolic pathways, and the interactions between microbes, microbes with plants, and microbes with animals. The advanced research topics include tools (e.g. genomics and metagenomics tools) and recent research results (in PBL format). The groups of microbes covered include viruses, bacteria, protozoa, and fungi. The lectures will cover materials derived from both textbooks and recent research articles. Inquiry and Problem-based learning will be a significant component of the course where students will be involved in reading, analyzing, presenting, and discussing recent research results in environmental microbiology and biotechnology. In addition, there will also be critiquing of peer essays and application of concepts to real world issues.

Time and location of regular lectures:
Thursday 11:30 - 13:20 LSB/B130E

Time and location of tutorial sections:
T01 Tuesday 11:30-14:20 MDCL1115

Tutorial sessions will be organized and led by teaching assistant Aaron Vogan. Each student will give ONE individual presentation and participate in ONE group presentation (4-5 students per group depending on class size). The individual presentation is 25min long with 5min of questions while the group presentation is 40min long with 5min of questions. The first presentation deals with an original research/opinion paper on environmental microbiology. The Instructor/TA will provide a list of papers from which students can choose. The second presentation is based on the PBL topics. A series of topics will be provided (see below). These sessions will familiarize students with some of the most topical environmental microbiology issues and to communicate them effectively.

Evaluation:
Course evaluation will consist of the following components:
1. Individual presentation (10%). The first presentation (8% of the total course grade; 25min long, 5min for questions) deals with an original research paper. Students may choose the paper from the list provided or choose their own from the primary literature on environmental microbiology (e.g. from the PLOS Journal Series and from journals such as Environmental Microbiology, Applied and Environmental Microbiology, Microbial Ecology etc.). A one-page summary should be provided to fellow tutorial classmates at the beginning of the presentation. The summary will be worth 2% of the total course mark.
2. Group presentation on the PBL topic (10%). PBL topics include:
   a. (i) Oil spills/leaks are very common, design a novel organism to clear up oil spills?
   b. (ii) Microbes are found in almost every imaginable ecological niche on earth. Design an experiment to determine whether a rock sample from 5km under the surface of Earth contain life.
   c. (iii) The human microbiome plays a critical role in human health and diseases, Design an experiment to test whether a specific gut microbe contributes significantly to human obesity
   d. (iv) Volatile organic compounds are everywhere and many are emitted by microorganisms. Design an experiment to determine the functions of microbial volatiles in nature
   e. (v). Global warming has been a big issue for the last two decades, how to use microbes to mitigate the global climate changes?

   Each group of 3 students chose one topic. I also welcome other topics from students. Both peer marking based on individual contributions (5%) and TA marking (5%) will be included.

3. Group summary paper (15%) based on PBL. The finalized summary paper should be maximum of 5 pages, single-spaced, 12 fonts. Need to include background, rationale, experimental design, limitations, and budget. Detailed guidelines will be posted.

4. Reviews of summary papers from two peer groups (5% total; 2.5% each)

5. Tutorial participation and discussion will account for 5% of the total mark.

6. Midterm test (35%). A 2hr midterm test covering materials from the first 12 lectures will be conducted during class time on Thursday, October 16th.

7. Two assignments (10%): population genetic data analyses (5%) and microbial diversity analyses (5%)

8. An Exit Interview with the instructor and TA (10%).

In accordance with the "Senate Resolution on Course Outlines," the instructors reserve the right to make changes in the course that may occur as the course progresses. In accordance with University policy, academic dishonesty, including plagiarism, will not be tolerated. If you need to clarify what constitutes plagiarism, please consult the statement on Academic Dishonesty in the Senate Policy Statements available either in abbreviated form in the university calendar or in entirety at: http://www.mcmaster.ca/univsec/policy/AcademicIntegrity2008.pdf.

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, students will be given reasonable notice with an explanation and an opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Reference textbook:

REFERENCE MATERIALS:
PLOS journals, American Society for Microbiology review journals, environmental microbiology journals, and other relevant periodicals are available in the Thode and Health Sciences Libraries.
Schedule of Lectures

**Week 1.**
Lecture 1-2. Thursday, September 4. **Course Introduction, Organization, and Fundamentals of Environmental Microbiology**

No tutorial this week. Students should download the list of suggested papers or choose a primary research paper by themselves for the first presentation.

**Week 2.**
Lecture 3-4. Thursday, September 11. **Microbial Diversity: fundamentals (species concepts, diversity estimates, and major microbial groups)**

Tutorial: Set up tutorial groups. Decide order of first round of presentations. Choosing research papers for first presentation. **Please dress appropriately: Mushroom foray to the back forests of McMaster (south of Cootes Paradise forest).**

**Week 3**
Lecture 5-6. Thursday, September 18. **Microbial Diversity in Natural Environments** *(Assignment #1 handing out)*

Tutorial: Introduction and discussion of PBL format and topics

**Week 4**
Lecture 7-8. Thursday, September 25. **Microbial Interactions with Plants and Animals**

Tutorial: First round of presentations: 4 presentations in each group, PBL discussions *(Assignment #1 Due; hand in electronically via email)*

**Week 5.**
Lecture 9-10. Thursday, October 2. **Microbial Metabolisms and Biotechnology**

Tutorial: First round of presentations: 4 presentations in each group, PBL discussions

**Week 6.**
Lecture 11-12. Thursday, October 9. **Microbes in Geochemical Cycles and Applications (waste water treatment)**

Tutorial: First round of presentations: 4 presentations in each group, PBL discussions

**Week 7.**
**Thursday, October 16. Midterm Exam: Covers materials from lectures 1 to 12 in room LSB/B130E from 11:30-1:20.**

No tutorial this week.
Week 8.
Lecture 13-14. Thursday, October 23. Next Generation Sequencing Technologies and the New Age of Environmental Microbiology
Tutorial: PBL discussions on group approach to tackle their specific issues

Week 9
Midterm Recess (October 30-November 1), no lecture this week
Tutorial: Visit a mushroom farm and hand out assignment

Week 10
Lecture 15-16. Thursday, November 6. Introduction to JGI Genome Portal and population genetic analyses
(Assignment#2 handing out)
Tutorial: Visit the wastewater treatment plant

Week 11
No formal lecture this week.
Thursday, November 13. Handing in draft paper on PBL topic, redistribute to classmates (each group receives two papers) for review
Tutorial: Group presentations and discussion on PBL issues

Week 12
No formal lecture this week. (Assignment#2 due, electronically)
Tuesday: Students handing in reviews to TA and Aaron redistributes the reviews back to authors; Discuss PBL issues
Thursday: Students revise their papers based on feedbacks and prepare their final presentations for the PBL topic next week.

Week 13
Group presentations during lecture time and tutorial time for PBL

Week 14
Exit Interview during tutorial time (10min each)
Revised PBL group summary papers due, include a rebuttal letter to comments from peers.

AVAILABILITY OF INSTRUCTORS: Dr. JP Xu is available by E-mail (jpxu@mcmaster.ca) and through A2L. Dr. Xu will attend most of the tutorials and can address questions about course materials.