

BIO 4PP3 – Environmental Microbiology and Biotechnology

Term I: 2018-2019

Instructor: Dr. Jianping Xu

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 synthetic microbiology, genomics tools, and their applications (in PBL format). In addition, we will have an experiential learning component at the Piccioni Bros Mushroom Farm on Rock Chapel Road in Dundas, including six visits of about 3h each where students will learn and perform the major steps in mushroom production. The groups of microbes that we will cover in this course include viruses, bacteria, archaea, and eukaryotic microbes, with a focus on fungi. The lectures will cover materials derived from both textbooks and recent research articles. Inquiry and Problem-based learning will be integrated into the course where students will be involved in reading, analyzing, and discussing research results in environmental microbiology and biotechnology, with a focus on mushroom cultivation.

Time and location of regular lectures:

Mondays 11:30 - 1:20 BSB_B205

Time and location of tutorials:

Fridays 11:30 – 2:20 TSH_B107

Evaluation:

Course evaluation will consist of the following components:

1. An open-book midterm test (35%) on lecture materials
2. A paper presentation (10%): 15min long, 5min for questions) deals with an original research paper published in 2017-2018 on edible mushrooms (wild or cultivated).
3. An evaluation by the mushroom company on performance during visits (10%)
4. A final report on experiential learning experiences at the mushroom company. Need to include specifics about all the components during the mushroom production cycle, including compost preparation, spawn production, mushroom fruiting, harvesting, packaging, transportation, workplace hygiene practices, quality insurance and control, and budgeting (15%)
5. A research proposal on how to solve one of the problems faced by the mushroom company (20%)
6. An Exit Interview with the Instructor (10%) at the end of the term.

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 books:

Hurst et al. 2009. Manual of Environmental Microbiology. 2nd Edition. ASM Press.

Stamets. 1983. The Mushroom Cultivator.

Wessner et al. 2013. Microbiology. Wiley and Sons.

REFERENCE MATERIALS:

PLOS journals, BMC 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.

Tutorial: Friday, September 7th. Tutorial: Set up tutorial groups. Introduction and discussion of PBL format and topics. **Please dress appropriately: Mushroom foray to the back forests of McMaster (south of Cootes Paradise).**

Week 2.

Lectures 1-2. Monday, September 10th. **Course Introduction, Organization, and Fundamentals of Environmental Microbiology**

Tutorial: Friday, September 14th. Decide order of paper presentation. First visit to mushroom farm (an overall introduction to mushroom production, visiting facility)

Week 3

Lectures 3-4. Monday, September 17th. **Microbial Diversity: fundamentals (species concepts, diversity estimates, and major microbial groups)**

Tutorial: Friday, September 21st. First group of presentations (3-4 students).

Week 4

Lectures 5-6. Monday, September 24th. **Microbial Diversity in Natural Environments (Discuss Assignments #1 and 2)**

Tutorial: Friday, September 28th. Second visit to mushroom farm (composting and substrate preparation).

Week 5

Lectures 7-8. Monday, October 1st. **Microbial Interactions with Plants and Animals**

Tutorial: Friday, October 5th. Second group of presentations (3-4 students), students' research topic discussions.

Week 6

Lectures 9-10. Monday, October 8th. **Microbial Metabolisms and Biotechnology**

Tutorial: Friday, October 12th. Third visit to mushroom farm (Substrate-spawn mixing and casing).

Week 7: October 15-19 Mid-Term Recess (No class or tutorial)

Week 8

Lectures 11-12. Monday, October 22nd. **Microbes in Geochemical Cycles and Applications**

Tutorial: Friday, October 26th. **Midterm Exam: Open book. Covers materials from lectures 1 to 12 in room from 11:30-1:20.**

Week 9

Lectures 13-14. Monday, October 29th. **Next Generation Sequencing Technologies and the New Age of Environmental Microbiology**

Tutorial: Friday, November 2nd. Third group of presentations; research proposal discussions

Week 10

Lectures 15-16. Monday, November 5th. **Introduction to synthetic microbiology and its applications**

Tutorial: Friday, November 9th. Fourth visit to mushroom farm (Harvesting)

Week 11

Monday, November 12th: Fourth group of presentations and research proposal discussion

Friday, November 16th: Fifth visit to mushroom farm (Packaging)

Week 12

Monday, November 19th: Fifth group of presentations (if needed) and research proposal discussions

Friday, November 23rd: Sixth visit to mushroom farm (logistics, planning, transportation, budgeting etc)

Week 13

Monday, November 26th: Research proposal discussions

Friday, November 30th. Exit Interview (10min each).

Week 14

Monday, December 3rd. Research Proposal due

Friday, December 7th: Summary of Experiential Learning experiences due.

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.