# Course Outline Form: ENVS2080 (Winter 2018)

## General Information

**Course Title:** Introduction to Environmental Microbiology

**Course Description:**

This course will introduce students to Environmental Microbiology, with a focus on the important roles of microorganisms in various environments such as soil, water and sediments. Discussion will emphasize the physiology, biochemistry and ecology of microorganisms, and how a good understanding of these microbial processes can enable beneficial applications of microorganisms in biotechnology and bioremediation.

**Credit Weight: 0.5 Credits**

**Academic Department (or campus):** School of Environmental Sciences

**Campus:** Guelph

**Semester Offering:** Winter 2018

**Class Schedule and Location:** TBD

## Instructor Information

Instructor Name: Professor Hung Lee and Professor Marc Habash

Instructor Email: [hlee@uoguelph.ca](mailto:hlee@uoguelph.ca); [mhabash@uoguelph.ca](mailto:mhabash@uoguelph.ca)

Office location and office hours: Bovey Building Room 3218 and 3238. Office visit to be arranged by appointment

## GTA Information

GTA Name: TBD

GTA Email:

GTA office location and office hours:

## Course Content

### Specific Learning Outcomes:

Microorganisms are ubiquitous in the environment and they exert a significant control over natural systems such as soils, sediments, streams, lakes, rivers and oceans. They are also the basis for biological waste treatment in engineered systems. In this course, I will introduce students to the fascinating field of environmental microbiology through selected topics listed in the Lecture Contents below. The labs will provide some hands-on experience working with microorganisms. Successful students are expected to:

1. Gain an awareness of the importance of microorganisms in the environment.
2. Comprehend the general properties of microorganisms that limit their growth, survival, and proliferation in the environment.
3. Learn the basic interactions between (a) microorganisms and their environments, and (b) microorganisms and chemicals in the environment.
4. Grasp the general strategies and considerations in isolating microorganisms from the environment.
5. Grasp the general strategies and considerations in identifying and detecting selected microorganisms in the environment by molecular methods.
6. Learn aseptic techniques and safety while doing laboratory research involving microorganisms.

### Lecture Content:

Subject materials to be presented in lectures:

1. General roles of microorganisms in the environment
2. General properties of microorganisms in relation to environmental science
3. Isolation, screening and preservation of microorganisms from the environment
4. Microbial growth
5. Utilization of mixed substrates by microorganisms
6. How do microorganisms cope with adverse conditions in the environment?
7. Environmental cleanup - microbial degradation of selected hydrocarbons.

Subject 1: Introductory overview of environmental microbiology; role and involvement of microorganisms in natural geochemical cycles described; 3-way interactions between microorganisms, environment and chemicals emphasized.

Subject 2: Overview of different types of microorganisms; “tools” to observe microorganisms; consequences of small size of microorganisms in terms of microbe’s metabolic rate, metabolic flexibility and dispersal. General reactions catalyzed by heterotrophs (aerobic respiration, anaerobic respiration and fermentation) and autotrophs (nitrification, sulfur oxidation) important in environmental science.

Subject 3. This subject is presented in the context of isolation of microorganisms for biotechnological applications. Attributes of an industrial microorganism, sampling strategies, screening, culture enrichment, qualitative screening, quantitative screening, examples of microbial activity screens; culture preservation and storage. Application of molecular biology to characterize isolated microorganisms.

Subject 4. Microbial growth defined; Physical, chemical and nutritional requirements of growth; measurements of microbial growth in batch culture; microbial growth phases and kinetics; growth rate and growth yield determination; biofilm formation.

Subject 5. Diauxic growth and other patterns of mixed substrate utilization; co-metabolism; dealing with a co-metabolic requirement

Subject 6. Describe some of the problems faced by microbes in the environment and how microbes overcome them. Proximity to substrates; chemotaxis. Coping with large substrates – secreting extracellular enzymes; cellulosomes. Coping with solid, insoluble hydrophobic substrates; ageing of substrates; biosurfactants and bioemulsifiers. Coping with dilute low-nutrient solutions; attachment to surfaces, nutritional benefits, protective benefits; metabolic adaptation, dormancy, spores, VBNC, cryptic growth. Transport limitation; substrate uptake; different modes of transport. Uptake of xenobiotics, transport limitation overcome by liposomes or by displaying the catabolic enzyme on cell surfaces. Coping with antimicrobial compounds – mechanisms used by bacteria and how they obtain them.

Subject 7. General strategies in pollutant degradation - central vs peripheral metabolic pathways. Structural constraints to pollutant biodegradation. Monooxygenases and dioxygenases in hydrocarbon degradation, degradation of chlorinated and nitroaromatic hydrocarbons.

### Labs:

The following labs will be conducted:

1. Lab orientation and safety
2. Compound microscope and staining
3. Isolation and enumeration of microorganisms
4. Growth and disinfection of microorganisms
5. Microbial enzyme activity
6. Biosurfactant and bioemulsifying activities
7. DNA extraction from bacterial cultures, soil, and water
8. Detecting bacteria in the environment: Polymerase chain reaction

### Seminars: none

### Course Assignments and Tests:

| **Assignment or Test** | **Due Date** | **Contribution to Final Mark (%)** | **Learning Outcomes Assessed** |
| --- | --- | --- | --- |
| Midterm |  | 30 | 1-6 |
| Lab performance | Lab reports are due 1 week after each lab | 30 | 4-6 |
| Final exam | April 22, 2016 | 40 | 1-6 |
|  |  |  |  |

Additional Notes (if required):

### Final examination date and time: TBD

### Final exam weighting: 40%

## Course Resources

### Required Texts: There are no specific texts for this course. Selected chapters in the following book, available online from the University of Guelph library webpage, can be consulted to aid in understanding of the lecture or lab material.

### Manual of Environmental Microbiology, 3rd Edition (2007) Edited by Hurst CJ, Crawford RL, Garland JL, Lipson DA, Mills AL & Stetzenbach LD. ASM Press. Washington, DC. 1256 pages.

### Recommended Texts:

### Lab Manual: Each laboratory experiment will be provided on Courselink before the lab.

### Other Resources:

Lectures are derived mostly from original published research & review papers or text books that are available online.

Lecture slides will normally be posted the day before each lecture.

### Field Trips: N/A

### Additional Costs: N/A

## Course Policies

### Grading Policies:

**Policy on late assignments:**

* Lab reports are due one week after the lab before the next lab period. 10% of the lab report marks are deducted on a daily basis after the due date.

### Course Policy on Group Work:

Students will do the labs in pairs, but submit individual lab reports for grading.

### Course Policy regarding use of electronic devices and recording of lectures:

Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the written permission of the presenter, whether the instructor, the lab GRAs or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## University Policies

### Academic Consideration:

The University of Guelph is committed to supporting students in their learning experiences and responding to their individual needs and is aware that a variety of situations or events beyond the student's control may affect academic performance. Support is provided to accommodate academic needs in the face of personal difficulties or unforeseen events in the form of Academic Consideration.

Information on regulations and procedures for Academic Consideration, Appeals and Petitions, including categories, grounds, timelines and appeals can be found in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml).

### Academic Misconduct:

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community, faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring.

University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Detailed information regarding the Academic Misconduct policy is available in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml).

### Accessibility:

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS), formerly Centre for Students with Disabilities (CSD), as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email sas@uoguelph.ca or visit the [Student Accessibility Services website (http://www.uoguelph.ca/csd/)](http://www.uoguelph.ca/csd/).

### Course Evaluation Information:

End of semester course and instructor evaluations provide students the opportunity to have their comments and opinions used as an important component in the Faculty Tenure and Promotion process, and as valuable feedback to help instructors enhance the quality of their teaching effectiveness and course delivery.

While many course evaluations are conducted in class others are now conducted online. Please refer to the [Course and Instructor Evaluation Website](https://courseeval.uoguelph.ca/) **for more information.**

### Drop period:

The drop period for single semester courses starts at the beginning of the add period and extends to the Fortieth (40th) class day of the current semester (the last date to drop a single semester courses without academic penalty) which is listed in [Section III (Schedule of Dates) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/).

The drop period for two semester courses starts at the beginning of the add period in the first semester and extends to the last day of the add period in the second semester.

Information about Dropping Courses can be found in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/).

## Additional Course Information

None