

Environmental Microbiology: EESC30H3 S

Instructor

Dr. Patricia Dörr de Quadros

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Email

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Office hours: Online, pre-scheduled.

Lectures: Fridays 1-3 pm

Room HW 408

Lab Classes: Tuesdays, 9 – 11 am, EV 222, or

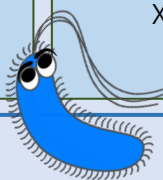
Wednesdays, 1 - 3 pm, EV 222

Pre-requisites: CHMA10H3, CHMA11H3,

BGYB50H3, BGYB51H3

TAs: Patricia Miller patricia.rider@mail.utoronto.ca

Xiaoqing Shao xiaoqing.shao@mail.utoronto.ca

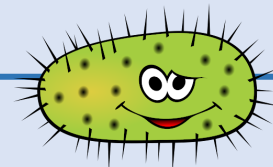


Course Description

Environmental Microbiology introduces students to the fascinating world of microorganisms, highlighting their evolution, importance, and functionality in the most varied environments. Students will learn about microbial abundance and diversity in common habitats and in peculiar niches under extreme environmental conditions. During the course we will explore the importance of microorganisms in soil formation and quality, in food production and plant health, in nutrient cycling and biodegradation of varied substrates and pollutants, in medicine and industry, in space exploration, and in bioremediation of contaminated soils.

In this course students will also learn how microorganisms can communicate with each other using signaling molecules, and how their genetic potential can be used for the advance of biotechnological processes. Furthermore, students will learn how to perform scientific experiments for monitoring, quantification, and qualification of microorganisms associated with plants, soil, and water, and how to use DNA sequences for identifying species and their function.

This course will provide students with the ability to demonstrate their knowledge of prokaryotic biodiversity and function, and to apply this understanding to solve problems and find solutions related to current environmental issues that threaten planetary and human health (i.e.: antibiotic-resistance, pollution, and global warming).

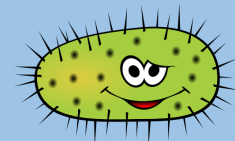


Student Learning Objectives

By the end of the course, students will be able to:

- Recognize the importance of microbial communities to the functioning of diverse ecosystems;
- Compare and evaluate microbial communities based on their DNA sequences;
- Predict changes in microbial community structure according changes in biotic and abiotic factors;
- Understand how plants, soil, and human microbiomes are interconnected and how they can influence each other;
- Integrate their knowledge in environmental microbiology and ecosystems management to find out solutions for environmental issues.

Schedule/ Lectures (Fridays):



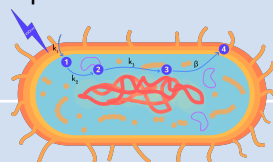
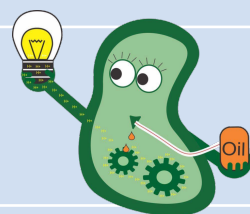
Module/ Week	Date	Lecture Topics	Readings
1	January 14 th	<p>Introduction, expectations, syllabus and course structure</p> <p>Microorganisms in the Environment</p> <ul style="list-style-type: none"> - Microbial evolution and diversity; - A historical perspective; - Overview of functions and applications of microorganisms; - Interconnectivity of ecosystems. 	Knoll, 2015 Hug et al., 2016
2	January 21 st	<p>Finding Energy and Carbon; Adaptations to Extremes</p> <ul style="list-style-type: none"> - Microbial metabolism and activity; - Range of conditions that support life and how microorganisms are adapted to that; - Extremophiles. 	Vaishnav et al., 2020
3	January 28 th	<p>Biogeochemical Cycling, Soil formation</p> <ul style="list-style-type: none"> - Influence of microbes on carbon, nitrogen, and sulphur cycles; - Influence of microorganisms on soil formation and quality; - Biodegradation of different substrates by microbes. - Organic matter. 	Falkowski, 2008
4	February 4 th	<p>Using DNA sequencing for identification of microbial taxonomy and function</p> <ul style="list-style-type: none"> - Microbial diversity; - DNA, genome, and metagenome; - DNA sequencing: methods and examples of data/current findings; - OMICS; 	Keegan et al., 2017 Nayfach et al., 2021 Biswas and Sarkar; 2018
5	February 11 th	<p>Agriculture and soil microbiome</p> <ul style="list-style-type: none"> - Soil microbial biodiversity and abundance; - Soil and plant microbiomes; - Soil pathogenic and beneficial microbes; - Influence of biotic and abiotic factors on food production; 	Rillig et al., 2019 Nannipieri et al., 2020 Aguilar-Paredes et al., 2020
6	February 18 th	<p>Plant microbiome: Benefits, function, and biotechnological applications</p> <ul style="list-style-type: none"> - Importance of microorganisms for agriculture: beneficial and pathogenic; - Microbial inoculants; - Biotechnological solutions for agriculture. - Review for Midterm 	Knight et al., 2018 Gilbert et al., 2014 Cordovez et al., 2019
7	February 25 th	Reading Week	Complant et al., 2019 Gilbert et al., 2014 Hardoim et al., 2008

Schedule/ Lectures (Fridays) - cont.



Module/ Week	Date	Lecture Topics	Readings
8	March 4 th	MIDTERM	
9	March 11 th	Bioremediation of contaminated soils <ul style="list-style-type: none"> - <i>In situ, ex situ</i>; - Natural attenuation, biostimulation, bioaugmentation - Bioprospection of microorganisms Seminar presentations	Agnello et al., 2020
10	March 18 th	Biodegradation of plastics; Antibiotic-resistant bacteria <ul style="list-style-type: none"> - Conventional plastics - Bioplastics; - The biology of plastics biodegradation - Mechanisms of antibiotic-resistance Seminar presentations	Compant et al., 2019 Miau et al., 2019
11	March 25 th	Biotechnological applications of microorganisms <ul style="list-style-type: none"> - Synthetic biology - Biomining - Microbes and production of pharmaceuticals - Microbes on food production Seminar presentations	Sarsaiya et al., 2020 Mussagy et al., 2019 Sánchez-Otero et al., 2019
12	April 1 st	Seminar presentations	
13	April 8 th	Seminar presentations Review for the final exam	
14	TBA	FINAL EXAM	

Schedule/ Laboratory Classes (Tuesdays or Wednesdays, EV 222):



Module/ Week	Tuesdays 9 -11 am	Wednesdays 1 – 3 pm	Laboratory Activity
1	January 18 th	January 19 th	- Assembling a Winogradsky column
2	January 25 th	January 26 th	- Assembling Soybean-Bradyrhizobium association experiment - Assembling plastics and bioplastics experiment
3	February 1 st	February 2 nd	- Assembling microbial fuel cells experiment
4	February 8 th	February 9 th	- Visualization of microbes from aquatic environment - Assembling CO ₂ evolution experiment
5	February 15 th	February 16 th	- Microbes counting – standard plate counting technique - Measuring current on microbial fuel cells experiment
6	March 1 st	March 2 nd	- DNA extraction - Measuring current on microbial fuel cells experiment - Titration – CO ₂ evolution experiment
7	March 8 th	March 9 th	- Gel electrophoresis - Measuring current on microbial fuel cells experiment - Titration – CO ₂ evolution experiment
8	March 15 th	March 16 th	- Measuring current on microbial fuel cells experiment - Titration – CO ₂ evolution experiment
9	March 22 nd	March 23 rd	- Measuring current on microbial fuel cells experiment - Titration – CO ₂ evolution experiment
10	March 29 th	March 30 th	- Soybean – Rhizobium symbiosis: Counting nodules, evaluation of N fixation

Seminar Evaluation:

- 30% of final mark
- Presentation dates TBD, taking place over 4 classes
- Select a peer-reviewed scientific paper about environmental microbiology
- Submit your presentation for suggestions
- Present the paper in a 20-30 minute seminar presentation, demonstrating your knowledge of the methods used to analyze the data and the significance of the results and conclusions.

Seminar –rubric

- Described the objective of the paper (10%)
- Put the study into context (10%)
- Informed the class of the methods used to analyze the data (25%)
- Explained the significance of the results (25%)
- Slide readability / good use of audio-visual, etc. (10%)
- Relevance of material to topic (10%)
- Ability to answer class questions (10%)

Supplementary Readings

- Manual of environmental Microbiology. Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai. 4th edition. 2016.
- Environmental Microbiology. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, 2014.
- Microbial Ecology. Ron Atlas and Richard Bartha, 4th edition.
- Brock: Biology of Microorganisms. Michael Madigan et al.; 12th edition.

Verification of Illness

Students who are requesting special academic consideration based on illness or injury must submit a [Verification of Student Illness or Injury](#) form. *Students must submit the form to the instructor via email and a carbon copy to [Gisela Bento](#) (for record-keeping).*

For COVID-19 related symptoms, the University is temporarily suspending the need for a doctor's note or medical certificate for absences and students must declare this through the Absence Declaration tool on [ACORN](#).

Visit the UTSC [COVID-19 Absence Declaration in ACORN](#) website for more information.

Emergency Planning

Students are advised to consult the university's preparedness site (<http://www.preparedness.utoronto.ca>) for information and regular updates regarding procedures relating to emergency planning.

Accessibility needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability or have any accessibility concern about the course, the classroom or course materials, please contact the UTSC Accessibility Services as soon as possible:
<http://www.utsc.utoronto.ca/~ability/>

We also suggest you also refer to the following University of Toronto Scarborough Library link:
<http://utsc.library.utoronto.ca/services-persons-disabilities>

Plagiarism

University of Toronto Code of Behaviour on Academic Matters states that "it shall be an offence for a student knowingly: to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e., to commit plagiarism.

For accepted methods of standard documentation formats, including electronic citation of internet sources please see the UofT writing website at <http://advice.writing.utoronto.ca/using-sources/documentation>.

The full Code of Behaviour regulations could be found from consulting
<http://www.sgs.utoronto.ca/facultyandstaff/Pages/Academic-Integrity.aspx>

WRITING AND ENGLISH LANGUAGE

As well as the faculty writing support, please see [English Language and writing support at University of Toronto](#) or the [Centre for Teaching and Learning](#) at UTSC.

The following is also useful:

Sylvan Barnett, *A Short Guide to Writing About Art*. 5-7th edition (New York: Harper-Collins, 1997)
William Strunk Jr., E.B. White. *The Elements of Style* (New York: MacMillan Publishing)

Services and Support

The following are some important links to help you with academic and/or technical services and supports:

- General student services and resources at [Student LifeLinks to an external site.](#)
- Full library service through [University of Toronto LibrariesLinks to an external site.](#)
- Resources on conducting online research through [University Libraries ResearchLinks to an external site.](#)
- Resources on academic support from the [Academic Success CentreLinks to an external site.](#)
- [Take-Home and Online Exams](#)
- Learner support at the [Writing Centre Links to an external site.](#)
- Information about [Accessibility ServicesLinks to an external site.](#)
- [Links to an external site.Student Online Course Planning and Resources](#)
- Quercus Information in the [Canvas Student Guide](#)