EES1104H Microorganisms and the environment

Course Instructor:
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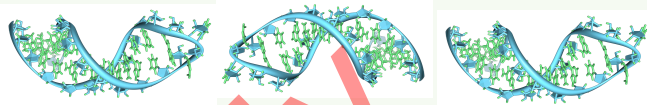**Email:**
patricia.dorrdequadros@utoronto.ca

Virtual Office hours
BB Collaborate – Thursday 2-4 pm
OR: Email me to set up a virtual meeting

Course time and location:
<u>Lectures</u>: BV498, Wednesdays 2-5 pm

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Course Description

Microorganisms and the environment introduces students to the microbial communities of diverse environments elucidating what functions they operate on different ecosystems and highlighting their genetic potential for biosynthesis of a myriad of enzymes and secondary metabolites of agricultural, pharmaceutical, and industrial interest. In this course, students will learn the importance of soil, plants, and human microbiomes, and how to access and compare sequences from environmental microbial communities. Students will work with real data collected from varied environments, assessing prokaryotic genomes and metagenomes in order to determine what microorganisms are present and what functions they can operate in the environment.

In this course students will learn how all ecosystems and their microbiomes are connected and and how their genetic potential can be used to detected problems and find out solutions into the context of current environmental issues concerning planetary and human health (i.e.: production of pharmaceutical molecules, antibiotic-resistance, bioinoculants, bioremediation, 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 different ecosystems;
- Predict changing of microbial community structures according changes in biotic and abiotic factors;
- Explain how plant, soil, and human microbiomes are interconnected and how they can influence each other;
- Collect sequences and integrate different databases to perform bioinformatic analysis;
- Assemble and compare different genomes and predict genomic potential of different microorganisms;
- Analyze metagenomic data and interpret the results, predicting functions of environmental microbial communities.

Schedule:

Module/ Week	Date	Lecture Topics	Readings	Quizzes/ Assignments
1	Sep 16th	Syllabus and intro to the course; microorganisms occurrence and functions in different environments: Interconnectivity		Quizzes Discussion groups
2	Sep 23th	Microbial evolution, diversity, and activity	Hug et al., 2016 Logan et al., 2019	Quizzes Discussion groups
3	Sep 30th	Environment: biotic and abiotic interactions; Extremoplyles	Vaishnav et al., 2020 Toju et al., 2018	Quizzes Discussion groups
4	Oct 7th	Soil and plant microbiomes and function; quorum sensing; intro to metabolic pathways and secondary metabolites	Feng et al., 2017 Gilbert et al., 2014; Keswani et al., 2020 Mitter et al., 2019	Quizzes Data exploration
5	Oct 14th	Molecular methods of microbial community analysis and DNA sequencing platforms	Karp et al., 2019 a and b Sayers et al., 2019	Quizzes Data exploration
6	Oct 21st	Metagenomics + Midterm	Parks et al., 2017 Hinke et al., 2013	Quizzes Data exploration
7	Oct 28th	Metagenome data analysis - II; interfacing with MGRAST - API	Paczian et al., 2019; Correa et al., 2020	Data exploration Seminars
8	Nov 4th	Genome sequencing and annotation; genome comparison; mining secondary metabolites	Marco and Abran, 2019; Davis et al., 2020	Quiz Data exploration Seminars
9	Nov 11th	Human microbiome: beneficial and pathogenic microbes and their influence on phisiological procceses	Cryan et al., 2019 Ro and Ross, 2017	Data exploration Seminars
10	Nov 18th	Synthetic biology and biotechnology	Karoui et al., 2020 Shelake et al., 2019 Gomez-Tatay 2019; Wurtzel et al., 2019	Quizzes Seminars Discussion groups
11	Nov 25th	Biotechnological applications of microbes on agriculture and medicine	Li et al., 2019 Razzaq et al., 2019	Quizzes Discussion groups
12	Dec 2nd	Biotechnological applications of microbes on industry and environmental bioremediation	Giovanella et al., 2020; Jaiswal 2020	Quizzes Discussion groups

Course Evaluation

20% Quizzes
20% Midterm exam
30% Metagenomics Seminar
30% Metagenome report

The evaluation will be carried out in accordance with the Graduate Grading and Evaluation Practices Policy (and how that policy is interpreted and applied in this Dept.)
http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/grading.pdf

Metagenomics seminar

- 30% of final mark
- Presentation dates TBD, taking place over 4 classes
- Select a peer-reviewed scientific paper that uses metagenomics to answer its research questions
- Submit your paper for approval
- 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.

Metagenomics 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 AV, etc. (10%)
- Relevance of material to topic (10%)
- Ability to answer class questions (10%)

Metagenomics assignment - introduction

- 30% of final mark
- Due: December 9th, 2020
- Use online server MG-RAST (https://www.mg-rast.org/) to explore publicly available metagenomic datasets
- Select 4-5 samples for taxonomic and functional potential comparisons of microbial communities
- IMRaD style final report 10-15 pages (excluding figures and references)

Metagenomics report - rubric

- Introduction of selected samples (10%)
- Methods used to collect the samples and data processing by MG-RAST (10%)
- Taxonomic comparisons between samples (20%)
- Functional potential comparison of 1-3 selected gene(s) (30%)
- Discussion (20%)
- Conclusions (10%)

Grading scale

http://calendar.artsci.utoronto.ca/Rules_&_Regulations.html#grading

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. *Students must submit the form to the instructor via email and carbon copy 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 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 concerns 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