

MMG1327H Molecular Genetics Graduate Topic Course

Course Title: Microbiomes in Health and Disease

Course Location: PGCL

Course Time and Date: April 17 - May 5, 2023 (Mondays/Fridays 3-5pm ET)

Course Instructor(s): John Parkinson

Instructor Contact Information (email): jparkin@sickkids.ca

Additional Lecturers (list name, email, Department): TBD

Maximum Number of Participants: 12

Course Overview:

Microbes do not operate in isolation but rather form complex communities featuring intricate relationships based on for example, competition or mutualism. Over the past decade there has been increasing recognition that disruptions in these communities, particularly within the human gut, are associated with an ever increasing variety of diseases including inflammatory disorders such as diabetes, inflammatory bowel disease as well as those impacting mental health. To provide more mechanistic insights into how changes in gut communities may contribute to disease, next generation sequencing technologies provide exceptional opportunities to study not only how these communities are structured, but also how they function. To date, most studies have relied on the use of 16S rRNA sequence surveys, where the 16S rDNA gene is used as a marker to define taxa present (i.e. who is there). More recently attention is turning to obtaining functional readouts through the application of shotgun DNA and RNA sequencing (metagenomics/metatranscriptomics) to define which genes and pathways are present and active (i.e. what can they do/what are they doing). Application to of these technologies to diseases such as IBD, diabetes and malnutrition are starting to dissect the pathways by which changes in the microbiome can impact their host.

In this course we will examine how next generation sequencing technologies as well as systems modelling have been applied to the study of microbiomes. The course will feature a mixture of lectures and student-led journal presentations. A course assignment will focus on a dry-lab tutorial that takes the students through the process of analyzing a next generation sequence dataset generated from complex microbial communities.

Course Objectives:

- Learn about next generation sequencing technologies and their application to microbiome
- Develop critical thinking skills concerning evaluating published articles and the media
- Gain practical experience in the processing and analysis of large sequence datasets

Marking Scheme:

- Punctual attendance 10%
- Participation in journal discussions 10%
- Journal presentation 40%
- Assignment 40%

If you anticipate missing a class you must let the instructor know in advance, given the weight on participation and the fact that there are only six classes. Providing that you had a legitimate reason for missing the class, you be expected to catch up on the reading for that week that you can use to make up for the lost class.

The basic outline for what will be covered in the six weeks is below. Assigned reading will be sent out the week in advance. All students are expected to read the assigned articles and comment in class. These articles are meant to provide context for the accompanying lecture.

Week 1: Course Overview / Next Generation Sequencing Technologies

Week 2: Microbiome Methods

Week 3: Microbiome in Early Life

Week 4: Microbiome in health and Disease I

Week 5: Microbiome in health and Disease II

Week 6: Microbiome Manipulation as Therapeutic Interventions