

MIMM 212: Laboratory in Microbiology



Welcome to MIMM 212! We are excited to have you participate in this course and be a member of Tiny Earth!

Land Acknowledgement:

McGill University is on land which has long served as a site of meeting and exchange amongst Indigenous peoples, including the Haudenosaunee and Anishinabeg nations. We acknowledge and thank the diverse Indigenous people whose footsteps have marked this territory on which peoples of the world now gather.

L'Université McGill est sur un emplacement qui a longtemps servi de lieu de rencontre et d'échange entre les peuples autochtones, y compris les nations Haudenosaunee et Anishinabeg. Nous reconnaissons et remercions les divers peuples autochtones dont les pas ont marqué ce territoire sur lequel les peuples du monde entier se réunissent maintenant.

General Information

Course #	MIMM 212
Term	Fall 2026
Number of credits	3
Course co-requisite(s)	MIMM 211, BIO 200
Class times	<u>Students must attend lectures and lab sessions</u> (Tuesdays & Thursdays)
Pre-lab Lecture	Tuesdays , 1:35 PM – 2:25 PM Duff Amphitheatre First lecture on Sept. 1 st will be in Leacock 232
Laboratory Sessions	Tuesdays , immediately following the lecture – 4:55 PM Thursdays (follow-up) , 2:35 PM – 3:55 PM Duff cubicles on the C-floor

Course instructor and Coordinator

Albert Berghuis, Ph.D.
Bellini Life Sciences Bldg.
3649 promenade Sir-William-Osler
Office: Room 466
albert.berghuis@mcgill.ca

Office hours: by appointment

*Only emails from McGill addresses will be accepted.

Communication plan: Available via email (expect a 48 hr response time), office hour meetings can be held in-person or via Zoom. Please refer to the Email policy discussed in the first lecture.

Teaching Lab Coordinators:

David Gagnon, Ph.D.

This course outline has been modified to meet the requirements of PASL

Tuana Correia Mesquita, M.Sc.

Nanopore DNA sequencing lab development:

Patrick Lypaczewski, Ph.D.

Previous course coordinators:

Samantha Gruenheid, Ph.D. & Jasmin Chahal, Ph.D.

Teaching Assistants:

Communication plan: via email/ after lab sessions

Will be provided when available	

Course Overview:

The purpose of this course is to engage you in the process of scientific investigation and discovery while teaching microbiology. Your mission is to discover antibiotic-producing bacteria from soil. We have chosen this research challenge because bacterial diseases successfully treated with antibiotics for decades are now threatening human health due to antibiotic resistance. Additionally, there are few new antibiotics under development in pharmaceutical companies: most major companies abandoned antibiotic discovery in the 1980s and '90s.

Although bacteria have been isolated from soil over the last 130 years, and many antibiotics have been discovered from among them over the last 70 years, there are still more bacteria and antibiotics to discover. Many of the antibiotics you find will have been reported previously in the scientific literature, but some may be new. To best complete your mission, this course will provide you with the opportunity to develop your knowledge of the scientific method, microbiology theory and methods, biosafety, appropriate record keeping and scientific communication. Learning is best accomplished when actively creating knowledge, so you are expected to be an active participant in this class. Information will be delivered in the reading and lectures, but you will be asked to process that information through analysis and problem-solving to ensure that you construct a lasting knowledge base.

Tiny Earth:

TINY EARTH: <https://tinyearth.wisc.edu/>

Our class is an active partner in “Tiny Earth”, a network of instructors and students focused on crowdsourcing antibiotic discovery from soil. The course you are currently enrolled in (or something very similar) is undertaken by tens of thousands of students annually in 47 U.S. states and 30 countries. You have therefore become part of a special opportunity to do real research alongside a wide community of young scientists who are eager to learn, discover, and tackle our world’s challenges together. You and thousands of your student colleagues will develop your scientific inquiry, problem-solving, and critical thinking skills all while contributing to solving a critical human health threat: the diminishing supply of effective antibiotics.

A Growth Mindset

This course is a CURE (Course-based Undergraduate Research Experience), where students gain insight into what it is like to be a scientist and researcher. The course has one overarching aim, and the outcome is unknown and unique to each student. It is designed for you to experience being a researcher while tackling challenges that will help you improve and learn new skills through mistakes, feedback, and active engagement with the material (a growth mindset). The course might initially feel unfamiliar, confusing, or overwhelming, which is a natural part of learning. Embracing these feelings is important as they accompany developing new knowledge and skills.

Mandatory Materials

- Lab manual: *Tiny Earth: A Research Guide to Studentsourcing Antibiotic Discovery*. Jo Handelsman et al. Publisher: Kendall Hunt Publishing. Available at the Le James McGill Bookstore or the [McGill Book Store Web site](#).
- Lab coat. Due to biosafety regulations, **lab coats used in this course must remain in the lab all term** and will be returned at the end of term.
- Safety glasses/goggles. (If you wear regular glasses in the lab, you do not need goggles)
- Permanent marker (eg “Sharpie”) and regular pen.
- Hardcover lab book with lined pages (not spiral bound). Numbered pages if possible, if not pages should be numbered by hand, in ink. These are available at the McGill Bookstore and elsewhere.
- A lock for the lockers

Learning Outcomes

By the end of this course, you will be able to:

1. Practice safe microbiology, using appropriate protective procedures and waste disposal.
2. Use aseptic techniques for the transfer and handling of microorganisms.
3. Understand the theory behind each laboratory experiment.
4. Perform common microbiology techniques.
5. Use appropriate microbiological media and test systems.
6. Properly prepare and view microbial specimens using microscopy.
7. Formulate hypotheses and design/optimize experiments based on the scientific method.
8. Work effectively in a team and manage time in a lab setting.
9. Collect, record and organize scientific data systematically and appropriately.
10. Effectively communicate scientific concepts and data.

MyCourses page

The MyCourses page will contain majority of the information you will need for this course, including rubrics, lecture recordings, lecture slides, some lab protocols, discussions and course announcements. Please refer to this page daily to ensure you are up-to-date with all the course information.

Instructional methods

The evidence is very clear that students who come to class and participate in the in-class activities gain a deeper and longer-lasting understanding of the material. This class uses an interactive

approach to lectures. These activities are designed to allow you to actively engage with the material and obtain feedback from your peers and the professor during class time.

In this class, we foster an inclusive and supportive learning environment. To view resources regarding how to best learn, please visit [Learning Resources](#). If you experience an overwhelming feeling by your academic work and/or would like to further develop time and workload management skills, please seek support from [Student Services](#).

Lab safety

Please read carefully. This course presents many hazards: physical (open flames, sharp metal and glass objects), chemical (stains, corrosives), and biological (possible pathogens). You will be explained the safety guidelines on the first day of class. You will then have to sign a form that states you have understood the guidelines and will follow the rules. The rules include no food or drinks in the lab, closed-toed shoes, long pants with no cuts, tied-up long hair and appropriate PPE (lab coat, goggles and gloves). Throughout the semester, you will be assessed on your knowledge of lab safety and biohazardous materials to ensure deep understanding.

Evaluation and feedback

In this course, your learning will be assessed through various assignments that will allow you and the professor to see your progress in achieving the learning outcomes. The mark distribution for the course is as follows:

Assessment	Each assignment (%)	Total worth (%)	Due dates
Lab reports (3)	10	30	See below
Lab performance-based evaluation (2)	5	10	Oct. 8 & Nov. 10
Lab book assessment (2)	7.5	15	Oct. 8 & Nov. 17
Lab skill assessment	10	10	Nov. 12
ESKAPE assignment	5	5	Oct. 1
Pre-lab quizzes (5)	2	10	See below
Powerpoint presentation draft	5	5	Nov. 17
Powerpoint presentation	15	15	Nov. 24
TOTAL		100	

A brief description of each assessment is shown below. Further details on the instructions, assessment criteria and logistics are posted in MyCourses.

Lab reports

You are required to write 3 lab reports throughout this course. The lab reports are written individually. The deadlines for each are listed in the course schedule below. You are expected to

follow the template, guidelines and rubric provided on MyCourses and in the lecture slides. Lab reports must be sent to your TA via email **by 11:59pm EST on the dates indicated below:**

	Content	Due date
Lab report #1(5%)	Abundance & diversity of bacteria in soil sample + mini-paper assignment	Oct. 6
Revised lab report #1 (5%)	Same as above but revised based on TAs feedback	Oct. 22
Lab report #2 (10%)	Antibiotic activity screens 1,2 and 3 and Chat GPT/Resources mini-assignment	Nov. 5
Lab report #3 (10%)	Characterization and identification of the positive producers	Dec. 1

Mini-paper assignment

This mini-paper assignment will count for 1% of your overall grade (lab report #1 first submission will be 4%) and should be submitted alongside your first submission of lab report #1. This mini-assignment provides an opportunity to understand how a primary scientific research article is structured and how scientific language introduces the project's aims and objectives. Since this can be a challenging concept for many students, reading a section of a scientific paper will help illustrate how to communicate your findings in lab reports.

Gen AI or Resources mini-assignment

This mini-assignment will be 2% of your overall grade (lab report #2 will be 8%) and will be submitted in with your report #2. You have the option of completing the Generative Artificial Intelligence (Gen AI) assignment or the Resources assignment. The Gen AI assignment will ask you to evaluate the output of Gen AI by prompting it with Tiny Earth-related content. You will determine if the information provided by Gen AI is accurate, reliable and relevant. The Resources assignment allows you to evaluate your sources for your lab report. The goal of this mini-assignment is to familiarize you with critically thinking about sources found online and evaluating their relevance in your reports.

NOTE – Generative AI usage beyond this assignment:

Generative AI resources are changing the way we work. For this course, it is strongly recommended that you produce the presentation and written material on your own. Gen AI should only be used for the specific assignment that asks for it. Producing your own work is a chance for you to develop critical analysis, interpretation, writing and oral communication skills in a supportive environment. GenAI has been known to provide factually inaccurate statements, implicit bias, misinterpretation of published data and references that might not exist. In the past, we have noticed that students who used GenAI to write their assignments had nonexistent references, and the flow of the report was inconsistent; thus, their grades reflected that. **GenAI should only be used for light editing, grammar and spelling. If you use GenAI, you must reference it appropriately and mention how it was used for your assignment. Failure to do so is a breach of academic integrity.** For more information about the level of risks of various tasks:

https://www.mcgill.ca/gps/files/gps/using_generative_ai_in_research_gps_guidelines_november_2024.pdf

Lab performance-based evaluations

Students will be assessed on their lab performance to measure “soft skills,” which are crucial to careers in the scientific field. You will receive feedback twice during the semester from your TA. This formative feedback will let you know your strengths and what to improve over the semester. The rubric is provided on MyCourses.

Lab book assessments

You will be required to keep a detailed lab book. Your TA will assess your lab book twice during the semester using the rubric provided on MyCourses. You are required to bring your lab book to **every lab session.**

Lab skill assessment

By the end of the course, you would have practiced common microbiology techniques countless times. To ensure that you have mastered the techniques, there will be a lab skill assessment where you will be asked to perform common techniques taught throughout the semester. Your TA will assess if you were able to perfect your lab skills. The checklist is available on MyCourses.

ESKAPE assignment

This creative assignment will allow you to present one of the ESKAPE pathogens to your cubicle. You are expected to answer questions listed in the lecture slides and MyCourses page. The rubric is available on MyCourses. This assignment will be presented during the lab session as seen in the schedule below. This assignment is done in partnership with your lab partner.

Pre-lab quizzes

The quizzes will consist of short-answer questions at the beginning of each laboratory exercise. There will be 5 quizzes which will count towards the total 10%. Each quiz will be 2%. These quizzes will be held in person before each lab session. The content of each quiz pertains to the lab being done that week along with the theoretical information from the pre-lab lecture and readings. If a quiz is missed due to absences, the other quizzes will be worth more than 2%.

	Content	Date
Pre-lab Quiz #1	Aseptic technique, media, lab safety	Sept. 15
Pre-lab Quiz #2	Microscopy and stains	Sept. 22
Pre-lab Quiz #3	Serial dilutions, antimicrobial resistance, antibiotic screening	Oct. 15
Pre-lab Quiz #4	Antibiotic screening, 16 S PCR and gel electrophoresis	Oct. 27
Pre-lab Quiz #5	Biochemical tests	Nov. 3

Powerpoint presentation

You are expected to present your entire semester project with your lab mate to the rest of your cubicle. This is like an oral lab report. You will have the opportunity to give a practice presentation where you will receive feedback. You will then give your final presentation to different TAs. The rubric is on MyCourses and will be discussed in class. This presentation will be given in-person in your assigned cubicle.

Lateness and Absences

A 5% deduction will be applied for each day of late submission of an assignment and will receive a 0 after a week. It is mandatory to attend all lab sessions. If you are unable to attend a class for a legitimate reason, you must let your TA, lab mate and the professor know. It will then be your responsibility to make up for your absence.

Course Schedule

The following schedule contains the dates, assignment deadlines and the lab activities that will take place.

Week	Dates	Lab Activities	Assignments
1	Tues Sept. 1	Introduction, outline, background information, course logistics, record keeping, safety intro. Lecture only – no lab this day. Lecture in Leacock 232!	
2	Tues Sept. 8	Common Techniques A: Aseptic technique, ubiquity of microorganisms	
	Thurs Sept. 10	Common Techniques A: Check results of lab, record results, save plates Practice serial dilution with loading dye. Provide one sterile 50 mL conical tube per group Ask your TA questions about lab notebook	Lab notebook/PBA assessments start next week
3	Tues Sept. 15 Add/drop deadline	Lab 1: Add 1g of your soil to 9 mL of H ₂ O and plate 100 μ L to TSA, 10% TSA, LB, PDA Weigh water content of soil and check pH of soil Common Techniques A: Check results of lab, record results, save plates Common Techniques B: Gram stain, spore stain, motility agar	Pre-lab quiz #1 TAs assign ESKAPE pathogens to students
	Thurs Sept. 17	Lab 1 follow-up: Characterize soil, record results, incubate plate until next week Common Techniques A: Check results of lab, record results, discard plates Common Techniques B: Record results, complete Gram stain, spore stain if necessary	TAs assign ESKAPE pathogens to students
4	Tues Sept. 22	Lab 1 follow-up: Record results, record abundance of bacteria in each plate and colony morphology Lab 2: Pipetting, serial diluting and plating of soil samples (TSA, 10% TSA, LB or PDA) – two media types per group	Pre-lab quiz #2
	Thurs Sept. 24	Lab 2 follow-up: record results, incubate plates until next week. 48 colony Picking and Patching in duplicate (keep plates)	
5	Tues Sept. 29	Lab 2 follow-up: note additional growth, continue/repeat patching if necessary, calculate CFU/g, store plates in fridge	
	Thurs Oct. 1	Plan antibiotic activity screen 1 (Lab 3 – 1 Gram + and 1 Gram – tester strain, 2 medias)	ESKAPE pathogen

			assignment presentation
6	Tues Oct. 6	Lab 3: Set up antibiotic activity screen 1, Gram stain of tester strains	Lab report #1 due
	Thurs Oct. 8	Lab 3 follow-up: Analyze and record results from antibiotic screen 1, record colony morphologies, streak plates of positive producers, leave plates to incubate until next week. Plan antibiotic screen 2 (Lab 4) and perform antibiotic activity screen 2.	Lab notebook #1 due TAs: Lab performance-based assessment #1
Fall reading week October 9 - 14			
7	Thurs Oct. 15	Lab 4 follow-up: Record results, prioritize clones for further characterization - 2 isolates/group. Gram stain tester strains Re-streak plates of positive producers Plan which tester strains you want to use for Lab 6	Pre-lab quiz #3 TAs hand back lab report #1
8	Tues Oct. 20	Lab 5: Set up 16S PCR Gram stain and spore stain of positive producers Lab 6: Test your positive producers against two other tester strains	
	Thurs Oct. 22	Lab 5 follow-up: Run PCR gel, repeat 16S PCR if necessary Continue Gram stain and spore stain of positive producers Lab 6 follow-up: Record results, save plates Streak fresh cultures for biochemical tests for Lab 7	Revised lab report #1 due
9	Tues Oct. 27	Lab 5 follow-up: Repeat 16S PCR if necessary, sequence 16S PCRs that worked Lab 6 follow-up: Record results Lab 7: Biochemical testing of positive producers. Inoculate positive producers in TSB (Lab 8)	Pre-lab quiz #4
	Thurs Oct. 29 Almost Halloween!	Lab 7 follow-up: Analyze results from biochemical tests Keep positive producers in TSB incubating for Tuesday (Lab 8) Make glycerol stocks of your two positive producers	TAs hand back lab report #1

10	Tues Nov. 3	Lab 7 follow-up: Finish getting results from characterization, perform any extra tests that need repeating. Lab 8: Perform the antibiotic sensitivity testing of isolates.	Pre-lab quiz #5
	Thurs Nov. 5	Lab 7 follow-up: Check results from characterization. Lab 8 follow-up: Record results, save plates TAs go over sequence analysis and lead discussion about characterization	Lab report #2 due
11	Tues Nov. 10	Lab 8 follow-up: Re-check results from characterization if necessary. Discard all plates Ask TA any questions about presentation.	TAs: Lab performance-based assessment #2
	Thurs Nov. 12	Lab skill assessment Hand in lab coats for washing.	Lab skill assessment
12	Tues Nov. 17	Peer Practice session for PowerPoint presentations. Hand in lab notebooks.	Lab notebook #2 due TAs hand back lab report #2
	Thurs Nov. 19		
13	Tues Nov. 24	PowerPoint presentations	
	Thurs Nov. 26		
14	Tues Dec. 1	Lab coats and lab notebooks will be returned. Happy Holidays and Good luck on your exams!	Lab report #3 due

Class recording

The pre-lab lectures will be recorded to allow you to review material outside of scheduled class time. Class recordings do not replace a student's presence in a class; rather, they provide complementary pedagogical support for student learning. The recordings will be uploaded 24 hr after the lecture date on MyCourses.

Intellectual property considerations

"I ask for everyone's cooperation in ensuring that this [video] and associated material are not reproduced or placed in the public domain. This means that each of you can use it for your own purposes, but you cannot allow others to use it by posting it online or giving it or selling it to others who may copy it and make it available. Thank you very much for your help with this."

Inclusive Learning Environment

This course is designed to help you learn to communicate professionally both during your time at McGill and in your future workplaces. In keeping with McGill's policies on student rights and responsibilities, it is expected that during class discussions and small group interactions, you will

communicate constructively and respectfully. Sexist, racist, homophobic, ageist, and ableist expressions will not be tolerated in the classroom or during group meetings held outside of class.

McGill is committed to providing an inclusive and supportive learning environment. If you experience barriers to learning in this course, do not hesitate to discuss them with your instructor. If you have a special learning need or disability, you are encouraged to contact the Office for Students with Disabilities: <https://www.mcgill.ca/osd/>.

Health and Wellness

Student well-being is a priority for the University. To help students find the support they need as quickly as possible, all of McGill's health and wellness resources have been integrated into a single [Student Wellness Hub](#), a one-stop shop for everything related to physical and mental health. If you need access to services or would like more information, you are strongly encouraged to visit the Virtual Hub: <https://www.mcgill.ca/wellness-hub/>.

McGill Writing Centre Tutorial Service

Writing well is key to both academic and professional success. The McGill Writing Centre (MWC) offers credit courses in academic and professional writing, and a tutorial service open to all McGill students: <https://www.mcgill.ca/mwc/tutorial-service>. The tutorial service offers one-to-one sessions with seasoned instructors and experienced tutors who will work with you at any stage of the writing process.

During the campus closure period, there will be no tutors on site and no administrative staff at the MWC to answer inquiries. Tutoring sessions will be conducted online via the Microsoft Teams platform. This application is available for free to all students through Office 365: <https://www.mcgill.ca/it/office365-software>. For information about how to book an appointment through Microsoft Teams, please go to <https://www.mcgill.ca/mwc/tutorial-service>.

Laptop Loaning:

This course requires students to research and write outside of class and thus, requires students to use computers. If you require a laptop, there is a Laptop loaning program: https://mcgill.service-now.com/itportal?id=kb_article&sysparm_article=KB0010885 and scroll down to "Audiovisual Equipment loans." It takes 2 business days so please fill out the form in advance.

McGill Library

Discover the McGill Library's rich array of resources. Watch a short welcome video in English, French, Arabic, Chinese, Hindi, Persian, Spanish, or Urdu: <https://www.mcgill.ca/library/orientation>.

Additional Statements

- McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures" (see www.mcgill.ca/students/srr/honest/ for more information)
- In accord with McGill University's Charter of Students' Rights, students in this course have

the right to submit in English or in French any written work that is to be graded/ *Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté (sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue)* **Note: Please contact Dr. Chahal if you wish to submit your assignments in French by the end of the add/drop period so that arrangements can be made for you to achieve the same learning outcomes as your peers**

- The [University Student Assessment Policy](#) exists to ensure fair and equitable academic assessment for all students and to protect students from excessive workloads. All students and instructors are encouraged to review this Policy, which addresses multiple aspects and methods of student assessment, e.g. the timing of evaluation due dates and weighting of final examinations.
- Instructor-generated course materials (e.g., handouts, notes, summaries, exam questions, etc.) are protected by law and may not be copied or distributed in any form or in any medium without explicit permission of the instructor. Note that infringements of copyright can be subject to follow up by the University under the Code of Student Conduct and Disciplinary Procedures.
- *As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the [Office for Students with Disabilities](#), 514-398-6009*
- [End-of-course evaluations](#) are one of the ways that McGill works towards maintaining and improving the quality of courses and the student's learning experience. You will be notified by e-mail when the evaluations are available. Please note that a minimum number of responses must be received for results to be available to students.
- In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.
- Additional policies governing academic issues which affect students can be found in the McGill Charter of Students' Rights (see the [Handbook on Student Rights and Responsibilities](#)).
- McGill has policies on sustainability, paper use and other initiatives to promote a culture of sustainability at McGill. (See the [Office of Sustainability](#).)
- Guidelines for the use of mobile computing and communications (MC2) devices in classes at McGill have been approved by the APC. Consult the [Guidelines](#) for a range of sample wording that may be used or adapted by instructors on their course outlines.
- To maintain a safe and respectful classroom environment, please ensure that any polling responses you submit are appropriate and relevant to the question asked. Please note that unless the poll is labelled as anonymous, your responses are identifiable to the instructor. Please see the [Code of Student Conduct and Disciplinary Procedures](#).
- Assessments in this course are governed by the [Policy on Assessment of Student Learning](#) (PASL), which provides a set of common principles to guide the assessment of students' learning. Also see [Faculty of Science-specific rules](#) on the implementation of PASL.