BIOCHEM 3AB3: ANTIBIOTICS ARE THE CORNERSTONE OF MEDICINE

PROFESSOR

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TEACHING ASSISTANTS

Denise Catacutan – PhD student in the Stokes lab; expert in *in vivo* infection dynamics
Gary Liu – PhD student in the Stokes lab; expert in artificial intelligence for antibiotic design

SCHEDULE AND CLASSROOMS

Course information will be posted on Avenue to Learn (A2L). Lecture and tutorial content will be posted on A2L. The weekly schedule for lectures and tutorials is:

Lecture 1 – Mondays from 4:30pm-5:20pm in room BSB-B156
Lecture 2 – Wednesdays from 4:30pm-5:20pm in room BSB-B156

Tutorial – Tuesdays from 9:30am-10:20am in room BSB-120

COURSE DESCRIPTION

This course explores antibiotic discovery and the influence of these drugs on modern medicine. We will discuss (a) the array of antibiotic classes that are currently employed in the clinic; (b) the methods through which our current antibiotics were discovered; (c) next-generation methods to identify novel antibiotics; and (d) possible mechanisms to overcome the economic disincentives that limit antibiotic discovery and development by for-profit entities.

COURSE OBJECTIVES

By the end of this course, you will have a strong foundational understanding of antibiotics from chemical, biological, and economic perspectives. You will also gain practical experience with computational tools for novel antibiotic prediction tasks and bacterial transcriptomics analysis.

TEXTBOOK AND CALCULATOR

This course does not use a textbook. We will be reading the primary scientific literature. PDFs of relevant papers will be uploaded to A2L.

GRADE BREAKDOWN AND DUE DATES

There will be an in-person written midterm test. It will consist of short-answer questions related to lecture topics covered to date. This test will be written using pen and paper, like in the old days.

Towards the end of the term, Gary and Denise will be assessing your technical skills learned during tutorials. Your tutorial-based written reports will consist of a step-by-step guide (think a cookbook) to (a) the analysis of a chemical screening dataset and subsequent property prediction model training (Gary) and (b) the analysis of a transcriptomics dataset (Denise). Each written guide should be roughly three typed pages in length, including figures.

Your final cumulating task is called “invent an antibiotic”. Here, you will be provided with a simple prompt such as, “invent a new antibiotic to treat an aggressive staph infection”. Using skills and knowledge acquired throughout the class, you will then leverage resources from the academic

literature and public data repositories (PubChem, GenBank, etc.) to identify a novel chemical with likely activity against your pathogen. This final task will be conducted in randomly assigned groups of four and will consist of a written report (structured like an academic paper; five pages, including figures) and a pitch presentation in which you will explain your approach (10 minutes/presentation).

Item Graded	% of Final Grade	Due Date
Midterm test (in-person written)	20%	February 14
RNA-seq tutorial (written report)	15%	March 26
Machine learning tutorial (written report)	15%	April 2
Invent an antibiotic (written report)	30%	April 9
Invent an antibiotic (pitch)	20%	varies

WORK SUBMISSION AND MARKING SCHEMES

All written assignments are to be submitted onto A2L by 11:59pm on the date the assignment is due unless otherwise stated. Marking schemes for the written reports and pitch will be discussed in lecture closer to the due dates, and then provided in writing on A2L. All written assignments are to be written using Arial size 11 font, single spaced, with 2 cm page margins. The midterm will be written during class time in person, marked by hand, and given back to you.

LATE WORK OR MISSED WORK

Late penalties will be assessed at 10% per day, including weekends. After 4 days, the assignment will not be accepted and a grade of 0 will be assigned. If you are absent from the university for a medical reason, you may report your absence using the McMaster Student Absence Form (www.mcmaster.ca/msaf) using either the MSAF (Self Report) for absences not longer than 3 days and work worth not greater than 25% of the final grade or MSAF (Administrative) for absences longer than 3 days or work worth more than 25% of the final grade. After filling out the MSAF you must immediately contact the instructor (normally within 2 working days) by email to learn what relief may be granted for the work you have missed and relevant details for submission.

REMARKING WORK

If you would like to have any work re-graded, please adhere to the Department of Biochemistry and Biomedical Sciences Regrading Policy available at the following website: https://biochem.healthsci.mcmaster.ca/education/undergraduate/forms-and-procedures/

COURSE SCHEDULE

Week of…	Lecture Topic	Tutorial Activity
January 8	Introduction	RNA-seq
January 15	Bacteria	Molecular property prediction

January 22	Antibiotic structure and function	RNA-seq
January 29	Antibiotic structure and function	Molecular property prediction
February 5	Antibiotic resistance	RNA-seq
February 12	Antibiotic resistance/midterm	Molecular property prediction
February 19	Mid-term recess	Having fun
February 26	Natural product mining	RNA-seq
March 4	Medicinal chemistry	Molecular property prediction
March 11	High throughput screening	RNA-seq
March 18	Artificial intelligence	Molecular property prediction
March 25	Economic hurdles	Question/answer
April 1	Class pitches	Class pitches
April 8	Class pitches	Class pitches

UNIVERSITY POLICIES

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g., the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy (http://www.mcmaster.ca/academicintegrity).

The following illustrates some examples of academic dishonesty:

- plagiarism, e.g., the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests.

USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (GAI)

While we acknowledge that the use of GAI, such as ChatGPT, will be helpful to your learning, we require you to act with academic integrity when being assessed. The main purpose of a university is the pursuit of knowledge and scholarship. As a student at McMaster University, you are expected to practice intellectual honesty and to fully acknowledge the work of others by providing appropriate references in your scholarly work. You must not take credit for work that is not your own. Please note

that the McMaster University Academic Integrity policy states under item 18(c) that "It shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source." If you use ChatGPT (or similar), explain how it was used in an appendix submitted with the main written document – prompts and model outputs will be required.

AUTHENTICITY AND PLAGIARISM DETECTION

This course may use a web-based service to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to turnitin.com or via an online learning platform (e.g., A2L, etc.) using plagiarism detection (a service supported by turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSE ONLINE CONTENT

In this course we will be using A2L as our online resource. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, usernames for the McMaster email accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

This course does not use online proctoring software for tests and exams.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning, and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online. It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in university activities. Student disruptions or behaviors that interfere with university functions on online platforms (e.g., use of Avenue 2 Learn or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by university instructors. The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern.

ASSIGNMENT DEADLINES AND MISSED OR LATE WORK

All written work must be submitted on the due date, as outlined above. It is the student's responsibility to ensure you have uploaded your assignment to the correct folder. Assignments submitted to incorrect folders risk incurring late penalties. Late penalties will not be waived unless your Faculty/Program Office advises the instructor that you have submitted to that office the appropriate documentation to support your inability to submit the work by the due date.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

In the event of an absence for medical or other reasons, students should review and follow the Policy on Requests for Relief for Missed Academic Term Work.

STUDENT ACCESSIBILITY

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructor as soon as possible to make alternative arrangements for classes, assignments, and tests.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labor disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L, and/or McMaster email.

CHANGE TO THE COURSE OUTLINE

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and opportunity to comment on changes. It is the responsibility of students to check their McMaster email accounts and course websites weekly during the term and to note any changes.