IBEHS 2PA2

Health Solutions Design Projects II-A: Lab Skills in Genetic Engineering

Fall Term (2025-26)

Course Outline

Calendar/Course Description

The first of two genetic engineering courses in the design and innovation sequence. The course emphasizes fundamentals of molecular biology and genetic engineering supported by wet lab experiments. Problem solving and design approaches are discussed and implemented.

Pre-Requisites and Anti-Requisites

Prerequisite(s): IBEHS 1P10 A/B; and registration in Level II of the Integrated Biomedical Engineering and Health Sciences (IBEHS) program.

Antirequisite(s): IBEHS 2P03

Course Schedule

Two 50-minutes lectures per week

One 170-minute lab every other week

Instructor Office Hours and Contact Information

Instructor:
Dr. Vince Leung
JHE A-412
leungv@mcmaster.ca

Office Hours:

- By appointment. Please email to book office hours.

Instructional Team

Lab Support TAs: Each Lab section will have some of the following TA's

- Kyle St Louis, stlouk1@mcmaster.ca
- Lauren Choi, choil4@mcmaster.ca
- Hady Ibrahim, ibrahh14@mcmaster.ca
- Chantal Luo, luoc29@mcmaster.ca
- Gloria Cimpu, cimpug@mcmaster.ca
- Irma Lozica, lozicai@mcmaster.ca
- Franky Liu, liuf76@mcmaster.ca
- Chelsey Ellis, ellisc15@mcmaster.ca
- Alisa Norenberg, norenbea@mcmaster.ca
- Felicity Rugard, rugardf@mcmaster.ca

Additional Instructional Support

Lab Technician:
Andrej Rusin
HSC 4H13
rusina@mcmaster.ca

Course Delivery

Avenue-to-Learn will be the online management system for the course. Through **Avenue**, you will be able to:

- Find all course materials (lecture slides, lab materials, project documents, etc.)
- View course-related announcements
- Complete online quizzes
- Submit course work (assignment, project deliverables) for grading
- View your gradebook

Materials and Fees

Textbooks

This course does not have a textbook, the following guidebook is available for free and will be helpful as a primer to synthetic biology: Synthetic Biology Guidebook for iGem High School

Software

Benchling: https://www.benchling.com/

MATLAB Simbiology

Course Objectives and Learning Outcomes (LO)

Upon successful completion of the course, the student should be able to:

LO.01	Apply the elements of engineering design to manipulate DNA (genetic material)
LO.02	Use software and computer aided design effectively for *in silico* genetic engineering
LO.03	Appreciate the breadth of genetic engineering applications in the Health Sciences
LO.04	Demonstrate effective application of Biochemical experimental design processes
LO.05	Explain the health and safety responsibilities of a professional bioengineer
LO.06	Learn the core skills and tools to perform hands-on genetic engineering
LO.07	Demonstrate self-directed, problem-based learning skills
LO.08	Demonstrate effective scientific and technical communication, both orally and in writing
LO.09	Demonstrate effective contributions as a significant member of a Design Team

LO.10	Develop a mathematical model for a biological system

Assessments

The course is assessed as follows.

GRADING MODULE	WEIGHT
Assignments	**15%**
Assignment 1: Educational Poster	(5%)
Assignment 2: Sustainable Practices in Synthetic Biology	(5%)
Assignment 3: Assembling a Plasmid on Benchling	(5%)
Pre-lab Quizzes (1% each)	**5%**
Post-Lab Quizzes (1% each)	**5%**
Final Lab Report	**10%**
In-Class Participation	**10%**
Tests	**55%**
Midterm Test	(15%)
Final Exam	(30%)
Lab Test	(10%)

Completion and Submission of Work

It is the student's responsibility to ensure assessments are correctly submitted to the correct location, on time, and in the specified format. ***Failure to correctly submit an assignment will result in a mark deduction*** (see below).

Submission Penalties

- Assignments and lab reports are to be submitted to the correct dropbox on Avenue to Learn. They must be submitted by 11:59 pm on deadline day to be considered for grading. A penalty of 20% per day late will be applied for any late submissions starting at 12:00 am on the day after the deadline.
- It is your responsibility to ensure any electronic submissions can be opened by the TA (submit as single PDF file) and in the correct dropbox. Submissions that cannot be opened or are in the incorrect dropbox will not be graded.
- Any Submissions deemed to be partially or fully copied will be considered an academic offence and be subject to terms laid out under the Academic Integrity Policy

Use of AI tools in the course.

Students may freely use generative AI in this course so long as the use of generative AI is referenced and cited following citation instructions given in the syllabus or in the assignment description. Use of generative AI outside assessment guidelines or without citation will constitute academic dishonesty. It is the student's responsibility to be clear on the expectations for citation and reference and to do so appropriately.

Important Dates

Week	Week of	Lectures	Wet Labs (WL)
1	Sep. 2	Module 0: Introduction to the Course Module 1: Central Dogma	No WL
2	Sep. 8	Module 2: Experimental Techniques in Synthetic Biology	WL-1: PCR Amplification, Plasmid Miniprep, and Gel Electrophoresis
3	Sep. 15	Module 2: Experimental Techniques in Synthetic Biology	No WL
4	Sep. 22	Module 2: Experimental Techniques in Synthetic Biology	WL-2: Molecular Cloning: Restriction Digests and Purification
5	Sep. 29	Module 2: Experimental Techniques in Synthetic Biology	No WL
6	Oct. 6	Module 2: Experimental Techniques in Microbiology	WL-3: Molecular Cloning: Ligation & Transformation
7	Oct. 13	Reading Week	
8	Oct. 20	Module 2: Experimental Techniques in Microbiology	No WL
9	Oct. 27	Module 2: CRISPR / Midterm Test	WL-4: Evaluation of Copper-Detecting Device & Ligated Plasmid Miniprep
10	Nov. 3	Module 3: Intro to Synthetic Biology	No WL
11	Nov. 10	Module 3: Building Biological Circuit	WL-5: Diagnostic Digest and Effects of Copper on Cell Survival
12	Nov. 17	Module 4: RNA Switches, Aptamers	No WL
13	Nov. 24	Module 4: Aptamers, Transforming Yeast and Mammalian Cells	Lab Test
14	Dec. 1	Review	No WL

Communication Policy

Communication with the teaching team should be done through McMaster email. Every attempt will be made to reply within 24 hours (excluding weekends). Please include a subject prefix of "IBEHS 2PA2". Emails must be sent from your @mcmaster.ca account. Be sure to include your student number in your email. For all inquiries or MSAFs requests, please email leungv@mcmaster.ca.

Inclusive Environment Statement

We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious

affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

We will gladly honour your request to address you by an alternate name or gender pronoun. Please advise of this preference early in the semester so that we may make appropriate changes to our records.

Accreditation

The Graduate Attributes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's actual grade in the course. For more information on Accreditation, please visit: https://www.engineerscanada.ca. Mapping of the course **Learning Outcomes (LO)** to the Canadian Engineering Accreditation Board (CEAB) **Graduate Attributes (GA)** are outlined in the table below:

GRADUATE ATTRIBUTE	LEARNING OUTCOME(S)
GA05 Use of Tools	
5.2 – Successfully uses engineering tools.	LO.02, LO.06
GA09 - Impact on Society & Environment	
9.1 – Evaluates the environmental impact of engineering activities, identifies uncertainties in decisions, and promotes sustainable design.	LO.03, LO.05
GA12 - Life-Long Learning	
12.1 – Reflects on one's own educational needs and opportunities for growth.	LO.07

For more information on Accreditation, please visit: https://www.engineerscanada.ca

CEAB Accreditation Units: Engineering Design 50%, Engineering Science 50%

McMaster Approved Policy Statements

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 behaviours that interfere with university functions on online platforms (e.g., use of Avenue 2 Learn, WebEx 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.

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. **It is your responsibility to understand what constitutes academic dishonesty.**

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. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g., submission of work not one's own or which other credit been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.

On all work submitted for credit by students at McMaster University, the following pledge is either required or implied: *"I understand and believe the main purpose of McMaster and of a university to be the pursuit of knowledge and scholarship. This pursuit requires my academic integrity; I do not take credit that I have not earned. I believe that academic dishonesty, in whatever form, is ultimately destructive to the values of McMaster, and unfair to those students who pursue their studies honestly. I pledge that I completed this assessment following the guidelines of McMaster's academic integrity policy."*

Authenticity / Plagiarism Detection

In this course we will be using a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. Students will be expected to submit their work electronically either directly to Turnitin.com or via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish to submit their work through A2L and/or Turnitin.com must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com or A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). To see the Turnitin.com Policy, please go to the following website: www.mcmaster.ca/academicintegrity.

Academic Accommodations for Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Academic Accommodation for Religious, Indigenous, or Spiritual Observations (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 examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Academic Accommodations for Relief for Missed Academic Work: McMaster Student Absence Form (MSAF)
In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

- All MSAFs are to be directed to leungv@mcmaster.ca. Sending to another email address will delay processing.
- It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.

Courses with an On-Line Element
In this course, we will be using **Avenue-to-Learn** and **Microsoft Teams**. 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 e-mail 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 any questions or concerns about such disclosure, please discuss this with the course instructor.

Online Proctoring
Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

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 for you.

Reference to Research Ethics
The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to https://reo.mcmaster.ca/.

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, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Notice Regarding Possible Course Modification

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 the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Integrated Biomedical Engineering & Health Sciences (IBEHS) Labs/Design Studio Safety

Information for Laboratory Safety and Important Contacts

This document is for users of IBEHS instructional laboratories at the following locations:

- ABB C104 (Design Studio)
- ETB 533 (Medical Imaging/Biomaterials Lab)
- ETB 534 (Medical Instrumentation/Robotics Lab)
- HSC 4N72 (Genetic Engineering Lab)

This document provides essential information for the healthy and safe operation of IBEHS instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in IBEHS. It is expected that revisions and updates to this document will be done continually. At McMaster University, HR maintains Health & Safety information that is also available at https://hr.mcmaster.ca/employees/health_safety_well-being/our-safety/lab-safety/.

Details on Standard Operating Procedures (SOPs), Health and Safety videos and other resources can be found online at the iBioMed Health and Safety webpage.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

- Food and beverages are not permitted in the instructional laboratories.
- A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
- Laboratory equipment should only be used for its designed purpose.
- Proper and safe use of lab equipment should be known before using it.
- The lab tech or course TA leading the lab should be informed of any unsafe conditions.
- The location and correct use of all available safety equipment should be known.
- Potential hazards and appropriate safety precautions should be determined, and the sufficiency of existing safety equipment should be confirmed before beginning new operations.
- Proper waste disposal procedures should be followed.
- Personal ergonomics should be practiced when conducting lab work.
- Current University health and safety issues and protocols should be known.

Location of Safety Equipment

Fire Extinguisher: on walls in halls outside of labs or within labs

First Aid Kit: ABB C104, ETB 533, ETB 534, HSC 4N72 or dial “88” after 4:30 p.m.

Telephone: on the wall of every lab near the door

Fire Alarm Pulls: Near all building exit doors on all floors

Who to Contact?

Emergency Medical / Security:

On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

Hospital Emergency Medical / Security:

For McMaster HSC, call Security at extension **5555** or **905-521-2100** from a cell phone.

Non-Emergency Accident or Incident: Immediately inform the Lab Tech, TA on duty or Course Instructor.

University Security (Enquiries / Non-Emergency):

Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

See Lab Tech, TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs.

Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

IBEHS Specific Instructional Laboratory Concerns: For non-emergency questions specific to the IBEHS laboratories, please contact appropriate personnel below from a McMaster phone:

- Leela Pilli, Laboratory Technician – 26888
- Parmveer Bola, Instructional Assistant – 23521
- Andrej Rusin, Wet Laboratory Technician – 28347
- Alexa Behar-Bannelier, Program Manager – 24548

In Case of a Fire (Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people.

1. Douse with water from safety shower immediately or
2. Roll on the floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if a blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents. Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press the wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you are not sure, ask!

Defined Roles

IBEHS Lab Technician	Leela Pilli, pillil@mcmaster.ca
IBEHS Instructional Assistant	Parmveer Bola, bolap1@mcmaster.ca
IBEHS Wet Lab Technician	Andrej Rusin, rusina@mcmaster.ca
IBEHS Co-Directors	Dr. Colin McDonald, cmcdona@mcmaster.ca Dr. Michelle MacDonald, macdonml@mcmaster.ca
IBEHS Program Manager	Alexa Behar-Bannelier, alexa.behar@mcmaster.ca
IBEHS Course Instructor	Please contact your specific course instructor directly