

We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "[Dish With One Spoon](#)" wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.

BIOCHEM 4E03 – GENE REGULATION IN STEM CELLS AND DEVELOPMENT

2024 Fall Term

Coordinator & Instructor: Dr. Mick Bhatia | **E-mail:** mbhatia@mcmaster.ca

TA's: Amro Elrafie elrafie@mcmaster.ca and Cam Hollands hollancg@mcmaster.ca

Office Hours: Monday 9:30 – 11:00 AM

Lectures: Mondays (MDCL 1105) at 8:30 AM to 9:20 AM, Wednesdays (MDCL 1105) 8:30 AM to 9:20 AM and Fridays (MDCL 1105) 10:30 AM - 11:20 AM and Virtual Lectures as indicated at these times.

COURSE DESCRIPTION

This course will describe the fundamental elements of the biochemistry and molecular controls of human stem cells, exploring the context in which these emerging concepts were discovered, as well as highlighting the translational and clinical impacts of each element as it relates to medical applications. The course is divided into 7 distinct modules, which introduce the key elements of stem cell biology related to: a brief history of stem cells, ethics of stem cells, the pluripotent stem cell, somatic stem cells, cancer stem cells, genetic engineering of stem cells, and the commercialization of stem cell technologies.

Each of the 7 modules is further divided into lectures and sub-topics, which start with an introductory lecture outlining the broader and global significance of each. The accompanying lectures of each module will explore the details of biochemistry and methodology, while emphasizing the translational and clinical impact or potential, including historical and ethical impact as it relates to human health and disease.

At the end of each module, there will be a Summary and Review that will also function as a tutorial session for discussion and questions see **Course Schedule and Important Dates**. In person classes are marked in red font, and well indicated. All other lectures will be available online at the schedule class time for no more than 24 hours.

Course Questions

Students MUST pre-submit their questions on Avenue to Learn's discussion forum prior to each module's Summary and Review session. The TAs will collect questions and Dr. Bhatia will discuss the response in person in classroom MDCL 1105 [see "Online Course Content and Office Hours" below]. In addition, students can ask questions during weekly office hours with the TAs.

Questions about course content should NOT be emailed directly to the TAs or Dr. Bhatia to allow the entire class to benefit from questions and answers collectively. Common and overlapping questions will be prioritized for review at the Module summary and review session and discussed in detail. Please note, specific module topics and case reviews at module summary classes are testable.

MATERIALS & FEES

REQUIRED MATERIALS/ RESOURCES

Course Web site

Course information and lecture slides will be posted on Avenue to Learn. If this course is not visible on your Avenue page, please contact the TA's. **Any and all changes to lecture order, virtual vs. in person, or timing of lectures will be posted on A2L at least 24-48 hours prior to event. Please check A2L for announcements and changes routinely.**

Recommended Textbook

No textbook is recommended. Lectures will provide references of scientific literature for further information where applicable.

IN PERSON AS WELL AS VIRTUAL COURSE DELIVERY

To follow and participate in the virtual components of this course, it is expected that you have reliable access to the following:

- A computer that meets performance requirements [found here](#).
- An internet connection that is fast enough to stream video.
- Computer accessories that enable class participation, such as a microphone, speakers and webcam.

If you think that you will not be able to meet these requirements, please contact uts@mcmaster.ca as soon as you can. Please visit the [Technology Resources for Students page](#) for detailed requirements. If you use assistive technology or believe that our platforms might be a barrier to participating, please contact [Student Accessibility Services](#), sas@mcmaster.ca, for support.

COURSE OVERVIEW AND ASSESSMENT

Course Schedule and Important Dates	Lecture Date	Lecture Code	Lecture Title
MODULE	Wed., Sept. 4	--	Course Introduction- MDCL 1105
M01: A Brief History of Stem Cells	Friday., Sept. 6	M01 L01	Introduction- MDCL 1105
			Canadian Stem Cell History, Part 1- MDCL 1105
	Mon, Sept. 9	M01 L02	The 1990 Nobel Prize- MDCL 1105
			A Brief History of Cloning- MDCL 1105
	Wed, Sept. 11	M01 L03	Canadian Stem Cell History, Part 2 MDCL 1105 The 2012 Nobel Prize MDCL 1105
Fri., Sept. 13	M01 L04	Module Summary and Review-- MDCL 1105	
Quiz 1	Mon., Sept. 16	--	24 hours to complete on A2L
M02: Ethics of Stem Cells	Mon., Sept. 16	M02 L01	Introduction- MDCL 1105
			Obtaining human embryonic stem cells- MDCL 1105
	Wed., Sept. 18	M02 L02	Human embryonic stem research, part 1 MDCL 1105
			Human embryonic stem research, part 2 MDCL 1105
	Fri., Sept. 20	M02 L03	Ethics of (blood) stem cell donations MDCL 1105
Ethics of medical tourism for stem cell treatments MDCL 1105			
Mon., Sept. 23	M02 L04	Module Summary and Review-- MDCL 1105	

Course Schedule and Important Dates	Lecture Date	Lecture Code	Lecture Title
Quiz 2	Wed., Sept. 25	--	24 hours to complete on A2L
M03: The Pluripotent Stem Cell	Wed., Sept. 25	M03 L01	Introduction- MDCL 1105 Embryonic Development: Fertilization to Implant- MDCL 1105
	Fri., Sept. 27	M03 L02	The biology of the Embryonic Stem Cell - MDCL 1105
	Mon., Sept. 30	M03 L03	Induced Pluripotent Stem Cell (PSCs): Reprogramming MDCL 1105
	Wed., Oct. 2	M03 L04	Applications of PSCs 1: understanding development
	Fri., Oct. 4	M03 L05	Applications of PSCs 2: modeling disease
	Mon., Oct. 7	M03 L06	Module Summary and Review- MDCL 1105
Quiz 3	Tues., Oct. 8	24 hours to complete on A2L- No Class, just quiz on-line	
Midterm 1	Wed., Oct 9	Multiple Choice and Short Answers- MDCL 1105 on MO1 to MO3	
NOTE: MID-TERM RECESS OCT 14 TO 18 INCLUSIVE			
M04: Somatic Stem Cells	Fri., Oct. 11	M04 L01	Introduction- MDCL 1105 Introduction to somatic stem cells- MDCL 1105
	Mon., Oct. 21	M04 L02	Haematopoietic system as the quintessential stem cell model Aging of somatic stem cells
	Wed., Oct. 23	M04 L03	Somatic stem cells in disease therapy and regenerative medicine Future applications of somatic stem cells
	Fri., Oct. 25	M04 L04	Module Summary and Review-- MDCL 1105
Quiz 4	Mon., Oct. 28	--	24 hours to complete on A2L
Review of Midterm	Mon., Oct. 28	--	Mid-Term Review- MDCL 1105
M05: Cancer Stem Cells	Wed., Oct. 30	M05 L01	Introduction- MDCL 1105 Introduction to Cancer Stem Cells, part 1- MDCL 1105
	Fri., Nov. 1	M05 L02	Introduction to Cancer Stem Cells, part 2 Stem cell states in cancer aetiology and progression
	Mon., Nov. 4	M05 L03	Role of CSCs in chemo resistance: AML and solid tumors Clinical implications of CSCs
	Wed., Nov. 6	M05 L04	Module Summary and Review- MDCL 1105
Quiz 5	Fri., Nov. 8	--	--
Midterm Assignment	Fri., Nov. 8	Assignment Posted	On A2L
Midterm Assignment	Mon., Nov 11	In Class Assignment	Written in person MDCL 1105, cited references allowed.
M06: Genetic Engineering	Wed., Nov. 13	M06 L01	Introduction- MDCL 1105 Introduction to Gene Editing Tools- MDCL 1105
	Fri., Nov. 15	M06 L02	Delivery Systems to Achieve Gene Editing Introduction to Transgenic Mice
	Mon., Nov. 18	M06 L03	Transgenic Mouse Derivation Transgenic Mice Case Study
	Wed., Nov. 20	M06 L04	Common uses and pitfalls of transgenic animals Comparisons of transgenic models
	Fri., Nov. 22	M06 L05	Module Summary and Review- MDCL 1105
Quiz 6	Mon., Nov. 25	--	24 hours to complete on A2L

Course Schedule and Important Dates	Lecture Date	Lecture Code	Lecture Title
M07: Commercialization of Stem Cells	Wed., Nov. 27	M07 L01	Introduction- MDCL 1105
			Commercialization of iPSCs and future directions- MDCL 1105
	Fri., Nov. 29	M07 L02	Pre-clinical and clinical stages of commercialized stem cell research
			The "institutionalization of commercialization" and global perspective on research commercialization
	Mon., Dec. 2	M07 L03	University-industry partnerships: benefits and limitations
			Regenerative Medicine: Approaches and Directions
	Wed., Dec 4	M07 L04	Overall Course Review Session-- MDCL 1105

Online Course Content and Office Hours

In this course we will be using Avenue to Learn (A2L). 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.

All course components other than those in person lectures indicated in **red of course schedule table above**, will be held as such:

- Online recorded lectures posted on Avenue to Learn.
- TA office hours will be held every Monday from 2:30PM–3:30AM on Zoom.
- Quizzes will be available online through Avenue to Learn
- Midterms will be available through Avenue to Learn, but will be administered in person, in Room MDCL 1105

At the end of each module, an in-person session will be hosted by Dr. Bhatia. More details on the lectures types and accessibility are below.

Recorded lectures:

Recorded lectures containing slides and accompanying narration will be posted on Avenue to Learn at the scheduled lecture times. Recorded lectures will not be accessible after the end of the lecture time. The lecture slides without lesson narration will be available regardless of lecture time.

Module Summary and Review Lectures:

Content reviewed in these lectures will be testable and held in person hosted by Dr. Bhatia and the TA's. Students are asked to post questions on the Avenue to Learn discussions forum. The TA will compile the questions and Dr. Bhatia will address the pre-submitted questions during the session. We can only confirm addressing questions posted before 5:00 PM of the previous day, but only those posted on Avenue to Learn.

Using Zoom

Zoom software is available at no cost: <https://zoom.us/download>

TA will send out an invitation on Avenue to Learn in the form of a weblink to the Zoom interactions when required such as office hours. The link will prompt to open the Zoom software. Permissions may need to be granted for Zoom to access hardware such as the microphone and camera.

Computer Hygiene During Online Assessments

We recommend following computer hygiene types in order to reduce the likelihood of technical difficulties during online assessments such as quizzes and midterms. This includes

- Shutting down all unnecessary programs
- Coordinate household internet and technology use
- Connect to the internet through a wired connection if possible
- Relocate closer to the WiFi hub
- Restart your computer 1-2 hours before the assessment

EVALUATION

Evaluation of Student Performance

The course will be graded as a combination of weekly online quizzes, two midterms, and a final exam. The weekly online quizzes will occur during tutorial which will cover the preceding module and be multiple choice questions. The two online midterms will be multiple choice as well as short answer questions, and each be worth 15% of your final grade. Midterm 1 will cover content from modules 1 through 3, and midterm 2 will cover content from modules 4 and 5. The final exam schedule will be announced closer to end of term as determined by McMaster registrars office and will be comprised of multiple choice as well as short and long answer questions and be worth 50% of your final grade.

Item Graded	Format	% of Final Grade	Date
Quiz 1	multiple choice (MC)	1.0%	Mon., Sept. 16
Quiz 2	MC	1.5%	Wed., Sept. 25
Quiz 3	MC	1.5%	Tues., Oct. 8
Midterm 1	MC and short answer	30%	Wed., Oct 9
Quiz 4	MC	1.5%	Mon., Oct. 28
Quiz 5	MC	1.5%	Fri., Nov. 8
Midterm Assignments	Assignments: Short and Long answers	11.5%	Mon., Nov. 11
Quiz 6	MC	1.5%	Mon., Nov. 25
Final Exam	MC, Short and long answers	50%	TBD

The final exam will test **cumulative knowledge** covered over the entire course. No make-up tests will be offered. If a quiz or midterm test is missed for a legitimate reason, the percent value of the test will be added to the final exam. That is, the final exam will be worth a larger portion of the final grade. Otherwise, the mark for the missed test will be zero.

If you are absent from the university for a medical or personal situation lasting up to 3 calendar days, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. Within 2 working days when using the MSAF, report your absence to the TAs and copy Dr. Bhatia and include MSAF and your student number in the email title.

Please note that the MSAF may not be used for term work worth 25% or more, nor can it be used for the final examination. Grades for midterm tests will be posted on Avenue to Learn. Percentage grades will be converted to a final letter grade (see Table below).

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49 -- Failure

All percentage grades within 0.5% of the next letter grade will be reviewed.

Remarking Work

If you would like to have any work regraded, please adhere to the Department of Biochemistry and Biomedical Sciences Regrading Policy available here, under regrading requests:

http://fhs.mcmaster.ca/biochem/undergraduate/forms_and_procedures.html.

Changes 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.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM 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”.

ACADEMIC ACCOMMODATION OF 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 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 instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behavior 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. 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 and examinations, including AI generated information.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) 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 or AI 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 or AI 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.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names 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 a course that uses on-line elements 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.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all 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, directly or via AI. Student disruptions or behaviors 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.

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.

RESEARCH ETHICS – NA in this course.

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.