

## **BME1454: Regenerative Engineering Fall 2021 Syllabus**

### **COURSE OVERVIEW**

#### **Course Description**

In this course we will delve into the innovative world of regenerative medicine; a translation-forward research field that aims to restore function to aged, injured, and diseased tissues. Each of our journeys will begin by highlighting foundational discoveries in stem cell biology that opened up new regenerative medicine possibilities, followed by tracking the path forged by subsequent researchers to overcome hurdles impeding the translation of the initial discovery to clinical practice. Curated and videos, and break-out activities will frame our discussions of stem cell biology, biomaterials, and tissue engineering approaches to treat blood, heart, brain, eye, and skeletal muscle tissues, while we also consider the ethics, costs, and translational hurdles associated with these regenerative medicine therapies. As Canada is the proud birthplace of the discovery of stem cells, much of the research we will draw upon was developed by scientists in Canada.

#### **Course Instructor**

Professor Penney M. Gilbert

Email: [penney.gilbert@utoronto.ca](mailto:penney.gilbert@utoronto.ca)

#### **Course Format**

BME1454 is a participatory course. Each week on Quercus there will be required pre-class reading and other short assignments to prepare the student for the upcoming class. The class component of the course, comprised of class discussions and break-out activities, will be delivered synchronously

#### **Learning Outcomes**

Upon completion of this course, a student should be able to:

- Describe landmark research experiments that led to the discovery of stem cells of the hematopoietic, neural, retinal tissues, as well as to the discovery of embryonic stem cells and induced pluripotent stem cells.
- Give examples of scientific hurdles that impede the translation of stem cell based therapies and offer putative solutions
- Explain the ethics, hurdles to translating, and cost of regenerative medicine therapies
- Employ inclusive approaches to maximize the outcome of small team discussions & projects
- Evaluate primary research articles and prepare critical assessments that are constructed by identifying and ensuring that the major scientific conclusion(s) is/are appropriately supported by the data and that minor scientific conclusions avoid overstatements.
- Prepare constructive written feedback to colleagues that is clear, celebrates strengths, and offers executable suggestions for improvement
- Formulate strategies to spark regenerative medicine innovation

### **MARKING\***

#### **Mark Breakdown**

Quercus Knowledge Checks

20%

Primary Literature Critiques	10%
Critique Peer Review	5%
Participation	15%
Midterm	25%
Final Project	25%
Total	100%

\*Remark: This course requires the completion of all components listed in the mark breakdown.

### Quercus Knowledge Checks

Each week you will find on Quercus the required pre-class assignments. The assignments will be comprised of a mix of items to read and short videos to watch. There will be Knowledge Check activities associated with most assignments. You are required to complete these activities to fulfill the Quercus Knowledge Checks component of BME1454.

Note: On occasion there will be readings marked with the label 'suggested'. These are relevant and recommended pieces of literature, but are not required reading.

### Primary Literature Critiques

Every other week there will be a required reading paper for which you will prepare a 1-page critical assessment based on the Critical Assessment Guide. There will be 6 of these assignments available over the term. You are required to complete the first three, the final three are optional. The goal is to improve your critical assessment over the course of the term. As such, your mark for this component of the course will be based upon the highest mark earned on the critiques that you submit. These assignments will be submitted via Quercus by 9am Toronto time on the day that we discuss the paper in class. They should be in **PDF format** and use the following naming structure: **last name plus first initial\_BME1454\_Critique1** (or 2, 3, etc as appropriate)

### Critique Peer Review

So as to improve your own critical assessment skills, and engage in the practice of providing constructive feedback to valued colleagues, you will provide peer review on the first three primary literature critiques prepared by colleagues in your class based on the Critical Assessment Peer Review Guide. Your feedback should be will be submitted via Quercus by 9am Toronto time one week after receiving your Peer Review assignment.

### Participation

The in class portion of this course has a strong participation component, and therefore, attendance and participation will be marked. In class we will form small groups for discussions and break-out activities. The topic of the discussions will be defined, and there will be roles to assign amongst yourself. Participation in these activities constitutes 80% of the participation mark. The remaining 20% is assigned based on active participation outside of the minimum expectations (e.g. asking questions, raising discussion, etc). Failure to notify Dr. Gilbert within 48 hours of a class absence related to illness or an internet connectivity issue will result in loss of the class participation mark for that day.

**\*\*Please inform Dr. Gilbert immediately if you are attending class from a location outside of Canada\*\***

### **Midterm**

At the halfway point in the course, there will be an 'in class', open book, midterm examination based on the materials covered up to that point in the course.

### **Final Project**

There will be a final team project that culminates in an in-class team presentation on the final day of class and submission of prepared documents.

## **POLICIES**

### **Equity, Diversity, Inclusivity**

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

### **Academic Integrity**

All suspected cases of academic dishonesty will be investigated following procedures outlined in the *Code of Behaviour on Academic Matters*. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the [University of Toronto website on Academic Integrity](#)).

### **Notice of Recording & Sharing**

This course, including your participation, may be recorded on video and may be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about the recording and use of videos in which you appear, please contact your instructor.

### **Accommodation**

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs.

Students with diverse learning styles and needs are welcome in this course. If you have a disability that may require accommodations, please feel free to approach me and/or the [Accessibility Services on the St. George campus](#).

### **Religious Observances**

The University provides reasonable accommodation of the needs of students who observe religious holy days other than those already accommodated by ordinary scheduling and statutory holidays. Students have a responsibility to alert members of the teaching staff in a timely fashion to upcoming religious observances and anticipated absences and instructors will make every reasonable effort to avoid scheduling tests, examinations or other compulsory activities at these times.

Please reach out to me as early as possible to communicate any anticipated absences related to religious observances, and to discuss any possible related implications for course work.

### **Family Care Responsibilities**

The University of Toronto strives to provide a family-friendly environment. You may wish to inform me if you are a student with family responsibilities. If you are a student parent or have family responsibilities, you also may wish to visit the Family Care Office website at [familycare.utoronto.ca](http://familycare.utoronto.ca).

### **Late Assignments**

A 5% penalty for each day that the assignment is late will be applied. An additional 5% penalty will be applied each day thereafter that the assignment is late.

### **Regrades**

If you would like to contest a grade on an exam or assignment, you must submit a written explanation of why you think the grade was incorrect. Please note that the ENTIRE exam or assignment may be subject to re-evaluation and your score may therefore go up, go down or remain the same. Regrade requests must be submitted to the instructor within two days of when the exam/assignment is returned.

### **Schedule**

Owing to the uncertainties of the world, and the vagaries of life, it may be necessary to make some adjustments in the details of the course schedule.

Week	Date	Topics	Assignments
Cell Therapy for Blood and Heart Tissue Repair			
Week 1		BME1454 introductions & course overview	
		Discovery: Adult stem cell fundamental properties	
Week 2		Discovery: HSC transplantations restore immune system function	
		Overcoming hurdles associated with HSC transplantation therapy	Critique_1
Week 3		Discovery: Establishment of pluripotent stem cell (PSCs) lines	
		Workshop: Stem cell ethics / Discovery: Induced PSCs (iPSCs)	Peer Review_1
Week 4		iPSC-derived cardiomyocytes to restore heart function	
		Workshop: Hurdles to translating regenerative medicine	Critique_2
Endogenous Repair of the Brain			
Week 5		Discovery: Neural stem cells in the adult brain can divide	
		Targeting neural stem cells to repair the brain: from bench....	Peer Review_2
Week 6		Targeting neural stem cells to repair the brain: .....to bedside	
		MIDTERM	
Biomaterials for Brain and Heart Tissue Repair			
Week 7		Biomaterials to augment brain endogenous repair after stroke	
		Workshop: Market Assessment Final project overview & team formation Midterm discussion	Critique_3
Week 8		Workshop: Final project ideation	
		Advances in 3D bioprinting to manufacture replacement tissues	
Week 9		Decellularized extracellular matrix (ECM) to replace vessels Final project technology approval session	
		Decellularized ECM to replace cardiac tissue	Critique_4
Cell-Laden Biomaterials & Gene Therapy in Regenerative Medicine			
Week 10		The birth of the tissue engineering field	
		Modular tissue engineering to treat diabetes	