

**Stem Cell Engineering:  
42-698-B  
Fall 2013**

**Carnegie Mellon University  
Department of Biomedical Engineering**

**Course Pages, Blackboard**  
( <http://www.cmu.edu/blackboard/> )

**Course Overview:**

This course will give an overview of milestones in stem cell research and will expose students to current topics at the frontier of this field. It will introduce students to the different types of stem cells as well as environmental factors and signals that are implicated in regulating stem cell fate. The course will highlight techniques for engineering of stem cells and their micro-environment. It will evaluate the use of stem cells for tissue engineering and therapies. Emphasis will be placed on discussions of current research areas and papers in this rapidly evolving field. Prominent researchers in the field of stem cell engineering will provide guest lectures on their current research throughout the semester. Additionally, each researcher will recommend a prominent paper to review, and will participate in a student run review of the paper. The final project will require student teams to develop a video, iOS/Android application or website that teaches an aspect of stem cell engineering targeted to K-12 students. The class is designed for graduate students and upper undergraduates with a strong interest in stem cell biology, and the desire to actively contribute to discussions in the class.

**Course Goals:**

This course will train students in advanced stem cell engineering topics including derivation, differentiation, and applications in tissue engineering and regenerative medicine. Review of current literature will provide students with an opportunity to develop critical reading skills and understand relevant concepts in stem cell biology and engineering. Interactions with prominent researchers will provide the ability learn directly from thought leaders and probe experts directly on key aspects of their studies and the state-of-the-art in the field of stem cell engineering. Throughout the course students will learn fundamentals of genetic engineering, stem cell culture, immunofluorescent imaging, soft lithography, variable stiffness substrates, tissue engineering, bioreactors, application/measurement of forces and other methods. Students will integrate classroom lectures and critical review of the literature to develop a multimedia project to teach K-12 students about stem cell engineering. Understanding the subject material and relating it to the K-12 student will teach science communication skills and encourage outreach to teach STEM topics to future engineers. The class will culminate with a presentation session of the multimedia projects.

**Course Objectives:**

To understand the fundamentals of stem cell engineering.

To train students in critical literature review.

To develop the skills needed to integrate knowledge learned in class and present it in an accessible format to K-12 students.

**Stem Cell Engineering****42-698B****Fall 2013****9 Units**Course Blackboard Page: <http://www.cmu.edu/blackboard/>

Blackboard Course Name: F13-42698-B: F13-Special Topics

**Lectures:**

Instructor: Adam W. Feinberg, Ph.D.

Office: PTC 4315

Office: Roberts Hall 143

Phone: 8-4897

Email: [feinberg@andrew.cmu.edu](mailto:feinberg@andrew.cmu.edu)

Lecture Days: Tuesday / Thursday

Lecture Times: 10:30 PM — 11:50 PM

Location: Scaife Hall 208

Office Hours: Professor Feinberg will be available after each lecture day for 45 min at his office in Roberts Hall. If you cannot make these times then please make an appointment by email. I will schedule other extra help times near the exam dates.

Location: Roberts Hall 143

TA: Kanika Rautji

Office: PTC 4204

Email: [krautji@andrew.cmu.edu](mailto:krautji@andrew.cmu.edu)

Office Hours: The TA will be available during each lecture and by appointment.

Location: Scaife Hall 208

**Policies****Attendance:**

Lecture attendance is **REQUIRED** and is important for your success in this class. Class participation is **HIGHLY** recommended and will count towards your class participation grade. In-class exchanges lead to a better understanding of the subject matter, and they provide me (the instructor) with an opportunity to discern what material needs additional/less coverage.

**Grading:**

- 20 % Exam #1 (Covering lecture materials and assigned readings)
- 20 % Exam #2 (Covering lecture materials and assigned readings)
- 20 % Team taught paper review and discussion.
- 10 % Class participation
- 25 % Final Team-Based Project
  - Each team will take a key concept or application in stem cell engineering and develop a plan to create a multimedia project to teach this concept/application to a K-12 audience. Examples included video, an iOS/Android application or a web/flash site available on the internet. Ideas will be presented in class and vetted by Prof. Feinberg.
  - The team will be required to propose the project. There will be an initial presentation of the proposal to the class where Prof. Feinberg will give feedback and OK the idea. A second presentation later in the semester will present the more mature idea and receive peer feedback.
  - For the final, groups will present the completed project in class to a select group of faculty/teachers with expertise in K-12 education.
- 5% Peer Assessment, (group members will evaluate each other using a standardized form)
- Unless otherwise told, the final grades will be based on the following scale:  
**A > 90 > B > 80 > C > 70 > D > 60 > R**

**Notes:**

- The two exams will cover only the materials covered since the last exam.
- The team taught paper review and discussion will require the student team to present a paper from the current literature to the class, critically review the content and lead a discussion on key points.
- The Final Project will be comprehensive in scope meaning students will be expected to incorporate relevant topics they have learned in the lecture.

**All assignment must be submitted on time** to receive credit. Any emergent issues that require an extension must be approved by Prof. Feinberg well before the assignment deadline.

**Cheating is unacceptable in any form!**

**Texts**Required:

1. "Engineering of Stem Cells," Senior Editor Ulrich Martin, Springer, (2009). (Available on Blackboard)
2. "Molecular Biology of the Cell," Editors Alberts, Johnson, Lewis, Raff, Roberts, and Walter. Garland Science (2002). Available online for free at <http://www.ncbi.nlm.nih.gov/books/NBK21054/>.
3. Selected articles from the current literature (To be posted on Blackboard).

Recommended (additional reading options):

1. "Stem Cell and Tissue Engineering." Editors Li, L'Heureux and Elisseeff, World Scientific (2011).
2. "Stem Cell Engineering: Principles and Applications," Editors Artmann, Minger and Hescheler, Springer (2011).
3. Biomaterials Science: An Introduction to Materials in Medicine, Second Edition, Buddy Ratner et. al., Elsevier Academic Press (2012).
4. "Tissue Engineering," Senior Editor Clemens Van Blitterswijk, Elsevier Inc., (2008).

**42-698-B Fall 2013: Projected Schedule**

<b>Week</b>	<b>Tuesday</b>	<b>Thursday</b>	<b>Assignments</b>
#1, Aug 27, 29	Course introduction and overview of cell biology	Introduction to stem cells and cell source	<b>Review:</b> cell biology as needed <b>Read:</b> Ch2
#2, Sep 3, 5	Embryonic morphogenesis and embryonic stem cells	Overview of current stem cell applications	<b>Read:</b> Ch6
#3, Sep 10, 12	Derivation and culture of ES cells	Web Based: Yamanaka lecture on iPS cells	<b>Read:</b> Ch1, Ch7
#4, Sep 17, 19	Genetic engineering and reprogramming of stem cells, iPS cells	Characterization and use of specific adult stem cell types	<b>Read:</b> Ch3 (09/17) Form Teams
#5, Sep 24, 26	Stem cell niches and overview of cell signalling	Overview of biomaterials and fabrication of tissue engineering scaffolds	<b>Read:</b> Ch7 and handouts
#6, Oct 1, 3	STEM Education	Development of cell-instructive biomaterials	<b>Read:</b> Ch4, Ch5
#7, Oct 8, 10	Exam 1 Review Example of Paper Review Expectations for prelim project plans	Example paper presentation and review	<b>Read:</b> Ch8
#8, Oct 15, 17	Exam 1	Preliminary project plan presentations	<b>Exam 1</b> <b>Due:</b> Prelim project
#9, Oct 22, 24	#1 Guest Lecture and Paper Review: <b>Kacey Marra (Pitt) Adipose-Derived Stem Cells</b>	1. Commercialization of stem cell-based therapies 2. Politics, Religion and Moral/Ethical Issues	Assigned Current Literature
#10, Oct 29, 31	#3 Guest Lecture and Paper Review: <b>Mike Modo (Pitt) Neural Stem Cells</b>	#4 Guest Lecture and Paper Review: <b>Kris Dahl (CMU) Nuclear Mechanics</b>	Assigned Current Literature
#11, Nov 5, 7	#5 Guest Lecture and/or Paper Review	#6 Guest Lecture and/or Paper Review	Assigned Current Literature
#12, Nov 12, 14	#7 Guest Lecture and Paper Review: <b>Jim Funderburgh (Pitt) Corneal Stem Cells</b>	#8 Guest Lecture and Paper Review: <b>Phil Campbell (CMU) Musculoskeletal</b>	Assigned Current Literature
#13, Nov 19, 21	Project presentations (peer feedback)	#9 Guest Lecture: <b>Lei Yang (Pitt)</b>	Assigned Current Literature <b>Due:</b> Project Update
#14, Nov 26, 28	#10 Guest Lecture and Paper Review: <b>Fabrisia Ambrosio (Pitt) Muscle Stem Cells</b>	<i>No Lecture (Thanksgiving)</i>	Assigned Current Literature
#15, Dec 3, 4	Exam 2	Final Project Presentations	<b>Exam 2</b> <b>Due:</b> Final project