BE709. From Cells to Tissue: Engineering Structure and Function

Christopher S. Chen, <u>chencs@bu.edu</u>

Course objectives

The goals of this course are to:

- 1. Introduce students to engineering concepts in understanding and manipulating the behavior of biological cells in the context of building functional multicellular tissue systems,
- 2. Develop proficiency in critically reading primary research literature.
- 3. Understand the scientific process from idea to publication
- 4. Appreciate the underlying forces, conflicts, and actors in science
- 5. Develop presentation skills

We will try to understand the interplay between cells, their extracellular microenvironment, and intracellular signaling pathways in regulating cellular and multicellular structure and function. In particular, we will explore the use of modern experimental approaches to characterize and manipulate cells for bioengineering applications, and the concepts in scaling cellular engineering to functional tissues. In this context, we will focus on several topics, including signal transduction and the molecular regulation of cell function, cellular microenvironment, cell adhesion and mechanics, stem cells, multicellularity, and experimental models of tissue development.

We will introduce both classic approaches and those that are still in early development. Due to the expansive nature of this area of science, we will only be able to introduce a sampling of the space.

Course structure

This is a literature-based course, and students will be given papers to discuss in class, and *students are expected to read all of them*. The literature has been carefully chosen to give students both depth and breadth in each topic area, and will reflect the cutting edge of cellular bioengineering.

This course will demand several modes of learning. The course requires substantial critical reading of primary literature and active discussion of the papers. A major component of this course will involve student-run presentation and critique of papers in detail to the class.

Our success depends on your reading and thinking about all of the assigned papers in advance of lectures, and taking initiative to assimilate background material as needed (cited papers, reference materials, etc..). The first part of the course will involve gaining a facile understanding of cell signaling, while the latter part will focus more heavily on cellular and multicellular engineering topics.

An outline for the course by topic:

I. Cell Signaling II. Cellular Adhesion and Mechanics III: From Cells to Tissue -Cell-cell interactions -2D versus 3D -Stem Cells -Organotypic Culture

-Emerging Technologies

Announcements

All announcements will be posted on the Blackboard website for the course, and by email when blackboard is not cooperating.

Grading

Grades will be based on active participation in class (30%), *daily* quizzes (20%), written assignments (10%), and oral team presentations (40%).

Reading material

The course will rely on primary literature, which will be provided in class.

A cell biology text will be useful as a reference: I recommend Alberts et al. <u>Molecular Biology of the</u> <u>Cell</u>, (ISBN: 0815332181) or Pollard's <u>Cell Biology</u> (ISBN: 0721639976). (Although google is fine reference as well).

*It is critical that you come to class having read the relevant material. Your informed participation in the discussion will be expected. As such short (5-10 minute) daily quizzes will be conducted at the beginning of every class on the assigned reading.

Class and University Policies

- COVID 19 & BU Community Health Expectations: Masks are required and face coverings must be worn over the mouth and nose at all times when in public spaces on campus, including classrooms. Students should be prepared to show proof that they are compliant with health attestations and testing in order to attend class. All students are expected to follow all university guidelines with respect to daily symptom checks, testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official BU policies regarding COVID, please visit: <u>http://www.bu.edu/dos/policies/lifebook/covid-19policies-for-students/</u>
- 2. Attendance & Absences. Attendance is expected at all lectures, and if you are not able to attend you must notify me in advance. Due to COVID restrictions on our classroom, you will be assigned with the option to attend class in person once per week. You will otherwise attend class by zoom.
- 3. **Community of Learning**. Your responsibility for ensuring a positive learning environment is to read all papers in advance of class, be active participants in the classroom, and to be respectful of each other as we learn the material together.