

Biomedical Engineering/Chemical Engineering/Biomaterials 584
Advances in Tissue Engineering

I. Instructor

Days/Times: Tuesday/Thursday 9:00 – 10:30

Location: 1121 LBME

Professor: David H. Kohn, Ph.D.
Departments of Biomedical Engineering, College of Engineering and
Biologic and Materials Sciences, School of Dentistry

Offices: 2213 Dentistry (2nd floor of research tower - taller of 2 buildings across
from Chemistry Building on N. Univ. Ave.)
2154 LBME

Office Hours: After class or by appointment

Phone: 764-2206

E-mail: dhkohn@umich.edu

Canvas Site: BIOMEDE 584 001 WN 2018

II. Course Goals/Learning Objectives

This is an advanced course in tissue engineering for graduate students with some background in this area (e.g. have taken BME 474 or equivalent introductory course, are doing research in this area, are supported by a training grant in this area), and the ability/desire to handle a graduate class based on open-ended discussions of the literature. Registration is reserved for students with MS/Ph.D. status.

- 1) Students will develop a broad and deep perspective of the interdisciplinary issues involved in tissue engineering, focusing on 3 areas of the tissue engineering triad:

Cell and matrix biology issues

Materials science and other engineering issues

Integrated engineering and biology issues

After detailed discussions about current topics in these 3 areas, strategies used to engineer specific tissues and organs will be presented, with clinical and translational issues integrated into the discussions.

- 2) Apply engineering/quantitative analyses to biological problems
- 3) Familiarization with current literature and learning to critique it
- 4) Ability to address open-ended problems
- 5) Critical thinking and analysis
- 6) Communication of ideas

III. Readings and Lecture Materials

- There is no textbook for this class, just several journal articles or chapters for each class, typically one review/background article and one recent research article in which the background information is applied to a tissue engineering problem.
- The first article may be review to some students and new to others. Please see me if you would like additional resources to get you up to speed or are interested in additional readings.
- The second article will be the focus of a class journal club in which we discuss the strengths/weaknesses of the paper and its utility in advancing tissue engineering.
- Articles + slides pertaining to each class will be uploaded to the course Canvas site; it is your responsibility to monitor Canvas for updates and to download and/or print files.
- It is expected that you will have read the article(s) prior to class and be prepared to engage in class discussions (participation counts for 20% of your grade)
- Slides that I lecture from may contain more information than slides in Canvas – some combination of handouts and writing in class best facilitates learning the material. Handouts are intended to help you assimilate and organize material. They are designed to provide a framework for your note taking and learning; they are not a substitute for your presence and active learning.
- The format of each class session is designed to provide several forms of learning, including faculty lecture, group discussion, student-led presentation/discussion, and will generally be as follows :
 - Summary of salient aspects of the topic of the day/1st article (Dr. Kohn/guest lecturer)
 - Answer questions about content of the first article
 - Discussion questions - open-ended; handed out before (students, each question possibly pre-assigned to a specific student)
 - Journal club discussing 2nd/applied article (student led class discussion)

IV. Course Requirements/Grading

There are no exams in this class, just the individual and team assignments listed below.

You will do well if you complete these assignments and do 3 things:

- 1) Prepare for class (read the articles)
- 2) Bring your thinking cap
- 3) Engage in the discussions and contribute your ideas

Error Project¹ 15%

Journal Club² 15%

Design Project³ 50%

Oral Presentation 25%

Written Proposal 25%

Class Participation⁴ 20%

¹ Guidelines for the “error project” will be discussed in more detail in class # 8 (30 Jan). In brief, you are to critically evaluate one or more papers on a topic of interest in tissue engineering. **Either** choose one paper that contains one (or more) error(s) **or** choose two papers that contradict one another. Papers should be new papers, not papers that you have read before or discussed in this class, other classes or journal clubs. Each student will submit a concise (~1 page) written summary of what he/she thinks the error is and a rationale for why he/she thinks it is an error. You should also speculate whether you think the conclusions of the paper would change if the error was corrected. If you choose 2 papers that contradict one another, take a position as to which paper you think is correct and why (or whether you think the approaches were sufficiently different that both papers are correct).

Due Date: 22 Feb

² The second part of each class will incorporate a student-led journal club. When it is your turn to lead the journal club, you should briefly summarize the paper (it is expected that everyone will have read the paper, so the summary of factual information should be brief) and spend the majority of the time presenting what you think the strengths and weaknesses of the paper are, whether you think the paper advances the field of tissue engineering, and whether the work can be easily translated. Remember that a good journal club does more than just summarize a paper, but critically dissects it. Class # 3 (11 Jan) will be dedicated to manuscript review and Dr. Kohn will lead a journal club of a recent paper that he reviewed.

³ Guidelines for the oral presentation and written proposal will be distributed and discussed in detail in class # 8 (30 Jan). Groups (formed by me) will define a problem of their choice in tissue engineering, pose research question(s)/hypotheses, a detailed methodology to address the problem(s), and write a comprehensive NIH-style research proposal to address the question(s)/hypotheses.

Students will work in teams of 3-4, assigned such that each group has diversity in terms of background and experience.

Prior to finalizing a topic, **each group must meet with me at least once to discuss their topic (all group members are required to attend this meeting).**

The order of the oral presentations will be determined randomly. A completed draft of the proposal will be due at the time of the oral presentation. The final proposal, incorporating reviewer (Dr. Kohn + class) suggestions, is **due 26 April** (~2 weeks after the last oral presentation). Therefore, the first group to give an oral presentation/hand in their written proposal will have the longest time to edit their proposal, whereas the group that has the longest time to prepare their oral presentation/written proposal will have the shortest time to revise theirs. The grade for the final written proposal will be docked 5% if the completed draft is not ready at the time of oral presentation, and the final report will be docked 1% for each day it is late.

⁴ Students are required to actively participate in class discussions and journal clubs during class, as well as during the project presentations at the end of the semester. In addition, each student group will evaluate each of the other groups' proposal presentations, and a brief written summary of this review (less than one page) will be due at the next class.

V. Honor Code

All students in this class are bound by the College of Engineering Honor Code, or Honor Code of their home School or College. You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of another's work. Any violation of the honor policies appropriate to each piece of course work will be reported to the Honor Council, and if guilt is established, penalties may be imposed by the Honor Council and Faculty Committee on Discipline. Such penalties can include, but are not limited to, letter grade deductions or expulsion from the University. Collaboration policies on individual assignments will be described in the assignment handout or discussion. If you have any questions about the policies in this course, please consult the course instructor.

BME/ChE/Biomaterials 584 - Advances in Tissue Engineering - Syllabus		
Date	Introductory Topics	Assignment Due
Thurs 04 Jan	Course introduction/Logistics	
Tues 09 Jan	Key issues in advancing tissue engineering	
Thurs 11 Jan	Reviewing Papers	
	Cell Biology Topics	
Tues 16 Jan	Cell culture	
Thurs 18 Jan	Cell sourcing and stem cells	
Tues 23 Jan	Extracellular matrices	
Thurs 25 Jan	Molecular basis for extracellular regulation of cells	
Tues 30 Jan	Proposal writing/form teams/choose presentation dates	Meet w/DK @ least once about topic
	Materials Science Topics	
Thurs 01 Feb	Naturally-derived matrices	
Tues 06 Feb	Synthetic polymeric matrices	
Thurs 08 Feb	Synthetic matrices with designed biological activity	
	Integrated Engineering/Biological Topics	
Tues 13 Feb	Biocompatibility, natural healing response	
Thurs 15 Feb	Biomechanics and functional tissue engineering	Proposal Topic
Tues 20 Feb	Tissue induction/drug delivery/gene therapy	
	Specific Applications	
Thurs 22 Feb	Engineering the nervous system	Error Summary
Tues 27 Feb	No Class/Winter Break	
Thurs 01 Mar	No Class/Winter Break	
Tues 06 Mar	Engineering teeth	Specific Aims
Thurs 08 Mar	Engineering the liver	
Tues 13 Mar	Engineering cartilage	
Thurs 15 Mar	Engineering skeletal muscle	
Tues 20 Mar	Vascular tissue engineering	
Thurs 22 Mar	No Class/Work on Proposals	
	Class Presentations	
Tues 27 Mar	Group Presentation	Written Proposal
Thurs 29 Mar	Group Presentation	Written Proposal
Tues 03 Apr	Group Presentation	Written Proposal
Thurs 05 Apr	Group Presentation	Written Proposal
Tues 10 Apr	Group Presentation	Written Proposal
Thurs 12 Apr	No Class/Work on Proposals/Revisions	
Tues 17 Apr	Group Presentation	Written Proposal
Thurs 26 Apr	Revised Proposals Due – All Groups	Revised Proposals