Tissue Engineering Laboratory
BE 5365/BIOL 4365
Spring 2016

Tuesday / Thursday 3:30-4:50pm
ERB 273

Instructor: Dr. Liping Tang
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Course Description: Introduction to laboratory techniques commonly used for culturing, growing, and analyzing cells and tissues, image processing, and scaffold fabrication methods with a focus on the mechanisms and applications of 3D printing technology.

Meeting Times: Tuesday & Thursday 3:30-4:50 pm
Location: ERB 273

Course Learning Goals/Objectives: Students will learn the necessary skills required for maintaining and analyzing cells in culture. Students will develop laboratory techniques related to cell assays and cell staining. Students will be introduced to concepts of designing in vitro tissue engineering products. Students will learn basic image processing techniques. Students will become familiar with fundamental 3D printing software and its tissue engineering applications.

Textbooks: Peer-reviewed journals and laboratory protocols will be used for this course and, when applicable, made available to students through the course folder.
Suggested Texts: For cell culture review

- *Culture of Animal Cells – A Manual of Basic Technique 4th edition, by Ian Freshney, 2000.*
- *UTA library call #QH585.2 .F74 2000 or* http://discover.uta.edu/?itemid=|uta-cat|1047659

Laboratory Safety Training Required:

Online at **www.uta.edu/training**. Login with UTA NetID and password.

Tentative Syllabus/ Laboratory Schedule:

Laboratory Methods

Jan 20 (Tue): Syllabus, Class introduction, group assignments
Demo: Equipment overview / use and operation
Handouts: Equipment use / Blackboard class setup

Jan 22 (Thur): Serial dilutions
Lab: Use of micro liter pipettes to make serial dilutions
Practical Lab Quiz: comparison to TA standards using spectrophotometer
Take Home: proper use of microscope and camera, Aseptic technique in a culture hood

Cell Culture

Jan 27 (Tue): Introduction to cells and cell culture (basic culture practice)
Lab: Observing cells in a culture flask / preparing a cell hood for cell culture / making "complete" media / media change in a culture flask
Take Home: Basic cell culture procedure, trypsinization

Jan 29 (Thur): Cell morphology and Cell subculture
Demo: Use of Image J for cell counting
Lab: View field area calculations, Cell subculture with trypsin
Take Home: Area calculations vs. hemocytometer, trypan blue assay

Feb 3 (Tue): Use of Hemocytometer
Lab: Cell viability with trypan blue
Take Home: cell viability calculations, cell seeding density calculations

Feb 5 (Thur): Seeding density and cell growth rate
Lab: Seeding of well plate at specified density
Take Home: MTS Assay and use of plate reader

Histology

Feb 10 (Tue): H&E Staining
Lab: H&E staining of fixed tissue samples
Take Home: Staining techniques for tissue cultures

Feb 12 (Thur): Giemsa Staining
Lab: Giemsa staining of fixed cell samples
Take Home: Staining techniques for cell differentiation

Salt-Leaching Scaffold Fabrication

Feb 17 (Tue): Salt leach scaffold fabrication
Lab: Formation of salt leached scaffold
Take Home: Expected porosity and implications

Feb 12 (Thur): Scaffold Characterization (Ethanol displacement)
Lab: Volume displacement calculation of scaffold porosity
Take Home: porosity calculations using ImageJ

Image Processing with MATLAB

Feb 17 (Tue): Introduction to MATLAB
Lab: Learning basic MATLAB functionality
Take Home: MATLAB familiarity for image processing

Feb 19 (Thur): MATLAB Image Processing: 3D Modeling
Lab: Learn how to perform basic 3D modeling with MATLAB
Take Home: 3D modeling of cultures and medical images

3D Printing – Introduction

Feb 24 (Tue): 3D Printing: Introduction
Lab: 3D printing basics
Take Home: Become familiar with basic ideas of 3D printing

Feb 26 (Thur): 3D Printing: Tissue engineering applications
Lab: 3D printing/tissue engineering intersections
Take Home: Learn the basics of 3D printing as it relates to tissue engineering

March 3 (Tue): **Group Presentations (Midterm)**

Mar 5 (Thur): **Midterm Exam (In-class)**

Mar 09-14 Spring Break

3D Printing – Software

Mar 17 (Tue): Solidworks introduction
Lab: Solidworks training
Take Home: Become familiar with the Solidworks user interface

Mar 19 (Thur): Solidworks model creation
Lab: Solidworks training
Take Home: Learn to create a simple model in Solidworks

Mar 24 (Tue): Solidworks model manipulation
Lab: Solidworks training
Take Home: Learn how to make useful changes to a Solidworks model

Mar 26 (Thur): Solidworks model design
Lab: Solidworks training
Take Home: Design a Solidworks model from scratch

3D Printing – Hardware

Mar 31 (Tue): 3D printer components
Lab: 3D printer hardware basics
Take Home: Become familiar with the physical components of a 3D printer

Apr 2 (Thur): Arduinos
Lab: Introduction to arduinos
Take Home: Learn how to program and take readings from an arduino

Apr 7 (Tue): 3D printer construction
Lab: Construction of a 3D printer / printing demo
Take Home: Learn how to construct a basic 3D printer and print a simple model

Apr 9 (Thur): 3D Printer modifications
Lab: Modifications to 3D printers for bioprinting / bioprinting demo
Take Home: Learn which modifications are made to 3D printers for bioprinting and how to make them

3D Printing – Scaffold Design

Apr 14 (Tue): Topic introduction
Lab: Introduction / selection from possible projects
Take Home: Gain an in-depth understanding of several tissue engineering Problems. Choose your group's scaffold design and speak with the TA about it

Apr 16 (Thur): Template development
Lab: Solidworks template development
Take Home: Begin developing a template for your scaffold

Apr 21 (Tue): Template finalization
Lab: In-class finalization of scaffold design
Take Home: Scaffold design finalization

Apr 23 (Thur): Prototype printing
Lab: In-class prototype printing
Take Home: Print a prototype of your scaffold

Apr 28 (Tue): Second prototype printing
Lab: In-class printing
Take Home: Print a second prototype of your scaffold and begin work on Final design

Apr 30 (Thur): 3D Printing: Scaffold design finalization
Lab: In-class final design printing
Take Home: Print your final scaffold

May 5 (Tue): **Final Exam (Presentations)**

May 7 (Thur): **Final Exam (Written)**

Overview of Course components

Quizzes (individual and unannounced): will be short answer format and are based on the assignments or topics covered in class.

Practical Lab Quizzes (group effort, dates given): are graded assignments to be done in class on a given day. Your results are compared against TA standards or controls.

Exams (individual - closed book): Two exams will be given as a midterm and final. These exams will be multiple choice or short answer format, and will reflect topics covered in class or from take home assignments.

Presentations (group effort): Two presentations will accompany the midterm and final. Presentations will be done in groups and will provide a summary of the labs and results of all topics covered. Presentations are due at the start of class on the assigned presentation day. **NO LATE PRESENTATIONS WILL BE ACCCEPTED!** More detail on format and requirements will be given prior to the report due dates.

Course Evaluation & Final Grade:
15% Quizzes/Labs/Homework + 15% Presentation 1 + 15% Midterm Exam + 15% Presentation 2 + 15% Final Exam + 25% Attendance and Participation

Americans With Disabilities Act. The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112 -- The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans With Disabilities Act - (ADA), pursuant to section 504 of The Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As a faculty member, I am required by law to provide **"reasonable accommodation"** to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with **informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.**

Academic Dishonesty. It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.
"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)