**MSE472 / BIOE473**
**Biomaterials Laboratory**
**Spring 2015**


**Instructor:**
Dr. Nathan Gabrielson
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**Lab:**
217-333-0444 (218 Kiln House)

**Teaching Assistants:**
TBA
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***Course Text:***
Required: Xian, Wujing (2009) *A Laboratory Course in Biomaterials*. Boca Raton: CRC Press.

Supplemental: Ratner, Buddy D., ed (2013) *Biomaterials Science: An Introduction to Materials in Medicine*. 3rd Edition. San Diego: Elsevier Academic Press.

Available as an online resource at:
http://www.sciencedirect.com/science/book/9780123746269

Website: http://compass2g.illinois.edu

**Class Meetings:**

| Activity | Section | Time | Location |
|---|---|---|---|
| Lecture/Discussion | AE1 | 11:00 – 11:50 AM, M W | 214 Ceramics |
| Laboratory | AB1 | 1:00 – 4:50 PM, M W | 218 Kiln House |
| | AB3 | 2:00 – 5:50 PM, T TH | 218 Kiln House |
| Office Hours | 11:00-11:50 AM, T TH or by appointment | | |

In general, we will spend 3-4 hours each week in lab. The actual amount varies each week, and any cancellations will be announced in class.

**Course Objectives:**
1. To learn laboratory science, methods and skills that are necessary for biomedical science and engineering.
2. To develop the written and oral communication skills essential for a clear, concise and persuasive presentation of research findings and results.
3. To facilitate critical thinking about research design, experimental observations and data analysis.
4. To gain experience working as part of a team.

**Grading:**

| | |
|---|---|
| Lab reports, executive reports, research proposal & group presentation: | 75% |
| Pre-Module 1 report: | 5% |
| Lecture attendance and participation: | 10% |
| Pre-lab quizzes, lab notebook and participation: | 10% |

**Grading Notes:**

1. This course consists of five modules. A lab report, executive summary, research proposal or oral presentation will be required for each module. Lab reports will be submitted online. Late submission will receive an automatic point deduction. Oral presentations will be given during the lecture period.
2. You are expected to review lecture notes and any supplementary information in advance of lectures. Your lecture attendance and participation grade may include discussion activities and quizzes on pre-assigned materials.
3. You are required to read the lab procedures before attending the lab session. A brief quiz will be given at the beginning of each lab session. The quiz will focus on the fundamental concepts of each lab, not on minute experimental details.
4. Everyone is required to keep a lab notebook which will be subjected to daily inspection and will be included in the quiz/lab notebook grade.

**Laboratory Policies:**

1. No food or beverages are allowed in the lab. Chewing gum is discouraged.
2. Closed-toe shoes are required for entry into the lab.
3. Avoid wearing your “best” clothes and consider wearing a lab coat.
4. Confine long hair, loose clothing and dangling jewelry.
5. Cover any cuts or scrapes with a bandage before attending lab.
6. Goggles/safety glasses are available and must be worn at all times in lab.
7. Wear disposable gloves at all times.
8. Never pipet by mouth.
9. Do not pick up broken glass with your hands, use a dust pan and broom.
10. Clean your lab space and equipment before departing.
11. Please exit the lab when making personal calls or sending texts or email messages. Abuse of this rule will result in cell phones being banned from the lab. Smartphones may be used during the lab exercises as references, calculators and other similar tools.
12. Thoroughly wash hands with soap prior to leaving the laboratory.

**Homework:**
Homework for this course includes reading lecture notes and assigned articles in advance of lectures, as well as preparing for each laboratory session. In addition, during the portion of the semester in which we are culturing cells, each group will be required to maintain their own group's cell cultures. This includes changing media over weekends. Members of your group will have to coordinate with the instructors to arrange times outside of class to "feed" cell cultures.

**Academic Integrity:**
Don't cheat. Anyone caught cheating during a quiz, on a lab report, or on the group project will be given a failing grade on the exercise and is subject to further disciplinary action. This policy also includes any acts of plagiarism. If you do not understand this policy, please see your instructor. For more details on the University's poly on academic integrity, see http://admin.illinois.edu/policy/code/article1_part4_1-401.html.

**Description of Course Modules:**

*Module I. Controlled release*
A model protein, bovine serum albumin (BSA), is encapsulated in a matrix of biodegradable poly(lactic-co-glycolic acid) (PLGA) through a double emulsion process. The encapsulation efficiency and drug loading of the resulting microspheres are evaluated. An in vitro controlled release study is subsequently performed, with data being collected throughout the semester.

*Module II. Natural biomaterials*
Collagen is extracted from bovine calf skin and purified. The dual nature of collagen as both a natural biomaterials and a protein are studied. Chitosan, another natural biomaterial, is used with collagen to form a collagen/chitosan composite material.

*Module III. Biocompatibility testing*
Assorted materials are tested for their cytotoxicity using in vitro cell culture methods. These methods include direct contact, extraction and cell adhesion/proliferation assays.

*Module IV: Skin tissue engineering*
Two cell types, fibroblasts and keratinocytes, are used to grow skin-like tissues. Histological studies are conducted to compare natural human skin and tissue engineered skin equivalents.

*Module V: Bioceramics*
Hydroxyapatite (HA) and fluoroapatite (FA) are synthesized. Porous composites of HA/FA and PLGA are fabricated and studied for their morphology, mechanical strength and degradability.