



BIOMEDICAL ENGINEERING

Carnegie Mellon University

42-203: Biomedical Engineering
Laboratory

Spring 2014

Instructor:

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Office hours: Wednesday: 11:00 AM to 12:00 PM
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TinyURL.com/bmescheduling

Teaching Assistants

Name	E-mail	Office Hours
Alan Campbell Teaching Assistant (Section A)	ascampbe@andrew.cmu.edu	Virtual and Physical Office Hours: TBD Other hours by appointment
Duke Miller Teaching Assistant (Section B)	adm1@andrew.cmu.edu	

Office hours (virtual and physical) will be announced after the students have been polled for days and times.

Please feel free to contact Dr. Zapanta or **either teaching assistant** if you have questions about the course content, laboratories, assignments, or how assignments were graded.

Class Times and Locations:

Section	Days	Time	Lecture Location	Lab Locations
A	Monday and Wednesday	1:30 PM to 2:50 PM	Smith Hall 125 A/B	Check class schedule for the location for each individual lab session
B	Tuesday and Thursday	10:30 AM to 11:50 AM	Smith Hall 125 A/B	

Alternative Laboratory Times: Some laboratory tasks may have to be performed outside of the allocated class time and days due to limited accessibility to key pieces of equipment and due to the nature of the lab (i.e. care of cells every two to three days). This scheduling outside of the allocated class time will be kept to a minimum and will be performed with every effort to accommodate students' schedules.

Textbook: No textbook is required for this course. Relevant articles and references will be posted on class the website on Blackboard. The Carnegie Mellon copyright policy can be found at <http://www.cmu.edu/policies/documents/Copyright.html>

Class Website: All registered students will have access to the class website via Blackboard (<http://www.cmu.edu/blackboard>). Class announcements, course information, instructor and teaching assistant information, course documents, and assignments are contained on this website. This website will be constantly updated with relevant information throughout the semester.

Prerequisites: 42-101 Introduction to Biomedical Engineering and 03-121 Modern Biology. Health Professional Program (HPP) students should use the cross-listed course number 03-206 when registering for this course.

Co-requisites: None

Course Description: This laboratory course is designed to provide students with the ability to make measurements on and interpret data from living systems. The experimental modules reinforce concepts from 42-101 (Introduction to Biomedical Engineering) and expose students to four areas of biomedical engineering: biomedical signal and image processing, biomaterials, biomechanics, and cellular and molecular biotechnology. Several cross-cutting modules are included as well. The course includes weekly lectures to

complement the experimental component. Priority for enrollment will be given to students who have declared the Additional Major in Biomedical Engineering.

Course Objectives:

By the end of this course, the students should be able to do the following:

1. Understand and follow guidelines regarding biological safety
2. Maintain a laboratory notebook that follows the guidelines given in class
3. Prepare a laboratory report
4. Demonstrate aseptic cell culture techniques
5. Perform transformation into a bacterial cell
6. Describe and demonstrate basic concepts and examples of biomedical signal and image processing, biomaterials, biomechanics, and cellular and molecular biotechnology
7. Perform literature search
8. Prepare a scientific poster
9. Collect, analyze, and interpret physiological measurements

Relation of Class to ABET (Accreditation Board for Engineering and Technology) Criteria

<i>ABET Criteria</i>	<i>Relation of Class to Criteria</i>	<i>Mechanism</i>
Ability to apply knowledge of mathematics, science, and engineering	Primary	Lectures Labs Lab reports Homework
Ability to design and conduct experiments, as well as to analyze and interpret data	Primary	Labs Lab reports Homework
Ability to function on multidisciplinary teams	Primary	All labs conducted in groups of two to four students
Ability to identify, formulate, and solve engineering problems	Secondary	Research project
Ability to communicate effectively	Primary	Lab reports Research project
Recognition of the need for, and an ability to engage in life-long learning	Secondary	Research project
Knowledge of contemporary issues	Secondary	Lectures Research project
Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Primary	Lectures Labs Lab reports Homework
Understanding of biology and physiology	Secondary	Lectures Labs Homework
Capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology	Primary	Lectures Labs Lab reports Research project Homework
Ability to make measurements on and interpret data from living systems	Primary	Lectures Labs
Ability to address problems associated with the interaction between living and non-living materials and systems	Primary	Lectures Labs Research project Homework

Class Procedures

Laboratory Notebooks: Laboratory notebooks are required for this course. Please purchase notebooks that have numbered pages and a duplicate set of pages. We will be collecting the duplicate pages of your lab notebooks for grading and for course documentation.

The Carnegie Mellon Art Store carries the notebook that would be suitable for this course: *Edison #77644, 100 duplicate sets of pages, no carbon, numbered pages, \$23.50*

The format for keeping laboratory notebooks will be described in excruciating detail in class. A sample laboratory notebook entry will be provided on Blackboard. Additional references for keeping a lab notebook include the following:

1. Harvey Mudd College: <http://www.physics.hmc.edu/howto/labnotebook.html>
2. Davidson College:
<http://www.bio.davidson.edu/courses/Molbio/labnotebook.html>
3. Rice University:
<http://www.ruf.rice.edu/%7Ebioslabs/tools/notebook/notebook.html>

Laboratory notebooks will be checked for format and content at the beginning of each lab or lab rotation. Students with incomplete notebooks will be penalized.

Laboratory Groups: Laboratory groups will be composed of a maximum of three (3) students. Lab groups will be chosen by the teaching assistants and will change with each lab. These groups will perform the laboratories together. However, each student will be expected to maintain a laboratory notebook and turn in an individual laboratory report (see following section) at the completion of each lab experiment. The role of each student member in the laboratory group should be clearly indicated in the laboratory report (i.e. who fabricated the hydrogels, recorded images, collected EKG data, etc.).

Laboratory Reports: Laboratory reports will be completed by *each student* following each laboratory module. The reports should contain the following components:

Title
Author
Abstract
Introduction
Methods and Materials (including equipment)
Results
Discussion
Conclusion
References

Appendices (such as detailed calculations, derivations, role of each group member in the completion of the lab, etc.)

Several “model” laboratory reports will be provided on Blackboard. Additional references for laboratory reports (in similar formats) include the following:

1. University of Toronto:
<http://www.engineering.utoronto.ca/Directory/students/ecp/handbook/documents/lab.htm>
2. Rensselaer Polytechnic Institute (RPI):
<http://www.ccp.rpi.edu/resources/electrical-lab-reports/>
3. University of Wisconsin:
<http://www.wisc.edu/writing/Handbook/ScienceReport.html>

Literature Review Poster: Each student will prepare a *literature review poster* that summarizes the application of a technique presented in this course to **current** biomedical research. Examples of biomedical research include the development of a medical device, treatment of a disease, or study of a biological process.

Periodic deadlines for specific project milestones throughout the semester are listed in the Due Dates section of this syllabus.

Grading

The final grade will be computed by combining homework, lab reports, lab notebook, class participation, and the final project in the following manner:

Lab Notebook Review	20%
Lab Reports	40%
Homework	15%
Literature Review Project	20%
Class Participation (lecture and lab)	5%
Total	100%

The following scale will be used to assign a final letter grade:

90 to 100%	A
80 to 89%	B
70 to 79%	C
60 to 69%	D
0 to 59%	R

The class participation score will be based on each student's participation in lecture and lab. This includes arriving in a timely manner and attendance (see following policy), preparation for the lab outside of class, and active participation in performing the lab.

Class Policies

Attendance: Attendance at lectures is *highly recommended*. Attendance at all labs is **required**. The concepts and techniques covered during the lectures and labs will most likely not be repeated. As a result, consistent attendance will help you learn, understand, and apply the concepts and techniques being presented.

If you have to miss a laboratory session for any reason, please contact Dr. Zapanta as soon as possible.

If you are unable to complete the laboratory tasks within the allocated time, please be prepared to stay after class or schedule alternative times with Dr. Zapanta or the teaching assistants to complete the tasks.

Assignment Due Dates: Homework assignments, lab reports, and laboratory notebooks are to be submitted by the ***beginning of class*** on the day it is due. These should be turned in via hardcopy. If you wish to turn in a hardcopy outside of class, please bring it to the BME Office in Doherty Hall 2100. **Please be aware that the normal office hours for the BME Office are 8:30 AM to 4:30 PM, Monday to Friday.**

Homework solutions (as appropriate) will be posted on the class website after the graded homework is returned. Any assignment turned in after the due date will be deducted 15 percentage points for every day it is late. Please note that that weekends count as late days!

Assignments can be turned in after one week (7 days) for corrections, but will count as a zero.

Class and Laboratory Decorum: Lectures will start and end on time. If you are late, please enter the class without disruptions. If you have to leave early, please make your exit as quickly and quietly as possible.

The use of cell phones (including texting!) and laptops during class and laboratories is prohibited and will not be tolerated.

Eating is only permitted in the lecture rooms, but please clean up your trash after class! **No food or beverage is allowed in any of the laboratories.**

Classroom activities may be recorded by a student for the personal, educational use of that student or for all students presently enrolled in the class only, and may not be further copied, distributed, published or otherwise used for any other purpose without the express written consent of Dr. Zapanta. All students are advised that classroom activities may be taped by students for this purpose.

Please keep in mind that these guidelines are necessary to maintain an environment that is safe and conducive for learning.

Lab Safety: The laboratory safety guidelines presented in class will be strictly enforced. This includes proper attire, the use of gloves, etc.

Accommodations due to Disabilities: If you wish to request an accommodation due to a documented disability, please inform Dr. Zapanta and contact Disability Resources (102 Whitfield Hall, 8-2013, lpowell@andrew.cmu.edu) as soon as possible. For ongoing documented classroom accommodations, a one-week notice is required. Accommodations for finals require three weeks notice.

Academic Integrity:

The Carnegie Mellon Code (<http://www.cmu.edu/student-affairs/theword/code.html>)

Students at Carnegie Mellon, because they are members of an academic community dedicated to the achievement of excellence, are expected to meet the highest standards of personal, ethical and moral conduct possible. These standards require personal integrity, a commitment to honesty without compromise, as well as truth without equivocation and a willingness to place the good of the community above the good of the self. Obligations once undertaken must be met, commitments kept.

As members of the Carnegie Mellon community, individuals are expected to uphold the standards of the community in addition to holding others accountable for said standards. It

is rare that the life of a student in an academic community can be so private that it will not affect the community as a whole or that the above standards do not apply.

The discovery, advancement and communication of knowledge are not possible without a commitment to these standards. Creativity cannot exist without acknowledgment of the creativity of others. New knowledge cannot be developed without credit for prior knowledge. Without the ability to trust that these principles will be observed, an academic community cannot exist.

The commitment of its faculty, staff and students to these standards contributes to the high respect in which the Carnegie Mellon degree is held. Students must not destroy that respect by their failure to meet these standards. Students who cannot meet them should voluntarily withdraw from the university.

Cheating (<http://www.cmu.edu/academic-integrity/defining/cheating.html>)

Cheating “occurs when a student avails her/himself of an unfair or disallowed advantage which includes but is not limited to:

1. Theft of or unauthorized access to an exam, answer key or other graded work from previous course offerings.
2. Use of an alternate, stand-in or proxy during an examination.
3. Copying from the examination or work of another person or source.
4. Submission or use of falsified data.
5. Using false statements to obtain additional time or other accommodation.
6. Falsification of academic credentials.”

Examples of cheating in academic life include the following:

- Copying someone else’s work
- Having someone else complete an assignment or take an exam for you
- Stealing an exam or paper
- Paying other students to do your work or buying papers
- Submitting or using falsified data
- Lying to obtain additional time or other accommodation.
- Falsifying academic credentials including but not limited to internship documentation, letters of recommendation, transcripts, and diplomas

Plagiarism (<http://www.cmu.edu/academic-integrity/defining/plagiarism.html>)

Plagiarism “is defined as the use of work or concepts contributed by other individuals without proper attribution or citation. Unique ideas or materials taken from another

source for either written or oral use must be fully acknowledged in academic work to be graded. Examples of sources expected to be referenced include but are not limited to:

1. Text, either written or spoken, quoted directly or paraphrased.
2. Graphic elements.
3. Passages of music, existing either as sound or as notation.
4. Mathematical proofs.
5. Scientific data.
6. Concepts or material derived from the work, published or unpublished, of another person.”

In academic life, plagiarism can include the following:

- Failing to cite references in your work or not attributing ideas contained in your work to the original source of those ideas.
- Cutting and pasting material from a web resource directly into their assignments or when they sample graphic or music files without attribution.
- Putting someone else’s ideas into your own words without the appropriate citation

In order to deter and detect plagiarism, online tools (Turnitin) and other resources are used in this class. The mission of the Office of Technology for Education is to support faculty in the selection, implementation and evaluation of educational technologies. As part of this mission, we continually monitor and assess the use of educational technologies on campus so that we can understand and better meet the needs of our faculty and students. Periodically, we may ask for information on the usability and value of the Turnitin tool. Your comments are vital to the evaluation of the tool and will help determine the future role that Turnitin will play at Carnegie Mellon.

If at any time you would like to provide comments or suggestions, or need assistance, please contact the Eberly Center for Teaching Excellence at <http://www.cmu.edu/teaching/eberly/>.

Unauthorized Assistance

(<http://www.cmu.edu/academic-integrity/collaboration/index.html>)

Unauthorized assistance “refers to the use of sources of support that have not been specifically authorized in this policy statement or by the course instructor(s) in the completion of academic work to be graded. Such sources of support may include but are not limited to advice or help provided by another individual, published or unpublished written sources, and electronic sources. Examples of unauthorized assistance include but are not limited to:

1. Collaboration on any assignment beyond the standards authorized by this policy statement and the course instructor(s).
2. Submission of work completed or edited in whole or in part by another person.
3. Supplying or communicating unauthorized information or materials, including graded work and answer keys from previous course offerings, in any way to another student.
4. Use of unauthorized information or materials, including graded work and answer keys from previous course offerings.
5. Use of unauthorized devices.
6. Submission for credit of previously completed graded work in a second course without first obtaining permission from the instructor(s) of the second course. In the case of concurrent courses, permission to submit the same work for credit in two courses must be obtained from the instructors of both courses”

Since the University Policy on Academic Integrity gives each instructor the ability to determine what is appropriate in each of their courses, it is possible that what is permitted or even required in one course may be prohibited in another. **Thus, it is absolutely crucial for students to know the expectations for each of their courses and to ask before they act in instances where the expectations are unclear.**

In academic life, inappropriate collaboration can include the following:

- Talking to friends about an assignment outside of class or working on homework with other students on assignments that the instructor has designated to be individual
- Dividing up problem sets or parts of a paper or lab among a group
- Sharing your code or essay with someone or sharing notes from previous semesters with students currently taking the class
- Accessing unauthorized information during an exam including from a cell phone
- Looking at someone else's exam
- Reusing work from another class, even if it is your own, without the permission of the instructors

Collaboration vs. Cheating: Collaboration is defined by Merriam-Webster’s Collegiate Dictionary (10th edition) as “to work jointly with others or together, especially in an intellectual endeavor.” Much of the work that is performed in this laboratory (and in biomedical engineering as a whole) is collaborative in nature. Therefore, collaboration is this class is encouraged during the execution of the labs. In addition, discussions regarding the content of homework assignments, lab reports, and the final project are also encouraged.

You are encouraged to discuss the course material, concepts, and assignments with other students in the class. **However, each student must eventually submit his/her own unique work (i.e. laboratory report, homework, etc).** If any collaboration was used to

complete an assignment, record the names of the collaborators and the nature of the collaboration. Any attempt to submit work that is not the student's own work will be considered to be an act of cheating and will be subject to prosecution.

If you have any questions regarding this policy, please contact Dr. Zapanta.

Consequences:

Any disciplinary actions regarding charges of cheating or plagiarism will follow the procedures described in the "Carnegie Mellon University Undergraduate Academic Disciplinary Actions Overview" that can be found at

<http://www.cmu.edu/policies/documents/AcadRegs.html>.

Expectations of Students and Instructors:

The instructors and teaching assistants have the right to expect the following of students:

1. Students will arrive to class on time
2. Students will be prepared for the lecture or laboratory by reviewing the lecture notes or lab protocols.
3. Students will turn in assignments on time (see policy on assignment due dates).
4. Students will immediately inform the instructor or the teaching assistants if extenuating circumstances prevent the student from attending a lecture or laboratory.
5. Students will follow the code of conduct regarding academic integrity, cheating, plagiarism, and collaboration as outlined in the syllabus.
6. Students will seek assistance when they need it.
7. Students will follow the lab safety guidelines as presented in class.
8. Students will work together effectively in lab groups to successfully complete the assigned laboratory tasks.
9. Students will be flexible and willing to perform laboratory tasks outside of the allocated class time.
10. If contacted by the instructor or teaching assistant by phone or e-mail, students will respond within 24 hours during the week and 48 hours on weekends.

The students have the right to expect the following of the instructor and teaching assistants:

1. A syllabus that describes class procedures, policies, and a course description will be provided.
2. Class sessions that will start and end on time.
3. Any changes to the course schedule will be provided to the students within 48 hours of the change.
4. The instructors and teaching assistants will be available outside class either during their posted office hours or during other pre-arranged times.
5. Lab reports, lab notebooks, and homework assignments will be returned within two weeks after the due date.
6. Phone calls or e-mails to the instructor or teaching assistants from students will be returned within 24 hours during weekdays and 48 hours on weekends.

These expectations were adapted and modified from those developed by Howard Culbertson at Southern Nazarene University. The original list of expectations can be accessed at <http://home.snu.edu/~HCULBERT/contract.htm>.

Course Outline

1. Introduction
 - a. Syllabus
 - b. Course outline
 - c. Lab reports
 - d. Lab notebooks
2. Good Laboratory Practices
 - a. Health and safety
 - b. Recording data
 - c. Data handling
 - d. Analyzing data (including MATLAB)
 - e. Reporting results
 - f. Ethical conduct
3. Cellular and Molecular Biotechnology
 - a. Introduction to the Biological Lab
 - i. Pipetting exercise
 - ii. Sterile technique
 - b. GFP Transformation into Bacteria (*E. coli*)
 - c. Cell Passage of Mammalian Cells

4. Biomedical Signal and Image Processing
 - a. Electrocardiography (EKG)
 - i. Data acquisition basics
 - ii. Measure and analyze EKG signals

5. Biomaterials/Biomedical Signal and Image Processing
 - a. Plate mammalian cells on PDMS (polydimethylsiloxane) samples of various stiffness
 - b. Observe changes in cell adhesion and spreading of mammalian cells based on PDMS stiffness
 - c. Quantify these changes using ImageJ

6. Biomechanics/ Biomedical Signal and Image Processing
 - a. Measure and analyze (EMG) Electromyography signals
 - b. Use EMG signals to control a virtual robotic arm

7. Literature Review Poster
 - a. Prepare a *literature review* that summarizes the application of a technique presented in this course to **current** biomedical research. Examples of biomedical research include the development of a medical device, treatment of a disease, or study of a biological process.
 - b. Poster presentation during last week of class

Course Schedule (Revised 1/8/2014)

Week	Section A	Section B	Topic	Lecture or Lab Location
1	1/13/14	1/14/14	Welcome to Class! Lab Notebook and Lab Reports	Smith Hall 125A/B
	1/15/14	1/16/14	Lab Notebook and Lab Reports How to Read a Scientific Paper	Smith Hall 125A/B
2	1/20/14	1/21/14	No Class – Martin Luther King Day Observance	
	1/22/14	1/23/14	Biological Safety Lecture	Smith Hall 125A/B
3	1/27/14	1/28/14	<i>Introduction to MATLAB - Lab</i>	<i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
	1/29/14	1/30/14	<i>Introduction to MATLAB - Lab</i>	<i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
4	2/3/14	2/4/14	Good Laboratory Practices Introduction to the Biological Laboratory – Lecture	Smith Hall 125A/B
	2/5/14	2/6/14	<i>Introduction to the Biological Laboratory – Lab</i>	<i>Smith Hall 125</i>
5	2/10/14	2/11/14	Research Proposal Overview GFP Transformation – Lecture	Smith Hall 125A/B
	2/12/14	2/13/14	<i>GFP Transformation – Lab</i>	<i>Smith Hall 125</i>
6	2/17/14	2/18/14	<i>GFP Transformation – Lab</i>	<i>Smith Hall 125</i>
	2/19/14	2/20/14	How to Perform a Literature Search Bioinstrumentation – Lecture	Smith Hall 125A/B
7	2/24/14	2/25/14	<i>Bioinstrumentation – 1st Half of Class - Lab</i>	<i>Smith Hall 125</i>
	2/26/14	2/27/14	<i>Bioinstrumentation – 2nd Half of Class - Lab</i>	<i>Smith Hall 125</i>
8	3/3/14	3/4/14	<i>Bioinstrumentation – Lab (Data Analysis)</i>	<i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
	3/5/14	3/6/14	<i>Introduction to ImageJ - Lab</i>	<i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
9	3/10/14	3/11/14	No Class – Spring Break	
	3/12/14	3/13/14	No Class – Spring Break	
10	3/17/14	3/18/14	<i>Cell Passage Lab - 1st Half of Class</i> <i>Final Project Discussion- 2nd Half of Class</i>	<i>Smith Hall 125</i>
	3/19/14	3/20/14	<i>Cell Passage Lab - 1st Half of Class</i> <i>Final Project Discussion- 2nd Half of Class</i>	<i>Smith Hall 125</i>
11	3/24/14	3/25/14	<i>Cell Passage Lab - 2nd Half of Class</i> <i>Final Project Discussion- 1st Half of Class</i>	<i>Smith Hall 125</i>
	3/26/14	3/27/14	<i>Cell Passage Lab - 2nd Half of Class</i> <i>Final Project Discussion- 1st Half of Class</i>	<i>Smith Hall 125</i>
12	3/31/14	4/1/14	Biomechanics – Lecture How Prepare a Scientific Poster – Lecture	Smith Hall 125A/B
	4/2/14	4/3/14	Biomaterials – Lecture	Smith Hall 125A/B
13	4/7/14	4/8/14	TBD	Smith Hall 125A/B
	4/9/14	4/10/14	No Class – Spring Carnival	
14	4/14/14	4/15/14	<i>Biomechanics/ Biomaterials – Lab</i>	<i>Smith Hall 125</i>
	4/16/14	4/17/14	<i>Biomechanics/ Biomaterials – Lab</i> <i>(Data Analysis)</i>	<i>Biomaterials: Smith Hall 125</i> <i>Biomechanics:</i> <i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
15	4/21/14	4/22/14	<i>Biomaterials/ Biomechanics – Lab</i>	<i>Smith Hall 125</i>
	4/23/14	4/24/14	<i>Biomaterials/ Biomechanics – Lab</i> <i>(Data Analysis)</i>	<i>Biomaterials: Smith Hall 125</i> <i>Biomechanics:</i> <i>Section A: WeH 5201 (Mac)</i> <i>Section B: WeH 5202 (PC)</i>
16	4/28/14	4/29/14	Class Review and Evaluations	Smith Hall 125A/B
	4/29/14, 5:30 to 7:30 PM		Poster Presentation	UC Connan

Due Dates

Revised 1/8/2014

Assignment	Section A Due Date	Section B Due Date
<ul style="list-style-type: none"> How to Read a Scientific Paper 	1/22/14	1/23/14
<ul style="list-style-type: none"> Introduction to MATLAB Homework Pre-lab homework for Introduction to the Biological Lab Lab notebook review for Introduction to the Biological Lab (pre-lab) 	2/5/14	2/6/14
<ul style="list-style-type: none"> Lab notebook review for Introduction to the Biological Lab (post-lab) Lab report for Introduction to the Biological Lab Pre-lab homework for GFP Transformation Lab Lab notebook review for GFP Transformation Lab (pre-lab) 	2/12/14	2/13/14
<ul style="list-style-type: none"> Potential literature review project topics 	2/19/14	2/20/14
<ul style="list-style-type: none"> Lab notebook review for GFP Transformation Lab (post-lab) Lab report for GFP Transformation Lab 	2/24/14	2/25/14
<ul style="list-style-type: none"> Pre-lab homework for Bioinstrumentation Lab Lab notebook review for Bioinstrumentation Lab (pre-lab) 	2/24/14 or 2/26/14	2/25/14 or 2/27/14
<ul style="list-style-type: none"> Literature review project topic, medical/biological significance, and how technique relates to some aspect of 42-203 	3/5/14	3/6/14
<ul style="list-style-type: none"> Pre-lab homework for Cell Passage Lab Lab notebook review for Cell Passage Lab (pre-lab) 	3/17/14 or 3/24/14	3/18/14 or 3/25/14
<ul style="list-style-type: none"> Lab notebook review for Bioinstrumentation Lab (post-lab) Lab report for Bioinstrumentation Lab 	3/19/14	3/20/14
<ul style="list-style-type: none"> Lab notebook review for Cell Passage Lab (post-lab) Lab Report for Cell Passage Lab 	3/26/14 or 4/2/14	3/27/14 or 4/3/14
<ul style="list-style-type: none"> Draft of Poster 	4/7/14	4/8/14
<ul style="list-style-type: none"> Pre-lab homework for Biomechanics/Biomaterials Lab Lab notebook review for Biomechanics/Biomaterials (pre-lab) 	4/14/14	4/15/14
<ul style="list-style-type: none"> Pre-lab homework for Biomaterials/Biomechanics Lab Lab notebook review for Biomaterials/Biomechanics (pre-lab) 	4/21/14	4/22/14
<ul style="list-style-type: none"> Lab notebook review for Biomechanics/Biomaterials Lab (post-lab) Lab report for Biomechanics/Biomaterials Lab 	4/23/14	4/24/14
<ul style="list-style-type: none"> Research project: Posters due for FREE printing 	4/25/14	4/25/14
<ul style="list-style-type: none"> Final copy of poster (if not printed by Dr. Zapanta) 	4/30/14	4/30/14
<ul style="list-style-type: none"> Lab notebook review for Biomaterials/Biomechanics Lab (post-lab) Lab report for Biomaterials/Biomechanics Lab 	5/2/14	5/2/14