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Date: 2 August 2010

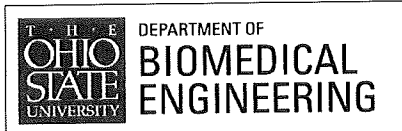
To: Randy Smith  
Vice Provost, Office of Academic Affairs

From: Ed McCaul   
Secretary College of Engineering Committee on Academy Affairs (CCAA)

Subject: Semester Conversion Proposal for the Undergraduate Minor in  
Biomedical Engineering

Attached is a letter from Richard Hart, Department Chair of Mechanical Engineering, as well as a semester conversion proposal for the Undergraduate Minor in Biomedical Engineering.

This proposal was reviewed by a subcommittee of CCAA. After reviewing the proposal and having some changes made to it the subcommittee recommended to the full committee that it be approved. After a discussion, CCAA unanimously approved the proposal on the 30<sup>th</sup> of July 2010 and requested that I forward the proposal to you for consideration by CAA. If you have any questions concerning this proposal please let me know.



**Richard T. Hart, Ph.D.**

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July 22, 2010

On behalf of the faculty from the Department of Biomedical Engineering, I am pleased to share our plans for the transition of our curriculum from one based on 10-week quarters to the new 14-week semester calendar. The BME Undergraduate Studies Committee (USC), comprised of six faculty and staff, began discussions on the conversion process in the Fall 2009 quarter. Weekly meetings have taken place since the start of Winter 2010, with accompanying updates to the full faculty at regular meetings (every 3 weeks). Similarly, a subcommittee of the Graduate Studies Committee (GSC) worked on the transition policies of the graduate programs starting in Fall 2009 until its final approval, with updates discussed at full faculty meetings. The proposed semester undergraduate advising (BINGO) sheet was approved by the faculty on March 12, 2010. Final approval for all five proposals is listed below.

All program proposals are based on the following principles:

- Student progress toward completion of the program will not be impeded by the semester conversion, assuming the student contacted the Department before the conversion to semesters.
- All students who complete the degree requirements under the semester system must complete all requirements of the new semester program.
- Semester program requirements may be met either by taking semester courses (or sequences), or by substituting a substantially equivalent quarter course (or sequence).
- BME does not anticipate using BME "bridge courses" in the transition process. However, bridge courses may be required or suggested by other Departments, including Mathematics and Physics.
- Issues that are not specifically addressed in the proposal will be handled through the Undergraduate Studies Committee and/or the Graduate Studies Committee, to resolve the problem with the student's best interest in mind.

We have made proposals for the following BME programs:

- BS in Biomedical Engineering
- Undergraduate Minor in Biomedical Engineering (**this document**)
- MS in Biomedical Engineering
- PhD in Biomedical Engineering
- M.D.-Ph.D. combined degree, with the PhD coming from Biomedical Engineering.

We have withdrawn our graduate interdisciplinary specialization.

We will follow college rules, as described in the college's proposal for semester conversion, for the implementation of our BS/MS program, and for the policy on General Education courses within the undergraduate major program.

We requested and received feedback from our current students and the BME External Advisory Board (EAB). Student comments were generally supportive, and raised only minor issues. One student did comment on the undergraduate program that a potential overlap of information in two of our lab courses, and we will address this issue. The EAB unanimously

endorsed all proposals, with generally minor comments. One EAB member asked about the appropriateness of having only one Statistics course and an absence of any Anatomy course requirement in the graduate programs. The BME Faculty had many discussions on this issue, and the consensus was that a minimum number of required courses for all graduate students was a critical component of our new graduate curriculum. Specifically, the student and advisor(s) would best be able to develop a program of study that would include the necessary depth in statistics, anatomy, or any other area deemed important for the student and also improve the time spent on focused research.

The faculty voted on April 23, 2010 to accept and endorse the new semester-based curriculum plans for:

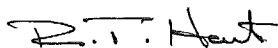
Undergraduate Major: 13 in favor, 0 opposed, and 0 abstaining  
Undergraduate Minor: 13 in favor, 0 opposed, and 0 abstaining

The faculty voted on May 14, 2010 to accept and endorse the new semester-based curriculum plans for:

Graduate Master's Program: 12 in favor, 0 opposed, and 0 abstaining  
Graduate Doctoral Program: 12 in favor, 0 opposed, and 0 abstaining  
Graduate MD-PhD Program: 12 in favor, 0 opposed, and 0 abstaining

Thank you, in advance, for your consideration of our plans.

Sincerely,



Richard T. Hart, Ph.D.

# Biomedical Engineering (BME) Program Proposal

Primary Contact: Mark A. Ruegsegger (Ruegsegger.1, 247-6890)

1. **Name of program**  
Biomedical Engineering
2. **Name of Degree**  
Biomedical Engineering Minor
3. **Responsible Academic Unit**  
Department of Biomedical Engineering
4. **Type of Program:**  
b. Undergraduate Minor
5. **Semester Conversion Designation**  
b. Converted with minimal changes to program goals and/or curricular requirements (e.g., name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)

## 6. Program Learning Goals

### BME Minor Program Objectives:

The objective of the biomedical engineering minor is to provide a focused, educational opportunity in the field of Biomedical Engineering for students outside of the BME Major program. The Minor program requires students to choose from one or more BME 'Domains' and they are challenged to creatively integrate engineering and life sciences within the context of the Domain(s). The graduates of this program will be better prepared to successfully pursue:

- Advanced study leading to research or professional practice in biomedical engineering.
- Advanced study leading to research or professional practice in health care.
- Careers in biomedical engineering industries or related technical and professional fields.

### BME Minor Program Outcomes:

Graduates from the Minor program will have demonstrated that, for at least half of the outcomes listed below, they possess the ability to:

- (a) Apply knowledge of mathematics, science, and engineering
- (b) Design and conduct experiments, as well as to analyze and interpret data
- (c) Design a system, component, or process to meet desired needs
- (d) Function on multi-disciplinary teams
- (e) Identify, formulate, and solve engineering problems
- (f) Understand professional and ethical responsibility

- (g) Communicate effectively
- (h) Understand the impact of engineering solutions in a global and societal context
- (i) Recognize the need to engage in life-long learning
- (j) Demonstrate knowledge of contemporary issues
- (k) Use the techniques, skills, and modern engineering tools necessary for engineering practice

**7. List the semester courses (department, title, credit hours) that constitute the requirements and other components of the program.**

The proposed semester-based curriculum list is presented in Appendix A, and has the following notable features:

- At least initially, BME courses will be taught only once per year. We will be actively advising students with an individual planning meeting, and advise how to select courses in the pre-conversion years so that this will not be a constraint for progress toward graduation. We are slightly disadvantaged with the Minor in that students don't always submit the BME Minor program forms before they take their first class (even though the Minor form and the BME website clearly state this). But we will work with the students as soon as they seek advice from the Department.
- Students are required to take either physiology or a biological sciences course. This broad requirement was made to provide a more reasonable pathway for students from other disciplines to complete the BME Minor.
- Students will take at least one (1) BME Domain Course that they select from a list of six (6) courses. These courses provide **breadth** in fields of biomedical engineering. The BME Minor also provides a means to develop **depth** in the Domain that interests them by requiring either a graduate-level follow-up course or a second, and related, Domain course.
- Students taking the Domain courses will have a slightly different class experience than the BME Major students in the course. This will be clearly explained in the course syllabus and throughout the course. Specifically, the BME Major students will have a two-week lab experience that includes experimentation, data collection and analysis, and a written and oral technical report. The BME Minor students will be given the collected data for analysis, and an alternate assignment of a literature review paper on a similar topic to the content of the lab.

**8. Current and Proposed Curriculum Advising Sheets**

The current and proposed curriculum advising sheets are presented in Appendices B and C, respectively.

**9. Curriculum Map Showing Attainment of Program Learning Outcomes**

The curriculum map of the BME Minor program learning outcomes is not required for this program.

**10. Rationale for Program Changes and Description of Changes**

Although Biomedical Engineering became a department in October 2006, the BME Minor program has been available to students for many years prior. The original quarter-based curriculum was developed for undergraduate students interested in getting a deeper understanding of the field of Biomedical Engineering by taking a physiology course, an introductory BME course, and four (4) graduate-level BME courses. Significant changes were made to the BME Minor in 2010, still within the quarter system. Specifically, undergraduate BME courses became the core of the Minor program, with graduate courses being optional as pre-requisites were met. This curriculum shift had several benefits, including better enforcement of pre-requisites for Minor students, and the ability for greater depth in the advanced BME courses. So, as we now move from quarters to semesters, the BME Minor Program proposal will have essentially no changes, except for changes associated with credit hours and total courses required for completion of the Minor.

The BME Undergraduate Studies Committee (USC), comprised of six Faculty and staff, began discussions on the conversion process in the Fall 2009 quarter. Weekly meetings have taken place since the start of Winter 2010, with accompanying updates to the Full Faculty at bi-weekly meetings. Input was requested from students, External Advisory Board, and advisors from other Engineering Departments. Comments were generally positive. A few department advisors commented that this Minor would not fit well into their UG program curriculum, but interested students may still want to try to take the Minor. The semester conversion proposal for the BME Minor program was approved by the Faculty on April 23, 2010.

**11. Provide a table to aid the Council on Academic Affairs reviewers as they check for credit hour changes.**

	A.) Number of credit hours in current program	B.) Calculated result for 2/3 of current quarter credit hours	C.) Number of credit hours required for proposed program
Total cr-hrs required for completion of program	20	13.3	12
Required cr-hrs offered by the unit	15	10	9
Required cr-hrs offered outside of the unit	5	3.3	3
Double counted cr-hrs	0-5	0-3.3	0-3

that meet two or more requirements*			
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\* Double-counting depends on the students Major and if there is a requirement for a Life Science course.

**12. Rationale for a Significant Change in Credit Hours (more than 4 cr-hrs)**

There is not a significant change in credit hours for this program.

**13. Transition Policy**

As stated in the cover letter, the Chair, along with all Faculty, is committed to ensuring that student progress toward graduation is not impeded by the conversion to semesters.

Student progress toward completion of the Minor will not be impeded by the semester conversion, assuming the student contacted the Department before the conversion to semesters. BME will be proactive in anticipating issues specific to the BME Minor during the transition process. We will post on our BME Minor webpage, [http://www.bme.ohio-state.edu/bmeweb3/bme\\_ugminor.html](http://www.bme.ohio-state.edu/bmeweb3/bme_ugminor.html), a statement that strongly encourages any student considering the BME Minor to meet with the Department before Fall 2012. All students who have completed a BME Minor form will be scheduled to meet with the advisor for an individualized meeting to plan how best to complete the Minor in the Semester system.

Most courses in the BME minor have pre-reqs of both Engineering and Life science courses. All pre-reqs will be clearly listed on the BME Minor form, so that students have all the information early on. To maximize efficiency in course selection, BME will actively work with each student to optimize their Domain choice, the identification of required pre-reqs, and the opportunity to double-count courses in their Major program.

We do not anticipate that the first two required courses, BME 3000 and a biological sciences course, will cause any delay for students, since BME 3000 will be offered every year in the Fall semester, and many biological sciences courses will likely be offered in all terms.

Students who have signed BME Minor forms prior to the first day of Fall 2010 (when the new quarter-based changes take place) and are still finishing their Minor program after the conversion will have the option of completing the program that they scheduled (all graduate-level courses) or switch to take the undergraduate BME 'Domain' courses, given that all pre-requisites are met. In either case, students will have completed the BME Minor when the equivalent of 12 sem cr-hrs (in any combination of quarter and semester courses) have been taken.

**14. Assessment Practices.**

Currently, all undergraduate courses are assessed through a variety of mechanisms:

- a. Assignments, exams and other metrics in the course
- b. Student evaluations of the course (anonymous, BME-initiated zoomerang survey) and instructor (eSEI).
- c. Quarterly course round-ups, where Faculty meet to discuss the strength and weaknesses, successes and deficiencies of all the courses just completed. A Continuous Quality Improvement (CQI) assessment plan is generated that documents strategies intended to improve the course for the next offering.

We do not anticipate that we will need to modify our current assessment practices after conversion to semesters.

**15. Assessment Plan on File with OAA Indicate, for an undergraduate degree program or major proposal, whether the program has a plan on file with the Office of Academic Affairs (Yes / No).**

The Assessment Plan does not apply to this Minor program directly, but the assessment plan for the BME Major program has been submitted on the OAA online site.



Appendix A: BME Minor program - Semester Course List

Required Courses	Course Number	Hours
Physiology or Biological Science course	Varies	3
Introduction to BME	BME 3000	3
<b>TOTAL</b>		<b>6</b>

BME Domain Courses	Course Number	Hours
Bioimaging	BME 4110	3
Biotransport	BME 4210	3
Biomaterials	BME 4310	3
Biomechanics	BME 4410	3
Molecular, Cell & Tissue Engineering	BME 4510	3
Biomedical Micro/Nanotechnology	BME 4610	3
<b>TOTAL</b>		<b>3-6</b>

Advanced BME Courses	Course Number	Hours
Cardiovascular Bioengineering	BME 5001	3
Biomed Microscopic Imaging	BME 5110	3
Biomedical Optics	BME 5120	3
Advanced Biotransport	BME 5210	3
Advanced Biomaterials	BME 5310	3
Biopolymer Structure and Function	BME 5359	3
Mechanobiology	BME 5420	3
Tissue Mechanics	BME 5421	3
Finite Element Analysis Applications in BME	BME 5430	3
Advanced Tissue Engineering	BME 5510	3
Cell Engineering	BME 5520	3
Biomedical Microdevices	BME 5610	3
Medical Devices and Design	BME 5639	3
Biomedical Ultrasound	BME 5186	3
Soft-Tissue Biomaterials	BME 5352	3
Hard-Tissue Biomaterials	BME 5353	3
Cellular Mechanics	BME 5470	3
Biofluid Dynamics of Phys Systems	BME 5475	3
Biomedical Nanotechnology	BME 5661	3
Micro and Nano Fluidics	BME 5663	3
Advanced Biomedical Nanotechnology	BME 5662	3
Cellular Nanotech	BME 5665	3
BioMEMS Microfabrication	BME 5667	3
Biomedical Transducers	BME 5668	3
Advanced Medical Devices and Design	BME 5669	3
Biomedical Instrumentation	BME 5771	3
<b>TOTAL</b>		<b>0-3</b>
<b>BME UNDERGRADUATE MINOR CURRICULUM TOTAL:</b>		<b>12</b>

**Appendix B: BME Minor program – Current Curriculum Advising Sheet**

All students must take a minimum of 20 credit hours total from the list below including BME 500 and 1 additional course from Set A. The remainder of the courses should be picked from those listed in Set B, starting with a 'Domain' course. Students must be aware of course pre-reqs and plan accordingly, usually several quarters in advance.

To enroll in Minor, an **Undergraduate Minor Program Form** ([http://www.bme.ohio-state.edu/bmeweb3/bme\\_ugminor.html](http://www.bme.ohio-state.edu/bmeweb3/bme_ugminor.html)) must be signed by your MAJOR advisor, and then brought to BME to be filed as soon as you begin taking minor classes.

**SET A**

Course no.	Title	Cr Hrs	Prerequisites	Offered
Varies	Physiology or biological science course	4-5	Varies with course	---
Examples: BIOL 113, EEOB 232, EEOB 415, Biochem 511				

**AND**

BME 500	Introduction to Biomedical Engineering	3	ME 410, BIOL 113, Physics 132, Math 254, and concur Math 415	Wi
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**SET B**

Course no.	Title	Cr Hrs	Prerequisites	Offered
<b>BME Domain Courses</b>				
Bioimaging	BME 411	4	BME 202 or 500, Phys 133, Math 415 and EEOB 232	Au
Biotransport	BME 421	4	BME 202 or 500, Math 415, ME 500, EEOB 232, and EEOB 415	Sp
Biomaterials	BME 431	4	BME 202 or 500, MSE 205, Math 415, ME 420, EEOB 232, and concur EEOB 415	Au
Biomechanics	BME 441	4	BME 202 or 500, Math 415, ME 420, EEOB 232, and EEOB 415	Sp
Molecular, Cell & Tissue Engineering	BME 451	4	BME 202 or 500, Math 415, EEOB 232, Biochem 511, and EEOB 415	Sp
Biomedical Micro/Nanotechnology	BME 461	4	BME 202 or 500, MSE 205, Biochem 511, and EEOB 232	Sp
<b>Advanced BME Courses</b>				
Biomed Microscopic Imaging	BME 611	3	BME 411 or equiv, and senior standing; graduate standing or permission of instructor	
Biomedical Optics	BME 612	3	BME 411 or equiv, and senior standing; graduate standing or permission of instructor	
Advanced Biotransport	BME 621	3	BME 421 or equiv, and senior standing; graduate standing or permission of instructor	
Advanced Biomaterials	BME 631	3	BME 431 or equiv, and senior standing; graduate standing or permission of instructor	
Biopolymer Structure and Function	BME 632	3	BME 431 or equiv, Chem 231 or equiv, and senior standing; graduate standing or permission of instructor	
Tissue Mechanics	BME 641	3	BME 441 or equivalent, and senior standing; graduate standing or permission of instructor	
Mechanobiology	BME 642	3	Senior or grad standing; or permission of instructor	
Finite Element Analysis Applications in BME	BME 643	3	Math 415 or equiv, EEOB 232 or equiv, and senior standing; grad standing or permission of instructor	
Advanced Tissue Engineering	BME 651	3	BME 451 or equiv, and senior standing; graduate standing or permission of instructor	
Cell Engineering	BME 652	3	BME 451 or equiv, and senior standing;	

			graduate standing or permission of instructor
Biomedical Microdevices	BME 661	3	BME 461 or equiv, and senior standing; graduate standing or permission of instructor
Medical Devices and Design	BME 679	3	BME 202 or 500 or equiv, and senior standing; graduate standing or permission of instructor
Cardiovascular Bioengineering	BME 701	3	Senior or grad standing in Engineering, Medicine, or Science; or permission of instructor
Biomedical Ultrasound	BME 716	3	BME 411 or equiv, and senior standing; graduate standing or permission of instructor
Soft-Tissue Biomaterials	BME 732	3	BME 631 or permission of instructor
Hard-Tissue Biomaterials	BME 733	3	BME 631 or permission of instructor
Cellular Mechanics	BME 740	3	ME 420 or equiv, BME 441 or equiv, and senior standing; graduate standing or permission of instructor
Biomedical Nanotechnology	BME 761	3	BME 461 or equiv, and senior standing; graduate standing or permission of instructor
Micro and Nano Fluidics	BME 763	3	MechE 504 or permission of instructor
Advanced Biomedical Nanotechnology	BME 764	3	BME 761 or permission of instructor
Cellular Nanotech	BME 765	3	Senior or grad standing in engineering; or permission of instructor
BioMEMS Microfabrication	BME 767	3	BME 661 or permission of instructor
Biomedical Transducers	BME 768	3	Senior or Grad standing in engineering; or permission of instructor
Biomedical Instrumentation	BME 771	3	BME 402 or equiv, and senior standing; graduate standing or permission of instructor
Advanced Medical Devices and Design	BME 779	3	BME 679 or permission of instructor

Please contact Cory at [matyas.3@osu.edu](mailto:matyas.3@osu.edu) if you have questions. Thank you!

**Appendix C: BME Minor program – Proposed Curriculum Advising Sheet**

All students must take 12 credit hours total from the lists below including BME 3000 and 1 additional course from Set A: either Physiology or other biological science course. The remainder of the courses – 6 credit hours (i.e., 2 courses) – should be selected from those listed in Set B, starting with at least one 'Domain' course.

To enroll in Minor, an **Undergraduate Minor Program Form** ([http://www.bme.ohio-state.edu/bmeweb3/bme\\_uqminor.html](http://www.bme.ohio-state.edu/bmeweb3/bme_uqminor.html)) must be signed by your MAJOR advisor, and then brought to BME to be filed as soon as you begin your first minor class.

**SET A**

Course no.	Title	Cr Hrs	Prerequisites	Offered
Varies	Physiology or biological science course	3	Varies with course	
Examples: EEOB 232, PhysioCB 311, BIOL 113 or equiv.				

**AND**

BME 3000	Introduction to Biomedical Engineer.	3	Physics 1, Eng Calc II; concur ME 2040 and BIOL 113s	Au
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**SET B**

Course no.	Title	Cr Hrs	Prerequisites	Offered
<b>BME Domain Courses</b>				
Bioimaging	BME 4110	3	BME 2000 or 3000, Physics 2, Math 3 and ANAT 2200	Au
Biotransport	BME 4210	3	BME 2000 or 3000, Math 3, ME 500, ANAT 2200, and EEOB 415	Sp
Biomaterials	BME 4310	3	BME 2000 or 3000, MSE 2010, Math 3, ME 2040, ANAT 2200, and concur EEOB 415	Au
Biomechanics	BME 4410	3	BME 2000 or 3000, Math 3, ME 2040, ANAT 2200, and EEOB 415	Sp
Molecular, Cell & Tissue Engineering	BME 4510	3	BME 2000 or 3000, Math 3, ANAT 2200, Biochem 511, and EEOB 415	Sp
Biomedical Micro/Nanotechnology	BME 4610	3	BME 2000 or 3000, MSE 2010, Biochem 511, and ANAT 2200	Sp
<b>Advanced BME Courses</b>				
Cardiovascular Bioengineering	BME 5001	3	Senior or grad standing in Engineering, Medicine, or Science; or permission of instructor	
Biomed Microscopic Imaging	BME 5110	3	BME 4110 or equiv, and senior or grad standing; or permission of instructor	
Biomedical Optics	BME 5120	3	BME 4110 or equiv, and senior or grad standing in Engineering or Science; or permission of instructor	
Advanced Biotransport	BME 5210	3	BME 4210 or equiv, and senior or grad standing; or permission of instructor	
Advanced Biomaterials	BME 5310	3	BME 4310 or equiv, and senior or grad standing; or permission of instructor	
Biopolymer Structure and Function	BME 5359	3	BME 2000 or 3000, Chem 231 or equiv, and senior or grad standing; or permission of instructor	
Mechanobiology	BME 5420	3	Senior or grad standing; or permission of instructor	
Tissue Mechanics	BME 5421	3	ME 540 or equiv, Math 3 or equiv, ANAT 2200 or equiv, and senior or grad standing; or permission of instructor	
Finite Element Analysis Applications in BME	BME 5430	3	Math 3 or equiv, ANAT 2200 or equiv, and senior or grad standing; or permission of	

			instructor	
Advanced Tissue Engineering	BME 5510	3	BME 4510 or equiv, and senior or graduate standing; or permission of instructor	
Cell Engineering	BME 5520	3	Chem 2 or equiv, and senior or grad standing; or permission of instructor	
Biomedical Microdevices	BME 5610	3	BME 4610, and senior or grad standing; or permission of instructor	
Medical Devices and Design	BME 5639	3	BME 2000 or 3000, and senior or grad standing; or permission of instructor	
Biomedical Ultrasound	BME 5186	3	BME 4110 or equiv, and senior or grad standing; or permission of instructor	
Soft-Tissue Biomaterials	BME 5352	3	BME 5310 or permission of instructor	
Hard-Tissue Biomaterials	BME 5353	3	BME 5310 or permission of instructor	
Cellular Mechanics	BME 5470	3	ME 2040 or equiv, Math 3 or equiv, BME 4410 or equiv, and senior or grad standing; or permission of instructor	
Biofluid Dynamics of Phys Systems	BME 5475	3	BME 4410 or equiv, ME 2040 or equiv; and senior or grad standing; or permission of instructor	
Biomedical Nanotechnology	BME 5661	3	BME 4610 or equiv, and senior or grad standing; or permission of instructor	
Micro and Nano Fluidics	BME 5663	3	MechE 504 or permission of instructor	
Advanced Biomedical Nanotechnology	BME 5662	3	BME 5661 or permission of instructor	
Cellular Nanotech	BME 5665	3	Senior or grad standing in engineering; or permission of instructor	
BioMEMS Microfabrication	BME 5667	3	BME 5610 or permission of instructor	
Biomedical Transducers	BME 5668	3	Senior or Grad standing in engineering; or permission of instructor	
Advanced Medical Devices and Design	BME 5669	3	BME 5639 or permission of instructor	
Biomedical Instrumentation	BME 5771	3	BME 3702 or equiv, and senior or grad standing; or permission of instructor	

Please contact Cory at [matyas.3@osu.edu](mailto:matyas.3@osu.edu) if you have questions. Thank you!