TO: The Faculty of the College of Engineering

FROM: School of Agricultural and Biological Engineering

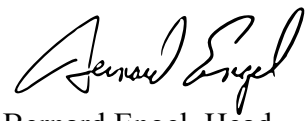
RE: New Undergraduate Course, ABE 22600 Biotechnology Lab I

The faculty of the School of Agricultural and Biological Engineering have approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

Course no. **ABE 22600 Biotechnology Lab I**
Terms offered – Fall, Lab 4 hours, Cr. 2
Requisites, Restrictions, and Attributes: None

Description: Focuses on nucleic acid manipulation. Modules include, making a eukaryotic library, identifying clones, sub-cloning into a bacterial expression vector and verification of the clone's identity by restriction analysis and DNA sequencing. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures. ABE 22600 content is primarily based on biological sciences, not engineering.

Reason: ABE is creating ABE 22600 for the purpose of cross-listing with the existing IT 22600. This is to reflect increased involvement of ABE instructors and students as well as ABE's significant resource support for this course. In Fall 2016, IT 22600 was taught by two faculty members, each with joint appointments in ABE (50% & 75%), and 49 out of 83 (59%) of registered students were ABE. The ABE 22600 Form 40 will be routed through Agriculture. The course descriptions are identical excepting the final statement which is included for ABET purposes.



Bernard Engel, Head
School of Agricultural and Biological Engineering

SYLLABUS ABE 22600
Fall 2016
BIOTECHNOLOGY LAB I

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Class Time: Lab (Section I) 9:30-11:20 T/R (DLRC128)
Lab (Section II) 11:30-1:20 T/R (DLRC128)
Lab (Section III) 1:30-3:20 T/R (DLRC128)
Lab (Section IV) 3:30-5:20 T/R (DLRC128)

Office Hours: Available by appointment

Course Description:

The course is part of the Howard Hughes Medical Institute's (HHMI) (http://www.hhmi.org/grants/sea/) National Genomics Research Initiative (NGRI) and is truly a research experience. Students will engage in hands-on discovery as scientists with the ultimate objective of contributing new mycobacteriophage (viruses that infect mycobacteria) genomes to the scientific literature and public databases (http://www.hhmi.org/news/pdf/hatfulljacobs.pdf).

Students isolate bacteriophage from local soil samples, purify them, perform electron microscopy, and isolate the viruses' DNA. During winter break, DNA samples will be sent to an external site for sequencing. In a following course, CNIT 227 (offered in spring), students download their sequence information from the Internet, annotate their selected phage genome (that is, identify the genes and other structures present), and compare their genome to other

phage genomes. All participants will share their discoveries, ideas, and challenges via the HHMI Science Education Alliance wiki (http://www.hhmi.org/seawiki/dashboard.action).

The objective of this course is to introduce the student to the step-by-step process of scientific discovery while developing adept technique in the application of several basic procedures commonly used in biotechnology research in both academic and industrial settings. Students will maintain a scientific notebook, learn to apply experimental design, develop critical thinking skills in the critique of journal articles, and use computer databases. More specifically, this course focuses on current laboratory techniques used to isolate, manipulate and identify biological molecules such as nucleic acids and proteins. Basic laboratory techniques (solution making, buffer preparation, good safety techniques), sterile technique and compliance procedures will also be discussed.

Textbook:

1. Phage Discovery Guide---Laboratory Manual by the Howard Hughes Medical Institute (posted on Blackboar)

General Objectives:

A. The student will be able to identify and define the basic terms within the field of biotechnology
B. The student will understand the basic concepts of the field of biotechnology
C. The student will understand the process of science and its interrelationship with technology and engineering
D. The student will acquire basic research skills such as
    a. The student will be able to perform techniques currently used in cell, molecular, and microbiology, while understanding the rationale behind the specific approaches.
    b. The student will be able to explain the experimental basis of techniques used, indicating the significance of the work, presenting, calculating, and discussing the data, and drawing conclusions.
    c. Given a specific biological question, the student will be able to determine appropriate applications of specific cell, molecular, and microbiological techniques.
    d. The student will gain experience in dissecting and extracting pertinent information from scientific journal articles.

Course Rationale:

The course objectives will be accomplished through critical exploratory readings, lecture/discussion, and laboratory and multimedia experiences designed to employ approaches used in biotechnology.
This is a 2 hour course intended for undergraduate students and is one of the core couses within the interdisciplinary program in biotechnology. The course will cover several techniques employed in biotechnological research. Lectures/discussion/labs will emphasize experimental design, technical applications and include the use of appropriate instrumentation.

Evaluation of Student Performance:

Assigned Readings and Reflections:
Readings and multimedia resources will be assigned to provide more information and background on the concepts applied in the research laboratory. There will be reflections over the laboratory activities and other resources. Reflections will be completed throughout the semester and submitted electronically to provide updates of laboratory progress, troubles encountered, and upcoming plans in the laboratory plans.
Lab Notebooks:

Lab notebooks will be maintained electronically and checked regularly throughout the semester for quality following the guidelines in the phage discovery guide laboratory manual. Lab notebooks will be used to document progress, record data, including evidence such as pictures of representative plates and electron micrographs.

Final Presentation and Report:

A final presentation and report will be completed to summarize research findings from the semester and outline potential future areas of research. The report will follow the rubric provided for a research paper in the phage discovery guide laboratory manual and the final presentation will be prepared and shared virtually with peers.

Laboratory performance. A portion of your grade (10%) will also depend on laboratory performance including, but not limited to, any of the following:
• Arriving late to class
• Being unprepared for the exercise
• Leaving the laboratory before completing the exercise
• Failing to clean up after an experiment
• Violating safety regulations
• Conducting yourself unprofessionally

General Course Policies

Contacting Dr. Clase and Dr. Rickus: Email. Sometimes email will be fast (within the hour), but sometimes email will be slow (many days). We are happy to correspond by email, but don't count on instantaneous communication. **Phone.** Leave a voicemail for urgent matters. Any issues regarding attendance should be communicated through direct (phone or voicemail) communication.

Missed or Late Work: Assignments must be turned in at the beginning of class or submitted via Blackboard Learn. Assignments will not be accepted via email unless special arrangements have been made in advance.

Late assignments will not be accepted unless special arrangements have been made with the instructor, preferably in advance. If prior arrangements have not been made, missed or late assignments will not receive credit. See policy below regarding arriving late/leaving early. Assignments can be accepted early.

Grade Complaints: Grade complaints must be submitted in writing to the instructor within 1 week after the graded material is returned to the student. Grade complaints will be subject to an entire regrade. All grades will be posted in Blackboard.

Use of Technology: Computers and other technologies are welcome in class when related to the course but please be professional and keep cell phone or other uses of technology, i.e. texting, social media, to a minimum as it may be distracting to both your fellow classmates and instructors and also unsafe in a laboratory environment.

Class Participation: You should attend all classes. Please see a more detailed description of Purdue's attendance policy below. You are expected to be both punctual and prepared for group activities and discussion. In addition, you are expected to stay for the entire class period. It is simply a matter of courtesy to your fellow students and the instructors. Past experience shows that successful students were those who attended class, participated in laboratory activities, and completed all assignments.

Evaluation:
The final grades for the course will be determined by a total accumulation of points from all activities and assignments. Individual progress toward course objectives and final grades will be computed based on the following weights:

Assignments	**Percentage**
Lab Notebooks	25
Reflections	15
Laboratory Performance	10
Final Presentation	25
Final Research Report	25
Total	100

Grading Scale:

Grade	**GPA Value**	**% Range**
A	4.0	93-100
A-	3.7	90.0-92.9
B+	3.3	87.0-89.9
B	3.0	83.0-86.9
B-	2.7	80.0-82.9
C+	2.3	77.0-79.9
C	2.0	73.0-76.9
C-	1.7	70.0-72.9
D+	1.3	67.0-69.9
D	1.0	63.0-66.9
D-	0.7	60.0-62.9
F	0.0	<60.0

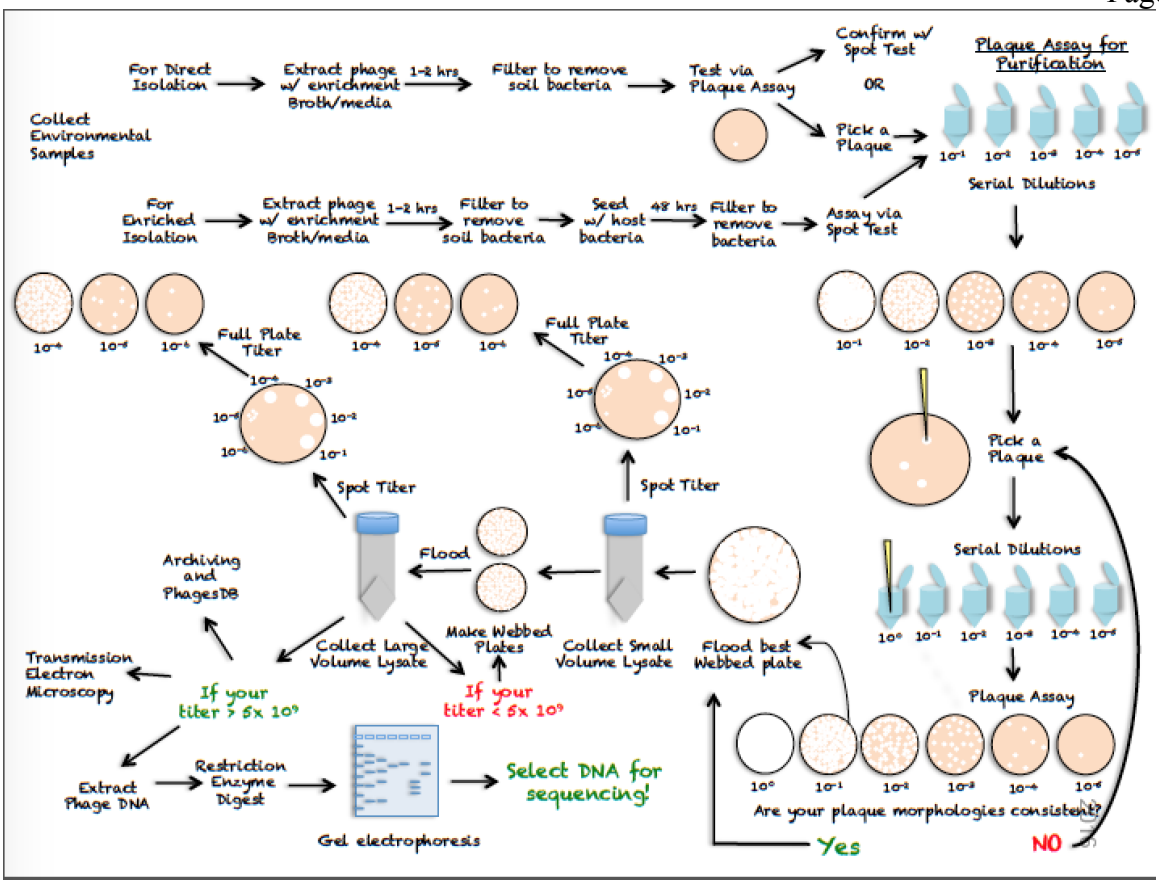
ABE 22600—Biotechnology Lab I
Fall 2016 Tentative Schedule

Weeks 1-4	**Isolate and purify phages from environmental samples** **Phage Discovery Guide: Chapters 1-6**	
Week	**Tuesday**	**Thursday**
One August 23	Course Overview; Lab Safety; Lab Notebooks;	Aseptic Technique Pipetting/Micropipetting; Aseptic Technique Demo; Sample Collection
Two August 30	Demo: preparing/plating top agar Direct plating of individual samples	Pick plaques; perform spot assays or titer from direct platings; titer and purification direct plating
Three September 6	Plaque assays on confirmed samples; Continue purification.	Continue purification (need to repeat minimum 3x)
Four September 13	Plaque assays on confirmed samples; Continue purification.	Continue purification (need to repeat minimum 3x)
Weeks 5-6	**Amplify purified phage** **Phage Discovery Guide: Chapter 7**	
Five September 20	Prepare small volume lysate with webbed plate	Continue preparation lysate (may still be continuing purification)
Six September 27	Make webbed plates	Collect large volume lysate
Weeks 7-9	**Isolate phage genomic DNA and perform restriction digest analyses of genomic DNA samples** **Phage Discovery Guide: Chapters 9-10**	
Seven October 4	Extract phage DNA	Extract phage DNA
Eight October 11	**OCTOBER BREAK (No Class)**	Extract phage DNA
Weeks 9-12	**Evaluate quality of DNA samples and decide which genomes to submit for sequencing**	
Nine October 18	Restriction enzyme digest and Gel electrophoresis	Restriction enzyme digest and Gel electrophoresis

Ten October 25	Restriction enzyme digest and Gel electrophoresis	Restriction enzyme digest and Gel electrophoresis
Eleven November 1	Class discussion of restriction enzyme analysis and quality gels	Class discussion of restriction enzyme analysis and quality gels
Weeks 12-15	**Transmission Electron Microscopy, prepare samples of phage lysates for archiving, and input information about phage samples on the phage database** **Phage Discovery Guide: Chapter 8**	
Twelve November 8	Prepare for Transmission Electron Microscopy Sign up for Session Time	Transmission Electron Microscopy Session 1 ***Thursday November 10 from 1:00 to 5:00 pm***
Thirteen November 15 ****Final Deadline for Sequencing--November 18***	Transmission Electron Microscopy Session 2 ***Tuesday November 15 from 1:00 to 5:00 pm***	Transmission Electron Microscopy Session 3 ***Thursday November 17 from 9:00 am to 1:00 pm***
Fourteen November 22	Transmission Electron Microscopy Session 4 ***Tuesday November 22 from 9:00 am to 1:00 pm***	**THANKSGIVING VACATION (No Class)**
Fifteen November 29	Prepare samples for archiving and phage database	Prepare samples for archiving and phage database
Sixteen December 6	View and comment on final presentations	View and comment on final presentations
Seventeen December 13	Finals Week Final Research Paper due	

*NOTE: The table above represents a tentative semester schedule and is subject to change per the discretion of the instructor.

Due to the nature of experimental research, the course syllabus for this laboratory will be more flexible than in a normal course. **Attendance is required** at all scheduled laboratory meetings. As well, students should expect to attend **additional open laboratory times** as needed each week depending on the progress of their particular samples.


Collect Environmental Samples
For Direct Isolation
Extract phage w/ enrichment Broth/media
1-2 hrs
Filter to remove soil bacteria
Test via Plaque Assay
Confirm w/ Spot Test
OR
Pick a Plaque
Plaque Assay for Purification
Serial Dilutions
For Enriched Isolation
Extract phage w/ enrichment Broth/media
1-2 hrs
Filter to remove soil bacteria
Seed w/ host bacteria
48 hrs
Filter to remove bacteria
Assay via Spot Test
Full Plate Titer
Spot Titer
Flood
Archiving and PhagesDB
Collect Large Volume Lysate
Make Webbed Plates
Collect Small Volume Lysate
Flood best Webbed plate
Transmission Electron Microscopy
If your titer > 5x 10⁹
If your titer < 5x 10⁹
Extract Phage DNA
Restriction Enzyme Digest
Gel electrophoresis
Select DNA for sequencing!
Are your plaque morphologies consistent?
Yes
NO