SEED Academy Spring 2008
Synthetic Biology Syllabus, 12th Grade

Contact Information

During SEED Saturday class session hours, we can be reached in the laboratory

Lab: 31-068
Lab Phone: 617-252-1548

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Justin Buck (Instructor)
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Office Hours

Office hours, tutoring, and homework help will be held on a weekly basis. Time and location of office hours will be announced at the beginning of the semester.

Description / Goal / Objective

Synthetic Biology is an exciting emerging field which seeks to develop and facilitate the engineering of biology as an intentional, rational, standardized, and reproducible discipline. Synthetic Biology takes a ground up approach to the creation of living machines for achieving a wide variety of engineering objectives in fields ranging from medicine to environment and energy to computation.

The goal of this class is to gain practical, hands-on experience in molecular biology techniques relevant to the field of Biological Engineering while learning the design concepts, methods, and rationale behind Synthetic Biology.

During the course, we will learn the process of cloning a gene from start to finish including using PCR to amplify a gene of interest, BioBrick assembly of DNA fragments, transformation of DNA into a host bacteria strain, and controlled expression through a variety of expression systems. Finally, we characterize the systems we have created so that they may be understood and used in a quantitative fashion.

Course Website

Course materials will be posted online at the course website (wiki format). Students are expected to be familiar with using the website for access to reading material, assignments, discussion, and project submission. The course website can be found at:

http://openwetware.org/wiki/SEED/2008

Grading

Assignments (30%)

Assignments are an essential component of the class. We rely on homework to extend learning objectives, assess progress, and reinforce key concepts. We encourage students to work together and discuss the class material, but all work is expected to reflect the student's individual work.

Homework will be assigned for each class session and will include: readings on course material, written summaries and critical evaluations, various problems and calculations, and final project design and development.

Quizzes & Exams (30%)
To determine the student progress and emphasize critical concepts, several brief in class quizzes will be given during the semester.

One comprehensive exam will be given at the end of class to assess success in achieving course objectives. The exam will be short and will encompass all of the topics covered in lecture, laboratory, and homework.

Labwork & Safety (20%)
As a laboratory class, completion of assigned labwork and strict adherence to the safety policy are of the utmost importance. There will be no tolerance for breaking safety rules. Students will be expected to work diligently to complete each experiment.

Attendance & Participation (20%)
Participation in class discussions is critical for comprehension of course material. Students are expected to actively join in on class discussions and ask questions to clarify confusing points that may come up.

Attendance / Schedule / Punctuality

Since a large portion of the course material includes labwork, attendance is required at all class sessions. Some information provided in lecture will not be available online. If an absence from class is necessary, the student is expected to complete all relevant assignments and to attend office hours/tutor session to review the material missed.

Class will be held during the first half of the morning session (9:45 am – 11:00 am) and all of the afternoon session (1:15 pm - 3:00 pm). Biological experiments take significant time to setup and run and are very sensitive to timing. Students are expected to arrive promptly at the beginning of class sessions ready to begin. Restroom access is inconvenient from 31-068 and you will be very busy during the class period, please try to plan accordingly.

Lab Safety

Our first priority is to create a safe environment for learning and discovery. Since this class will be taught in a laboratory setting, there are special considerations for classroom safety. The first day of class will include a biosafety training session; students are required to attend this session and follow all practices describe during the presentation. Some key highlights of laboratory safety:

- ✓ NO eating or drinking in Lab
- ✓ NO open-toed shoes
- ✓ NO shorts, skirts, or dresses
- ✓ Safety glasses & laboratory coat MUST be worn at ALL times
- ✓ Gloves required when performing experiments
- ✓ Use only equipment and materials you are instructed

SEED Academy Spring 2008
Synthetic Biology Module Session Summary

Session Number	Date	Lecture Topic	Laboratory Activity
1	**February 9**	• Introduction: What is Synthetic Biology? • History, Goals, Applications, and Methods Overview	• Biosafety Training • Fundamental Biological Laboratory & Sterile Techniques • Project Demonstrations
2	**February 23**	• The Central Dogma of Biology • DNA Structure & Modification Processes • What is Cloning?	• Restriction Enzyme DNA Digestion • Agarose Gel Assay for Restirction Digest Products
3	**March 1**	• PCR Technology • Synthetic Biology Design Pardigm (Parts, Devices, Systems)	• PCR Amplification of Beta-galactosidase (LacZ-alpha) • Identification of product
4	**March 8**	• Cloning vs. BioBrick Assembly Process	• BioBrick Part Preparation • Restriction Digest • Start Gel Purification
5	**March 15**	• Fundamental Engineering Concepts in Application to Synthetic Biology	• Finish Gel Purification • Ligation & Transformation
6	**March 22**	• DNA Sequencing & Synthesis Technology	• Clone Stock Preparation • Plasmid Mini-Prep • Prepare DNA for Sequencing
7	**April 5**	• Phases of Cell Culture Growth • Enzyme Kinetics	• Gene Expression Induction • Beta-galactosidase Assay
8	**April 12**	• Part Characterization • Control Systems Design	• Constitutive Promoter Analysis
9	**April 26**	• Experimental Design	• Modification of Physiological Conditions & Affect on Gene Expression / Enzyme Activity
10	**May 3**	• **Exam** • Pitfalls in Synthethic Biology • Concluding Remarks	• Finish Experiment on Condition Modification • Data Analysis • Finish Course Projects