

BIOE44: Fundamentals for Engineering Biology Lab

Lectures: Tuesday/Thursday 9-9:50 AM, Shriram 104

Labs: Tuesday/Thursday, 1-4 PM or 4-7 PM, Shriram 114

Instructors: Dr. Christina Smolke (csmolke@stanford.edu) and Dr. Joseph Shih (jdshih@stanford.edu)

Office hours: Dr. Smolke – 10-11 AM Mon or by appointment, Shriram 237

Dr. Shih – 12-1 PM Mon or by appointment, Shriram 283

TAs: 1-4PM: Maya Nagasawa (maya52@stanford.edu) and Mathias Voges (mvoges@stanford.edu)

4-7PM: Sung Jin Park (spark@stanford.edu) and Tianyi Wang (tywang88@stanford.edu)

TA Office hours: TBD

Supplementary Textbooks:

At the Bench: A Laboratory Navigator by Kathy Barker. We suggest this textbook as a primer for students who are new to working with living organisms in the lab environment.

Statistics at the Bench: A Step-by-Step Handbook for Biologists by Rebecca W. Doerge and Martina Bremer. We suggest this textbook as a primer for students new to statistics who have not taken the CME series or have not had any MATLAB experience.

Course outline and readings

Introduction to next-generation techniques in genetic, molecular, biochemical, and cellular engineering. Lab modules build upon current research including: gene and genome engineering via decoupled design and construction of genetic material; component engineering focusing on molecular design and quantitative analysis of experiments; device and system engineering using abstracted genetically encoded objects; and product development based on useful applications of biological technologies.

A syllabus with associated readings is listed below. Readings should be completed prior to the lecture on the day indicated.

Date	Main Topic	Lecture (Instructor)	Lab	Assignment and Practical Due Dates	Required & Suggested Readings
9/23	Introduction	Who-What-When-Where-How-Why? (Both)	Welcome to BIOE44, Self-Assessment #1		
9/25	Introduction	Organisms you will be working with (Shih)	P1 P2: Part 1 P4: Part 1		How to Use a Pipette.pdf <i>At Bench: 89-99 (Chapter 5: Laboratory Notebooks), 247-296 (Chapter 11: bacteria; DNA)</i>
9/30	Practical tools	Prokaryotic Gene Design (Smolke)	P3: Part 1A P4: Part 2 P5: Part 1	HW #1 due: Ideas art gallery	
10/2	Practical tools	PCR Technology & Uses (Shih)	P2: Part 2 P3: Part 1B P4: Part 3	Group formation	Watch PCR video: http://www.youtube.com/watch?v=eEcy9k_KsDI
10/7	Practical tools	Eukaryotic Gene Design (Shih)	P2: Part 3 P3: Part 2A P4: Part 4		<i>At Bench: 187-245 (Chapter 9: Working without Contamination; Chapter 10: Eukaryotic cell culture), 375-392 (Electrophoresis DNA gels)</i>

10/9	Practical tools	Reading Scientific Papers (Smolke)	P3: Parts 2B and 3 Sharing ideas	HW #2 due: Top 3 project ideas	Assigned paper.
10/14	Engineering Concepts	Abstraction (Smolke)	Experimental design	Project topic selected	<i>At Bench: 69-87 (Chapter 4: How to set up an experiment) Statistics: 44-55 (Chapter 4: Design of experiments)</i>
10/16	Engineering Concepts	Standardization (Smolke)	Experimental measurement	Proposed project approved	<i>Statistics: 57-69 (Chapter 5: Confidence intervals); 71-94 (6.1 & 6.2: Hypothesis testing principle and common tests)</i>
10/21	Practical tools	Experimental Design and Measurement A (Shih)	Generate initial DNA designs	HW #3 due: Paper summary	
10/23	Practical tools	Experimental Design and Measurement B (Shih)	Design feedback & part polishing	P5 Part 1 due Proposal due 10/26	
10/28	Engineering Concepts	Engineering Cycle & Decoupling via Synthesis (Smolke)	P1 & P2 testing	P1 Concepts due	
10/30	Beyond the Lab	Model Organisms as Chassis (Shih)	Run PCR gels P3 testing		
11/4	Beyond the Lab	Lab: check cells	DNA2.0 visit	P2 Concepts due	
11/6	Beyond the Lab	Safety and Security (Smolke)	Experimental design review (peer to peer)	HW #4 due: Daily lab plan	"Recipe for Destruction" and "1918 Flu and Responsible Science"
11/11	Beyond the Lab	Security discussion (Smolke)	Get DNA - Start project testing and glycerol stocks	P3 Concepts due, HW #5 due: Commentary on security articles	
11/13	Beyond the Lab	Ownership, Sharing, Innovation (Smolke)	Project testing		PatentGuide.pdf
11/18	Needs and Opportunities	Guest speaker	Project testing	P4 Concepts due	
11/20	Needs and Opportunities	Guest speaker	Project testing	P1-P4 completed by 11/21	
11/25	Thanksgiving	No class			
11/27	Thanksgiving	No class			
12/2	Needs and Opportunities	Guest speaker	Project testing	P5 Concepts due	
12/4	Needs and Opportunities	Guest speaker	Project testing, Self-Assessment #2		
12/11	Final Presentation	3:30-6:30PM, location TBD		P5 Part 2 due Final Paper due 12/6	

Grading

Your grade will be based on five factors: Lab practicals, a sensor/actuator design project, pre-lab questionnaires, homework and lab checks, and an instructor-evaluated participation grade. The breakdown is as follows:

Lab practicals – 40% total, 25% conceptual knowledge, 15% skill

- P1: Getting DNA out of cells
- P2: Polymerase Chain Reaction
- P3: Getting DNA into cells
- P4: Making clonal glycerol stocks
- P5: Designing and documenting a part

Sensor/Actuator project – 40%

Proposal (15%) – Group written, 6 page, 3000 word limit (including figures, not including references), due by 11:59PM, 10/26

Group presentation (5%) – during finals week

Final paper (20%) – Group written, 8 page, 4000 word limit (including figures, not including references), due by 11:59PM, 12/6

Pre-lab questionnaires – 5%

To ensure you look over the lab protocol prior to the start of lab, in the first 4 weeks of class we will post pre-lab questionnaires in the Coursework Assignment tab. These will be a few questions about the lab protocols for each day that you must answer prior to the start of that lab.

Homeworks and lab checks – 10%

There will be 5 homeworks throughout the quarter. Homeworks are usually relevant to the next or previous lecture or lab and are due at the beginning of lecture or lab (depending on the homework). No credit will be given for handing in late homework! For lab checks, we require you to maintain a lab notebook and at the end of each Tuesday lab (starting after the first lab) we will check if you have important information recorded in your notebook and if your notebook is generally comprehensible. We will also check if you kept your lab bench clean at the end of each lab.

Instructor/TA assessment of participation and effort – 5%

Late policy for practical concepts, proposal, and final paper: -10% each day late up to 5 days, no credit after 5 days.

Note: We purposefully design the course so that the median should be between B+/A-. However, it will take substantial effort to get an A and a lot of effort to get an A+. Be aware that there may be little or no curve.

Coursework and Piazza

The course website is at <https://coursework.stanford.edu/portal/site/F14-BIOE-44-01>

Any weekly reading not from the textbooks will be posted on Coursework. Announcements will also be made through the Coursework site. Homework assignments, project proposal, and papers should be submitted via the Coursework Dropbox. When submitting, please check the box informing the instructors that you have submitted the assignment.

We will be using Piazza to answer student questions throughout the quarter. To sign up, please go to piazza.com/stanford/fall2014/bioe44

Conclusion

As we move through the semester, we may adjust the material to suit the composition, interest, and progress of the class. We welcome your suggestions about what topics and concepts you would like addressed further. Good luck and welcome to BIOE44!