**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 (sppark@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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Main Topic</th>
<th>Lecture (Instructor)</th>
<th>Lab</th>
<th>Assignment and Practical Due Dates</th>
<th>Required &amp; Suggested Readings</th>
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<tbody>
<tr>
<td>9/23</td>
<td>Introduction</td>
<td>Who-What-When-Where-How-Why? (Both)</td>
<td>Welcome to BIOE44, Self-Assessment #1</td>
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| 9/25 | Introduction | Organisms you will be working with (Shih) | P1  
P2: Part 1  
P4: Part 1 | | How to Use a Pipette.pdf  
*At Bench: 89-99 (Chapter 5: Laboratory Notebooks), 247-296 (Chapter 11: bacteria; DNA)* |
| 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 | | *At Bench: 187-245 (Chapter 9: Working without Contamination; Chapter 10: Eukaryotic cell culture), 375-392 (Electrophoresis DNA gels)* |
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<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
<th>Other Details</th>
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<tbody>
<tr>
<td>10/9</td>
<td>Practical tools</td>
<td>Reading Scientific Papers (Smolke)</td>
<td>P3: Parts 2B and 3 Sharing ideas HW #2 due: Top 3 project ideas Assigned paper.</td>
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<td>10/14</td>
<td>Engineering Concepts</td>
<td>Abstraction (Smolke)</td>
<td>Project topic selected At Bench: 69-87 (Chapter 4: How to set up an experiment) Statistics: 44-55 (Chapter 4: Design of experiments)</td>
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<tr>
<td>10/16</td>
<td>Engineering Concepts</td>
<td>Standardization (Smolke)</td>
<td>Proposed project approved Statistics: 57-69 (Chapter 5: Confidence intervals); 71-94 (6.1 &amp; 6.2: Hypothesis testing principle and common tests)</td>
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<tr>
<td>10/21</td>
<td>Practical tools</td>
<td>Experimental Design and Measurement A (Shih)</td>
<td>HW #3 due: Paper summary</td>
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<tr>
<td>10/23</td>
<td>Practical tools</td>
<td>Experimental Design and Measurement B (Shih)</td>
<td>Design feedback &amp; part polishing P5 Part 1 due Proposal due 10/26</td>
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<td>10/30</td>
<td>Beyond the Lab</td>
<td>Model Organisms as Chassis (Shih)</td>
<td>Run PCR gels P3 testing</td>
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<td>11/4</td>
<td>Beyond the Lab</td>
<td>Lab: check cells</td>
<td>DNA2.0 visit P2 Concepts due</td>
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<td>11/6</td>
<td>Beyond the Lab</td>
<td>Safety and Security (Smolke)</td>
<td>Experimental design review (peer to peer) HW #4 due: Daily lab plan &quot;Recipe for Destruction&quot; and &quot;1918 Flu and Responsible Science&quot;</td>
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<td>11/11</td>
<td>Beyond the Lab</td>
<td>Security discussion (Smolke)</td>
<td>Get DNA - Start project testing and glycerol stocks P3 Concepts due, HW #5 due: Commentary on security articles</td>
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<td>11/13</td>
<td>Beyond the Lab</td>
<td>Ownership, Sharing, Innovation (Smolke)</td>
<td>Project testing PatentGuide.pdf</td>
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<td>11/18</td>
<td>Needs and Opportunities</td>
<td>Guest speaker</td>
<td>Project testing P4 Concepts due</td>
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<td>11/20</td>
<td>Needs and Opportunities</td>
<td>Guest speaker</td>
<td>Project testing P1-P4 completed by 11/21</td>
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<td>11/25</td>
<td>Thanksgiving</td>
<td>No class</td>
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<tr>
<td>11/27</td>
<td>Thanksgiving</td>
<td>No class</td>
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<tr>
<td>12/2</td>
<td>Needs and Opportunities</td>
<td>Guest speaker</td>
<td>Project testing P5 Concepts due</td>
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<td>12/4</td>
<td>Needs and Opportunities</td>
<td>Guest speaker</td>
<td>Project testing, Self-Assessment #2</td>
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<td>12/11</td>
<td>Final Presentation</td>
<td>3:30-6:30PM, location TBD</td>
<td>P5 Part 2 due Final Paper due 12/6</td>
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**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 you 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!