Welcome to 20.109

Laboratory Fundamentals of Biological Engineering

Orientation Lecture
Fall 2009
20.109

Laboratory Fundamentals of Biol Eng

Course Mission

- To prepare students to be the future of Biological Engineering
- To teach cutting edge research skill and technology through an authentic research experience
- To inspire rigorous data analysis and its thoughtful communication
Module 1  DNA Engineering
Module 2  System Engineering
Module 3  Biomaterials Engineering

openwetware.org/wiki/20.109(F09)
DNA Engineering: GFP recombination vector

**Experiments**
- Design and create vectors for expressing fluorescent protein in mouse embryonic stem cells
- Use fluorescence to analyze recombination of variously damaged DNA substrates

**Lab Skills**
- Retrieve and manipulate sequences from databases
- Clone PCR-amplified DNA fragments
- Transfect mammalian cells
- Flow Cytometry
System Engineering: Bacterial photography

Lab Skills
- Optimize a system
- Genetic screen
- Western analysis
- Sequence analysis
- $\beta$-gal assay

Experiments
- Measure bacterial photography output
- Screen library for mutations that increase dynamic range of system
- Identify amino acid changes and their consequences
Biomaterial Engineering: Phage battery

Experiments
- Grow gold nanowires on phage surface
- TEM to visualize
- Assemble battery
- Measure capacity

Lab skills
- Phage material production
- Fabrication of bio-based device
- Effect of variation: % Au vs %Ag
## Expectations

<table>
<thead>
<tr>
<th>Some of your expectations of us</th>
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<tbody>
<tr>
<td>• that we will come to class and lab prepared</td>
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<td>• that our assignments are clear and reasonable</td>
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<td>• that we will treat every 109er with respect</td>
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<td>• that we will give everyone equal chance at success</td>
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<table>
<thead>
<tr>
<th>Some of our expectations of you</th>
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<tbody>
<tr>
<td>• that you will come to class and lab prepared</td>
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<td>• that you will not interfere with each other’s learning</td>
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<td>• that you will invest the very best of yourself</td>
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<td>• that you will offer honest and frequent feedback</td>
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Course Details

Lecture  Tuesdays and Thursdays 11-12, 66-144
Lab  Tuesdays and Thursdays 1-5, 56-322

Wednesdays and Fridays 1-5, 56-322

There are no “make-up” labs

Work must be turned in on time

reports, homework: at beginning of lab
lab notebook pages: at end of lab

You will perform experiments in pairs

Assignments can be worked on together but submitted individually
“Celebrations of learning”

50% Written Work  
Modules 1 and 2  

30% Oral Presentations  
Modules 2 and 3  

10% Homework Assignments  

5% Daily Lab Quizzes  

5% Lab Notebooks

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Assignment</th>
<th>% of Final Grade</th>
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<tbody>
<tr>
<td>1</td>
<td>DNA Engineering</td>
<td>&quot;Progress Report&quot;</td>
<td>15</td>
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<tr>
<td></td>
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<td>&quot;Memo&quot;</td>
<td>10</td>
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<tr>
<td>2</td>
<td>System Engineering</td>
<td>research article</td>
<td>25</td>
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<td>3</td>
<td>Biomaterial Engineering</td>
<td>oral presentation of research idea + written text</td>
<td>20</td>
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<tr>
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<td>Journal Club I or II</td>
<td>oral presentation</td>
<td>10</td>
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Foundations/Skills

• Basic Laboratory Skills
  following and designing protocols
  first-hand experience with equipment and procedures
  how to keep a lab notebook

• Robust Quantitative Analysis of Data
  statistical analysis when appropriate
  repetition of protocols to assess quality of findings
  effect of experimental perturbations on outcome

• Verbal and Written Communication
  two oral presentations
  three written reports

• Critical Thinking
  analysis and discussion of primary scientific literature
“what we learn to do we learn by doing…”