Welcome to 20.109
Laboratory Fundamentals of Biological Engineering

Orientation Lecture
Fall 2011
20.109
“Data, data everywhere”

Pre-req: data understanding

<table>
<thead>
<tr>
<th>Lane</th>
<th>Sample</th>
<th>Volume to load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Takelakofeen” system molecular weight standards</td>
<td>10 μl</td>
</tr>
<tr>
<td>2</td>
<td>Hi-Bru positive control protein</td>
<td>50 μl</td>
</tr>
<tr>
<td>3</td>
<td>wild type lipid sensor</td>
<td>50 μl</td>
</tr>
<tr>
<td>4</td>
<td>instant candida 1</td>
<td>50 μl</td>
</tr>
</tbody>
</table>

Diagnostic digest
- mock
- A
- A + EGFP

These are experiments, so you will not find the answers on Wikipedia

20.109
“The most important class you’ll take @ MIT”

- Teaching is not the same as learning
- Studying is not the same as learning

Reality is complex

20.109
“Stuff you need to know”

- We see you as men and women, not boys and girls
- We see you as men and women, not boys and girls

20.109
“Data, data everywhere”

50,000 geotagged photos from Flickr
Map frequency of color hues in photos
Plot high freq color on location

http://bostonography.com/

THE ZOO ON YOUR SKIN

Laboratory Fundamentals of Biological Engineering
"Stuff you need to know"

- Reality is complex

Laboratory Fundamentals of Biological Engineering
"The most important class you’ll take @ MIT"

- We see you as men and women, not boys and girls

- We see you as men and women, not boys and girls

- Reality is complex
20.109
Laboratory Fundamentals of Biological Engineering

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

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

Lab Skills
- Optimize a system
- Genetic screen
- Western analysis
- Sequence analysis
- β-gal assay

Biomaterial Engineering: Phage solar cell
Experiments
- Mineralize phage surface
- TEM to visualize
- Assemble solar cell
- Measure performance

Lab Skills
- Phage material production
- Fabrication of bio-based device
- Effect of variation: Ratio of SWNTs to phage

Expectations
Some of your expectations of us
- that we will come to class and lab prepared
- that our assignments are clear and reasonable
- that we will treat every 109er with respect
- that we will give everyone equal chance at success

Some of our expectations of you
- that you will come to class and lab prepared
- that you will not interfere with each other’s learning
- that you will invest the very best of yourself
- that you will offer honest and frequent feedback
Course Details

Lecture  Tuesdays and Thursdays 11-12, 4-153
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”

45% Written Work Modules 1 and 2
30% Oral Presentations Modules 2 and 3
10% Homework Assignments
5% Daily Lab Quizzes
5% Lab Notebooks
5% Blog and Summary

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Assignment</th>
<th>% of Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Risk Engineering</td>
<td>Assignment</td>
<td>20</td>
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<tr>
<td></td>
<td></td>
<td>Presentation</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>System Engineering</td>
<td>Research Article</td>
<td>10</td>
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<td></td>
<td></td>
<td>Treatment</td>
<td></td>
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<tr>
<td>3</td>
<td>Behavioral Engineering</td>
<td>Final presentation of research idea + written lab</td>
<td>20</td>
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<tr>
<td></td>
<td></td>
<td>Presentation</td>
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<tr>
<td></td>
<td></td>
<td>Overall</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blog &amp; Summary</td>
<td>5</td>
</tr>
</tbody>
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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...”