

Welcome to 20.109

**Laboratory Fundamentals of  
Biological Engineering**

Orientation Lecture  
Fall 2010

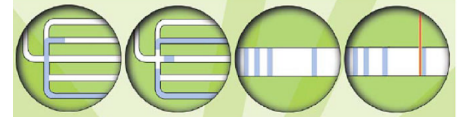
**20.109**

**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

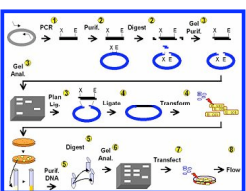
**20.109(F10): Laboratory Fundamentals of Biological Engineering**



[openwetware.org/wiki/20.109\(F10\)](http://openwetware.org/wiki/20.109(F10))

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



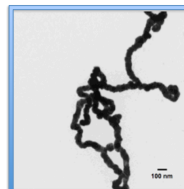
#### Lab Skills

- 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



#### Lab skills

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

#### Experiments

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

### 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

**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

Module	Topic	Assignment	% of Final Grade
1	DNA Engineering	"Progress Report"	15
		"Pg"	5
2	System Engineering	research article	25
3	Biomaterial Engineering	oral presentation of research idea + written text	20
also in 2	Journal Club   or	oral presentation	10
overall		"Blog & Summary"	5

### 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...”