Welcome to 20.109

Laboratory Fundamentals of Biological Engineering

Orientation Lecture

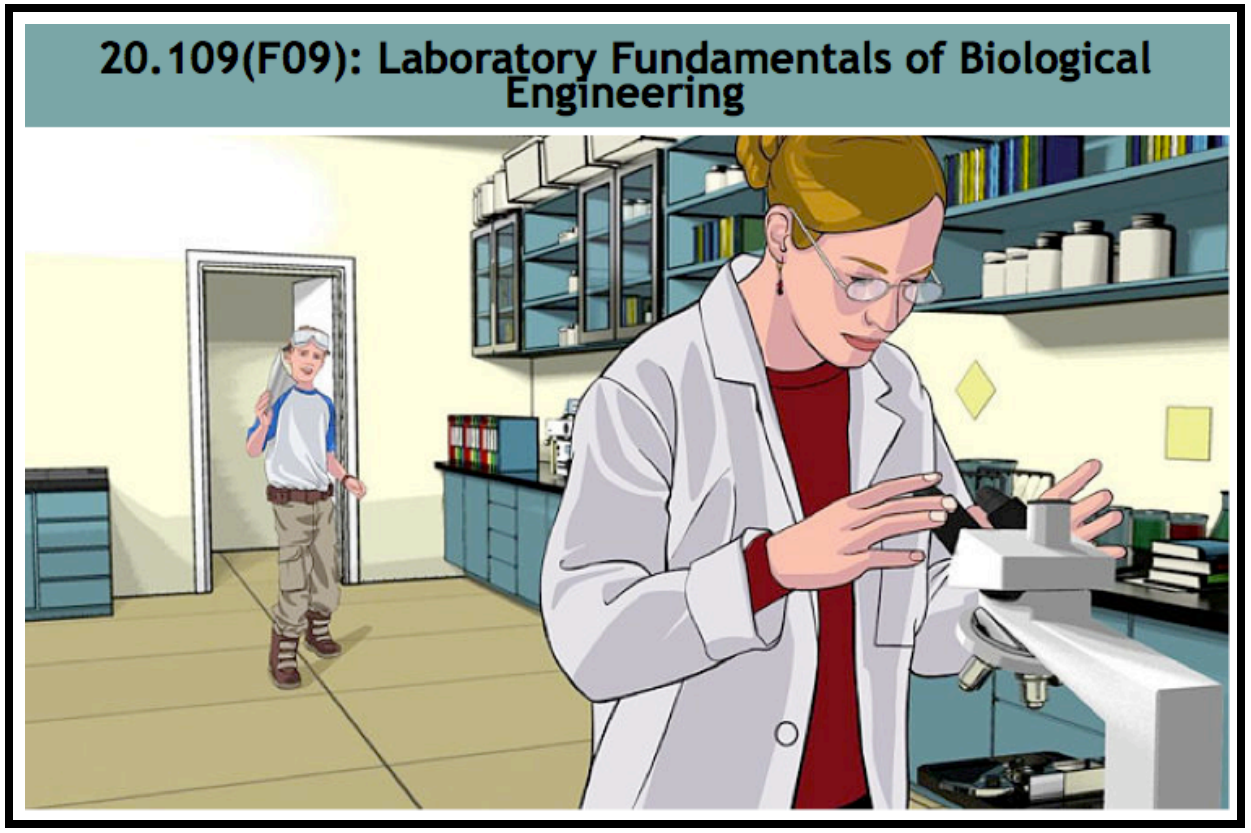
Fall 2009

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

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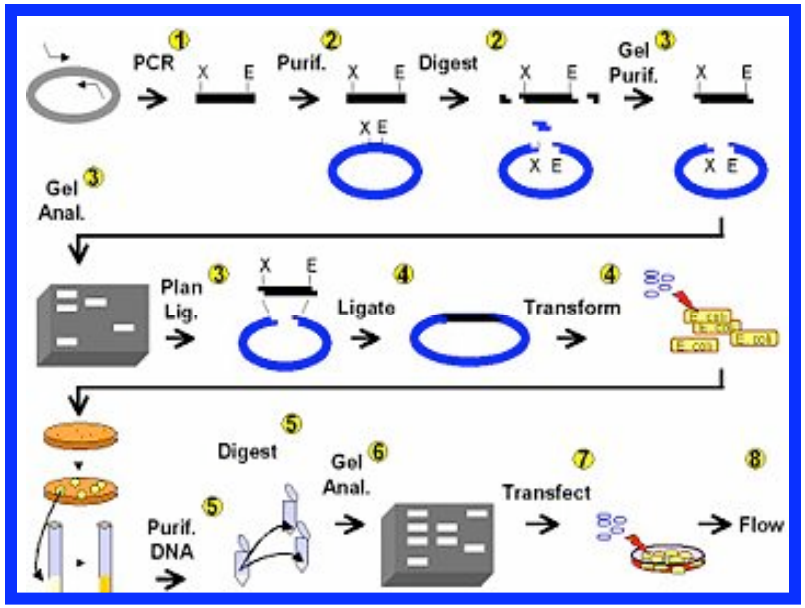
DNA Engineering: GFP recombination vector



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

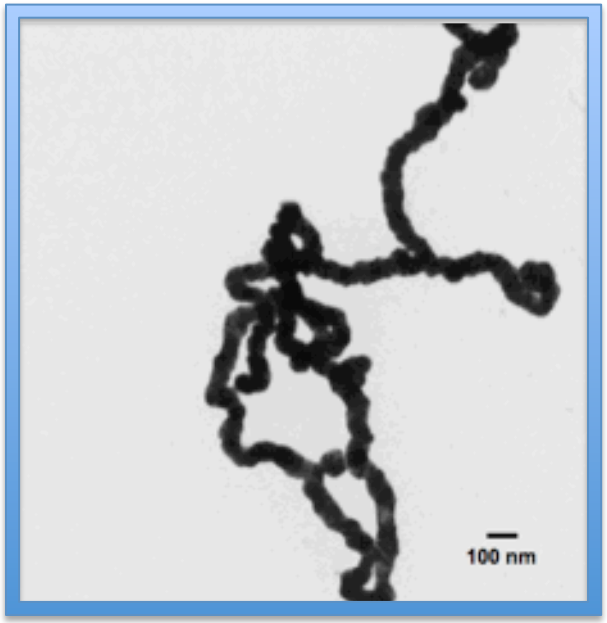
Lab Skills

- Optimize a system
- Genetic screen
- Western analysis
- Sequence analysis
- β-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

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, 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

Module	Topic	Assignment	% of Final Grade
1	DNA Engineering	"Progress Report"	15
		"Memo"	10
2	System Engineering	research article	25
3	Biomaterial Engineering	oral presentation of research idea + written text	20
also in 2	Journal Club I or II	oral presentation	10

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…”