

Welcome to 20.109
Laboratory Fundamentals of
Biological Engineering

Orientation Lecture
Fall 2007

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

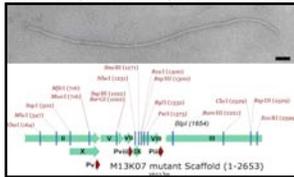
20.109(F07): Laboratory Fundamentals of Biological Engineering



Home People Schedule Fall 2007 Assignments Lab Basics OWR Basics
Genome Engineering Expression Engineering Biomaterials Engineering

Module 1	Genome Engineering
Module 2	Expression Engineering
Module 3	Biomaterials Engineering

Genome Engineering: M13 redesign



Courtesy of Elsevier, Inc. <http://www.sciencedirect.com>. Used with permission.
 Source: Speerthie, L., et al. "Construction of a Microphage Variant of Filamentous Bacteriophage." *J Mol Biol* 228, no. 3 (December 5, 1992): 720-4.

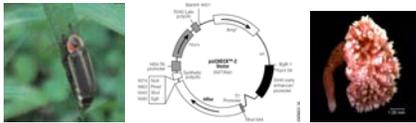
Experiments

- Modify existing genome to tag one coat protein
- Refactor genome, order its synthesis and test
- Compare infection of minimal and robust *E. coli* genome

Lab skills

- DNA manipulations
- digests
- transformation
- electrophoresis
- Western analysis
- Cell & phage culture

Expression Engineering: siRNA



Left: Firefly photo courtesy of Eloise Mason. Used with permission.
 Center: Plasmid map courtesy of Promega Corporation. Used with permission.
 Right: "Sea pansy" (*Renilla reniformis*) courtesy of NOAA. Used with permission.

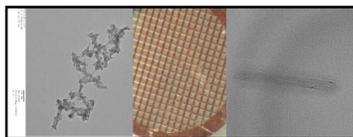
Experiments

- Silence expression of a gene using RNAi
- siRNA design
- transfection
- RNA and protein measurements
- Assess intended and unintended consequences

Lab skills

- Genetic and physical manipulations of mouse ES cells
- Luciferase measurements
- siRNA design
- Microarray analysis

Biomaterial Engineering: phage nanowires



Experiments

- Build prototype electrochromic device
- Grow iridium nanowires on phage surface
- Pattern indium tin oxide slide
- Electrodeposit phage nanowires
- Overlay solid polymer electrolytes

Lab skills

- Phage material production
- TEM
- Fabrication of bio-based device
- Design and variation of experimental conditions

State-of-the-Art Laboratory Classroom

Space for 12 students • Demonstration Area • 20 Computer Drops
• Gas/Vacuum/Air/Water • Modern Equipment •



Cell and Tissue Culture Facility

HEPA Filtered Air • 3 Sterile Hoods • 6 incubators • 2 inverted
microscopes • Modern Culture Equipment



Support Room

Autoclave • Dishwasher • Ice Machine
• CO₂ Source • Vacuum Source



Course Details

Lecture Tuesdays and Thursdays 11-12

Lab Tuesdays and Thursdays 1-5
Wednesdays and Fridays 1-5

There are no "make-up" labs

Work must be turned in on time

lab 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

Grading

50% Written Work **Modules 1 and 2**

30% Oral Presentations **Modules (1 or 2) and 3**

10% Homework Assignments

5% Daily Lab Quizzes

5% Lab Notebooks

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
two written reports

• Critical Thinking

Analysis and discussion of primary scientific literature
