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

Module 1  Genome Engineering
Module 2  Expression Engineering
Module 3  Biomaterials Engineering
openwetware.org/wiki/20.109(F07)
Genome Engineering: M13 redesign

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

Experiments
- Silence expression of a gene using RNA
  - 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 indium 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, 13-3101

Lab  
Tuesdays and Thursdays 1-5, 13-3095
Wednesdays and Fridays 1-5, 13-3095

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