Welcome to 20.109

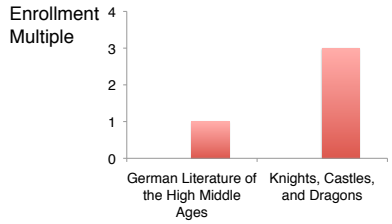
Laboratory Fundamentals of Biological Engineering

Orientation Lecture
Fall 2011

HOME / NEWS / EDUCATION

Colleges find juicy titles swell enrollment The Boston Globe

Many opt for courses like 'Economics of Sin'



from Boston College German Studies Professor Michael Resler

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Laboratory Fundamentals of Biological Engineering

"Building biology and the box it comes in"

"Data, data everywhere"

"The most important class you'll take @ MIT"

"Stuff you need to know"

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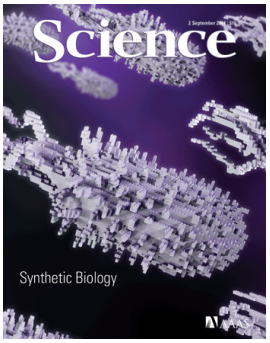
"Building biology and the box it comes in"

NATURE

Build life to understand it

Michael Elowitz & Wendell A. Lim

Nature **468**, 889–890 (16 December 2010) | doi:10.1038/468889a



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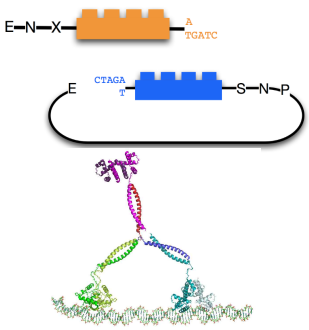
"Building biology and the box it comes in"



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"Building biology and the box it comes in"

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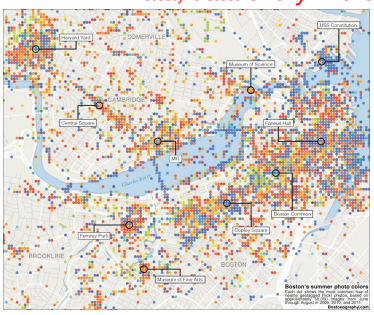
"Data, data everywhere"



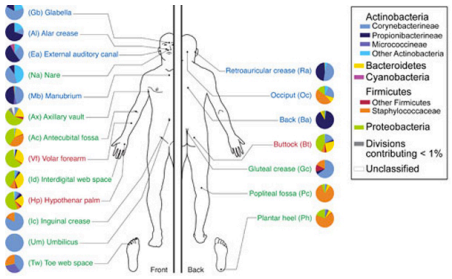
50,000 geotagged photos from Flickr

Map frequency of color hues in photos

Plot high freq color on location

http://bostonography.com/

20.109
"Data, data everywhere"



THE ZOO ON YOUR SKIN

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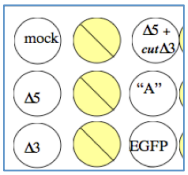
"Data, data everywhere"

Pre-req: data ➡ understanding

Lane	Sample	Volume to load
1	"Kaleidoscope" protein molecular weight standards	10 ul
2	H6-EnvZ positive control protein	50 ul
3	wild type light sensor	50 ul
4	mutant candidate 1	50 ul

Diagnostic digest 1	plasmid with insert	plasmid no insert
Enzyme(s) used		
Buffer used		
Temperature		
Predicted fragments		



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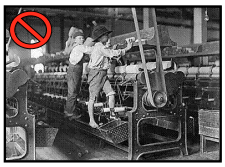
"The most important class you'll take @ MIT"

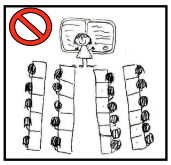
- We see you as men and women, not boys and girls



Boys in Bibb Mill No. 1. Macon, Georgia.

20.109
"The most important class you'll take @ MIT"

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



These are <u>experiments</u>, so you will not find the answers on Wikipedia

20.109
"Stuff you need to know"

- Reality is complex

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Laboratory Fundamentals of Biological Engineering

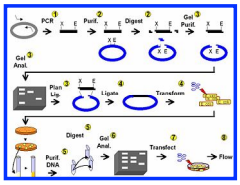
Course Mission

- 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

openwetware.org/wiki/20.109(F11)

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

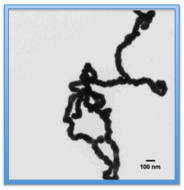
Experiments

- 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

Module	Topic	Assignment	% of Final Grade
1	DNA Engineering	lab practical	10
		ppt summary	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
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…"