

Welcome to 20.109!

Fundamentals of Biological Engineering

9/10/15

Insight from previous 109ers

Words of wisdom...

Lesson learned: Label Your Tubes

Don't be afraid to ask your professors and TA's questions:

Failure is Beautiful Too

GO TO OFFICE HOURS! You will get useful tips and comments for your presentation.

BE Communications Lab is a great resource!

“Well, lucky for you, like Dora the famous explorer, you have two helpful items: a map and a backpack. Vamanos!

This map, of course, is the information-packed Wiki that we so delightfully get to use...
...you can turn to backpack – [instructors] or the other sections TAs.”



“You may think I’m kidding, but I really think my brain exploded, much like the picture above...”



“Then we read. A lot.”



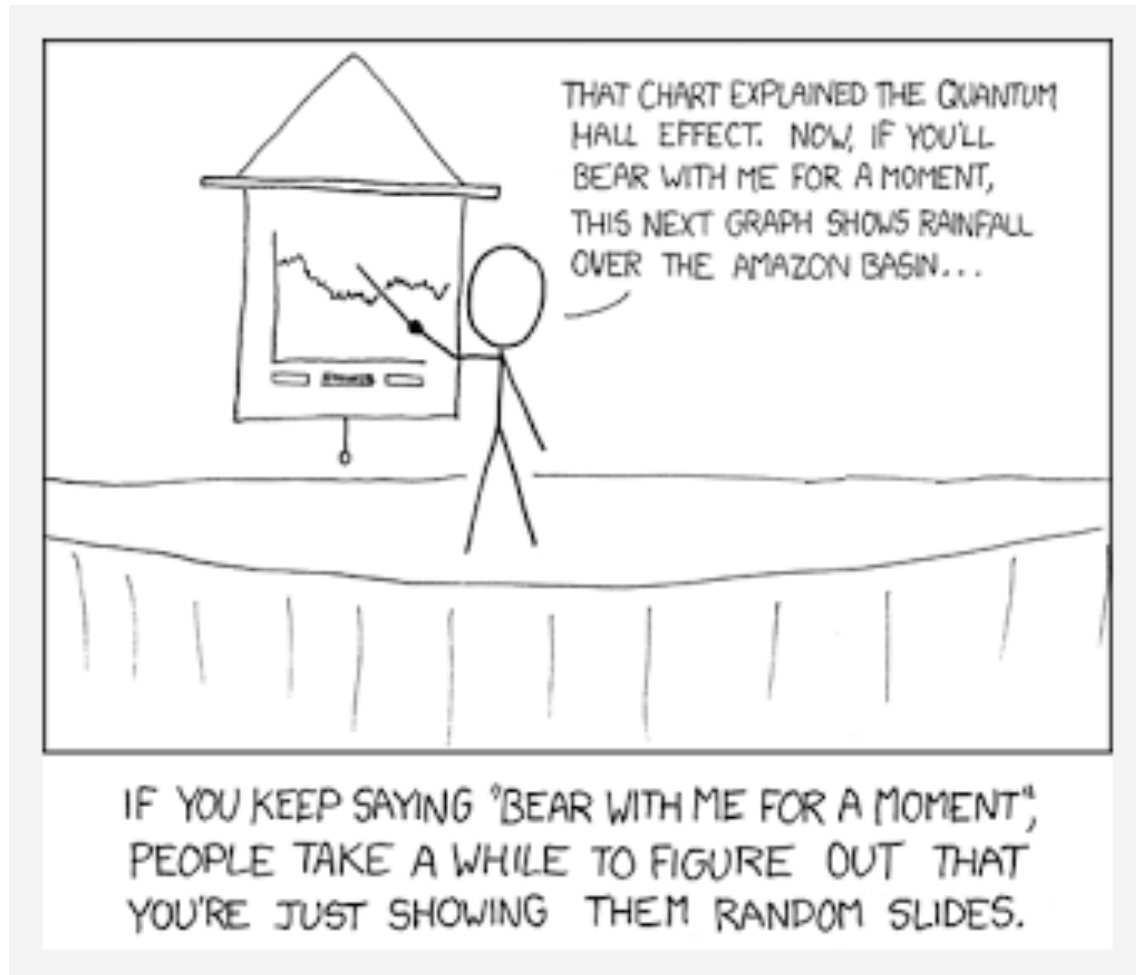
“However long you think it’s going to take,
double it and add two.”



“In the end, I’ve learned that aesthetics and comprehensive accuracy in figures are not a dichotomy, and you can have both with experience...”

<u>P-VALUE</u>	<u>INTERPRETATION</u>
0.001	HIGHLY SIGNIFICANT
0.01	
0.02	
0.03	
0.04	SIGNIFICANT
0.049	
0.050	OH CRAP. REDO CALCULATIONS.
0.051	ON THE EDGE OF SIGNIFICANCE
0.06	
0.07	HIGHLY SUGGESTIVE, SIGNIFICANT AT THE $P < 0.10$ LEVEL
0.08	
0.09	
0.099	HEY, LOOK AT THIS INTERESTING SUBGROUP ANALYSIS
≥ 0.1	

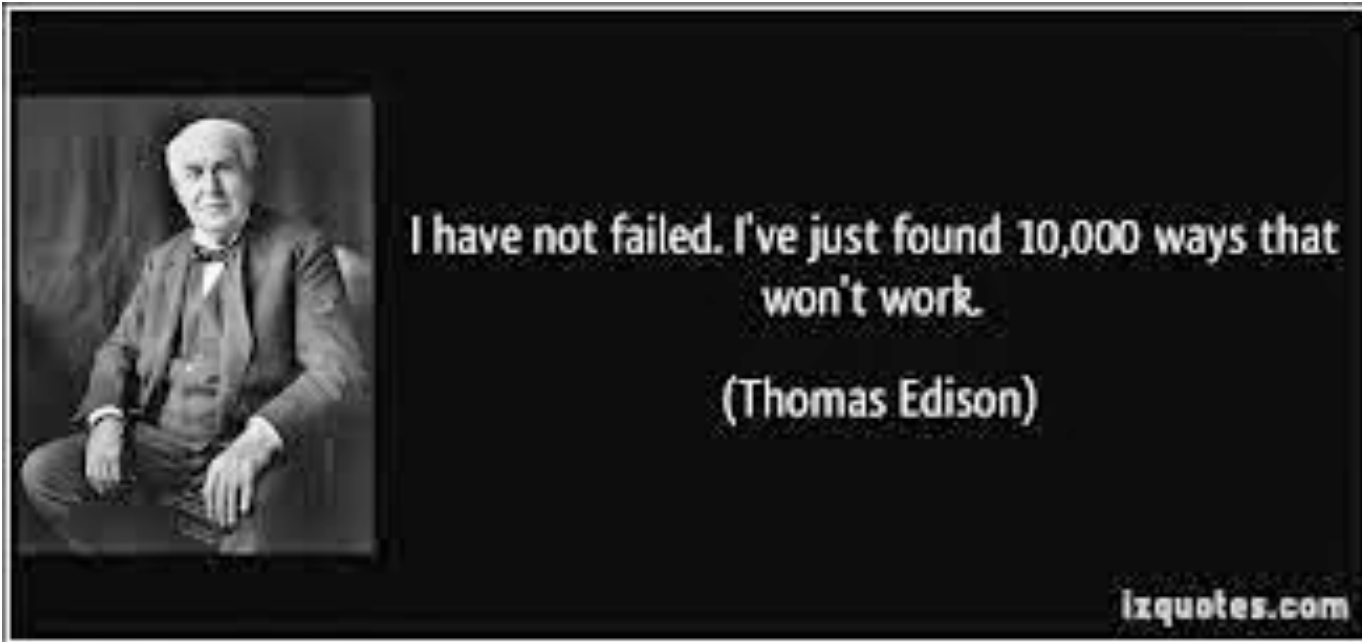
“I didn’t have to use this technique thanks to the seamless slide-making skills 20.109 taught me.”



“...we came up with another idea, our current one, that had not been done before and were able to make progress from there.”



“I consider this perspective a valuable new part of my tool belt as a biological engineer, and I am eager to continue to mature my intuition on creating valuable experiments.”



“Beyond the writing and oral practice that 20.109 gave us, I believe we also learned a lot about teambuilding and teamwork...”

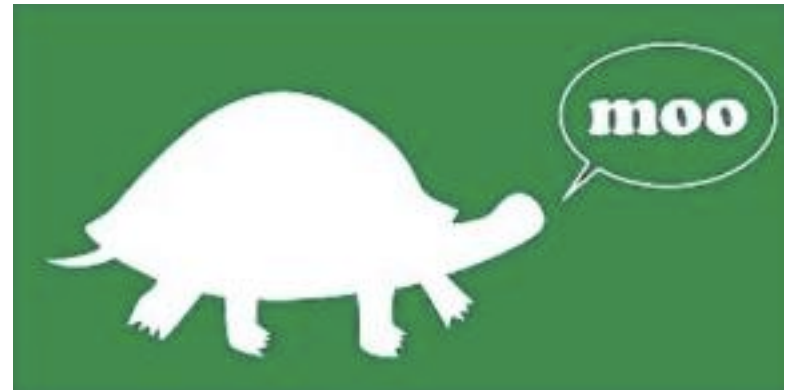


“I was searching for a picture to illustrate confidence and when I found this one with a lion on it, I was sold.”



An introduction to 20.109

- Meet the team
- Core mission
 - Building a better bioengineer
- Modular structure
 - Module 1: DNA Engineering
 - Module 2: Protein Engineering
 - Module 3: Biomaterials Engineering
- Logistics



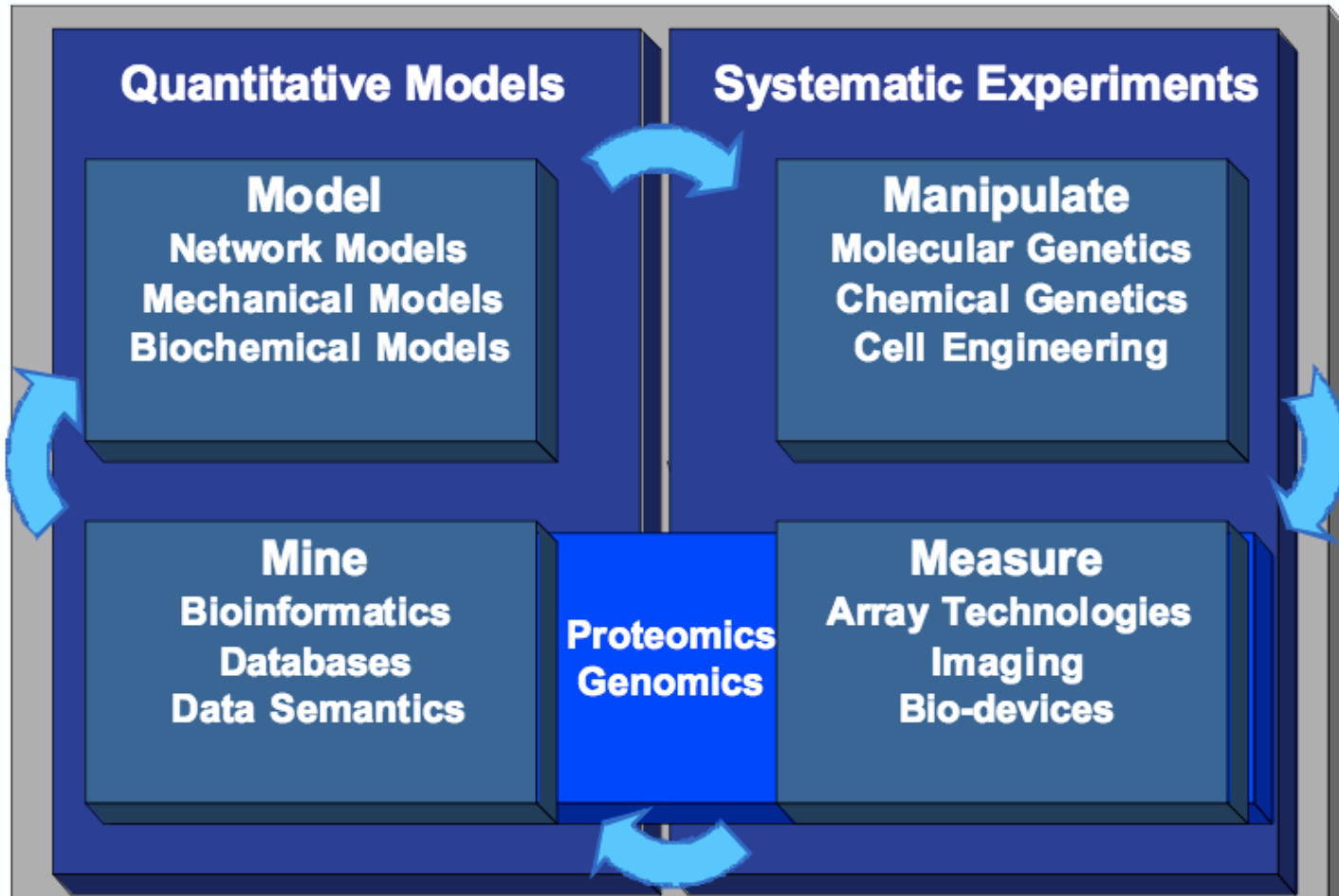
Meet the 20.109 teaching team

- Lecture / laboratory
 - Prof. Bevin Engelward (M1)
 - Dr. Noreen Lyell (M2, T/R)
 - Prof. Angela Belcher (M3)
 - Dr. Maxine Jonas (T/R)
 - Dr. Leslie McClain (W/F)
- Communications
 - Dr. Vivian Siegel
 - Diana Chien



- Teaching assistants
 - Andee Wallace
 - George Sun

Core mission of BE department



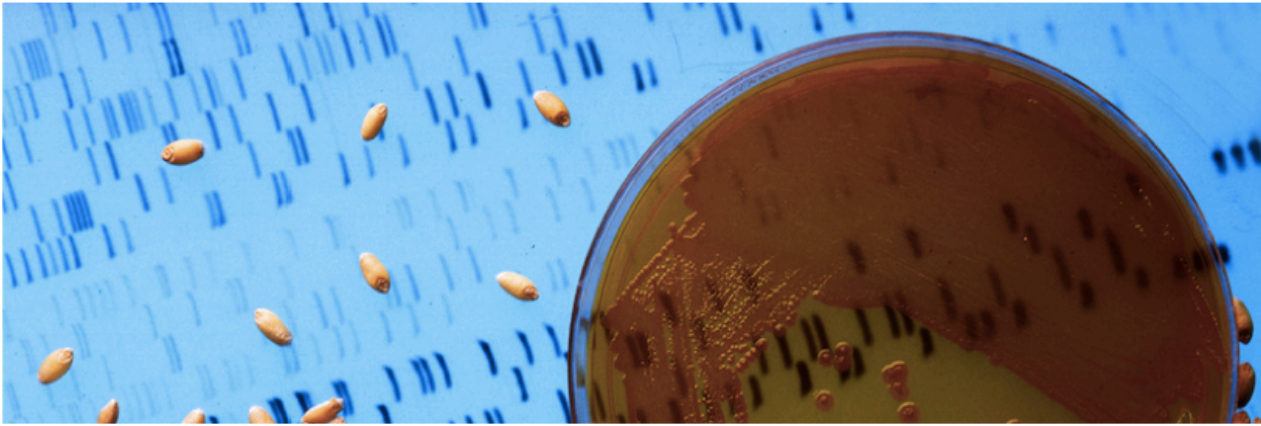
Definition of BE from Prof. Doug Lauffenburger

Core mission of 20.109

- 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**

Modular structure of 20.109

20.109(F15): Laboratory Fundamentals of Biological Engineering



Home People Schedule Fall 2015 Assignments Homework Lab Basics Wiki Basics
DNA Engineering Protein Engineering Biomaterials Engineering

Welcome and details for fall 2015

Lecture: T/R 11-12 (16-220)
Lab: T/R 1-5 or W/F 1-5 (56-322)
People: Instructor and student web pages may be found at the linked [People](#) page.

Module 1: DNA Engineering (Prof. Bevin Engelward)

Module 2: Protein Engineering (Dr. Noreen Lyell)

Module 3: Biomaterials Engineering (Prof. Angela Belcher)

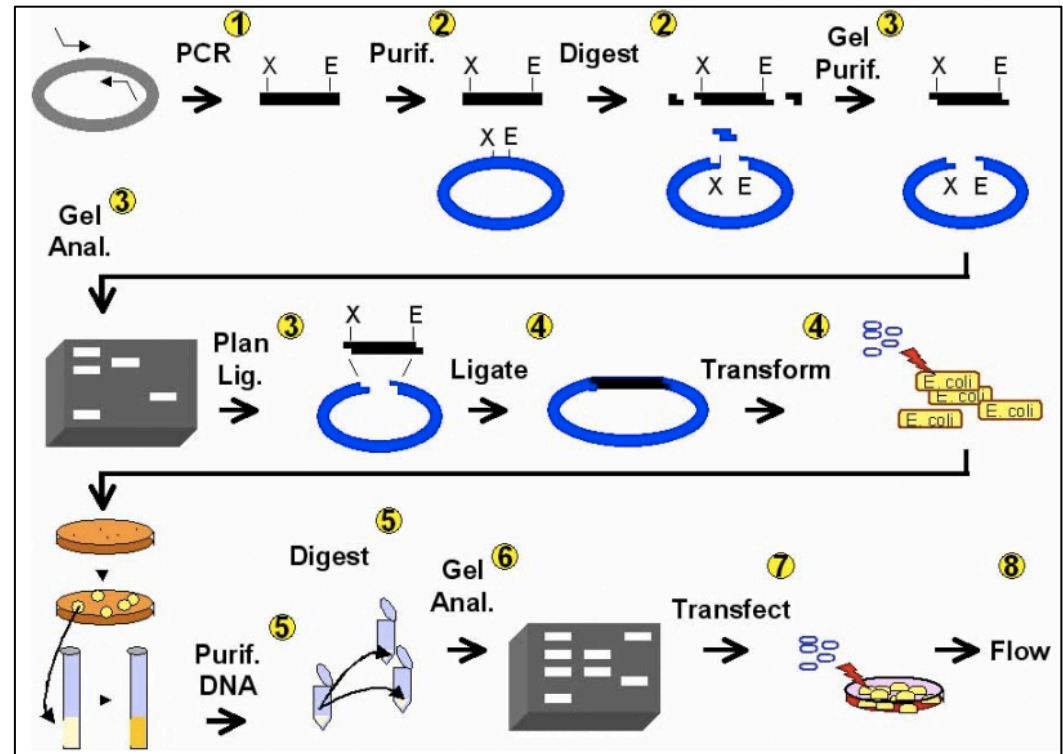
Module 1: DNA Engineering

- Experiments

- Design and create vectors expressing fluorescent protein
- Measure HR in mouse embryonic stem cells

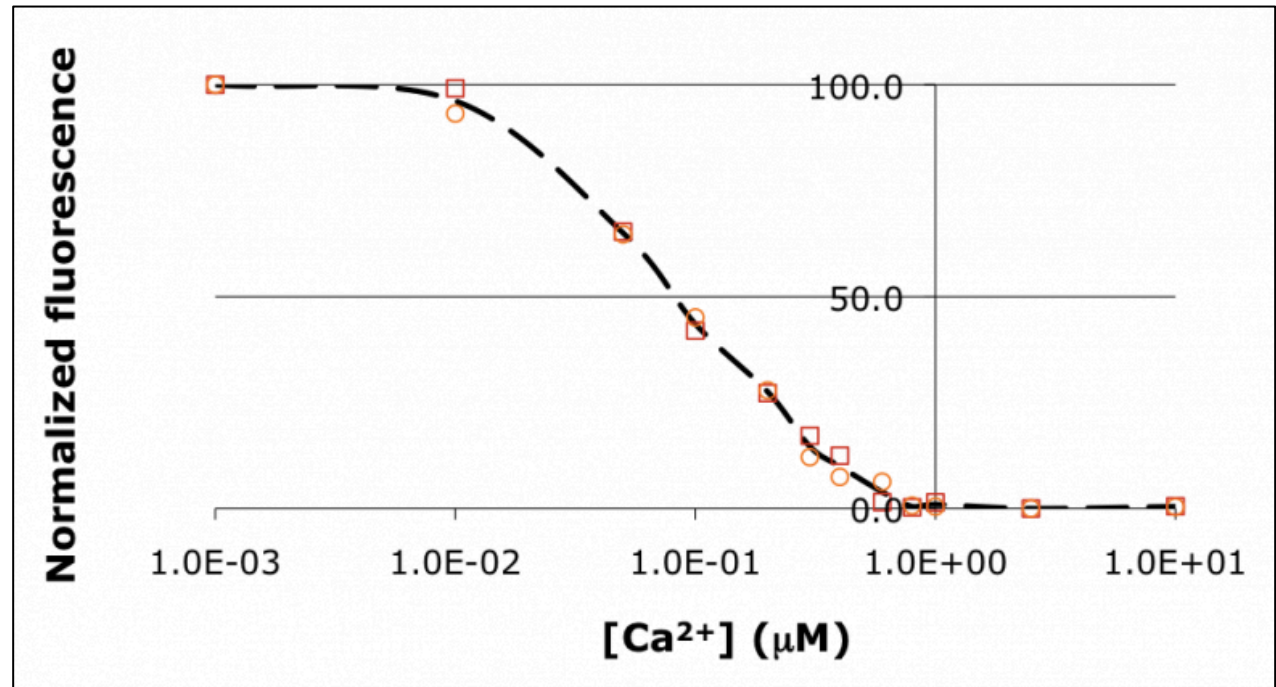
- Lab skills

- Retrieve and manipulate sequences from databases
- PCR amplify DNA fragments and clone into vector
- Transfection of mammalian cells and flow cytometry



Module 2: Protein Engineering

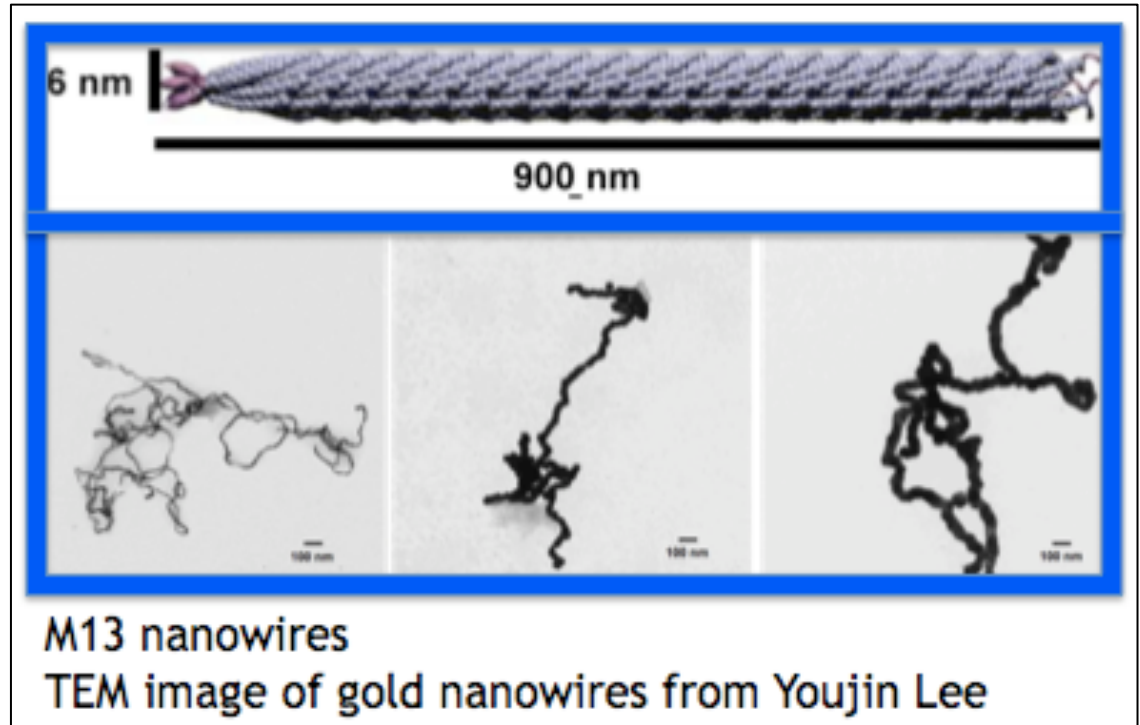
- Experiments
 - Generate point mutations in calcium binding protein
 - Measure response to calcium



- Lab skills
 - Manipulate protein sequences
 - Protein purification and titration assays

Module 3: Biomaterials Engineering

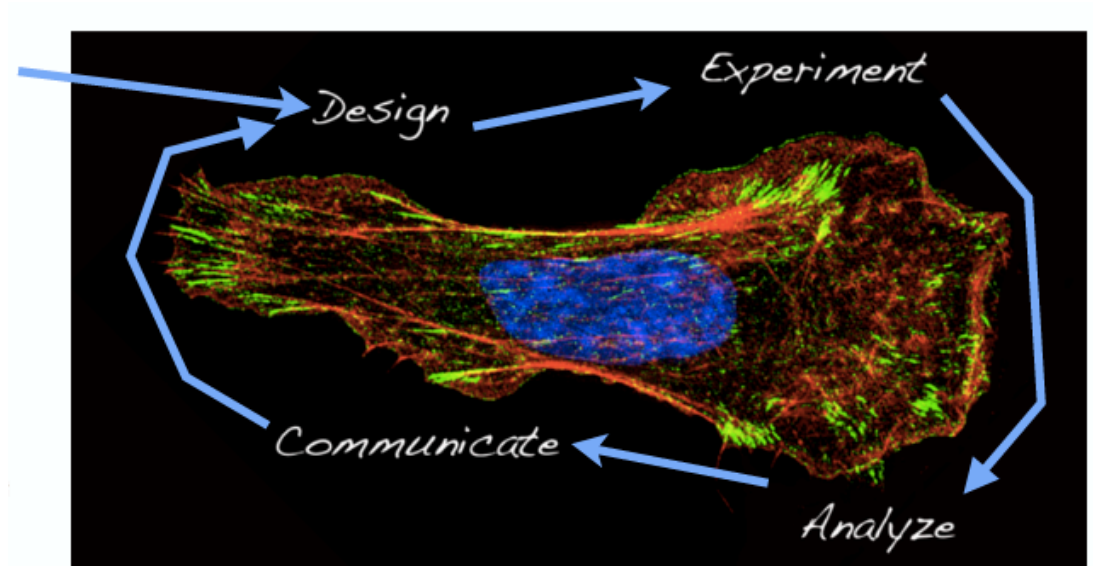
- Experiments
 - Mineralize phage surface with nanoparticles
 - Use TEM to visualize structure
 - Assemble and test batteries



- Lab skills
 - Bacteriophage M13 material production
 - Fabrication of bio-based devices

Workflow in 20.109

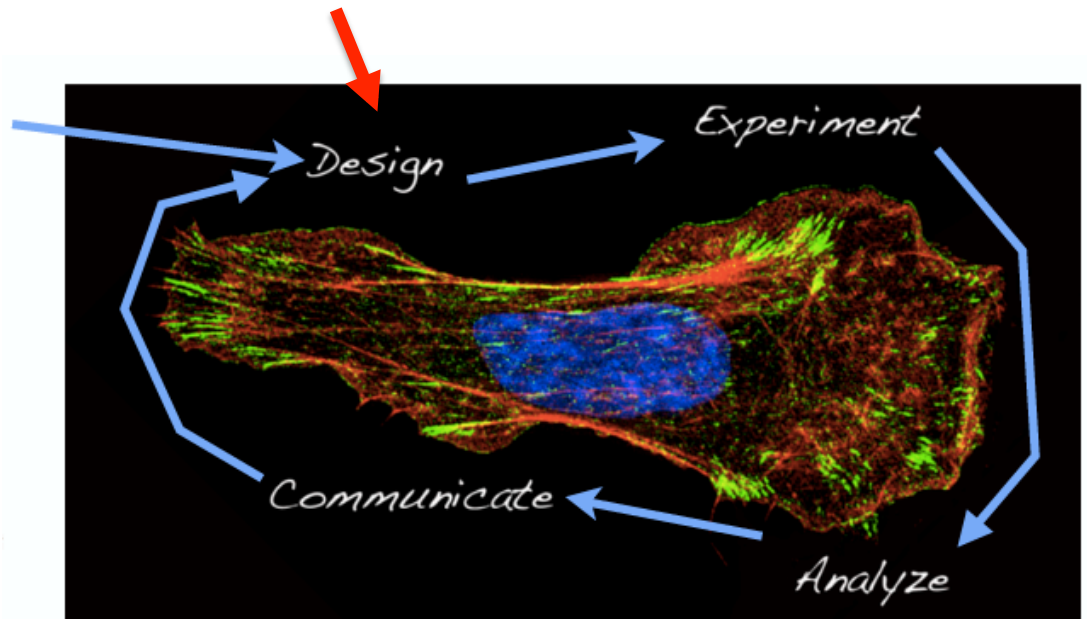
- We start here...
- But, you can't design an experiment without analyzing some data!



Workflow in 20.109

Research

- We start here...
- But, you can't design an experiment without analyzing some data!



Experiments in 20.109

We aim to prevent 'just follow the protocol' syndrome



Experiments in 20.109

We do relevant and cutting edge science

And we do it
safely...



A technician mouth pipetting environmental water samples in Malta.
Image: E Mandelmann. Source: History of Medicine

Experiments in 20.109

We analyze real and novel data

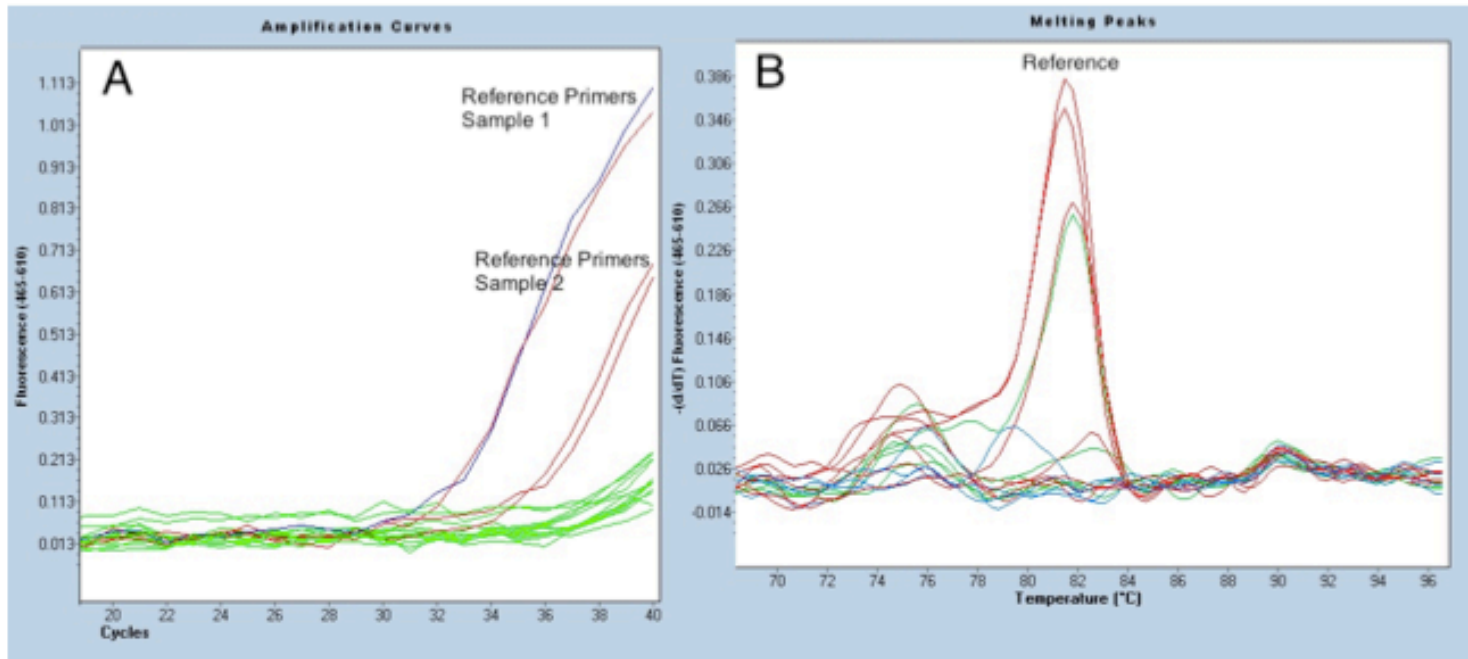


Figure 1: Amplification and Melting curves for qPCR assay. Primer pair absolute sensitivity was evaluated via qPCR against known AIV-containing samples. Samples 1 and 2 correspond to AIV-containing samples, sample 3 is a negative control. (A) Amplification curves for qPCR assay. Curves that resulted in successful amplification are labeled with primer pair and sample ID. Experiments were run in duplicate. (B) Melting curves for same assay. Melting peak corresponding to reference primer amplicon is labeled.

Written and oral communication

MODULE	TOPIC	ASSIGNMENT	GRADING
1	DNA Engineering	Summary	15%
		Mini-presentation	5%
2	Protein Engineering	Research report	25%
		Journal club presentation	10%
3	Biomaterials Engineering	Research proposal presentation	20%
		Mini-report	5%

- Written communication assignments – 45%
- Oral communication assignments – 35%
- Daily work and participation – 20%

Why communicate your science?



EcoPress is a website highlighting the science and scientists of the Natural Resource Ecology Laboratory at Colorado State University

why scientists should tell more stories

RECENT PUBLICATIONS

ARTICLES

INTERVIEWS

OPINIONS

EDUCATION

THIS IS HOW I DID IT...

FROM THE FIELD

ECOPICS

EVENTS

NREL NEWS

LINKS

CITATION SUBMISSION

PODCAST



Credit: jvoves (via Flickr, <http://bit.ly/190MCCw>)

<http://nrelscience.org/2013/09/26/why-scientists-should-tell-more-stories/>

Why scientists should tell more stories

“Story is the number one way we learn from past experiences, to be better people, and share in experiences. Yet as scientists we feel the need to separate ourselves from this proven method of communication...

...encourage the use of narrative in science, but with caution. I would argue that narrative is imperative for science communication. Data already incorporates a narrative; we just need to find ways to bring it to light.”

We are here to help

- BE Communications Lab
 - Instructors
 - Dr. Vivian Siegel
 - Diana Chien
 - Writing fellows
- 20.109 Teaching faculty



Course logistics

- Lectures
 - Tuesday and Thursday 11-12p in 16-220
 - Prof. Engelward → Dr. Lyell → Prof. Belcher
- Laboratory sections
 - Tuesday and Thursday 1-5p in 56-322
 - Wednesday and Friday 1-5p in 56-322
- Details
 - You will work in pairs throughout the semester
 - Collaboration with integrity is key

Expectations

- Your expectations of us...
 - We will come to class and laboratory prepared
 - Our assignments will be clear and reasonable
 - We will treat every 109er with respect
 - We will give everyone equal chance at success

Expectations

- Our expectations of you...
 - You will come to class and laboratory prepared
 - You will not interfere with each other's learning
 - You will invest the very best of yourself
 - You will be honest with your peers and the teaching faculty

Our goals for you

- Organize a constructive laboratory notebook
- Implement laboratory protocols and troubleshoot
- Interpret and analyze data
- Recognize the utility of models and assays
- Critically examine scientific literature
- Communicate your science
- Work as a team
- Provide constructive and helpful feedback

Final notes

- Please arrive to laboratory today and tomorrow on time
 - Damon from EHS will be delivering a training presentation
- Please wear/bring pants and closed toed shoes
 - We will be working in the lab