

Welcome to 20.109!

Fundamentals of Biological Engineering

9/7/17

Insight from previous 109ers

Words of wisdom...

Lesson learned: Label Your Tubes

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

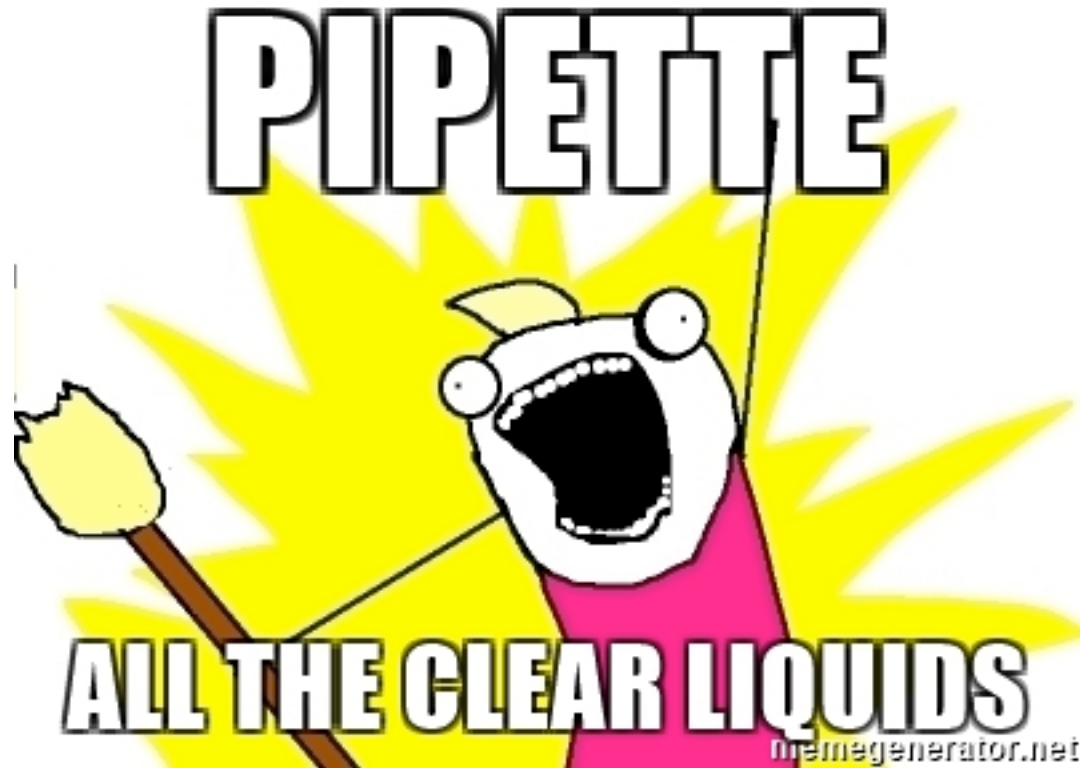
Failure is Beautiful Too

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

BE Communications Lab is a great resource!



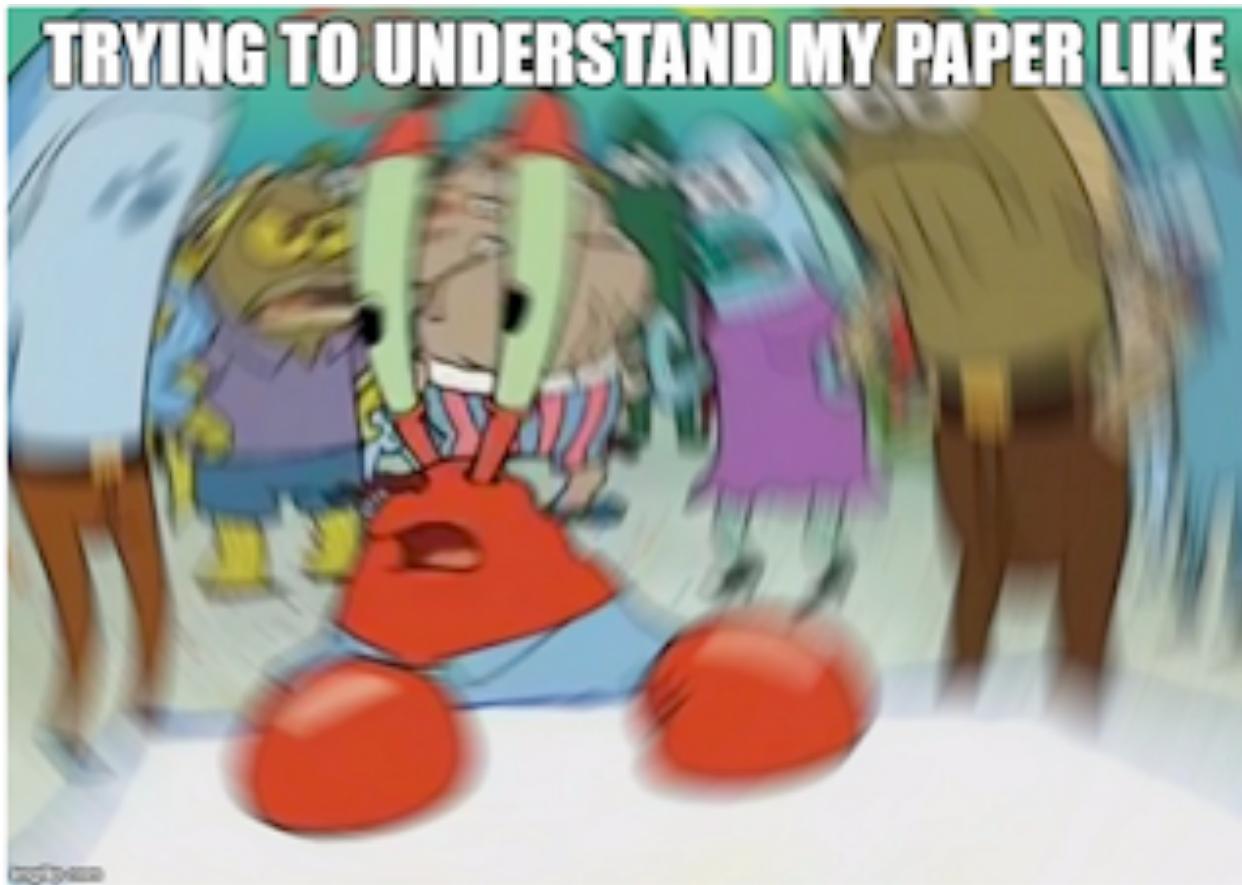
“After sitting through the introduction on day one, my first thought was “FINALLY!” This class sounded like it was going to be the most applicable class to real life that I had ever taken. I feel that up until this point, I’ve been learning subjects that all build on each other in interesting ways...Here was finally a class that would combine both theory and actual application to complete meaningful projects.”



“I have real life course 20 skills and actual methods I can talk about in an interview (either with my parents when they ask what course 20 is or with employers). 20.109 combines all these really unique teaching techniques to become a really weird, cool class. It's not like any other class I've taken at MIT. 20.109 is a recombinant class that is teaching me what it really means to be course 20.”

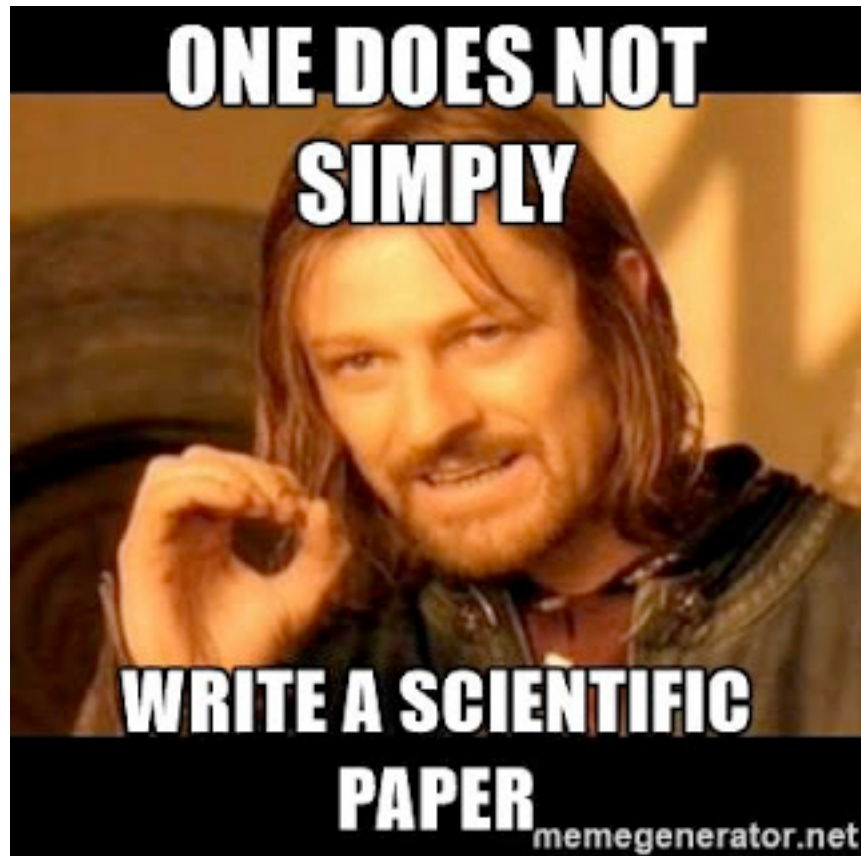
“Over the past year or so I have been learning how to read...scientific papers. Honestly, this is a skill I will be developing for a long time. I feel like scientific paper reading is something you can never be too good at. Yes, I am reading the words on the page, but what do these words mean?? What do the figures tell? Are the authors discussing anything in their discussion?”

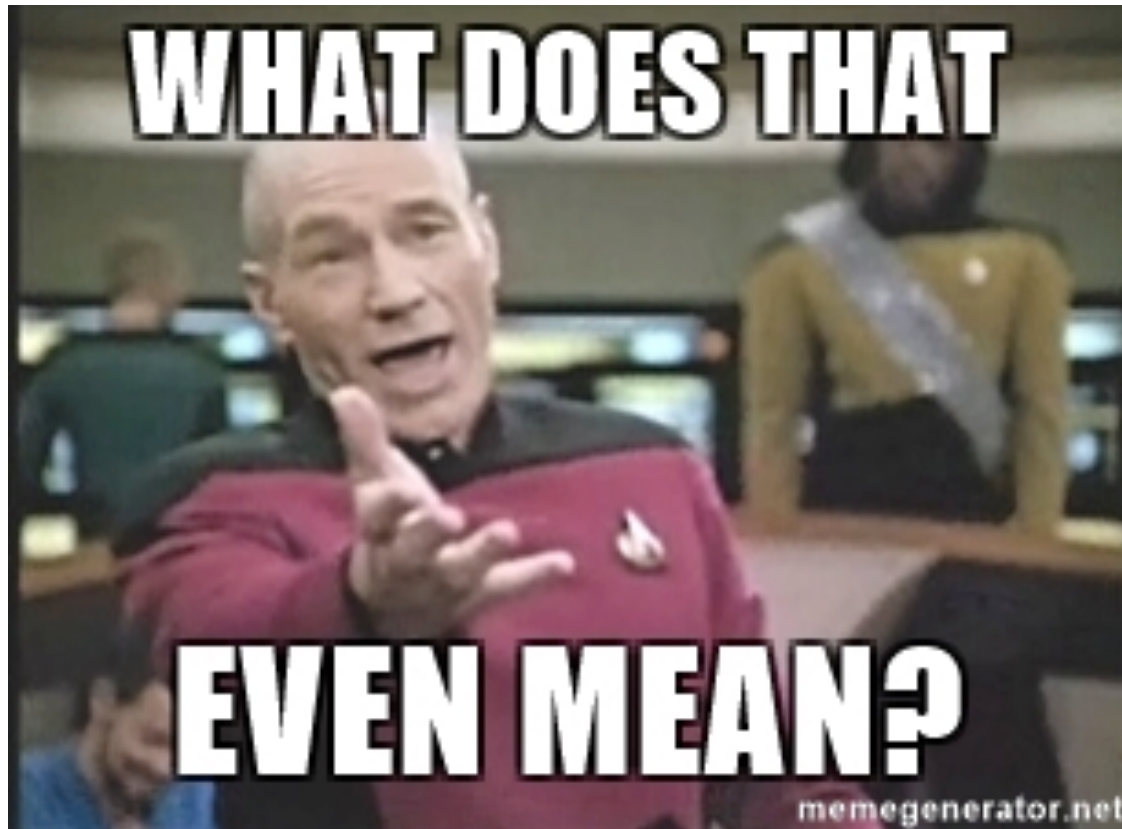




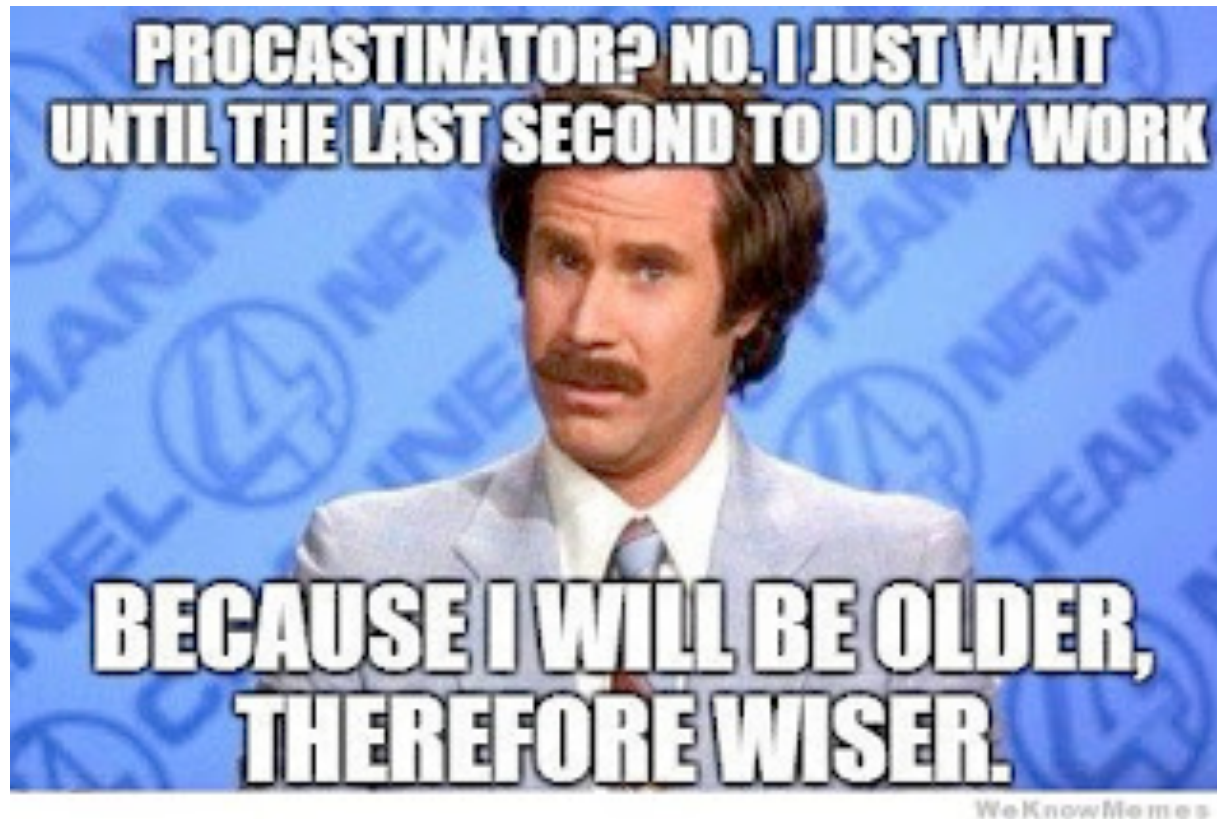
“Reading, or rather decoding, this paper was probably one of the most difficult parts of the process for me. As interesting as the subject matter was, there was a lot of terminology and methods that were used that I was unfamiliar with, and the paper was quite long.”

“Mod2 report was certainly a tough one.”





“One of the hardest parts of writing this paper was that the results were not very clear-cut and often contradictory with what was expected... That's exactly like real life though. In my UROP we often get contradictory or unsatisfactory results as well.”



“I regret not starting earlier on this assignment. I think I should have started at least a week earlier so I could feel less pressed for time at the end. Also, I feel like I was relatively inefficient when working. In the beginning I felt less pressured so I got things done really slowly.”

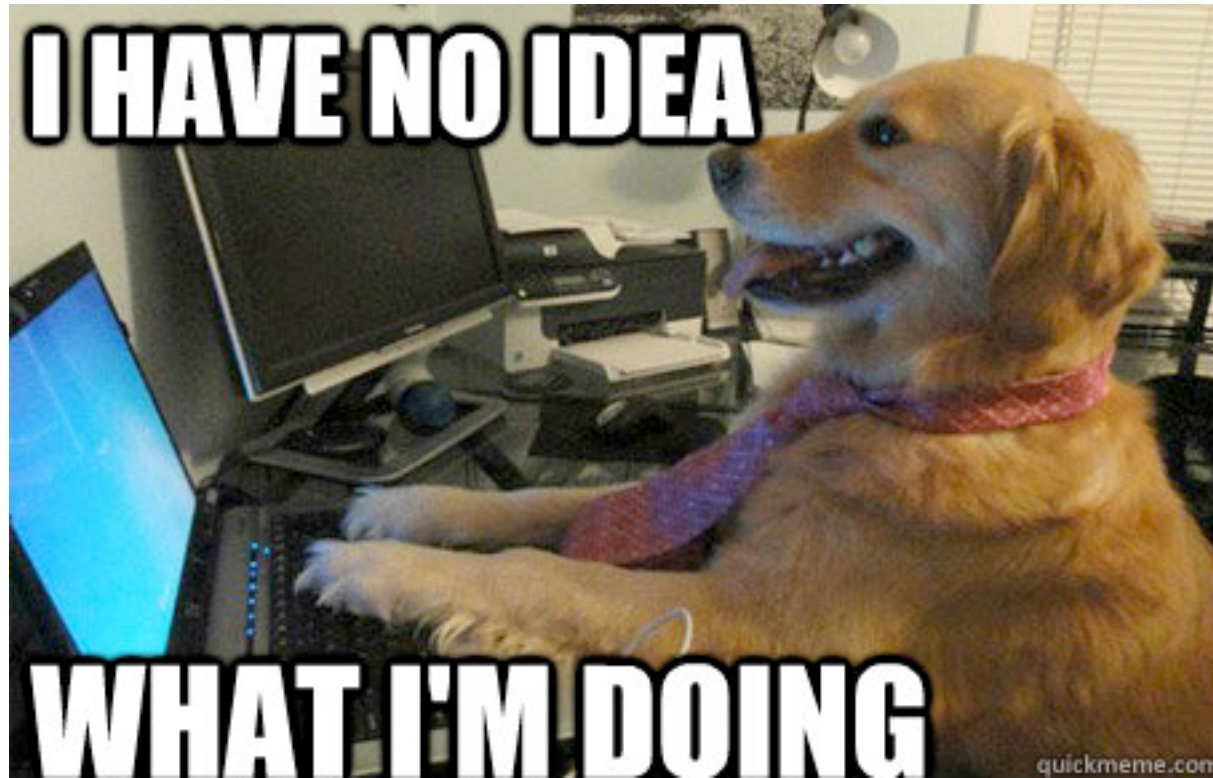


“Coming up with a research proposal was probably my favorite part of 20.109. I don't think I am asked to produce 100% original ideas very often here, but I think this project allowed me to do that. I think that is probably one of my favorite parts of biology and I am glad that I could do it again. So, yeah what a way to end 20.109, it was a great time and I think I learned a lot!!!!”

“Though the class could be stressful and was a lot of work at times, it has probably been my favorite class here at MIT so far...

Thank you so much to all the instructors who invested so much time and energy into making this a great experience for all of us taking the class. I’m sure I speak for all of us when I say that we all appreciate the support and encouragement.”





“But most importantly, I think I've become much better at scientific communication. Before, I could identify whether a paper was good or bad, but I guess I never really thought about what really made it good or bad. Furthermore, the thought of writing a paper seemed like an insurmountable task to me, and I definitely had no idea how to even begin doing such a thing.”



“In then end, I ended up with a super cool battery and a mind full of knowledge. I feel more like the quintessential scientist than ever before. I have held a beaker, cooked a battery, and put on a lab coat. And I feel more secure in my choice to be course 20 than before.”

“Leaving 109, I definitely feel like an engineer. 109 opened the door to all the things a BE student can do...”

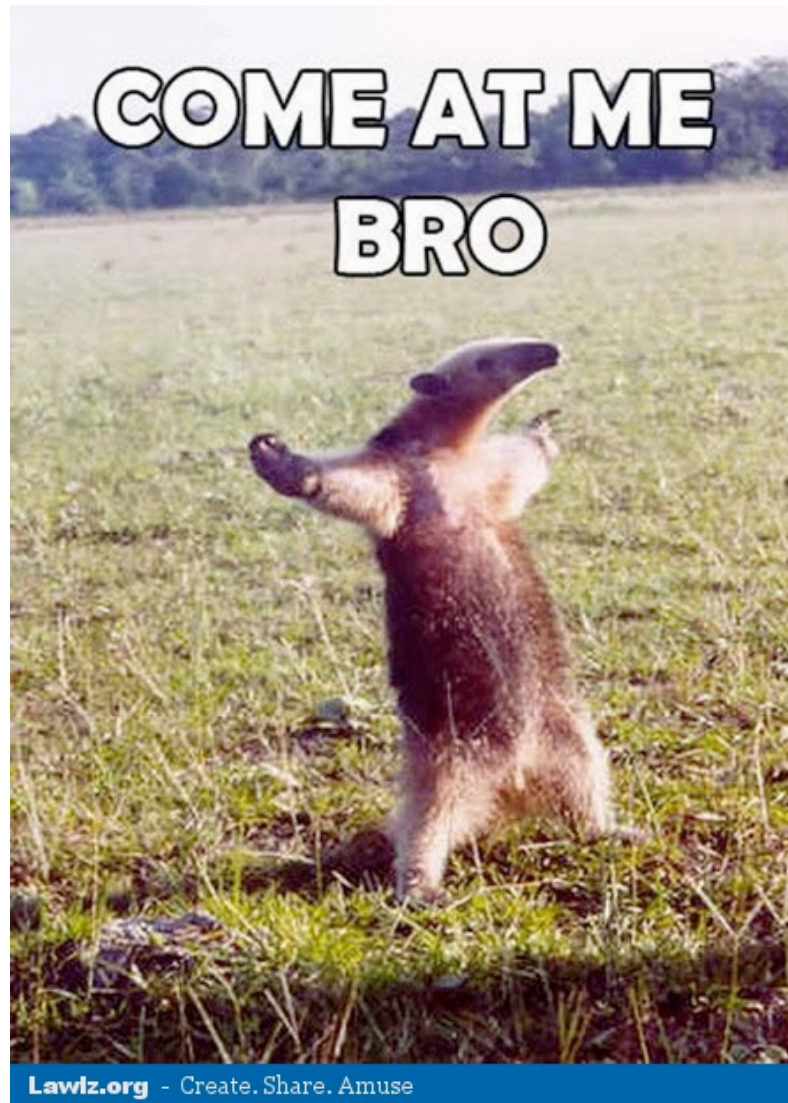


Friendships can end.
Girlfriends/boyfriends can end.
Only **lab partner** has no **end**.



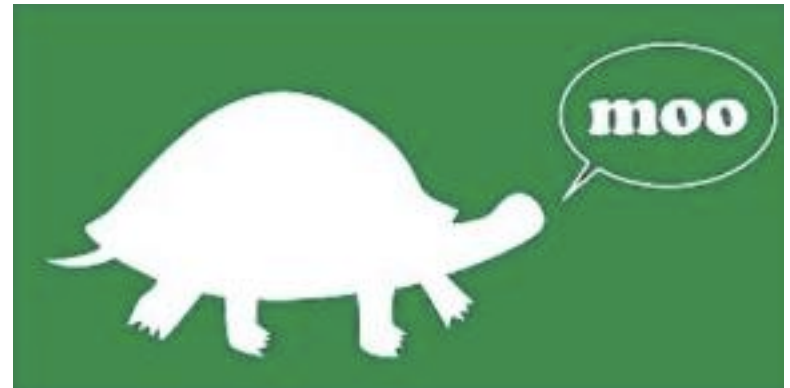
“Thanks to all my fellow 109ers for making this class such a fun experience (: I do wish I took this class earlier, but I'm glad that I got to meet y'all by taking it this semester... I enjoyed working with you and getting to know you, and I'm really happy with what we've accomplished this semester (: ”

“And the good news? I do get another shot at this!
20.380...you're going down.”



An introduction to 20.109

- Meet the team
- Core mission
 - Building a better bioengineer
- Modular structure
 - Module 1: Measuring genome stability
 - Module 2: Manipulating metabolism
 - Module 3: Engineering biomaterials
- Logistics



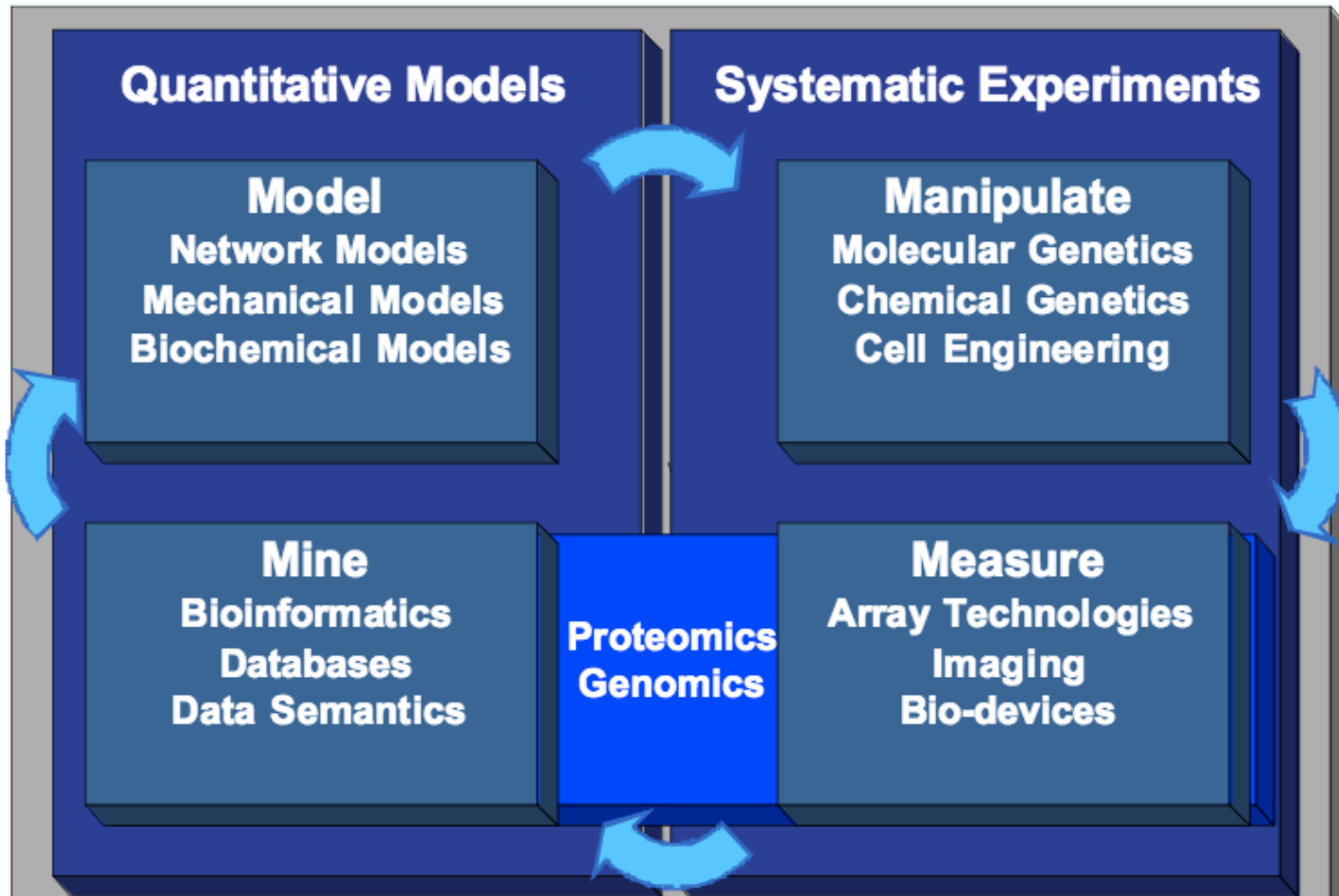
Meet the 20.109 teaching team

- Lecture / Laboratory
 - Prof. Bevin Engelward (M1)
 - Dr. Noreen Lyell (M2)
 - Prof. Angela Belcher (M3)
 - Dr. Leslie McClain (T/R)
 - Dr. Josephine Bagnall (W/F)
- Communication
 - Dr. Sean Clarke
 - Dr. Prerna Bhargava



- Teaching assistant
 - Eric Lehnhardt
- Research assistant
 - Dr. Jifa Qi

Core mission of BE department



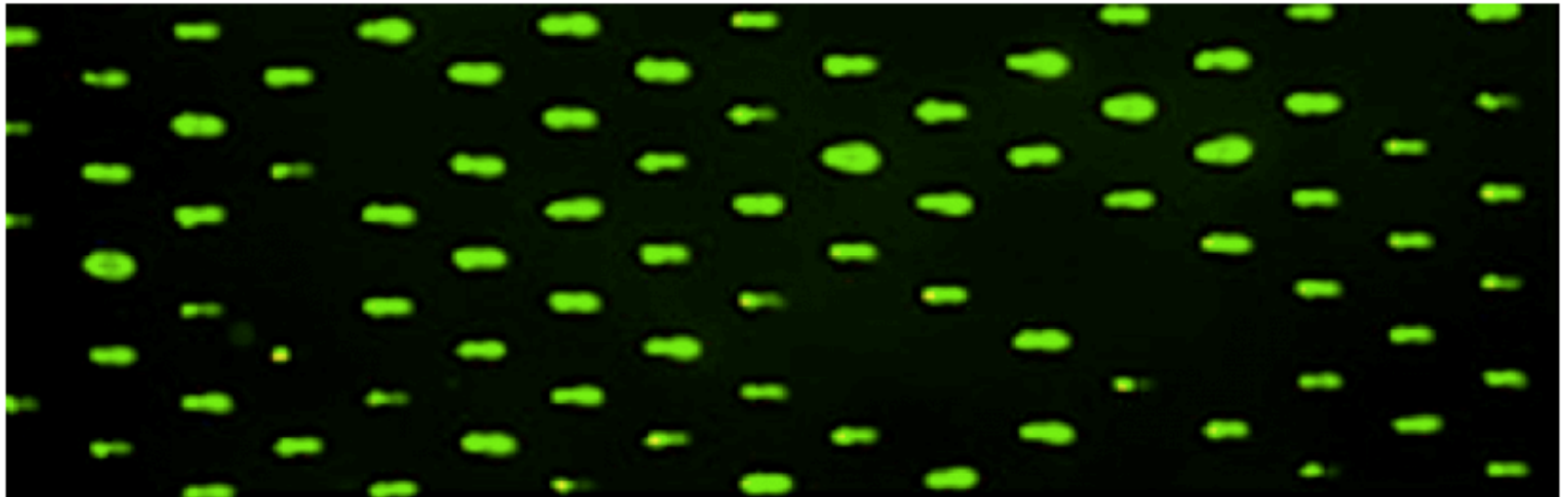
Definition of BE from Prof. Doug Lauffenburger

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(F17): Laboratory Fundamentals of Biological Engineering



Fa17 Schedule Announcements Assignments Homework Communication
1. Measuring Genomic Instability 2. Manipulating Metabolism 3. Engineering Biomaterials

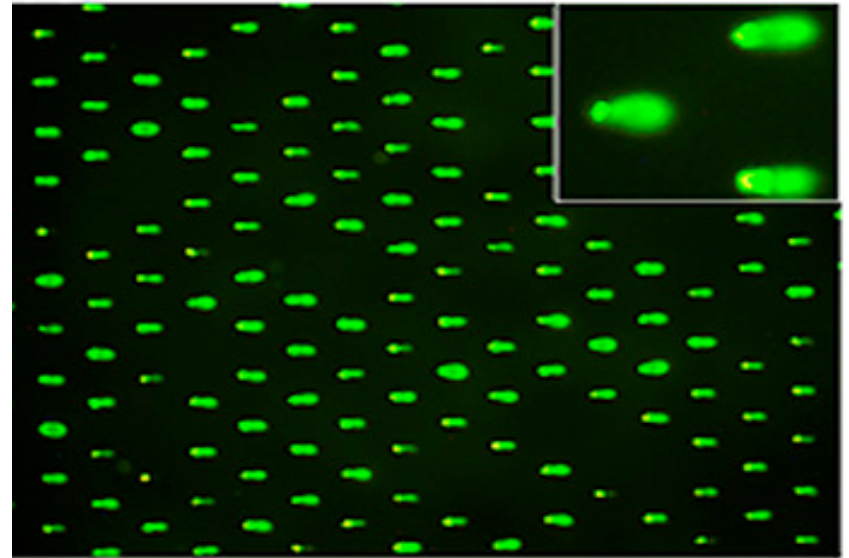
Module 1: Measuring genomic instability (Prof. Engelward)

Module 2: Manipulating metabolism (Dr. Lyell)

Module 3: Engineering biomaterials (Prof. Belcher)

Module 1: Measuring genomic instability

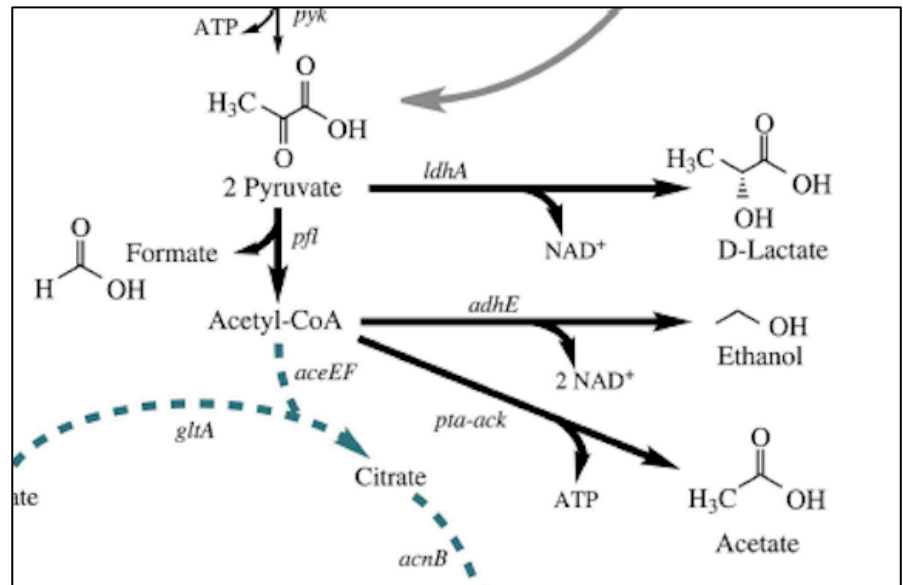
- Fundamental Concepts in High Throughput Quantitative Single Cell Analysis, Binding Affinity, Pathway Intermediates, Immunohistochemistry



- Key Concepts: Genome Structure/Function, Cancer Etiology, Molecular Responses to CRISPR Products

Module 2: Manipulating metabolism

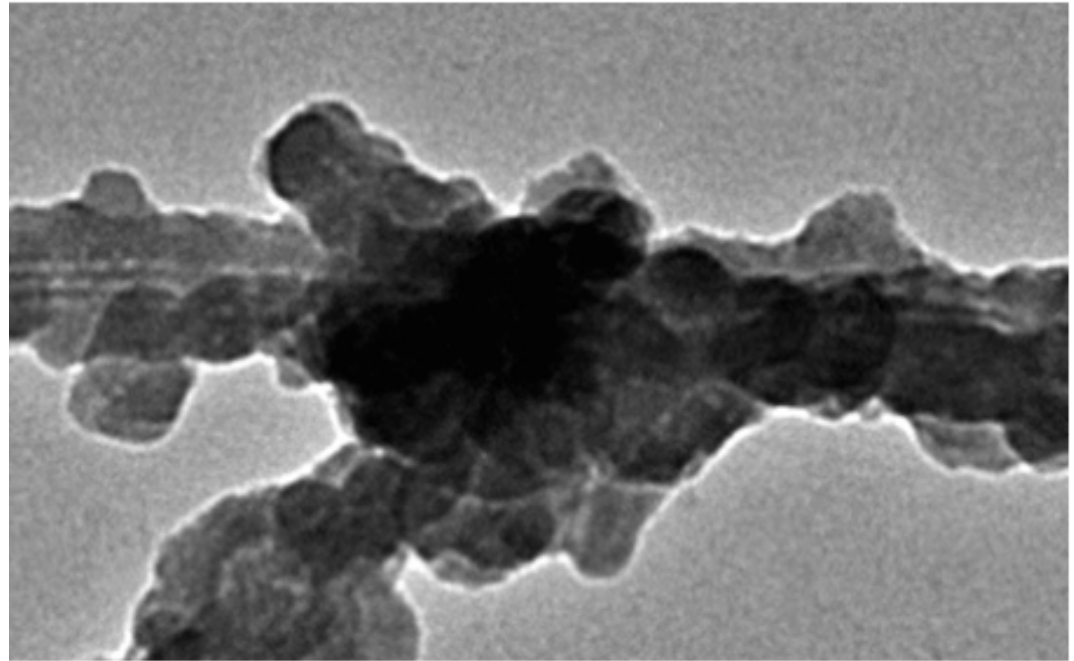
- Experiments
 - Alter genetic circuitry using CRISPRi system to increase fermentation products
 - Colorimetric biochemical assay
- Lab skills
 - Bacterial culturing
 - Molecular biology techniques



Module 3: Engineering biomaterials

- Experiments

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

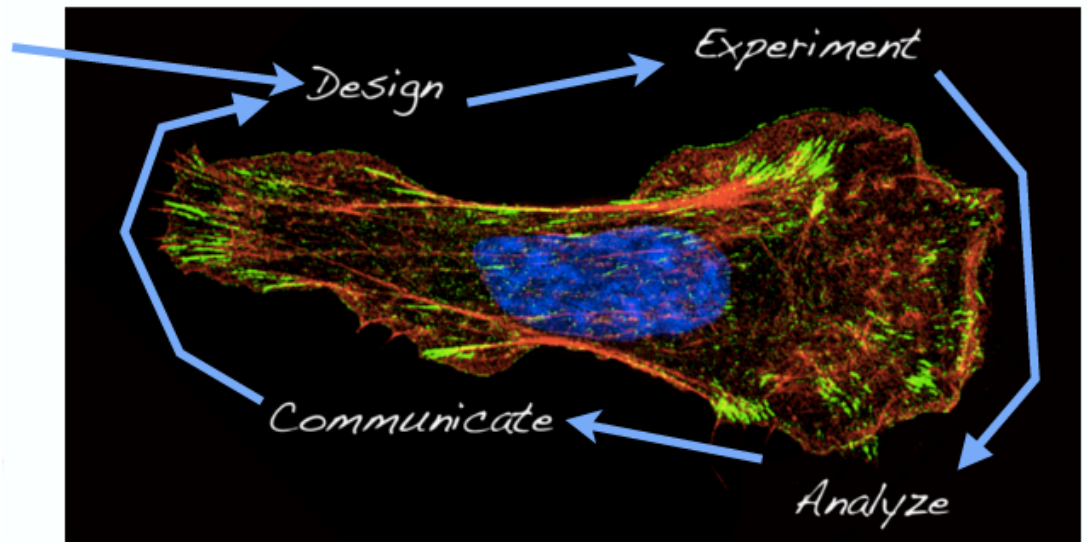


- Lab skills

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

Workflow in 20.109

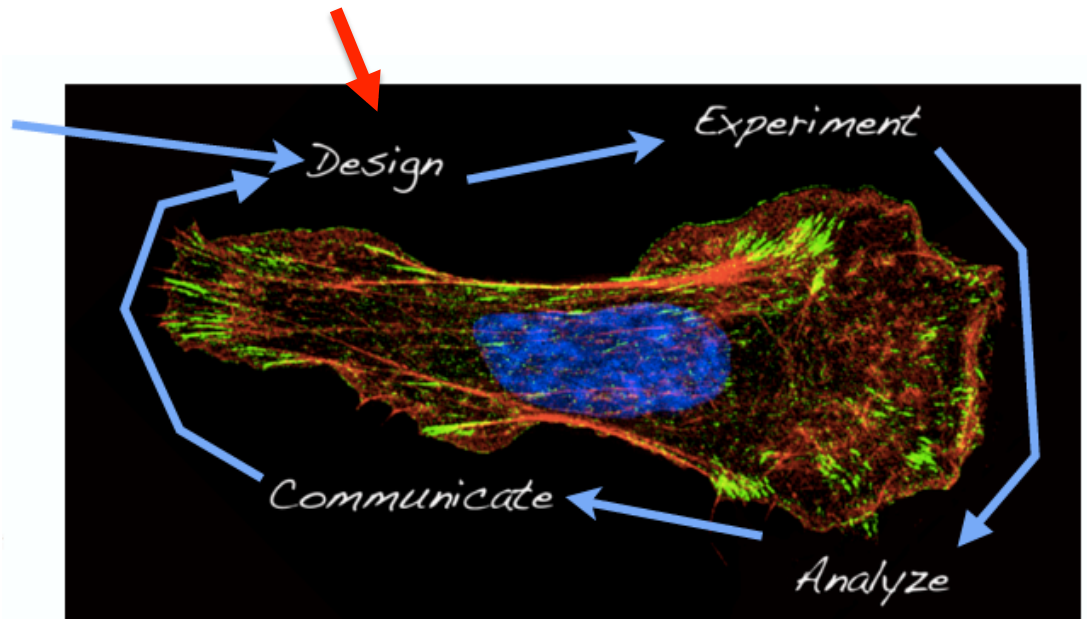
- We start here...
- But, you can't design an experiment without analyzing some data!



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!!

Experiments in 20.109

We analyze real and novel data

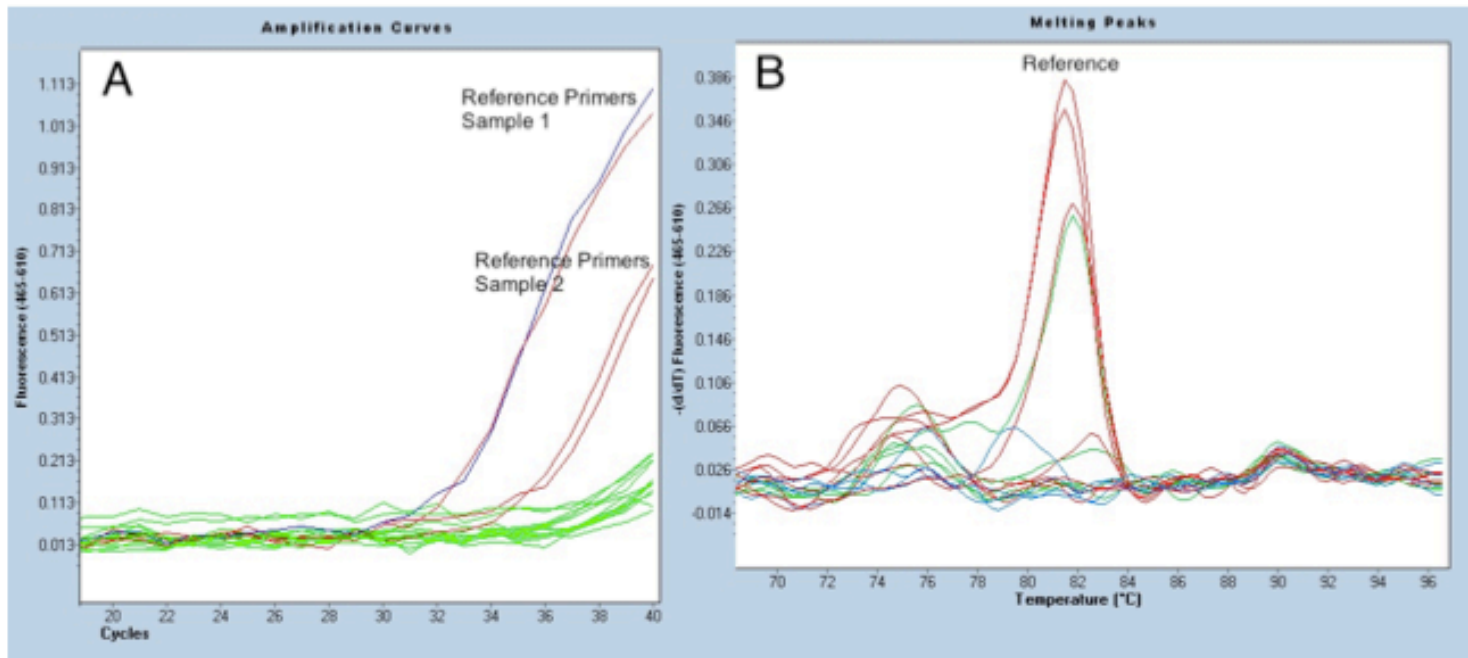


Figure 1: Amplification and Melting curves for qPCR assay. Primer pair absolute sensitivity was evaluated via qPCR against known AIV-containing samples. Samples 1 and 2 correspond to AIV-containing samples, sample 3 is a negative control. (A) Amplification curves for qPCR assay. Curves that resulted 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	WEIGHT
1	Measuring genomic instability	Data summary	15%
		Mini-presentation	5%
2	Manipulating metabolism	Research article	20%
		Journal club presentation	15%
3	Engineering biomaterials	Research proposal presentation	20%
		Mini-report	5%

- Written communication assignments = 40%
- Oral communication assignments = 40%
- 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!

- 20.109 Teaching faculty
- BE Communications Lab
 - Instructors
 - Dr. Sean Clarke
 - Dr. Prerna Bhargava
 - Writing fellows



BE Communication Lab

BE Communication Lab



Helping you communicate effectively.

Staffed by the BE Communication Fellows, the BE Communication Lab offers writing and speaking support for scientists by scientists.

Course 20 undergraduate students, graduate students and post-docs are invited to bring in any communication-related pieces they are working on – from coursework and posters to resumes and publications.

We encourage students to **book an appointment** at any stage in the writing process – the sooner the better. In addition to offering coaching, the BE Communication Lab runs **workshops** and is building an online tool box to help you find tips and resources quickly to help you communicate more effectively.

NEW!

Check out our blog, created by the BE Communication Fellows: <http://thebench.scripts.mit.edu/home/>.

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
 - We will be clear and reasonable in all assignments
 - 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
 - You will be prepared for lecture and laboratory
 - 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 / tomorrow on time
 - Will begin with EHS 109-specific training
 - See Noreen if you received an email concerning General Biosafety Training, but have not completed the course with EHS
- Please wear / bring pants and closed toed shoes
 - We will be working in the lab