

Welcome to 20.109!

Fundamentals of Biological Engineering
Spring 2017

Insight from previous 109ers

Words of wisdom...

Another thing I definitely learned is that if you ever feel unsure about what conclusions can be drawn from any procedures you performed in lab, or if you aren't sure if the information you are about to include in your report is superfluous, never hesitate to **ask the 20.109 faculty for feedback**- these awesome people are actually there to help us!

Ask questions.

Take advantage of office hours.

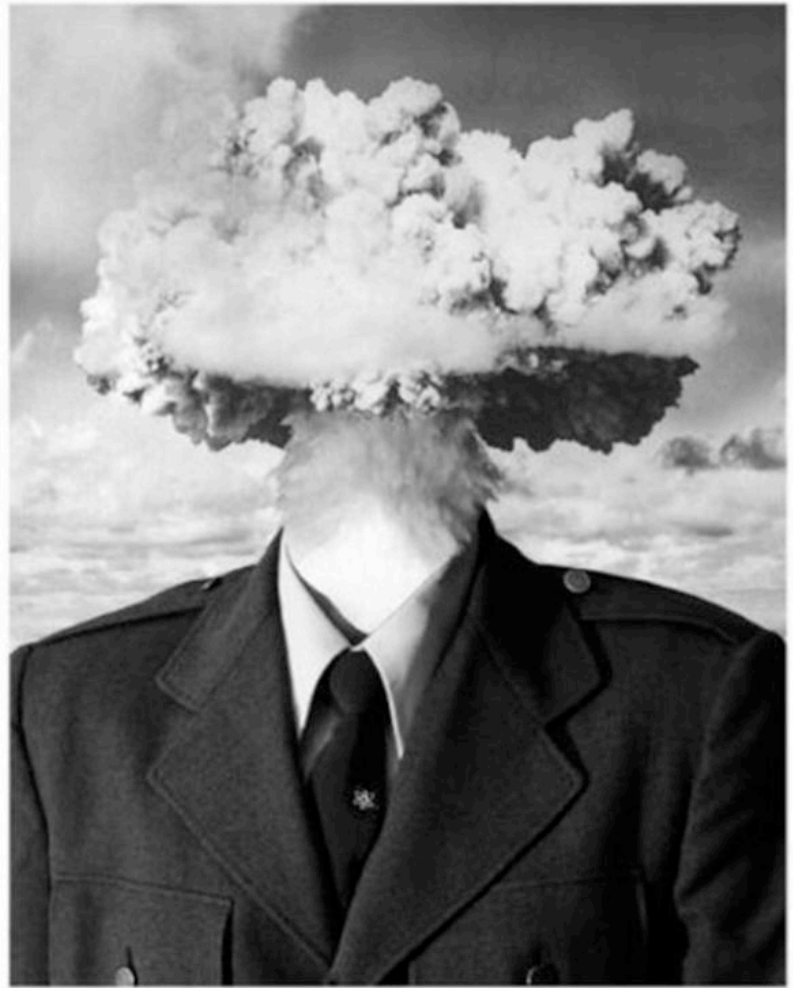
Tip 211: Get a jump start on the next major assignment

Makes sure to always check the wiki

Don't leave everything to the very last minute.

BE Communication Lab Meetings? 10/10 Would Recommend!

“It was really cool doing a module that was so different from the previous 2 modules. I had no idea you could use viruses to make batteries!”



“These good feelings come from a lot of things. One, the support system of classmates was great... Lastly, the staff was friendly, approachable and supportive which just makes everything easier.”



“Although I felt like I was drowning in a sea of assignments and...in the end I think I appreciate having the homework assignments because they really did make it easier to write the culminating ...”



“The homework (while time-consuming) was helpful in preparing for the larger assignments... There were extensive office hours to ask for advice. Perhaps most importantly, it was evident the 20.109 staff were invested in our success.”

“ I am also glad for all of the Mod2 homeworks... I can't believe I'm saying this, but I sort of wish we had more of them, so approaching the final report didn't seem as daunting or time consuming.”



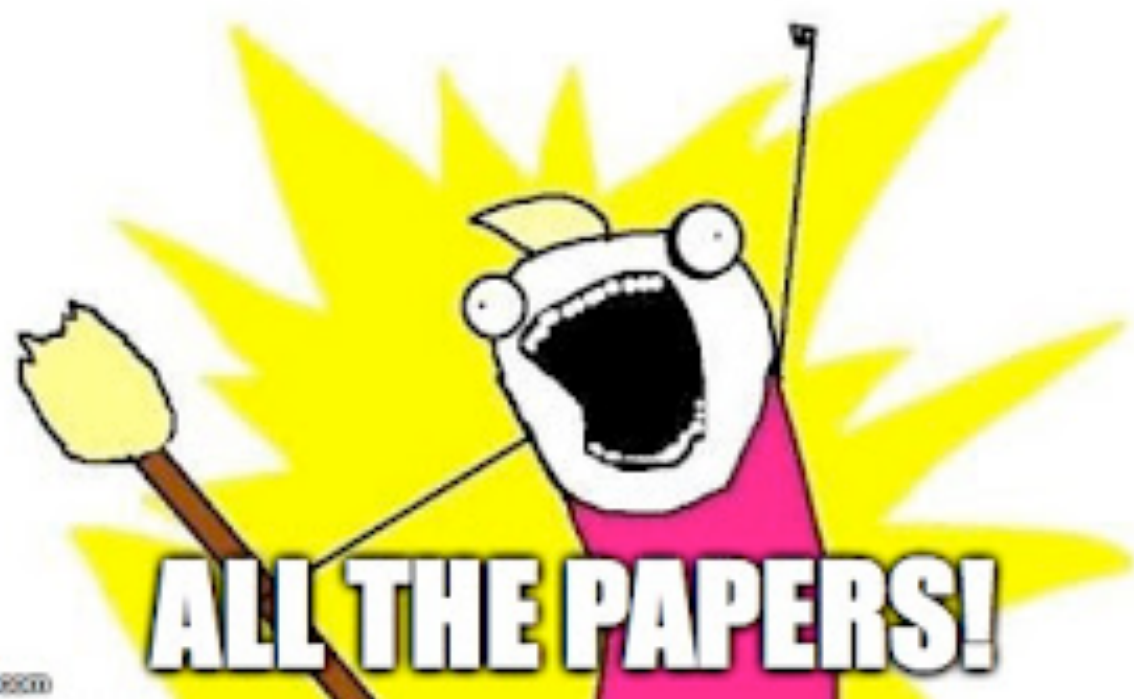
READ



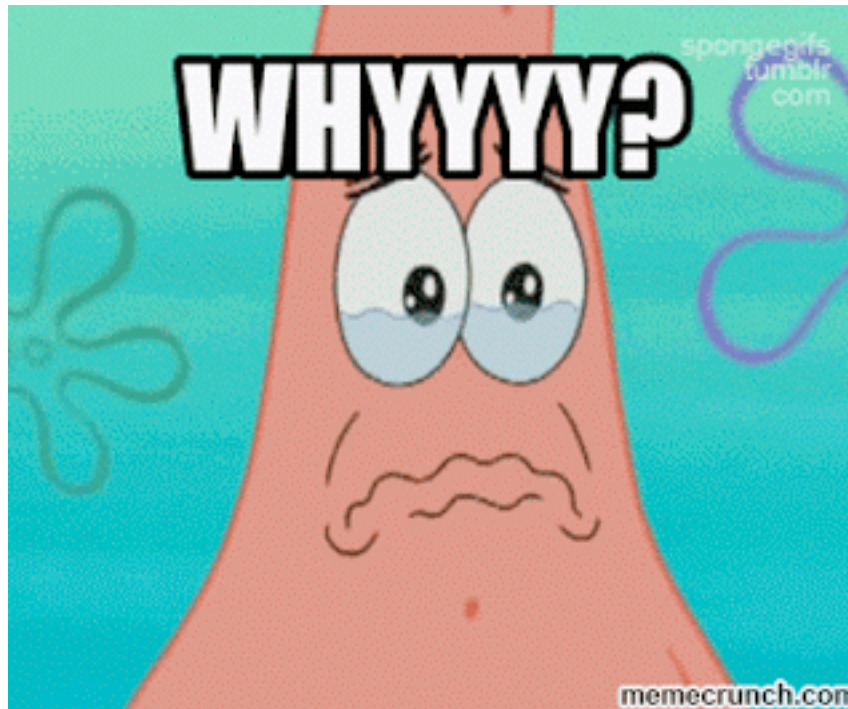
ALL THE PAPERS?

imgflip.com

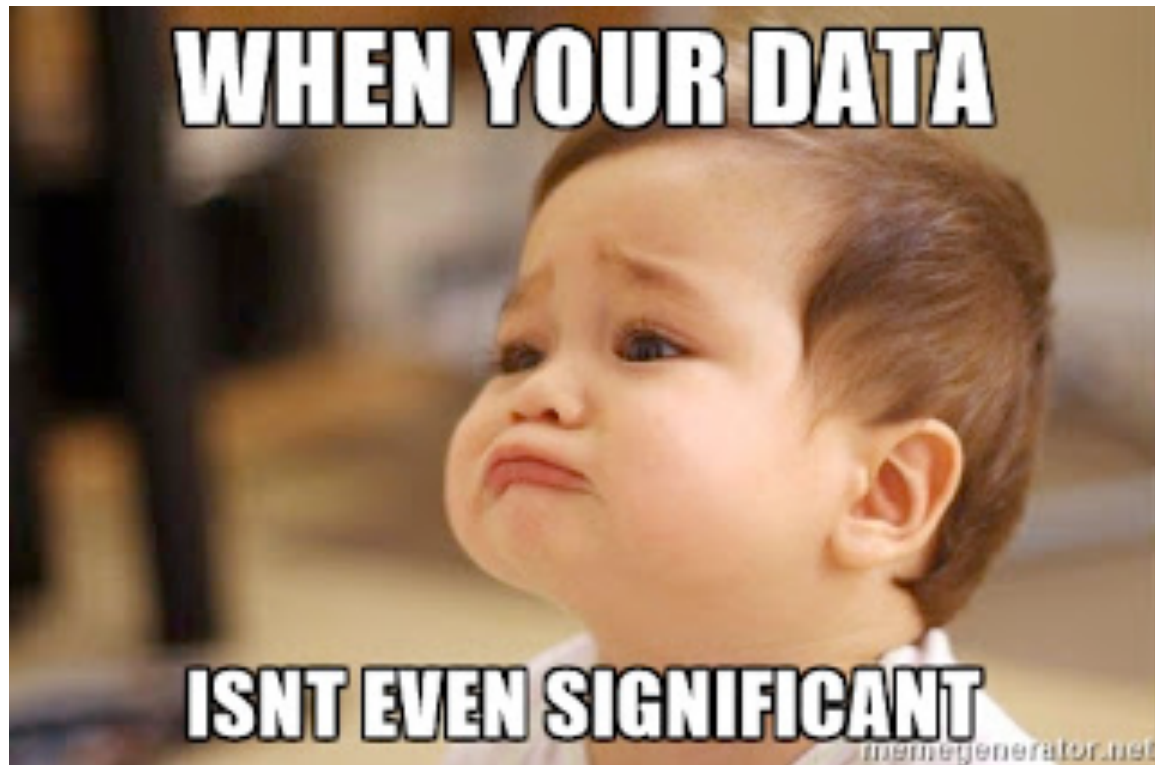
READ



“Having experiments fail is really disheartening. You spend all this time, sometimes months, trying to set up an experiments. You order all the supplies and get everything perfectly into place, and when you finally go to test this beautiful idea, it fails.”



“109 also exposed many of us to our first real technical writing and everything this entails...knowing when and where to include interpretations, exactly how to interpret data, and discovering the real meaning of ‘significance’.”

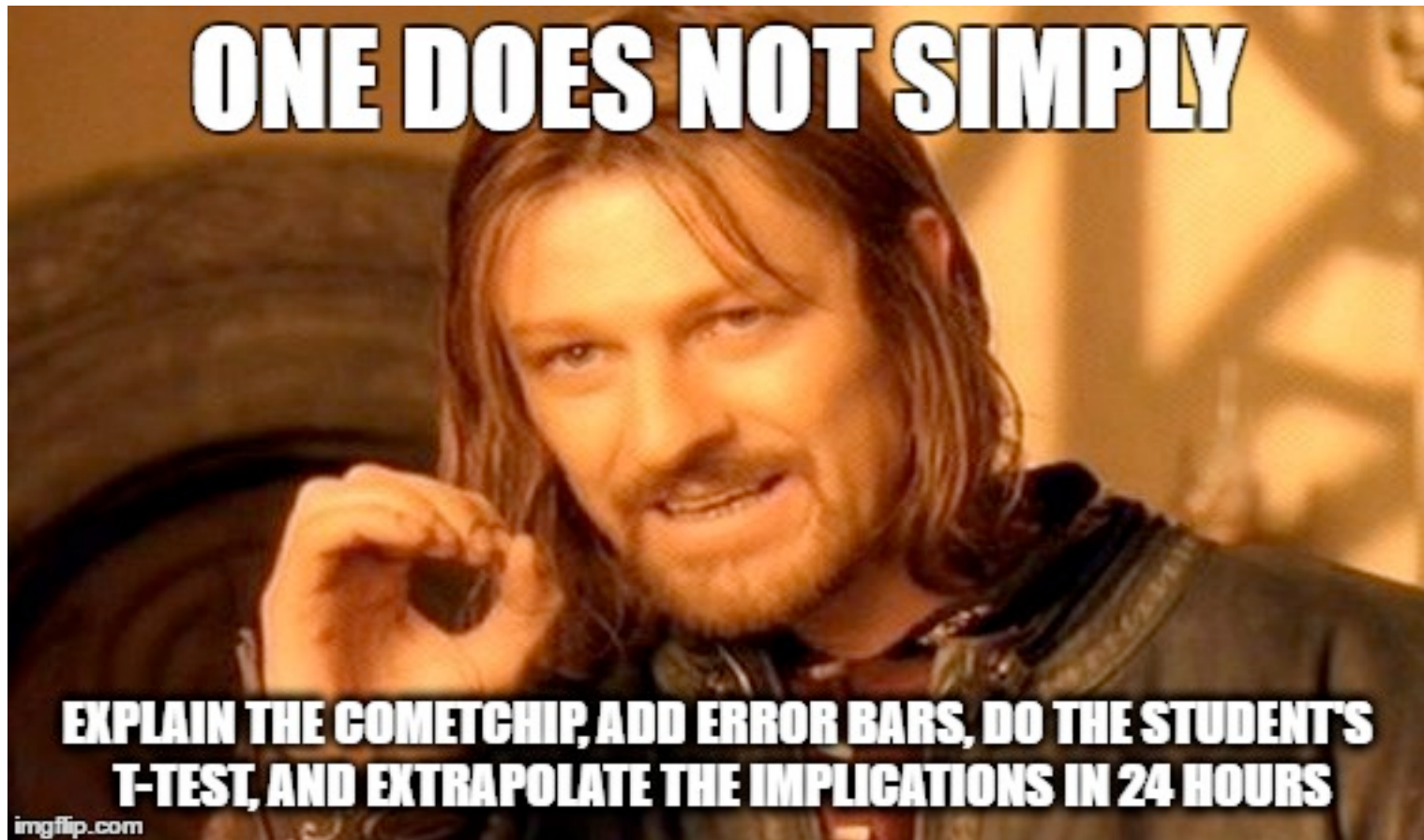


“While I think I would have still been excited about the expected TEM results..., the fact that our data differed significantly from what was expected didn’t hurt as far as making it interesting...

Now I have to figure out some plausible hypotheses for why the iron phosphate content is so low –”



“I feel like the best part of this module was having unlimited help in understanding the material and additional hands behind the scenes to make everything possible.”



WHEN ITS YOUR TURN

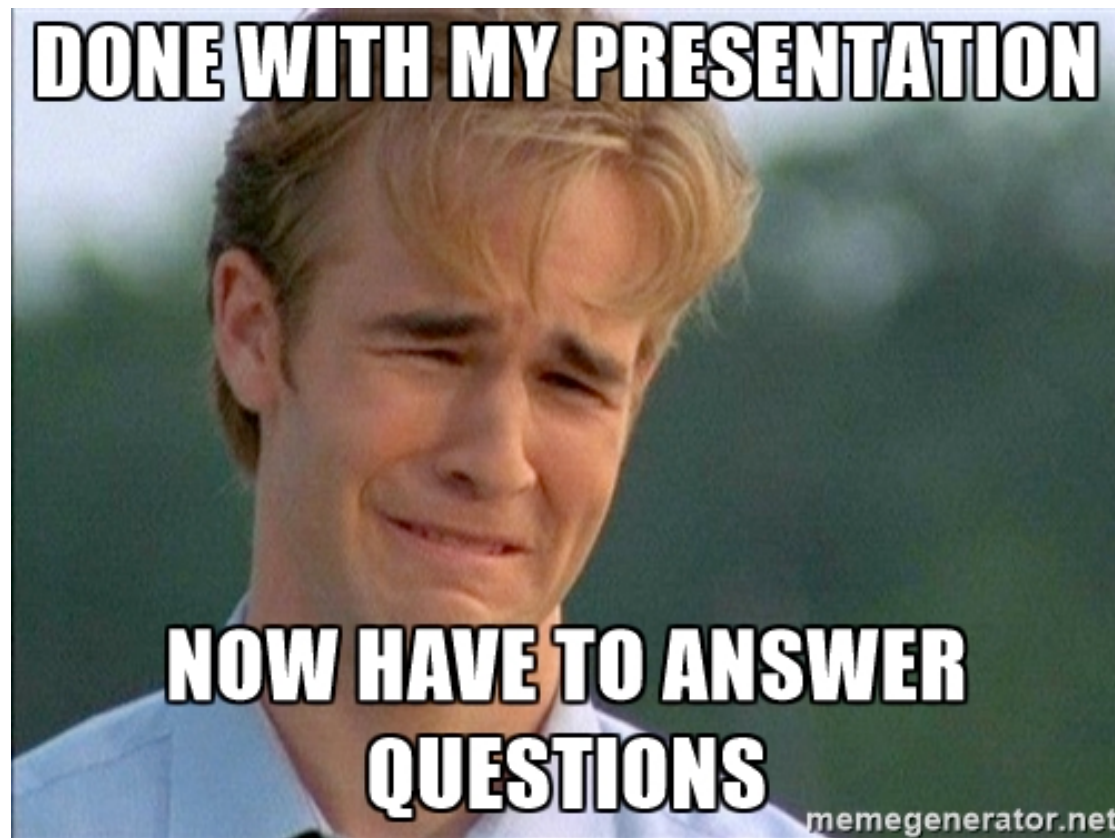
AT JOURNAL CLUB

memecrunch.com

“Despite my lack of love for public speaking, I really enjoyed the Journal Club Presentation. Speaking is something I want to improve on, so practice is good no matter how much I grumble. And it was pretty fun to hear everyone else's presentations. Everyone did a very nice job and it was an interesting way to learn some new information.”



“When I realized that we would be presenting our own research idea, I was terrified... To be honest, I didn’t think I had the knowledge and experience to propose a novel project... Ideas came on their own, so much so that I felt surprised by myself. For the first time I can really envision myself as a future researcher.”



“When it came time for questions and I got to use the extra slides I prepared, I was pretty pumped to pull them up.”



20.109 has changed my life. How? Here are a few examples:

Before 20.109 people told me that 20.109 was impossibly hard.

After 20.109 I will tell people that it's not the material that's challenging but the time-management and systematic work you must do to succeed.

Before 20.109 I had a general idea of what Bioengineering was, but I wasn't sure if I'd be good at it.

After 20.109 I'm way more confident that I can and will be a successful Bioengineer.

Before 20.109 I was scared to propose/follow my own research ideas because I thought I didn't have the knowledge to come up with something that would work.

After 20.109 I think that, while I still have a lot to learn, I can come up with interesting ideas RIGHT NOW.

Before 20.109 I didn't know anything about writing research proposals or papers.

After 20.109 I feel like I can whip out a pen and paper anywhere anytime and produce something decent just like that.

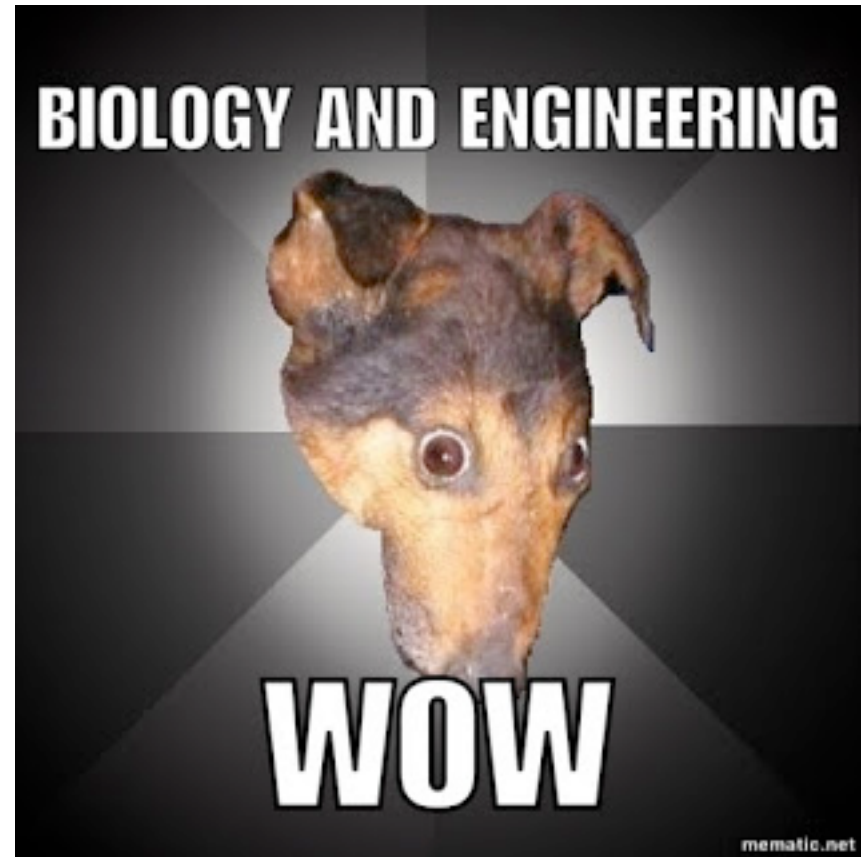
“At first, I complained a lot about how much time I spent for this class but thinking about it now, the time I spent in this class built up to shape me become a creative thinker and a better researcher...”



“I'm sort of growing more into the biological engineering mode of seeing what biology can do for us, not in a super-controlling way but as a way of making the life we have more sustainable, or efficient...”



“Usually classes are stressful and mere requirements to be able to graduate. However, 20.109 was the first time I've ever told my friends and family that I loved a class. This class has more than reinforced my interest in the Biological Engineering major.”

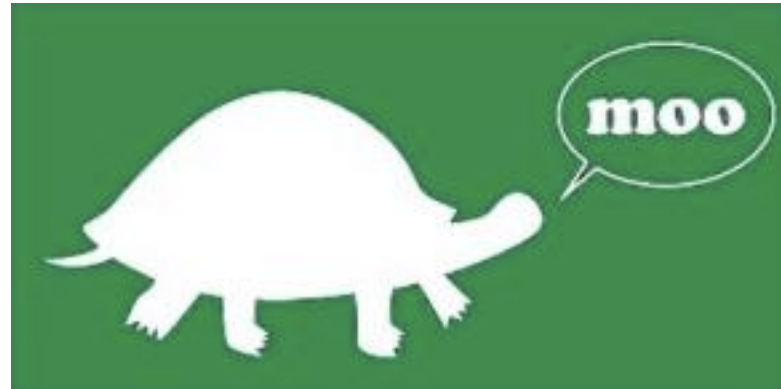


“My partner mentioned this as we left our feedback lunch yesterday and I couldn't agree more--it felt like we were leaving home. It's not often that I feel like I will miss a class and the staff. 20.109 will always have a special place in my heart as the class that made me a bioengineer.”



An introduction to 20.109

- Meet the team
- Core mission
 - Building a better bioengineer
- Modular structure
 - Module 1: High-throughput ligand screening
 - Module 2: Gene expression engineering
 - Module 3: Biomaterials engineering
- Logistics



Meet the 20.109



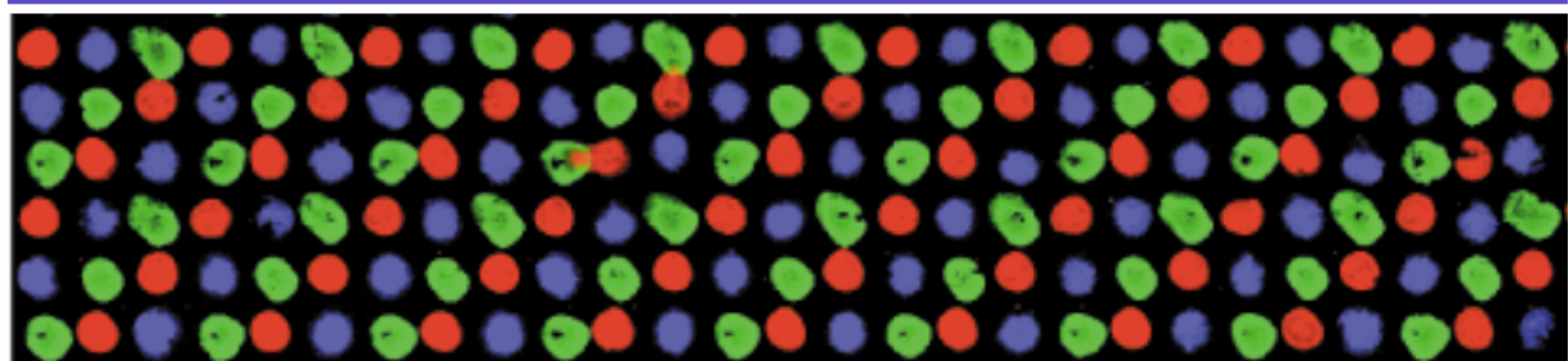
- Lecture / laboratory
 - Prof. Angela Koehler (M1)
 - Prof. Leona Samson and Prof. Fraenkel (M2)
 - Prof. Angela Belcher (M3)
 - Dr. Noreen Lyell
 - Dr. Maxine Jonas (T/R)
 - Dr. Leslie McClain (W/F)
- Communications
 - Dr. Diana Chien
 - Dr. Sean Clarke
- Teaching assistant
 - Rob Wilson
- Research assistant
 - Dr. Jifa Qi

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(S17): Laboratory Fundamentals of Biological Engineering



Schedule Spring 2017	Announcements	Assignments	Homework	Communication
1. High-throughput ligand screening	2. Gene expression engineering	3. Biomaterials engineering		

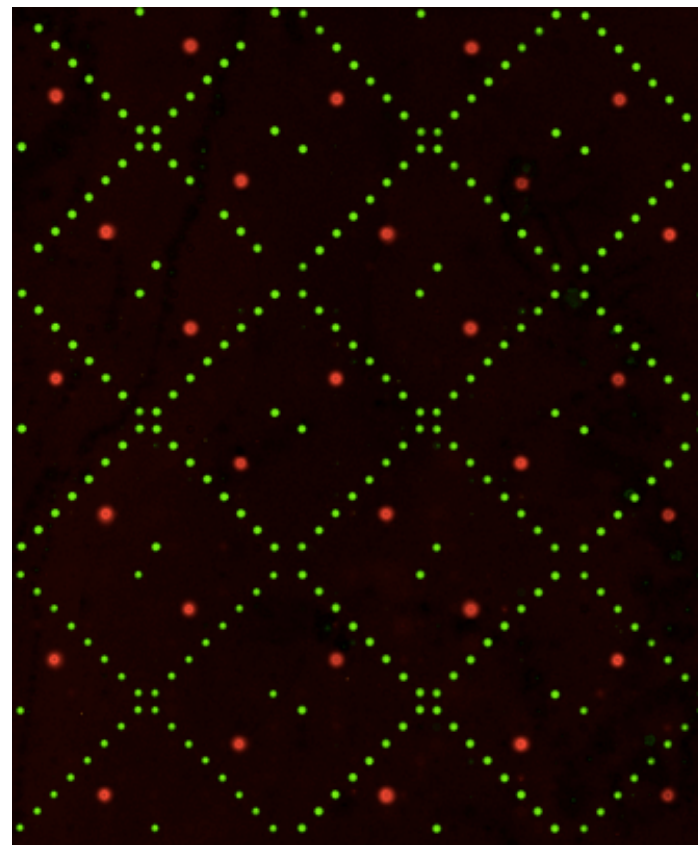
Module 1: High-throughput ligand screening (Koehler)

Module 2: Gene expression engineering (Samson/Fraenkel)

Module 3: Biomaterials engineering (Belcher)

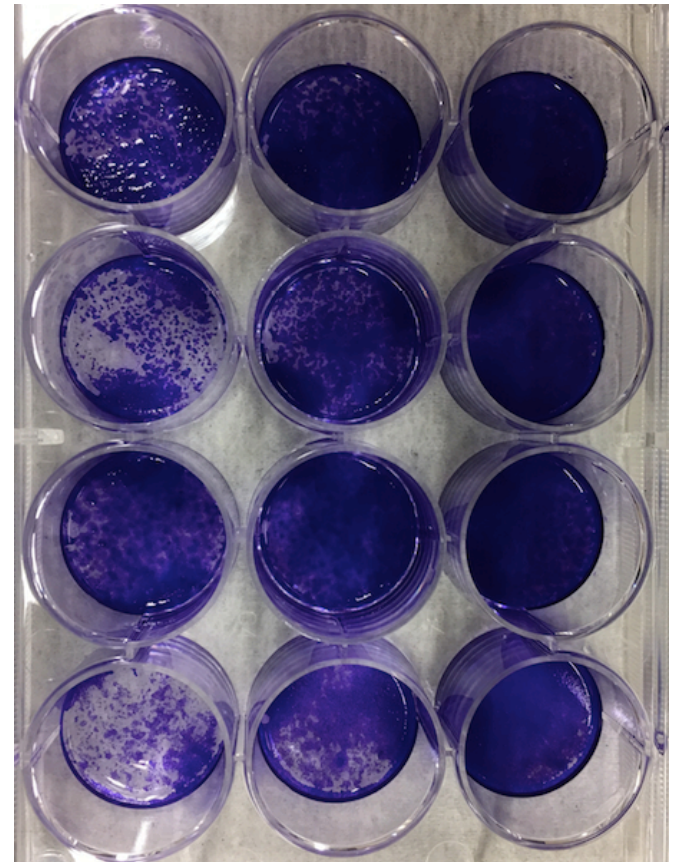
Module 1: High-throughput ligand screening

- Experiments
 - Purify protein and assess purity / concentration
 - Screen small-molecule microarray
- Lab skills
 - Molecular biology techniques
 - High-throughput screening
 - Data analysis



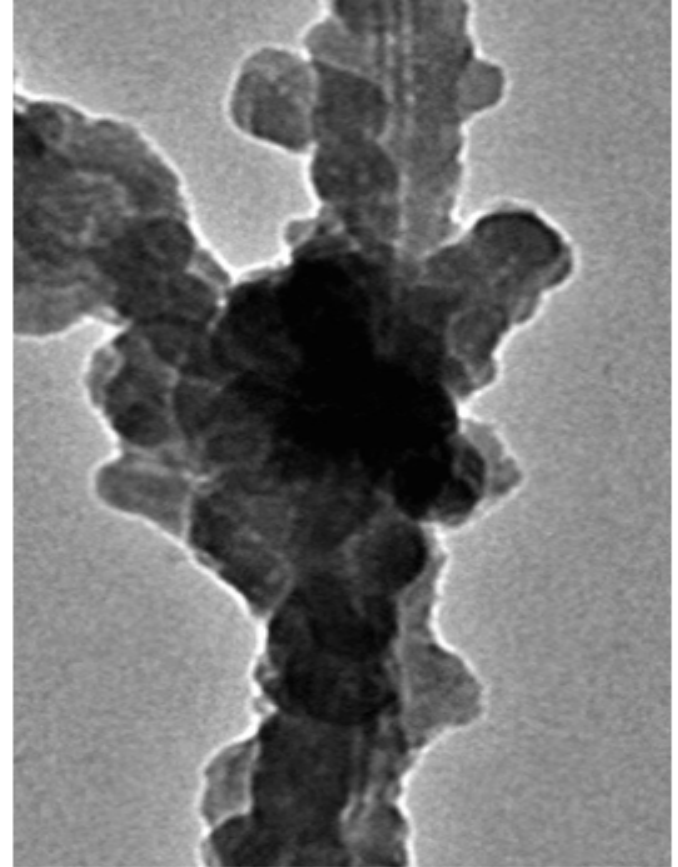
Module 2: Gene expression engineering

- Experiments
 - Measure gene expression using qPCR and RNA-seq
 - Examine cell survival in response to drug treatment
- Lab skills
 - Mammalian tissue culture
 - Molecular biology techniques



Module 3: Engineering biomaterials

- Experiments
 - Mineralize phage with nanoparticles
 - Visualize nanowires with TEM
 - Construct cathode material
- Lab skills
 - Biomaterial production
 - Capacity measurements



Resources in 20.109

Schedule Spring 2017

Announcements

Assignments

Homework

Communication

1. High-throughput ligand screening

2. Gene expression engineering

3. Biomaterials engineering

Schedule details:

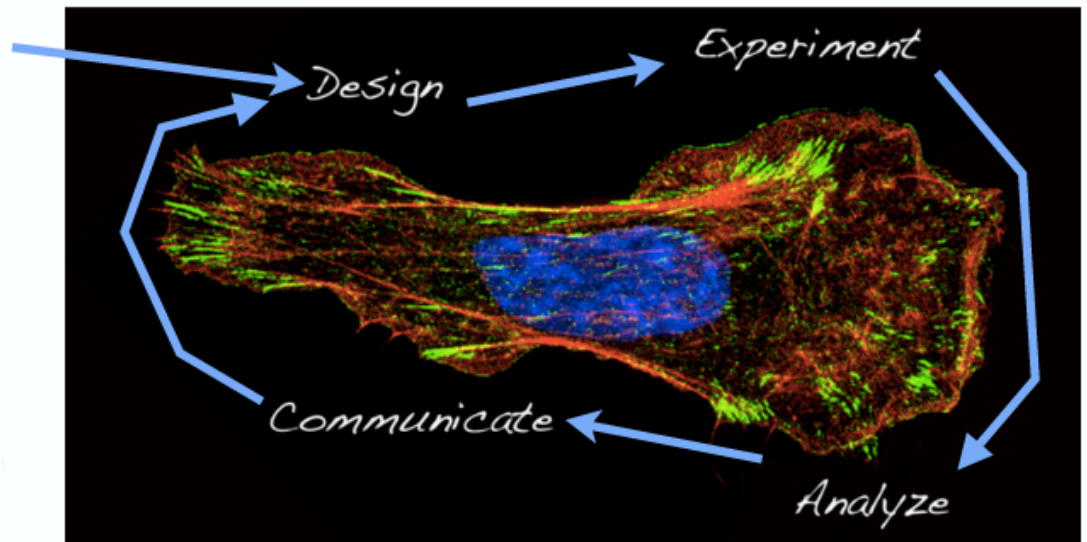
Lecture: T/R 11-12 (4-149)

Laboratory sections: T/R 1-5 or W/F 1-5 (56-322)

MODULE	DAY	DATE	LECTURER	LABORATORY EXPERIMENTS	ASSIGNMENTS
		T/W Feb 7/8	NLL	Orientation	
1	1	R/F Feb 9/10	AK	In silico cloning and induce protein expression	Orientation quiz Homework due
1	2	T/W Feb 14/15	AK	Purify induced protein	Homework due
1	3	R/F Feb 16/17	AK	Evaluate purity and concentration of protein	Laboratory quiz Homework due
		T/W Feb 21/22		President's day holiday	
		R/F Feb			

Workflow in 20.109

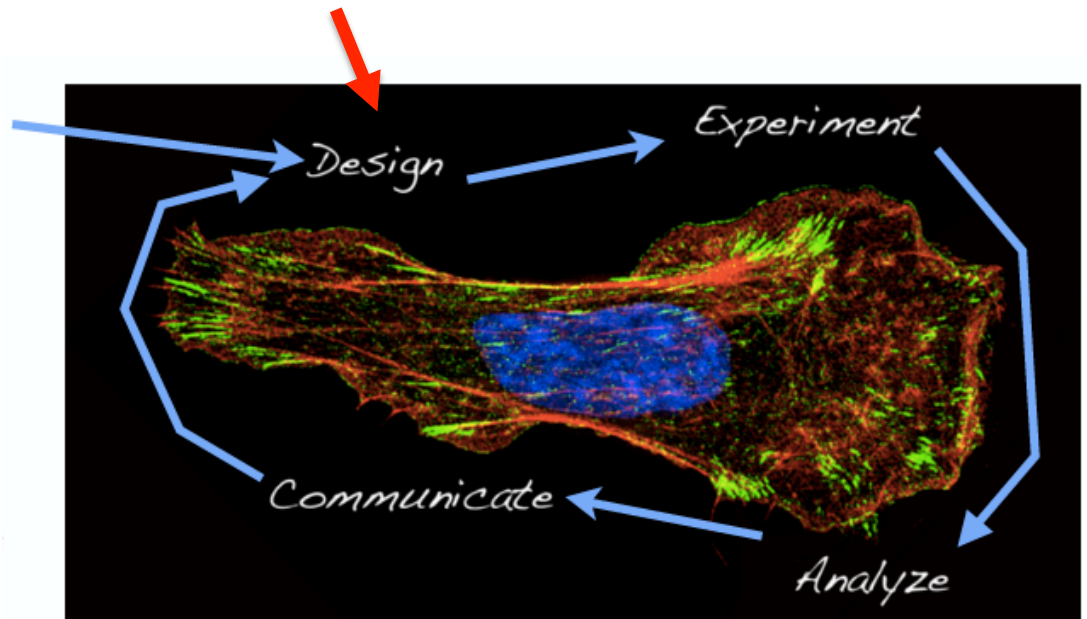
- We start here...
- But, you can't design an experiment without analyzing some data!



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



Best practices in 20.109

We do relevant and cutting edge science...



and we do it safely!!

We analyze real and novel data in 20.109

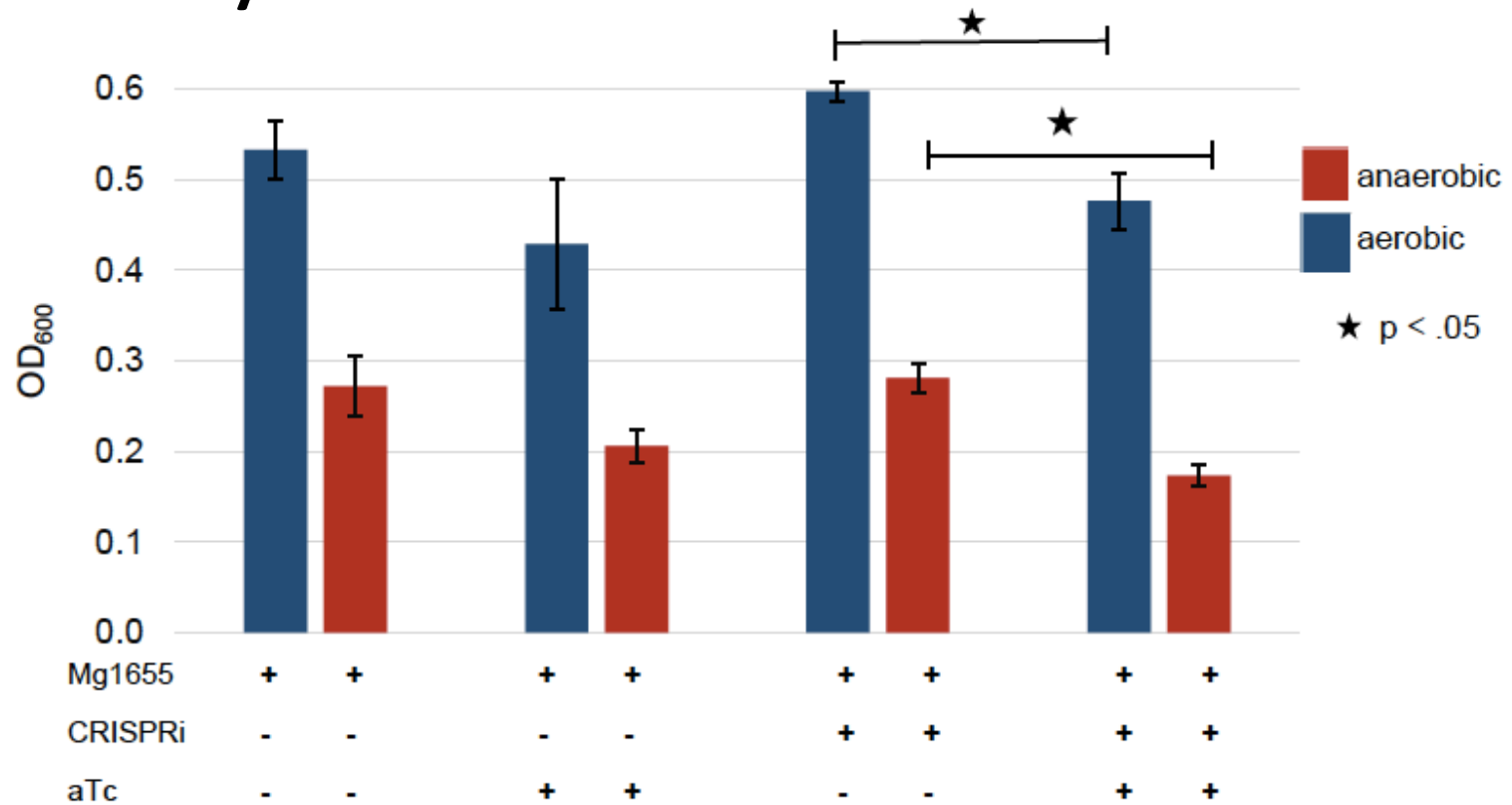


Figure 4. O₂ affects E.coli growth significantly and activated CRISPRi decreases overall cell growth. Conditions similar for CRISPRi and aTc presence were compared in aerobic and anaerobic conditions to check for side-effects on growth rate. Across all four conditions there was a significant difference between aerobic and anaerobic conditions. In addition there was a significant difference between aerobic CRISPRi+O₂+aTc and inactivated CRISPRi+O₂-aTc. Also, there was a significant difference between anaerobic CRISPRi-O₂+aTc and CRISPRi-O₂-aTc. ★ = p<.05

Written and oral communication

MODULE	TOPIC	ASSIGNMENT	WEIGHT
1	High-throughput ligand screening	Data summary	15%
		Mini-presentation	5%
2	Gene expression engineering	Research article	20%
		Journal club presentation	15%
3	Biomaterials engineering	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 Communication Lab
 - Instructors
 - Dr. Diana Chien
 - Dr. Sean Clarke
 - 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/>.

<https://be.mit.edu/communicationlab>

Course logistics

- Lectures
 - T/R 11-12p in 4-149
 - Strongly encouraged attendance
- Laboratory sections
 - T/R or W/F 1-5p in 56-322
 - Required attendance
- 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 and tomorrow on time
 - Representatives from EHS will be delivering a safety training presentation
- Be sure to wear/bring pants and closed toed shoes
 - We will be working in the laboratory