to 20.109!

Laboratory Fundamentals of Biological Engineering

9/1/20

Insight from previous 109ers

Words of wisdom…

Lesson learned: Label Your Tubes

BE Communications Lab is a great resource!

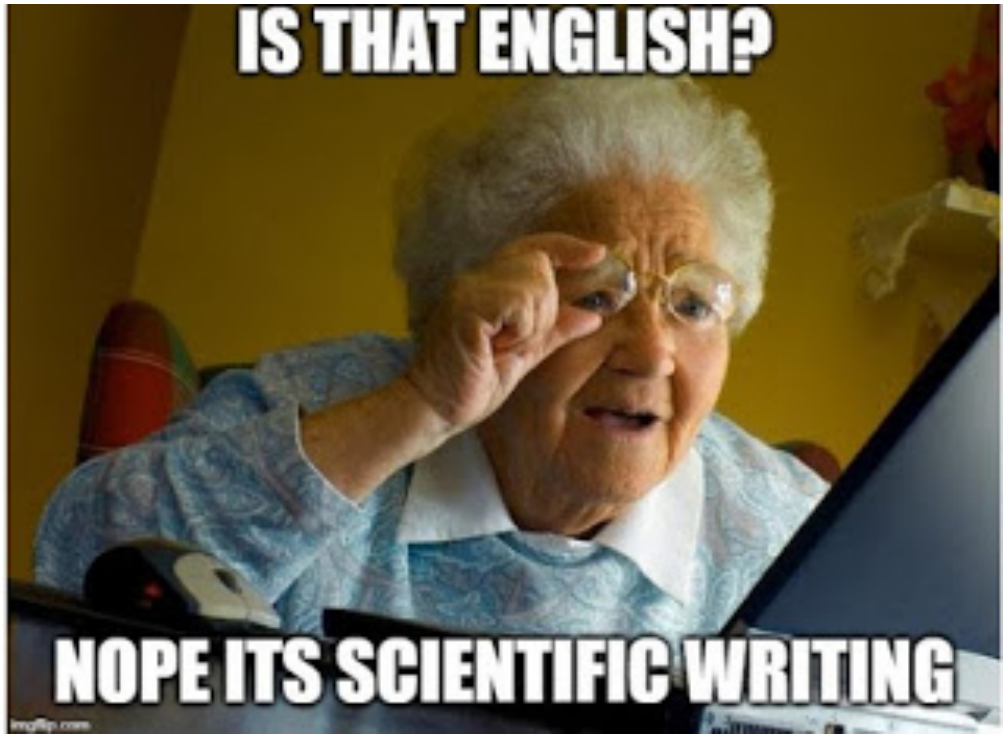
Don't be afraid to ask your professors and TA's questions:

Failure is Beautiful Too

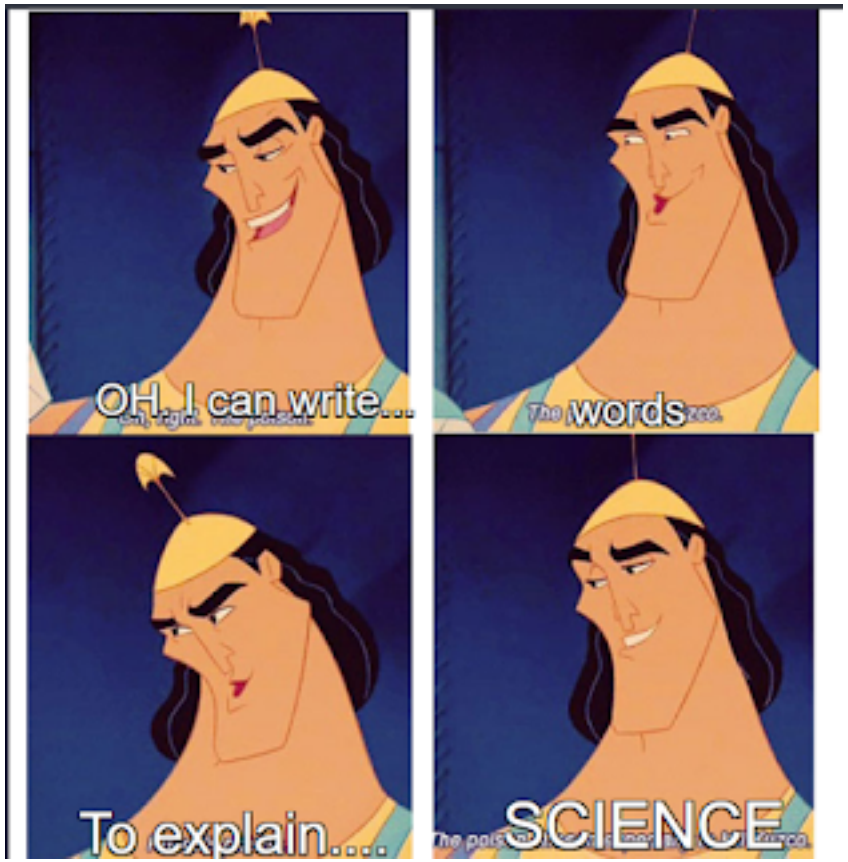
GO TO OFFICE HOURS! You will get useful tips and comments for your presentation.

Best Preparation for Graduate School EVER

A Call for Accessible Scientific Writing



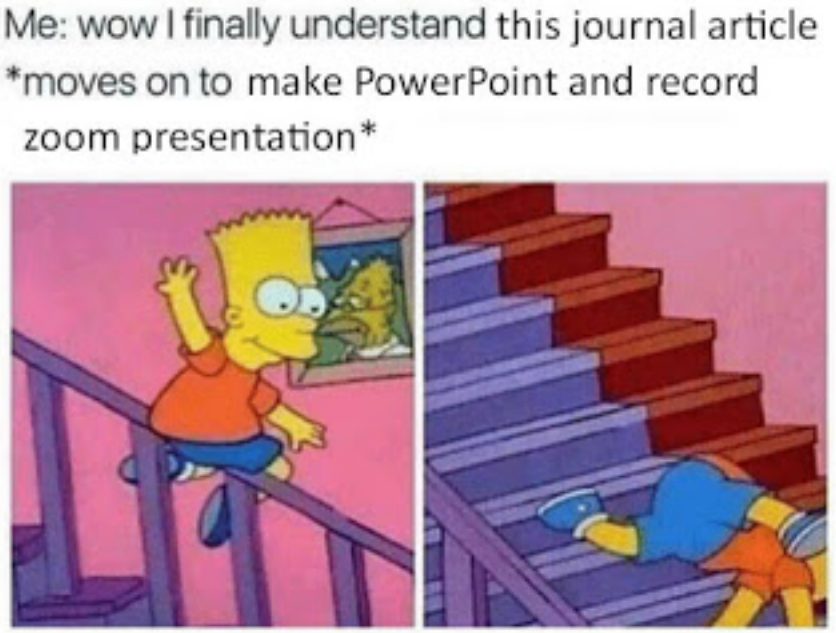
Scientific Writing: Cut the Fluff and Write the Facts



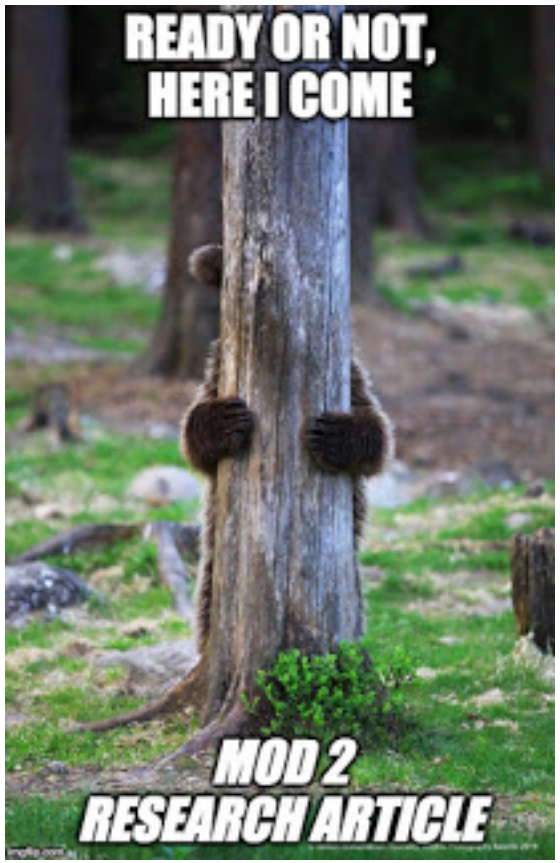
Practice, practice, practice!

Hey! That actually wasn't half bad

I'm more confident in my ability to comprehend a journal article and connect the figures to the experiments in the text. I also learned just how important it is to practice a presentation - even if this wasn't in-person, I still had to be able to speak coherently and sound like I knew what I was talking about (which was definitely not the case when I first practiced running through my slides).



The hardest part of writing is getting started.



Time is flying...

October 4th - 10 Days Before the Data Summary Deadline:

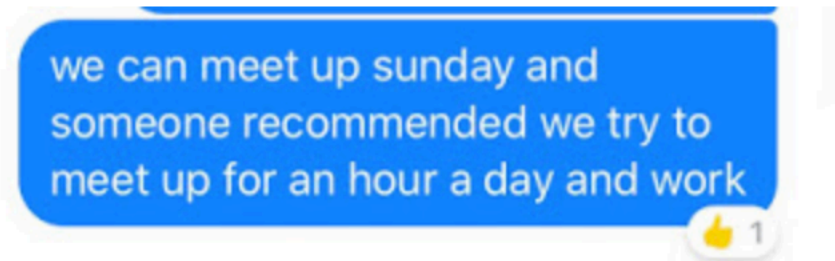


Figure 1: A very well intentioned and prepared 20.109 student plans to start and finish the Data Summary early.

As my lab partner and I began planning for the Data Summary, we knew it was going to be a lot to take on. I would be out of town the weekend it was due and we had exams to study for the week after. We had both never written a scientific paper before and were completely unprepared for what was to come. So we planned. We would meet every day for an hour and try to chip away at the assignment little by little, eventually freeing up our weekend.

Anything worthwhile is going to take effort

Breathing helps!


ME
LESLIE DURING
OFFICE HOURS

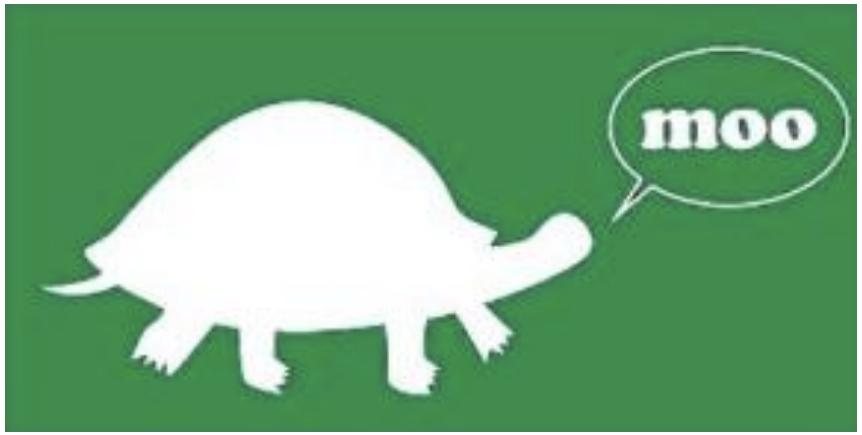
Working in a team!

One positive aspect of doing school from home has been being able to bring my dogs to school with me. I never thought I would see the day when I could bring my dogs to lab, but the whole second half of the semester, my dogs have learned a ton

I even treated myself to one of these delicious, home baked chocolate chunk cookies my sister made over the weekend - I guess there are some perks to being stuck at home 😋

A brief introduction to 20.109

- Core mission
  - Building a better bioengineer
- Meet the Fa20 team
- Experimental overviews
  - Module 1: Screening ligand binding
  - Module 2: Measuring gene expression
  - Module 3: Engineering antibodies
- Logistics



Our core mission is building bioengineers

- 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**

Meet the 20.109 Fa20 teaching team

- Lecture / Laboratory Instructors
  - Prof. Bevin Engelward (M1)
  - Prof. Jacquin Niles (M2)
  - Dr. Noreen Lyell (M3)
  - Dr. Leslie McClain
  - Dr. Becky Meyer
- Communication Instructors
  - Dr. Sean Clarke
  - Dr. Prerna Bhargava
- Teaching assistants
  - Aimee Moise (T/R)
  - Bri Ko (W/F)
- Research Assistants
  - Khan

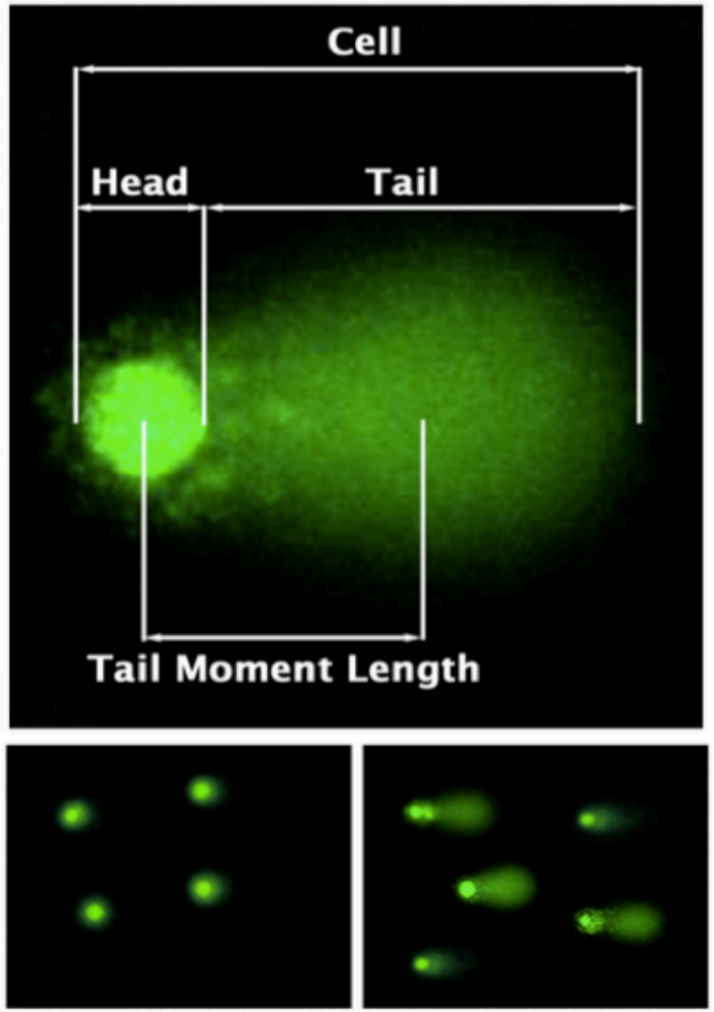
Mod1: Genomic Instability

Knowledge and Conceptual Goals:

- Importance of genomic stability in preventing diseases
- How small structural changes have large consequences
- Biochemistry of a multistep DNA repair pathway
- Cost/benefit of DNA repair
- Importance of pathway balance
- Public health importance of studying combined exposures
- Importance of interdisciplinary research for public health
- Responsibility to community stakeholders
- Responsibility as research advocates

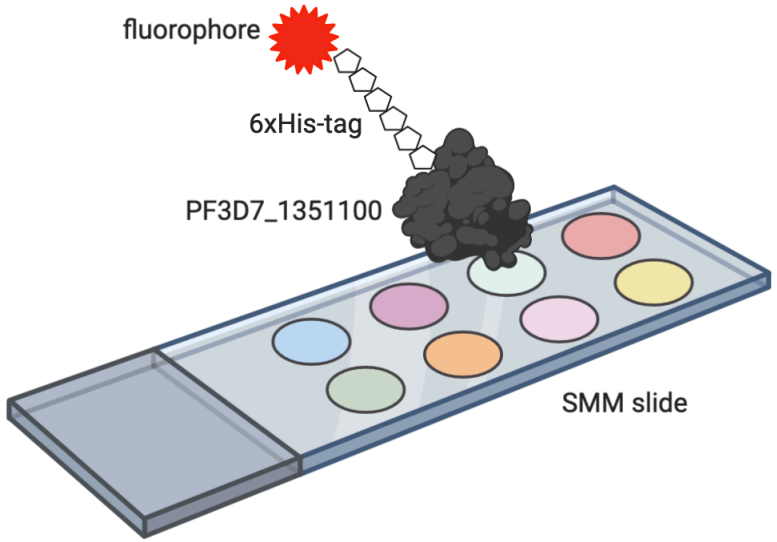
General Research Knowledge:

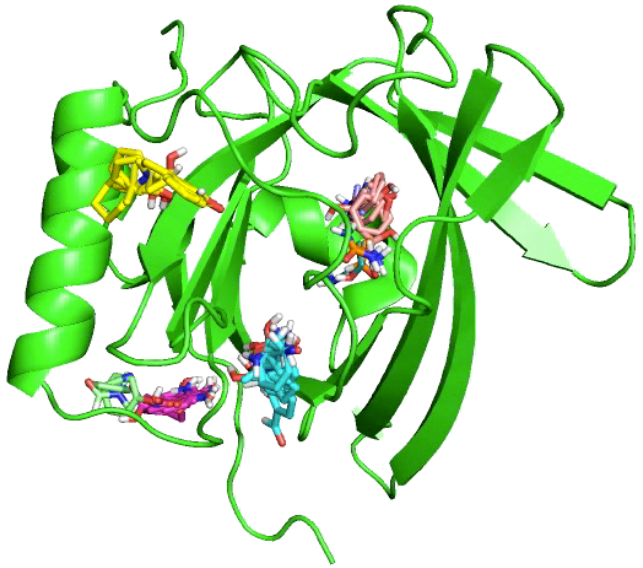
- Mammalian cell culture
- Immunofluorescence
- Quantitative image analysis
- High-throughput assay development and application
- Data presentation and conservative interpretation



Mod2: drug discovery

- Research goal: Identify & characterize small molecule binders to a protein drug target
- Laboratory skills
  - Recombinant protein expression and purification
  - High-throughput screening assays to identify small molecule hits
  - *In silico* analysis of hits

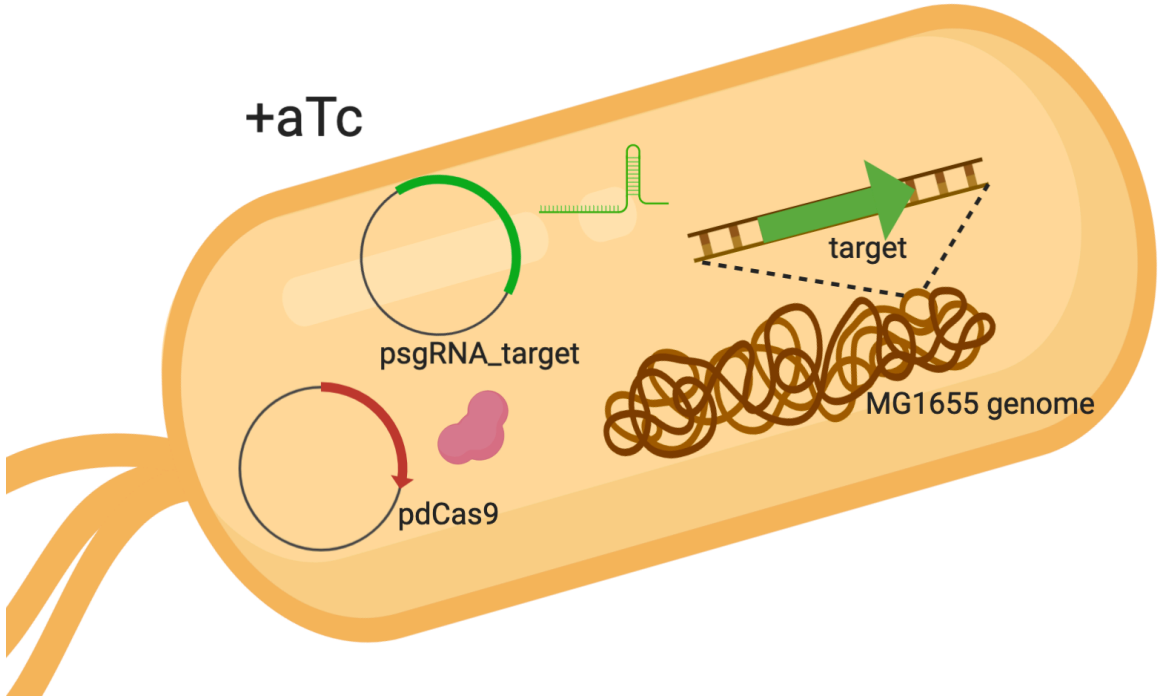




Mod3: metabolic engineering

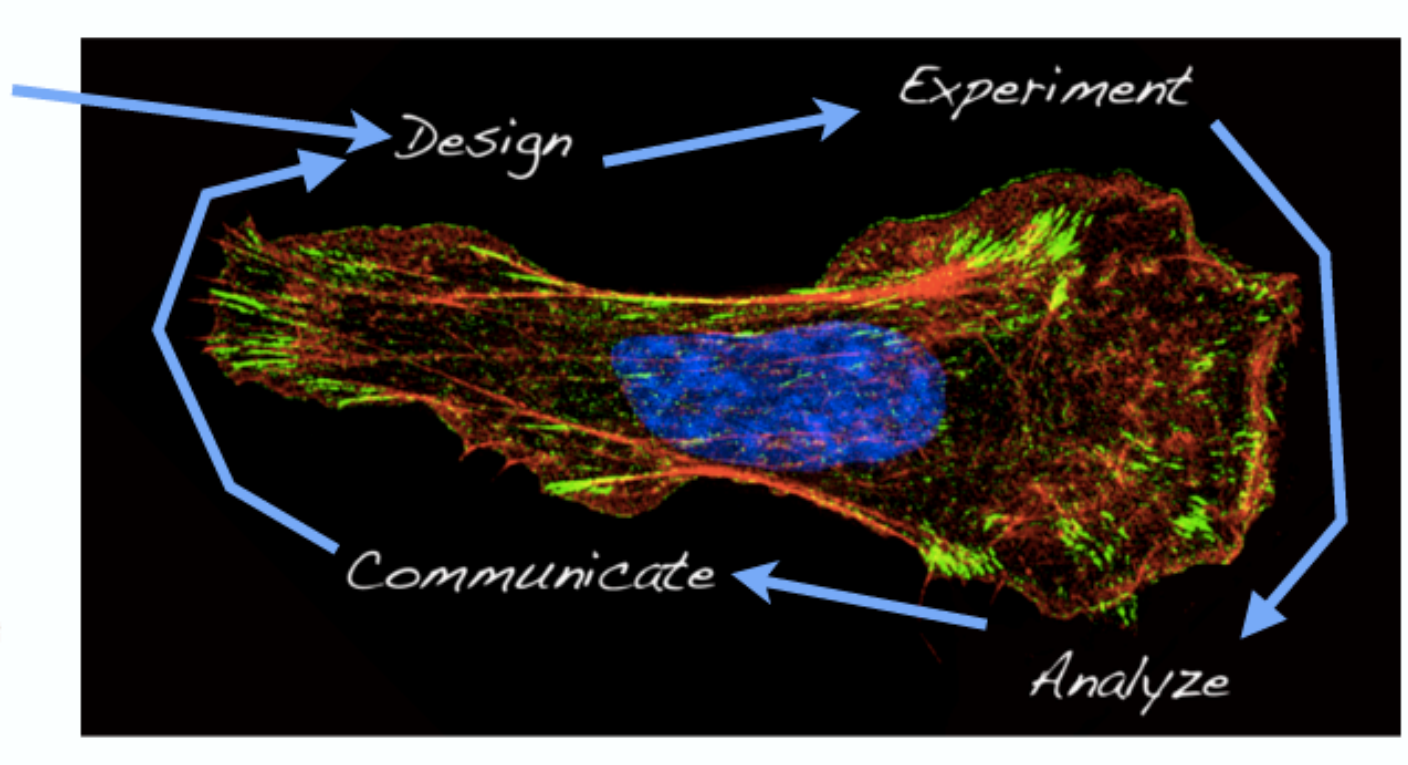
- Research goal: Increase ethanol yield in *E. coli* using **CRISPRi system to inhibit expression of genes** that encode enzymes that are involved in anaerobic fermentative metabolism

- Laboratory skills:
  - Bacterial cell culturing
  - Molecular biology assay processing
  - Data analysis



Workflow in 20.109

We start here…

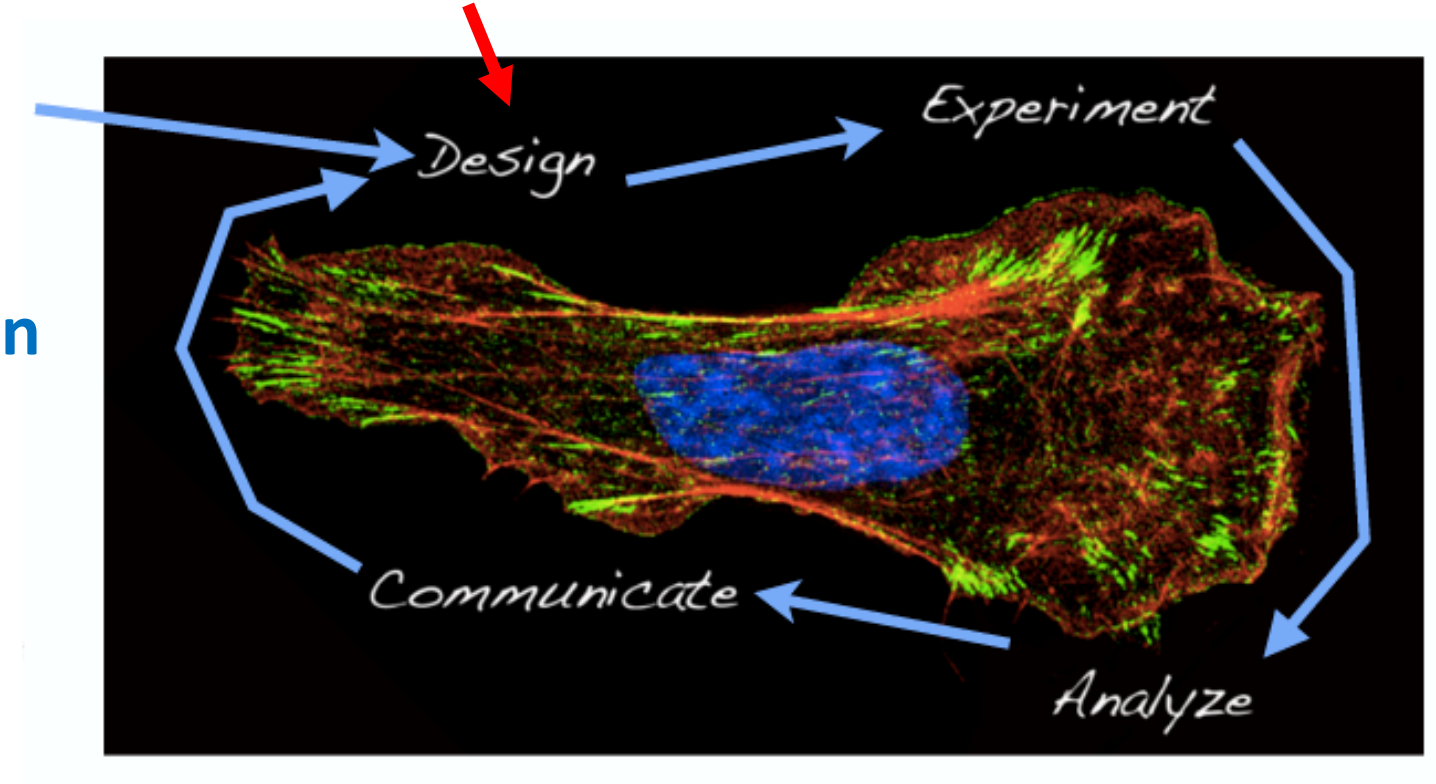


Workflow in 20.109

Research!

We start here…

But you can't design an experiment without reviewing the literature!



We do real science

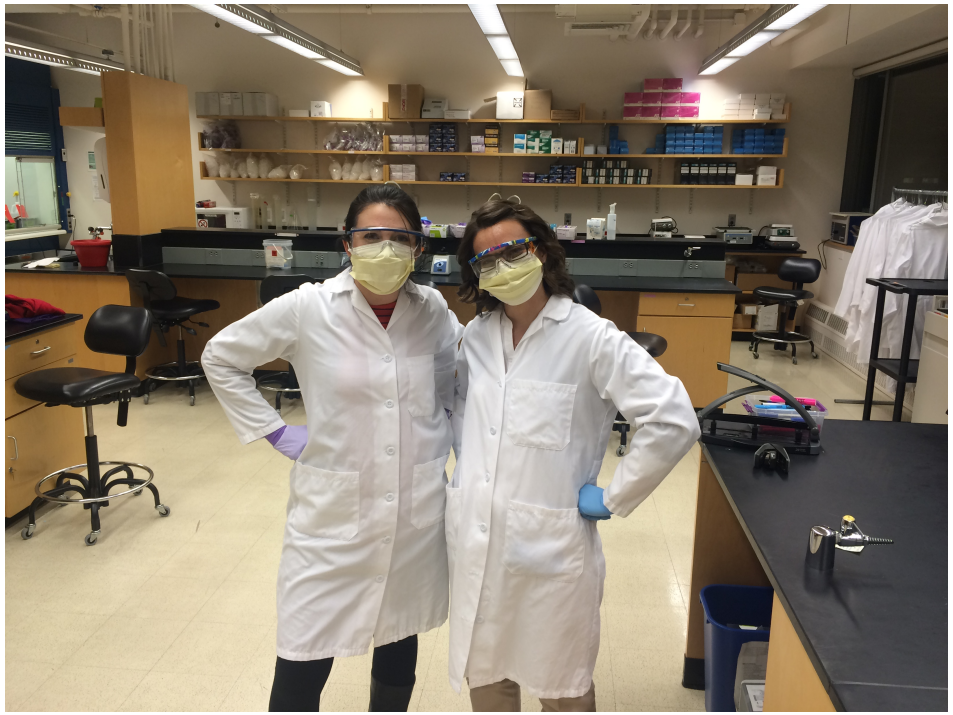
We aim to prevent ‘just follow the protocol’ syndrome

Will discuss not only how experiments are completed, but what each step actually does

We follow best practices

We do relevant and cutting edge research

Will discuss best practices for data collection and personal / environmental safety



We analyze and report data

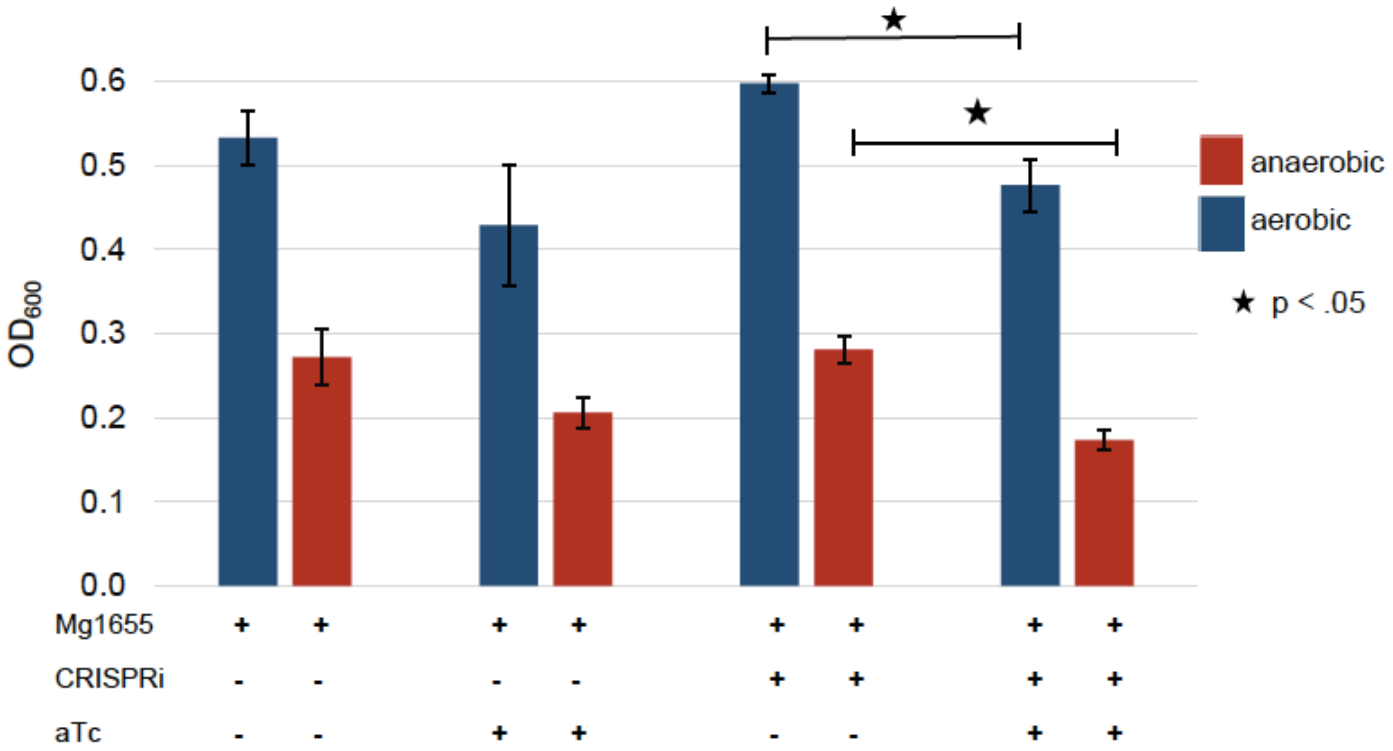


Figure 4. O_2 affects E.coli growth significantly and activated CRISPRi decreases overall cell growth. Conditions similar for CRISPRi and aTc presence were compared in aerobic and anaerobic conditions to check for side-effects on growth rate. Across all four conditions there was a significant difference 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

We develop written and verbal communication skills

MODULE	TOPIC	ASSIGNMENT	WEIGHT
1	Genome instability	Data summary	15%
		Mini-presentation	5%
2	Drug discovery	Research article	15%
		Journal club presentation	15%
3	Metabolic engineering	Research proposal presentation	20%
		Mini-report	5%

- Written communication assignments = 35%
- Verbal communication assignments = 40%
- Daily work and participation = 25%

Why communicate your science?

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

RECENT PUBLICATIONS
ARTICLES
INTERVIEWS
OPINIONS
EDUCATION
THIS IS HOW I DID IT...
FROM THE FIELD
ECOPICS
EVENTS
NREL NEWS
LINKS
CITATION SUBMISSION
PODCAST

why scientists should tell more stories

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

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

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 Team
  - Faculty
  - Instructors
  - Teaching assistants
- BE Communication Lab
  - Instructors
  - Writing fellows

BE Communication Lab is a great resource

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.

mitcommlab.mit.edu/be

Schedule and structure logistics

- Lectures meet Tuesday and Thursday 11-12p in 56-154
  - Prof. Engelward ➔ Prof. Niles ➔ Dr. Lyell
- Class divided into two laboratory sections
  - Tuesday and Thursday 3-5p
  - Wednesday and Friday 3-5p

- Details
  - You will work in pairs throughout the semester
  - Collaboration with integrity is key!

Expectations in 20.109…

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

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 this semester

- 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 administrative notes

- Attendance is expected, in both lecture and laboratory
- Participation is required
  - Laboratory exercises are completed with your partner
  - Some homeworks and assignments are completed with your partner
- **We know this will be a new and interesting experience for everyone, please always feel free to reach out with questions / comments / concerns as we move through the semester!**