

Research Proposals

20.109 Communication Workshop 5

Dr. Prerna Bhargava

Dr. Sean Clarke

Helping you communicate effectively.


be.mit.edu/communicationlab

We have seen a variety of different assignments in 20.109...

- Figures
- Titles and Abstracts
- Manuscripts
- Journal Clubs

- Proposals

All assignments use the same basic communication skills:

- Figures
 - Titles and Abstracts
 - Manuscripts
 - Journal Clubs
 - Proposals
- 
- Know your audience
 - Tell a story
 - Convey clear logic
 - Use clear, precise language and presentation

Concretely, these communication skills translate to the following:

- Clear **visual data** in the form of figures and slides; reducing signal to noise
- Titles as **strong messages** on slides
- Tell **a story** with a clear take-home message and conclusions
- Use **hourglass structure** to draw the audience in

All these help make a good proposal too!

What if you have \$1 million



to give to someone's
biological engineering project?

Say you have \$1 million

What would you want to know from
the person you're giving it to?

A successful proposal must convince its readers that the proposed work is **significant** and **achievable**.

Proposals are future papers (with twists)

Both

have structured sections

tell stories

include methods, controls & statistics

argue for excitement and validity

Papers

framed as a **question**

outcome sounds **un**certain

the **findings** are exciting

Proposals

framed as a **hypothesis**

outcome sounds certain

innovation is exciting

The 109 proposal is a team presentation

12 minutes + Q & A

Speaking and slides

Audience: peers & teaching staff



Tell us **why, what, and how**

Why Identify the **gap/need**

What What is the clear idea you propose?
Impact?

How Key steps to accomplish goals (“aims”)

We care about the **methods**:
specify techniques, *in vitro*, *in vivo*, system?

Show us **expected data**

If things don't work, what will you do?

Have **controls and work-arounds**

Significant

Achievable

Use slides to convey:

- a brief project overview
- sufficient background information identifying a **clear problem**
- a **statement of the research problem and goals** (specific research aims)
- details and methods for goals
- predicted outcomes, alternate approaches, needed resources
- **societal impact** if all goes well

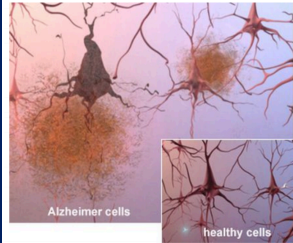
Begin with background that highlights the problem and the current state

Alzheimer's affects 5.4 million Americans

- Information about disease and progression

Transition statement linking to β -amyloid plaques (written on slide and/or stated verbally)

β -amyloid plaques contribute to degeneration of nerve function



- General information about plaque origin and structure
- Block cell-cell communication
- Induce apoptosis
- Lead to generalized destruction of brain tissue

Symptoms of Alzheimer's may be alleviated by elimination of plaques

- Information about current field of research
 - Briefly, what has been done

Though some progress has been made in reducing plaques, our aim is to convert them to usable product

Novel amyloid-to-dark chocolate (ADC) enzyme recently discovered

- Identified in our laboratory using a yeast two-hybrid screen
- Information about ADC enzyme

Leading to a clear statement of your research problem and goals

Clear, concise research statement

3-4 goals to prove your hypothesis

Research aim: use ADC to convert β -amyloid plaques to dark chocolate

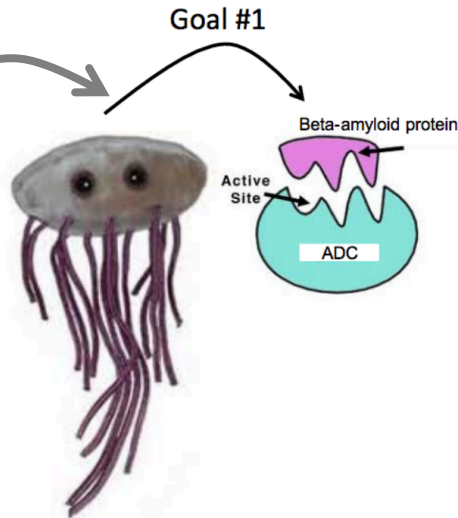
- **Goal 1:** Optimize the production of genetically engineered ADC using non-toxic *E. coli* strain
- **Goal 2:** Determine enzymatic efficiency of engineered ADC *in vitro* using harvested β -amyloid plaques
- **Goal 3:** Measure efficacy of engineered ADC *in vivo* using a mouse model of Alzheimer's disease

Each goal should have a slide for what you'll do

Title of your goal

Optimize production of ADC in *E. coli*

Schematic of goal/ method/ expected results



- Engineer BL21(DE3) to express ADC
 - Clone ADC into pXYZ
 - Test protein expression
 - Additional steps...
- Potential setback
 - Possible solution

Key methods

Potential limitations and alternative approaches

Include a slide that highlights the **impact** this work would have on society and science

Why is this work important?

Why should someone give you money to do this work?

Remember:

You want to highlight that you are solving an important (and real) problem with an innovative solution.

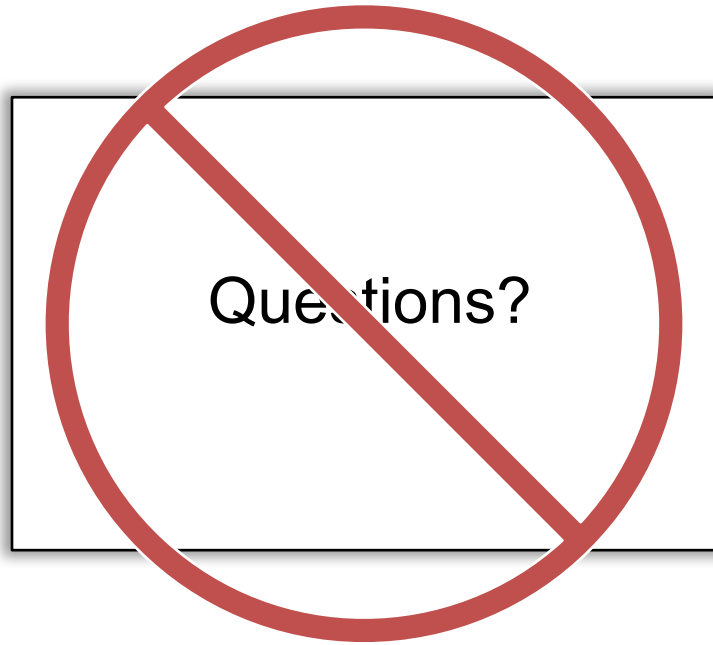
And this should be clear to your audience.

Adapt to presenting as a group

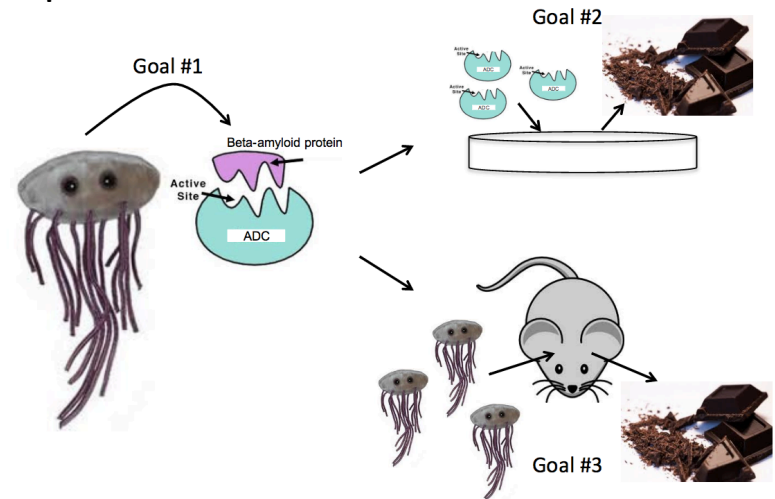
- Decide who will say what
- Announce organization/transitions
 - “I’ll introduce our Question and Aims, and Prerna will talk about the Methods we’ll use...”
- Stay visually quiet when you’re not on
- Don’t read, just use transitions and bits of text to guide yourselves
- Leave a helpful slide up on screen during Q&A
- Flip to earlier or supplementary slides as needed

PRACTICE PRACTICE PRACTICE

Make good use of your last slide



Conversion of β -amyloid plaques to usable product in treatment of Alzheimer's



Proposals are hard!

1. How do I come up with a good proposal topic that is feasible and significant?
2. What should my aims be?

How do I come up with a good proposal topic that is feasible and significant?

Spend time brainstorming as a team

Go for **quantity**--bring up **a lot of ideas**, raising your probability of coming up with a good idea

Defer judgment

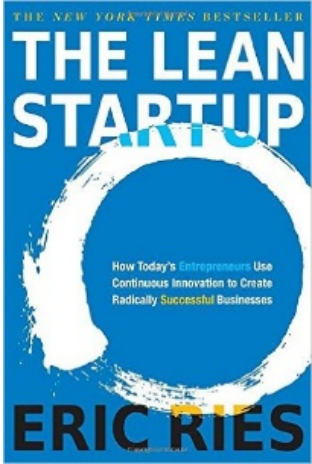
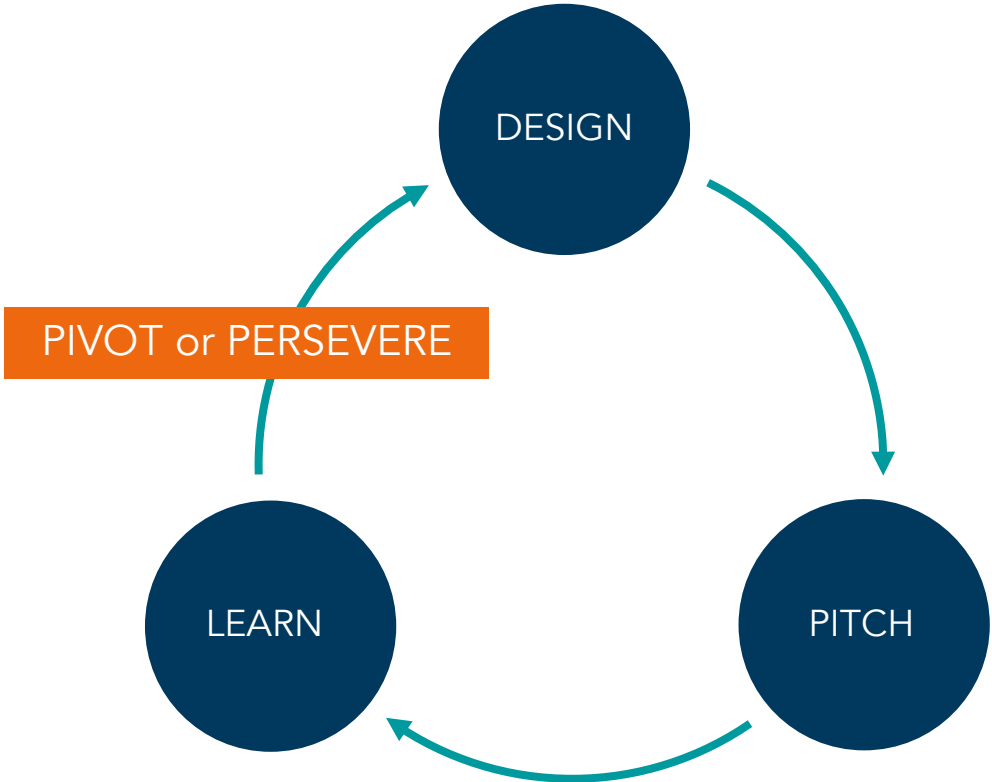
Build on the ideas of others

Encourage **wild ideas**, be bold and creative

Stay **open to feedback** -- it is how you learn and grow!

As you progress, **pivot** and be nimble

Going through feedback loops improves your design



Some things to avoid this time:

- Incremental improvements
 - A lab built a battery with zinc, I want to build a battery with nickel.
- Scope that is too big/too small
 - I want to build a rocket ship out of bacteria
 - I am going to build a genetic circuit in *E. coli*, requiring cloning just one gene

Two ways to ideate:



Language matters in brainstorming

Supportive language

And...

What if...?

Also...

(try being visual)

Unhelpful language

No...

But...

That is wrong...

That doesn't make sense...

Great.

Activity:

Let's try brainstorming for 10 min. in teams

- Take the **most interesting research finding** you identified and talk about why you think it is an **important problem to solve** or an **intriguing technology**
- Ideate **potential ways to solve** your identified problem or apply the technology
- This is NOT binding, so be creative!

Once you have a topic or idea,
you'll need goals/aims to get there.

What are critical steps that need to be taken
in order to answer your question?

best first steps
logical order
feasibility

Your goals should address critical steps to reach your solution



Goal #1

Goal #2

Goal #3



Your goals should address critical steps that allow you to reach your solution



Alzheimer's is a big problem; B-amyloid plaques contribute

#1 Produce ADC

Proposal is to convert plaques with the novel enzyme ADC

#2 Determine if ADC can get rid of plaque protein

#3 Determine if getting rid of plaques can affect model Alzheimer's



Get rid of plaques to cure Alzheimer's

Activity:

Let's try coming up with aims...



We don't have a good way to improve the innate immune response to bacteria

We propose to study extracellular vesicles and their role in cell-cell communication between bacteria and hosts.

Goal #1

Goal #2

Background: Bacteria produce extracellular vesicles that could be involved in communication

Goal #3



Study signals sent by bacteria to communicate with the host, potentially finding a way to protect the host

See the wiki for an example slide deck

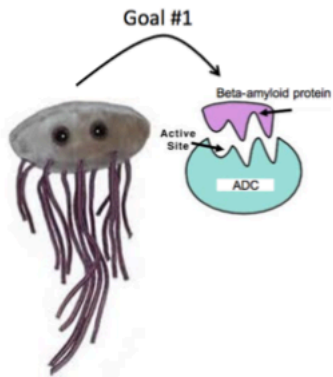
Engineered bacteria for the conversion of amyloid plaques to dark chocolate

Shannon K. Hughes and Noreen L. Lyell

Research aim: use ADC to convert β -amyloid plaques to dark chocolate

- **Goal 1:** Optimize the production of genetically engineered ADC using non-toxic *E. coli* strain
- **Goal 2:** Determine enzymatic efficiency of engineered ADC *in vitro* using harvested β -amyloid plaques

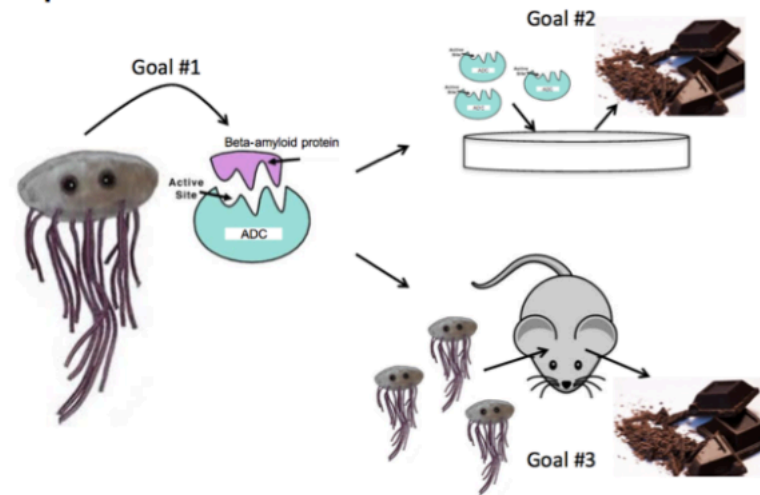
Optimize production of ADC in *E. coli*



- Engineer BL21(DE3) to express ADC
 - Clone ADC into pXYZ
 - Test protein expression
 - Additional steps...
- Potential setback
 - Possible solution

Goal 3: Measure efficacy of engineered ADC

Conversion of β -amyloid plaques to usable product in treatment of Alzheimer's



Here's additional help

- Previous workshops on figures, journal clubs, abstracts, and manuscripts
- be.mit.edu/communicationlab
- [NIH Small Grant Program \(R03\)](#): appropriate scale
- [NIAID](#): includes alternate approaches if first approach doesn't work
- [BE Research Guide](#): (email Howard Silver hsilver with suggestions!)



It's going to be fun!

Be sure your presentation includes:

- Sufficient background to orient the audience to the problem and current state of the field
- A strong problem statement/knowledge gap
- A clear proposal statement/hypothesis
- Clear aims/goals that follow a logic leading to the end goal
- Succinct methods highlighting what you will do
- Alternate approaches
- Strong impact statement

Your slides and presentation should:

- Convey a single message per slide
- Have titles that are messages
- Only contain relevant material (reduce signal/noise)
- Include schematics to help your audience
- Be organized, with a plan about who will speak when