

Research Proposals



These are so fun!

20.109 Communication Workshop 5

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Helping you communicate effectively.

be.mit.edu/communicationlab

We have seen a variety of communication assignments in 109...

Figures

Titles and Abstracts

Manuscripts

Journal Clubs

Proposals



We are here.

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 skills translate to:

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

All these help make a good proposal too!

Let's say you have \$1 million



to give to someone's
biological engineering project?

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 **uncertain**

the **findings** are exciting

Proposals

framed as a **hypothesis**

outcome sounds certain

the **innovation** is exciting

The 109 proposal is a team presentation

12 minutes + Q & A

Speaking and slides

Audience: BE enthusiasts and experts
(your 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 & speech to convey these parts:

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

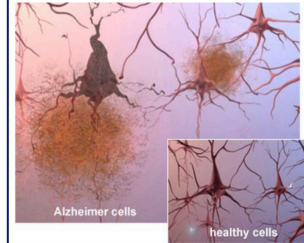
Background highlights the problem you propose to solve and the current state of the field (*why, why now?*)

1 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)

2 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

3 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

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

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

Then provide a clear statement of your research problem and goals (*what, how?*)

Clear, concise research statement

3-4 goals to prove your hypothesis

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

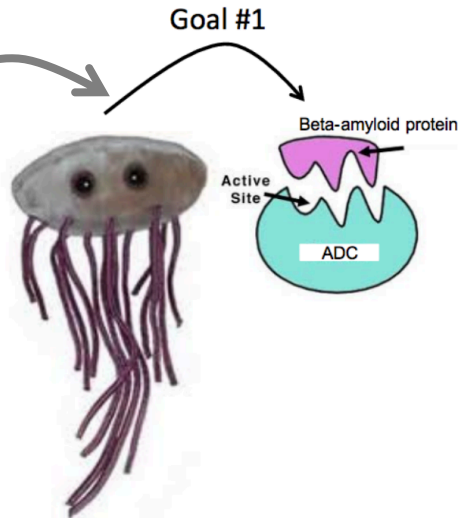
- **Goal 1:** Optimize the production of genetically engineered ADC using non-toxic *E. coli* strain
- **Goal 2:** Determine enzymatic efficiency of engineered ADC *in vitro* using harvested β -amyloid plaques
- **Goal 3:** Measure efficacy of engineered ADC *in vivo* using a mouse model of Alzheimer's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

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.

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 all the tips for good slide design

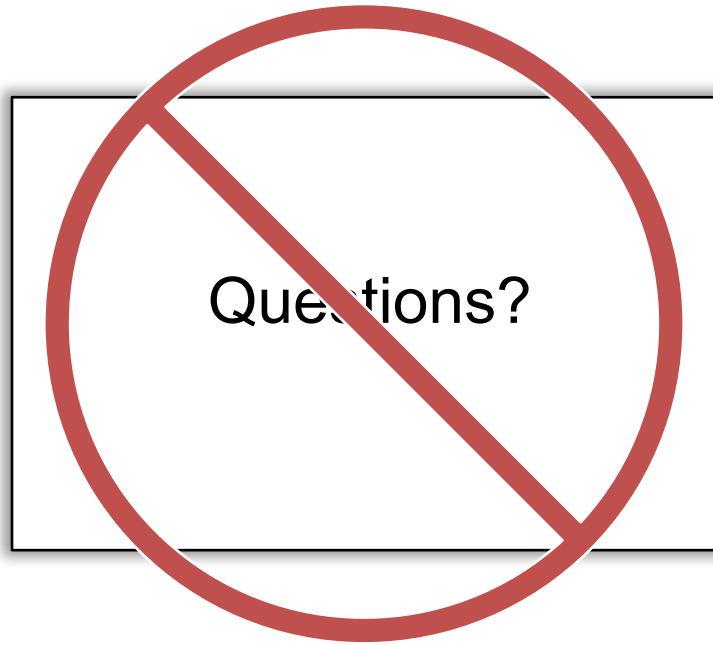
- One message per slide
- Titles as messages
- Use visuals/schematics when you can
- Only include relevant text
- Maximize signal to noise

New! Adapt to presenting as a team

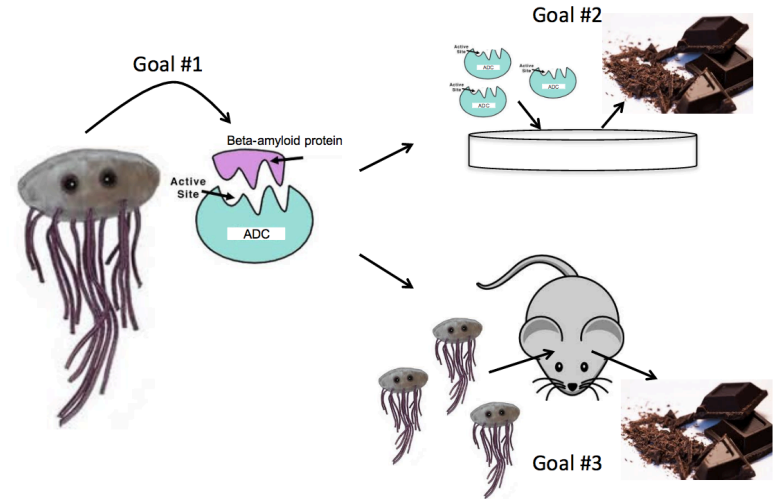
- Decide who will say what
- May announce organization/transitions
 - “I’ll introduce our Question and Aims, and Prerna will talk about the Methods we’ll use...”
- Stay visually quiet when you’re not speaking
- Don’t read from slides, just use transitions and bits of text to guide
- Q&A: Share answers
- Leave a helpful slide up, flip around 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 challenging!

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

Ideas come from many sources

- Recent papers (discussion sections!)
- Popular news articles
- Seminars or conferences
- Your own bug list
- Talking to people, especially experts

- Idea trees
- 5 Whys method

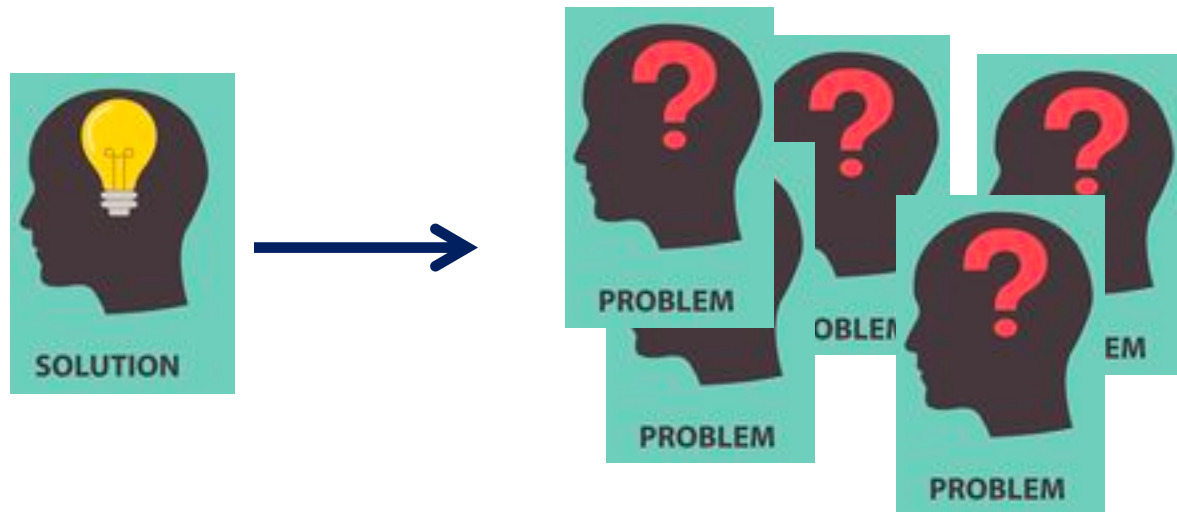


Two strategies for innovation

"market pull"



"tech push"



Spend time brainstorming on your own and as a team

Go for **quantity**--having **a lot of ideas** raises your probability of coming up with a good idea

Defer judgment

Build on the ideas of others

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

Rules from design firm **IDEO**

Language matters in brainstorming

Supportive language

And...

What if...?

Also...

Get visual!

Unhelpful language

No...

But...

That won't work...

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!

Some pitfalls to avoid are:

Incremental improvements

- A lab built a battery with zinc, so let's build a battery with nickel.

Idea/buzzword stacking

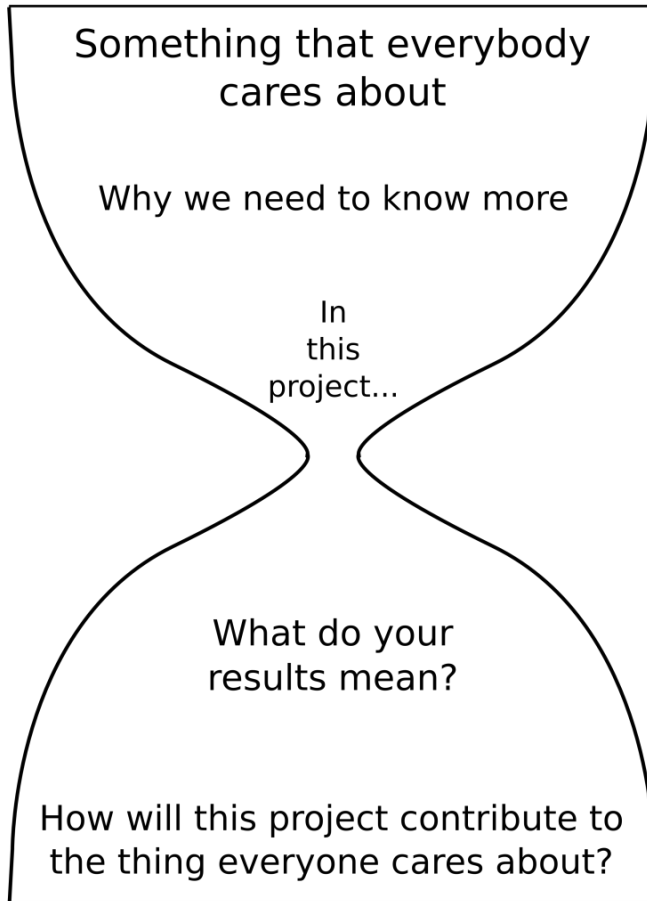
- Let's use CRISPRi & optogenetics on the gut microbiome

Scope that is too big/too small

- Let's build a rocket ship out of bacteria
- Let's build a genetic circuit in *E. coli* that only requires cloning one gene

Remember your hourglass!

Your proposal should match your identified problem



Knowledge gap, Unknown

HERE WE PROPOSE...

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

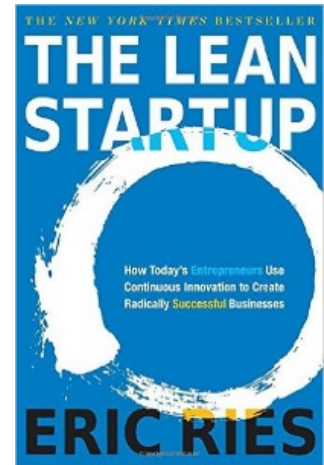
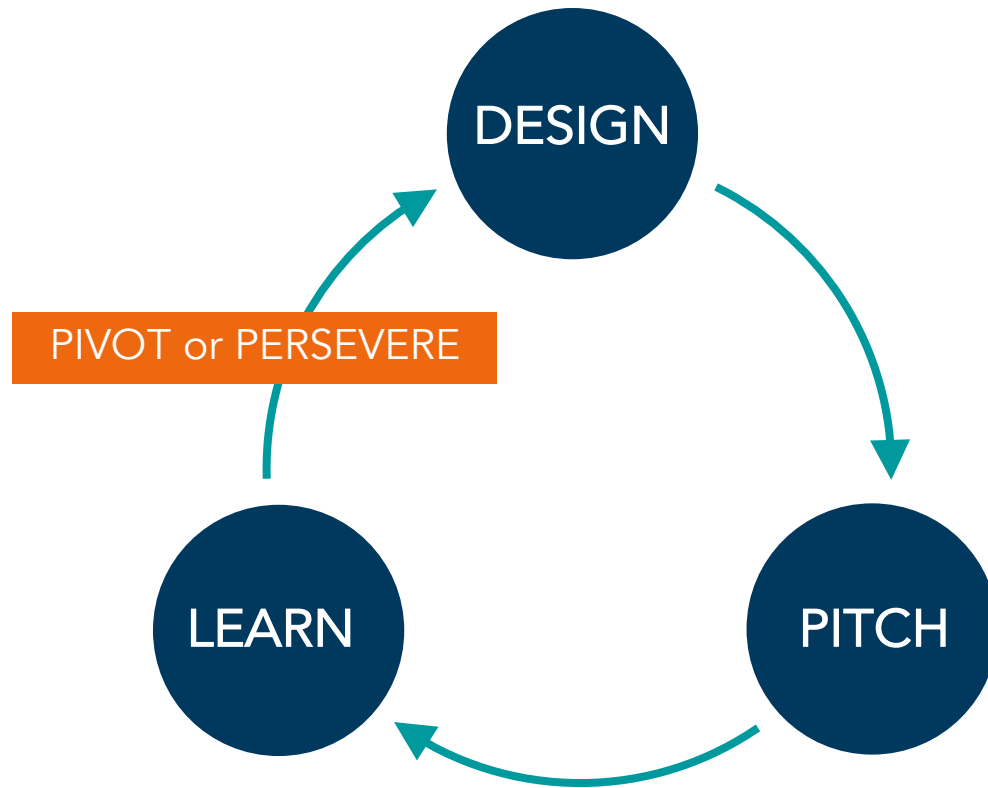
#2 Determine if ADC can get rid of plaque protein

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



Get rid of plaques to cure Alzheimer's

Going through feedback loops improves your design



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

Be nimble and **pivot** or build support for your **hunches**

See the wiki for an example slide deck

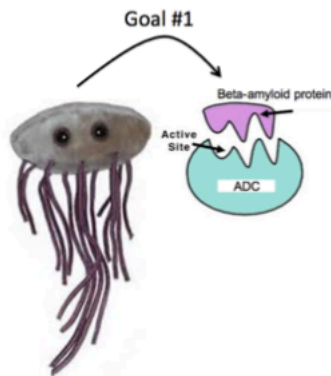
Engineered bacteria for the conversion of amyloid plaques to dark chocolate

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

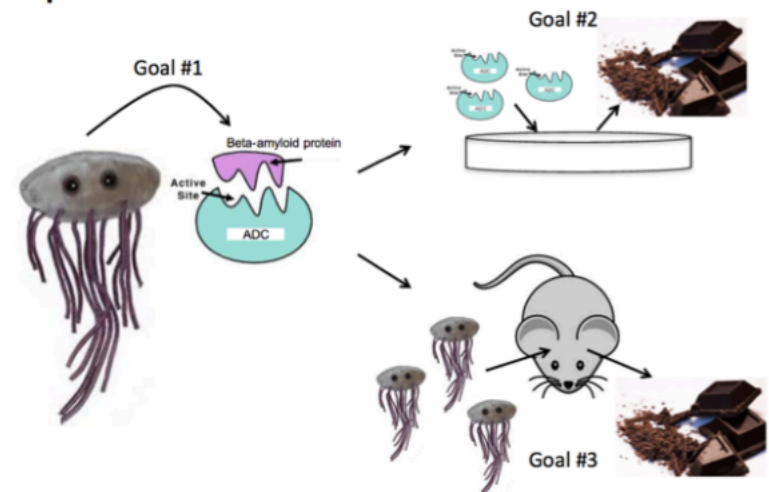
Optimize production of ADC in *E. coli*



- Engineer BL21(DE3) to express ADC
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 - 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

- [From Prof. Jen Heemstra's blog: Research ideas, part 1: It's not magic](#) (also parts 2-4 on the side)
- [NIH Small Grant Program \(R03\)](#): appropriate scale
- [NIAID](#): includes alternate approaches
- [BE Research Guide](#): (email Howard Silver hsilver with suggestions!)
- Previous workshops on wiki, BECL



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