

Communication Lab

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



All assignments use the same basic communication skills:

Know your audience Tell a story Convey logical science More signal, less noise

Concretely, these skills translate to:

- Clear visual data in figures and slides, with strong signal to noise ratio
- Making titles = **strong messages** on slides
- Planning a story with a clear take-home message, logical transitions, 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)

<u>Both</u>

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

<u>Proposals</u>

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 Achievable

Use slides & speech to convey these parts:

- a brief project overview
- sufficient background to show 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?*)

2

- 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)

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

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

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

- Identified in our laboratory using a yeast twohybrid 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 ("aims") 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 βamyloid plaques
- Goal 3: Measure efficacy of engineered ADC in vivo using a mouse model of Alzheimer's disease

Each goal gets 1-2 slides for what you'll do



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 would 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 <u>our Question and Aims</u>, and Prerna will talk about the <u>Methods we'll use</u>..."
- 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





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



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 ideating

Supportive language

And... What if...? Also...

Get visual!

Unhelpful language

No... But... That won't work... That doesn't make sense... Great. Activity in teams: 10 min. brainstorming

- Take a minute to say why you picked a finding, either because it's an important problem to solve or an intriguing technology
- Ideate
 - ways to <u>solve</u> your identified problem and/or
 - ways to <u>apply</u> the technology

Go for quantity, most ideas wins

Don't judge ideas yet! They are fragile.

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 the 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 the critical steps to take to answer your question?

best first steps? logical order? feasibility?

Goals are critical steps toward your solution



Your goals move logically to a solution



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 βamyloid 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

al 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 (+ parts 2-4 on the side)
- NIH Small Grant Program (R03): appropriate scale
- <u>NIAID</u>: includes alternate approaches
- <u>BE Research Guide</u>: (email <u>hsilver</u> with suggestions!)
- Previous workshops on wiki, appointments at 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

Be sure your slides & presentation:

□ Are practiced! Convey a single message per slide □ Have titles that are messages Only contain relevant material that you discuss (reduce signal/noise) Include schematics to help your audience • Are organized with a plan about who will speak when