MIT BE
BIOLOGICAL ENGINEERING

Communication Lab

20.109 Communication Workshop 5: Research Proposal

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Helping you communicate effectively.
be.mit.edu/communicationlab

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

- Readers are busy and easily distracted
- Opportunities are limited

  time limits on applying again, specific requests

  (whereas there's always another journal for your paper)
- Proposal skills are transferable

The 109 proposal is a little different

12 minutes + Q&A

Speaking and slides

Audience of peers & teaching staff

Strategies are the same, from 109 to NIH.

https://youtu.be/lAOGtr0pM6Q

https://youtu.be/lAOGtr0pM6Q

…but it's mostly the same

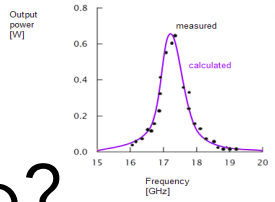
Tell us the why, how, and what will result

Identify the knowledge gap

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

"You can't just shove things into a mouse."

Show us what expected data will be



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

Have controls and work-arounds

Proposals are future papers (with little twists)

Papers:

Question

Outcome uncertain

Findings are exciting

Proposals:

Hypothesis

Outcome certain

Innovation is exciting

Both have sections, methods, controls & statistics, tell stories, argue for excitement and validity

Review assignment rubric

Category	Elements of a strong presentation
Knowledge and explanation of subject matter:	• relates proposal to topics covered in 20.109 when appropriate • sufficiently explains concepts/ methods/etc. *not* covered in 20.109
Idea	• the what, why, and how (*are you going to do it*) of the idea are each clear and compelling • the project scope is reasonable • exhibits novelty/creativity
Overview	• clear and concise description of the social and scientific context (and/or central question and significance)
Background	• sufficient for intelligent non-experts to understand the proposal • describes/credits relevant prior art
Problem and Goals	• well-defined hypothesis and goals (specific research aims)
Details/Methods	• staged roadmap for investigation and/or helpful schematics as you go • the experiments address the central question and include good controls • methods needed to understand the predicted outcomes are explained, without unecessary detail
Outcomes	• show sample data if experiment works (summarize in tabular form, make mock graphs, show published images from similar work, etc.) • describe alternate assays, questions, and/or information still gained if experiment does not work
Resources	• consider specialized resources needed (e.g., plasmids, cell lines, access to large/costly equipment) • detail is good, but not needed for every resource; nor is detailed budget info. required
Impact and Summary	• reiterate central question and its significance to science and society
Q&A	• answers that convey understanding • when you lack knowledge, tell how you would approach the question based on what you know
Overall organization of talk	• content introduced in logical, easy-to-follow sequence • main points emphasized, repeated • transition statements between ideas
Overall effectiveness of slide text/visuals	• slide titles convey key message • good balance of text and figures • text/figures large enough to be seen (including axis labels!) • considered use of color • not too many or too few slides
Overall effectiveness of delivery	• all elements of a good individual presentation (effective use of voice, body, and language), plus: • collaborative effort: partners speak for equal times, don't interrupt each other, take turns being "on stage" • overall appears rehearsed, with smooth transitions between speakers; talk is cohesive • review/preview structure of talk • 12' length (+/- 0.5 min)
Talking points	• main points to be made during talk (can be incomplete sentences) • well thought-out transitions • best work will include supporting detail, in case needed for Q&A

Examples & resources

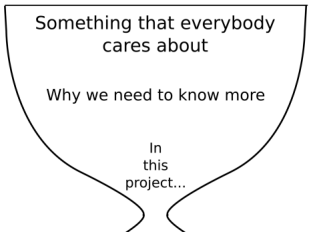
- NIH Small Grant Program (R03): appropriate scale
  http://grants.nih.gov/grants/funding/r03.htm
- NIAID: includes alternate approaches if first approach doesn't work
  http://www.niaid.nih.gov/researchfunding/grant/pages/appsamples.aspx
- BE Research Guide:
  http://libguides.mit.edu/bioleng
  (email Howard Silver hsilver@mit.edu with suggestions!)

Sections balance two goals…

1. **Overview**: brief statement of knowledge gap, research question, and significance
2. **Background**
3. **Research Question** + **Specific Aims**
   a) well-defined, testable hypothesis
   b) 3-4 tests of that hypothesis
4. **Methods**
5. **Outcomes** predicted if everything goes according to plan, and if nothing does
6. **Resources** needed to complete the work
7. **Impact** on science, society

Sections map to familiar ones

1. Overview:
Brief statement of knowledge gap, research question, significance, like the first half of an Abstract



2. Background

Orients us like an Introduction

3. Research Question + Specific Aims

Just like Results, posed to the future as an objective or hypothesis

3. Research Question + Specific Aims

Objective/Hypothesis: Our objective is to obtain nanoparticles optimized for targeted drug delivery and imaging of prostate cancer.

We hypothesize that polymer-based nanosponges developed using a step-wise, function-driven design format are an effective modality for simultaneous targeted drug delivery and imaging of prostate tumors.

Dr. Andries Zijlstra, Vanderbilt University

3. Research Question + Specific Aims

Aim #1. Generating a panel of prostate cancer-targeting nanosponges optimized for tumor targeting, drug cargo loading, and drug release kinetics

Aim #2. Identifying the most effective combination of tumor targeting nanosponges considering a combination of different targeting peptides, drug cargo, and release kinetics

Aim #3. Evaluating the use of nanosponge therapy against human prostate cancer using human tissue xenografted in SCID mice

Dr. Andries Zijlstra, Vanderbilt University

Activity: Evaluate the example proposal

Take about 8 minutes

Read the questions and then the proposal

Answer the handout questions

Activity: Frame a Research Question + Specific Aims

1. Pick one of the fields that you and your partner are interested in. (This is just an exercise, not a commitment!)
2. Identify a testable hypothesis or research question in that field.
3. Brainstorm 3-4 ways of testing that hypothesis.

4. Methods: lay out an experimental roadmap to meet aims

- Include brief statement of overall approach: don't just dump details
- Don't just say "data analysis"
  - Metrics, cutoffs, tests?
  - What would tell you your hypothesis was true?
- You don't have to develop this all on your own: talk to faculty, grad students
  - *How do people usually measure X?*
  - *Is there an animal model for Y?*

4. Methods: use schematics & visuals

Outline your specific aims:

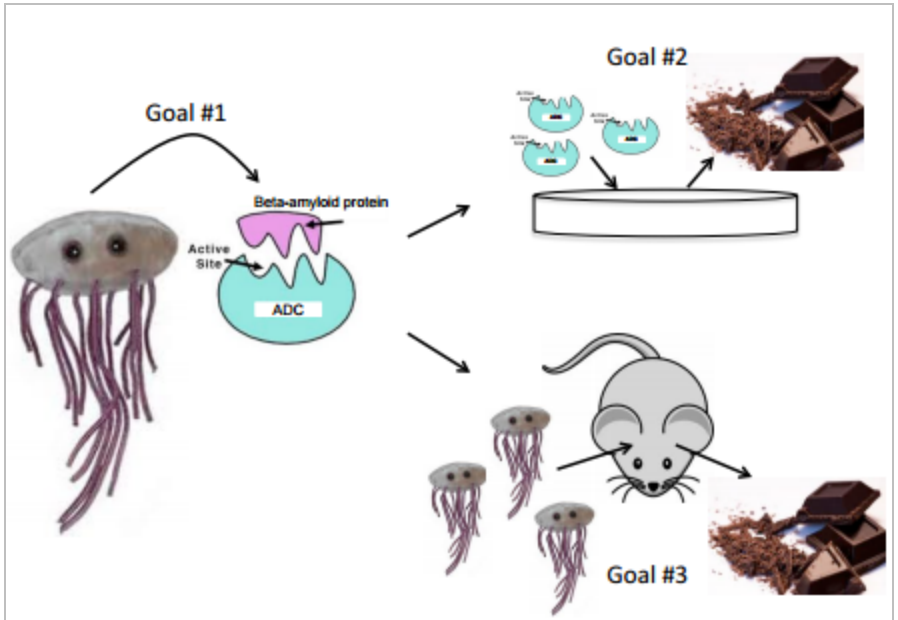


Figure 2: A thoughtful, informative, well-drawn schematic of our research plan. The figure legend should explain the diagram such that a reviewer might not even need to read the text of the proposal.

Demonstrate a method:

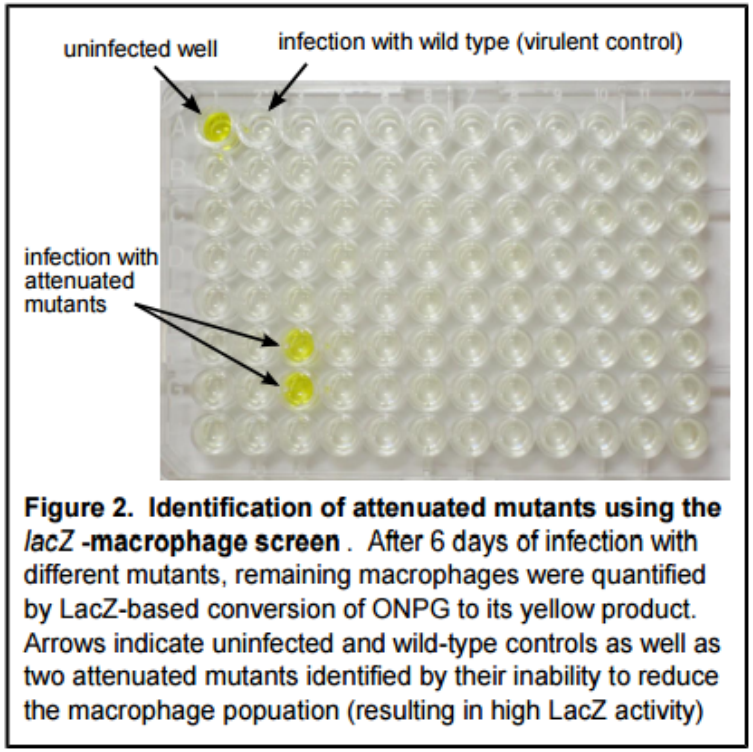


Figure 2. Identification of attenuated mutants using the *lacZ* -macrophage screen . After 6 days of infection with different mutants, remaining macrophages were quantified by LacZ-based conversion of ONPG to its yellow product. Arrows indicate uninfected and wild-type controls as well as two attenuated mutants identified by their inability to reduce the macrophage popuation (resulting in high LacZ activity)

5. Predicted Outcomes:

Create representative visuals of expected data

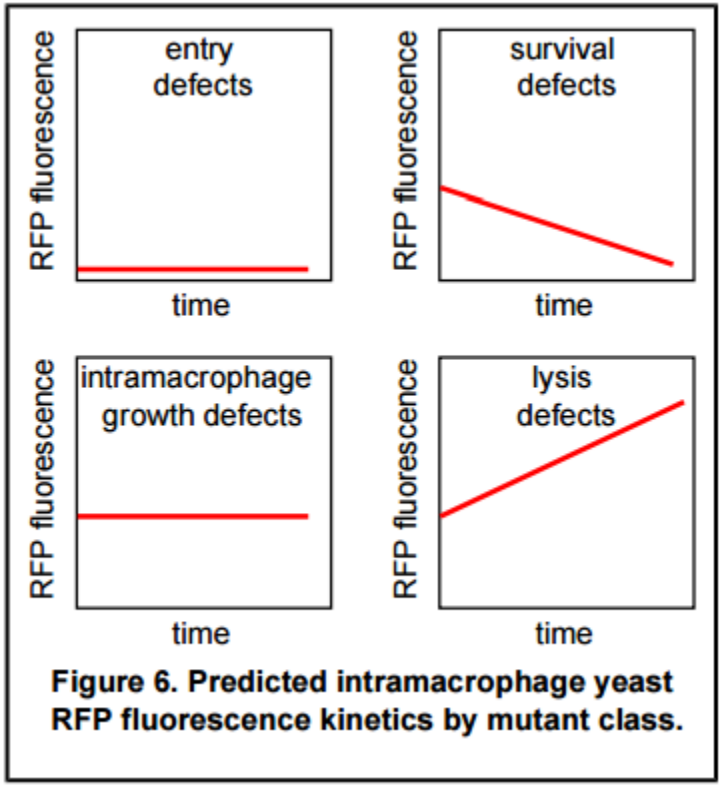


Figure 6. Predicted intramacrophage yeast RFP fluorescence kinetics by mutant class.

5. Predicted Outcomes:
What could go wrong?

- What are other ways you could test the same question?
- Demonstrates that some advance is likely
- You can think through potential pitfalls and prepare for them

5. Predicted Outcomes: what could go wrong?

3.2.2.5. Potential problems and alternative approaches.

It is possible that since reovirus T1L antagonizes innate immune responses via multiple mechanisms, as indicated by our preliminary data (Section 1.4.2) and reassortant experiments statistically linking the S2 and L2 genes to IFN antagonism (24), **substitution of the T1L M1 gene into the T3D backbone may be insufficient to fully decouple the IFN response** from the apoptotic response following infection.

In this case, we will use information derived from Specific Aim 1, to **identify other genes associated with IFN antagonism, to generate an "IFN-dead" virus** in the pro-apoptotic T3D backbone. The transcriptional networks induced by this virus would then be profiled, as above.

If these approaches fail to segregate apoptosis induction from IFN signaling, we will **profile changes in gene expression** induced by T1L and T3D in IFNAR-deficient MEFs.

It is also possible that microarray slides or software provided through the GCAT consortium **may not be sufficiently robust** to accommodate the level of depth of the proposed experiments. In this case, we would then use commercially available microarrays, such as the GeneChip® Human Gene 1.0 ST Array (Affymetrix), similar to those used previously (45).

Geoffrey Holm, R15 application, via niaid.nih.gov

6. Resources: mention unique elements in Methods

You don’t need a dedicated Resources slide.

Will you need a hospital, core facility, collaborators?

7. Impact: reiterate central question & significance

Innovation and Impact: The proposed work is highly innovative at two levels:

1) The use of unique polymer chemistry in the design of a polymer-based nanoparticle, and
2) the synergistic function-driven design approach implemented by integrating the expertise of three investigators.

The proposed particle would greatly impact prostate cancer therapy as it would enable tumor specific delivery of established and newly design therapeutics.

Dr. Andries Zijlstra, Vanderbilt University

Group presentation skills

- Don’t switch off too frequently
- Announce organization & transitions between partners

  “Noreen will introduce the Question and the Aims, and then I’ll talk about the Methods…”
- Show your excitement! Modulate your voice

See the wiki for example slide deck

Engineered bacteria for the conversion of amyloid plaques to dark chocolate

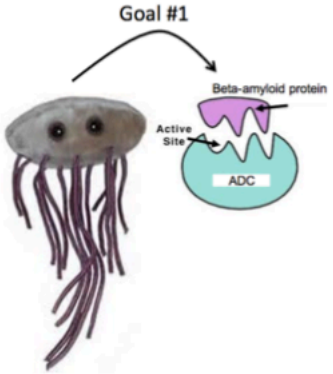
Shannon K. Hughes and Noreen L. Lyell

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

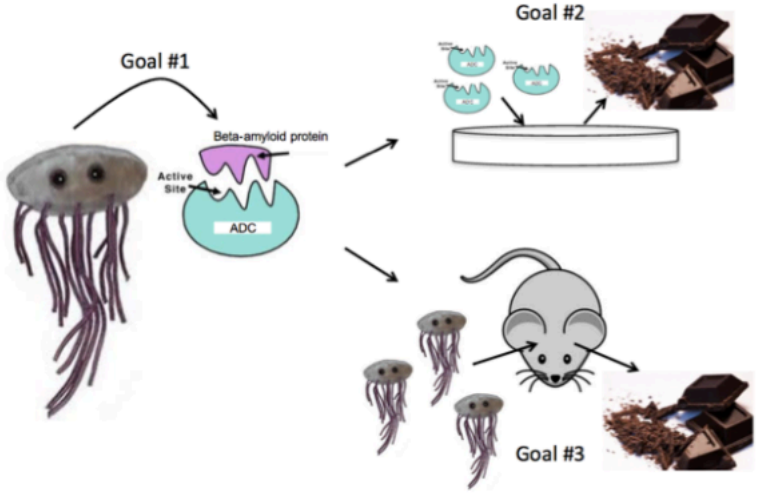
al 3: Measure efficacy of engineered ADC

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

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



Feedback from the journal club presentations

- Do interact with your slides
- Excessive animations are distracting & inconvenient
  - Use simple styles
  - Group content – not everything has to appear one-by-one

There's additional help

be.mit.edu/communicationlab

- NIH Small Grant Program (R03): appropriate scale http://grants.nih.gov/grants/funding/r03.htm
- NIAID: includes alternate approaches if first approach doesn't work
  http://www.niaid.nih.gov/researchfunding/grant/pages/appsamples.aspx
- BE Research Guide:
  http://libguides.mit.edu/bioleng
  (email Howard Silver hsilver@mit.edu with suggestions!)