Proposal Writing in a Nutshell

Context

Medical Student Research Program

- Faculty Information
- Student Information
- University of Utah Research Opportunities
- External Research Opportunities
- Schedule
- Registration
## Resources

**Bioengineering 6060: Scientific Proposal Writing and Presentation**

**Course Goals:** To be effective in science and engineering, graduate students must have well developed communication skills in all forms of scientific exchange. The pursuit of these skills is a long term task that continues throughout a professional career. The general goal of this class is to improve those skills and to create a framework for ongoing improvement well beyond the class.

**Specific Aims:** A major component of the PhD program is the preparation of a research proposal, which includes both a written document and an oral presentation. The specific aims of this course support achieving these requirements through:

1. Developing general presentation and writing skills for scientific communication.
2. Learning the specific features, components, and style of a written research proposal
3. Creating oral presentations that support the presentation of the research proposal and the ability to defend it in a public setting.
4. Developing constructive criticism skills in order to evaluate communication and suggest approaches to improvement.

**Course Components:** We will use a spectrum of learning approaches to achieve the specific aims including didactic lectures, homework assignments, and in-class presentations, supported by discussion and a high degree of interaction in and out of class. The use of constant feedback from instructors and fellow students will be a key element of the learning process so that students learn not only to improve their own communication skills but also to provide constructive critique in written and oral communications that we see.

### Rob's Grant Information Page

A list of granting sources and links to grant applications. The choices reflect my biomedical bias and is in no way comprehensive.

### Granting Agency Policy and Program Information

- [University of Utah Health Science Resources for Basic Sciences](http://www.sci.utah.edu/~macleod/grants/) including [Research grant Information](http://www.sci.utah.edu/~macleod/grants/)
- [College of Engineering grant Information](http://www.sci.utah.edu/~macleod/grants/)

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**Find Your Purpose**

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**CAUTION**

Please do not proceed beyond this point.

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**Proposals in a Nutshell**

**Bioengineering 6060 Presentations**
Who is the Audience?

- If you don’t know, find out.
- Don’t assume too much!!

What are Review Criteria?

“The criteria used by the committee are the same as those used at NIH study sections”

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http://www.sci.utah.edu/~macleod/grants/
But That’s OK, They Are the Granting Agency

• Does the project represent hypothesis-driven science? Is there a clearly stated hypothesis and is there a test of the hypothesis?

Hypothesis vs. Engineering Research
What Else Do They Want?

- Is there evidence that the student was involved in writing the proposal?
- Does the project offer a learning experience for the student?
- Is it feasible to accomplish, or at least initiate, a body of work in the allotted time frame?

Pitfalls of Proposals

- Overambitious
- Naive
- Unfocused
- Low impact
- Incoherent
- Lacks Innovation
Tips for Proposal Writing

Propose something significant.

Make it exciting.

Probe for mechanisms and seek new models.

Be very clear and concise.

Avoid proposing to "collect more data."

Pull it together but don’t pack it too tight.

http://www.sci.utah.edu/~macleod/grants/insiderguide.pdf

Standard Grant Structure

Specific Aims

• Significance
• Innovation
• Approach
• Investigator(s)
• Environment
• Impact
Specific Aims Page

Three Key Questions

What are you going to do?  STRONG research question

Why is it important to do this?  Who cares? So what? What happens if you do this?

Why is your approach innovative? How is your approach creative? How are you going to do it?
One Strategy

Example

- Structure
  - Background
  - Significance
  - 3 Aims
  - Impact
  - Environment
- Each Aim
  - Describes action
  - Identical organization
  - Clear and direct

Proposals in a Nutshell

Specific Aims

Microscopy has emerged as one of the most powerful and informative ways to analyze cell-based high-throughput screening (HTS) samples in experiments designed to uncover novel drugs and drug targets. However, many diseases and biological pathways can be better studied in whole animals—particularly diseases that involve organ systems and multicellular interactions, such as metabolism and infection. The worm Caenorhabditis elegans is a well-established and effective model organism that can be robotically prepared and imaged, but existing image-analysis methods are insufficient for most assays.

We propose to develop algorithms for the analysis of high-throughput C. elegans images, validating them in three specific experiments to identify chemicals to cure human infections and genetic regulators of host response to pathogens and fat metabolism. Novel computational tools for automated image analysis of C. elegans assays will make whole-animal screening possible for a variety of biological questions not approachable by cell-based assays. Building on our expertise in developing image processing and machine learning algorithms for high-throughput screening, and on our established collaborations with leaders in C. elegans research, we will:

Aim 1: Develop algorithms for C. elegans viability assays to identify modulators of pathogen infection

Challenge: To identify individual worms in thousands of two-dimensional brightfield images of worm populations infected by Microsporidia, and measure viability based on worm body shape (live worms are curvy whereas dead worms are straight).

Approach: We will develop algorithms that use a probabilistic shape model of C. elegans learned from examples, enabling segmentation and body shape measurements even when worms touch or cross.

Impact: These algorithms will quantify a wide range of phenotypic descriptors detectable in individual worms, including body morphology as well as subtle variations in reporter signal levels.

Aim 2: Develop algorithms for C. elegans lipid assays to identify genes that regulate fat metabolism

Challenge: To detect worms versus background, despite artifacts from sample preparation, and detect subtle phenotypes of worm populations.

Approach: We will improve well edge detection, illumination correction, and detection of artifacts (e.g., bubbles and aggregates of bacteria) and enable image segmentation in highly variable image backgrounds using level-set segmentation. We will also design feature descriptors that can capture worm population phenotypes.

Impact: These algorithms will provide detection for a variety of phenotypes in worm populations. They will also improve data quality in other assays, such as those in Aims 1 and 3.

Aim 3: Develop algorithms for gene expression pattern assays to identify regulators of the response of C. elegans to Staphylococcus aureus infection

Challenge: To map each worm to a reference and quantify changes in fluorescence localization patterns.

Approach: To detect worms versus background, despite artifacts from sample preparation, and detect subtle phenotypes of worm populations.

Impact: These algorithms will enable addressing a variety of biological questions by measuring complex morphologies within individual worms.

In addition to discovering novel anti-infectives and genes involved in metabolism and pathogen resistance, this work will provide the C. elegans community with (a) a versatile, modular, open-source toolbox of algorithms readily usable by biologists to quantify a wide range of important high-throughput whole-organism assays, (b) a new framework for extracting morphological features from C. elegans populations for quantitative analysis of this organism, and (c) the capability to discover disease-related pathways, chemical probes, and drug targets in high-throughput screens relevant to a variety of diseases.

Primary collaborators
Microscopy has emerged as one of the most powerful and informative ways to analyze cell-based high-throughput screening (HTS) samples in experiments designed to uncover novel drugs and drug targets. However, many diseases and biological pathways can be better studied in whole animals—particularly diseases that involve organ systems and multicellular interactions, such as metabolism and infection. The worm Caenorhabditis elegans is a well-established and effective model organism that can be robotically prepared and imaged, but existing image-analysis methods are insufficient for most assays.

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Writing Specific Aims

• Direct, clear, active statement
• Challenge or significance
• Approach: rationale, or preliminary results
• Expected outcomes
• Stay away from extremely technical words and jargon

Hofmann, pg 413

Example

• Simple words and statements
• Direct and explicit addressing of all points
• Scope is reasonable, not saving the world in one grant!

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Emphasis

Version 1
Aim 1: Develop algorithms for C. elegans viability assays to identify modulators of pathogen infection

Version 2
Aim 1: Identify modulators of pathogen infection by means of C. elegans viability assays

Version 3
Aim 1: Carry out C. elegans viability assays to identify modulators of pathogen infection

Note the effect of “Power Positions”

The Rest of the Proposal
Significance

- Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses.
- Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
- Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.
• Explain how the application challenges and seeks to shift current research or clinical practice paradigms.
• Describe any novel theoretical concepts, approaches or methodologies, instrumentation or intervention(s) to be developed or used, and any advantage over existing methodologies, instrumentation or intervention(s).
• Explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation or interventions.
• Not all proposals need to be innovative (at least, this is the NIH official policy)
Approach

Essentials of the “Approach”

AKA “Research Design and Methods”

Specific Aims

Link

How

Be Confident... use future tense

More Essentials

Structure of Approach

Overview & Rationale

Experimental Design

Impact

Analysis

Expected Results
Approach I

• Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project.
• Unless addressed separately in a Resource Sharing Plan, include how the data will be collected, analyzed, and interpreted as well as any resource sharing plans as appropriate.
• Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.

Approach II

• Describe previous or preliminary results that indicate the feasibility of the proposed approach.
• If the project is in the early stages of development, describe any strategy to establish feasibility, and address the management of any high risk aspects of the proposed work.
• Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised. A full discussion on the use of Select Agents should appear in a Select Agent Research section.
Impact

• Describe how the research will exert a sustained, powerful influence on the research field.

http://www.ariadne.ac.uk/issue35/harnad/
The Tools of the Trade

Text Tools

\textbf{\LaTeX} VS \textbf{W}

effort and time consumption

document complexity and size

impossible to do

MS Word

LaTeX
Making Figures

1. GraphicConverter
2. Adobe Illustrator
3. SnipzProX
4. MATLAB
5. Screen Capture

Proposals in a Nutshell

Literature Reference Tools

1. EndNote
2. PubMed
3. Mendeley
4. www.mendeley.com/
5. www.mendeley.com/papers/
THE GRANT CYCLE

HOW IT'S SUPPOSED TO WORK:

WRITE GRANT → GET $ → DO RESEARCH → PUBLISH RESULTS

(REPEAT)

HOW IT REALLY WORKS:

DO RESEARCH

GET RESULTS, BUT DON'T PUBLISH THEM YET. CALL THEM "PRELIMINARY RESULTS."

WRITE GRANT TO DO WHAT YOU ALREADY DID → GET $ → OK, NOW YOU CAN PUBLISH RESULTS

USE $ TO PAY FOR AN UNRELATED NEW PROJECT

WWW.MCRCOMICS.COM