



University of California Berkeley

SUMMER UNDERGRADUATE  
RESEARCH FELLOWSHIPS

# Writing a STEM Research Proposal

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# Personal Background

- Dual B.S., University of Nevada, Reno, 2013
  - Biology
  - Biochemistry and Molecular Biology
  - American Sign Language (A.A., Western Nevada College)
  - Minors: Analytical Organic Chemistry, Spanish, Mathematics
- Ph.D. 2<sup>nd</sup> year, UCB-UCSF BioE
- Research Interests:
  - Orthopedic/skeletal biology
  - Molecular and biomechanical determinants of musculoskeletal disease
  - Intersection of mechanical and biochemical cues

# Technical Style

## Good writing

- Terse
- Objective
- Refutable
- Tangible
- Immediately evident
- Precise language

## Bad writing

- Unspecific
- Presumptuous
- “Sales-y”

Show, don't tell! Coherence, clarity, completeness

# Technical Style

There is plenty of fascinating research being done on osteocytes because they might be key to preventing or treating musculoskeletal diseases.

“Plenty of fascinating research...” Like what?

Why would osteocytes be key?

“might be key to preventing or treating m.d.” How? Why?

Instead:

Although they were once thought to be fairly inactive, a recent discovery (insert reference) identified osteocytes to play a critical role in bone remodeling, which has previously been associated with the progression of diseases such as osteoarthritis (insert reference). A number of recent publications have focused on studying the mechanism for osteocytic bone remodeling (insert references), in the hopes of identifying novel therapeutic targets for musculoskeletal disease.

# For SURF...

- For SURF L&S and SURF RH Independent:
  - Use “I” instead of “we.” (unless you’re talking about something you worked on as a team)
  - Discuss your motivations, not your lab group’s.

# SURF Proposal Structure

- Research Statement
- Background/Justification
- Research Plan
- Qualifications
- Bibliography
- Appendix (optional)
- Additional Support (optional)

# Research Statement

- What it is:
  - Context of the research you're proposing.
  - Potential impact of the research.
  - The research question you will be asking (hypothesis).
- What you need to show:
  - Your research is “plugged in” to your field and addresses a key gap of knowledge.
  - Your research question is thought-out and specific.
  - Your research will result in something tangible.
  - Your research has broad impacts (Why should we care?)
- Structure:
  - Broadest → Broad → More specific



# Questions to help you with Research Statement

- What will be the final product of this work? (thesis, publication, a new research tool, etc.)
- What do you want to find out? What don't we already know?
- Why are you doing this research? Why should we care? (Often, this is a new intriguing result that raises a new question to be investigated. Tie it back to society, the real world.)
- What are the broader impacts of this research to the field, society?

# Example Statement

Osteoporosis affects millions of individuals worldwide and is characterized by dysregulation of biochemical signaling in bone [1]. In healthy bone, these signaling pathways regulate multiple cellular processes, such as differentiation, behavior, and maintenance of the extracellular matrix [2]. Mechanical stimulation of bone has been shown to modulate this biochemical regulation, and in fact the biochemical response of osteocytes to mechanical stimulation is involved in several tissue-level characteristics [3,4]...

# Example Statement

(Insert favorite signaling pathway) is a critical signaling pathway in osteocytes that is indeed mechanosensitive, and has been shown to be disrupted in the context of osteoporosis [5]. However, the mechanism for the mechanical regulation of this pathway remains unclear, representing a key gap of knowledge in the field. I propose to investigate this mechanism employing techniques with high spatiotemporal resolution, such as... potentially identifying novel therapeutic targets for osteoporosis and other musculoskeletal diseases. The proposed work will result in an academic publication that will be disseminated to other investigators through academic journals.

# Background/Justification

- What it is:
  - Overview of previous work in the field – What's the big picture?
  - Explanation of how your work addresses the gap in the field
  - Enough technical details for the reader to understand your project
  - Explanation of importance/impact of your work
- What you need to show:
  - You understand what's going on in your field, and how your work fits into that.
  - You have the authority to say your research is important/novel.
- Can be helpful to...
  - Restate your hypothesis
  - Briefly mention an experimental overview (just enough to lead the reader into your Project Plan)

# Background/Justification

- Convention
  - Move from macro → micro, citing from oldest references to the most recent.
  - Last reference is usually the most recent, and is usually a publication from your lab.
- How do I find good references?!
  - Talk to PI/advisors.
  - Read recent publications from your lab.
  - Read review articles.
  - Look at citations from good papers.

# Research Plan

- What it is:
  - Describes your hypothesis in detail. (first paragraph)
  - Outlines the steps you will take to prove/disprove your hypothesis (Specific Aims)
  - Establishes the metrics/benchmarks you will use.
  - Outlines how your time will be allocated. (Timeline!)
  - Addresses alternatives and contingency plans.
- What you need to show:
  - You have a well thought-out and thorough plan of action.
  - You have clearly defined methods, and metrics for evaluating your results.
  - You've thought about potential delays or obstacles.
  - Your Aims are appropriate, reasonable, and not interdependent.

# Research Plan

- Level of Detail
  - Enough detail for a scientist/engineer outside your field to understand it.
- Include
  - Methodology
  - Equipment
  - Timeline
  - Troubleshooting
- Don't Include
  - Concentrations of reagents
  - Lines of code
  - Etc.

# Qualifications

- What it is:
  - Describes experience, coursework, and training that is relevant to your research plan.
  - Describes access, contacts, support, resources to help you complete your proposed work.



# Bibliography

- What it is:
  - References to related and pertinent work.
- What you need to show:
  - That you didn't make all of this up.
- Don't include a reference you haven't read!
  - Cite important scholarly sources from your field.

# What will the selection committee be looking for?

- NSF: Intellectual Merit and Broader Impact
- Intellectual Merit:
  - Importance for advancing the field
  - Your qualifications
  - Novelty of the proposed work
  - Organization, thoroughness, completeness of proposal
  - Sufficient access to resources

# What will the selection committee be looking for?

- Broader Impacts
  - Big Picture (advancing society, science as a whole)
  - How exactly will this project make an impact?
  - Examples
    - Development of therapeutics
    - Novel device/assay
    - Environmental/conservational impact
    - Etc.

# Getting Started

- Write down what you can!
  - Editing is much easier once you have a framework.
- Come into office hours.
  - [www.wejoinin.com/justinlopez](http://www.wejoinin.com/justinlopez)
- Get feedback from as many people as possible.
- Read and follow instructions carefully!

# Resources

- [surf@berkeley.edu](mailto:surf@berkeley.edu)
- [www.wejoinin.com/justinlopez](http://www.wejoinin.com/justinlopez)