Guidelines and Advice for SURF Program Proposals

Requirements
In the electronic application, applicants are asked to outline their research proposals and goals in the following ways.

1. Title
2. Description (4500 characters max.). You are asked to “Outline your purpose and goals in terms that a scientifically literate generalist would understand. (Think of someone in another field or who has not studied science for a few years.) But, don’t dilute the science! Satisfy your supervisor(s) that you’ve described your proposed research in a suitably rigorous way!”
3. Explain why you have selected this particular project (2000 characters max.). You are advised that “There are many ways to answer this question, but, basically, this is an opportunity to catalog your relevant strengths. Explain some of the reasons that the particular project fits your experience. Explain some of the assistance you may be able to provide your supervision on an existing or future project. Perhaps you might explain some of the reasons that you are a suitable candidate to be chosen by your supervisor for this particular project.”
4. What you hope to learn from the whole experience of SURF. You are asked to “Explain the three most important things that you hope to learn through completing this project of summer undergraduate research.” While your project description should address the goals of the research project itself, you may wish to define what you hope to learn more holistically here: for example, learning how to put theory into practice, learning how to become a more independent learner, learning how to work in a team or a lab, learning how to link areas of knowledge, learning how to interpret experimental data, learning how to present a research report, and many, many more!

General advice
• Describe your project in a way that is clear, concise, and free of grammatical and spelling errors.
• Demonstrate your knowledge of the subject and the research to be conducted.
• Outline a clear timeline for the research or otherwise demonstrate the project’s feasibility and the consistency of your research goal with the time available.
• Explain in your own words both the connection between your project and the supervising faculty member’s area of expertise.
• Explain the aspects of the project where you will operate with most independence or take most responsibility.
• List appropriate scholarly citations and references to demonstrate your understanding of the field. References should be formatted in the style appropriate to your discipline. If you refer to a grant proposal made by your mentor, please cite the grant proposal as one of your sources.

Resources:
• Brown University, Biology http://biology.brown.edu/bug/suggested-research-proposal.html
• Duke University http://undergraduateresearch.duke.edu/start/writing-research-proposals
• webGURU http://www.webguru.neu.edu/undergraduate-research/research-funding/research-proposals
Matters to Address in a Research Proposal and Suggested Order or Headings

1. **Title**
   - Your title should be clear, descriptive, and specific.

2. **Motivation for the research**
   - Give context for your research project and/or question(s): why is this an important area to study?
   - Provide a few references to the most important and relevant peer-reviewed scientific literature and if appropriate, policy documents that will motivate and guide your research.

3. **Overall research goal**
   - What do you want to find out?
   - If you have a project that is already well defined:
     1. What is your guiding research question?
     2. What specific questions or hypotheses will you test in order to answer the overall question (be explicit about what these are)?
     3. What is the state of scientific knowledge in this area, and how will your research question advance that knowledge?

4. **Approach** (methods, e.g. field experiments, economic surveys, meta-analysis of existing data, that you will employ to gain a better understanding and set of tools to pursue research in your chosen area or, if you are further advanced in your research, test the hypotheses laid out in part 3)
   - What will you do to answer the overall research question?
   - What data will you collect? Where will you do the research?
   - What equipment or technical resources will you need?
   - How long will the research take?
   - How will you analyze and interpret your data?

5. **Anticipated results** (based on your knowledge of related and previously conducted research in this area)
   - What do you predict that the results of your experiments, surveys, etc. will yield in terms of data? Why?

6. **Significance of the proposed research** (to the scientific community and society)
   - Why are you excited about the proposed research, and why should the reader be as well?
   - How does the proposed research relate to what has already been done in this area?

7. **Literature cited**
   
   (adapted from “Suggested Format for a Research Proposal,” Office of Biology Undergraduate Education, Brown University)
Examples of SURF Project Proposals from 2012-2013

The 2013-2014 SURF Program project proposal requirements differ from previous years. Last year applicants were asked to prepare a one page max. research proposal that included the following: applicant’s name; title and description of proposed research project; explanations of why the applicant selected the proposed research project, the applicant’s reason for seeking undergraduate research experience, and how that experience relates to the applicant’s academic and career plans. This year’s questions require a concise statement of your research project proposal, but ask you to identify and explore your research and personal goals in a little more detail.

Example 1: Identifying Specific Zrf (2-4) Protein Targets in the Developing Zebrafish Brain.

Over the years, researchers have intensely studied nervous system development. The Barresi lab uses the zebrafish model to study this developmental process. It is understood that axons are guided across the midline by contact attractants and repellants in the developing zebrafish brain environment. This midline-crossing event leads to the formation of commissures, a cluster of nerve fibers that serve to connect the two sides of the central nervous system.

Previous research of axon pathfinding at the zebrafish forebrain midline has shown that the axons of the postoptic commissure interact with astroglial cells, which may function as a supportive substrate to promote axonal growth across the midline (Kaprelian et al., 2001). These astroglial cells express glial fibrillary acidic protein (GFAP). Gfap can be identified by the antibody zebrafish radial fiber 1 (ZRF-1). There are three additional ZRF proteins (2-4), and all four ZRFs were made to understand the structuring of neural segments in embryonic zebrafish hindbrain (Trevarrow et al., 1990). The Barresi Lab has used ZRF to try to determine the arrangements of specific groups of neurons, commissural tracts, neuropil areas, and radial glial fibers in zebrafish (Marcus and Easter, 1995). Imagining of these antibodies in the forebrain shows differential ZRF expression in astroglia, which suggests different astroglial cell types may be recognized by these antibodies.

The goal of this project is to determine the proteins that are being recognized by the ZRF-2, ZRF-3, and ZRF-4 antibodies. Identification of these proteins will provide new insight into the development of these important but significantly understudied astroglia. The plan of action is to use biochemical techniques, such as western blots and immunoprecipitation, to determine the proteins that are binding these antibodies.

As a biochemistry major and prospective neuroscience minor, I’m pursuing this project to develop it into a biochemistry honors thesis. The project’s clear application in the field of neuroscience fulfills my personal curiosity in neuroscience.

Though I have previously done research in labs at Smith College and beyond, I am interested in pursuing this project because it is much more applicable to my scientific interests. Most importantly, this project will help me develop skills as an independent researcher as I will soon be leading this project. I hope to use these skills in the future when I pursue research after Smith College through a possible Fulbright and while at and beyond medical school.

Risha Sinha, ’14, Biological Sciences Major
393 words [2563 characters]
Example 2: Revising *SAS and R: Data Management, Statistical Analysis, and Graphics*

This proposed research project is a continuation of work begun this spring semester. Professor Horton and Ken Kleinman’s *SAS and R: Data Management, Statistical Analysis, and Graphics* is a reference for users of SAS and/or R. Since the book has been published in 2009, certain aspects of the code have been outdated by improved standards and new code options. The objective is to revise this guidebook in anticipation of publishing an updated edition; the dated coding will be cleaned up, and corrections from the addendum of errata that are currently distinct from the book will be incorporated into the new edition. A secondary objective is collaboration between Professor Horton and research assistants to develop a presentation that combines statistical computing, statistical education and the mosaic package in R.

I am currently working with Professor N. Horton on a similar project during the spring semester. Having a chance to be a part of this project from start to finish would be a great experience. I am interested in mathematical publishing and would like to see what the entire process entails. Working on this project has also increased my knowledge of statistical computer programming and statistics in general. This is especially valuable since there are not many upper level statistics classes at Smith.

I plan to attend graduate school in Applied Mathematics after graduating from Smith. Research experience would be key in fostering my mathematical intuition and problem-solving abilities. I am still unsure what branch of mathematics will be my main focus in graduate school; at an undergraduate level it is hard to gain in-depth experience in a specific topic. Therefore, a focused research experience could help me determine where my specific interests lie.

Example 3: Field Station Interpretation & Chestnut Orchard Establishment

I will be working with Reid Bertone-Johnson, Field Station Manager, on a variety of projects at the Ada & Archibald MacLeish Field Station. The two main focuses will be the creation of interpretive materials and the establishment of an experimental chestnut orchard. I will be creating the content and format of interpretive signs for the Field Station and then making these signs in the Center for Design and Fabrication. I may also create other interpretive materials, such as brochures etc.

Early this summer, 650 chestnut seedlings are being planted at the Field Station. These are the first of an eventual 3,000 chestnuts that will be planted in a one-acre space at MacLeish, as part of an effort to bring back the American chestnut, a historically important tree that was wiped out by an exotic pathogen. The chestnuts being planted are crosses between American and Chinese chestnuts; Chinese chestnuts are resistant to the chestnut blight, and these seedlings represent the first generation of resistant crosses. I will be helping to plant, care for, and keep a tally on these seedlings.

I have worked with Reid Bertone-Johnson in a few capacities before: he is my STRIDE mentor for the Mill River Greenway Initiative, he’s my minor advisor and current professor for Landscape Studies, and as an avid naturalist I have visited the Field Station with him for various purposes. I am very passionate about the field station and its potential value to the Smith community, and I’m excited to work on interpretive material to draw more Smithies to MacLeish. (I’m also looking forward to using the tools in the Center for Design and Fabrication.) I’m thrilled to work on the chestnut restoration project as well; I love botany, and this is a new kind of ecological restoration that I’m honored to be part of.

As an Environmental Science & Policy major and Landscape Studies minor, I know that these projects and anything else I might work on in association with the field station this summer will help me find clarity about what kind of environmental or landscape work I may want to do in the future. They will also give me incredibly useful practical skills, such as working with fabrication equipment.

EJ Wald, ’15, Environmental Science & Policy Major

369 words [2206 characters]