Writing Better NSF Research and Education Proposals

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Caution

Most of the information presented represents the opinions of the individual program officer and is not an official NSF position.
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I. Overview

When you go to a Federal agency asking for money, be sure your request fits within the goals of the agency.
The NSF Mission is

- To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense (NSF Act of 1950)

The NSF strategic goals are related to:

- Discovery - advance frontiers of knowledge
- Learning - cultivate an inclusive S&E workforce
- Research infrastructure - investment in advanced instrumentation, cyber infrastructure, tools, etc.
- Stewardship - support excellence in S&E research and education

NSF funds fundamental research and education in most areas of science, mathematics and engineering
• We look for research and education proposals that
  - Are innovative and push the frontiers of knowledge
  - Contribute to national needs and priorities
  - Go beyond marginalia
  - Integrate well with educational goals
  - Involve research
DOs

• Build on your strengths
• Differentiate this proposal from your Ph.D. thesis work and other sponsored work
• Perform thorough literature search and exploratory research before writing the proposal
  - Journal articles (update with personal contact)
  - Read the NSF Grant Proposal Guide (GPG)
• Establish and keep your contacts
DON'Ts

• Rush
• Wait until last minute (1 month) to contact program directors
• Make the proposed work (whether it be research or education) too broad
• Make the proposed work too narrow
• Ask for too much (or too little) money
• Ignore rules (Grant Proposal Guide or solicitation) and misc. items
II. Proposal Basics

- Write to the reviewers (not to us and not to yourself)
- Your proposal will be judged by the reviewers
- Reviewers want to know four things:
  - What is it about (the goals/objective)?
  - How will you do it (the technical approach)?
  - Can you do it (you and your facilities)?
  - How will you know if it worked (assessment for educational proposals)
  - Is it worth doing (intellectual merit and broader impact)?
- This is, basically, all the proposal needs to convey - but it needs to convey this
Mentoring for Postdoctoral Researchers

- Beginning January 5, 2009, proposals that include funding to support postdoctoral researchers must include a description of the mentoring activities that will be provided for such individuals.

- Mentoring activities may include:
  - Career counseling;
  - Training in preparation of grant proposals;
  - Publications and presentations;
  - Guidance on ways to improve teaching and mentoring skills;
  - Guidance on how to effectively collaborate with researchers from diverse backgrounds and disciplinary areas; and
  - Training in responsible professional practices.
Mentoring for Postdoctoral Researchers (Cont'd)

• Proposed mentoring activities will be evaluated as part of the merit review process under the Foundation's broader impacts merit review criterion.

• Proposals that do not include a separate section on mentoring activities within the Project Description will be returned without review.
Follow the NSF Guidelines

- Proposal & Award Policies & Procedures Guide (PAPPG)
  - Grant Proposal Guide (GPG)
  - Grants.gov Application Guide
- Program Solicitation
- Budget guidelines
Grant Proposal Guide (GPG)

- Provides guidance for preparation and submission of proposals to NSF;
  - Allowable fonts, margins, page limits, bio format, etc.
  - Process for deviations from the GPG
  - Process and criteria by which proposals will be reviewed
  - Reasons why a proposal may be returned without review
  - Reconsideration process
  - Process for withdrawals, returns & declinations
  - Award process and procedures for requesting continued support
  - Budget line item definitions
  - Process for submission of collaborative proposals (subawards and multiple proposals)
III. Getting a Research/Education Topic
The Research Topic

- It must be research or a new education idea
- It must not have been done before
- It must be significant
- There must be higher than probability zero that you can do it
- It must lend itself to a viable plan
- You must have the facilities to accomplish the work
- It should fit into your strategic plan
• Do you know in your field?
  - What is the current state-of-the-art
  - Who are the top ten researchers
  - What they are doing right now
  - Where they get their funding
  - What they consider to be the key research issues
  - Who would likely review your proposal
  - How much money is available for a grant/what the grant opportunities are
The objective is a concise statement of what you intend to find out that we don’t already know.
The Research/Education Objective

- This is probably the hardest part of the proposal and the most important aspect
Four acceptable ways to do it right:

- The research objective of this proposal is to test the hypothesis $H$.
- The research objective of this proposal is to measure parameter $P$ with accuracy $A$.
- The research objective of this proposal is to prove conjecture $C$.
- The research objective of this proposal is to apply method $M$ from field $Q$ to solve problem $X$ in field $R$.
The Research Objective

- How to do it right:
  - The research objective of this project is to measure the cross-section of the muon-nutrino interaction at 5 GeV accurate to 10%.
  - The research objective of this proposal is to test the hypothesis that chip formation in high-speed machining of brittle materials is determined by parameters x, y and z.
  - The research objective of this project is to determine whether on-demand peer tutoring using i-pods can enhance learning in organic chemistry.
The Research Objective

• Doing it right:
  - Begin: “The research objective of this project is…”
  - Limit: 25 words or less
  - Be specific about what you intend to find out
  - Be specific about what you intend to find out
  - Be sure your statement is comprehensible
  - Be sure your objective leads directly to a research procedure to accomplish the objective
  - Put it up front—sentence one, paragraph one, page one
  - Do not give a weather report or state-of-the-union address
IV. Finding a Home
Questions - Step One

• Is your “research” research?
  - If it isn’t, it doesn’t belong at NSF

• If the answer is “no,” skip to the end, look for support from other sources

• If the answer is “yes,” what is your research objective?
  - The right NSF home for your research depends on your research objective, not on the application of your research

NSF does not support applications studies
Step Two

• Look up NSF’s web site: www.nsf.gov
  - Read the current Grant Proposal Guide
  - Check out research programs, read what research topics they support
  - Look up new initiatives, read the current announcements

• Then call the appropriate program officers
  - Be prepared to answer the question: “What is your research objective?” (25 words or less)

NSF does not support applications studies
**Important Questions**

- Does my research topic fit well with your program?
- Does your program have funds to support my research if my proposal reviews well?
- What size grant is pushing the limits of your funding ability?
- What are your proposal submission deadlines?
- How are proposals submitted to your program reviewed?
Questions You Shouldn’t Ask

- So, will you fund my proposal?
- Is this a good idea?
- What topic do you think I should work on?
- What are my odds?
- If I send a copy of my proposal to you, will you help me edit it? Will you tell me what you think of it?
- My proposal wasn’t funded, so can I resubmit it as an EAGER?
Catch 22

- My research doesn’t fit in any single NSF program, how about joint submission/review?
  - Did you formulate a clear research objective?
  - Is your research objective too broad?
  - Do you want to consider focusing your scope?

- Suppose my research really does span multiple programs?
  - Contact all relevant program directors
Should I Meet My Program Officer?

- Why? What do you intend to gain?
- Or is your goal to schmooze? (It doesn't help)
  - Don't even think about taking your program officer to lunch
- If you decide to meet:
  - Be prepared to listen (you don't learn by talking)
  - Be prepared with questions
  - Remember, the program officer is not the panel
  - You can get a free trip to NSF (more later)
How Could a Meeting Help?

- Your program director can:
  - Give advice on proposal submission
  - Help you understand a review of a previous proposal
  - Point you to resources you can use to help write a better proposal next time
  - Give general guidance on good proposal writing
  - Give you ideas for collaborations

Program officers look forward to constructive meetings with PIs
How Could a Meeting Help?

Note—you learn by listening, not by talking. So shut up and listen.
V. Writing the Summary
Writing the Summary

• The most important statement is your statement of the goal(s)/objective(s)
  - It should be sentence 1 of paragraph 1
  - Do not begin with a weather report: “The sky is falling. Tools are breaking. Designs are failing...”
  - Do not begin with a state-of-the-union address: “Business is moving off shore. Manufacturing is going to the ...”

• Remember, this is not a tech paper, it is not a murder mystery (where we find out what the objective is on page 15)

• Don't forget the Intellectual Merit and Broader Impact statements
What We Want to Know

• What is your research objective?
  - This is what directs your proposal to the appropriate program

• What is your approach?
  - Outline — just two or three sentences

• Why is your contribution important to your research or education community (the intellectual merit)?

• If successful, what will be the benefit to society (the broader impact)? Why is your project important to society?
The objective of this research project is to test the hypothesis that too many monkeys in a tree will cause the tree to break. The approach will be to take a sample of ten trees and load them with monkeys until they break...

**Intellectual Merit** - It is important that we know how many monkeys can climb a tree before it breaks because this affects our perceptions of monkey procreation and... The Snerd Theory holds that tree size limits monkey procreation. This study challenges that theory with the notion that... If the objective hypothesis is correct therefore, it will transform our approach to...

**Broader Impact** - Monkeys are used in medical research. By knowing how many monkeys can fit in a tree, we will be able to provide more monkeys for such research thereby advancing medical science more quickly and improving the quality of life. Also, by watching the monkeys get hurt when the tree breaks, graduate students will be less likely to climb trees, thereby increasing their probability of graduating.
Remember

- Your proposal may (will) be returned without review if:
  - You fail to include explicit statements of intellectual merit and broader impact (entitle them Intellectual Merit, Broader Impact)
  - You use the wrong font or it is too small
  - The margins are too narrow
  - Your bio is incorrectly formatted
  - You have an unauthorized attachment

- We have been lenient in the past, we will not be permitted such lenience in the future, and you anger the reviewers anyway
VI. The 15 Page Narrative

- The next 15 pages of your proposal give supporting information and detail to your summary
- Start with a restatement of your goal(s)/objective(s), clarify it, and provide a plan to accomplish it
- Provide a convincing argument that you can carry out your proposed plan
- Restate and provide detail on your intellectual merit and broader impact

This is a good time to put forth your best effort
Sections for the 15 page Narrative of an Education Project

- **Goals & expected measurable outcomes**
- **Rationale (similar for a research or education project)**
  - Introduction
  - Background
  - Justification
- **Project Plans (for education)**
  - Implementation strategy
  - Evaluation strategy
  - Dissemination strategy
  - Management strategy
An effective rationale for an educational proposal discusses:

- The importance of the problem (industry needs, emerging area)
- The potential impact of the work (society problem, large number of students impacted, global)
- Prior work by others (referenced to the literature)
- Prior work by applicant (preliminary data)
- Evidence or theoretical basis indicating that the approach will solve the problem (referenced to the literature)
- Potential problems, limitations, alternate approaches
- Potential contributions to teaching and learning knowledge base

- Don’t limit to Intellectual merit -- also include broader impacts
Importance of the Rationale

• The rationale should convince the reader that the applicant
  - Has identified an important, big-impact problem (Intellectual Merit)
  - Understands the problem and the prior work
  - Has thought about the broader impacts in general and broadening participation in particular
Project Plan.

A. Implementation strategy for an Education Proposal

- Plan to accomplish the Goals and Objective
- Reasonable Timeline
- Identify personnel responsible for each task
- Flowchart of work
B. Evaluation Plan for Education Proposals

• Name & qualifications of the evaluation expert

• Goals and outcomes and evaluation questions

• Tools & protocols for evaluating each outcome

• Analysis & interpretation procedures

• Confounding factors & approaches for minimizing their impact

• Formative evaluation techniques for monitoring and improving the project as it evolves

• Summative evaluation techniques for characterizing the accomplishments of the completed project.
• The evaluation plan should convince the reader that the applicant
  - Has clear measurable expected outcomes
  - Will collect, analyze, and interpret appropriate data
  - Will complete an informative evaluation both for monitoring (formative) and for validating (summative)
Project Plan

C. Dissemination Plan for an Education Proposal

• Include specifics in description of publication efforts
  – Conference or journal, budget, tentative title, purpose
• Put material in a form suitable for NSDL
• Explore other venues
  – Specialty websites and list servers, CUR, PKAL
• Target and involve a specific sub-population
  – Integrate community building, dissemination, and evaluation
• Explore commercialization
• Explore beta test sites
• The dissemination plan should convince the reader that the applicant
  - Will have something to disseminate
  - Has plans to inform and encourage others and to facilitate their use of your innovation
The management plan should convince the reader that the applicant

- The PI has the skills to conduct the work and produce a useful product
- The PI has a realistic understanding of the time needed for each component.
Tips on Writing any Proposal

- Use only 12 point font
- Do not use figures or tables as filler—everything should contribute
- Everything should be legible—do not use 2 point font on figures or tables
- Be sure to include a clearly stated set of goals/objectives
- Use only the required format
- Be sure to include intellectual merit and broader impact statements in the body of the proposal
Tips on Proposal Writing con't

• Don't include letters of support if
  - They aren't very supportive
  - Letters from several companies/universities are identical
  - They are letters from previous proposals

• Don't cut and paste together new proposals from old declined proposals

• Set the proposal aside for a week then proofread your proposal before you submit it (and ask a friend to proofread the proposal)
VII. Intellectual Merit and Broader Impact Statements
IM and BI Statements

• They are required
• Your proposal will be rated based on them
• But:
  - What are they?
  - What should you include?
  - How should they shape your proposal?
Intellectual Merit

• The Intellectual Merit is the contribution that your research makes to the knowledge base and how that impacts the field

• Questions:
  - What is already known?
  - What will your research add?
  - What will this do to enhance or enable research in your or other fields?
  - Why is your contribution important to your research community?
  - How will your results be “transformative”?
Broader Impact

- The Broader Impact focuses on the benefit to society at large as a result of your research result

- Means to benefit society include:
  - Economic/environment/energy/health/safety
  - Education and training
  - Providing opportunities for underrepresented groups
  - Improving research and education infrastructure

The key issue is how your results will be applied — why would the general public care?
Your goals/objectives and approach should determine the intellectual merit and appropriate broader impact.