Writing NSF Research Proposals

Luis Echegoyen
UTEP – February 21, 2013

Acknowledge
George Hazelrigg – NSF ENG
Overall Guidance

• Proposal Writing: Idea(s)-based
• Craftsmanship helps
• It is more an Art than a Science
• You can avoid Mistakes and Pitfalls
• You CANNOT ensure success
• Finding the right program(s)
• Language: Precise, easy to understand, avoid jargon, avoid acronyms
• Aesthetically pleasing, good balance between text and graphics (a picture is worth a thousand words)
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, cyberinfrastructure, 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
NSF

• Looks for research 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
CAREER Awards

• Funds the academic career development of new faculty (it is not a research award)
• Is based on a development plan –”well argued specific proposal for activities that will build a firm foundation for a lifetime of integrated contributions to research and education”
• Requires Preliminary Data
• Devote real time to develop an educational plan
• Duration: 5 years
• Min (in many programs, it’s also a Max.) amount: $400,000
• Deadline: July each year
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
IM and BI Statements

• They are required; both in Project Summary and in Project Description
• Separate section in Project Description
• 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”?
  - “Newness” is not enough
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 – Don’t get overconfident at UTEP!
  – Improving research and education infrastructure

The key issue is how your results will be applied — why would the general public care?
Proposal Basics

• Write to the reviewers (not to program officers and directors 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)?
  – Is it worth doing (intellectual merit and broader impact)?

• This is, basically, all the proposal needs to convey – but it needs to convey this
The Research Topic

• It must be a new research 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
The Research Objective

• This is probably the hardest part of the proposal and the most important aspect

The objective is a concise statement of what you intend to find out that we don’t already know
The Objective

• 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 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 long-winded account...
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 descriptive 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?
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

• NSF will return, and you anger the reviewers anyway

• Submit **ON TIME**
Tips on Proposal Writing

• Use only font types and sizes allowed (Arial, Courier New, or Palatino Linotype at a font size of 10 points or larger; Times New Roman at a font size of 11 points or larger; or Computer Modern family of fonts at a font size of 11 points or larger. No more than six lines of text within a vertical space of one inch – Spacing – exactly 12.
• 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
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
• Requires a separate broader impact section!
• A picture is worth a thousand words
Tips on Proposal Writing

• 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)
My “Ideal” Proposal

• Based on “just-published” article – preliminary data, accepted by community – proof of concept
• One or two Graphics that clearly describe(s) overall concept
• Easy to read/understand, avoids jargon
• Concise but explicit and convincing
• Avoids duplication
• Precise language
• Flows unaided (acronyms, structures, formulas)