ATMO 5352: Proposal Writing Lecture Notes
March 29, 2010
Kyle C. Wiens

(I’ve reviewed several NSF proposals, and I’ve written a couple. I haven’t had any of mine funded, so I’m certainly no expert. Much of this information has been compiled from other sources. For example, grant writing workshops I’ve attended.)

Scientific Process and Writing Proposals

The Research Process

1. Have a good idea (and maybe some preliminary “pilot” data)
2. Write the proposal (and hope it gets funded)
3. Do the work (not really discussed in this lecture, but you get this in all your other classes, including some elements of this class)
4. Write and submit articles (to be discussed in a later lecture)

The Idea (the most important thing):

• Where/how to get good ideas
  o Read the literature (best method for me). This also helps ensure that your idea is quasi-original and prepares you to write the proposal (since you will have to provide background information for your idea anyway).
  o Attend conferences. Usually very inspiring and intense: exposure to (and generation of) lots of ideas over a short time
  o Look at NSF web-site of awarded proposals (read the abstracts to generate new ideas that are different from, or at least extensions of, what others are doing)
  o Collaboration
    ▪ Advisor, peers, etc.
• But is it a good idea?
  o Too similar to something else?
    ▪ Originality: bad if too similar to existing idea…
    ▪ But maybe good if you can take existing work and apply it to a new problem, i.e., expand concept to novel implementation (maybe this is what is mean by “transformative”?). This actually tends to get funded the most often because you are building on tested results, hence there is greater probability that the funding will lead to significant results. Hence, greater probability of funding.
    ▪ Completely novel research seems to be funded only for established scientists with proven track record.
  o Is it feasible?
    ▪ Affordable
    ▪ Availability of sufficient resources
      ▪ Instruments
      ▪ Personnel
- **Usually, must have a testable hypothesis.**
- Does it fill a gap in knowledge, i.e., significant impact on the field?
- Are you qualified to do the work?
- **Will anyone fund it?**

Anecdote of trip to science history museum in Florence, Italy:
As I toured the museum, it was striking to me how many years passed (e.g., 50 A.D. to 1400 A.D.) with little or no advancement of knowledge in the western world (i.e., during Dark Ages). Yet there was a burst of advancement in 1400-1600. Reason for the difference: money. Specifically, rich patrons and political will to fund research.

Examples: Prince Henry the Navigator of Portugal, the Medici of Florence.

More recent example: the space race and Cold War between USSR and USA. Now: rich “patrons” are primarily government institutions www.grants.gov and www.nih.gov and www.nsf.gov for example. and private foundations (e.g., Gates, Hughes, Lindbergh) http://foundationcenter.org/

**You have the idea, now determine what you need to do the work:**

- Instruments to get the required data
  - Must have them (or budget for them) to make proposal feasible.
  - Alternatively, the proposal itself could be to design/build/purchase the instruments, as long as you identify a clear need (gap to fill) for them. Example: NSF MRI: Major Research Instrumentation grant.
- Labor (you, students, collaborators, other staff)
- Time (realistic time line given available resources)
- Resources (computing resources, other infrastructure)
  - Always a plus to have an existing research base.

**The Proposal:**

- Identify a need, provide the idea that meets the need and aligns with agency goals.
- Which agency?
  - Different agencies have different goals.
  - Different agencies also have different proposal requirements, formats, guidelines.
  - Same agency often has a variety of different proposal types, e.g., NSF has (standard, CAREER, MRI, etc.)
  - Does it have to be collaborative?
- A funding agency gives money to accomplish specific activities that you propose (unless there is a guiding RFP: request for proposal), and these activities must address goals of the agency. So, position your idea so that its relationship to that mission is **obvious**.
- Example, NSF mission and description: http://nsf.gov/about/glance.jsp
Resources at NSF (www.nsf.gov):

- Look at what’s already funded (this can be fun and good for ideation)
    - Relevant organizations for ATMO research:
      - AGS, EAR, GEO
- Get the proposal guide and other useful information
  - Addressing “broader impacts”:
  - Google: “example nsf proposal”

Writing the proposal:

- Before you write it, make sure it is a good idea, that it hasn’t already been solved or funded (determine via lit review, NSF award search), and that you are enthusiastic about doing the work.
- Suggestion: Write a ~1 page version of the proposal first, obviously very condensed but gets the main points on the page. You’ll have to write something very similar as the “Project Summary” of your proposal anyway, so might as well do it first to get yourself organized. Write it in this order:
  - Statement of the problem/need.
  - What is known (background)
  - Identify the knowledge gap your proposed work will fill.
  - What central hypothesis(es) you will test, or what need you will meet.
  - Rationale for why this work needs to be done and why you are able to do it.
  - What results to expect (be realistic).
  - Which of the results are expected to be potentially important in advancing the field, and why.
  - Broader impacts to society.

A few tips on writing style:

- Expect a non-expert audience to read the summary (abstract) and maybe even the full proposal. Although keep in mind that at least one expert may be on the review committee (and if that expert’s work is related to the proposal, he/she will expect to see his/her publications discussed in the background section).
- Each paragraph makes one (and only one) point.
- Paragraphs have a logical progression (lead the reader to your conclusions, persuade).
• Simple declarative sentences. Avoid compound sentences, excessive clauses, and flowery language.
• Be specific
  o Bad: “The proposed state-of-the-art research will lead to significant advances in the field.” That’s bad because it is overly general.
  o Better: “The proposed research will result in X.”
• Avoid “buzz” words like “state-of-the-art” and “cutting-edge”.
• Avoid weak words like “hope, believe, try, should, would, might”. Instead use stronger words like “expect”, i.e.,
  o “We expect this research to produce x”. Instead of “we believe/hope this research will produce x.”
• Be concise (there are page limits!) and be clear.
• Make it easy to read (maybe even fun to read). A proposal is typically different from a journal article in this respect, more like writing a newspaper article. 😊
  o Just the essence.
  o Make it easy to find the information, i.e., a very specific order. Make it obvious.
  o Limit use of abbreviations and acronyms. They can be irritating if the reader is not familiar with them.
  o Limit use of italics and bold type to emphasize the most important stuff (like sub-section headings, objectives, etc.)

The NSF proposal evaluation criteria: An NSF proposal has to address these two things specifically and typically has two sections titled as such:

1. “Intellectual Merit”
   a. Significance: how important is the work in advancing knowledge and understanding?
   b. Applicants: How well qualified is/are the applicant(s)?
   c. Approach: Is the proposed work well conceived and organized?
   d. Environment: Are the resources described adequate to accomplish the proposed work?
   e. Innovation: Are the underlying concepts for the proposed work creative, original and transformative? [not really sure what is meant by “transformative”, seems like a bureaucratic buzz word to me.]

2. “Broader impact”
   a. Advance discovery while promoting teaching, training and learning.
   b. Broaden participation of underrepresented groups.
   c. Enhancement of infrastructure for research and education.
   d. Broad dissemination of research results.
   e. Benefit to society.
The NSF proposal, section by section:

Again, see the following for more detailed information: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg

Specifically, Chapter 2: Proposal Preparation Instructions

It is very important that the guidelines are followed exactly (except for budget in the case of this class). I suggest you title your sections and sub-sections exactly as indicated below by the quoted text.

a. You do not need a cover sheet for this class project.
b. “Project Summary”
   a. One-page maximum.
   b. Think of this as an executive summary (abstract). It should be a self-contained and compelling mini-version of the full proposal. You want this summary to engender enthusiasm. Write this with the mind-set of trying to convince a funding official that the rest of the proposal is worth reading and/or distributing to reviewers. Also treat this as a template for the body of the proposal, i.e., the body of the proposal will repeat (or paraphrase) this summary, then expand upon it.
   Note: strangely, this has to be written in third-person (which I personally hate), but that’s the way it is.
   Note: this summary must have the following two sub-sections. I suggest you actually have sub-sections entitled as such:
   c. “The Intellectual Merit of the Proposed Activity”
      i. Might go something like this:
      ii. 1st sentence: what the proposal is about and why it is relevant to this funding agency.
      iii. Rest of 1st paragraph: statement of the problem/need, i.e., what is known, what is the gap. That is, make it clear that there is a need to do the proposed work.
      iv. Second paragraph: your solution to the problem/need. Objective(s) of this proposal or formulation of hypothesis (if appropriate). Make your objective(s) definite, i.e., there must be an expected result. “The objective is to study tornadoes” is not definite. “The objective is to determine the role of baroclinity in tornadogenesis” is definite. Hypothesis must be testable, i.e., able to be refuted or supported.
      v. Third paragraph: How you will meet the objective (or test the hypothesis), and what the expected results are.
   d. “The Broader Impacts Resulting from the Proposed Activity”
      i. Fourth paragraph: see, for example, www.nsf.gov/pubs/gpg/broaderimpacts.pdf

The first sub-section (intellectual merit) might take up about 2/3 of the page, for example.
c. “Table of Contents”
d. “Project Description”
   a. 15-page maximum, and that includes any figures.
   b. This is the meat of the proposal. It should flow very clearly and logically
      from identification of the problem to resolution of the problem: what you
      propose to do, how you propose to do it, what you expect to accomplish, how
      long it will take, and why it matters. I’ve seen a variety of styles for this,
      depending on the scope of the proposal, how many objectives there are, etc.
      The following is a basic suggested type of organization. Should include the
      following, for example
         i. “Overview and Objectives”: Justification for significance of the
            problem, i.e., why this work should be done. You might even have a
            sub-section title “Significance of the problem”. If there are multiple
            objectives, list them clearly and separately (bullet points or a
            numbered list are fine for this).
         ii. “Background” (literature review). Doesn’t need to be comprehensive,
             but should clearly indicate knowledge of subject area. Stick to the
             discussion of the literature that is directly relevant to the proposed
             work. Important: if there are multiple problems/objectives to be
             addressed by the proposed work, make sure this background section
             encapsulates each one in a single sub-section or (ideally) a single
             paragraph, and each of those should end with the indication that a
             conclusion (resolution of the problem) could be reached….by the work
             proposed, of course. That is, don’t leave it open ended or unsolvable.

         (Note: the remainder of this project description should correlate with the
         overview and background sections. That is, clearly identify how the proposed work
         will address the problem(s). Example: if the overview and background sections
         identify problems ‘x’, ‘y’, and ‘z’; then the rest of the narrative should
         specifically address ‘x’, ‘y’, and ‘z’.)

         iii. Relevant experience, preliminary results and “pilot data” (if there are
              any). This shows evidence that your proposed work has merit and is
              feasible, and that you are capable. Most proposals seem to require
              some preliminary results. Publications/presentations/theses are valid
              components of “preliminary work” here.
         iv. “Proposed Research Activity”: Specifics about the work to be done
             (i.e., what instruments, what methodology). Again, be very obvious
             and specific about how problem ‘x’, ‘y’ and ‘z’ will be addressed by
             the instruments and methodology. If appropriate, break this down into
             separate paragraphs/sections, each of which clearly addresses a
             separate problem or topic.
         v. “Expected Results and Outcomes”. Be specific: “Goal #1”. “Goal
            #2”, etc. Be realistic, too.
It’s also a good idea to identify potential problems, and state how you will address them.

vi. “Timeline of Proposed Activities”. Try to be specific. Indicate your best estimate of time required for achieving the results. Be realistic.

vii. “Broader Impacts”: see above PDF document again. Also appropriate to include how this proposed work fits into long-term career goals, future research projects, etc.

(Note: it is always a good idea to break into sub-sections, and sub-sub sections with descriptive headings. Basically, make the information easy to find.)

e. “References Cited”
f. “Biographical Sketch(es)”
   a. Include yourself, of course.
   b. Also include any collaborators you have in mind.

g. “Budget”
   a. Be thankful that you don’t have to include a budget for this class project. 😊 Still, it would be useful for you to read the NSF instructions about budgets to get a feel for all the components you would have to consider.