HOW TO WRITE A GRANT: ONE PERSON’S APPROACH.

John Boothroyd, Ph.D.
Professor of Microbiology and Immunology
Associate Vice Provost for Graduate Education
Stanford University

STEP ONE: DEFINING THE QUESTION.

- Quiet space with pencil and paper at hand.
- Pose questions as you go - HOW, WHAT IS RESPONSIBLE FOR…
- Identify one interesting and important QUESTION.
- Articulate your hypotheses, if appropriate, but BE CAREFUL NOT TO BIASE THE SCIENCE!
- Bounce these off of colleagues.
- Check out what’s known.
STEP TWO: DEFINING THE APPROACH.

- Consider MULTIPLE approaches without regard to what is possible.
- Think about which would best enable you to address the question.
- Choose one or two that can FEASIBLY be used for your grant [balance innovation with practicality].

STEP THREE: PREPARING TO WRITE.

- Consult your program officer (always a good idea)
- Sketch out the plan on paper.
- Have a balanced portfolio of low-risk, “bread and butter” with some high-risk, high-gain but not central to rest of grant.
- Sketch out the plan on computer.
- Enlist your collaborators (early!).
STEP FOUR: WRITING – STYLE ISSUES.

- Communicate (*talk*) to the reader
- LESS IS MORE!! Keep within borders – leave spaces between paragraphs - (reviewer’s mood is more important than your data)
- Abstract and/or specific aims will make or break you.
- No conditional words (might, could, should) - only “will”. If conditionals are tempting then explain, “If…, then…”.
- Avoid semi-waffle words (characterize, attempt, study) in goals. Better are “identify”, “determine”, “define”.
- Spell-check and proofread!!!
TITLE.
- short, sweet but broad enough to encompass unanticipated areas but not so broad that cannot write another grant in related area.

ABSTRACT (NIH)
- two paragraphs.
- for lay audience.
- first is for the context (e.g., disease-relevance) and emphasize its importance.
- end first paragraph with question you will address.
- second paragraph is for approach you will use.
- this is PUBLIC information - do not reveal patentable ideas.

BUDGET [if not modular]
Personnel:
- PI should have significant percentage effort (20% minimum, depending on how big a program you want but don't use up all your % early on).
- keep in mind 5+ years out that total percent does not exceed 95% (max allowed). Don't defraud!
- include people by name, if appropriate; add their c.v.'s. [but, caution, you may have to report their departure when leave, changes in other support, etc.]
- include people who will not be paid off the grant as "freebies".
BUDGET [if not modular]

Equipment:
- spread items over multiple years so doesn’t inflate first year.
- match year of purchase to time-plan.
- ask for 50% cost for some big items - explain where other 50% will come from in justification.

Supplies:
- divide into medium categories.
- total should not exceed 15-20k/fte (full-time-equivalent) unless unusual.

Other:
- VERY useful category - try to get things out of supplies so 15-20k rule not exceeded.
- include core facility charges, tuition, publication costs (page charges and reprints), equipment maintenance, photocopying lab notebooks, software, etc.
Budget Justification:

- JUSTIFY, JUSTIFY, JUSTIFY!!!
- personnel - what will each person do exactly - which sub-project.
- why do you need the technical support - what will s/he do
- equipment - why can’t you borrow it? why aren’t the six you have enough already? why is it needed full-time for THIS project?
- supplies - explain any special needs - impress that are keeping the amounts as low as possible - mention cost-saving measures.

CVOS:

- Provide cv’s for everyone who helps make the case for how the project is doable by you.  NOTE: their other support will need to be provided and there are reporting requirements around key personnel.
- Include cv’s for collaborators (and letters of support).

RESOURCES:

- List big stuff that makes the project doable by you.
- Be sure jives with equipment being requested!
- List core facility support available with special emphasis on any unique/world class cores (e.g. FACS, SFGF).
- Give square feet of space available to you for this work.
OTHER SUPPORT [for all key personnel]:
- Be inclusive.
- Divide overlap into scientific and budgetary.
- Explain VERY well why there is no overlap or what you will do if there is ["If both grants are funded, discussions will be held with the respective agencies and budgets (and specific aims?) reduced as appropriate to ensure there is no overlap"].
- List specific aims if you think it will help. For post-docs, explain that salary may be requested from fellowship applications but supplies will come from this grant.
- If their salaries are included on the grant and fellowship applications have been submitted, explain that an additional person will be hired if the apps are successful.

TEXT (NIH: 25 pages max; 12 pages as of Jan., 2010)

Specific Aims [one full page]:
- Aims should embody the whole grant- the rest is fluff. Make these pure MEAT!!!! Sub-numbering helps keep it terse.
- Have a guaranteed useful and interesting outcome.
- Clear thread through whole grant - ideally ONE medium question and several related sub-questions.
- Set the scene with 2-3 sentences of background.
- State the QUESTION or GOAL (generally, you should not make the hypothesis the "lead" since the answer might be "no" after $1M of tax money; if appropriate, make the hypothesis clear AFTER the question)
- Specific Aims MUST match [verbatim] headings in the grant!
- Give enough detail that can understand what will be done.
- Provide back-up strategies where needed.
[Generic example]

---- is an important disease that. Currently, we know little about ----. My overall goal is to determine (understand) how ---- does ----. My hypothesis is that changes in gene expression regulate this process and I will therefore use a combination of genetic and biochemical approaches to determine ----. My specific aims are:

1. **Determine the genes involved in ----.** To do this, I will select mutants in ----. That is, I will:
   1.a. Chemically mutagenize strain xx
   1.b. Select and clone mutants able to ---- by putting them through ----

2. **Analyze mutants identified in Aim 1 with respect to ----**
   2.a. Determine complementation groups through mating ...
   2.b. If complementation proves impossible, I will use molecular genetic means to accomplish this aim. That is, I will ----

3. **Pursue five mutants that represent different extremes of the phenotypes characterized in Aim 2 by:**
   3.a.

---

**Background:**

- Give only what is needed to appreciate the context of the work.
- Tell what is known and then **what are the questions that are outstanding** (in bold, if you like)? Tell the reader this is a question you will address in your grant.
- Cite references by name.
- Don't just self-cite (intellectual dishonesty).
- **Be sure you have conveyed:**
  - Why is your question **interesting**?
  - Why is it **important** to answer?
  - How is the question **novel**?
  - How is at least one approach **innovative** (balanced portfolio)?
Preliminary Results:

- Ideally, by aim but not always possible.
- Proof-of-concept. My plan is DOABLE. It is doable by ME - now you just have to give me the money to do it.
- Aesthetics count.
- Make it flow.
- Don’t overwhelm with minutiae.
- Keep fonts in figures big enough to read (NIH now mandates).
- Avoid color unless needed.
- Sometimes work is done out of sequence i.e., give proof of principle for a 3rd year specific aim.
- Describe and emphasize any unique/world class core facilities (e.g. FACS, SFGF).

Experimental plan:

- Specific Aims verbatim as headings.
- Flow between sections. [“Having identified -- in Aim3, we next need to .....”].
- Have a “Rationale” or “Approach” section that is a virtual stand-alone. Explain why your chosen strategy is best among the various alternatives.
- Then have an “Experimental detail” section for each. Provide detail on aspects that are not standard. What vector might be important. What strain or cell line surely is (and why you chose it). How to do a routine assay is not. Make clear where YOU have direct experience with a technique.
- Emphasize unique/world class collaborators and core facilities and get letter of support unless clearly inappropriate.
Experimental plan (continued):

- Explain choices - how many will you choose and what criteria will you use to choose them. Be careful of mushrooming fishing expeditions (and mixed metaphors).
- Have “Pitfalls and Alternative Approaches” for each section. Describe any major hurdles that could prove problematic (but be careful they are not fatal and/or non-circumscribable). List back-up strategies and explain circumstances under which you will switch them. Give just enough detail that can stand alone.
- If something falls outside the scope of the grant, say so, but be sure it really does and you are not just using this as a fudge for something that is important but too risky.

Conclusion:

- One sentence to start. [N]Through the experiments described above, I expect to determine [or we will learn]. Ô
- Emphasize, we have all of the techniques in hand or available through our collaborators/consultants.
- Then include future goals. [My long term goals is to use the information/clone/reagents generated in this five year period b next .... Ô] This provides context. Everything interesting should have a future!
Time Line:

- Show how the work will flow.
- BE CAREFUL THAT THIS MATCHES EQUIPMENT AND PERSONNEL JUSTIFICATION.

Appendices:

- Have letters from people who will provide any reagents not in hand.
- Have letters from collaborators.
- Have letters from advisors if non-standard techniques or equipment.
- Do NOT include extra data — only data that is already included but doesn’t incorporate into text well (should not be an issue these days).

Addenda:

- Possible to send to NIH after submission and before review.
- Need permission — ask your program officer/executive secretary.
- Two pages maximum is best.
- Give data that establish proof of concept and feasibility.
- Update on papers published/accepted since original submission.
- Don’t go overboard and nothing is better than a little.
THINGS YOU MUST GET ACROSS:

- What will we learn?
- Why interesting, important, doable, ... exciting!!!
- Don’t be over-ambitious in scope and/or approach.
- Communicate! PEOPLE are reading your grant, not computers...

The Review Process – Revised!!

- Three real readers/reviewers
- Primary and secondary write reviews; tertiary can be oral or written
- Others chime in if something catches their eye or ear
- NEW! Reviewers rate using scale of 1-9 [high-low] on each of five criteria:
  - Significance
  - Investigator(s)
  - Innovation
  - Approach
  - Environment
- What matters is “Impact Score” (also 1-9; not weighted average of the five criteria)
- Reviewers give initial score; all discuss; reviewers revise scores; all vote
- Average impact score of all 15-20 voters is what matters; all votes count equally!
Training awards: Special Notes

- Emphasize training plan (include this course!!)
- Emphasize career path of past trainees in that group
- Get a second mentor if primary mentor's track record is not long