Advice on Writing Grant Proposals

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National Science Foundation (NSF)

Arlington, VA

• Nation’s major basic-research agency – supports all fields of fundamental science and engineering, except medical science

• Mission: “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…”

• Annual budget of $7B, 20% of all federally funded research

• Awards ~10,000 new grants/year

http://www.nsf.gov/
U.S. Department of Energy (DOE)

Germantown, MD

- Nation’s major energy-research agency – supports most fields of physical science and technology
- Annual budget >$25B, includes 40% of all federally funded research in physical sciences and technology

http://energy.gov/
Nevada is an EPSCoR/IDeA State

- Experimental Program for the Stimulation of Competitive Research (EPSCoR) – NSF, DOE, NASA, EPA, … **DOD, USDA** (dormant in FY11)
  - Large statewide grants (NSF, DOE, NASA)
  - *Equipment grants (DOD, USDA)*
  - Individual-PI grants (DOE, **DOD, USDA**)
  - Co-Funding (NSF, EPA, **USDA**)

- Institutional Development Awards (IDeA) – NIH
  - IDeA Networks of Biomedical Research Excellence (INBRE) – large statewide grants
  - Centers of Biomedical Research Excellence (COBRE) – more-focused group grants

http://www.epscorfoundation.org/
Developing an idea for a grant proposal

• Build on your prior experiences
• Focus on your strengths
  – Unique background or capabilities
• Communicate with colleagues
  – Knowledgeable & funded in your field
• Look at what grants are currently funded in the Agency & Program of your choice
  – Know your ‘competition’ and what gets funded
• Discuss with the Program Officer
Developing a grant proposal – Collaborators: Should I or shouldn’t I?

• Yes,
  – If they provide complementary strengths
  – If there is agreement on division of responsibilities
  – If you are confident they can deliver
  – If it is required by the Program (e.g., DOE EPSCoR)

• No,
  – If their expertise overlaps too much with yours
  – If any additional funds required are too high
  – Just to work with friendly colleagues
Assembling a Grant Proposal

- **Project Summary or Abstract**
  - Typically 1 page max
- **Project Description**
  - Typically 15 pages max
  - Includes results from prior work
- **Curriculum vita**
  - 2 pages max
- **Budget**
  - Each Agency has standard forms – OSP can help!
- **Budget Explanation**
  - No page limit, but best to keep it short
Project Summary / Abstract

• Concise statement of proposed work, research plan, and its importance/relevance
  – *Must be logical and ‘to the point’*

• Keep it simple
  – *Limit jargon, acronyms, especially in the title*

• Don’t oversell or overpromise
  – *No Hyperbole!*

• Should make reviewer eager to read proposal

• I usually write this part last
**Project Summary / Abstract**

**Broader Impacts**

- For NSF, Project Summary **must** address
- **Broader Impacts**
  - *Significance to other fields of research*
  - *Potential applications, patents, etc.*
  - *Infrastructure development for research or education*
  - *Educational impacts (undergrads, grad students)*
  - *Societal Impacts*
  - *K-12 and/or community outreach*
  - *Involvement of underrepresented groups*

- Don’t oversell or overpromise

- Good ideas get grants, but broader-impact requirements must be respected
Project Description

• Follow same logical path as Project Summary
  – But with details needed by expert evaluators
  – But only those details required – don’t overdo it

• Include prior results or experience (highlights)
  – Need to convince reviewers of your capability

• Propose a range of goals
  – Easy, intermediate, hard
  – Don’t promise too much, keep it realistic
  – It’s OK to include work in progress among the goals

• References
  – Only those explaining key points are really important
  – But … be sure to reference likely reviewers!
2. Linear dichroism in nondipole photoemission from chiral molecules. [Broader impact: Since the discovery of optical activity in chiral molecules [Pasteur 1848], they have received special attention due to their abundance and importance in biology, as well as the related and still unresolved question of the origin of homochirality [Bonner 1991, Bada 1995], the unique invariant handedness at the molecular level of terrestrial life forms. Free, unoriented chiral molecules with a given handedness are known to exhibit unique chemical properties such as asymmetric reactivity, a basic process in metabolism and pharmaceutical efficacy, as well as physical properties such as circular dichroism (CD). How and when homochirality originated has intrigued scientists ever since Pasteur’s pioneering studies. Numerous explanations of homochirality have been posited, and are split between biotic and abiotic … abiotic explanations suggest homochirality is an inevitable consequence of fundamental physical processes. … Within the abiotic category, explanations include interactions with asymmetric electric, magnetic, or electromagnetic (photon) fields. … In contrast, little consideration has been given to linearly polarized light as a possible cause of enantiomeric excess and homochirality.]
Project Description – cont. (2)

- Structure with sections, subsections, titles, etc.
- Keep it simple
  - *Use simple sentences, words, phrases as feasible*
  - *Limit jargon and acronyms*
- Figures are worth a 1000 words, but don’t overdo them
- Spell check
- It’s OK to mention circumstances peculiar to UNLV (e.g., new grad program, limited resources) – *just don’t make it sound like success is impossible*
Most budget items are noncontroversial, e.g.,
- GA stipends and associated tuition and fees
- Summer salary for you, the PI
- Post-doc salary, if appropriate to the project scope
- Moderate travel to conferences or for research
- Operating expenses (~$1K/mo normal & expected)

Don’t sweat any of the above – *cursory explanations are fine*

OSP can help with budget forms and numbers!
Budget & Budget Explanation (cont.)

- Items that require special justification
  - Salary for a senior person other than you, the PI
  - No GA included in proposal
  - More than moderate domestic travel
  - More than once-a-year foreign travel
  - High operating expenses

- Items that require special justification and specific mention in the Project Description
  - Expensive equipment purchases
  - Subcontracts to another institution
NSF Review Criteria

Intellectual Merit

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Broader Impacts

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_3.jsp#IIIA1
DOE Review Criteria

1. Scientific and/or technical merit or the educational benefits of the project;
2. Appropriateness of the proposed method or approach;
3. Competency of applicant's personnel and adequacy of proposed resources;
4. Reasonableness and appropriateness of the proposed budget; and
5. Other appropriate factors, established and set forth in a notice of availability or in a specific solicitation.

http://science.doe.gov/grants/process.asp
What if My Proposal Isn’t Funded?

• Don’t take it personally!
• Most-common result
  – Success rates (including renewals) at federal agencies vary from 5% to 25% depending on area
• Read reviews carefully for clues to improve
• Talk to your Program Officer
  – They are typically direct about your future chances
• Seek advice from senior members of your field
• Ask someone knowledgeable, but outside your field, to read your revised proposal
Grant Proposals for NIH

Martin R. Schiller, PhD
School of Life Sciences
University of Nevada Las Vegas
National Institutes of Health (NIH)

- Nation’s major medical research agency
- Funds science that leads to health advancement
- Located in Bethesda, MD
- Most funding distributed to academic researchers in the United States

http://opa.faseb.org/pages/Advocacy/advocacyresources.htm
NIH supports research to improve health…

- Current annual budget of over $28 billion
- More than 80% goes to extramural research
  - Over 50,000 competitive grants
  - 325,000 scientists
  - 3000 universities
How NIH Supports Research…

- Researchers write proposals for funding
  - What is the scientific question?
  - Why is this a good idea?
  - How will the experiments be done?
  - What will be the impact on science & medicine?

- Proposals are reviewed
  - Peer-reviewed by scientists to ensure high quality
  - Reviewed by NIH officials and public members for applicability to scientific or health priorities
Grant Mechanisms
Research Projects

R01  Research Project
R03  Small Research Grant
R21  Exploratory/Developmental Grant
R15  Academic Research Enhancement Award (AREA)
R43, R44  Small Business Innovation Research Grant (SBIR)
P01  Research Program Project
Grant Mechanisms
Fellowship & Research Career Programs

F31, F32: Postdoctoral Individual National Research Service Award (NRSA)

K22: Career Transition Award (NIAID)
K01: Career Transition Award (NCI)

K08: Clinical Investigator Award
K23: Mentored Patient-Oriented Research Career Development Award
Medical Breakthroughs...

- Often come from unrelated areas of basic and clinical science
- Are based on many years of generating fundamental knowledge
- Scientists solve different pieces of the puzzle over time
Scientific Method

- Observations
- Questions
- Hypotheses
- Experiments
- Data analysis
- Interpretations and conclusions
Research Plan of a Grant Application

A. Specific Aims
B. Significance and Innovation
C. Approach
Specific Aims Page – Content

1. Identify the gap in our knowledge
2. Identify why the gap is important (significance)
3. State the hypothesis to be tested
4. List the specific aims (objectives) to test the hypothesis
5. Briefly summarize the experimental approach for each aim
A. SPECIFIC AIMS
HIV-1 is a recently emerged human virus that over the past 30 years has ignited the worldwide AIDS pandemic[1]. Extensive characterization of HIV genome encoded proteins has led to a collection of ~24 antiretroviral (ARV) drugs that are routinely used to curtail the spread of infection[2]. Despite these advances, a significant number of patients undergoing antiretroviral therapy develop mutated viral strains with drug resistance[3-8]. Sexual and blood borne transmission of resistant HIV strains to new individuals leads to increased load of drug resistance in the population[9,10]. Many researchers have performed focused regional studies to determine how new resistant strains arise and are transmitted (e.g. [3,7,11,12]). However, in order to better understand the spread of resistance in the global human population, both a more broad-based and centralized approach is needed.

We propose to continue building upon the new alpha version of HIVAtlas, a database-driven, web-based tool that provides an efficient and sustainable approach useful for 1) helping researchers study the global spread of HIV resistance, immune epitopes, and other important HIV functions, and 2) guiding policy makers in managing the use of antiretrovirals. Since ~40 million people are HIV-positive and most infected individuals are treated without sequencing of the HIV genome, current ARV therapy does not take advantage of existing drug resistance data[13]. We have named it HIVAtlas to emphasize the key feature of the graphical user interface, namely a map-based depiction of the global distribution of drug resistance mutations.

An example of how HIVAtlas could help guide policy decision for antiretroviral treatment follows. Our preliminary analysis shows that the Darunavir/Ritonavir antiretroviral combo therapy should not be used in Ghana, Niger, Mali, and Nigeria. Nearly 100% of the HIV-1 sequences in these countries, have two mutations in the HIV protease, one known to give resistance to Darunavir and one that gives resistance to Ritonavir. Darunavir and Ritonavir are often used together to treat patients infected with HIV-1 and these drugs should not be used in these countries unless the infected patient’s HIV genome is sequenced and lacks these mutations. Use of HIVAtlas in antiretroviral management would likely reduce the mortality rate in infected patient populations, decrease the global HIV resistance load, help design new Highly Active AntiRetroviral Treatments (HAARTs), and have a huge economic impact. We propose the following aims.
5. List aim and summarize the approach for each aim

**Aim 1. To adapt the HIVToolbox database for country-specific drug resistance mutation scoring.** With funding from our R21 award, we have already built a centralized HIVToolbox database that has >200,000 HIV sequences, ~1700 drug resistance mutations, and various pre-calculated sequence alignments\(^{19}\). In this aim we propose to adapt this database for the HIVAtlas implementation of geographic presentation by calculating new sequence alignments grouped by both countries and clades. We will also model and import additional data such as HIV immunological epitopes from public sources.

**Aim 2. To build HIVAtlas, a HIV geographic atlas mutation tracking web application.** We propose to continue building a web application that allows users to examine HIV allele frequencies in different countries. Most of the data for the application will be from our integrated HIVToolbox database and some from completion of aim 1. The application will have several widgets/selection menus for choosing HIVAtlas display data for drug resistance mutations, protein-protein interactions, functional sites, immune epitopes, HIV groups and clades, and antiretroviral drug resistance mutations. Registered users will be able to enter new HIV-sequence data or datasets for analysis.

**Aim 3. To deploy and disseminate HIVAtlas.** Our anticipated user groups will include, HIV scientists and pharmaceutical companies, policy makers, and treatment programs. HIVAtlas will be deployed as an open-access web application. To promote use of the application we will present seminars and workshops, direct mailing to clinics, publish papers about the new tool, and request hyperlinks to this tool from websites related to HIV treatment and research.
Specific Aims Page – Tips

- One page
- Concise, clear and logical
- Not overly technical language
- Aims should be related but not interdependent
- A polished gem!
Specific Aims - Common Concerns

1. The hypothesis is not clear
2. The rationale is weak
3. The problem is not significant
4. The experimental design is weak
5. The proposal is driven by technology rather than a scientific question
6. The proposal is a “fishing expedition” – experiments without a clear scientific question
7. The proposal is sloppy (mistakes and typos)
Research Plan of a Grant Application

A. Specific Aims
B. Significance and Innovation
C. Approach

- Repeat aim title
- Rational
- Experimental design
- Conclusions, limitations, potential pitfalls, alternative approaches
- Methods
Review of your proposal

- ~120 study sections
- 60-100 grant / study section
- Study section rosters (about 20 people) can be found at:
  http://www.csr.nih.gov/Roster_proto/sectionI.asp
- Each grant has about 3 reviewers
- All study section members score the grant 1-9
- Choose a study section that has goals consistent with your proposal
  http://www.csr.nih.gov/Roster_proto/sectionI.asp
  http://grants1.nih.gov/grants/award/award.htm
What criteria do the reviewers use?

• Significance
• Approach
• Innovation
• Investigator
• Environment
• Impact
What if your first grant is not funded?

- Learn from it and succeed - a majority do
- Study criticism in pink sheet
- Decide if problems are reparable
- Attend diligently to each criticism
- Keep a positive tone and attitude in addressing criticism
Remember

There is no grantsmanship that will turn a bad idea into a good one, but……..

There are many ways to disguise a good one

William Raub, Past Deputy Director of NIH
References

- http://www.ninds.nih.gov/funding/write_grant_doc.htm
- http://sciencecareers.sciencemag.org/
Resources

- National Institutes of Health
  http://www.nih.gov

- National Science Foundation
  http://www.nsf.gov

- Library of Congress
  http://thomas.loc.gov

- NIAID Home Page
  http://web.fie.com.web/fed/nih
Resource

- Hints for Writing Successful NIH grants by Ellen Barrett. [http://chroma.med.miami.edu/Ellens.how.to.html](http://chroma.med.miami.edu/Ellens.how.to.html)
- How to Ask for a Research Grant by Janet S. Rasey. In Writing, Speaking, and Communication Skills for Health Professionals. Yale University Press. Pg 91-117