NSF Grant Application Mentor
An Educational How-to Manual
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Thank you for ordering the “NSF Grant Application Mentor: An Educational How-to Manual” from the Principal Investigators Association Library. This resource is designed to help you better understand — and make the most of — your NSF grant application to the National Science Foundation (NSF).

Dr. Stephen Matheson served as co-author for this report. Dr. Matheson has a master's degree in toxicology and a PhD in neuroscience. Currently working as a scientific writer and editor, Dr. Matheson taught at an undergraduate college for 10 years after a postdoctoral research fellowship at Massachusetts General Hospital. While in academia, Dr. Matheson was a PI or co-PI on several NSF grants, including three successful MRI proposals, and wrote a successful NIH R15 proposal. He has reviewed NSF grant proposals and scientific manuscripts for several journals.

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Best Regards,

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Color Key:
Throughout this report, we have used highlighted text to indicate the following:

☐ — original text by authors of this report
  (no color)
☐ — directly quoted NSF information
  (pink)
☐ — paraphrased NSF information
  (yellow)
☐ — directly quoted information from successful NSF grant applications
  (blue)
CHAPTER 1: STARTING THE GRANT APPLICATION PROCESS

A good grant proposal always begins with a good idea, and like any scientist, you are full of good ideas. But the process of obtaining funding from NSF requires more than a good (or great) idea, more than a great project or a great team. For one thing, the idea must be distilled and honed, built into something more like a thesis, then developed into a coherent and robust project.

Before tackling that important task, you must first determine whether your idea belongs at NSF and whether you qualify as an applicant. If so, then you can launch the application process, which includes these crucial steps.

• You will determine the appropriate NSF funding mechanism for you and your project. NSF supports research through various programs, which are constantly changing.

• You must select a research project that plays to your strengths — your knowledge, expertise, and passion — while aligning with NSF funding goals. And those goals are constantly changing.

• Importantly, you should assemble a team to help you craft the proposal. You need the technical expertise of your colleagues, but more importantly, you need the experience of those who have been through this process before. You need people who understand your goals and who are willing and able to give you critical feedback.

• You will develop your idea into a complete project, with clear objectives and well-defined activities designed to meet those objectives. Ideally, this process will involve cycles of development in consultation with your team.

And then it’s time to write. You should schedule this task in consultation with the submission guidelines pertinent to the NSF program to which you are applying. In addition, you should coordinate your calendar with your team, to ensure that the proposal gets the critical vetting it will likely need to be successful. In the rest of this chapter, we will add detail to the steps in this process.
QUALIFYING FOR AN NSF GRANT

No matter how good or important your project may seem to you and your colleagues, it won’t even be reviewed if it fails to meet NSF funding requirements.

First, every application topic must be consistent with NSF funding guidelines. Although NSF was founded “to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering,” it has established some specific limitations on the kinds of grants awarded. Here is how NSF puts it in the Proposal and Award Policies and Procedures Guide (PAPP):

NSF does not normally support technical assistance, pilot plant efforts, research requiring security classification, the development of products for commercial marketing, or market research for a particular project or invention. Research with disease-related goals, including work on the etiology, diagnosis or treatment of physical or mental disease, abnormality, or malfunction in human beings or animals, is normally not supported. Animal models of such conditions or the development or testing of drugs or other procedures for their treatment also are not eligible for support. However, research in bioengineering, with diagnosis- or treatment-related goals, that applies engineering principles to problems in biology and medicine while advancing engineering knowledge is eligible for support. Bioengineering research to aid persons with disabilities also is eligible.

What this means:

The NSF states that “it is responsible for the overall health of science and engineering across all disciplines.” Thus, to determine whether your proposal is a good fit for NSF, it is better to focus on what NSF does not do.
• NSF normally does not award grants supporting biomedical research. This is the most important criterion for most grant-seekers. Projects with disease-related goals, whether in humans or animal models, will not be considered by NSF. The notable exception is research in bioengineering.
  • NSF normally does not award grants supporting pilot studies.
  • NSF normally does not support projects aimed at commercial development of a product or invention.
  • NSF normally does not consider proposals pertaining to national security, by excluding research that requires security classification. In other words, if your results cannot be released publicly, unclassified, your project probably will not be supported by NSF.

If your proposed research does not align with these guidelines, you might consider seeking a grant award from another source, such as the National Institutes of Health (NIH) or Department of Defense. Or you might consider contacting a program director in your area of interest (described more below) to discuss ways in which your project can fit into NSF priorities and/or how it can be modified to increase its chance of success at NSF.

Directorates and Offices Also Weigh in

Next, you must consider that NSF programs are administered by an array of offices and directorates, each with a distinct set of goals. Directorates are responsible for large areas of research (for example, Engineering) and are subdivided into organizations that oversee subfields of those large areas (for example, Chemical, Bioengineering, Environmental, and Transport Systems is a Division within the Engineering Directorate). Offices have more focused areas of responsibility (for example, Cyberinfrastructure). These subdivisions of NSF accept proposals and make awards, and they also steer research funding through specific programs.
Directorate for Engineering (ENG)

ENG supports engineering research and education through five divisions.

The Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division supports research and education in bioengineering and environmental engineering and in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means.

The Civil, Mechanical and Manufacturing Innovation (CMMI) Division supports projects in civil, mechanical, industrial and manufacturing engineering, and materials design. In addition, the Division has a focus on the reduction of risks and damage resulting from earthquakes and other natural and technological hazards.

The Electrical, Communications and Cyber Systems (ECCS) Division supports research and education on device and component technologies, power, controls, computation, networking, communications and cyber technologies.

The Division of Engineering Education and Centers (EEC) encourages the integration of engineering research and education to accelerate technological and educational innovation and improve the quality and diversity of engineering graduates.

The Division of Industrial Innovation and Partnerships (IIP) fosters partnerships throughout NSF to advance technological innovation, and plays an important role in the public-private innovation partnership enterprise.
In addition, the **Office of Emerging Frontiers in Research and Innovation (EFRI)** is charged with helping ENG focus on important emerging areas in a timely manner.

**Directorate for Biological Sciences (BIO)**  

BIO supports biological research and education through five divisions.

The **Division of Biological Infrastructure (DBI)** supports activities that provide the infrastructure for contemporary biological research. These include instrumentation-related activities, research resources, and training opportunities.

The **Division of Environmental Biology (DEB)** supports research on the origins, functions, relationships, interactions, and evolutionary history of populations, species, communities, and ecosystems.

The **Division of Integrative Organismal Systems (IOS)** supports research aimed at an integrative understanding of organisms as units of biological organization, with particular emphasis on systems-level approaches to the study of their development, function, behavior, and evolution.

The **Division of Molecular and Cellular Biosciences (MCB)** supports research that contributes to a fundamental understanding of living systems at the molecular, subcellular, and cellular levels.

The **Emerging Frontiers (EF)** Division supports innovative interdisciplinary activities that expand the frontiers of biological research.
Directorate for Computer and Information Science and Engineering (CISE)

CISE supports research and education in all areas of computer and information science and engineering through three divisions.

The Division of Computing and Communication Foundations (CCF) supports research and education projects that explore the foundations of computing and communication devices and their usage.

The Division of Computer and Network Systems (CNS) supports research and education activities that invent new computing and networking technologies and that explore new ways to make use of existing technologies.

The Division of Information and Intelligent Systems (IIS) studies the interrelated roles of people, computers, and information.

Directorate for Geosciences (GEO)

GEO supports research and education in the atmospheric, earth, and ocean sciences through three divisions.

The Division of Atmospheric and Geospace Sciences (AGS) supports research on the behavior of the earth’s atmosphere and its interactions with the sun.

The Division of Earth Sciences (EAR) supports research into the structure, composition, and evolution of the Earth, the life it supports,
and the processes that govern the formation and behavior of the Earth’s materials.

The Division of Ocean Sciences (OCE) supports research, infrastructure, and education concerning all aspects of the global oceans and ocean basins, including their interactions with people and the integrated Earth system.

Directorate for Mathematical and Physical Sciences (MPS)

MPS supports research and education that seeks to understand the universe and the laws that govern it through five divisions.

The Division of Astronomical Sciences (AST) supports research in all areas of astronomy and astrophysics and related multidisciplinary studies.

The Division of Chemistry (CHE) supports research in all traditional areas of chemistry and in multidisciplinary fields that draw upon the chemical sciences.

The Division of Materials Research (DMR) supports projects aimed at understanding the behavior of matter and materials and at creating new materials and new knowledge about materials phenomena.

The Division of Mathematical Sciences (DMS) supports a wide range of projects aimed at developing and exploring the properties and applications of mathematical structures.

The Division of Physics (PHY) supports fundamental research across the intellectual frontiers of physics.
In addition, the **Office of Multidisciplinary Activities (OMA)** aims to support initiatives that cross traditional disciplinary boundaries within MPS.

**Directorate for Social, Behavioral and Economic Sciences (SBE)**

SBE supports into human behavior, interaction, and social and economic systems, organizations and institutions through two divisions.

The **Division of Behavioral and Cognitive Sciences (BCS)** supports research on human cognition, language, social behavior and culture, as well as research on the interactions between human societies and the physical environment.

The **Division of Social and Economic Sciences (SES)** supports projects examining human, social and organizational behavior.

In addition, the **SBE Office of Multidisciplinary Activities (SMA)** supports programmatic activities that cut across NSF and SBE boundaries.

**The Directorate for Education and Human Resources (EHR)**

EHR aims to achieve excellence in U.S. science, technology, engineering and mathematics (STEM) education at all levels and in all settings through four divisions.

The **Division of Graduate Education (DGE)** manages programs that support STEM graduate education, while the **Division of Undergraduate Education (DUE)** supports programs advancing STEM undergraduate education.
The Division of Human Resource Development (HRD) oversees efforts to enhance the quality of STEM education and research through broadening participation by historically underrepresented groups.

The Division of Research on Learning in Formal and Informal Settings (DRL) supports projects to improve the effectiveness of STEM learning for people of all ages in both formal and informal settings.

Office of Cyberinfrastructure (OCI)

OCI supports cyberinfrastructure resources, tools and related services such as supercomputers, high-capacity mass-storage systems, and an array of software tools and services that hide the complexities and heterogeneity of contemporary cyberinfrastructure while seeking to provide ubiquitous access and enhanced usability.

Office of Polar Programs (OPP)

OPP funds basic research and its operational support in the Arctic and the Antarctic through three divisions: Arctic Sciences (ARC), Antarctic Sciences (ANT), and Antarctic Infrastructure and Logistics (AIL).

Office of International Science and Engineering (OISE)

OISE supports programs to expand and enhance leading-edge international research and education opportunities for U.S. scientists and engineers.
Office of Integrative Activities (OIA)

OIA develops, oversees and leads cross-cutting activities at NSF and administers major NSF-wide programs including the Science and Technology Centers, Major Research Instrumentation, and Experimental Program to Stimulate Competitive Research (EPSCoR).

Now, it may not be obvious where to begin looking for support for your work, especially if your ideas straddle traditional disciplinary boundaries. One excellent tactic for selecting which NSF organization best suits your needs is to contact specific program directors – frequently called PDs, but also referred to as program officers (POs). PDs are experts in particular subfields, who oversee grants and proposals in those fields. Many serve on a short-term basis as a service to that field.

How do you find a relevant PD for your proposal? First, pick an office or directorate and go to that organization’s website, where you can review the staff directory in relevant subdivisions to identify good contacts. For example, suppose that your proposal concerns evolution and function of transcription factors. Clearly you would begin in the Directorate for Biological Sciences, but which division would be best? The IOS Division includes the Developmental Systems Cluster, which supports evolutionary developmental research related to yours; the MCB Division includes the Genetic Mechanisms Cluster, which supports evolutionary genetics research related to yours. The website for each cluster includes the names, specializations, and contact information for the PDs, some of whom will oversee projects like yours. You may choose to contact two or more PDs, depending on how your research fits into subdisciplinary categories.

When you speak with the PDs you have identified, you can discuss possible topics for investigator-initiated research, such as new scientific directions and opportunities and unpublished high-priority topics. NSF divisions routinely
update their priorities through various mechanisms described in the next section, but a person-to-person conversation with a PD can be a very efficient means of identifying the specific funding possibilities for your project.

A PD is a busy professional like you, and you want this person to be your friend. So think about how to make the conversation fruitful. One idea is to schedule the discussion in advance and to write a brief (one page or less) lay outline of your project for the PD to look over. This can enable both of you to focus on funding ideas without spending too much time on finer technical points. No matter what, be sure that you have done some homework before contacting a busy PD. “I’m always surprised at how many times somebody will call up and they don’t know what any of the programs are,” says Bruce M. Kramer, PhD, senior advisor in the Division of Civil, Mechanical and Manufacturing Innovation (CMMI).

How to Identify Current Funding Priorities at NSF

We have mentioned that NSF funding goals are constantly changing. This enables NSF to track changes in science and to remain at least somewhat nimble as new knowledge and technologies emerge and as new subfields are created. But it also means that grant opportunities change regularly, making the process of seeking funding that much more complicated. You should view this is a good thing: while NSF is always accepting proposals to fund good science within its areas of responsibility, it also solicits proposals in specific areas of inquiry. If one of those areas overlaps with your interests, then you may have a new funding opportunity.

The best way to identify funding opportunities is to regularly visit the websites of the NSF divisions and/or offices most closely related to your work. Each site has a section called “Funding Opportunities” that provides a list of currently active programs; the list can be sorted by due date or by title, and provides links to the specific guidelines for each program. Such lists can be found at the level of a directorate or of a division.
When perusing the current funding opportunities at a particular NSF division, you will see two basic types of announcement (regarding full proposals): program announcements and program solicitations. NSF describes these distinct mechanisms in the **Grant Proposal Guide (GPG)**:

**Program Announcement**

The term “program announcement” refers to formal NSF publications that announce NSF programs. Program announcements and program descriptions are the primary mechanisms used by NSF to communicate opportunities for research and education support, as well as to generate proposals. Program announcements utilize the generic eligibility and proposal preparation guidelines specified in the GPG and incorporate the NSB approved merit review criteria.

**Program Solicitation**

The term “program solicitation” refers to formal NSF publications that encourage the submission of proposals in specific program areas of interest to NSF. They generally are more focused than program announcements, and normally apply for a limited period of time. Competition among proposals is more precisely defined than with program announcements, and proposals received compete directly with each other for NSF funding. Program solicitations are issued when the funding opportunity has one or more of the following features:

- Provides supplemental proposal preparation guidance or deviates from the guidelines established in the Grant Proposal Guide;
- Contains additional specially crafted review criteria relevant to the program;
- Requires submission of a letter of intent or preliminary proposal;
- Deviates from (or restricts) the standard categories of proposers specified in Section E. below;
- Limits the number of proposals that may be submitted by any organization and/or researcher/educator;
- Specifies additional award conditions or reporting requirements;
- Anticipates use of a cooperative agreement; or
- Permits inclusion of the payment of fees to awardees, when appropriate.
What this means:

A program announcement is a standard — often long-standing — description of a funding program. Such programs employ standard NSF criteria for eligibility, preparation, and review, and have regular deadlines. For example, the MCB division in the BIO directorate has a standing program announcement for investigator-initiated research projects, with two deadlines per year. By contrast, a program solicitation is often an invitation to researchers to submit proposals on a specific topic or for a specific purpose. Such solicitations may add review requirements (often topical) or adjust eligibility criteria, so as to elicit proposals that aim to accomplish the specific goals of the program.

The distinction between an announcement and a solicitation can be a bit unclear. For example, the MCB program announcement is described as a solicitation, probably because it has narrower eligibility requirements than the standard NSF requirements. It is, nevertheless, a standing program announcement, meaning that it does not change or expire over the short term.

The important point is that NSF solicits proposals through specific and formal publications that are provided on the NSF website. These publications can and do change, so it is imperative that you remain abreast of the current programs in the NSF divisions that most interest you.

You and Your Institution Must Qualify for NSF Support as Well

In addition to your research qualifying for NSF support, you and your host institution must also qualify. NSF has few specific requirements for researchers who submit proposals; although graduate students are discouraged from submitting, there is no overall requirement of a doctoral degree or specific position. Your institution, however, must be located in the United States.

However, many NSF programs have more specific requirements, so be sure to
verify that you and your institution are eligible for consideration for the grant you seek. Note that unless otherwise specified, unaffiliated individuals can apply for support, if they can demonstrate access to the necessary resources.
MAKING A PLAN

It should go without saying that preparing a grant application is a time-consuming process. Depending on whether your proposal is complicated by the use of animal or human subjects or other special circumstances (such as work outside the U.S.), you can expect to spend two to six months preparing your proposal. And even if your proposal is funded on the first try, without resubmission or revision, it will be at least six months before you get any money. Of course, reviewers may not approve your proposal, requiring revision and resubmission. And not all superior proposals get funded, given budgetary limits and intense competition.

In fact, given the mean success rate of 22% (in 2011) across NSF directorates, most proposals face initial rejection followed by revision and resubmission. This means that the typical time course of obtaining NSF funding extends to more than a year. While the wheels are slowly turning, you must continue to run a research program, perhaps while teaching and supervising trainees and managing other efforts. Clearly, you need a game plan.

Thinking About Long-term Strategy

As you consider your research career, keep the NSF funding mechanism in perspective. The average NSF grant (in 2011) lasts a little less than three years and provides a little more than $100,000 in annual support. Of course, some grants may last more than three years, and many awards exceed $100,000 per year. Nevertheless, while standard NSF grants can support lots of good research, they are clearly not intended to support large-scale research efforts that require numerous personnel or significant budgets for technology or consumables.

Thus, as you prepare to create your proposal, spend some time thinking about how the project and the funds fit into a longer-term plan for your research and your career. Such reflection can help keep research projects efficient and appropriately sized, and can keep you focused on your main ideas. After all, as soon as this project gets funded, you should begin thinking about if/how it will get renewed.
Choosing the Right NSF Program For Your Project

One of the most important aspects of your grant application strategy is to identify one or more NSF funding programs appropriate for your research. We have already discussed ways to discover current NSF programs, emphasizing the NSF website and contact with program directors. Once you have identified the best divisions and clusters for your project, you will want to pay attention to the kinds of programs that can best help your effort. Here are some of the different options:

Major research instrumentation (MRI) grants

This program aims to increase access to shared scientific and engineering instruments for research and research training in institutions of higher education, museums, science centers, and not-for-profit organizations. Development and acquisition of research instrumentation for shared inter- and/or intra-organizational use are encouraged, as are development efforts that leverage the strengths of private sector partners to build instrument development capacity at academic institutions. If your research would profit from access to new instrumentation, or if your main goal in pursuing research funding is to acquire or access an instrument, this may be a good option.

Research at Undergraduate Institutions (RUI)

RUI activity supports research by faculty members of predominantly undergraduate institutions through the funding of (1) individual and collaborative research projects, (2) the purchase of shared-use research instrumentation, and (3) Research Opportunity Awards for work with NSF-supported investigators at other institutions. This may be a good choice if you work at a college or other undergraduate-oriented institution.
**EARly-concept Grants for Exploratory Research (EAGER)**

The EAGER funding mechanism may be used to support exploratory work in its early stages on untested, but potentially transformative, research ideas or approaches. This work may be considered especially “high risk-high payoff” in the sense that it, for example, involves radically different approaches, applies new expertise, or engages novel disciplinary or interdisciplinary perspectives. These exploratory proposals may also be submitted directly to an NSF program, but the EAGER mechanism should not be used for projects that are appropriate for submission as “regular” (i.e., non-EAGER) NSF proposals.

**Grants for Rapid Response Research (RAPID)**

The RAPID funding mechanism is used for proposals having a severe urgency with regard to availability of, or access to data, facilities or specialized equipment, including quick-response research on natural or anthropogenic disasters and similar unanticipated events.

If you think your project could be funded through one or more of these mechanisms, talk to a PD with expertise in your field.
CHOOSING AND DEFINING THE PROJECT

Here are some tips on how to craft a project topic, with NSF-specific requirements in mind.

1. **Most importantly, rely on your colleagues and your team.** Find trusted advisors and/or mentors who can provide critical analysis of your ideas and plans. As you consider the suggestions to follow, make it a priority to tackle the project with a team, and make a commitment to discussing these issues with peers and mentors.

2. **Aim to make a large impact on a focused area.** The issue of impact will be discussed in much more detail in later chapters of this manual; for now, it is enough to note that NSF has established “broader impacts” as key criteria by which proposals are judged. Your work must exert broad impact, but it also must remain focused. A focused effort is more likely to be judged feasible — young investigators, in particular, are prone to proposing far more work than can be reasonably accomplished in the study period. Moreover, a focused endeavor is less likely to overlap with competing proposals. So, spend time thinking about how to make a broad impact in the areas in which you are most competent.

3. **Identify the knowledge gaps and opportunities in your field, so you can identify and occupy a niche for your group.** While focusing on questions and areas that excite you, look for areas that are already crowded or overly competitive. Make it a priority to know your field and your colleagues, and brainstorm with them about questions that need to be answered. Ensure that you are an expert.

4. **Thoroughly research the current funding opportunities in the divisions of NSF that overlap with your interests and expertise.** Be willing to consider altering your ideas and projects to better match priorities at NSF.
5. Examine your proposed topic as a reviewer would, and urge your team and your advisors to do the same. Make a list of potential or likely reviewers, and make it a point to know their work and their characteristics. Consider how they might view your ideas, and anticipate their criticism (or enthusiasm). Even better, run it by a PD at NSF, who can also help you think about specific reviewers. This is what Thomas Statler, PhD, Program Director in Astronomy, suggests:

After you know what you are going to propose, but before you start writing, call your program director. Briefly explain what it is you want to do, and ask about the likely composition of the panel that will be reviewing your proposal. Wide focus or narrow? Experts in your specialty or not?

6. It’s worth repeating: find colleagues who will help you, who are willing to take the time to give you feedback, and who are willing to tell you if/when that first idea is a dud. And if you can forge a working relationship with a PD, that’s even better.

Once you have a suitable topic, it’s time to define the project. More specifically, you must define the objectives of the work, by generating a clear and testable hypothesis. These objectives should be used to generate an outline of the proposal, with a provisional title. And, if you haven’t already done so, you must choose a program to which you will apply and a target date for submission.

**Identifying Your Objectives**

Most successful grant proposals, like most successful research groups, are hypothesis-driven. The hypotheses are the driving force, and the research has the singular purpose of testing those hypotheses. Your grant proposal should make it clear that your aim is to ask and answer questions, not to collect information or find new ways of doing things.

Your hypotheses should be specific and testable, and they should be stated
outright. Whether you have a single unifying hypothesis for the entire project or discrete ones for each objective, it should be completely clear that your work is hypothesis-driven.

Watch for what we might call pseudo-hypotheses. For example, your aim may be to understand the roles of a family of proteins in flower development. That’s a good aim, but it’s not a hypothesis. It won’t do to restate the aim by claiming that “we hypothesize that this family of proteins will be involved in flower development.” Be specific and direct: “We hypothesize that members of the X family control flower development in Y by directing the synthesis of Z during P.” Don’t feel the need to advance multiple hypotheses; in fact, some experts suggest that a proposal that is tightly focused on a single hypothesis can be stronger than one that addresses multiple hypotheses.

Note that even if your proposal seeks to acquire an instrument, or is otherwise different from a classic hypothesis-driven research study, the presence of well-conceived, hypothesis-driven science is important in establishing the intellectual merit of your proposal. As we will discuss in later chapters, intellectual merit is the second pillar (along with broader impacts) of merit review of all NSF proposals.

**Outlining the Proposal**

The next step in preparing your application is to create a very basic outline of your proposal, and to come up with a provisional title. This exercise will be straightforward if you have been perusing NSF announcements, reading the literature, and brainstorming with colleagues about ideas and hypotheses. The purpose is to create the framework for your writing plan, and to finalize the division and program of NSF to which you will submit your proposal.

At a minimum, the outline should state your objectives (ideally as hypotheses) and your basic strategy for achieving these objectives. One way to proceed is to look ahead to the Project Summary that you will write as you complete the
Each proposal must contain a summary of the proposed project not more than one page in length. The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity.

The overview includes a description of the activity that would result if the proposal were funded and a statement of objectives and methods to be employed. The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge. The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes. The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically or technically literate lay reader. It should not be an abstract of the proposal.

Using those requirements as simple guidelines at this point, you should be able to jot down objectives, basic methods, and some notes on intellectual merit and broader impacts. You may wish to refer to what NSF means by “intellectual merit” and “broader impacts,” but that’s probably not necessary, since the goal is to create a map that will become more detailed later.

This outline should be the subject of at least one meeting of your team, and should be honed with attention to focus, clarity, feasibility, and impact. It should be a page long at the most, and may work as a bulleted list.

**Choosing a Title**

NSF makes little mention of the title and has vague requirements: “The title of the project must be brief, scientifically or technically valid, intelligible to a scientifically or technically literate reader, and suitable for use in the public press.”
And NSF reserves the right to change it. You might think this means that the title is relatively unimportant, but that’s probably a mistake.

Consider these thoughts and pointers on your project title.

1. You are competing with smart and capable scientists in an environment where as few as 15% of applications are successful. So it is important to convey freshness, innovation, creativity, originality. Table 1 below contains titles of successful proposals from various disciplines. Excerpts from some of these proposals are used elsewhere in this manual.

### Table 1. Titles of Successful Proposals

<table>
<thead>
<tr>
<th>Directorate/Division</th>
<th>Title</th>
<th>Type of program</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO/IOS</td>
<td>The molecular basis of ethylene regulation of photoperiodic floral induction in plants</td>
<td>RUI</td>
</tr>
<tr>
<td>BIO/IOS</td>
<td>Parasites and the evolution of mating systems: Do parasites drive complex behavior in animals?</td>
<td>CAREER</td>
</tr>
<tr>
<td>BIO/MCB</td>
<td>Estradiol’s modulation of central auditory processing</td>
<td></td>
</tr>
<tr>
<td>GEO/AGS</td>
<td>ROS as mediators of rapid long-distance self-propagating signals</td>
<td></td>
</tr>
<tr>
<td>GEO/AGS</td>
<td>Impact of assimilating satellite microwave radiance on tropical cyclone rapid intensification forecasting</td>
<td></td>
</tr>
<tr>
<td>GEO/EAR</td>
<td>Microbial successions in the aftermath of a Snowball Earth event</td>
<td>EAGER</td>
</tr>
<tr>
<td>GEO/EAR</td>
<td>Application of cluster expansion method to first-principles mineralogy</td>
<td>EAGER</td>
</tr>
<tr>
<td>MPS/DMS</td>
<td>Flat forms, bi-Lipschitz parametrizations, and calculus on singular spaces</td>
<td></td>
</tr>
<tr>
<td>MPS/DMS</td>
<td>Cluster algebras, critical groups, and tropical curves</td>
<td></td>
</tr>
<tr>
<td>MPS/DMS</td>
<td>Game theory and the geometry of Banach spaces</td>
<td></td>
</tr>
<tr>
<td>ENG/CBET</td>
<td>Infrared excitable nanoparticle-based photosensitizers for targeted photodynamic therapy</td>
<td></td>
</tr>
<tr>
<td>ENG/ECCS</td>
<td>Wideband cognitive sensing from a few bits</td>
<td></td>
</tr>
<tr>
<td>CISE/IIS</td>
<td>Control of a robotic manipulator via a brain-computer interface</td>
<td>RUI</td>
</tr>
<tr>
<td>CISE/CNS</td>
<td>Enabling privacy-utility trade-offs in pervasive computing systems</td>
<td>Large Collaborative</td>
</tr>
<tr>
<td>SBE/SES</td>
<td>Sovereign default in emerging economies</td>
<td></td>
</tr>
<tr>
<td>SBE/BCS</td>
<td>Post-collapse community and social hierarchy in the Titicaca Basin, Peru: Survey and excavation at Machu Llacta</td>
<td></td>
</tr>
</tbody>
</table>
Browse the titles of recent awards in your area to get ideas of good titles (because they are interesting) and titles to avoid (because their similarity to yours can make your work seem unoriginal or redundant). To do this, go to the website for the division of interest, and click on “Awards” on the menu on the left. You will come to a page that allows you to view awards in various ways; one choice is “view lists of awards made by ________”. Clicking on that link enables you to browse current grants in all of the programs of that division. At the directorate level, you will find a link called “________ AWARDS” in the menu near the top of the page.

2. Strive for clarity, brevity, and accuracy, and include words that emphasize the suitability of your project for the division or office to which you are submitting the application. It should be clear at a glance why your proposal was sent to the program you chose.

3. Choose words that bespeak results (“...identifying direct effects...”) rather than words that refer to experimental approaches (“...genetic analysis of...”). Refer to “the basis” or “the impact” or “the development” rather than “a study” or “efforts.” Choose words that make it clear that you are an authoritative expert. Assume that you will be successful.

On the other hand, choose words that are plain, clear, and straightforward. Examine each word to see if it really belongs. Here are two examples of titles with these attributes.

- One recent successful application (mentioned in the table above) proposed “research based on the analysis of molecular fossils in bitumens that are tightly bound in original minerals” that was “specifically targeting the sediments of the Marinoan cap carbonate” to look for “evidence of methane venting.” The PI explains in the Project Summary that these analyses “may yield insights into the microbial communities that populated the paleo-water column and sediments and processes that resulted in chert formation and attendant fossil preservation.” The
• Another recent successful application proposed three related projects, described in the Project Summary as follows: “The first project involves a study of cluster algebras...with an eye towards proving the positivity conjecture... The second project is an exploration of critical groups of graphs, also known as sandpile groups... The third project involves the study of various objects from algebraic geometry, including linear systems and Jacobians..., also known in the literature as quantum graphs or abstract tropical curves.” The title is short and sweet: “Cluster algebras, critical groups, and tropical curves.”

A good title does not have to be as brief as those are, nor must a good title avoid action verbs. But take note of how the investigators used clear terms, technically accurate but without significant jargon.

4. As always, show your title to your team. Show it to your colleagues and peers. Show it to your mentor. Run it past your PD. Let it be a work in progress as well as a guiding light.

**Choosing a Target Date**

Many NSF programs have standard application deadlines, such that batches of proposals compete simultaneously for a fixed allotment of money. Applications for these programs are typically accepted during a window of a month or two. However, many other NSF programs accept proposals continuously, and so have no specific deadlines at all. Others provide target dates that indicate time frames for meetings of panels or committees, but applications are still accepted after that date. Thus, depending on the program, you may have a specific deadline, or none at all.
Table 2 below provides a sample of application windows from the two largest NSF directorates (in terms of numbers of grants awarded), Engineering (ENG) and Mathematical and Physical Sciences (MPS).

**Table 2. Examples of application windows**

<table>
<thead>
<tr>
<th>Directorate/Division</th>
<th>Program</th>
<th>Window or target date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering/CBET</td>
<td>All programs</td>
<td>8/15 to 9/18 or 1/15 to 2/19</td>
</tr>
<tr>
<td>Engineering/CMMI</td>
<td>Most or all full proposals</td>
<td>9/1 to 10/1 and 1/15 to 2/15</td>
</tr>
<tr>
<td>Engineering/ECCS</td>
<td>Most or all full proposals</td>
<td>10/1 to 11/1</td>
</tr>
<tr>
<td>MPS/AST</td>
<td>Astronomy and Astrophysics Research Grants (AAG)</td>
<td>9/15 to 11/15</td>
</tr>
<tr>
<td>MPS/Chemistry</td>
<td>All unsolicited proposals</td>
<td>9/1 to 9/30 or 10/1 to 10/31</td>
</tr>
<tr>
<td>MPS/Physics</td>
<td>Most programs</td>
<td>Last Wednesday in October</td>
</tr>
<tr>
<td>MPS/Materials Research</td>
<td>All unsolicited proposals</td>
<td>9/1 to 10/31</td>
</tr>
</tbody>
</table>

Some divisions, such as Engineering/CBET, MPS/Chemistry, and MPS/Materials research, have announced very recently (in 2012) that they are standardizing submission windows across their programs. By contrast, in some divisions, such as Mathematical Sciences in MPS (MPS/DMS), submission windows vary significantly. The important point, then, is **that submission deadlines are not standard at NSF (in contrast to NIH), so you will not know your target date until you know the program to which you will apply.**

Some people thrive under pressure and actually find deadlines useful. But whether or not you are that kind of person, a deadline imposes a schedule on the grant-writing process. Establishing such a schedule, with or without a do-or-die deadline, will help you plan and write effectively. So, if you are not facing a deadline imposed by NSF, it is smart to impose one yourself. Call it a “target date” to reduce stress, but make it serious, and use it to schedule the work that needs to be done and, importantly, the meetings with your team and your advisors that are so important to your success. Write the date down, make it official, plan a celebration for the day after.
If you really, *really* don’t like the pressure of a deadline, consider establishing your own target date that is well before the actual deadline. (Some successful grant writers have been known to plan their writing *for between* deadlines, specifically to avoid facing down a deadline.)
ESTABLISH A WRITING SCHEDULE

Once you have outlined your proposal and selected a target date, you can easily sketch a schedule for the tasks ahead of you. You should create a schedule that helps you get the feedback you need and, especially, that helps you avoid a last-minute rush that results in a flawed proposal. Reviewers need reasons to reject proposals, and careless errors fit the bill. A reasonable schedule will help you avoid that outcome, and help you reduce your stress to merely insane levels.

Start with the assumption that preparing a good proposal will take at least two months. (Based on the complexity of the proposal and on your own schedule and abilities, it might take months longer.) Then, set up a task list with due dates, based on the major components of the application (many of which are discussed in later sections). Such a schedule might look something like Table 3 below.

Table 3. A Sample Writing Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow potential research topics</td>
<td></td>
</tr>
<tr>
<td>Research NSF funding opportunities, talk to PD</td>
<td></td>
</tr>
<tr>
<td>Identify hypotheses, outline proposal with title</td>
<td></td>
</tr>
<tr>
<td>Submit outline to colleagues and advisors</td>
<td></td>
</tr>
<tr>
<td>Draft Project Description</td>
<td></td>
</tr>
<tr>
<td>Draft intellectual merit and broader impacts statements</td>
<td></td>
</tr>
<tr>
<td>Submit Project Description and statements to colleagues and advisors</td>
<td></td>
</tr>
<tr>
<td>...and so on</td>
<td></td>
</tr>
</tbody>
</table>

The schedule can keep you from drifting and wasting time, and it can keep the big picture view in front of you and your team as the process unfolds. As each section is drafted, the whole application begins to take shape, and this makes modifications and clarifications much easier. (For this reason, be willing to produce rough drafts, especially of the Project Description, to keep the process moving.)
CONCLUSION

When you have clearly defined your research project, chosen a team of advisors, identified a division and program, wrestled with hypotheses and objectives, and agreed on a writing schedule, you will have laid solid groundwork for writing a successful NSF grant proposal. It seems like a lot of work up front, and it is a significant undertaking. But these are things that good scientists love to do anyway, and the benefits of some careful thought and hard-headed planning are hard to exaggerate. Your schedule will keep you focused on your goals, and ensure that your excellent ideas are honed and tested before facing the harsh light of NSF merit review.
CHAPTER 2: KNOWING YOUR AUDIENCE: NSF REVIEW CRITERIA AND REVIEWERS

Consider this blunt advice from Thomas Statler, PhD, current program director at NSF:

Know your audience and communicate with them effectively. Write your proposal so that it gives the reviewers what they need to understand, not what you want to say.

“Know your audience.” That is important advice for anyone writing anything, but it is especially critical when writing a grant proposal. Your proposal is not being written for your friends or colleagues, for your department chair or tenure committee, or for the government or taxpayers. It is being written for a program director and some reviewers. That is your audience. That is your only audience.

In this chapter, we will explore the criteria by which this audience will judge your proposal. These criteria are unique to NSF, and they amount to far more than just “write clearly and have a hypothesis.” The NSF merit criteria are tied to the Foundation’s Core Values statement, and NSF signals their importance by returning without review those proposals that fail to address the criteria — explicitly — in the one-page Project Summary that leads off every application.

In other words, you cannot write an effective NSF proposal without knowing your audience, and you cannot know your audience without a solid understanding of the NSF merit review criteria. Therefore, we will first discuss the criteria in depth, and then turn to some specific strategies for identifying and communicating with your target audience as you write.
UNDERSTANDING THE NSF MERIT REVIEW CRITERIA

We have repeatedly mentioned the two NSF merit criteria, intellectual merit and broader impacts, by which your application will be judged. The criteria will be a constant focus of your grantwriting, and of later sections of this manual, so you might consider marking these pages.

In late 2012, NSF announced a revision of these all-important criteria. The revision does not change the criteria in any fundamental way, but provides two new clarifying components: a new set of merit review principles that undergird the criteria, and a clearer articulation of the considerations used to assess merit. In addition, NSF has new expectations for how the criteria are discussed in your proposal.

Merit Review: The Merit Review Principles

First, here are the new Merit Review Principles, as articulated in the GPG:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.

- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These broader impacts may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.

- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between
the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

**What this means:**

The main purposes of these new principles seem to be:

- to emphasize the importance of broader impacts;

- and to provide guidance to NSF personnel on how to assess broader impacts across groups of proposals.

That second guideline encourages PDs and others to consider aggregate effects of broader impacts across proposals. For example, a program or PD may consider the combined benefit of a shared programmatic emphasis on recruitment of a certain population among different proposals within the program. Those proposals may enjoy a competitive advantage due to that shared emphasis. PDs are directed to think about such things, but also to expect PIs to deliver.
Merit Review: The Merit Review Criteria

The two merit review criteria have not changed, but NSF is now framing them somewhat differently. Here is how the criteria are presented in the GPG:

Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

NSF goes on to describe the considerations used to assess the two criteria:

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to:

   a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
b. Benefit society or advance desired societal outcomes (Broader Impacts)?

2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?

3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?

4. How well qualified is the individual, team, or organization to conduct the proposed activities?

5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

First, we will examine the meaning of the criteria and considerations, then briefly look at the ways in which the new articulation of merit review differs from that used through 2012.

**What the criteria mean:**

Basically, the intellectual merit criterion concerns the quality of the science and of the scientist(s). The broader impacts criterion concerns the influence of the science outside of the field of endeavor. Stated in this way, the criteria may seem straightforward, as though one may simply write a great proposal and let the reviewers make their judgments. But this is not the case.
Defining Intellectual Merit

The merit considerations include all the kinds of factors that you would expect to be examined when assessing a research proposal. The five considerations are as follows:

- **Significance** of the research question
- Conceptual **innovation** and **creativity** of the proposal
- **Soundness** of the research design
- **Qualifications** of the PI and the team
- Sufficient access to **resources**

That last consideration — access to resources — might seem an odd inclusion in a list of factors determining intellectual merit. But it is a factor when considering feasibility of the proposed work, and in any case it is a specific criterion by which your application will be judged.

It may seem to you that NSF is somewhat vague in defining the intellectual merit criterion. This probably reflects the fact that the intellectual merit considerations are straightforward — to whatever extent such subjective judgments can be straightforward — and that there is little more to say. It is true that standards and specifics will vary among subdisciplines and among reviewers and program officers, but you should expect that the assessment of the scholarly merit of your proposal will proceed according to the norms of your field, which you surely know well. Nevertheless, it is a very good idea to query your PD regarding specific considerations that your reviewers are likely to be looking for.

We will repeatedly revisit intellectual merit in later chapters. For now, it is enough to be familiar with the criterion and the considerations it entails.
Defining Broader Impacts

To better understand the broader impacts criterion, consider NSF’s Core Values as discussed in its most recent Strategic Plan document.

NSF is:

**Visionary**—imagining the future, working at the frontier, realizing the full potential of the research and education community, embracing risk, advancing promising ideas wherever and whenever they arise, and encouraging creativity and initiative;

**Dedicated to Excellence**—investing optimally the resources entrusted to us, realizing the full potential of our people and managing a capable and motivated organization that provides an inclusive and positive work environment, and rewarding accomplishment;

**Learning and Growing**—continually improving our ability to identify opportunities, promoting learning and growth for the science and engineering community and the agency, and sharing our best insights with others;

**Broadly Inclusive**—seeking and including contributions from all sources while reaching out, especially to groups that are underrepresented, serving scientists, engineers, educators, students, and the public across the nation, and exploring opportunities for partnerships, both nationally and internationally; and

**Accountable**—operating with integrity and transparency, and maintaining quality in administration, management, and oversight.

It’s worth taking a few minutes to compare the Core Values statement with the broader impacts considerations, to get a sense of NSF’s priorities when it comes to broader impacts. Notice two key themes of those core values: education and inclusiveness. We will come back to them momentarily.
Before 2013, NSF indicated five considerations that make up the broader impacts criterion, and these remain useful categories of broader impacts:

- **Advancement of teaching and learning** in concert with discovery and understanding
- **Broadening** participation of underrepresented groups
- **Enhancement of infrastructure** for research and education
- **Dissemination** of results
- **Creation of societal benefits**

You can see that education and inclusiveness constitute the first two considerations mentioned. Clearly, education and inclusiveness are big priorities at NSF, and are major components of the broader impacts merit criterion. It is possible to get NSF funding without emphasizing these considerations. But if you can craft your project and your proposal with either or both as a central aspect of your activities, you can increase the effectiveness of your pitch by making your broader impacts a significant asset.

However, the 2013 changes acknowledge a serious problem with the broader impacts criterion — despite efforts to define broader impacts and to educate proposers and reviewers about how to document and assess them, confusion was rampant. According to Joanne Tornow, Deputy Assistant Director of the SBE Directorate, there were “persistent anecdotal reports about confusion related to the Broader Impacts criterion, and inconsistency in how the criterion was being applied.” Proposers seemed to be saying, “What do you mean? What do you want?”

Interestingly, NSF now provides far less information about broader impacts than it used to — the categories on the previous page have been removed, as has a document describing examples of broader impacts (discussed below). As Dr. Tornow puts it, “We’re not listing anything, because this is for you to tell us what your interest is, where you think your project fits.” According to another NSF
official, the document containing examples was deleted because “when people see examples, they feel like it’s a list.” What, then, are broader impacts?

This is how NSF amplifies the meaning of broader impacts in the GPG:

NSF values the advancement of scientific knowledge and activities that contribute to the achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

That list does resemble the five categories listed above, and it should give you a basic idea of what NSF is looking for in broader impacts.

**Examples of Broader Impacts**

The broader impacts criterion is unique to NSF, and as we just mentioned, it has generated some confusion among investigators. Here is how NSF described this problem a few years ago.

Experience shows that while most proposers have little difficulty responding to the criterion relating to intellectual merit, many proposers have difficulty understanding how to frame the broader impacts of the activities they propose to undertake.

NSF responded by preparing a document called “Merit Review Broader
Impacts Criterion: Representative Activities” that includes many specific examples of activities that demonstrate broader impacts. You may find the examples helpful, as long as you avoid the mistake of seeing them as expectations. Here are some selected examples in each category of broader impact.

**Advance Discovery and Understanding While Promoting Teaching, Training and Learning**

- Integrate research activities into the teaching of science, math and engineering at all educational levels (e.g., K-12, undergraduate science majors, non-science majors, and graduate students).
- Include students (e.g., K-12, undergraduate science majors, non-science majors, and/or graduate students) as participants in the proposed activities as appropriate.
- Develop research-based educational materials or contribute to databases useful in teaching (e.g., K-16 digital library).
- Encourage student participation at meetings and activities of professional societies.
- Establish special mentoring programs for high school students, undergraduates, graduate students, and technicians conducting research.
- Develop, adopt, adapt or disseminate effective models and pedagogic approaches to science, mathematics and engineering teaching.

**Broaden Participation of Underrepresented Groups**

- Establish research and education collaborations with students and/or faculty who are members of underrepresented groups.
- Include students from underrepresented groups as participants in the proposed research and education activities.
- Establish research and education collaborations with students and faculty from non-Ph.D.-granting institutions and those serving underrepresented groups.
- Make campus visits and presentations at institutions that serve
underrepresented groups.

- Mentor early-career scientists and engineers from underrepresented groups who are submitting NSF proposals.
- Participate in developing new approaches (e.g., use of information technology and connectivity) to engage underserved individuals, groups, and communities in science and engineering.

*Enhance Infrastructure for Research and Education*

- Identify and establish collaborations between disciplines and institutions, among the U.S. academic institutions, industry and government and with international partners.
- Maintain, operate and modernize shared research and education infrastructure, including facilities and science and technology centers and engineering research centers.
- Upgrade the computation and computing infrastructure, including advanced computing resources and new types of information tools (e.g., large databases, networks and associated systems, and digital libraries).
- Develop activities that ensure that multi-user facilities are sites of research and mentoring for large numbers of science and engineering students.

*Broad Dissemination to Enhance Scientific and Technological Understanding*

- Partner with museums, nature centers, science centers, and similar institutions to develop exhibits in science, math, and engineering.
- Give science and engineering presentations to the broader community (e.g., at museums and libraries, on radio shows, and in other such venues.).
- Make data available in a timely manner by means of databases, digital libraries, or other venues such as CD-ROMs.
- Publish in diverse media (e.g., non-technical literature, and websites, CD-ROMs, press kits) to reach broad audiences.
Benefits to Society

- Demonstrate the linkage between discovery and societal benefit by providing specific examples and explanations regarding the potential application of research and education results.
- Partner with academic scientists, staff at federal agencies and with the private sector on both technological and scientific projects to integrate research into broader programs and activities of national interest.
- Analyze, interpret, and synthesize research and education results in formats understandable and useful for non-scientists.
- Provide information for policy formulation by Federal, State or local agencies.

Specific Examples of Broader Impacts from Successful Proposals

As helpful as the preceding examples will be as you consider your project design, it is more instructive to examine approaches used in successful proposals. So, let’s look at some successful applications to see how the investigators included and documented broader impacts.

Each of these examples is taken from the Project Summary. As mentioned earlier, this is the one-page overview that begins every proposal, and must explicitly address the merit criteria. In the next chapter, we will focus on the Project Summary, and later chapters will explore how to weave the criteria into the rest of the proposal. For now, note two features of the description of broader impacts in these successful applications.

- In the Project Summary of many successful applications, broader impacts are emphasized, not merely mentioned. In some cases, the section on broader impacts accounts for nearly half of the Project Summary.
In the Project Summary of many successful applications, broader impacts are identified in detail. Successful applicants often provide the names of specific programs (to broaden participation of underrepresented groups, for example) or specify the nature of dissemination routes (content in websites to be created, for example).

Before you read these examples, note that all of these proposals were prepared before NSF changed the requirements regarding the description of broader impacts in the Project Summary. As you will see in the next chapter, explicit articulation of broader impacts is now a structural requirement in the Project Summary. So, study these examples to learn how to effectively craft and describe broader impacts, but do not use them as templates for the preparation of a Project Summary.
Proposal title: Estradiol’s modulation of auditory processing

Directorate/Division: BIO/IOS

Excerpt from broader impacts description:

First, this proposal is expected to provide the first comprehensive investigation on the organization and functional consequences of E2’s modulation in the processes by which the vertebrate brain encodes and interprets behaviorally-relevant communication signals. Second, the PI has established an exchange program between the US and the University of Sao Paulo, Brazil, that allows students at all levels to participate in research that challenges existing scientific dogma and to benefit uniquely from the transformative process of scientific discovery. As part of this exchange program, the PI will also offer yearly short courses that will train students and faculty, both practically and theoretically, on modern methods in molecular and systems neuroscience. This program is also designed to aid faculty members in Brazil to implement novel techniques in their own laboratories. Third, the PI established an extracurricular program with the Park Road Elementary School (Rochester area), that will introduce children, their parents and teachers to concepts in neuroscience and the importance of basic scientific research. Fourth, the PI will continue training students and young scientists from minority groups in his laboratory. Currently 87.5% of the PI’s group (7/8) belongs to under-represented minorities.
Proposal title: Optical imaging studies of ovarian epithelial cell migration and invasion using microfabricated models of the extracellular matrix

Directorate/Division: ENG/CBET

Excerpt from broader impacts description:

The trainees here will be similarly immersed in a highly interdisciplinary research environment, involving aspects of cancer biology, optical engineering, software engineering, and photochemistry. Concurrently, the PI developed a course on special topics in imaging and microscopy which includes multiphoton excited fabrication as part of the biomedical engineering and biomedical sciences syllabus. This includes a discussion of multiphoton excited fabrication papers from the literature and a lab component where the students will learn how to fabricate and optically image 3D crosslinked protein scaffolds.

The PI will have a display highlighting this work at the new Connecticut Science Center focusing on 7-12 grade education. He will also present a series of presentations in the local 7th grade classroom on cell biology and microscopy. The co-PI is highly active in Connecticut education in hospitals, where she educates physicians, nurses, medical assistants and women about cancer prevention and detection. In these efforts she has developed a Women’s Cancer Prevention Program where she discusses gynecological cancers, and how state of the art methods will help in early diagnoses and treatment.
Proposal title: The geometry of Banach spaces and its applications

Directorate/Division: MPS/DMS

Excerpt from broader impacts description:

In the past, the investigator was invited to give talks to logicians and Banach space theorists at the AMS conference in Miami, Florida. He was also invited to give talks at the SUMIRFAS, Texas A&M University with a larger group of audiences. The investigator will talk at the coming AMS conference in San Diego and do the same at whatever related conferences.

The investigator served as the SemCzar for the Workshop in Analysis and Probability at Texas A&M University for two years. He organized the seminar session, encouraged and provided chances for graduate students and young researchers to give talks. He was also the organizer of the Graduate Working Seminar in Functional Analysis (which was funded by the Owen Chair of Mathematics at Texas A&M University). He will continue participating in the workshop and contributing to the organization.

From fall 2007, the investigator will start helping E. Odell organize seminars in functional analysis in the University of Texas at Austin where he will communicate and collaborate with other Banach space theorists about applications of logic and set theory to the geometry of Banach spaces.
**Proposal title: ROS as mediators of rapid long-distance self-propagating signals**

Directorate/Division: BIO/MCB

Excerpt from broader impacts description:

The two key “Broader Impacts” of the proposed research are: 1) Educational outreach for K-12 and multidisciplinary training to graduate and undergraduates trainees. Undergraduate students will experience science as a tool of discovery through participation in mentoring programs. They will be trained in different aspects of signal transduction, genetics and bioinformatics analysis. A summer outreach workshop will teach high school students about molecular biology in Arabidopsis, signal transduction, the environment, and modern agriculture. This laboratory-based internship program will provide self-confidence building experiences and expose the students to laboratories and scientists. Both undergraduate and K-12 outreach and training activities will target the underprivileged and underrepresented in science. 2) Development and maintenance of a centralized website dedicated for rapid systemic signaling in plants. The goal of the website will be to increase interest in science through short movie clips and PowerPoint presentations developed for students of all ages and the general public. In addition, the site will be used to share information and resources between different groups of researchers, such as electrophysiologists and molecular biologists.
These examples should make it clear that successful proposals do not merely pay lip service to broader impacts — good proposals integrate these activities into the project, and the investigators highlight the activities when summarizing their work. So, consider the following advice as you contemplate the broader impacts of your ideas and your proposal.

1. **View the broader impacts criterion as an invitation to be creative, and as an opportunity to enhance your work and your application.**

2. **While brainstorming with your team, include sessions devoted to broader impacts, and be open to adding activities that expand the broader impacts of your project.**
WRITING FOR YOUR AUDIENCE: THE REVIEWERS

In the previous chapter, you were urged to take steps to identify the reviewers who are likely to judge your application, perhaps with the help of your program director. You may be able to identify specific individuals who will probably serve as reviewers or sit on a review panel, or may only be able to get an overall impression of the group or panel. There is but one purpose in this: to define the audience for whom you are writing.

The comments of some NSF program directors suggest that many applicants fail to accurately identify their audience. For example, Dr. Thomas Statler encourages investigators to avoid this mistake:

Know your audience and communicate with them effectively. Write your proposal so that it gives the reviewers what they need to understand, not what you want to say. A proposal is not a review article. While context is certainly important, your proposal needs to convincingly demonstrate that the scientific questions you are interested in are questions that must be answered, that the approach you have chosen is the best way to obtain those answers, and that you are the go-to guy/gal to do the work.

Dr. Statler’s remarks address two related issues: audience and content. We will revisit his advice on content and strategy in later chapters, but note now that a key error made by many applicants is a failure to write for the correct audience.

Your audience — your only audience — is the program director and the reviewers. Your goal — your only goal — is to provide these people with the information that they need to catch your vision for your project and to be convinced that it merits an award. Establish this mindset early in the grantwriting process, and remind yourself to be reviewer-centered.

REMEMBER:
Your audience — your only audience — is the program director and the reviewers.
Here are some strategies for remaining reviewer-centered as you begin to write your proposal.

**Think like a reviewer, and write with the reviewer in mind.** As you read your drafts, read them like a reviewer. When you ask colleagues to read drafts, ask them to think like a reviewer at NSF, and seek those who will know what this means.

**Help the reviewer find what she is looking for.** The reviewer knows the merit criteria as well as you do, and she is looking for evidence of intellectual merit (significance of the project, qualifications of the PI, resources available) and broader impacts. Be explicit in pointing these things out, and don’t worry about stating the obvious. For one thing, the key components may not be as obvious as you think. But more importantly, your goal is to make the reviewer’s job easy. Use the words that you know she is looking for: significance, impact, inclusive, underrepresented, resources, hypothesis, benefits, outreach.

Michael Lesiecki, Ph.D., has been a PI and reviewer of numerous NSF grants. He estimates that the typical NSF reviewer assesses 10 to 12 proposals, spending 90 to 120 minutes on each. The PD, who ultimately decides the fate of your application, is a busy professional like you; in fact he or she may be an academic scientist serving at NSF for just a year or two. You cannot assume that the reviewer can or will spend the time to discover the important facets of your project. It is up to you to help the reviewer see why your proposal should be funded.

**Write in the language of your discipline, expert to expert.** You are talking to a fellow scientist, and one of your goals is to communicate the fact that you are an expert in the field. This is not a review article; your audience is (or should be) a group of experts.

**Think of ways to grab your reviewer’s attention.** For example, highlight the urgency of your question, and/or the significance of the outcomes of your activities.
Mention deficits (in knowledge, resources, or opportunities) that will be erased by your project. Use italics to emphasize creative or transformative aspects of your approach or to draw attention to the development of a new outreach program.

If you combine those strategies with the specific knowledge you have obtained regarding your reviewers, you can establish a reviewer-centered approach to your project design and to your proposal. It is hard to overstate the benefits of this way of thinking about an NSF grant application.
CONCLUSION

A successful NSF grant proposal is built on more than just good ideas from a good scientist. It requires a deep understanding of NSF’s priorities, as articulated in the unique and specific merit criteria. While no proposal can succeed without impressing reviewers with its intellectual merit, the broader impacts criterion provides investigators with opportunities to think creatively about engagement, outreach, and benefits resulting from their research. If you commit yourself to significantly integrating broader impacts into your project, while remaining focused on developing a strong and well-resourced research program, you can outline a proposal that highlights your strengths and the ways in which you and your group can contribute to your discipline.

With those criteria constantly in mind, writing for reviewers and no one else, you can position your proposal for success in a famously competitive environment.
CHAPTER 3: PRESENTING YOUR PROJECT AND YOUR INDIVIDUAL QUALIFICATIONS

The NSF grant application requires you to outline your research topic and your plan, in an all-important section called the Project Summary.

In this part of the application, storytelling is a key goal and a valuable skill. You seek to get your reviewers excited about your proposal, so that they decide to champion your work. You want to tell a story, with an introduction, some characters, a problem or challenge, and a satisfying conclusion. The Project Summary is an encapsulation of your bigger story, with less detail but more drama.

This section is important for at least two reasons. First, it sets the tone of your proposal; ideally, it attracts the attention and piques the interest of reviewers. Second, it directly addresses the most important criteria used in merit review at NSF: intellectual merit and broader impacts. If your Project Summary fails to specifically and separately address those two criteria, NSF will return your proposal without review. That’s how important those criteria are, and that’s how important the Project Summary is.

So, in this chapter, we will look at what makes a good Project Summary, looking at examples from successful proposals, after reviewing NSF’s basic formatting requirements.

We also examine biographical sketches and look at some ways to use them creatively to enhance your proposal.

Finally, we explore the requirements for collaborative proposals involving multiple organizations. NSF encourages such collaborative efforts and provides specific guidelines for such proposals.
BEFORE YOU BEGIN WRITING: NOTES ON FORMATTING

Your proposal will be uploaded to NSF using their FastLane system. This process will be described in a later chapter. While the FastLane system performs some formatting automatically (for example, it generates a table of contents), you must take care of most layout and formatting (for example, margins and page numbering) yourself. Here are the key formatting requirements that you should establish in your documents from the beginning.

1. Pagination

FastLane does not automatically paginate a proposal. Each section of the proposal must be individually paginated prior to upload to the electronic system.

2. Fonts, margins and spacing

The proposal must be clear, readily legible, and conform to the following requirements:

a. Use one of the following typefaces:

   • Arial, Courier New, or Palatino Linotype at a font size of 10 points or larger;
   • Times New Roman at 11 points or larger; or
   • Computer Modern family of fonts at 11 points or larger.
   • Macintosh users may also use Helvetica or Palatino typefaces at 10 points or larger.

A font size of less than 10 points may be used for mathematical formulas or equations, figure, table or diagram captions and when using a Symbol font to insert Greek letters or special characters. PIs are cautioned, however, that the text must still be readable.
b. No more than six lines of text within a vertical space of one inch.

c. Margins, in all directions, must be at least an inch.

These requirements apply to all uploaded sections of a proposal, including supplementary documentation.

3. Page formatting

Since many reviewers will be reviewing proposals electronically, proposers are strongly encouraged to use only a standard, single-column format for the text. Avoid using a two-column format since it can cause difficulties when reviewing the document electronically. While line spacing (single-spaced, double-spaced, etc.) is at the discretion of the proposer, established page limits must be followed. (Individual program solicitations, however, may eliminate this proposer option by requiring other type size, margin or line spacing requirements.)

The guidelines specified above establish the minimum type size requirements; however, PIs are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the proposal. Small type size makes it difficult for reviewers to read the proposal; consequently, the use of small type not in compliance with the above guidelines may be grounds for NSF to return the proposal without review. Adherence to type size and line spacing requirements also is necessary to ensure that no proposer will have an unfair advantage, by using smaller type or line spacing to provide more text in the proposal.

REMEMBER:

No more than six lines of text within a vertical space of one inch.

Margins, in all directions, must be at least an inch.
What this means:

First, choose a standard font from the list NSF provides, and choose a standard line spacing mode that ensures that there are no more than 6 lines of text per vertical inch. For example, the text in the box below is printed in Arial 10 point, with line spacing set to 1.1 in Microsoft Word, illustrating the appearance of text printed at 6 lines per vertical inch. If you choose a 10-point font size, be sure to examine a page of printed text to ensure that you do not exceed 6 lines of text per inch.

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..." With an annual budget of about $6.9 billion (FY 2010), we are the funding source for approximately 20 percent of all federally supported basic research conducted by America’s colleges and universities.

Next, set your margins to 1 inch, and turn on page numbering.

Those are the basics, but watch for specific requirements added by particular programs. Emphasize readability, and resist the temptation to shoehorn as much text as possible into your page limit. Brevity, after all, is the soul of wit, where “wit” in the context of grantwriting refers to clarity and persuasiveness.

TIP:
Watch for specific requirements added by particular programs.
DESIGNING AND WRITING YOUR PROJECT SUMMARY

It is hard to overstate the importance of the Project Summary. This single page is where you make your first impression, and you want reviewers to be intrigued and excited based on what you write in this section. NSF has the following expectations and requirements (from the GPG).

Each proposal must contain a summary of the proposed project not more than one page in length. The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity.

The overview includes a description of the activity that would result if the proposal were funded and a statement of objectives and methods to be employed. The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge. The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes. The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically or technically literate lay reader. It should not be an abstract of the proposal.

Proposals that do not contain the Project Summary, including an overview and separate statements on intellectual merit and broader impacts will not be accepted by FastLane or will be returned without review.

What this means:

- Clearly, it is utterly critical that your Project Summary explicitly emphasize intellectual merit and broader impacts; in fact, NSF has just instituted a new requirement forcing you to structure your Project Summary so that it includes an
overview, a statement on intellectual merit, and a statement on broader impacts. We will look again at this formatting requirement below.

- It is also important to emphasize clarity; note that NSF would like project summaries to be comprehensible to non-specialists and even to lay readers, without reference to other sections of the grant or to the professional literature.
- And it is important to emphasize the activities that the grant will support. This leaves relatively little room for expansive background information.

At first glance, these expectations may seem unreasonable. Clarity will surely require some conceptual groundwork, and specific descriptions of activities and impacts seem essential. These goals must be met in a single page of text, or roughly 750 words. (Beginning in 2013, the limit is much more specific — 4700 characters. This is due to the required use of text boxes when entering the summary on FastLane, as explained later in this chapter.) The task is challenging, yes, but not unreasonable. We will consider some overall pointers, and then examine several examples of summaries from successful proposals.

**Deciding When to Write the Project Summary**

Some grantwriting advisors recommend that the Project Summary be written after the rest of the proposal is complete.

On the other hand, there are advantages to writing the summary early in the process. The summary should be a product of your early preparations (see Chapter 1), in which you created an outline of the project, your hypotheses, and your objectives. Such a summary can serve as a guiding light as you describe your project in more detail.
So, if you do write the summary first, consider it to be provisional, and assume that it will be revised upon completion of the main body of the application. You may even choose to revise it a few times during the refining of your project. And if you elect to write the summary last, consider first developing a detailed outline as a framework to keep you and your team focused on your hypotheses and objectives.

**Strategies for Creating a Compelling Project Summary**

Whether you are writing your final Project Summary or creating a provisional draft, consider these suggestions for crafting an effective summary.

1. **Establish the knowledge gap** as quickly as possible.

2. Briefly and strongly **mention the importance of closing this knowledge gap**.

3. **Present your ideas as the solution to the problem** presented by the knowledge gap. Where appropriate, state your hypothesis clearly and succinctly.

4. **Make it clear that your group is the best suited** to solving the problem.

5. **Be specific about your activities and impacts**; make it clear that you have a specific plan of attack.

6. **State your objectives clearly**, and be specific about your methods and/or approach.

7. **Find ways to emphasize key points** (such as knowledge gaps and impacts) using subheadings, italics, or underlining. As Michael Lesiecki puts it, “You are extremely familiar with your work’s significance because you’re well-versed on the literature and input from your colleagues. But the reviewer needs clear statements in your proposal that define your project’s magnitude. State the obvious because
what may seem obvious to you is not necessarily obvious to the reviewer.”

8. **Remain hypothesis-driven and reviewer-centered**, as described in Chapters 1 and 2.

### Specific Examples of Project Summaries from Successful Proposals

As when we examined broader impacts, it can be very instructive to see how successful investigators have written the Project Summary. Thus, we will consider 4 examples from various disciplines.

Each Project Summary is presented in its entirety, in a format resembling the original (with respect to font size, headings, and spacing) but without personal information. Some have been edited slightly to correct typos. Following each example, notable strategies and techniques are discussed along with weaknesses and things to avoid.

Note that there is significant variation in how investigators approach the summary. Some of the diversity represents discipline-specific conventions, and you may find some of the approaches odd or inappropriate for your discipline or project. However, this variation indicates that you are free to be creative in how you seek to present your case and in how you direct the reviewer’s attention. So, if you see a basic outline that you really like, sketch it out and adapt it for your project.

However, note that all of these examples are taken from proposals submitted before 2013. If you are submitting for a deadline after January 13, 2013, you must follow a specific format in preparing your summary. While this need not significantly restrain your creativity, it does mean that you should **not use these examples to guide you in formatting the summary**.
Example 1: ROS as Mediators of Rapid Long-Distance Self-Propagating Signals

**Project Summary:**

**SCIENTIFIC MERIT**

Plants are the principal solar energy converter sustaining life on Earth. To optimize their photosynthetic reactions, plants must rapidly acclimate to changes in their environment, as well as respond to a diverse array of biological challenges. Fundamental mechanisms underlying rapid systemic signaling in response to different environmental stresses in plants remain, however, largely unknown. We recently uncovered a rapid self-propagating systemic signal in plants that travels at a rate of 8.4 cm min⁻¹, is dependent on ROS accumulation along its path and the presence of the respiratory burst oxidase homolog D (RbohD) gene, and responds to a surprisingly broad array of stimuli, including wounding, cold, heat, high light, and salinity stresses. **Our long-term goal is to determine the mechanism and mode of regulation of rapid systemic signaling in plants.**

Our specific aims are:

1. **Use a genetic screen to clone genes involved in rapid systemic signaling:** Can we identify the rapid signal? The hypothesis being tested is that different proteins, including enzymes involved in the synthesis of small signaling molecules and/or specific membrane channels, are used by plant cells to mediate rapid systemic signaling.

2. **Perform domain analysis to determine the role of the Ca2+-binding (EF-hand) and phosphorylation sites of RBOHD in mediating rapid systemic signals.** The hypothesis being tested is that changes in Ca2+ fluxes and/or phosphorylation of RBOHD are required for rapid systemic signaling.

3. **Study the rapid systemic response of Arabidopsis to different abiotic stimuli: Is there specificity in rapid systemic signaling?** The hypothesis being tested is that rapid systemic signaling, triggered by different abiotic stimuli, will...
result in acclimatory responses that are unique to the inducing stress.

We will use a combination of research tools, including genetics, molecular biology, advanced whole-plant imaging, and bioinformatics, to dissect the rapid systemic signaling pathway of plants. We will then test our working model for rapid systemic signaling in plants using gain- and loss-of-function mutants.

BROADER IMPACT

The genetic identification of different components of the rapid systemic signaling pathway of plants will shed light on the different mechanisms that mediate rapid auto-propagating ROS-related signals in other multicellular organisms. A tissue-scale gradient of ROS was, for example, recently reported to mediate rapid wound signaling in zebrafish. Dissecting the rapid systemic signaling pathway of plants will also enable us to identify key regulators that could be used to enhance the tolerance of different crops and plants to biotic and abiotic stresses, potentially preventing yield losses estimated at 30-40 billion dollars annually in the US. The two key “Broader Impacts” of the proposed research are: 1) Educational outreach for K-12 and multidisciplinary training of graduate and undergraduate trainees. Undergraduate students will experience science as a tool of discovery through participation in mentoring programs. They will be trained in different aspects of signal transduction, genetics and bioinformatics analysis. A summer outreach workshop will teach high school students about molecular biology in Arabidopsis, signal transduction, the environment, and modern agriculture. This laboratory-based internship program will provide self-confidence building experiences and expose the students to laboratories and scientists. Both undergraduate and K-12 outreach and training activities will target the underprivileged and underrepresented in science. 2) Development and maintenance of a centralized website dedicated for rapid systemic signaling in plants. The goal of the website will be to increase interest in science through short movie clips and PowerPoint presentations developed for students of all ages and the general public. In addition, the site will be used to share information and
resources between different groups of researchers, such as electrophysiologists and molecular biologists.

**Strategies and Techniques to Note:**

1. Rather than merely mentioning intellectual merit and broader impacts, the investigator organized the whole summary under those two headings.

2. The investigator used underlining, bold face, and italics to highlight the knowledge gap, the objectives, and the key impacts.

3. The investigator provides specific information on the nature of the proposed outreach programs and dissemination projects.

4. The investigator provides specific hypotheses being tested.

5. Background information is brief and to the point, beginning with a very basic introductory statement and reaching specifics within a short paragraph.

6. The knowledge gap is identified, and highlighted, in the first 3 sentences.

**Weaknesses:**

1. The mixture of bold face and underlining in the specific aims section is a bit busy.

2. Some sentences could be more succinct, and the whole summary could be tightened to be briefer and punchier.
## Example 2: Game Theory and the Geometry of Banach Spaces

### Project Summary:

**INTELLECTUAL MERIT**

The study of the geometry of Banach spaces has achieved great success during the past two decades. These achievements have influenced and have been influenced by many other areas of mathematics, especially logic and set theory. For example, the Ramsey theory plays a crucial role in Banach space theory while the famous Gower’s “block Ramsey theorem” has the reverse impact. By playing certain “infinite games”, E. Odell and Th. Schlumprecht gave an answer to a problem of J. Bourgain from the 1980’s. Recently, the investigator applied the “infinite Ramsey theory” to get a factorization theorem which answers a thirty-year old problem of W. B. Johnson. The investigator then extended the theorems to operators from spaces with certain asymptotic structures. Similar results are obtained. Very recently, combining the techniques of game theory and the classical machinery of Banach spaces, the investigator and W. B. Johnson give an intrinsic characterization of subspaces and quotients of separable reflexive spaces with unconditional bases. It provides solutions to several well-known open problems of Banach space theory, some of which date back to the 1970’s. These facts provide evidence for the deep connections between two seemly different fields of mathematics and produce strong motivation for the investigator to continue exploring the connections.

The investigator will employ methods of logic and set theory to study the subspaces of spaces of $p$-integral functions, especially the complemented subspaces and the “small” subspaces of these spaces. Necessary and sufficient conditions for operators from spaces with certain asymptotic structures to factor through spaces with simpler and better structures will be explored. Characterizations of subspaces and quotients of spaces with shrinking unconditional basis and subsequences of normalized weakly null sequences will also be investigated.
BROADER IMPACTS

In the past, the investigator was invited to give talks to logicians and Banach space theorists at the AMS conference in Miami, Florida. He was also invited to give talks at the SUMIRFAS, Texas A&M University with a larger group of audiences. The investigator will talk at the coming AMS conference in San Diego and do the same at whatever related conferences.

The investigator served as the SemCzar for the Workshop in Analysis and Probability at Texas A&M University for two years. He organized the seminar session, encouraged and provided chances for graduate students and young researchers to give talks. He was also the organizer of the Graduate Working Seminar in Functional Analysis (which was funded by the Owen Chair of Mathematics at Texas A&M University). He will continue participating in the workshop and contributing to the organization.

From fall 2007, the investigator will start helping E. Odell organize seminars in functional analysis in the University of Texas at Austin where he will communicate and collaborate with other Banach space theorists about applications of logic and set theory to the geometry of Banach spaces.

Strategies and Techniques to Note:

1. Rather than merely mentioning intellectual merit and broader impacts, the investigator organized the whole summary under those two headings.

2. The investigator provides specific information on the nature of the proposed outreach programs and dissemination projects.

3. The summary is succinct and clear, reasonably intelligible to non-experts.

4. The benefits to the field are stated clearly.
5. The investigator provides specific information on the nature of educational programs and collaborative projects.

**Weaknesses:**

1. The knowledge gap is stated somewhat weakly, and not until the second paragraph.

2. Project activities and potential outcomes could be more strongly emphasized and/or described in more detail in the second paragraph.

**Example 3: Control of a Robotic Manipulator Via a Brain-Computer Interface**

**Project Summary:**

A brain-computer interface (BCI) is a system that allows individuals with severe neuromuscular disorders to communicate and control devices using their brain waves. There are over two million people in the USA that are afflicted by these disorders, many of whom could greatly benefit from assistive devices controlled by a BCI. Over the past two years, it has been demonstrated that a non-invasive scalp-recorded electroencephalography (EEG) based BCI paradigm can be used by a disabled individual for long-term, reliable control of a personal computer. This BCI paradigm allows users to select from a set of symbols presented in a flashing visual matrix by classifying the resulting evoked brain responses. It is proposed that the same BCI paradigm and techniques used for the aforementioned demonstration can be straightforwardly implemented to generate high-level commands for controlling a robotic manipulator in three dimensions according to user intent. The proposed application is envisioned to provide superior dimensional control over alternative BCI techniques, as well as provide a wider variety of practical functions for performing everyday tasks. This research will serve as a step toward providing
disabled individuals a new level of autonomy for performing everyday tasks, hence improving their quality of life.

Electrocorticography (ECoG), electrical activity recorded directly from the surface of the brain, has also recently been demonstrated to be a viable control for a BCI. ECoG has also been shown to have superior signal-to-noise ratio, and spatial and spectral characteristics compared to EEG. The current EEG signals used to operate proposed BCI have not been characterized in ECoG. It is hypothesized that these ECoG signals can be used to improve the speed/accuracy performance for BCI applications, including control of a robotic manipulator.

The objectives of this proposal are: 1) to demonstrate that an EEG based BCI can provide accurate and reliable high-level control of a robotic manipulator, 2) to characterize evoked responses obtained from ECoG and use as control signals to operate a simulated robotic manipulator, and 3) to assess the level of control (speed and accuracy) between the two recording modalities, and compare the results to competitive BCI techniques.

**INTELLECTUAL MERIT**

This research will provide to the scientific community: 1) an initial characterization of relatively unexplored ECoG responses, 2) an investigation into how the EEG and ECoG responses can be better implemented for advanced BCI device control, 3) a novel man-machine interface between the human brain and a robotic manipulator, and 4) insight into the practicality of a BCI operated assistive manipulation device.

**BROADER IMPACTS**

This research will provide: 1) the advancement of a viable alternative for direct assistive devices for the disabled community, 2) advancement of an emerging neural/biomedical engineering field, 3) a more scientifically trained workforce of students active in this field, 4) a new and unique collaboration between two of the main scientific and educational institutions in Jacksonville, FL.
Strategies and Techniques to Note:

1. The summary is succinct and clear, reasonably intelligible to non-experts.

2. The benefits to the field and to society are clearly stated.

3. The hypothesis and objectives are clearly stated.

Weaknesses:

Broader impacts could be covered in more detail; specifically, training of students and the enhanced institutional collaboration are worthy of more specific descriptions.

Example 4: The molecular basis of ethylene regulation of photoperiodic floral induction in plants

Project Summary:

Intellectual merit of the proposed activities:

Determining when to flower is one of the most important decisions a plant must make, and elucidation of the signal transduction pathways mediating the timing of the floral transition is both a biologically exciting and an agriculturally important area of current research. Many plants flower in response to photoperiod, and many of the molecular details governing this response have been revealed. Surprisingly, the role of the gaseous hormone ethylene in the promotion of photoperiod-induced flowering has yet to be established, as ethylene has long been recognized as a flowering inhibitor. However, experiments from the P.I.’s laboratory demonstrate that ethylene is required for photoperiod-induced flowering in the short-day plant Pharbitis (Ipomoea nil, formerly Pharbitis nil). Evidence from the P.I.’s laboratory and others suggests that ethylene also promotes the
photoperiod-induced early flowering of long-day Arabidopsis thaliana plants. The goal of this proposed work is to determine, at the molecular level, the role ethylene plays in regulating photoperiodic floral induction in both Pharbitis and Arabidopsis. Specifically, quantitative reverse transcription polymerase chain reaction (qRT-PCR) will be used to determine whether ethylene regulates key flowering genes in both plants. Additionally, ethylene measurements from wild-type and mutant plants will be used to determine whether the transcription factor CONSTANS (CO), the protein responsible for activating the photoperiod flowering pathway, up-regulates ethylene biosynthesis in Arabidopsis.

**Broader impacts expected from these activities:**

While many of the molecular details of flowering have been revealed in recent years, regulation of flowering by the hormone ethylene remains an overlooked and a potentially key piece of the puzzle. This research will fill in a major gap in our knowledge of plant flowering by exploring ethylene’s regulation of photoperiod-induced flowering in two model plants. Furthermore, the majority of the project will be carried out by undergraduate researchers at a Primarily Undergraduate Institution (PUI) in the rural EPSCoR state of Vermont. The P.I. has mentored six women and two Hispanic students on undergraduate research projects in the past and will continue to make every effort to include members of underrepresented groups in her research program in the future. As an EPSCoR state, Vermont’s population as a whole is underrepresented in science, and the proposed research activities will significantly increase participation by undergraduate students in scientific research. The P.I. has also established an outreach program in which she mentors science teachers and students from nearby Montpelier High School on independent research projects in her laboratory. The requested funding will enhance research infrastructure at Norwich University by providing a large piece of equipment (an environmentally-controlled plant growth chamber) for research use, as well as for use in undergraduate science courses. In line with the teacher-scholar model, the P.I. incorporates plant-based research projects into her undergraduate biochemistry courses and this chamber
will increase opportunities for student involvement. The proposed research may also have agricultural implications, as well. Most crop plants are annual plants, and determining when to flower is critical for their reproductive success. Therefore, the results of the proposed research on flowering in two different annual plants (mouse-ear cress and Japanese morning glory) may be extrapolated to economically significant plants in the future.

Strategies and Techniques to Note:

1. Rather than merely mentioning intellectual merit and broader impacts, the investigator organized the whole summary under those two headings.

2. The investigator provides specific information on the broader impacts of the project, which emphasize education and inclusivity.

3. The summary is succinct and clear, reasonably intelligible to non-experts.

4. The knowledge gap is identified, and highlighted, in the first 3 sentences, and re-emphasized in the second paragraph.

5. The investigator provides specific information on the nature of educational programs and collaborative projects.

Weaknesses:

1. The plain formatting — key information is not highlighted with italics or underlining, and the section consists of two large paragraphs — does not help the reviewer find major points.

2. The final paragraph seems to introduce two new plants, but these are the same plants mentioned earlier with genus/species names. Introducing the common names earlier could make the summary easier to read, especially for non-specialists.
Final Thoughts on the Project Summary

The preceding examples illustrate the fact that an effective Project Summary can take several different forms. Choose a format and strategy that works best for you and your project, in consultation with your team. And, importantly, solicit feedback from non-specialists, asking them to comment on whether your summary is clear enough to be understood (at a basic level) by non-experts and even laypeople. This kind of feedback can significantly improve your summary, making it more compelling to the experts who you need to impress.

Entering the Project Summary in FastLane

As mentioned above, beginning in January 2013, the NSF FastLane system will force you to divide your Project Summary into three sections:

- An overview
- A statement on intellectual merit
- A statement on broader impacts

Each section is entered into a separate text box, and you cannot submit your proposal without entering text into those three text boxes. There are no length requirements for these boxes, so you are welcome to divide the text among the boxes as you see fit. However, the total number of characters in the summary — in all three boxes combined — must not exceed 4700.

NOTE: If you need to use special characters in your Project Summary, then you can upload a document without using the text boxes. Current NSF instructions indicate that the summary must be uploaded as a PDF file, as a supplemental document. If you intend to use special characters in your Project Summary, to be uploaded, be sure to check with your PD regarding requirements for this process. As of late 2012, specific instructions were not available for the procedure.
Using Biographical Sketches to Highlight Your Expertise

Recall that one of the intellectual merit criteria is this one: “How well qualified is the proposer (individual or team) to conduct the project?” As Tom Statler emphasized, it is important that you convince the reviewers “that you are the go-to guy/gal to do the work.” Biographical sketches are a major tool by which you will accomplish this.

A biographical sketch is, as the name implies, a kind of abbreviated vita. It will include some of the same information as your vita, in a condensed format. But it would be a mistake to make any other comparison with a full resume or vita — a biographical sketch has a very specific format and very specific goals. It is important to understand the requirements that NSF has for this document, and it is very important to take its preparation seriously. If you merely cut and paste some information from your vita, without carefully considering what to include (and what to omit), you are likely to miss an opportunity to strengthen your application.

You may be familiar with biographical sketches required by other agencies (for example, NIH). Do not assume that such documents can be easily adapted for use in your NSF grant. NSF has some unique expectations, and requires you to meet those expectations in a two-page document.

First, look at the requirements for biographical sketches, from the GPG.

A biographical sketch (limited to two pages) is required for each individual identified as senior project personnel. (See GPG Exhibit II-7 for the definitions of Senior Personnel.) The following information must be provided in the order and format specified below.

**Do not submit** personal information such as **home** address; **home** telephone, fax, or cell phone numbers; **home** e-mail address; date of birth; citizenship;
drivers’ license numbers; marital status; personal hobbies; and the like. Such personal information is irrelevant to the merits of the proposal. If such information is included, NSF will make every effort to prevent unauthorized access to such material, but the Foundation is not responsible or in any way liable for the release of such material. (See also GPG Chapter III.G).

(a) Professional Preparation

A list of the individual’s undergraduate and graduate education and postdoctoral training as indicated below:

Undergraduate Institution(s) Major Degree & Year
Graduate Institution(s) Major Degree & Year
Postdoctoral Institution(s) Area Inclusive Dates (years)

(b) Appointments

A list, in reverse chronological order, of all the individual’s academic/professional appointments beginning with the current appointment.

(c) Products

A list of: (i) up to five products most closely related to the proposed project; and (ii) up to five other significant products, whether or not related to the proposed project. Acceptable products must be citable and accessible including but not limited to publications, data sets, software, patents, and copyrights. Unacceptable products are unpublished documents not yet submitted for publication, invited lectures, and additional lists of products. Only the list of 10 will be used in the review of the proposal.

Each product must include full citation information including (where applicable and practicable) names of all authors, date of publication or release, title, title of...
enclosing work such as journal or book, volume, issue, pages, website and Uniform Resource Locator (URL) or other Persistent Identifier.

(d) Synergistic Activities

A list of up to five examples that demonstrate the broader impact of the individual’s professional and scholarly activities that focuses on the integration and transfer of knowledge as well as its creation. Examples could include, among others: innovations in teaching and training (e.g., development of curricular materials and pedagogical methods); contributions to the science of learning; development and/or refinement of research tools; computation methodologies, and algorithms for problem-solving; development of databases to support research and education; broadening the participation of groups underrepresented in science, mathematics, engineering and technology; and service to the scientific and engineering community outside of the individual’s immediate organization.

(e) Collaborators & Other Affiliations

• Collaborators and Co-Editors. A list of all persons in alphabetical order (including their current organizational affiliations) who are currently, or who have been collaborators or co-authors with the individual on a project, book, article, report, abstract or paper during the 48 months preceding the submission of the proposal. Also include those individuals who are currently or have been co-editors of a journal, compendium, or conference proceedings during the 24 months preceding the submission of the proposal. If there are no collaborators or co-editors to report, this should be so indicated.

• Graduate Advisors and Postdoctoral Sponsors. A list of the names of the individual’s own graduate advisor(s) and principal postdoctoral sponsor(s), and their current organizational affiliations.

• Thesis Advisor and Postgraduate-Scholar Sponsor. A list of all persons (including their organizational affiliations), with whom the individual has had an association as thesis advisor, or with whom the individual has had an association
within the last five years as a postgraduate-scholar sponsor. The total number of graduate students advised and postdoctoral scholars sponsored also must be identified.

The information in section (e) above of the biographical sketch is used to help identify potential conflicts or bias in the selection of reviewers. See GPG Exhibit II-2 for additional information on potential reviewer conflicts.

What this means:

The key members of your team are the “senior project personnel,” which we will examine later. For each, you must provide a two-page biographical sketch that begins with the person’s name, degrees, and professional appointments, without including personal information. Such information is immaterial to the process, and this is just another reason why editing a vita is a poor way to create an NSF biographical sketch. Apparently, this is a somewhat common mistake.

After presenting this biographical material, you must list up to 10 publications — up to 5 that are closely related to the project, and up to 5 more. You can include manuscripts in press, but not papers merely submitted for publication, and you can include patents, copyrights, and “software systems developed.” You must not include any additional publications, nor can you include lectures, posters, or other presentations.

In the next section, you present a list of up to 5 “synergistic activities,” and NSF is quite specific about what these should be. The activities should demonstrate the broader impact of your previous and ongoing work, with a specific focus on “the integration and transfer of knowledge as well as its creation.” This means that the examples you provide should demonstrate, to the extent

REMEMBER:
Provide a two-page biographical sketch that begins with the person’s name, degrees, and professional appointments, without including personal information.

STRATEGY:
The examples you provide should demonstrate, to the extent possible, interactions between research and education — consistent with NSF’s strong stated emphasis on such activities.
possible, interactions between research and education — consistent with NSF’s strong stated emphasis on such activities.

Look again at this list of suggestions:

- Innovations in teaching and training (e.g., development of curricular materials and pedagogical methods)
- Contributions to the science of learning
- Development and/or refinement of research tools
- Computation methodologies, and algorithms for problem-solving
- Development of databases to support research and education
- Broadening the participation of groups underrepresented in science, mathematics, engineering and technology
- Service to the scientific and engineering community outside of the individual’s immediate organization

These elements should sound familiar; this is a list of activities that qualify as excellent broader impacts.

In the final section, you will list collaborators, mentors, and students. While this information will surely establish your intellectual merit to some extent, NSF has a different purpose — screening for potential conflicts of interest among reviewers. The requirements are specific:

- All individuals are named with their current organizational affiliation.
- Collaborators and co-authors are listed for the last 4 years.
- Co-editors (of a journal or conference proceedings) are listed for the last 2 years.
- All students for whom you have served as a thesis advisor are listed.
- Trainees (for example, postdoctoral fellows) that you have advised are listed for the last 5 years.
- The total number of students and trainees is provided at the end.
These lists provide only names and affiliations under the appropriate heading; you do not specify the article or project on which you collaborated.

Note that the biographical sketch is strongly focused on the NSF merit review criteria: sections a–c, and to some extent e, establish your qualifications under the intellectual merit criterion. Section d provides crucial information about broader impacts, by inviting you to show how you are already involved in the kinds of activities that NSF values. This means that the NSF biographical sketch is much more than a simplified vita. It is a tool for reviewers to assess you and your team with respect to both merit criteria. And it is an opportunity for you to highlight the experience and expertise of your team, while emphasizing your commitment to NSF’s priorities by documenting your ongoing involvement in activities associated with the broader impacts criterion.

### Formatting Biographical Sketches

Unlike NIH, NSF does not provide a specific form for the creation of biographical sketches, so you are free to use fonts consistent with the rest of your proposal. There is no need to use a fancy layout or to employ tables or other devices. Most NSF biographical sketches are simple and straightforward, with the following characteristics:

- The PI’s name is in bold, often centered.
- Beneath the name is current contact information, which is optional, although you will probably want to provide your title and current institution.
- Each of these subsections is indicated in bold:
  - **Professional Preparation**, beginning with earliest degree
  - **Appointments**, beginning with current appointment
  - **Related Publications**
  - **Other Significant Publications**
• Synergistic Activities
• Collaborators and Co-editors
• Graduate Advisors and Postdoctoral Sponsors
• Former Students and Trainees

• Lists of names should be alphabetized by last name, and are typically presented as surnames with initials.

Identifying “Senior Project Personnel”

While your work may involve several postdoctoral fellows, graduate students, undergraduate students, and others, these people are not senior project personnel as defined by NSF. The following are considered Senior Personnel:

1. (co) Principal Investigator(s) -- the individual(s) designated by the proposer, and approved by NSF, who will be responsible for the scientific or technical direction of the project. NSF does not infer any distinction in scientific stature among multiple PIs, whether referred to as PI or co-PI. If more than one, the first one listed will serve as the contact PI, with whom all communications between NSF program officials and the project relating to the scientific, technical, and budgetary aspects of the project should take place. The PI and any identified co-PIs, however, will be jointly responsible for submission of the requisite project reports.

2. Faculty Associate (faculty member) -- an individual other than the Principal Investigator(s) considered by the performing institution to be a member of its faculty or who holds an appointment as a faculty member at another institution, and who will participate in the project being supported.

So, senior project personnel are PIs, co-PIs, and other participating scholars holding a faculty position or its equivalent. Biographical sketches are required for all such participants.
Describing the Talents of Your Team

Your group may include fellows, students, and other professionals whose efforts are crucial to your success. Because you seek to convince the reviewers that your team is more than up to the task, you should provide information on their “exceptional qualifications that merit consideration in the evaluation of the proposal.”

NSF does not specify a format here. However, the guide for using the Grants.gov site, where you will upload your proposal, suggests that biographical sketches include: Education and Training, Research and Professional Experience, Collaborators and Affiliations (for conflicts of interest), Publications, and Synergistic Activities. Because this outline is so similar to the required format discussed above, it is best to use the same format for all biographical sketches in your proposal. For all senior personnel, follow the guidelines above without modification. But for other personnel, provide that information that will be most helpful to reviewers: education and training, key publications, and synergistic activities.

Note that these additional biographical sketches give you the opportunity to bolster your application significantly. By including publications and synergistic activities for other personnel, you can increase the numbers of these assets beyond the strict limits imposed on individual biographical sketches. For example, if a research fellow co-authored a paper and assisted in an educational presentation, both can (and should) be reported on her biographical sketch despite being omitted from yours. In this way, the full picture of your team’s expertise and activities can be presented.

If you are writing an equipment grant, you will name major users and “auxiliary users.” The major users are the equivalents of PIs, and you must provide standard sketches for them. For auxiliary users, NSF expects a “short biographical
sketch” and a list of up to 5 publications that are closely related to the proposal. This amounts to a standard biographical sketch without additional publications, synergistic activities, and lists of collaborators. Again, it is best to use a standard format for all biographical sketches to enhance readability of your application and to simplify the work of ensuring that these documents, prepared by others, are in good order.
SPECIAL CONSIDERATIONS WHEN WRITING COLLABORATIVE PROPOSALS

NSF is enthusiastic about group projects, which are frequently multidisciplinary. When the investigators are at a single institution, no special procedures are necessary beyond the identification of the co-PIs and the preparation of full biographical sketches.

However, some group projects involve multiple institutions, and this substantially complicates the process. NSF refers to these proposals as collaborative proposals, and urges PIs who are contemplating such a project to contact the appropriate NSF Program Director before submitting the application.

In fact, if you are planning such a collaboration, you should contact a PD in the planning stages of your project. The first decision you face is the choice of a method of submission and management of your proposal. There are two options:

1. Submission by a single organization, which manages the grant and provides funds to the collaborating institutions through subawards; or

2. Simultaneous submission of the same project by two or more organizations.

Regardless of which strategy you adopt, you must be clear about why and how you have chosen the collaborative model. From the GPG:

All collaborative proposals must clearly describe the roles to be played by the other organizations, specify the managerial arrangements, and explain the advantages of the multi-organizational effort within the Project Description.

The GPG describes the first option (the single proposal method) as follows:
The single proposal method allows investigators from two or more organizations who have developed an integrated research project to submit a single, focused proposal. A single investigator bears primary responsibility for the administration of the grant and discussions with NSF, and, at the discretion of the organizations involved, investigators from any of the participating organizations may be designated as co-PIs. Please note, however, that if awarded, a single award would be made to the submitting organization, with any collaborators listed as subawards.

This approach is seemingly straightforward, although it requires thorough management. By submitting the proposal, your organization is asserting that it is capable of effectively managing the grant (meaning the money). If NSF disagrees, it may require a revised proposal.

The second option seems a bit more complicated, but does not require a single organization to manage the grant. Here are excerpts from the GPG describing this method:

In many instances, simultaneous submission of proposals that contain the same Project Description from each organization might be appropriate. For these proposals, the project title must begin with the words “Collaborative Research:”. The lead organization’s submission will include a Cover Sheet, Project Summary, Project Description, References Cited, Biographical Sketches, Budgets and Budget Justification, Current and Pending support, and Facilities, Equipment and Other Resources for their organization. Non-lead organization submissions will include all of the above for their organization except the project summary, project description, and references cited which are the same for all collaborating organizations. FastLane will combine the proposal submission for printing or electronic viewing.

The lead organization does have some additional responsibilities regarding plans for mentoring (if applicable) and data management, but otherwise this
method keeps the participating organizations fiscally separate. Nevertheless, the separate submissions constitute a single proposal, so several unique procedures are required when submitting this type of collaborative proposal. These are detailed in the GPG and should be discussed in advance with a PD as the proposal evolves.
CONCLUSION

The Project Summary and your biographical sketches represent critical opportunities to demonstrate the intellectual merits of your ideas and your team, and to highlight the broader impacts that your work has created and will create if your proposal is successful. By remaining focused on the considerations that make up those two review criteria, you can ensure that your entire proposal constitutes a compelling demonstration of the intellectual merit of your project and the beneficial outcomes that it is sure to generate.
CHAPTER 4: DOCUMENTING YOUR RESOURCES AND YOUR COMMITMENT TO THE RESEARCH COMMUNITY

A major component of the intellectual merit criterion concerns access to resources. Together with your biographical sketch and other evidence of your team’s qualifications, documenting the resources of your institution establishes your suitability to tackle the project you have proposed. In addition, these descriptions can portray your institution as one worthy of an NSF investment, especially if you are considering an equipment grant. This section of the proposal, therefore, should not be taken lightly. Recall what Tom Statler emphasized in his advice to investigators: you must convince reviewers that “you are the go-to guy/gal to do the work.”

In this chapter, we will dissect NSF’s expectations for describing institutional resources, and we will look at examples from successful proposals.

We will then turn to your responsibilities to the research community, with regard to the sharing and management of data and other products of your research.
DETAIL YOUR FACILITIES AND RESOURCES

Here are NSF’s expectations for this section, from the GPG:

Facilities, Equipment and Other Resources

This section of the proposal is used to assess the adequacy of the resources available to perform the effort proposed to satisfy both Intellectual Merit and Broader Impacts review criteria. Proposers should describe only those resources that are directly applicable. Proposers should include an aggregated description of the internal and external resources (both physical and personnel) that the organization and its collaborators will provide to the project, should it be funded. Such information must be provided in this section, in lieu of other parts of the proposal (e.g., budget justification, project description). The description should be narrative in nature and must not include any quantifiable financial information. Reviewers will evaluate the information during the merit review process and the cognizant NSF Program Officer will review it for programmatic and technical sufficiency.

What this means:

You may have considered pasting boilerplate text from institutional documents or websites here, but that would be a big mistake. **This section should be a narration of the specific facilities and resources that your organization will provide to your group when your project is funded.** It should not be a bullet list of instruments that exist somewhere on your campus, or a vague description of lab sizes and numbers of computers. The section should amount to a clear and forceful demonstration that you will have everything you need to get the work done. Note that this information is not to be presented anywhere else in your proposal, so this is the place where you will make the case that your environment is well suited to your work. And NSF is keen to remind you of this, closing with the plain statement that reviewers and the Program Director will use this section to assess the merit of your proposal.
If you feel you have nothing to report in this section, here are two things to consider.

1. Think about it again after you have read the rest of this section. There are surely resources that are already available to you, through your institution or from elsewhere, that will be helpful (or critical) as you perform the proposed work and activities. This section allows you to tell reviewers about why you are the right person and why your place is the right place. It’s not a good idea to say nothing here.

2. If you ultimately decide that there is nothing to describe, a statement to that effect must be included in this section of the proposal and uploaded into FastLane.

**Formatting and What to Include**

There are two ways to include this information in your proposal. The best option by far is to write the section yourself, formatted for consistency with the rest of your application, and then upload it along with your other materials. The second option (on the NSF FastLane system) is to fill out an online form consisting of a series of text boxes bearing labels. There is no good reason to use the second option, so we will proceed with the assumption that you will write and upload a document describing your organization’s resources. According to the FastLane system, you should include the following categories of information, when and if applicable to your application:

- Laboratory
- Clinical
- Animal
- Computer
- Office
- Other
- Major Equipment
- Other Resources (includes resources used in field studies or at a different location)

**REMEmBER:**

This section allows you to tell reviewers about why you are the right person and why your place is the right place. It’s not a good idea to say nothing here.

**TIP:**

The best option by far is to write the section yourself.
The FastLane site also includes the following directions.

For each resource you list, state the following:

- Capabilities of resource
- Capacities
- Proximity
- Availability

These instructions can be summarized in some key recommendations.

1. Describe only resources that are directly applicable to your project, but include any relevant instrument or resource that emphasizes your claim that your environment is suitably equipped, resourced, and supportive of your work. Think about what you would be looking for as a reviewer, and focus on those things. Avoid padding your description with peripheral or irrelevant inclusions, but provide a thorough summary of your institutional environment.

2. Be specific, especially when the instrument or resource is particularly important to the success of your project.

3. Write in sentences and paragraphs; do not merely provide lists.

4. Where applicable and possible, link the resource to an aim or experiment. If one or more of your activities will be notably challenging, make it a point to indicate that you have the necessary resources to get the job done.

5. When appropriate, include information about broader institutional resources, such as libraries, transportation, and communication.
Descriptions of Facilities, Equipment and Other Resources from Successful Proposals

When it comes to the need for special equipment and resources, NSF proposals vary widely in complexity. A mathematician or economist may need little more than an office, a computer, a good library, and some smart colleagues. A field biologist may require offsite facilities, state-of-the-art analytical instruments, and specialized resource management (of biohazards, for example).

Thus, we will look at descriptions from three very different successful proposals. Note how each highlights the available resources in the context of the proposed work. The investigators’ formatting has been retained, while the text has been slightly edited to remove names and some specific locations.

Example 1: ROS as mediators of rapid long-distance self-propagating signals

Facilities, Equipment and Other Resources

The laboratory (1,000 sq. ft.) is located in the Agriculture Building. The recently remodeled laboratory and shared equipment areas are fully equipped to carry out the proposed molecular genetic and biochemical research objectives. Available lab equipment includes low- and medium-speed refrigerated centrifuges, refrigerated microfuges, polyacrylamide and agarose gel electrophoresis apparati and power supplies, sequencing gel apparati and high voltage power supplies, incubators, waterbaths, and –80°C freezers. All equipment necessary for recombinant DNA manipulations, DNA isolation, RNA isolation, and protein purification and isolation including PCR thermocyclers, and speed vac systems/lyophilizers are available including a large laminar flow hood for sterile work. Common facilities available to the PI include a walk-in cold room (150 sq. ft.), automated X-ray developer and dark room facilities, digital imaging system (Bio-Rad), a Kodak 2000MM imager,
a Leica epifluorescence microscope with a “W-view” setup, a Nikon Eclipse E400 epifluorescence microscope, an Olympus IX 81 FV 1000 confocal microscope, flatbed scanners, gamma irradiator, autoclaves (4), baking ovens, shared centrifuge room containing several low and medium speed refrigerated centrifuges and ultracentrifuges (2).

**Computer:** The lab houses 8 personal computers (PC) all of which are networked via departmental servers providing full network access to the global Internet/WWW resources and color laserjet printers. Computer facilities adjacent to the lab include a digital image analysis system with Gel-doc CCD camera, a phosphorimager, and several digital cameras for documentation. The department also maintains The Center for Bioinformatics and Molecular Modeling (see below).

**Offices:** Office space for each PI is about 150 sq. ft. with additional student benches within the lab available for postdoctoral research associates and graduate students.

**MAJOR EQUIPMENT:**

The following major equipment is housed in the Genomics Center: Perkin Elmer (ABI) 3700 96 place-capillary DNA sequencer, Perkin Elmer (ABI) Prism 310 DNA sequencer, Qiagen 3000 BioRobot liquid handling system for automated plasmid preparations, ESI micro/macro DNA/colony array system, GSI Lumonics Scanarray 5000 laser confocal scanner, Perkin Elmer (ABI) Prism 7000 Sequence Detection System for real time PCR, MJ Research Tetrad thermocycler, Packard Scientific fluorescence plate reader, incubator with microplate agitator, Sorvall benchtop centrifuge with microplate rotor, Savant Speed-vac with microplate rotor, V&P Scientific library replication system, Sanyo ultra-low chest freezer, 25c. ft capacity, Penguin Linux server with Geospiza Finch Package software for DNA sequence sample management. An Affymetrix Fluidics Station, a GeneArray Scanner and GeneChip workstation running Affymetrix Microarray Suite software were installed in 2004. The facility is managed full time by Ms. X, who has had extensive experience running DNA sequencing projects at the Center for Disease
Control in Atlanta and at this university. A second full-time technician, Mr. Y, is primarily responsible for microarray analysis.

**OTHER RESOURCES:**

The Biochemistry departmental office provides full secretarial (2) and accounting support (2) for all departmental faculty. The department also employs a full-time computer specialist for faculty computer-related support, web design and maintenance, and related tasks. A facilities manager in Agriculture maintains shared instrumentation and coordinates repair of autoclaves, growth chambers, etc. Mechanical and electrical repair services for small equipment items such as vacuum pumps and water baths are available in the Physiology and Cell Biology Department.

**Plant Growth Facilities**

Laboratory plant growth facilities include a state-of-the-art green house (1,500 sq. ft.) with high pressure sodium lamps for supplemental lighting, heating and cooling capabilities, approved for BL-1P containment research. Seven Arabidopsis growth chambers (3 Percival model - E-30BHO and 4 Percival model AR75L), and two Conviron growth chambers (a reach-in E15 and a walk-in PGW36) growth chambers are located in the greenhouse headhouse complex adjacent to Fleischmann Hall. These facilities have been approved for BL-1P containment research with transgenic plants.

**Nevada Center for Bioinformatics**

The Nevada Center for Bioinformatics (CFB) (http://bioinformatics.unr.edu) was established in 2001 with funding from NIH BRIN (Biomedical Research Infrastructure Network) and NSF EPSCoR (Experimental Program to Stimulate Competitive Research) to meet the growing bioinformatics and molecular modeling needs of Nevada researchers. This center is directed by Dr. S.
Example 2: Cluster algebras, critical groups, and tropical curves

Massachusetts Institute of Technology
Department of Mathematics

Facilities and Other Resources:

Laboratory:
Animal:
Computer:

The campus at the Massachusetts Institute of Technology is networked by both a wired 100/1000 Mbps Ethernet LAN and campus-wide 802.11 b/g wireless networks. MIT utilizes both proprietary and open source workstations and servers, including Linux, Unix and Macintosh platforms. In addition to office workstations, MIT provides clusters of workstations throughout campus running a customized distribution of Linux derived from Red Hat Enterprise 4. Network security is provided by the Kerberos authentication protocol.

The Math Department maintains its own subnet and domain, and provides separate email, file storage, computational, and internet services for faculty and staff over a Gigabit Ethernet LAN. Faculty workstations run Fedora Linux, and department servers run Red Hat Enterprise Linux and Fedora Linux. The department maintains 4 workstation clusters running Fedora Linux, and a variety of network printing services are available for networked computers.

Office:
MIT provides basic office space and library services for faculty.

Clinical:

Other:
Example 3: A distributed computational/physical system for micromanufacturing

Facilities, Equipment and Other Resources

The Robotics Institute at Carnegie Mellon University pursues advanced research in the emerging field of robotics and is recognized as a world leader. It is an academic department of the School of Computer Science, offering Ph.D. and Masters degrees in robotics. A multitude of unique research equipment is available in over a dozen laboratories spanning basic areas of perception, cognition, and manipulation—to mobile robot systems, advanced manipulators and manufacturing.

The proposed research will be performed within the Microdynamic Systems Laboratory, part of the Robotics Institute, founded and headed by RH. Major equipment for this 2100 sq. ft. laboratory was donated by the IBM Thomas J. Watson Research Center, including computers, three SCARA robots, a PUMA 560, a two-arm IBM electric Cartesian robot, vision systems, planar motion systems and several micro-motion robots including two IBM Fine Positioners and four IBM Magic Wrists. A number of unique robotic systems have been developed in the laboratory, including magnetic levitation haptic devices, the minifactory modular micromanufacturing system, teleoperation systems, and mobile robots including the ballbot dynamically-stable mobile robot as well as six-legged running machines and a six-legged climbing machine. Test equipment includes a number of high-speed digital oscilloscopes, spectrum analyzer, structural dynamics analyzer, and two laser interferometers. Several workstations, personal computers, and real time computers incorporating digital signal processors are available in the laboratory. The Microdynamic Systems Laboratory uses a number of on-campus model shops and off-campus fabricators to create unique robots, systems, and human-computer interface devices “from the ground up.”
Note that descriptions from successful proposals vary in length and format. Some, like example 2, adopt the box-like format of the online system, while others opt for a simple set of paragraphs. Some include significant detail, down to square footage of relevant facilities, while others paint a more minimalist picture. All, however, establish the fact that the institution is more than adequately equipped to support the research.

As with your Project Summary, find a format and style that you like (and that is consistent with the rest of your proposal), then focus on the recommendations above as you draw up your description. Keep your reviewers in mind at all times, and remember that they will be assessing the intellectual merit of your proposal as they read about your institution and environment.

In conclusion, consider this advice from Michael Lesiecki, Ph.D., who has served as both a Principal Investigator and a reviewer for NSF grants. “The reviewer won’t assume that you already have the resources that you need for the project — you need to tell her this clearly in your proposal.” Dr. Lesiecki notes that this should also be emphasized in the Project Description, which we discuss in the next chapter.
ANOTHER IMPORTANT RESOURCE: YOUR COLLABORATORS

When preparing grants for other agencies, you may have included letters of support from colleagues or collaborators, attesting to the excellence of your team or your ideas. NSF does not provide a mechanism for the inclusion of such letters, and the GPG implies that their inclusion can cause your application to be returned without review. (Note that some program solicitations may explicitly require such letters, and will provide guidelines for their preparation and submission.)

However, your project may benefit from the advice or assistance of collaborators who are not paid members of the team. For example, a colleague may plan to assist you with data analysis, or to provide advice on the use of an instrument. In such cases, you must include a letter of commitment from each collaborator. Here is how the GPG describes these letters:

Any substantial collaboration with individuals not included in the budget should be described and documented with a letter from each collaborator, which should be provided in the supplementary documentation section of the FastLane Proposal Preparation Module.

Note that these are not the types of collaboration described at the end of Chapter 3; letters of commitment are provided only by unpaid collaborators or consultants.

The inclusion of letters of commitment can bolster your case that your environment is adequately supportive of your work, especially if the unpaid collaboration substantially expands the reach of your project. For example, if you will be using sophisticated microscopy in some of your experiments, a letter of commitment from an expert colleague assures reviewers that the experiment will be done as planned, and underscores the resources that your institution has to offer.

STRATEGY:
Your project may benefit from the advice or assistance of collaborators who are not paid members of the team.

TIP:
You may wish to invite a more accomplished colleague to collaborate on some aspect of your project, and to provide a letter, to strengthen the intellectual merit of your proposal.
In addition, the letter amounts to a tacit endorsement of your project. Thus, you may wish to invite a more accomplished colleague to collaborate on some aspect of your project, and to provide a letter, to strengthen the intellectual merit of your proposal.

**Final Thoughts on Resources: Minding Your Independence**

As you describe your environment and consider recruiting collaborators, give some thought to the issue of independence, especially if you are a young investigator. Reviewers are sensitive to indications that an investigator is not truly independent, especially if she is working in the same department or institution where she was trained. In such cases, letters from collaborators and descriptions of resources in neighboring labs can have a negative impact, reinforcing the perception (accurate or not) that the investigator is merely an extension of her mentor’s lab.

If you are facing this challenge, the section on Facilities and Resources is one of the most important places to emphasize your independence. Describe your dedicated resources (for example, your lab space and instruments that are “yours”) in detail, and mention any equipment or facilities that are your exclusive responsibility. Consider recruiting collaborators from outside your former mentor’s group, ideally from outside your institution. Include statements and phrases that distinguish your lab or group from your former mentor’s team: “Although the Smith lab works in a somewhat different field, its X instrument will be used for analysis of Y.”
DEVELOPING AND WRITING YOUR DATA MANAGEMENT PLAN

NSF has explicit policies for the sharing of the results of research, through dissemination but also through the sharing of software, samples, tools, and other materials. From the Award and Administration Guide (AAG):

4. Dissemination and Sharing of Research Results

a. Investigators are expected to promptly prepare and submit for publication, with authorship that accurately reflects the contributions of those involved, all significant findings from work conducted under NSF grants. Grantees are expected to permit and encourage such publication by those actually performing that work, unless a grantee intends to publish or disseminate such findings itself.

b. Investigators are expected to share with other researchers, at no more than incremental cost and within a reasonable time, the primary data, samples, physical collections and other supporting materials created or gathered in the course of work under NSF grants. Grantees are expected to encourage and facilitate such sharing. Privileged or confidential information should be released only in a form that protects the privacy of individuals and subjects involved. General adjustments and, where essential, exceptions to this sharing expectation may be specified by the funding NSF Program or Division/Office for a particular field or discipline to safeguard the rights of individuals and subjects, the validity of results, or the integrity of collections or to accommodate the legitimate interest of investigators. A grantee or investigator also may request a particular adjustment or exception from the cognizant NSF Program Officer.

c. Investigators and grantees are encouraged to share software and inventions created under the grant or otherwise make them or their products widely available and usable.
d. NSF normally allows grantees to retain principal legal rights to intellectual property developed under NSF grants to provide incentives for development and dissemination of inventions, software and publications that can enhance their usefulness, accessibility and upkeep. Such incentives do not, however, reduce the responsibility that investigators and organizations have as members of the scientific and engineering community, to make results, data and collections available to other researchers.

Implementation of these policies is primarily achieved through the establishment and exercise of Data Management Plans. The expectations for these documents are described in detail in the GPG:

Proposals must include a supplementary document of no more than two pages labeled “Data Management Plan”. This supplement should describe how the proposal will conform to NSF policy on the dissemination and sharing of research results and may include:

- the types of data, samples, physical collections, software, curriculum materials, and other materials to be produced in the course of the project;

- the standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies);

- policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements;

- policies and provisions for re-use, re-distribution, and the production of derivatives; and

- plans for archiving data, samples, and other research products, and for preservation of access to them.
Data management requirements and plans specific to the Directorate, Office, Division, Program, or other NSF unit, relevant to a proposal are available at: http://www.nsf.gov/bfa/dias/policy/dmp.jsp. If guidance specific to the program is not available, then the requirements established in this section apply. FastLane will not permit submission of a proposal that is missing a Data Management Plan.

A valid Data Management Plan may include only the statement that no detailed plan is needed, as long as the statement is accompanied by a clear justification. Proposers who feel that the plan cannot fit within the supplement limit of two pages may use part of the 15-page Project Description for additional data management information. Proposers are advised that the Data Management Plan may not be used to circumvent the 15-page Project Description limitation. The Data Management Plan will be reviewed as an integral part of the proposal, coming under Intellectual Merit or Broader Impacts or both, as appropriate for the scientific community of relevance.

What this means:

You must indicate all the ways in which you will share the results of your research, with an emphasis on publication of findings and on dissemination and preservation of other products (data, software, etc.). In addition, you must describe the anticipated results of your project, by identifying the data, curricular materials, software, and samples that you expect to create.

It is possible that your work will also result in the creation or collection of tangible derivatives, such as biological samples or genetically altered organisms. These need not be described in your Data Management Plan, but consider the NSF policy from the AAG:
Unless otherwise provided in the grant, all legal rights to tangible property collected or created during NSF-assisted research remain with the grantee or investigators as determined by the policies of the organization. As members of the scientific and engineering community, both grantees and investigators are responsible for making such tangible property appropriately available to other researchers.

If your project will not generate data or samples, then your Data Management Plan document will consist of a statement to that effect, along with some explanation. Note that this statement will be evaluated by your reviewers.

What to include

So, what exactly constitutes “data,” and what kinds of samples must be shared and retained? These and many other questions must be answered as you prepare your Data Management Plan (DMP), and the basic NSF documents are of little help. Data management and sharing generates a lot of uncertainty among investigators, so NSF maintains a Frequently Asked Questions page on its website. And the answer to many of those questions is, “This will be determined by the community of interest.” Clearly, then, you will need to confer with colleagues and fellow experts when you have questions about how to write your DMP, and you should ask your PD to weigh in if necessary.

Here are some guidelines on how to proceed with the crafting of a DMP.

1. First, **acquire the specific guidelines issued by your directorate.** All of the directorates provide a directorate-specific document providing guidance in the development of a DMP, and all of these documents include at least a little more information than the GPG offers. In the Mathematics and Physical Sciences directorate, each division has a specific document.
If your application is going to a non-directorate division, such as the Office of Cyberinfrastructure, there is no specific document that you can use, so you must begin with the basic NSF instructions.

2. Next, **outline a DMP by identifying the kinds of data that you will generate** and the normal means by which such data are managed and shared. For example, if you know that you will generate DNA sequence data, outline how such data are typically stored and managed, and think about the public databases into which such data are typically deposited.

3. Based on your outline, **identify problems or questions that require further attention.** For example, you may be concerned that some of your data should not be shared publicly at all (due to privacy concerns) or that it shouldn’t be shared until your group has published its findings. NSF makes clear allowances for such issues, but you may wish to discuss them with other experts or with a PD.

4. **Ensure that your DMP clearly addresses the relevant questions posed by NSF.** Label sections accordingly. For example, include sections with these titles:

   a. Types of data and other materials to be produced;
   b. Standards to be used for data and metadata format and content;
   c. Policies for access and sharing;
   d. Policies and provisions for re-use, re-distribution, and the production of derivatives; and
   e. Plans for archiving data and other research products, and for preservation of access.

Again, your proposal may not need all (or any) of these sections.

5. **Remain reviewer-centered.** Focus on what you would want to know as a reviewer.
6. Think of the DMP as another opportunity to highlight the intellectual merit and broader impacts of your proposal. This is not some bureaucratic hurdle — it’s an essential part of your application, reviewed by your expert peers. Use it to emphasize the many ways in which your work will contribute to your field and to broader communities.
A Look at a DMP from a Successful Proposal

Keeping in mind the diversity of kinds of data and output from proposals in different disciplines, let’s look at an example of a DMP from a successful application, presented in its original format.

Example: Post-collapse community and social hierarchy in the Titicaca Basin, Peru: Survey and excavation at Machu Llacta

Data access plan

The results and the conclusions of the project will be disseminated through several means:

- **Scholarly publications.** Our expectation is to have published at least three articles in English and Spanish on the project within two years of the completion of fieldwork, and a book-length monograph on the site within five years of the completion of fieldwork.

- **Theses and dissertations.** Graduate students will be encouraged to join the project with a view to developing their doctoral dissertations from this or related data. While we recognize that dissertations don’t happen right away, data not written up within a set time frame (five to seven years from the end of the project) will “revert” to the PI and co-PI to be published in other venues.

- **Scholarly presentations.** We will present the work and results of the project at the SAAs, other professional conferences, and invited lectures.

- **Public lectures in Spanish** in Puno, Tiquillaca, and Vilque, during and after the project field seasons. This is an essential activity that demystifies the project and easily makes information available to the local and regional community at very low cost.

- **A small site exhibit** and walking tour brochures at the municipal building in Tiquillaca.

- **A bilingual project website.** Funds for the development and maintenance of the website are sought in this grant proposal. While the main pages will discuss the
project and its findings in general terms, researchers and interested students will also be able to access detailed data that can be stored and disseminated more easily and cheaply through the website than in any other way.

- Field reports submitted to the INC after each field season, as required by Peruvian law.

- Copies of all resulting publications will be given to the library at the Museo de Arqueología, Antropología y Historia del Perú in Lima (as required by law), the INC office in Puno, and the municipal library in Puno. Copies of Spanish-language publications will also be given to the municipal archive of Tiquillaca.

**Detailed data** from the project will also be made available:

- Through the website (see above).

- Through the development of the dataset for GIS instruction at the university level. A separate intramural grant will be sought to aid in the development and dissemination of databases and labs for instruction. (The dataset previously collected on intrasite architecture at Pukara has already been repurposed for a class on GIS in Archaeology, made available to GIS consultants and other GIS classes at the University of Virginia, and used in a colleague’s Spatial Data Analysis class.)

**Physical collections** will be curated, stored and made accessible to qualified outside researchers in an INC-supervised location after the analysis is complete, as required by Peruvian law. Since INC space in Puno is limited, the most logical resting place for them is at the Museo de Pukara. This newly restored and expanded museum has a permanent guard staff and ample storage, lodging, and lab space so that later researchers can visit and study the collections.

Things to note about this example:

1. The investigators are **specific** about their publication plans.

2. The DMP **highlights broader impacts**, by detailing dissemination efforts in both professional and lay communities.
3. Boldface and underlining are used to **direct attention to key themes**.

4. Through Spanish-language dissemination and use of data in courses, the investigators are targeting top NSF priorities, and their DMP allows them to **re-emphasize this fact** about their proposal.
CONCLUSION

Through effective description of your institutional environment, collaborators, and data management plan, you can enhance and highlight the intellectual merit and broader impacts of your proposal. By remaining reviewer-focused, you can transform these seemingly mundane and bureaucratic tasks into significant assets in your application. In the next chapter, we turn to the meat of your proposal: the Project Description.
CHAPTER 5:
DEMONSTRATING THE SIGNIFICANCE OF YOUR RESEARCH TOPIC

The meat of your proposal, where you describe in detail the activities you aim to undertake, is the Project Description. When you talk about writing a grant, it is almost certainly the Project Description you have in mind. It is the main attraction. It is the place where you make the case for your ideas and your plan.

There are some specific things you need to know as you tackle the Project Description, and we will discuss them in this chapter. But the main tools you will need are tools we have already emphasized in previous chapters. You will need to write clearly and succinctly; you will need to think like a reviewer and remain reviewer-focused; and you will need to specifically highlight the broader impacts of your work. This is why the chapter on the building of the main attraction is the fifth of seven — those tools are central to your success.

In this chapter, we will examine the requirements for this all-important section — the page limit, rules for the use of URLs, and inclusion of results from prior NSF grants. Then we will look at strategies for creating a compelling narrative, looking at examples from successful proposals and building on the strategies emphasized in previous chapters in this manual. We will conclude with some remarks on references cited, which (happily) are not included in your 15-page limit, and a brief look at renewals and at strategies for resubmission.
THE PROJECT DESCRIPTION: LENGTH AND RULES

Here are NSF’s length expectations for this section, from the GPG:

Brevity will assist reviewers and Foundation staff in dealing effectively with proposals. Therefore, the Project Description (including Results from Prior NSF Support, which is limited to five pages) may not exceed 15 pages. Visual materials, including charts, graphs, maps, photographs and other pictorial presentations are included in the 15-page limitation. PIs are cautioned that the Project Description must be self-contained and that URLs that provide information related to the proposal should not be used because 1) the information could circumvent page limitations, 2) the reviewers are under no obligation to view the sites, and 3) the sites could be altered or abolished between the time of submission and the time of review.

Conformance to the 15-page limitation will be strictly enforced and may not be exceeded unless a deviation has been specifically authorized.

What this means:

First, understand that you have 15 pages, and you cannot exceed that limit without explicit permission. That permission can come from one of two sources.

1. Some program solicitations explicitly specify different page limits.

2. You can obtain authorization from an Assistant Director or Office Head (or a designee thereof) of the relevant NSF organization.

In either case, if you do exceed the limit, you must provide either the program solicitation number or the name of the official who authorized the deviation. Clearly, the page limit is serious business.
Second, understand that you cannot steal extra space by providing key information online. While it is certainly appropriate to cite a URL as a reference, you must be careful to avoid using URLs to provide additional information about your research plan. The key standard is clear — the proposal should be self-contained, so that your reviewers can effectively evaluate it without reference to any other source.

Your references will be included in the References Cited section, which is not a part of the Project Description section and therefore does not count against your 15-page limit. In addition, you must describe Results from Prior NSF Support in this section, and that text does reduce the space available to detail your research plan.

Finally, refer to Chapter 3 for general formatting rules and guidelines, in the section entitled “BEFORE YOU BEGIN WRITING: NOTES ON FORMATTING.”

REMEMBER: The proposal should be self-contained.
THE PROJECT DESCRIPTION: CONTENT EXPECTATIONS

In the section of the GPG on how to prepare the Project Description, NSF begins by reaffirming its commitment to the two merit criteria, as you should expect. The description of the section’s content is as follows.

The Project Description should provide a clear statement of the work to be undertaken and must include: objectives for the period of the proposed work and expected significance; relation to longer-term goals of the PI’s project; and relation to the present state of knowledge in the field, to work in progress by the PI under other support and to work in progress elsewhere.

The Project Description should outline the general plan of work, including the broad design of activities to be undertaken, and, where appropriate, provide a clear description of experimental methods and procedures. Proposers should address what they want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified. These issues apply to both the technical aspects of the proposal and the way in which the project may make broader contributions.

The Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the proposed activities. Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to the project. NSF values the advancement of scientific knowledge and activities that contribute to the achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and
public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

The description concludes by noting that your data management plan is to be included elsewhere in the proposal, as we saw in the previous chapter.

**What this means:**

NSF provides little guidance on how to write the main body of your proposal. The one thing that NSF makes clear, again and again, is the centrality of the merit review criteria and, in particular, the broader impacts criterion. If you weren’t already convinced of the importance of weaving broader impacts into your project’s design, the fact that NSF devotes 2/3 of its instructions regarding the Project Description to a recitation of the broader impacts criterion should end all doubt. Indeed, beginning in 2013, you are now required to devote a separate and specific section of the Project Description to a description of the broader impacts of your activities.

So, before we explore strategies for designing, organizing, and writing the Project Description, it’s worth noting that it would be a serious mistake to tackle this section without having worked hard on creating broader impacts and including them among your project’s goals and activities.

**Including Results from Prior NSF Support**

NSF specifically requires you to report previous NSF funding and the outcomes and impacts of that work, within the Project Description. The instructions in the [GPG](#) are unusually specific.

**REMEMBER:**

The one thing that NSF makes clear, again and again, is the centrality of the merit review criteria and, in particular, the broader impacts criterion.
If any PI or co-PI identified on the project has received NSF funding (including any current funding) in the past five years, information on the award(s) is required. Each PI and co-PI who has received more than one award (excluding amendments) must report on the award most closely related to the proposal. The following information must be provided:

(a) the NSF award number, amount and period of support;

(b) the title of the project;

(c) summary of the results of the completed work, including accomplishments related to the Broader Impact activities supported by the award and, for a research project, any contribution to the development of human resources in science and engineering;

(d) publications resulting from the NSF award;

(e) evidence of research products and their availability, including, but not limited to: data, publications, samples, physical collections, software, and models, as described in any Data Management Plan; and

(f) if the proposal is for renewed support, a description of the relation of the completed work to the proposed work.

Reviewers will be asked to comment on the quality of the prior work described in this section of the proposal. Please note that the proposal may contain up to five pages to describe the results. Results may be summarized in fewer than five pages, which would give the balance of the 15 pages for the Project Description.
What this means:

It is not sufficient to merely mention previous NSF support in a section on preliminary data or on ongoing studies. You will surely do that in your Project Description, but note that NSF wants a specific report on the previous grant, including the award number, amount, and title. For this reason, most successful applications provide this information in a separate section of the Project Description. Reviewers will look for it, and are required to evaluate it, so you should make their job easier by providing it separately and clearly.

Some facts to note:

1. The requirement applies only to the grant most closely related to your current proposal, and only to grants in the previous five years. This does not mean that you should not discuss results from other grants. Indeed, you should be keen to demonstrate your past productivity by highlighting previous awards on related topics — this is an important way to demonstrate intellectual merit of your proposal. But you need only provide specific information on one previous grant.

2. The requirement applies to co-PIs as well.

3. Broader impacts are emphasized.

The section must be less than five pages long, and counts toward the 15-page limit. These limitations are probably unimportant; in most successful proposals, information on prior NSF support accounts for one page or less of text.

However, if your proposal seeks renewal of ongoing NSF support, this section becomes centrally important, and you will want to extensively detail the outcomes, impacts, and ongoing efforts from that previous grant. We will briefly explore renewal proposals near the end of this chapter.
OUTLINING AND ORGANIZING THE PROJECT DESCRIPTION

In Chapter 1, we discussed the importance of establishing objectives and hypotheses as anchoring points for your project, and the wisdom of creating an outline based on those objectives. And in Chapter 3, we explored the importance of the Project Summary and its role in guiding your subsequent writing. So, at this point, you should have a solid framework upon which to build the Project Description. Specifically, you should have some clear objectives and at least a rough plan for a set of activities to achieve those objectives. Ideally, both the objectives and the activities will be strongly linked to broader impacts that you can highlight early and often.

It may be that your outline is pretty solid, or that it is little more than a sketch in need of more work. In either case, it is worth considering the basic components that a good Project Description must include.

1. **You must clearly and explicitly identify your objectives.** Many successful proposals devote a separate section to this task, often at the beginning of the Project Description. In addition, many successful proposals use the objectives (or specific aims) to organize subsequent sections of the proposal. We will look at examples below, but for now it is enough to note that your proposal must emphasize the project’s objectives.

2. **You must place your objectives into the context of the state of the art in your field,** emphasizing the significance of your questions and your expected outcomes. You will do this by surveying current knowledge in the field and by discussing work in progress by your group or by others.

3. **You must make it clear that you have a specific plan of attack,** anticipating challenges and difficulties, aiming at specific outcomes and seeking to achieve specific broader impacts.
4. **You must make it clear that you are well qualified to achieve your objectives.** You will do this by summarizing your past or ongoing work and by detailing your expertise whenever you describe a challenging or new technique or activity that you propose to undertake.

**Choosing a Format for Your Project Description**

Successful NSF proposals employ various formats for the Project Description. In some cases, the format is fairly simple, with just one or two types of sections or headings. On the other hand, some effective formats involve several sections with layered subsections. The kind of format that is best suited to your proposal will depend in part on your discipline and the nature of your project, and in part on your personality and preferences. You should consider all of those factors as you decide on a format, but if you are unsure of what the reviewers are expecting, check with your PD.

**Project Description Formats from Successful Proposals**

The following examples come from successful applications in widely varying fields — the first three examples are from the same proposals used as examples in Chapter 3 to illustrate effective Program Summaries, presented in the same order. The examples illustrate organizational strategy by presenting the section headings employed by the investigators. In each case, the headings are in blue, interspersed with comments to explain or expand the way the authors use the section. Although we have changed the font (to Times New Roman in every case), we preserved the style (spacing, capitalization, punctuation) used by the investigator.

As you read these examples, keep this very important point in mind. **As of January 2013, NSF requires you to devote a separate and specific section to a discussion of broader impacts. Regardless of how you choose to format your Project Description, be sure to include such a section.**
Example 1: ROS as Mediators of Rapid Long-Distance Self-Propagating Signals

This proposal employs major headings, minor headings, and various subheadings, and is organized based in part on specific aims, which are roughly equivalent to research objectives. (The use of specific aims is common in biology-related proposals, and is mandated for NIH grants.)

**PROJECT DESCRIPTION**

Our long-term goal is to determine the mechanism and mode of regulation of rapid systemic signaling in plants.

*Our specific aims are:*

Each specific aim is stated in bold and expanded in a short paragraph.

**STATEMENT OF THE RESEARCH PROBLEM**

This section (about a page long) consists of three paragraphs establishing the knowledge gap, with each paragraph introduced by a subheading in bold face.

**RATIONALE AND SIGNIFICANCE**

This section is also about a page long, and consists of several paragraphs with these subheadings:

- Arabidopsis as a Model Plant for the Genetic Dissection of ROS Signaling.
- Relevance to Agriculture.
- Relevance to Cell Biology.
Relationship to Principal Investigator Long-Term Objectives.

Innovation.

Note that this section is specifically aimed at establishing intellectual merit (innovation, significance) and broader impacts (societal benefits).

PRELIMINARY RESULTS

This section is about four pages long and includes several figures. It begins with a numbered list of key findings.

WORK PLAN

This section is divided into three sections, one for each specific aim, with subsections as illustrated in this excerpt:

Aim 1. Use a genetic screen to clone genes involved in rapid systemic signaling: Can we identify the rapid signal?

Primary Objectives

1. Use a genetic screen to identify mutants impaired in rapid systemic signaling.

2. Clone and characterize genes required for rapid systemic signaling.
Perspective:

This is the main subsection. It begins with an introductory paragraph (the perspective) then provides details of the planned experiments.

Expected Results for Aim 1.

Potential Problems and Alternatives for Aim 1.

Future Directions for Aim 1.

RESULTS FROM PRIOR NSF SUPPORT

PLAN TO INTEGRATE RESEARCH AND EDUCATION

The Program Description ends with a one-paragraph estimated timetable for the proposed activities.

In this example, you can see that the investigator has strongly emphasized broader impacts by including an entire section on integration of research and education (nearly a page long in this case).

A major advantage of using specific aims as a framework for writing the Project Description is organization — the project’s key ideas and objectives are clearly emphasized, and the activities are presented systematically. A disadvantage of this approach is the potential for the section to appear complex and busy, with numerous fonts, headings, subheadings, and sub-subheadings. It is important, therefore, to think carefully about these things and to choose as simple an organization as possible. Be consistent in your use of fonts; for example, use bold face for all subheadings, without introducing italics or underlining on top of bold face to distinguish types of subheadings.

STRATEGY:
A major advantage of using specific aims as a framework for writing the Project Description is organization.
Example 2: Game theory and the geometry of Banach spaces

This proposal uses a simple but effective format, with three major headings and a small set of subheadings.

1. Project Overview

This brief section consists of two paragraphs: in one, the proposed work is summarized, and in the second, broader impacts are described.

2. Objectives

The PI presents the objectives in a brief bullet list.

3. Present state of knowledge and problems

Background information is presented in about a page of text. The rest of the section consists of numbered problems, each in a subsection labeled with the type of problem that is being considered. For example, one section consists of a two-page discussion labeled “Factorizations of operators” followed by the statement of two problems, Problem 2a and Problem 2b, in italics.

The three main headings are centered, while the subheadings are in bold and on the same line as the paragraph they introduce.
Example 3: Control of a Robotic Manipulator Via a Brain-Computer Interface

This proposal also uses a fairly simple format.

1 Problem Definition

This two-page section provides background information and focuses in on the knowledge gap and societal need.

2 Research Objectives

In about half a page, the investigators state their central hypothesis and list their three research objectives.

3 Key Participants

The main collaborators in the study are described in about a page.

4 Previous Work

The investigators’ previous findings are detailed in around three pages, in clearly labeled subsections.

5 Research Plan & Methodology

The section begins with an introductory paragraph noting that the work will be conducted in three phases, which are briefly explained.

5.1 Phase I

5.1.1 Robotic Interface Design
5.1.2 EcoG Feature Identification and Response Characterization

This section includes subsections labeled in bold face as part of each paragraph.

5.2 Phase II

5.3 Phase III

The subsections in 5.2 and 5.3 are similar to those in 5.1.

6 Assessment Metrics

7 Project Coordination and Management Plan

8 Proposed Schedule, Milestones, and Potential Impediments

9 Expected Outcomes, Intellectual Merit, & Broader Impacts

9.1 Intellectual Merit

9.2 Broader Impacts

10 Results from Prior NSF Support

In this example, the investigator uses relatively few subheadings, and numbers them clearly. Headings and subheadings are in bold face, and font use is consistent and clear.

References to the merit criteria are explicit. The section on Key Participants is not required, but the investigators have used it to highlight their qualifications, a central aspect of intellectual merit. Note that instead of using specific aims to organize the research plan, this group has divided their project into phases. Although each phase is associated with a particular objective, the research plan is
organized chronologically, a subtle distinction from a focus on aims. If your project involves sequential goals or phases, a format like this one may help you keep your Project Description clear and organized.

**Example 4: Parasites and the evolution of mating systems: do parasites drive complex behavior in animals?**

This example is worth looking at for at least two reasons. First, it employs a simple and effective formatting strategy that we haven’t seen yet. Second, it includes a section responding to reviews of a previous submission. (Strategies for resubmission of proposals are discussed later in this chapter.)

**I. INTRODUCTION**

This section includes three paragraphs, labeled as follows.

**Overview.**

Response to reviews. Here, the PI lists areas of weakness identified by previous reviewers, then summarizes changes made in response to these criticisms.

Results of prior NSF support.

**II. BACKGROUND**

This two-page section develops the basic research questions, with background information, then briefly outlines the research plan. Key points are presented in bold, directing the reviewers’ attention to important concepts, hypotheses, research questions, and a statement of impact: “**By linking these three research components, this project represents a powerful test of a novel conceptual**
framework that interweaves parasite transmission dynamics with mating system theory.”

III. RESEARCH PLAN

A. The Study System

This one-page section describes the unique experimental system and its useful features.

B. The Hypotheses

Each major hypothesis is presented in a paragraph, beginning with the hypothesis stated in bold and ending with a specific prediction stated in italics.

C. Study Design

This section, seven pages long, introduces the various approaches to be used in the study and describes how each will be employed to address the hypotheses. Notice that the section is not organized by hypothesis or by expected chronology, but that each subsection includes information on data analysis and (where necessary) on expected outcomes. The specific paragraph headings are listed here so you can see how the investigator organized the subsections.

Component 1. Longitudinal observations: patterns of association between male behavior and parasite infection

    Individual identification of study subjects

    Territorial status and reproductive effort

    Parasitological methods and sampling
Data analysis

Data interpretation and alternative outcomes

**Component 2.** Experimental studies: parasite effects on male decision-making, behavior and mating success

- Anthelmintic treatment
- Bachelor male experiment
- Territorial male experiment
- Behavioral observations

Data analysis

Data interpretation and alternative outcomes

**Component 3.** Field and physiological studies: mechanisms underlying associations between mating behavior and parasite infection

a. Field studies

- Mapping territories
- Estimating focal pellet group and larval densities
- Midden removal experiment

Data analysis
b. Physiological studies

- Hormone assays and methodology
- Fecal sampling and hormone extraction
- Hormones, behavior and parasites
- Data analysis
- Data interpretation and alternative outcomes

**Personnel**

This paragraph was probably included to address previous reviewer concerns. If you suspect that your proposal will raise questions among reviewers regarding the ability of your team to accomplish your objectives, or if you believe that the composition of your team is a key asset, you may choose to highlight your personnel in the Project Description, as was done here and in Example 3 above.

**IV. EDUCATION PLAN**

This section is a page and a half long, and details the investigator’s planned efforts to integrate education and research. It ends with a paragraph on assessment of educational outcomes.

**V. SUMMARY**

A final paragraph summarizes the proposal and includes a sentence in bold that explicitly asserts the intellectual merit of the work: “The work outlined in this proposal is based on strong theoretical foundations and represents a novel and timely investigation of the role parasites play in shaping complex animal behavior.”
In this example, judicious use of headings and subheadings, bold type, summary statements, and concept-based organization makes for a Project Description that is easy to follow and that points to important merit review-related information in a way that guides the reviewer.

**STRATEGY:**
Judicious use of headings and subheadings, bold type, summary statements, and concept-based organization makes for a Project Description that is easy to follow.
WRITING THE PROJECT DESCRIPTION

With a good outline, and a solid plan for organizing your Program Description, you are ready to begin writing the narrative. Here are ten guidelines to follow as you write; some of them should sound quite familiar.

1. To remain reviewer-centered, regularly read your narrative as a reviewer would. Write for the reviewers and for no one else.

2. Keep the review criteria in mind at all times. Using bold or italic fonts, occasionally emphasize points that specifically address intellectual merit (e.g., innovation, advance, your qualifications) or broader impacts.

3. When it comes to the merit criteria, don’t hesitate to state the obvious. Go ahead and write: “Our proposal is particularly well resourced...” or “These experiments will transform our understanding of...” As Michael Lesiecki puts it, “Help the reviewer do her job.”

4. Provide summary paragraphs throughout the proposal, to help the reviewer follow your logic and to emphasize intellectual merit and broader impacts.

5. Provide key background information, but recall Tom Statler’s advice: you are writing a grant proposal, to be read by experts; you are not writing a review article.

6. Anticipate problems or weaknesses, and address them explicitly.

7. Break up the text, if you can, with figures or text boxes or just a little white space. This can make your Project Description look more like an interesting, readable story and less like a chore for the reviewer.
8. **Write your first draft without worrying about the page limit**, focusing instead on clarity while always thinking like a reviewer.

9. **Look for opportunities to highlight your expertise**. Your qualifications are an important intellectual merit consideration, so you want to remind the reviewer (on occasion) that you and your team are more than capable of doing the work. As mentioned earlier in this chapter, a good place to do this is whenever you know that you are proposing an activity that is notably challenging or novel.

10. **Keep your team and your advisors or mentors involved**. Get their feedback as the Program Description takes shape, and insist that they evaluate the research plan as a tough reviewer would.

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**Keeping the Project Description Under 15 Pages**

It is likely that your first draft, and perhaps several subsequent drafts, will be more than 15 pages long. (Maybe this section should be called “Getting the Project Description under 15 pages.”) If/when that is the case, begin by determining the nature of the problem.

1. **The section might be too long because your writing is too wordy.**

   First, consider the obvious possibility that you have been a bit too extravagant in your descriptions, and that your prose could profit from some serious editing. In these situations, you may find that others are better at spotting the fat than you are.

   Consider looking first at sections that provide background information, keeping in mind that the reviewers are experts who do not want or need to read the basics of your topic. And try some of these suggestions.
• **Look for ways to offload some of your background or methodological descriptions to the references.** You may be able to reduce a paragraph of technical detail to a sentence like this: “Measurements and analysis will be performed using well-established methods (Smith, 2008; Jones et al., 2010).”

• **Watch for unnecessary repetition**, of descriptive phrases or of technical details. If a particular phrase recurs several times, try an abbreviation, or consider providing a name for the procedure or detail being discussed. Try to avoid repeating technical details (such as “…using a McGarrity-Trieseldorf decondenser…”) — when “as before” will work just as well. Removing wordiness will also make your proposal easier to read.

• **Resist the temptation to squeeze an overlong narrative into the available space** using formatting tricks (by shrinking caption fonts, for example) or using URLs or references in the place of important explanation. If you just need a few lines, first work hard at tightening your prose.

• If your Project Description just barely fits, and looks like it was jammed into the available space so as to effectively cover the page with ink, **endeavor to shorten it so that it looks more like an efficient, carefully written 15-page narrative.** Remember that you want to make the reviewer’s job as easy as possible. Try to present her with a document that isn’t unnecessarily hard on the eyes.

2. **The section might be too long because your proposal is too ambitious.**

It may not be too late to consider the possibility that your narrative reflects the scope of your proposal, and that the work you propose is either excessively grandiose or excessively complex. In other words, it could be that you need to either scale back the project, or reorganize it so that the various activities mesh well. If you need more than three or four total pages (anywhere in the proposal) to explain the background and significance of the activities, then it may be that
something is wrong with your plan.

Take some time to think about whether downsizing, simplifying, or both can get you closer to a shorter and tighter Project Description. Confer with your team and be sure that someone other than you has read the narrative carefully.
USING REFERENCES WISELY

As mentioned above, the References Cited section is not subject to a page limit. Here are the instructions for this section, from the GPG:

Reference information is required. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. If the document is available electronically, the website address also should be identified. Proposers must be especially careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. While there is no established page limitation for the references, this section must include bibliographic citations only and must not be used to provide parenthetical information outside of the 15-page Project Description.

If there are no references cited, a statement to that effect should be included in this section of the proposal and uploaded into FastLane.

What this means:

1. There are no specific formatting requirements for the section, so you should format citations according to the norms in your field. Note especially that there are no requirements for formatting of citations in the text, so you are free to use numbers, parenthetical citations, or superscripts, again deferring to accepted practices among your colleagues.

2. You are free to provide URLs for references available online, but this is not a strict requirement. NSF provides the following clarification of this point:

If the proposer has a website address readily available, that information should be included in the citation, as stated above. It is not NSF’s intent, however, to place an undue burden on proposers to search for the URL of every referenced
Publication. Therefore, inclusion of a website address is optional. A proposal that includes reference citation(s) that do not specify a URL address is not considered to be in violation of NSF proposal preparation guidelines and the proposal will still be reviewed.

This odd equivocation is meant to relieve you of any obligation to acquire an URL for all of your citations, and you should not consider it a high priority to find URLs for citations that no reviewer would ever need to hunt down. On the other hand, if you suspect (or hope) that the reviewers will look at certain references, it is a very good idea to make every effort to find URLs for those. Remember that you want to help the reviewer do her job.

3. While it is a good idea to use references in the place of unnecessary descriptions of background information or methodological detail, you must avoid providing non-bibliographic information in this section, and be careful to ensure that your proposal is essentially self-contained. For example, note the difference between “Levels of X will be assessed using well-established procedures (described in Smith, 2010)” and “See Smith (2010) for a description of our procedures.” The reviewer should be reasonably expected to understand your proposal without referring to several references. Again, when in doubt, put yourself in the reviewer’s shoes and ask whether you would be annoyed by the extent to which you feel compelled to look something up, as opposed to being occasionally curious about the details of your proposal.

**TIP:**
When in doubt, put yourself in the reviewer’s shoes and ask whether you would be annoyed by the extent to which you feel compelled to look something up.
SPECIAL INSTRUCTIONS FOR RENEWALS AND RESUBMISSIONS

In this section, we will look at procedures for submitting a renewal proposal - to fund ongoing work on a project - and for resubmitting a proposal that was unsuccessful on the first try.

Two Completely Different Options for Preparing a Renewal Proposal

NSF does accept proposals for renewed funding of an ongoing project, and offers two distinct ways to put the application together. Here are the guidelines for renewal proposals from the GPG.

A renewal proposal is a request for additional funding for a support period subsequent to that provided by a standard or continuing grant. A renewal application competes with all other applications and must be developed as fully as though the applicant is applying for the first time. Renewal proposals must be submitted at least six months before additional funding is required or consistent with an established deadline, target date or submission window. In preparing a renewal proposal, proposers should assume that reviewers will not have access to previously submitted versions of the proposal. Please note the National Science Board strongly endorses the principle that all expiring awards are to be recompeted.

All proposals for renewed support of research projects, from academic institutions only, must include information on human-resources development at the postdoctoral, graduate and undergraduate levels as part of Results from Prior NSF Support. This may involve, but is not limited to, the role of research in student training, course preparation and seminars (particularly for undergraduates). Special accomplishments in the development of professional scientists and engineers from underrepresented groups should be described. Graduate students who participated
in the research should be identified by name. This requirement does not apply to non-academic organizations.

PIs are encouraged to discuss renewal proposals with the program prior to submission of a proposal. Unless precluded by individual program requirements, PIs may choose either of the following two formats for preparation of a renewal proposal. Both types of renewal proposals must be submitted electronically via the NSF FastLane System.

A. Traditional Renewal

The “traditional” renewal proposal is developed as fully as though the proposer were applying for the first time. It covers all the information required in a proposal for a new project, including results from the prior work. The 15-page limitation on the project description applies.

B. Accomplishment-Based Renewal

In an “Accomplishment-Based Renewal” (ABR) proposal, the Project Description (including the Results from Prior NSF Support) is replaced with the following items:

- copies of no more than six reprints of publications resulting from the research supported by NSF (including research supported by other sources that is closely related to the NSF-supported research) during the preceding three to five year period. Of the six publications, two preprints (accepted for publication) may be included;

- information on human resources development at the postdoctoral, graduate and undergraduate levels; and

- brief summary (not to exceed four pages) of plans for the proposed support period.
All other information required for NSF proposal submission remains the same.

It must be clearly indicated in the proposal that it is an ABR submission and the box for “Accomplishment-Based Renewal” must be checked on the proposal Cover Sheet. ABR proposals may not be submitted for consecutive renewals.

PIs are advised that the ABR is a special type of renewal proposal appropriate only for an investigator who has made significant contributions, over a number of years, in the area of research addressed by the proposal. Investigators are strongly urged to contact the cognizant Program Officer prior to developing a proposal using this format.

**What this means:**

Technically speaking, you do have two options when seeking renewed funding for your ongoing work. The first option is to write a new proposal, which will compete for funding in the same way as your previous proposal(s) did. The second option is the very interesting ABR renewal, in which the Project Description is constructed from published work arising from the previous funding.

Note, however, that according to some experts, ABR renewals are quite rare in practice. And NSF makes it clear that these renewals are meant for established, successful investigators. **If you think an ABR renewal might make sense for you, be sure to discuss this with a PD.**

In all likelihood, you will seek renewal in the more traditional way: you’ll write a new proposal, highlighting your excellent new ideas and your track record from your previous grants. This process is not different from that described in this manual.
How Renewals Differ at NSF and NIH

It is widely agreed that renewals are viewed differently at NSF as compared to NIH. Renewals at NIH are generally thought to have a significant advantage over new applications, whereas this is not the case in most if not all divisions at NSF.

If you are a new applicant, take heart: your proposal should be viewed as essentially equal to those of investigators seeking their third consecutive renewal.

If you are seeking renewal, this simply means that you must not assume that you will enjoy any advantage as a returning investigator. Your proposal will be judged on its merits, and any advantage you have will result from your successful work in the past.

Resubmitting a Proposal that Was Not Funded the First Time

As we saw in Chapter 1, the average success rate across NSF divisions is 22%. So initial failure - called declination - is not uncommon. If your proposal is declined, you have three options.

1. You may conclude that the ideas in the proposal should be abandoned, in whole or in part, and decide to start over with a new set of ideas and objectives.

2. You may conclude that the proposal was not judged correctly or fairly, and pursue a process called reconsideration. This process is described in the GPG and, as you might guess, begins with a conversation with the PD. Reconsideration is beyond the scope of this manual, but you should keep the option in mind if you are not satisfied with the reviews of your proposal.
3. You may conclude that the proposal can be retooled with the reviewers’ critiques in mind, and that it can compete successfully upon revision. So you may opt for **resubmission**.

As with renewals, you will enjoy no particular advantage upon resubmission. Your application will be put in the hopper with all the others, and considered solely on its merits. And as with renewals, this stance distinguishes NSF from NIH, where resubmissions tend to be considered somewhat differently.

However, if you choose to resubmit, you do have one specific asset that you did not have before: criticisms and suggestions from actual reviewers. Although NSF does not provide statistics on success rates for resubmitted proposals, it is well known that such proposals do better than new applications. It should be obvious why this is the case: the review process should reveal ways in which the proposal can be strengthened.

So, if you have been declined, consider these suggestions for identifying your next steps.

1. **Read the reviewers’ comments carefully**, and share them with your mentors and team members as appropriate.

2. You are likely to be disappointed and frustrated at first, so **take some time to recover from the unpleasant news, then mull the comments at some length**. Try to separate your consideration of the critiques from the stress and disappointment that is sure to be a part of the situation.

3. **Schedule a conversation with your PD**, in which you can explore these basic questions:

   - What were the core problems with the proposal?

   - How likely is it that these problems can be solved?
• What solutions make the most sense?

Note that the solutions may be as simple as adding some new broader impacts, or clarifying some technical issues. Or they may be as drastic as discarding most of the objectives, or moving the proposal to a different division or directorate. Expect your PD to be blunt. If necessary, invite her or him to be straightforward with you; the PD is the chief decision-maker, after all, and is likely to have significant insight into the prospects for a resubmission.

4. Based on the results of your debriefing with the PD, conduct a thorough postmortem on the proposal. Were your mistakes minor, or were there some significant weaknesses in the proposal? Were these mistakes the result of a major oversight, and how can this be remedied? Do you need another mentor, or a collaborator? Or just a proofreader? Should you pursue reconsideration?

5. Finally, no matter how you proceed, be sure that you profit from the criticisms of the reviewers. However disappointing or infuriating the review process turns out to be, it would be a mistake to completely ignore feedback from experts who almost certainly volunteered their time to read and consider your proposal.
CONCLUSION

The Project Description is the main event, and you want your ideas and objectives to perform well. So spend some time reflecting on the best way to organize the section, and consider the examples in this chapter as you design your narrative. Keep the review criteria ever before you, and don’t hesitate to state the obvious or to shamelessly promote your planned activities. Take one last look at the kinds of broader impacts that NSF prefers.

If your proposal is declined, get good advice and look for the ways in which the review process can make your proposal better.

At this point in the manual, we have discussed the “fun part” of writing a grant: brainstorming, designing a project, writing a narrative description. But there’s more to do — and it’s the kind of work that earns the dreaded descriptor “bureaucratic.” So, in the next chapter, we will look at budgeting and at other special sections that you may need to include in your proposal.
CHAPTER 6:
BUDGETING AND SPECIAL TOPICS

If the Project Description is the “main event,” then the budget and the preparation of supplementary materials must seem like sideshows or petty annoyances. But in fact, these elements are fundamental components of your application. Putting together a clear and well-justified budget requires careful thought — the same kind that is necessary to generate a strong and compelling research proposal.

In this chapter, we will consider concepts and recommendations in preparing budgets, and look at examples of budget justification narratives from successful proposals. Then we will examine some of the special considerations that you may need to disclose or document in your proposal.
CREATING AND JUSTIFYING YOUR BUDGET

Designing the budget for your NSF proposal need not be an overly daunting or stress-inducing task. Many aspects of the budget will emerge somewhat automatically from the outlining and planning of your activities. This means that the preparation of the budget is best accomplished in parallel with the development of the proposal and the planning of its goals and activities. If you know early on that you intend to hire a postdoctoral fellow to perform some of the research, or that you will need to acquire a specific instrument to accomplish a critical objective, then it is wise to begin gathering necessary information (price quotes, for example) early in the grantwriting process.

NSF budgeting procedures are fairly straightforward, and you will find few of the guidelines and requirements to be surprising. Note, however, that the modular budgeting option that is so popular at NIH is not available to you at NSF. Your budget must be specific, for each year of funding that you are requesting, and must be accompanied by explicit justification.

Designing a Budget: Basic Considerations

Before delving into expectations and guidelines for creating your budget, consider these overall principles and strategies.

1. While your budget will not be specifically assessed by reviewers, it can affect your proposal’s success and it will be examined by the Program Director.

Peer reviewers are charged with judging your proposal according to the merit review criteria, which do not refer to budgetary considerations. However, recall that the soundness of your research design is a major consideration in the evaluation of intellectual merit. The quality of your budget — the extent to which it
appears carefully reasoned and appropriately scaled — can significantly influence a reviewer’s perception of the strength of your proposal.

Providing an appropriate level of detail indicates thoughtful attention to the means by which your objectives will be achieved. So, experts such as Michael Lesiecki recommend that you be sure to “flesh out your budget’s details.” For example, briefly explain the travel budget (certain meetings at certain times, with estimated costs) or the publication budget (specific fees for publishing in chosen journals). These efforts reinforce the perception that you have a clear plan.

Conversely, a bloated or overly detailed budget can reinforce the perception that your proposal is “too ambitious.” Such a criticism is unlikely to originate solely in a wordy budget section. However, if your final budget numbers seem high — compared to similar grants or to average awards in the field — and if you know that your proposal is on the complicated side, take care to address the perception (or the reality) that you are overreaching.

In addition to these reviewer-centered considerations, note that the Program Director will review your budget and can negotiate it with you during the review process. We will briefly discuss this possibility in Chapter 7.

2. Keep in mind that some budgeting decisions are not up to you. Issues such as cost sharing and indirect cost rates, which you must include in your budgeting process, are negotiated between your institution and NSF. This is likely to be true of salary figures and some other parameters that are specific to your institution.

3. Assume that you will need some administrative help to prepare your budget, and arrange for that help in advance. For example, if you are requesting funds for salaries, you will need to know whether the costs of your employees’ fringe benefits are included in indirect costs (so-called overhead) at your institution or should be included in your budget as direct costs. Grant administrators at your institution can easily convert many of the more mystifying aspects of your budget
into trivial matters, so be sure to enlist their help before you sit down to grind out the details.

**4. Be willing to spend some time and effort on your budget** — in other words, don’t pass it off as a mere formality. Take the time to think carefully about everything you need for your research to be fruitful, and then ask for exactly what you need. As Dr. Lesiecki notes, “This is what the reviewer wants to see — a realistic budget instead of made-up numbers.”

Dr. Joseph Brennan, a former NSF Program Director, noted that preparing a budget is at once simple and complex. He identifies one key principle, with a major qualification, for developing a budget.

The simple solution to the question of budgeting is: **The budget should be sufficient to attain all of the objectives of the proposal.** There is an additional caveat. **The amount requested should conform to the pre-established award sizes, or be comparable to program awards of similar complexity.** (From “NSF Proposal Preparation: The View of an Ex-Program Officer,” Notices of the AMS 54: 1153-1157, 2007.)

Dr. Brennan’s caveat raises the important question: how can you determine pre-established award sizes or see budgets from previous awards of similar complexity? Pre-established award amounts may be disclosed in a Program Solicitation, so look there first if your proposal is in response to a solicitation. Otherwise, ask your PD for guidance on these questions.

**5. Be aware of NSF’s expectations for budget items,** as described in the [GPG](#):

The proposal may request funds under any of the categories listed so long as the item and amount are considered necessary, reasonable, allocable, and allowable under the applicable cost principles, NSF policy, and/or the program solicitation. Amounts and expenses budgeted also must be consistent with the proposing
organization’s policies and procedures and cost accounting practices used in accumulating and reporting costs.

Budget Categories: Descriptions and Policies

You will enter your budget in the FastLane system, which will generate a form automatically. You will provide entries in the following categories:

- Salaries and wages for senior personnel (PIs)
- Salaries and wages for other personnel (fellows, students, staff)
- Fringe benefits
- Equipment
- Travel
- Participant costs
- Materials and supplies
- Publication costs
- Consultant services
- Computer services
- Subawards
- Other

In the sections to follow, we will look at guidelines and policies for budgeting in each of these categories, ending with some examples of items that would appear in the mysterious “Other” category.
Budgeting Salaries and Wages: Senior Project Personnel

This is one of the more complicated components of the budgeting process, as there are some important NSF policies to follow while navigating your institution’s policies and expectations. NSF places clear limits on the extent to which it will fund salaries, especially for PIs and other senior project personnel. From the GPG:

NSF regards research as one of the normal functions of faculty members at institutions of higher education. Compensation for time normally spent on research within the term of appointment is deemed to be included within the faculty member’s regular organizational salary.

As a general policy, NSF limits salary compensation for senior project personnel to no more than two months of their regular salary in any one year. This limit includes salary compensation received from all NSF-funded grants. This effort must be documented in accordance with the applicable cost principles. If anticipated, any compensation for such personnel in excess of two months must be disclosed in the proposal budget, justified in the budget justification, and must be specifically approved by NSF in the award.

NSF award funds may not be used to augment the total salary or salary rate of faculty members during the period covered by the term of faculty appointment or to reimburse faculty members for consulting or other time in addition to a regular full-time organizational salary covering the same general period of employment. Exceptions may be considered under certain NSF programs and must receive the prior written approval.

Note that the same principles apply toward other types of institutions.
What this means:

NSF will cover the equivalent of a summer salary for a full-time academic researcher, but rarely funds anything more than that. If you intend to ask for more than 2 months’ salary for any principal investigator or other senior project personnel, discuss the matter with your Program Director well in advance. For a reminder of what is meant by “senior project personnel,” see Identifying “senior project personnel” in Chapter 3.

A Note on Cost Sharing

NSF forbids voluntary cost sharing, which occurs when someone is working “for free.” Do not enter nonzero amounts of effort without corresponding costs. (It is fine to enter zero person-months, and zero pay.) If you are unsure of whether your reports of effort are related to cost sharing, discuss the matter with a qualified administrator at your institution or ask your PD for guidance.

Budgeting Salaries and Wages: Other Personnel

NSF is reluctant to pay the salaries of PIs, but students, fellows, and dedicated staff are a wholly different matter.

Adding students, fellows, and technical staff to your budget is straightforward. Here are the relevant guidelines from the GPG:

For postdoctoral associates and other professionals, the total number of persons for each position must be listed, with the number of full-time-equivalent person-months and total amount of salaries requested per year. For graduate and undergraduate students, secretarial, clerical, technical, etc., whose time will be charged directly to the project, only the total number of persons and total amount of salaries requested per year in each category

REMEMBER: Do not enter nonzero amounts of effort without corresponding costs.
is required. Salaries requested must be consistent with the organization’s regular practices. The budget justification should detail the rates of pay by individual for senior personnel, postdoctoral associates, and other professionals.

The budget may request funds for support of graduate or undergraduate research assistants to help carry out the proposed research. Compensation classified as salary payments must be requested in the salaries and wages category.

**What this means:**

While you need not provide a lot of detail regarding most staff salaries, note that you must specify the rates of pay for professionals, meaning PIs, postdocs, and “other professionals.” This latter category is left undefined by NSF, but clearly includes those with technical expertise and/or advanced degrees who are named co-PIs or collaborators (or the equivalent). If you have any doubt about whether a particular team member is a “professional,” either consult your PD or just provide the information.

**Budgeting Administrative and Clerical Salaries**

Note that NSF has specific policies regarding the funding of salaries for administrative or clerical staff, stated clearly in the GPG:

In most circumstances, particularly for institutions of higher education, salaries of administrative or clerical staff are included as part of indirect costs. Salaries of administrative or clerical staff may be requested as direct costs for a project requiring an extensive amount of administrative or clerical support and where these costs can be readily and specifically identified with the project with a high degree of accuracy. Salaries for
administrative or clerical staff shall be budgeted as a direct cost only if this type of cost is consistently treated as a direct cost in like circumstances for all other projects and cost objectives. The circumstances for requiring direct charging of these services must be clearly described in the budget justification. Such costs, if not clearly justified, may be deleted by NSF.

**What this means:**

Salaries for administrative and clerical staff can only be included in your budget when and if the position is clearly and exclusively linked to the project. General clerical support is not eligible for NSF funding. For example, while it is not appropriate to request funding to cover the salary of the administrative manager of your laboratory, it is appropriate to include the salary of an administrative assistant to manage data or collections that are specific to your proposed project. In the GPG, NSF points to additional sources of information on this topic (such as the AAG), and you should refer to these materials if you have any doubt about whether to include administrative or clerical salaries in your budget.

**Budgeting Fringe Benefits for Employees**

The cost of non-salary benefits (health care, Social Security, other payroll deductions) for your employees should be included in your budget. Of course, you can include only those costs associated with budgeted salaries. Amounts are calculated according to your institution’s typical accounting practices.

**Budgeting Costs of Equipment**

The acquisition of a key instrument or apparatus may be one of your major goals in seeking NSF support, so this is likely to be an important part of your budget. Here are the relevant guidelines from the GPG:
Equipment is defined as an item of property that has an acquisition cost of $5,000 or more (unless the organization has established lower levels) and an expected service life of more than one year. It is important to note that the acquisition cost of equipment includes modifications, attachments, and accessories necessary to make the property usable for the purpose for which it was purchased. Items of needed equipment must be adequately justified, listed individually by description and estimated cost.

Allowable items ordinarily will be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose equipment, such as a personal computer and office furnishings, are not eligible for support unless primarily or exclusively used in the actual conduct of scientific research.

What this means:

An item budgeted in this category will have these characteristics:

- It costs more than $5000
- It has a usable life of longer than 1 year
- It has a research-specific purpose
- The functionality is not already available to you

Your budget entry must include solid justification and a specific description with an estimated cost. Importantly, note that the cost of the equipment includes everything necessary for it to be useful to you in your project — installation, taxes, and shipping are all part of the cost of the item.
If you need an instrument that costs less than $5000, you will include it in the “Materials and supplies” section of your budget, described below.

There are two main exclusions applied to equipment: the item must not be already available, and must not be a “general-purpose” item. However, items that seem to be excluded can be readily justified under various circumstances. For example, you may be able to justify requesting funds for a second instrument of some kind for your lab, if it is clear that the proposed research requires more access to the instrument’s function than your current capacity can provide. Similarly, a laptop computer — that would be considered general-purpose equipment under most circumstances — can be reasonably justified when it will serve a dedicated purpose in the project. (Note, however, that a laptop computer is unlikely to cost $5000, and may fit better in the “Computer services” section of the budget, described below.)

**Budgeting Travel Costs**

Travel is an essential part of many research projects. NSF has some specific expectations for travel budgets, as described in the GPG:

Travel and its relation to the proposed activities must be specified and itemized by destination and cost. Funds may be requested for field work, attendance at meetings and conferences, and other travel associated with the proposed work, including subsistence. In order to qualify for support, however, attendance at meetings or conferences must be necessary to accomplish proposal objectives, or disseminate its results.

Allowance for air travel normally will not exceed the cost of round-trip, economy airfares. Persons traveling under NSF grants must travel by US-Flag Air carriers, if available.

**TIP:**
You may be able to justify requesting funds for a second instrument of some kind for your lab, if it is clear that the proposed research requires more access to the instrument’s function than your current capacity can provide.
Domestic Travel line item

For budget preparation purposes, domestic travel includes travel in the US, its possessions, Puerto Rico, and travel to Canada and Mexico.

Foreign Travel line item

Travel outside the areas specified above is considered foreign. The proposal must include relevant information, including countries to be visited (also enter names of countries on the proposal budget), dates of visit, if known, and justification for any foreign travel planned in connection with the project.

What this means:

There are three key issues to keep in mind when budgeting travel.

- Travel must have a specific purpose — to conduct research or to disseminate results.

- Travel must be itemized and justified, and separately budgeted for domestic and foreign trips.

- Air travel must be via American carriers (when possible) in economy class.

The last requirement (that NSF-funded air travel use US-flag carriers) might seem odd. It results from the Fly America Act of 1978 and applies to all federal government divisions and agencies. This requirement applies regardless of cost differential, convenience, or institutional preference. Fortunately, if you are forced to complete a leg of your journey on a non-American airline (due to a flight cancellation or other glitch), you will not be in trouble. But otherwise, be sure to book all federally funded travel on American carriers.
Finally, note that this budget category should be used for long-term travel to work sites. In cases that involve a stay of six months or longer, you may be able to include travel and expenses for dependents. See the GPG for specific guidelines, and/or consult with administrators at your institution.

**Budgeting Costs for Program Participants**

Your proposal may include programs that involve travel, meals, lodging, or other expenses for people (typically students and trainees) participating in project-related activities. For example, if you are running a technical workshop for fellows or trainees, you will request funds for their travel, lodging, and meals in this section. Things get most interesting when the participants are employees of an institution. Here are the NSF guidelines, from the GPG:

This budget category refers to costs of transportation, per diem, stipends and other related costs for participants or trainees (but not employees) in connection with NSF-sponsored conferences, meetings, symposia, training activities and workshops. For some educational projects conducted at local school districts, however, the participants being trained are employees. In such cases, the costs must be classified as participant support if payment is made through a stipend or training allowance method. The school district must have an accounting mechanism in place (i.e., sub-account code) to differentiate between regular salary and stipend payments.

**What this means:**

You cannot get funds to cover the expenses of your institution’s employees participating in an NSF-sponsored activity, unless the project involves training of teachers.
NSF does not permit per diem allowances for local participants, although you can provide meals and coffee breaks for all participants. If some or all of your participants are already supported by federal funds, take note of these additional rules from the AAG:

Participant support allowances may not be paid to trainees who are receiving compensation, either directly or indirectly, from other Federal government sources while participating in the project. A non-NSF Federal employee may receive participant support allowances from grant funds provided there is no duplication of funding of items and provided no single item of participant cost is divided between his/her parent agency and NSF grant funds.

These are important things to keep in mind when estimating costs of your activities (if any) that involve outside participants, but remember that you are only providing estimates at this point. When you run your event or activity, you will want to revisit NSF’s rules and expectations before providing per diem allowances to your participants.

**Budgeting for Materials and Supplies**

This section of the budget will require significant planning in many lab-oriented proposals. Here is where you will estimate your costs for consumables and supplies that may include small instruments and tools. NSF has little to say in the GPG:

The proposal budget justification should indicate the general types of expendable materials and supplies required. Materials and supplies are defined as tangible personal property, other than equipment, costing less than $5,000, or other lower threshold consistent with the policy established by the proposing organization. Cost estimates must be included for items that represent a substantial amount of the proposed line item cost.
Although NSF requires cost estimates only for “items that represent a substantial amount” of your total, it is a good idea to provide an outline of the kinds of items included in this category and the estimated costs of each type of item.

**Budgeting for Costs of Publication, Storage, and Dissemination**

Note that this category includes a variety of expenses associated with reporting and disseminating your results, including costs associated with storage and preservation of specimens or products of your research. From the GPG:

The proposal budget may request funds for the costs of documenting, preparing, publishing or otherwise making available to others the findings and products of the work conducted under the grant. This generally includes the following types of activities: reports, reprints, page charges or other journal costs (except costs for prior or early publication); necessary illustrations; cleanup, documentation, storage and indexing of data and databases; development, documentation and debugging of software; and storage, preservation, documentation, indexing, etc., of physical specimens, collections or fabricated items.

**Budgeting for Consultants**

Your project may require you to pay outside experts as consultants. NSF provides specific and stringent guidelines for this practice.

Consultants are members of a particular profession or possess a special skill and who are not officers or employees of the performing organization. Costs of professional and consultant services are allowable when reasonable
in relation to the services rendered. Payment for consultant services should be comparable to the normal or customary fees charged and received by the consultant for comparable services, especially on non-government contracts and grants.

Anticipated consultant services must be justified and information furnished on each individual’s expertise, primary organizational affiliation, normal daily compensation rate, and number of days of expected service. Consultants’ travel costs, including subsistence, may be included. If requested, the proposer must be able to justify that the proposed rate of pay is reasonable.

**What this means:**

Most importantly, the choice of a consultant and his or her fee must be carefully considered and justified in detail. Note that you can request funds to cover travel and associated expenses.

**Budgeting for Computer Services**

In general, NSF expects your institution to provide you with the basics, including access to standard office equipment and network services. However, your project may have exceptional or specific computing needs, and those costs are budgeted in this section. From the GPG:

The cost of computer services, including computer-based retrieval of scientific, technical and educational information, may be requested only where it is institutional policy to charge such costs as direct charges. A justification based on the established computer service rates at the proposing organization must be included. The proposal budget also may request costs
for leasing of computer equipment. General purpose (word processing, spreadsheets, communication) computer equipment should not be requested. Special purpose or scientific use computers or associated hardware and software, however, may be requested as items of equipment when necessary to accomplish the project objectives and not otherwise reasonably available.

Subawards in Your Budget

Subawards were previously mentioned in Chapter 3 when we briefly looked at management options for collaborative proposals involving researchers at more than one institution. Such subawards will be entered and described in this section of the budget.

However, there are some other situations in which subawards (similar or identical to subcontracts) may comprise part of a project budget. Here is how NSF views this practice (from the GPG):

Except for the procurement of such items as commercially available supplies, materials, equipment or general support services allowable under the grant, no significant part of the research or substantive effort under an NSF grant may be contracted or otherwise transferred to another organization without prior NSF authorization. The intent to enter into such arrangements must be disclosed in the proposal, and a separate budget should be provided for each subawardee, if already identified, along with a description of the work to be performed. Otherwise, the disclosure should include a clear description of the work to be performed, and the basis for selection of the subawardee (except for collaborative/joint arrangements).
In other words, NSF is not enthused about such arrangements in general, and requires them to be thoroughly documented and justified when included in a proposal. Note that collaborative arrangements, in the context of a joint collaborative proposal, are not frowned upon. In such cases, there is no need to justify “selection of the subawardee.” But your proposal must clearly describe the arrangement (collaborative or otherwise) and the work to be done.

**Budgeting Outside the Lines: the “Other” Category**

There are many budget items that may be essential to your project but don’t fit into any of the categories mentioned so far. NSF mentions some interesting examples in the [GPG](https://www.nsf.gov/pubs/nsf18129/nsf18129.pdf): aircraft rental, space rental at research establishments away from the grantee organization, minor building alterations, payments to human subjects, service charges, and construction of equipment or systems not available off the shelf. In the [AAG](https://www.nsf.gov/pubs/nsf18129/nsf18129.pdf), you will find policies for the inclusion of budget items in these categories:

1. Rearrangements and alterations (of facilities)
2. News release costs
3. Renting/leasing facilities or special equipment
4. Relocation costs
5. Costs for meetings and conferences

You may be able to think of other things that might appear in your budget but that don’t seem to belong in the standard categories. The “Other” category allows you to include these costs, with your description and justification. All costs included in this category must be itemized and detailed in the budget justification section.
Unallowable Costs

As you might guess, there are some things you cannot include in your budget — entertainment, meals or refreshments (for yourself or your group), and alcoholic beverages are singled out in the GPG due to “sensitivity.”

Preparing Your Budget Justification

We have repeatedly mentioned that many of your budget items must be itemized and/or justified. This is accomplished in a separate document, apart from the budget form in FastLane, which provides the necessary information with references to budget line items. NSF provides no guidelines for the structure or format of the document, but does require that it be no more than three pages long.

Perhaps the best way to understand how to format such a document is to look at some examples from successful proposals. (NSF provides a sample budget and justification on its website, but we do not recommend that you use it as a guide; it is actually an example of how not to clearly and effectively communicate budgetary needs and priorities.)

In the examples to follow, we have preserved the overall format and have removed or replaced all personal information. As in previous chapters of this manual, you will see that successful proposals vary widely in the amount of detail provided by the investigator, and in the organization and format of the budget justification. As before, choose an approach that works well for you and that uses a style and format that is consistent with the rest of your proposal.
**Example 1: Game theory and the geometry of Banach spaces**

<table>
<thead>
<tr>
<th><strong>Budget Justification Page</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Justification</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Domestic Travel: The PI will attend a number of conferences in connection with this research, including meetings of the American Mathematical Society and conferences at the Mathematical Sciences Research Institute and the American Institute of Mathematics.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Foreign Travel: The PI will also attend international conferences in connection with this research, including a conference in Shanghai, China, December 17 - 21, 2008 (First Joint International Meeting of the American Mathematical Society with the Shanghai Mathematical Society).</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Consultants: The PI requests support for visits by consultants who will be very useful for the proposed research. Possible consultants include S. Holmes, B. Euclid and S.S. Pythagoras.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Equipment and Supplies: Communication costs necessary for the proposal, plus other research supplies.</td>
</tr>
</tbody>
</table>
Example 2: Optical imaging studies of ovarian epithelial cell migration and invasion using microfabricated models of the extracellular matrix

Budget Justification

Year 1

Personnel:

[deleted]

Capital Equipment:

We are requesting replacement diodes for one of the Nd:YAG pump lasers used on this project ($15K).

General Supplies

We are requesting $14,928 for laboratory supplies. These will include proteins, antibodies, fluorescent dyes, cell culture supplies, other reagents, and disposable plastics.

Travel

We are requesting travel support such that the PI and trainees can attend one domestic meeting each, for a total of $5,000.

Year 2

Personnel:

[deleted]
**General Supplies**

We are requesting $22,195 for laboratory supplies. These will include proteins, antibodies, fluorescent dyes, cell culture supplies, other reagents, and disposable plastics.

**Travel**

We are requesting travel support such that the PI and trainees can attend one domestic meeting each, for a total of $5,150.

**Year 3**

**Personnel:**

[deleted]

**General Supplies**

We are requesting $18,806 for laboratory supplies. These will include proteins, antibodies, fluorescent dyes, cell culture supplies, other reagents, and disposable plastics.

**Travel**

We are requesting travel support such that the PI and trainees can attend one domestic meeting each, for a total of $5,305.
Example 3: Cluster algebras, critical groups, and tropical curves

Massachusetts Institute of Technology
BUDGET JUSTIFICATION

Cluster Algebras, Critical Groups, and Tropical Curves

Principal Investigator: Dr. X. Smith

1. PERSONNEL

[deleted]

2. FRINGE BENEFITS

[deleted]

3. EQUIPMENT

Funds are requested for the following equipment in Year 1 of the budget:

• $5,000 for a Tablet PC available from Lenovo or equivalent with external monitor and LCD projector, 8GB of memory, 3.06GHz dual processor, for the purpose of presenting talks and disseminating research.

4. DOMESTIC TRAVEL

Funds are requested for the PI to attend national meetings and research visits for the purpose of meeting with researchers and sharing results. The PI intends to take approximately 6 domestic trips per year (for example, the Joint Mathematics meeting, AMS Sectionals, the Maurice Auslander Distinguished Lectures). Travel expenses are projected to increase by 3% each year.
5. INTERNATIONAL TRAVEL

Funds are requested for the PI to attend international conferences for the purpose of meeting with researchers and sharing results. The PI intends to take approximately 3 international trips per year. (For example, the Formal Power Series and Algebraic Combinatorics Conference will be held in Iceland, Japan, and France in the summers of 2011, 2012, and 2013). Travel expenses are projected to increase by 3% each year.

6. MATERIALS AND SUPPLIES

The expenses listed can be identified as specific to this research program. The materials and supplies estimated in this proposal represent the consumable research materials that are required to administer a research project of this size, and are projected to increase by 3% each year. These costs include computer supply costs, software, and research books.

7. FACILITIES AND ADMINISTRATIVE COSTS

[deleted]
Example 4: Parasites and the evolution of mating systems: do parasites drive complex behavior in animals?

Budget Justification

1) Salary and Personnel:

[deleted]

2) Travel:

Foreign travel to field site (5 round-trips per year @ $2,000/trip): I request a total of $10,000 per year in foreign travel costs. These funds will allow Dr. Jones to visit the field site twice a year and for the graduate student to visit the field site for an extended visit once per year (1 trip/year). The funds will also cover 1 trip per year for field assistants, including initial relocation to and return from the field site or an interim visit to University of Montana for bringing back hormone samples, conferring with the PI, and running analyses. I also request a modest travel allowance ($250) in Year 1 for 2-3 trips to Kenyatta University (from MRC) to meet faculty and students and generate interest in the field course.

To cover room, board and usage fees at the field site, I request $8,870 per year. Funds requested will cover 2 months for Dr. Jones and 12 months for the field assistant. Estimates are based on a fee schedule provided by Mpala Research Center. PI: 2 months @ 985/month = $1970; Field assistant: 12 months @ $575/month = $6900.

Domestic Travel - dissemination of project results ($1,200/year in Years 1-5): I also request additional funding in the amount of $1,200 in each year for presenting the results of this research. The funds will be used for 1-2 members of the project team to attend scientific meetings and will defray airfare, lodging and registration costs.
Participant support: I request $4500 in Years 2 & 4 to cover the expenses for the field course including: student room & board (5 students x 8 nights x $45/night = $1800) and transportation (van rental @ 8 days = $2200; fuel = $500); and $2986 in Years 3 & 4 to cover expenses for one Kenyan undergraduate to perform research at MRC including: room & board for 2 months (2 months @ 468/month = $936), roundtrip travel from Nairobi to MRC ($50) and stipend ($2000).

3) Materials, Supplies and Other Costs:

Laboratory and field equipment (total request = $7,350 in Year 1): For parasitology work, I request $500 to purchase a new binocular compound microscope that will be used for parasitological analyses and dedicated for use on this project. This microscope will add another compound microscope to the field site lab allowing more than one person to do important parasitological work at the same time. I also request $300 to purchase a set of fine mesh U.S. standard filters for parasite larvae isolation from grass samples. For hormone work, I request $400 to purchase a freezer that will be dedicated to storage of fecal samples or hormone analyses. Cold storage of fecal samples is a priority and having a separate small freezer dedicated for this purpose will ensure maintenance of appropriate sample conditions. I also request $300 to purchase a water bath and balance for processing hormone samples. For field work, I request $1,500 to purchase 2 pairs of binoculars and a spotting scope for use in behavioral observations. I also request $350 for a GPS unit to record coordinates for mapping gazelle territories. Finally, I request $4,000 to purchase two high-speed laptop computers with large storage capacity and capability to run sophisticated data analysis and GIS software. The computers will be used by the field assistant, graduate student and PI to enter data as it is collected in the field and to perform data analyses on site. All funds requested above will be used to purchase equipment in Year 1 of the project.

Hormone analyses: I am requesting the following funds for collection and processing of hormone samples. Approximately 3000 fecal samples per year will be collected in Years 1 & 2 (28 males x 2 samples/week x 52 weeks), so for both of these years I am requesting $24,000 for hormone assays (3000 samples/year x
$4/assay x 2 assays per sample [testosterone + glucocorticoid]). In Year 3, I am requesting $3840 for hormone assays for samples collected from the bachelor male experiment (24 males x 2 samples/week x 10 weeks x $8). In Years 4 & 5, I am requesting half of this amount each year ($1920) for running assays from the territorial male experiment. For the purchase of sample collection, storage and processing vials and reagents (e.g. 95% ethanol, absolute methanol), I am requesting $4,000 in Years 1 & 2 and $1000 in Years 3-5. Finally, to defray the costs of transporting samples from the field site in Kenya to Montana State University, I am requesting $500/year to cover excess baggage, shipping and export/import permit costs.

**Vehicle fuel and maintenance (total request = $5,340/year):** The project will have a 4WD vehicle to use for data collection at the field site, thus I am requesting funds to cover yearly fuel and maintenance costs. Fuel: 45 gallons/month x 12 months x $6/gallon = $3,240/year. Maintenance (including lubrication, spare parts, tires, insurance and road tax): $150/month x 12 months = $1,800/year. Insurance and road tax: $300/year.

**Field, lab and computer supplies (total request = $2,500/year):** To cover the costs of field and lab supplies and consumables, I am requesting $2,300 per year. This will cover the purchase of ear tags for marking study subjects, sample bags and vials for fecal and grass sample collection, labware and reagents for parasitological work (e.g. microscope slides, pipettes, etc.), field notebooks, sharpies, measuring tapes and tools for field experiments, including anthelmintic drugs for the treatment experiment. I also request an additional $200 per year for purchasing computer storage media and other computer accessories and supplies.

**Field course supplies (total request = $500 in Years 2 & 4):** In Years 2 & 4, I request $500 for the purchase of materials and supplies for the field course. Relevant items include small equipment (e.g. spare binoculars, GPS units, and measuring tapes) slides, sampling bags and vials, reagents, etc.
Research permit costs: In Years 1-5, I request $200 for student research permit fees ($100 per student). In Year 3, I request $300 for renewal of the project research permit.

Other Direct Costs:

Publication Costs: I request $300 each in Years 3-5 toward the cost of publishing the results of our research.

Photocopying costs: $100 per year will be utilized for photocopying expenses.

Graduate tuition: I request $11,500 (with 5% increases in subsequent years) to cover non-resident tuition for the graduate student.

Consultant services: For capture of Grant’s gazelle, I request funds to contract the Kenya Wildlife Service (KWS) Game Capture Unit. Based on an itemized budget provided by KWS, I am requesting $6,000 for the capture of ~60 animals by mass capture in Year 1. An additional $4,000 is requested Years 3-5 for individual capture of bachelor and territorial males for the treatment experiments.

Mpala Research Center requires that all research projects hire a local field guide/assistant, thus I request $2400/year for this service.

Communication costs: I request $1000 per year for communication costs which includes email and internet access at the field site (for transmission of emails between the field site and University of Montana) and long-distance telephone costs between the University of Montana and the field site.

Indirect Costs

[deleted]
Some Final Thoughts on Preparing Your Budget

Now that we’ve slogged through the details of budgeting a proposal, be sure to remain focused on the guidelines and principles discussed in the beginning of this chapter. In addition, consider these final pieces of advice on your budget.

1. Carefully read the Program Solicitation that pertains to your project — it may contain very specific budgeting information.

2. Keep the budgeting process linked to the generation of your project outline and to the development of your ideas. Don’t just tack it on at the end.

3. Get experts involved.

4. Account for inflation in your cost estimates.

5. Examine the GPG and the AAG whenever you have specific or technical questions. Some esoteric topics (e.g., cost sharing, indirect cost computation) are not covered in detail in this manual, but may be important as you prepare your proposal.

TIP: Account for inflation in your cost estimates.
SPECIAL CONSIDERATIONS: ANIMAL RESEARCH, USE OF HUMAN SUBJECTS, AND POSTDOCTORAL TRAINING

NSF funds grants in disciplines ranging from psychology to particle physics to parasite biology. The application process, therefore, must accommodate important particulars related to all areas of inquiry. So, the NSF application provides for variations and additions that allow it to work for specific types of application (such as those for early career development) and specific kinds of work (such as those involving animals or human subjects).

In this section, we will look at some special considerations that require applicants to provide additional information. There are many more such considerations, so you should search the GPG for special instructions that may affect your application.

If your application requires you to provide special or supplementary information, you must determine whether the information should be included in the Project Description or as a supplement to the application. The GPG provides specific guidelines for inclusion of supplemental information outside of the Project Description — these inclusions are provided in a section called Special Information and Supplementary Documentation. One example is the Data Management Plan, discussed in Chapter 4. Here is a partial list of special topics or considerations that you may need to address in this section of your proposal:

• Rationale for performance of all or part of the project off-campus or away from organizational headquarters.

• Documentation of collaborative arrangements of significance to the proposal through letters of commitment.
If a proposed project might have an environmental impact, the proposal should furnish sufficient information to assist Foundation officials in assessing the environmental consequences of supporting the project. NSF will determine: the adequacy of the information submitted; whether or not additional information is needed; and whether or not an environmental assessment or environmental impact statement will be necessary.

Work in foreign countries. Some governments require nonresidents to obtain official approval to carry out investigations within their borders and coastal waters under their jurisdiction. PIs are responsible for obtaining the required authorizations and for advising NSF that they have been obtained or requested.

Research in a location designated, or eligible to be designated, a registered historic place. Where applicable, the box for “Historic Places” must be checked on the proposal Cover Sheet.

Research involving field experiments with genetically engineered organisms.

Documentation regarding research involving the use of human subjects, hazardous materials, vertebrate animals, or endangered species.

Projects that involve technology utilization/transfer activities, that require a management plan, or that involve special reports or final products.

And note that some program solicitations may specify additional information to be provided in this section.
Proposals Involving Vertebrate Animals

If you work with vertebrate animals, then you have certainly already navigated institutional regulations and approval, through an IACUC. However, NSF adds some expectations of its own, and you should examine them well in advance of your application date. Here is a slightly edited version of the relevant section from the GPG:

a. Any project proposing use of vertebrate animals for research or education shall comply with the Animal Welfare Act and associated regulations pertaining to the humane care, handling, and treatment of vertebrate animals held or used for research, teaching or other activities supported by Federal awards. Proposed projects involving use of any vertebrate animal for research or education must be approved by the submitting organization’s Institutional Animal Care and Use Committee (IACUC) before an award can be made. For this approval to be accepted by NSF, the organization must have a current Public Health Service (PHS) Approved Assurance.

In the case of research involving the study of wildlife in the field or in the lab, for the provision in the PHS Assurance for Institutional Commitment (Section II) that requires the organization to establish and maintain a program for activities involving animals in accordance with the Guide for the Care and Use of Laboratory Animals, the organization has established and will maintain a program for activities involving animals according to the Guide. The organization will follow recommendations specified in the Guide for details involving laboratory animals, and taxon-specific guidelines approved by the American Society of Ichthyologists and Herpetologists, the American Society of Mammalogists, and the Ornithological Council.

b. Sufficient information must be provided within the 15-page Project Description to enable reviewers to evaluate the choice of species, number of animals to be used, and any necessary exposure of animals to discomfort,
pain, or injury.

c. Research facilities subject to the Animal Welfare Act using or
intending to use live animals in research and who receive Federal funding
are required to register the facility with the Animal and Plant Health
Inspection Service (APHIS), US Department of Agriculture. A current listing
of licensed animal dealers, and other information, may also be obtained from
APHIS.

d. Projects involving the care or use of vertebrate animals at a foreign
organization or foreign field site also require approval of research protocols
by the US grantee’s IACUC. If the project is to be funded through an award
to a foreign organization or through an individual fellowship award that will
support activities at a foreign organization, NSF will require a statement
of compliance that the activities will be conducted in accordance with all
applicable laws in the foreign country and that the International Guiding
Principles for Biomedical Research Involving Animals will be followed.

e. The following information should be provided on the NSF Cover
Sheet:

(1) The box for “Vertebrate Animals” must be checked on the
proposal Cover Sheet if use of vertebrate animals is envisioned.

(2) The IACUC approval date (if obtained) must be identified in the
space provided.

If IACUC approval has not been obtained prior to submission,
the proposer should indicate “Pending” in the space provided for the
approval date. If a decision is made to fund the proposal, the organization
must provide a signed copy of the IACUC approval letter to the cognizant
program. The letter should indicate approval of the proposed activities
and must be submitted prior to an award being issued.
(3) The PHS Approved Animal Welfare Assurance Number must be entered in the space provided.

**What this means:**

The requirement for IACUC approval of research involving animals applies to all federally funded research, and essentially all institutions require such approval regardless of the source of funding. Thus, as you surely know, IACUC approval processes and PHS assurances are a part of animal research whether or not you are seeking NSF funding. NSF is asking for documentation of these processes, and does not require additional or extraordinary procedures.

NSF does add an additional expectation that should be noted: your Project Description must make it clear why animal experiments or procedures are necessary, and why the types of animals or procedures proposed are important to the goals of your project.

**Proposals Involving Human Subjects**

NSF policies for research involving human subjects are similar to those for animal research, in that your application must document compliance with laws and policies governing such work regardless of funding source. From the GPG:

a. Projects involving research with human subjects must ensure that subjects are protected from research risks in conformance with the relevant federal policy known as the Common Rule. All projects involving human subjects must either (1) have approval from the organization’s Institutional Review Board (IRB) before issuance of an NSF award or, (2) must
affirm that the IRB or an appropriate knowledgeable authority previously designated by the organization has declared the research exempt from IRB review, in accordance with the applicable subsection, as established in section 101(b) of the Common Rule. If certification of exemption is provided after submission of the proposal and before the award is issued, the exemption number corresponding to one or more of the exemption categories must also be included in the documentation provided to NSF.

If the project involves human subjects and is to be performed outside of the U.S., evidence of IRB approval also is required. If there is no IRB approval provided, and the foreign country is not included in the [2012 HHS OHRP International Compilation of Human Research Protections], nor is an Assurance on file with OHRP, NSF may decline to support the project.

b. The following information regarding the organization’s intention to utilize human subjects as part of the project should be provided on the NSF Cover Sheet:

(1) The box for “Human Subjects” must be checked on the proposal Cover Sheet if use of human subjects is envisioned.

(2) If human subject activities are exempt from IRB review, provide the exemption number(s) corresponding to one or more of the exemption categories (as defined in the Common Rule).

(3) If the research is not designated as exempt, the IRB approval date should be identified in the space provided. This date, at minimum, should cover the period at which the project is initiated. If IRB approval has not been obtained prior to submission, the proposer should indicate “Pending” in the space provided for the approval date. If a decision is made to fund the proposal, the organization must provide a signed copy of the IRB approval letter to the cognizant program. The letter should indicate approval of the proposed activities and must be submitted prior
to an award being issued.

(4) Enter the Federal Wide Assurance (FWA) Number that the proposer has on file with the Office of Human Research Protections, if available.

Including a Postdoctoral Researcher Mentoring Plan

Consistent with its emphasis on the combination of research and education/training, NSF requires applicants who will be mentoring postdoctoral fellows to document the planned mentoring activities that will comprise their training, in a one-page description.

Here are the expectations, from the GPG:

Each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. If a Postdoctoral Researcher Mentoring Plan is required, FastLane will not permit submission of a proposal if the Plan is missing. In no more than one page, the mentoring plan must describe the mentoring that will be provided to all postdoctoral researchers supported by the project, irrespective of whether they reside at the submitting organization, any subawardee organization, or at any organization participating in a simultaneously submitted collaborative project. Proposers are advised that the mentoring plan may not be used to circumvent the 15-page project description limitation. Mentoring activities provided to postdoctoral researchers supported on the project will be evaluated under the Broader Impacts review criterion.

Examples of mentoring activities include, but are not limited to: career counseling; training in preparation of grant proposals, publications and

REMEMBER:
The mentoring plan is not a place to add experimental details or descriptions of broader impacts in an effort to cheat on the 15-page limit for the Project Description.
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.

What this means:

First, note that the requirement applies only if you have requested funds to pay a postdoctoral fellow. If you have requested such funds, your application will not be reviewed without a mentoring plan.

Second, note that the mentoring plan is not a place to add experimental details or descriptions of broader impacts in an effort to cheat on the 15-page limit for the Project Description. Nevertheless, this document is clearly another opportunity to highlight the broader impacts of your proposal and to re-emphasize the activities that you have detailed in your sections on broader impacts.

As with your broader impacts in general, view the postdoctoral mentoring plan as an opportunity to highlight your creativity and to underscore your commitment to NSF priorities. In addition, consider these suggestions as you write the plan.

1. Explicitly link the activities in the training plan to those described elsewhere in your proposal. If you intend to develop a workshop on professional ethics, for example, be sure to describe it in the main body of your proposal (in sections devoted to broader impacts in the Project Summary and Project Description) as well as in the mentoring plan.

2. Be specific and concrete in your descriptions of the training activities. Make it clear that you take postdoctoral training seriously and that you have thought of how your proposed activities will lead to the professional development of postdoctoral fellows.

TIP: View the postdoctoral mentoring plan as an opportunity to highlight your creativity and to underscore your commitment to NSF priorities.

STRATEGY: Make it clear that you take postdoctoral training seriously and that you have thought of how your proposed activities will lead to the professional development of postdoctoral fellows.
3. Include activities that foster both professional development (e.g., acquisition of skills) and career development (e.g., goal setting and preparation of a vita or resume).

4. Mention or describe plans for assessment and feedback.

For guidance on how to formulate your mentoring plan, see the toolkit prepared by the National Postdoctoral Association ("Developing a Postdoctoral Mentoring Plan").

NSF has no specific formatting or content requirements for the mentoring plan, so you should prepare the document in a style that is consistent with the rest of your application. You can review sample mentoring plans at the FASEB website — although the FASEB plans are not specifically intended for use in NSF applications, they are clearly suitable as examples of how to design a plan.

The IIB Division of the Engineering Directorate at NSF provides the sample mentoring plan included on the next page. Note that this example was designed for applications to the SBIR program, and so it includes language and examples specific for small business-related proposals, and it is considerably longer than the one-page limit. Of course, the example is meant only to illustrate the kinds of information that your mentoring plan should include, depending on the activities entailed in your research.
Postdoctoral Researcher Mentoring Plan

This Postdoctoral Researcher Mentoring Plan has been prepared by <organization name>. The Plan establishes guidelines for work to be performed by a Postdoctoral Researcher in support of the NSF <SBIR or STTR> <Phase I or Phase II> Project Awarded to <company name>, entitled “<title of project>”. The Postdoctoral Researcher assigned to the project will work in <name/university> laboratory and will conduct research on <name tasks>.

1. **Orientation** will include in-depth conversations between <company researcher name> and the Postdoctoral Researcher. Mutual expectations will be discussed and agreed upon in advance. Orientation topics will include (a) the amount of independence the Postdoctoral Researcher requires, (b) interaction with coworkers, (c) productivity including the importance of scientific publications, (d) work habits and laboratory safety, and (e) documentation of research methodologies and experimental details so that the work can be continued by other researchers in the future.

2. **Career Counseling** will be directed at providing the Postdoctoral Researcher with the skills, knowledge, and experience needed to excel in his/her chosen career path. In addition to guidance provided by <post doc researcher name>, the Postdoctoral Researcher will be encouraged to discuss career options with researchers and managers at <university name> and with former students and colleagues of <post doc researcher name>.

3. **Experience with Preparation of Grant Proposals** will be gained by direct involvement of the Postdoctoral Researcher in proposals prepared by <company name>. The Postdoctoral Researcher will have an opportunity to learn best practices in proposal preparation including identification of key research questions, definition of objectives, description of approach and rationale, and construction of a work plan, timeline, and budget.
4. **Publications and Presentations** are expected to result form the work supported by the grant. These will be prepared under the direction of `<post doc researcher name>` and in collaboration with researchers at `<company name>` as appropriate. The Postdoctoral Researcher will receive guidance and training in the preparation of manuscripts for scientific journals and presentations at conferences.

5. **Teaching and Mentoring Skills** will be developed in the context of regular meetings within `<university name>` research group during which graduate students and postdoctoral researchers describe their work to colleagues within the group and assist each other with solutions to challenging research problems, often resulting in cross fertilization of ideas.

6. **Instruction in Professional Practices** will be provided on a regular basis in the context of the research work and will include fundamentals of the scientific method, laboratory safety, and other standards of professional practice. In addition, the Postdoctoral Researcher will be encouraged to affiliate with one or more professional societies in his/her chosen field.

7. **Technology Transfer** activities will include regular contact with researchers at `<company name>`. The Postdoctoral Researcher will be given an opportunity to become familiar with the university-industry relationship including applicable confidentiality requirements and preparation of invention disclosure applications.

8. **Success of the Mentoring Plan** will be assessed by monitoring the personal progress of the Postdoctoral Researcher through a tracking of the Postdoctoral Researcher’s progress toward his/her career goals after finishing the postdoctoral program.
CONCLUSION

Writing a budget and documenting compliance with various regulations does not have to be a major pain in the neck. By keeping budgetary issues connected to the development of the larger proposal, and by enlisting administrative help early in the process, the crafting of your budget can be integrated into the overall process. It might not seem like fun, but it still takes thought and creativity — hallmarks of good scientists.

In our final chapter, we will look at what happens when the proposal is complete: how to submit it on the NSF FastLane system, and how the review process unfolds.
CHAPTER 7:
SUBMISSION AND REVIEW OF YOUR PROPOSAL

In the previous six chapters, we have walked through the process of preparing the key aspects of an NSF proposal. If you have completed all of those steps, then you are quite close to the end. Really, all you need to do is upload those files to a website — it takes about ten minutes.

Just kidding. Submitting your proposal is a bit more complicated than that, and it is likely that you have a few tasks to complete before you have all the parts of your application assembled. In this final chapter, we will look at the tasks that constitute the end game in this process. We will suggest a template for a checklist, provide a basic overview of the use of the NSF FastLane system, and then sketch the events that transpire after your proposal is received by NSF. We will also look quickly at the Grants.gov system, an alternative to FastLane that you may consider.
ASSEMBLING YOUR APPLICATION MATERIALS

In Chapter 1, we discussed the usefulness of creating a schedule for the preparation of your proposal. Here, we will look at how to create a checklist of tasks for the final assembly of your proposal.

Ideally, you will establish this checklist days or weeks before your submission deadline. The most important tasks on the list — preparation of the various documents covered in earlier chapters, and collection of specific information to be covered in this chapter — involve aspects of the application process that you can identify before you even begin to brainstorm or write. Other tasks may be added, however, as you develop the proposal. So it makes sense to create the list in a way that enables you to expand it as necessary. Consider using a dedicated whiteboard or an online tool that all team members can access.

Creating the Checklist: Documents and Information

In this manual, we have discussed the writing of several types of documents (for example, Project Summary, Project Description, and Biographical Sketches). Many of the items on your checklist will refer to the preparation of these documents, which will be submitted as is to the NSF FastLane system.

However, some items on your checklist will be tasks that involve developing or collecting information that will not be submitted in documents. Instead, this information will be provided to the FastLane system, which will generate forms and documents automatically. Your budget is the most important example here — you will not submit a budget document, but you will enter the data online and the budget document will be generated by FastLane. (Note that your budget justification is a document that will be uploaded like other prepared documents.)
Creating the Checklist: Identifying Tasks Unique to Your Proposal

Many of the tasks on your checklist will be typical aspects of the application process, such as preparation of a Project Description or developing a budget. But it is possible that your proposal will include information or documents that are unusual or special. There are two possible sources of special requirements for your proposal.

1. **The program solicitation to which you are responding may specify peculiar requirements that necessitate special documentation.** For example, small business innovation programs may require you to document previous commercialization arrangements or to describe cooperative research agreements.

2. **The specific characteristics of your proposal may necessitate special documentation.** For example, your research may involve proprietary information or human subjects, requiring you to include additional documents or information.

Before you make your checklist, but after you have finalized your proposal topic and identified the specific program to which you are applying, identify all of the specific requirements relevant to your proposal. Carefully read the program solicitation, and the relevant subsections of the GPG, looking for directions that apply specifically to your program and/or to your proposed research. These tasks will be added to the standard checklist, which we will develop in the next section.
Creating the Checklist: Starting with a Standard Task List

Here are standard task lists that you can adapt for your specific proposal. Of course, you may choose to use online tools or familiar and favored formats, but these task lists demonstrate one way to organize the assembly of your application materials.

Table 1. Standard Documents

<table>
<thead>
<tr>
<th>Document</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Project summary</td>
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<tr>
<td>Project description</td>
<td></td>
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<tr>
<td>References cited</td>
<td></td>
</tr>
<tr>
<td>Biographical sketches</td>
<td></td>
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<tr>
<td>Budget justification</td>
<td></td>
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<tr>
<td>Current and pending support</td>
<td></td>
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<tr>
<td>Facilities, equipment and other resources</td>
<td></td>
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<tr>
<td>List of recommended/excluded reviewers (optional)</td>
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</table>

Table 2. Special and Supplementary Documents

<table>
<thead>
<tr>
<th>Document</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Data management plan</td>
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<tr>
<td>Postdoctoral mentoring plan</td>
<td></td>
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<tr>
<td>Others as needed</td>
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</tbody>
</table>
Table 3. Required Information

<table>
<thead>
<tr>
<th>Information</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Budget data</td>
<td></td>
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<tr>
<td>Approvals and certifications (e.g., IA-CUC or IRB approval numbers)</td>
<td></td>
</tr>
<tr>
<td>PI information</td>
<td></td>
</tr>
<tr>
<td>Program information (e.g., directorate and solicitation number)</td>
<td></td>
</tr>
<tr>
<td>Other as needed</td>
<td></td>
</tr>
</tbody>
</table>

Creating the Checklist: Notes on Certifications

You will see that your institution must provide certain certifications on your application. These certifications are usually performed by an official of the institution, the “Authorized Organizational Representative,” or AOR, and must be completed within five days of the submission of your materials. You will find a complete list of these certifications in the GPG. Some of the more comprehensible examples include:

- The AOR (or individual proposer) is required to complete certifications regarding the accuracy and completeness of statements contained in the proposal, as well as to certify that the organization (or individual) agrees to accept the obligation to comply with award terms and conditions.

  - Certification Regarding Conflict of Interest: The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest will be satisfactorily managed, reduced or eliminated in accordance with the organization’s conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

REMEMBER: Certifications are usually performed by an official of the institution.
• Drug-Free Workplace: The AOR is required to complete a certification regarding the Drug-Free Workplace Act.

• Certification Regarding Lobbying: When the proposal exceeds $100,000, the AOR is required to complete a certification regarding lobbying restrictions.

• Certification Regarding Nondiscrimination: The AOR is required to complete a certification regarding compliance with NSF nondiscrimination regulations and policies.

• Certification Regarding Responsible Conduct of Research (RCR): The AOR is required to complete a certification that the institution has a plan to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students, and postdoctoral researchers who will be supported by NSF to conduct research.

While most or all of these certifications are formalities that require no effort on your part, keep these important facts in mind.

1. If you are submitting as an individual, check with your PD or other NSF official about the certifications you must make and how to go about it.

2. Be sure to notify administrators at your institution of your submission date (at least), so they are prepared to provide the necessary certifications.
USING THE FASTLANE SYSTEM

NSF conducts most of its business — including submission, review, and management of grants — through the online FastLane system. The system is well documented, and subject to somewhat regular updates and (minor) changes. In this section, we will provide an overview of how to access the system, some tips on how to use it, and suggestions on preparing to submit your application.

The most important thing you need to know is this: you must prepare in advance to use FastLane.

Registering as a FastLane User

In previous chapters, we have emphasized the importance of including experts, such as administrators at your institution, in the development of your proposal. If you have done this, then you probably already know that you cannot simply visit the FastLane site, pick a username and 8-character password, and proceed to upload a grant proposal.

Registration on FastLane entails registration as a PI through the administration of your institution. This is accomplished through what NSF calls the “sponsored projects office” (SPO) of your organization, although it may have a different name within that organization. The SPO must itself be registered with NSF.

Thus, early in the development of your application, you should ensure that you are a registered NSF FastLane user, by acquiring or verifying such registration through your SPO.

If you are applying as an individual, check with NSF about how to register as a PI.
Setting Up as a FastLane User

As soon as you have your registration information, log in at fastlane.nsf.gov and poke around. Enter any basic demographic information, and familiarize yourself with the menus and feel of the system. Verify that you are listed as a PI, and that details such as your address are correct. If there are errors or problems, contact your SPO first — they should be able to fix any glitches.

Setting Up a New Application

The process of assembling your application online need not occur in one sitting, and in fact it is wise to upload documents as they are completed. Therefore, you should initiate your new proposal as soon as you are committed to a particular program and research plan. Once the proposal is initiated, you can edit it as often as you wish.

To do this, go to “Proposal Functions” on the main FastLane page. (You will need to be logged in as a PI or co-PI.) One of the options is “Proposal Preparation.” You will be visiting that page frequently.

Once on the next page, you will be able to select a button called “Prepare Proposal” that takes you to a page full of options (including other proposals in progress). One button is “Create Blank Proposal.” Clicking on that button takes you to the main console for preparing a new proposal. The screen includes links to prepare or upload all of the documents found on your checklist. In fact, this screen functions as a checklist, providing upload dates next to documents or sections that have been drafted or completed. It’s not a very good checklist, so you’ll want to keep your own, but it’s good to know that the system provides some simple feedback regarding the progress of your application.
**Editing the Application**

Once you have created the blank proposal, FastLane will give it a temporary number. The next time you click on “Prepare Proposal” on the Proposal Preparation page, you will see the temporary proposal on the list of choices. You will select that proposal from the menu, then click on Edit. This will take you to the console mentioned above, where you can add, delete, or update files and information.

**Adding Users to the Proposal**

If you wish to allow a team member to have access to the application in order to add or edit documents or information, you can assign a PIN to the proposal using the menu described in the previous paragraph. The team member can now access the proposal on FastLane, using the proposal number and the PIN.

**Checking the Proposal for Completeness**

At any time during the preparation of your application, you can ask FastLane to give you a status update by clicking on “Check” after selecting the proposal from the menu described above. The system will highlight (in garish yellow) those required elements that are missing or incomplete.

This may seem like a good way to make sure that everything important has been included, but in fact the system is unaware of any special requirements that your program solicitation may have added, or that your particular project entails. So it’s not a good idea to rely solely on the “Check” option to ensure that your application is complete.

**TIP:**

If you wish to allow a team member to have access to the application in order to add or edit documents or information, you can assign a PIN to the proposal using the menu described in the previous paragraph.

**REMEMBER:**

It’s not a good idea to rely solely on the “Check” option to ensure that your application is complete.
Submitting Your Completed Proposal

Once you are sure that everything is in order (and, ideally, you have convinced at least one of your team members of this), then you notify your SPO that the application is ready for submission. They will then submit (and digitally sign) the proposal, and you can proceed to thank your team and get caught up on your sleep.
USING GRANTS.GOV

In this manual, we have been assuming that you will submit your application using NSF’s FastLane system. However, as you may know, you have another option: the Grants.gov system, which represents the future of grant proposals to all federal agencies. In the years to come, FastLane will be phased out, and you will use the tools and common forms on Grants.gov to submit proposals to NSF, NIH, DoD, NASA, and any of dozens of other federal grant-making agencies.

For now, FastLane is the main NSF system — the Grants.gov tools simply generate forms for FastLane. But Grants.gov really is the future, and many institutions are encouraging applicants to use Grants.gov now.

This section provides a brief overview of Grants.gov, focusing on some of its peculiarities and the ways in which it differs from FastLane. Before you read it, however, it would be wise to determine whether your institution’s SPO requires or prefers the use of one system or the other.

Registration and Setup

To use Grants.gov, like FastLane, you must complete a registration process. Your institution must first register, and probably already has. To obtain your own registration credentials, contact your SPO.

You may register as an individual on Grants.gov and use the system to apply for grants that are open to individual applicants.

Once you have registered, you can create a profile containing your basic information.

REMEMBER:
Determine whether your institution’s SPO requires or prefers the use of one system or the other.
Downloading a New Application

To begin your application, you must locate the program announcement or solicitation to which you are responding. This is easy to do on the Grants.gov page, and you will see that when you find the right program, you can follow a link called “Application” to reach the page from which you will download the customized application.

How Grants.gov Differs from FastLane

As mentioned above, when you use Grants.gov to prepare a NSF grant, you are basically using the Grants.gov tools to generate a series of PDF files that constitute the same materials as those generated by FastLane. Here are some of the key differences between the two systems.

1. FastLane allows you to upload your documents in various formats, and then converts the documents to PDF files.

   Grants.gov, conversely, generates nothing but PDF files.

2. The FastLane system is an essentially online system, in which you provide information and documents so that the system can generate the final application.

   By contrast, if you use Grants.gov for your NSF proposal, you will download a freestanding package that consists of all necessary forms, as PDF files that can be edited using Acrobat Reader. You generate your application materials offline, and then upload them as a complete package. Note that when you download the application materials, you will provide an email address so that you can receive updates if/when the application materials or requirements change. Such notifications would occur online in FastLane.

3. When you submit an NSF proposal through Grants.gov, the Grants.gov
system generates the PDF files that FastLane requires (as PDFs) then inserts them into FastLane.

**What this means:**

There is one key distinction that you must note if you choose to use Grants.gov, and it concerns the need to generate PDF files. While your downloaded application package includes the forms you need, it cannot help you create the documents that form the backbone of your proposal. These include the Project Summary, Project Description, and other documents that we discussed earlier in this chapter. **It is up to you to create PDF versions of these documents.**

There are plenty of good tools for creating PDF documents from other documents, and modern versions of Microsoft Word, OpenOffice, NeoOffice, and other word processing software are all capable of doing this. However, if you are using more specialized (or simpler) software to write text, you will need to ensure that the conversion to PDF format is done correctly. Check the [NSF website](https://www.nsf.gov) for guidance on how to use various programs to create acceptable PDF documents. If you are using Adobe Acrobat, NSF provides [specific instructions and downloadable option files](https://www.nsf.gov) for use with certain versions of Acrobat and Acrobat Distiller.

**Submitting Your Completed Proposal**

To check on your proposal’s completeness, and then to submit it when it is complete, you use buttons in the application package. This is much nicer than FastLane, but note that the system will not accept your application if you are not properly registered or if there are any problems in your documents. FastLane, on the other hand, can provide you with ongoing feedback on your documents, so you know about problems in advance.
Final Notes on Submitting Your Proposal

As you move toward completion of your proposal and are preparing to submit it, keep these guidelines in mind.

1. Regardless of which online system you use (FastLane or Grants.gov), you will need to prepare in advance, by acquiring registration credentials, gathering information, and ensuring that you can create the required documents correctly.

2. Both FastLane and Grants.gov are subject to periodic changes and updates, so watch for important announcements regarding content and formatting.

3. Be sure to work with your SPO, and notify them well in advance of your submission. It is likely that they can make your job much easier.

4. Create and use a checklist of some kind. It’s a small amount of effort that can help you avoid a train wreck.

TIP:
Both FastLane and Grants.gov are subject to periodic changes and updates, so watch for important announcements regarding content and formatting.

STRATEGY:
Create and use a checklist of some kind. It’s a small amount of effort that can help you avoid a train wreck.
WHAT HAPPENS NEXT: REVIEW AND PROCESSING OF YOUR PROPOSAL

Once the proposal is successfully submitted, it undergoes peer review and then is subject to a recommendation for funding. At the end of this process, you will receive feedback from the PD and reviewers, and if all goes well, you will also receive funding for your research project.

As we review the basic process, keep this fact in mind: the PD (also called the Program Officer in NSF lingo) is the central player. He or she will assign reviewers, assess their critiques, and make the recommendation for funding. As we have already seen, it is hard to overstate the importance of making a good impression on the PD.

There are three stages in the vetting process after your proposal is submitted.

First, the PD will assess your proposal to ensure that it includes all required elements and is suitable for further review. Careful attention to the advice in this manual and to the program solicitation or announcement should ensure that your proposal is not returned without review. Second, the PD will assign reviewers to the proposal, who will review it according to NSF’s merit review criteria. Third, the PD makes a recommendation to the Division Director.

Once a recommendation has been made, you will receive copies of all of the information used in the review of your proposal, including reports of the reviewers and/or review panels.

Let’s look at this process in some more detail.
First Steps: Initial Vetting and Assignment of Reviewers

The NSF website provides a clear outline of each step in the handling of your proposal. Here is how the first events are described:

Upon receipt of a proposal, Program Officers conduct a preliminary review to ensure completeness and conformance with NSF requirements. Adherence to these requirements is strictly enforced (unless the proposal has an approved deviation). If the proposal does not adhere to the instructions in the GPG (or the program solicitation, if applicable), NSF may return the proposal without review. There are nine reasons for which a proposal may be returned without review.

If the proposal is complete and conforms to NSF requirements, NSF Program Officers identify at least three external reviewers to review the proposal. The review may be conducted by ad hoc reviewers, a panel of experts, or a combination of both. For some programs, site visits are also conducted. Some categories of proposals may not be externally reviewed. For example, proposals submitted to Rapid Response Research Grants (RAPID) and EArly-concept Grants for Exploratory Research (EAGER) are internally reviewed only. For some other categories of proposals (for example, proposals for international travel), NSF staff have the option of conducting internal review only. In addition, Program Officers are also responsible for identifying potentially disqualifying conflicts of interest among reviewers.

NSF guidelines for reviewer selection are designed to ensure that the reviewers selected are experts in their field and will provide program officers with the proper information needed to make a recommendation in accordance with the approved merit review criteria for projects.
Note that your proposal may or may not be reviewed by a panel — many proposals are reviewed by ad hoc reviewers who do not meet as a group. In addition, some types of proposals are reviewed in house by NSF staff. All proposals are reviewed by experts.

**Next steps: Peer Review and Assessment by the PD**

The NSF Program Officer reviews the proposal and analyzes the input received from the external reviewers. In addition to the external reviews, Program Officers consider several factors in developing a portfolio of funded projects. For example, these factors might include different approaches to significant research and education questions; potential (with perhaps high risk) for transformational advances in a field; capacity building in a new and promising research area; or achievement of special program objectives. In addition, decisions on a given proposal are made considering both other current proposals and previously funded projects. After scientific, technical and programmatic review and consideration of appropriate factors, the Program Officer makes an award/decline recommendation to the Division Director.

**What this means:**

It is important to note that the decision-making process used by the PD while developing a recommendation includes several factors beyond the nature of the critiques by peer reviewers. PDs will also make certain value judgments based on NSF priorities (including its stated interest in high-risk research), on specific program goals, and on comparisons with similar proposals in the same batch (or among recent proposals).
Thus, as quoted above, full review of the proposal is based on considerations that are scientific, technical, and programmatic in nature. In other words, **assessment of your application entails more than the generation of a score and/or a ranking.** This is why early contact with a PD can make a big difference — PDs know the landscape of recent submissions and Division priorities in their area. They are not merely experts who understand your field.

Your PD will make the final recommendation on your proposal, but the final decision usually occurs at the Division level. The Division Director may change some decisions based on division-level goals, but this is uncommon.

**After Review: Getting the Verdict and Reviewers’ Feedback**

You will receive a lot of information with the decision, as NSF releases nearly all details of the processing of the application:

When a decision has been made (whether an award or a declination), the following information is released electronically to the Principal Investigator (PI) through FastLane:

- description of the context in which the proposal was reviewed;
- copies of all reviews used in the decision (with any reviewer-identifying information redacted);
- copy of panel summary, if the proposal was reviewed by a panel at any point in the process;
- site-visit reports, if applicable.

In addition, if not otherwise provided in the panel summary, the PI is provided an explanation (written or telephoned) of the basis for the declination. A PI also may request and obtain any other releasable material in NSF’s file on
his/her proposal. Everything in the file, except information that identifies either reviewers or other pending or declined proposals, is usually releasable to the PI.

As you can see, you will receive all of the reviewers’ comments and summaries, both in the form of individual reviewer reports and (if applicable) panel reports, in addition to an explanation from the PD for the basis of the decision if your proposal is declined.

See Chapter 5 for information on how to proceed after a declination.

**Behind the Curtain: Some Details About the Review Process**

As you already know, the people reviewing your proposal will be instructed to focus on the merit review criteria, and must specifically comment on these aspects of your application. In addition, they will rate your proposal overall, using this metric:

- **Excellent** — Outstanding proposal in all respects; deserves highest priority for support
- **Very good** — High quality proposal in nearly all respects; should be supported if at all possible
- **Good** — A quality proposal, worthy of support
- **Fair** — Proposal lacking in one or more critical aspects; key issues need to be addressed
- **Poor** — Proposal has serious deficiencies

Given the fairly intense competition, it is unlikely that a grant rated lower than “Very good” by any reviewer will be successful.
If your proposal is reviewed by a panel, the process will differ somewhat. Individual reviewers will assess your proposal as described above, but each reviewer will be a member of a panel that will consider a batch of related proposals together. When the panel meets, all of the proposals in the batch will be discussed, and each will be given a rating by the panel — highly recommend, recommend, or do not recommend. More specifically, the panel will rank the proposals in the batch, and group them as just described. Typically, only proposals that are highly recommended are funded.

Whether or not your proposal is reviewed by a panel, it will be read and summarized by at least three experts, and you will receive all of the comments and critiques provided by the reviewers.
CONCLUSION

By following the advice in this chapter and throughout this manual, you can position your NSF proposal for success. Of course, it is up to you to generate a winning idea and to translate it into a solid research plan.

In this final chapter, we have outlined effective processes for submitting the proposal, and sketched the review process. Note that the importance of communication with the PD was emphasized again, as was the need for careful planning of all of the stages of the process of designing, writing, and submitting an NSF grant proposal.

Keep in mind that NSF grants and programs vary widely, and some include requirements and procedures not discussed in this manual. Therefore, always read solicitations and program descriptions carefully, and don’t be surprised if and when guidelines or requirements change.

We wish you success in your endeavor!
Appendix A: NSF Checklist

PREPARATION

☐ Your research idea matches NSF’s stated goals
☐ Your research idea matches the goals of one of NSF’s Directorates or Offices
☐ Your institution qualifies for NSF support
☐ Choose the right grant mechanism for your proposal
☐ Generate a focused, testable hypothesis
☐ Write a provisional title
☐ Choose the date to submit your application
☐ Create a writing schedule

BROADER IMPACTS

☐ Research and brainstorm on broader impacts
☐ Read successful proposals for ideas/examples

PROJECT SUMMARY

☐ Use proper formatting
☐ Stay within length requirements
☐ Include the following in your Project Summary:
  • Brief overview of the project
  • Discussion of intellectual merit
  • Discussion of broader impacts
☐ Think like a reviewer
☐ Examine samples from successful proposals
**Biographical Sketches**

- Use NSF formatting
- Determine Senior/Key Personnel
- List your previous positions, beginning with your present one
- Do not list more than 10 peer-reviewed publications or other products (5 most closely related, and 5 other)
- List 5 synergistic activities, linked if possible to broader impacts
- If you’re an early-stage investigator, stress your independence from others at your institution

**Facilities and Resources, Data Management Plan**

- Assess your facilities and resources
- List using sentences, not bullet points
- Prepare a document even if there is nothing to list
- Use Facilities and Resources to establish or reinforce your independence
- Get letters of commitment from collaborators if applicable
- Assess needs for data management
- Review requirements for Data Management Plan, examine examples
- Acquire specific guidelines from your directorate or office
- Ensure that your plan meets NSF guidelines
- Use your plan to reinforce broader impacts
- Write your plan with reviewers in mind
**PROJECT DESCRIPTION**

- Outline contents, with the following required elements included:
  - Section on broader impacts
  - Section on results from prior NSF support
- Choose a format and style, examining successful proposals
- Explicitly name and describe your objectives
- Write with reviewers in mind
- Emphasize your qualifications
- Keep under 15 pages
- Keep References Cited section separate

**BUDGETING**

- Be in touch with your institution’s SPO about budget and indirect costs
- List and categorize the project’s needs for equipment and resources
- Review NSF policies regarding budgets and salaries
- Determine fringe rates for employees
- Obtain estimates for equipment purchases
- Research consumable costs
- Determine travel needs and estimate costs
- Determine participant costs, if applicable
- Identify other costs and categories, and estimate their budgets
- Account for inflation over the time of your project
- Review budget items to determine which need to be detailed in budget justification
- Write budget justification (3 pages maximum) after examining examples
**Special Considerations**

- Identify special sections or considerations needed in your proposal
- Outline documents, refer to examples from successful proposals
- Check with your SPO regarding requirements

**Submitting the Proposal**

- Obtain FastLane login credentials from your SPO, and notify SPO of program and submission date
- Set up your FastLane account, familiarize yourself with the site
- Create new application
- Create a checklist for submission:
  - Identify tasks unique to your proposal
  - Start with checklist of standard documents and supplementary documents
  - Add unique tasks and required information
- Gather documents and information, referring to checklist
- Upload documents and enter information
- Check completeness
- Have SPO submit application
- Take team out for celebratory refreshments
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About the Consulting Editor — Stephen Matheson, PhD

Dr. Stephen Matheson has a master’s degree in toxicology from Rutgers University and UMDNJ, and a PhD in neuroscience from the University of Arizona. He completed a postdoctoral research fellowship at Massachusetts General Hospital (MGH) and Harvard Medical School, working in developmental neuroscience in the MGH Cancer Center. Dr. Matheson taught at Calvin College in Grand Rapids, Michigan for 10 years, and collaborated with researchers at the Van Andel Research Institute while teaching in the graduate school of the Van Andel Institute. While in academia, Dr. Matheson was a PI or co-PI on several NSF grants, including three successful MRI proposals, and wrote a successful NIH R15 proposal. He has reviewed NSF grant proposals and scientific manuscripts for several journals.

Dr. Matheson currently works as a scientific editor at a major multidisciplinary journal of the life sciences, while writing and consulting. He lives in the Boston area and enjoys music, cycling, coffee, and scientific ideas.