The NSF Faculty Early Career Development (CAREER) Program: Selecting a Research Topic and an NSF Program

This is the first in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal.

The largest single grant program dedicated to junior faculty is the National Science Foundation’s CAREER program. In this article, we’ll describe the program’s basics, such as eligibility requirements, discuss how to select a research topic for the CAREER, and offer guidance on identifying the particular NSF program to which you should submit.

The Basics

NSF awards over 500 CAREER grants each year. These grants provide five years of funding (a minimum of $500,000 total for proposals submitted to the Biology Directorate and a minimum of $400,000 for all other proposals) to tenure-track, untenured faculty holding an assistant professor or equivalent position. Faculty may submit up to three applications for the grant as long as they have not already won a CAREER grant. NSF accepts proposals annually with a typical due date of mid-July. Links to the solicitation, an FAQ page, and abstracts of previously awarded CAREER projects can be found at NSF’s CAREER webpage. The solicitation for 2011 CAREER submissions hasn’t yet been released, but no significant changes to the previous solicitation are expected.

In an official sense, NSF awards CAREER grants in all areas of research normally supported by NSF, but in practice, some directorates fund more CAREER grants than others. Each directorate sets its own priorities, and some directorates place a strong emphasis on awarding CAREER grants to promising junior faculty, while others prefer to use “core” (or “unsolicited”) awards for that purpose (see a detailed discussion of the core awards in the September issue). Also, some directorates have larger budgets than others and are therefore able to fund more CAREER grants. Graphs showing numbers of proposals submitted and funded by the various directorates in recent years can be found in NSF’s CAREER presentation for the most recent Regional Grants Conference.

Selecting a Research Topic

Your research plan should address an area of interest to NSF; it should be innovative and exciting; and it should hold the promise for significant impact in your field. Research that promises only incremental progress, for example, “dotting the i’s and crossing the t’s” on a well-established line of inquiry, will not be competitive. On the other hand, high-risk projects with little preliminary data, or topics in which you have no previous publications, are unlikely to be funded because reviewers want to fund projects with a good probability of success, and they may feel your project entails too much risk.

Your CAREER research plan will, of course, be based on your research interests and your previous work, but junior faculty often find that they have a significant amount of leeway in choosing exactly which of several topics to propose. For example, at this point in your career,
your research interests may follow two or three directions: a continuation of dissertation research, a relatively newer and more innovative offshoot of that research, or perhaps research on a different but related topic you’re conducting in collaboration with other faculty. You’ll typically have the strongest track record in terms of data and publications in the research related to your dissertation topic. On the other hand, the newer research directions may be more exciting and innovative. Which topic should you propose? Unfortunately, there are no easy answers to this question, but you can use some criteria to help balance innovation and impact against risk. Ask yourself:

- What are my long-term research goals (the big questions I want to answer in the next 20 years) and which project topic will best help me advance toward those goals?
- Can I explain clearly why this research topic is important and will have a significant impact in my field? If the research topic is a continuation of a long line of research (perhaps started by your dissertation advisor 20 years ago), it will be difficult to make that case.
- Does this topic fit well with the interests of an NSF program (more about selecting the program later)?
- Can I develop a convincing five-year research plan on this topic? (If there are potential show stoppers in years one or two, such as a negative result that would end the project, then this topic may not be mature enough for a CAREER.)
- Do I have enough preliminary results and/or publications to convince reviewers that I have the necessary expertise and am likely to be successful? If my publications do not directly address the topic, can I make the argument that skills gained from previous experience can transfer well to this new topic?

If you feel you are generally well qualified to conduct research on a topic, but an aspect of the research lies somewhat outside your expertise (an increasingly common occurrence as new areas of research blur disciplinary lines), it may be a good idea to recruit a collaborator who can contribute that expertise. CAREER grants do not allow a coPI, but established researchers will often be happy to provide advice in the role of an off-budget collaborator.

Choosing the NSF Program to Which You Will Submit

PIs must submit CAREER grants to a particular directorate and program within NSF based on the area of research addressed by the proposed project. It’s very important to make sure that your proposal is submitted to the NSF program that best fits your research because a good CAREER proposal submitted to the wrong program may be doomed. (The Program Officer may transfer your proposal to a different program that offers a better fit, but it’s not wise to assume this will occur.) For information on how to use NSF’s website to find the NSF directorate and program that best fits your research, see the videos posted at the bottom of Academic Research Funding Strategies’ Workshop webpage.

After you’ve done some web research and identified one or more possible programs, contact the Program Officer(s). It’s always a good idea to contact the Program Officer when working on any NSF proposal, but it’s especially important in the case of the CAREER.
Officers can give you feedback on the NSF program that best fits your research as well as advice on points to emphasize and pitfalls to avoid. They can also tell you about any recent changes in emphasis or interests in their program. [Note: Program Officers may be called “Program Directors” in some NSF programs; these terms are synonymous.] To contact a Program Officer (PO), e-mail the PO a short description (one or two paragraphs) of your research idea and ask to set up a time for a phone conversation. POs are very busy, so you may need to be persistent, but also remember that they travel frequently, so give them at least a week to respond. Even if it does take several attempts to set up a call with the PO, remember that the vast majority of NSF POs are very happy to talk to you, and especially encourage faculty who plan to submit CAREER proposals to contact them.

*In the next article, we’ll discuss background work you can do to develop your Education plan.*
The NSF Faculty Early Career Development (CAREER) Program: Planning Your Education Component

This is the second in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal.

The largest single grant program targeted specifically for junior faculty is the National Science Foundation’s CAREER program. CAREER proposals require a Career Development Plan to, in the words of NSF, “build a firm foundation for a lifetime of integrated contributions to research and education.” This means that in a CAREER proposal, you must not only have a research plan but you must also have an education plan integrated with your research. Last month, we covered the basics of the CAREER program and discussed how to select your research topic. In this article, we’ll discuss the background and planning work you need to do to develop your education component.

Scope and Activities

PIs often ask, “How important is the education plan?” The answer is that the highly competitive nature of the CAREER program, to which many good proposals are submitted, makes it very important. Both the research and the education plans must be excellent in order to compete successfully for this award. That doesn’t mean that the education plan must be as extensive as the research plan, or that the description of your education plan should take up half of your proposal. In a 15-page project description, the education, outreach, and broader impacts discussion in a proposal from a PI at a research-intensive institution typically runs around 3 pages in length. (Proposals from predominantly undergraduate institutions typically include education components that run a bit longer.) However, just as the research plan will be judged based on how innovative, significant, and carefully considered it appears to be, so the education plan will be judged by the same criteria. A conventional, unoriginal education plan will be unlikely to excite reviewers and will put your proposal at a disadvantage. What’s more, as with scientific research, education plans considered innovative five years ago (by, for example, including graduate students in the research) are no longer considered new and innovative, with the result that the bar for the education component keeps rising.

Successful education plans propose activities that go beyond what would be expected as a normal part of the job of being a faculty member but are not so ambitious as to impose an unreasonable burden on the PI who, after all, must still earn tenure. Connecting with existing infrastructure on your campus, such as an existing Research Experiences for Undergraduates program, or a science summer camp for middle schoolers, can allow significant impact without taking too much of your time on logistics. However, making at least one of your activities unusual or innovative will help your education plan stand out against the competition.

Education plans typically include several activities, often aimed at different constituencies. Most CAREER education plans include activities to enhance undergraduate and graduate education; they also often include outreach to K-12 students, or to the larger...
community. At least one of the proposed activities should address diversity. For example, a PI might plan to:

1) develop a new undergraduate course utilizing inquiry-based learning techniques, incorporating the PIs’ research results;
2) act as a mentor for high school students developing science fair projects at a school with high minority enrollment;
3) host two undergraduate students from a predominantly undergraduate institution for summer research experiences using an NSF REU Supplement (you can simply state in your proposal that you plan to apply for a supplement if awarded a CAREER); and
4) develop and moderate an interdisciplinary journal club for graduate students interested in interdisciplinary topics related to the PI’s research.

Other examples of CAREER education and outreach activities are listed at the end of this article.

Remember also that even relatively commonplace educational activities can be enhanced with a little thought. So, for example, the centerpiece of your educational plan may be an ambitious program involving high school students, and you’ll want to describe this program in detail. But if you’ll also be mentoring graduate students (a relatively standard activity) you can make this activity more interesting by creating a structured mentoring plan, including special training for students in communication skills, or providing special experiences tailored to the students’ career goals. Similarly, it’s generally expected that you’ll include undergraduates in your research, so think about how you can “punch up” this activity, perhaps by implementing recent innovations in undergraduate research discussed in the literature.

Planning Your Education Component

**Understanding NSF’s Motivation:** When planning your education component, it’s helpful to understand what NSF is trying to accomplish by requiring an integrated education component. NSF wants to break down what they see as the artificial division between research and education in academia. In a recent regional grants conference, a Program Officer said that they want to change the “zero sum” mindset that conducting educational activities must come at the expense of a faculty member’s research and vice versa. Your education and research components should be integrated in such a way that each reinforces the other.

It’s also important to understand that NSF wants researchers to view their education activities with the same rigorous, scientific mindset with which they view their disciplinary research. A researcher would never propose a research project without having read the literature and understanding what others have done in the field. This should also be true for the educational component. Similarly, the educational activities should have clear goals and objectives like those described for the research project. They should also be motivated by a clear need or intellectual question, and the PI’s enthusiasm about the project should come through in the proposal.

**Your Motivation:** The first thing to consider when developing your education component is, what are you interested in doing? Remember that you may win this grant, in which case you’ll be spending the next five years doing what you propose. So be sure to propose something you want to do. Is there an educational issue or need that you feel strongly about? Perhaps you have a child in elementary school and would like to help improve the
quality of science instruction in elementary school. Perhaps you want to encourage more women to pursue careers in physics. It could be that you want to help improve understanding of your subject in the community. Maybe you’ve been teaching a sophomore class in your field and have noticed that the students aren’t really grasping an important concept. Any of these issues could inspire a variety of educational activities that would be appropriate for a CAREER.

**Read the Literature:** Next, read the educational literature to find out what others have done in this area. A very helpful resource is [http://www.eric.ed.gov/](http://www.eric.ed.gov/), a searchable database of education research articles. If, for example, your goal is to encourage more girls to pursue careers in physics, you might look for articles about the factors that affect girls’ interest in science. You might also look to see what others have done in this area and how successful those efforts have been. If you find some interesting approaches, it’s fine to propose to implement those approaches at your campus. NSF doesn’t expect their PIs to reinvent the wheel; implementing approaches that have been successful elsewhere and assessing the results will contribute to the body of knowledge in education.

**Assessment:** This brings us to the importance of having a plan for assessing the success of your educational activities. Remembering that NSF expects CAREER educational activities to contribute to the body of knowledge about which educational activities are and aren’t effective, it’s no surprise that NSF expects PIs to have a plan to assess the effectiveness of CAREER educational activities. In developing an assessment plan, consider what you’re trying to accomplish with the particular activity. How will you determine whether you reached your objective? For example, if you’re trying to encourage girls to pursue careers in physics, you could administer questionnaires to measure the changes in participants’ awareness of careers in physics and their attitudes toward pursuing careers in physics. If your education plan includes innovative approaches to teaching a particular concept in a sophomore engineering class, you could test students’ understanding of the concept compared to students who pursued the standard curriculum.

**Dissemination:** Finally, NSF expects that new knowledge generated by your educational activity be disseminated so that others can benefit from it. Having a strong dissemination plan will help you distinguish your educational plan from others’. Think about what the products of your educational plan will be and how they can best be disseminated. If you’re modifying your curriculum, you might post resources on a website to allow others to implement a similar curriculum. If you develop a program that is successful in engaging middle schoolers in exploring engineering research, you could document your efforts and the results in a paper for an engineering education journal, present the results at a conference, and post resources for the activities you developed online for others to use.

Put yourself in the place of a faculty member at another university who would like to implement a project based on the one you’re proposing. What would that person find helpful? A popular website, [http://nanohub.org/](http://nanohub.org/), provides a venue for faculty members to share nanoscale simulations and has also incorporated social networking elements to help faculty members interact about how they are using the simulations and what other things could be developed. An Open Education Resource movement is growing in the education community, and it can provide good avenues to disseminate course materials and tools. For example, Rice University has the “Connexions” project at which you can post your materials, allowing others
to try them out and review them. This brings the added benefits of peer review. Your dissemination plan could, for example, include a commitment to place resources generated by your educational activities in locations where other people can access them, use them, and then provide feedback.

Having a well-thought-out plan that allows others to duplicate and build on your educational successes will maximize the impact of the funds NSF has committed to your project, making your project more attractive to reviewers.

Finding Collaborators

Depending on the complexity of the educational activities you have in mind, it might be a good idea to recruit a collaborator with educational research experience. This might be faculty in your institution’s departments of Education, Educational Psychology, etc., or in organizations such as a Center for Teaching Excellence, if you have one on your campus. These faculty can be especially helpful in assisting you to connect with teachers or K-12 schools and in helping you to develop an assessment plan. While you cannot have a co-PI or Senior Personnel on your CAREER project, you can commit funds to pay a graduate student from Education to help you, for example, to develop and administer surveys or learning assessment instruments. If you mainly need advice and guidance, senior faculty are often happy to do that without any funding.

If you decide to recruit an educational collaborator, be sure to start that process early. Schedule a meeting with your potential collaborator in which you describe what you have in mind and solicit advice. If they agree to assist you, ask them if they’d be willing to provide a letter of collaboration that you can include in your proposal and discuss what specifically should be in that letter. (It’s often a good idea to offer to write a first draft of this letter that your collaborator can then edit.)

Supporting Your Institution’s Mission and Leveraging Existing Activities

Your CAREER project should not only reflect your own career goals but it should also support your institution’s mission. For that reason, NSF generally expects that a CAREER proposal from a faculty member at a Predominantly Undergraduate Institution (PUI) will include a more extensive educational component and a research component that, while still excellent in quality, is smaller in scope than they would expect from a research-intensive university. This reflects the PUI’s more education-focused mission. Similarly, if you teach at an HBCU, NSF would expect to see an education component that focuses in large part on activities that improve education in some way for African American students, since that is the central mission of an HBCU.

Aligning your educational goals with those of your institution also allows you to leverage ongoing campus activities in your CAREER project. For example, if your institution has a special focus on rural students, activities may already have been designed that reach out to those students, such as special science workshops or summer camps. You could leverage those programs by committing to develop an activity based on your research for one of the workshops, or by providing on-line resources to support camp activities. To find out the ongoing activities on your campus, talk to other faculty, your department head, and staff in
your dean’s office. If your university has an outreach office, you should contact them, and you can browse the NSF awards site to find out whether your institution has been awarded projects, such as a Research Experiences for Undergraduates (REU) site or a Research Experiences for Teachers (RET).

You should also consider exploring connections your institution may have with other organizations in your community, such as local community colleges, K-12 schools, community organizations, and local industry. Working through contacts on your campus who have developed these relationships can allow you to build on these existing relationships, developing a unique educational component that also supports your institution’s priorities.

Establishing a Track Record

Creating a track record and preliminary results can lend credence to your education plan just as they would to your research plan. Consider developing a long-term educational agenda that you plan to follow in your career in the same way that you developed a research agenda. Then begin pursuing that agenda immediately rather than waiting for CAREER funding before getting started. Start engaging in activities, pursuing collaborations, and volunteering for activities related to your educational objectives, and be sure to document the results. If, for example, you have already mentored undergraduate students in your lab or implemented innovative teaching techniques in courses you’ve been teaching, be sure to mention these activities and their results in your CAREER proposal. If you don’t yet have funding to support these activities, they may be relatively small in scale, but they demonstrate that you are committed to your educational goals, and they give you preliminary results to build on as part of your CAREER project.

In the next article in this series, we’ll discuss things to keep in mind when you actually start writing your CAREER proposal.

More CAREER Education Component Examples

Below are excerpts from funded CAREER proposals. (You can find more examples by looking through Project Summaries posted on NSF’s awards database.)

“The PI will (1) collaborate with faculty and students from neighboring minority serving institutions (2) educate and train graduate and undergraduate students on research, including summer research experiences at national laboratories, (3) efficiently interact with high school teachers and students through on-campus NSF-RET programs, (4) prepare graduate and undergraduate students as next generation educators, (5) develop curriculum for undergraduate and graduate students, and (6) develop a website to disseminate research and educational outcome. Research and educational plans are closely integrated to foster a nature process of learning and discovery. The CAREER plan will impact graduate and undergraduate students learning and training through multiple approaches, including active learning and teaching, research experience at national laboratories, etc. The CAREER plan will seek to
maximize the dissemination of research outcomes in nanomechanics to a broader group of audience, including minority serving institutions, and high school students. A model is described that may help to prepare students as next generation educators.”

“The educational component of this CAREER plan has two main projects that link the on-going research with student-centered curriculum and mentoring projects based on a constructivist pedagogy. The first project involves curriculum revision and design of an undergraduate course and a graduate course, respectively. The second project "SMARTGirls" is a multilayered mentoring program to encourage high school girls from underprivileged rural areas to pursue careers in science and engineering.”

“Integrated with the research efforts is an educational initiative that seeks to increase minority participation in undergraduate research experiences (REUs). A combination of industry REUs, internships, and student-led short courses will accomplish dual duties of human capital development and technology transfer. Concurrently, the PI will work with local administration to improve minority participation in existing departmental REU programs.”

“The philosophical framework of this research is also harnessed in an education plan that strives to enhance the scientific literacy of students and educators by empowering them with the knowledge base and skills necessary to confront frontier challenges in the biosciences and bioengineering. These goals will be accomplished by using this research as a foundation for creating research and education opportunities for both graduate and undergraduate students. Furthermore, this work incorporates outreach activities designed to expose high school students to college-level research and education. These activities will also serve to recruit under-represented minority groups to bioscience research and will be used to disseminate new instructional tools to high school educators.”

“The educational and outreach component has four foci: (1) The PI will incorporate, further develop, and assess several Paradigms of Physics module courses in coordination with their developers at Oregon State University. The Paradigms of Physics program consists of several short module-like-courses, taught during the junior year, that focus on key paradigms that cut across several branches of physics. This allows students to better connect many interwoven ideas in different subfields. (2) The PI will involve undergraduates in the groups research projects. (3) The PI will enhance graduate education through student participation in international collaborative research, including visits to international experimental groups. (4) The PI plans to develop outreach activities to increase public awareness of spintronics and its broad impact in society, including public lectures and the development of a website describing spintronics research at TAMU at a general level. In addition a website dedicated to the specialized diluted magnetic semiconductor research community will be further developed.”

“Graduate and undergraduate students will be trained in both solid-state and solution chemistry techniques as part of this cross-disciplinary project. To integrate research and education, a new research-driven course in inorganic materials chemistry will be developed,
and it will contain both classroom and laboratory components and be accessible to graduate and undergraduate students from all materials-relevant science and engineering majors. In addition, a summer fellowship will be established to allow students from traditionally underrepresented groups to participate in this modern solid-state chemistry project.”

“The educational plan will enhance research and education opportunities in modern science and technology at TAMU and in the local community, especially including underrepresented groups from rural areas of Texas. A series of three cross-disciplinary graduate courses "The Physics of Information" on physical principles of storage, processing, and transmission of information will be developed. A broad array of activities is designed to improve the quality of science and technology instruction for undergraduate, middle- and high-school students, and to select and mentor students who are willing and able to pursue careers in science.”
The NSF Faculty Early Career Development (CAREER) Program: Things to Keep in Mind When You Start Writing

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This is the third in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal.

The largest single grant program dedicated specifically to junior faculty is the National Science Foundation’s CAREER program. In the November issue, we described the basics of the CAREER program and discussed how to select your research topic, and in December, we discussed the background and planning work you need to do to develop your education component. In this month’s article, we’ll shift our focus to the process of actually writing your CAREER proposal. Even if you’re experienced in writing proposals to NSF, it’s important to keep in mind that the CAREER program differs from other NSF programs in important ways, and therefore when you’re writing a CAREER proposal, you should keep in mind some special considerations.

A CAREER Grant Invests in the PI

First, more than any other program at NSF, the goal of the CAREER is to invest in and promote the PI’s career and research. NSF wants to identify promising early-career researcher/educators working in areas of interest to NSF and provide the boost to help them along a path to become leaders in their fields. It’s therefore important to remember that, as you write your proposal, you’re not just trying to convince reviewers to invest in your five-year project; you’re trying to convince them to invest in you. This means you’ll need to be more present in the text of your proposal than is ordinarily the case in a standard research proposal. You’ll need to explain to reviewers:

1. Your long-term career goals and interests
2. The importance to NSF of your long-term research and education goals
3. Your potential to become a future leader in your field
4. The way in which this grant will help you become a leader in your field.

As you develop your text, you’ll need to make a convincing case that your research plan and objectives are in a high-impact, dynamic area of science or engineering of interest to NSF. (Research topics that have already been well explored and offer opportunities for only incremental advancements are unlikely to give you the opportunity to become a leading researcher and are of less interest to this NSF award.)

You’ll also need to convince reviewers that your project will make a significant contribution to that research area. This means that you’ll need to clearly describe the expected outcomes of your research and how they will advance the state of knowledge in your field. Remember that reviewers may not be experts in your particular subfield, so you’ll need to clearly describe why this research is likely to be significant in your field. You’ll also need to explain how the proposed five-year project fits into your larger career research plans. After your CAREER project is over, where do you expect to go from there? How does this fit into your long-term research goals?
Because NSF is looking to invest in the most promising researchers, you’ll need to explain why you have the potential to become a leading researcher. Be sure to describe your past research and educational accomplishments (usually as part of your “preliminary results” section) clearly and convincingly for reviewers. Don’t allow your important past work to get buried in a voluminous “background” section where reviewers might miss it. If something you did was important, or if you were the first to accomplish something, explain that to the reviewers. Be sure to cite your previous publications.

NSF Uses the CAREER Program to Change Academic Culture

When you read the CAREER solicitation, you’ll find numerous references to integrating research and education. This is a recurring theme at NSF, and it’s important to understand what NSF means by this phrase. NSF feels that academic culture often perceives research and education as competing priorities. If a faculty member at a research-intensive university spends a significant amount of time on educational activities, her department head may become concerned that her research will suffer. Similarly, a predominantly undergraduate institution may discourage faculty from doing research, seeing it as a distraction from its educational mission.

One of NSF’s core missions is to recruit and educate the next generation of engineers and scientists and to promote a scientifically literate society. As NSF sees it, the following are some of the best ways to achieve that mission: to involve students in research, to integrate research results into the curriculum, and to reach out beyond the walls of academe to educate the society at large about science and the latest research. But how can NSF encourage researchers to actively engage in these kinds of education and outreach efforts when faculty see time spent on these activities as a drain on their research, and when department heads, senior colleagues, and promotion and tenure committees don’t value these activities?

NSF is tackling this problem using the “carrot” of prestigious CAREER grants, which require integrating education and research along with providing clear institutional support for these activities.

For this reason, reviewers will be looking for evidence that your research and education plans align with your institution’s mission and goals, and that your department head recognizes and fully supports your proposed project. Reviewers want to know that your institution and leadership are invested in the success of both the research and educational activities of your project and that you will be rewarded for these activities by your department.

NSF also requires a letter from your department head or chair describing the department head’s and institution’s support for your project and including some language attesting to your eligibility for the CAREER grant (see the solicitation for the exact wording). This letter isn’t just a formality. Reviewers will actually look at this letter to determine whether the PI’s department head enthusiastically supports the PI and her project and will provide the institutional support to help her become successful. (We’ll discuss the department head letter in more detail in a subsequent article)

Reviewers Need to Understand How Your Project Fits Your Institution’s Mission
In your CAREER proposal, you should describe the mission and priorities of your institution (remember that your reviewers may be from other parts of the country and may not know much about your institution) and explain how your activities fit those priorities. Connecting with on-campus educational and outreach activities can also help illustrate to reviewers that your project will benefit activities in which your institution has already invested. Does your institution serve a particular type of student (for example, rural students, non-traditional students, African American students, etc.)? Does your institution have special connections (for example, with local community colleges, industries, high schools, or community organizations)? Describing these existing connections and building on them in your project activities will also illustrate how your project fits the priorities of your institution.

Moreover, if you teach at a predominantly undergraduate institution that’s more education focused, then it’s expected that you’ll have a more extensive education component than if you teach at a Research Intensive institution, since that fits your institution’s mission and priorities. This doesn’t mean that your research plan doesn’t have to be excellent; it just means that the scope of your research plan will probably be smaller, and your education plan should be larger.

Similarly, you’ll need to explain how the topic of your research fits the interests and priorities of your department and institution, and how your project will benefit your institution’s research enterprise. It may be that you were hired as part of a department’s efforts to build capacity in a specific area, or it may be that your institution generally works to build its research activities. Explain this briefly in your proposal so that reviewers will understand the institutional context into which your CAREER project will fit.

*Next month, we’ll talk about structuring your Project Description.*
The NSF Faculty Early Career Development (CAREER) Program: Structuring Your Project Description

This is the fourth in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal. Next month, we’ll discuss writing the CAREER Education Plan. See end of article for upcoming ARFS NSF CAREER Workshop.

The largest single grant program targeted specifically for junior faculty is the National Science Foundation’s CAREER program. In the November issue, we covered the basics of the CAREER program and discussed how to select your research topic; in December, we discussed the background and planning work you need to do to develop your education component; in the January issue, we discussed what NSF is trying to accomplish with the CAREER program and how that should influence the writing of your proposal. In this month’s article, we’ll discuss various ways PIs can structure the CAREER project descriptions.

NSF gives PIs a lot of flexibility in writing their project descriptions. The only requirements are that the project description should not exceed 15 pages, and it must include:

- a description of the proposed research project, including preliminary supporting data where appropriate, specific objectives, methods and procedures to be used, and expected significance of the results
- a description of the proposed educational activities, including plans to evaluate their impact on students and other participants
- a description of how the research and educational activities are integrated with one another
- results of prior NSF support, if applicable

A Typical CAREER Outline

Exactly how you organize these descriptions is left up to you. Below is a typical outline for a CAREER project description. Below, we’ll discuss what you want to accomplish with each of these sections and possible variations on this structure.

I. Introduction and Overview (1 – 2 pages)
   - Goals and Significance of Career Plan (both research and education components)
   - Overview of approach and why it’s innovative

II. Research Plan (9 – 10 pages for research-intensive institution; may be less for PUI or CC)
   - Background and Significance (3 pages or less)
   - Prior Work and Preliminary Results
     - Short overview paragraph describing outcomes of preliminary work and how they pertain to the proposed project
     - Detailed discussion of preliminary results
   - Experimental Plan
     - Overview of tasks and how they fit together
Discussion of each task and methodology to be used
  - Schedule with milestones

III. Education Plan (3–4 pages for research-intensive institution; may be more for PUI or CC)
  - Education Objectives and Expected Outcomes
  - Background (cite educational literature)
  - Prior Work and Preliminary Results
  - Education and Outreach Activities
  - Assessment
  - How research and education plans are integrated (this may be included as a separate section after the education plan)
  - Schedule and milestones

IV. Results of Prior NSF Support (if applicable) (1 short paragraph per project)

Other successful approaches include interweaving the education plan throughout the project description (for example, including the education background in the Background section, including your prior work in education under Prior Work and Preliminary Results, etc.). Many PIs don’t designate a separate “Research Plan,” but instead include the sections devoted to their research (Background, Prior Work, etc.) as main subheadings. The Education Plan remains a main subheading after the research sections. Some PIs whose research entails new or complex methods will include a separate Methodology section. Feel free to structure your Project Description based on your project and the information you need to convey.

The Introduction and Overview

This section is probably the most important part of your Project Description. It’s critical that you interest and excite your reviewers within these first few pages. By the time your reviewers finish reading this section, they should:

1. Understand what you’re trying to accomplish with the proposed project and how it fits into your long-range career goals
2. Be excited by the significance of your research and the potential outcomes and impact in your field
3. Have a basic understanding of what you will do in your project and why your approach is innovative
4. Understand how your education goals relate to your research and to your long-range education interests
5. Understand the basics of how this research builds on your previous work and qualifications

In short, the introduction and overview section should provide a skeletal preview of your entire proposal and present your best arguments for why you should be funded. After reading this section, the reviewer should have a good idea of where the proposal is going and he should be convinced that your project is significant and exciting. At this point, the reviewer should like your idea and be rooting for you; the remainder of the proposal should serve to provide the details and supporting arguments to convince her that you can really accomplish the proposed project.
Be sure to discuss both your research and educational goals and objectives in this section. If you focus only on research, your educational plan will look like an afterthought tacked onto the last few pages of your project description.

When formulating your goals, be sure that they communicate how the world will be different after your research project is complete. Be careful to avoid vague words, such as saying you will “investigate” a phenomenon. **What questions will you answer? What hypothesis will you test? What specific new knowledge will you generate?**

The Research Plan

Writing the research plan can be challenging because you need to include enough details to convince reviewers that you have thought through your project thoroughly, but you don’t want to drown your reviewers in technical minuitia (and, of course, you have a page limit to observe). This is where colleagues can provide invaluable assistance by reading your proposal draft and identifying technical issues that you may need to address more clearly.

**Background and Significance.** When you write the background section, remember that your goal is to explain how your work fits into the existing body of knowledge and why it's significant. Avoid simply writing a literature review; instead, describe previous work in the field and the current state of the art as they are connected to your proposed research. What are the holes in current knowledge that you will fill? How will your work extend the current state of the art? Be sure to mention seminal work, but don’t feel you have to provide a comprehensive review of everything done in the field. It can be tempting to write too much in your background section since that’s usually an easy section for PIs to write. Remember that most of your research plan should be devoted to your research methods and approach, and the background section usually shouldn’t be longer than about 3 pages.

**Preliminary Results.** Whether you need preliminary results and the extent of those results varies by discipline. In addition, if you are proposing high-risk research or research in an area that’s new to you, you’ll need more preliminary results to convince reviewers that your idea is likely to succeed or that you have the required skills to conduct your proposed project. If you’re unsure of the expectations in your field, talk to your colleagues, particularly those who have been funded by NSF. Your preliminary results section should clearly describe what your preliminary results will contribute to the proposed research. Do these results point to an exciting line of inquiry that motivates your proposed research? Do they demonstrate that your proposed approach is feasible? Do they demonstrate that you have mastered the methodology required to conduct the proposed project? Don’t just present your results and leave it up to the reviewers to make these connections – state them explicitly before you launch into the details of your research results.

**Experimental Plan.** It’s a good idea to start this section by discussing your research objectives and then summarizing your approach. If your plan is organized around tasks, list the tasks and briefly summarize what you will accomplish in each task. If your research plan is complex (for example, you have several lines of inquiry that will come together at some point), consider including a flow chart, concept diagram, table or some other graphic that will help reviewers understand your overall plan early in the section before going into the details.
collaborators will provide important assistance or resources, mention them early in the summary of your approach as well as in the section where you discuss those tasks in detail.

It’s important to be as specific as possible about your research plans. If you received grant funds tomorrow, what would you do first? What will you have accomplished in the first 6 months? In the first year? What will be the output of each task? Are there any potential show stoppers? If so, how will you work around them? Reviewers have a large number of proposals that they have to winnow down to the fundable few; to accomplish this, they naturally look for any potential fatal flaws in the research plan. By discussing potential risks in your research plan and describing how you will address them, you can answer questions that reviewers are likely to bring up in the review panel and avoid these risks appearing as fatal flaws.

It’s challenging to describe a 5-year research project in a few pages, but you need to convince reviewers that you have a well-considered plan that is likely to accomplish the goals you’ve set out. Reviewers generally expect to see more details about the first 2 or 3 years of your project and progressively fewer details in the later years of the project. **Remember also that the CAREER is a grant and not a contract.** Some PIs hesitate to put down details in their proposals because they fear they will be locked into those plans. However, a vague plan will not give reviewers enough information to judge how likely you are to be successful in accomplishing your stated research goals. NSF understands that research can take unexpected turns and your plans may change. Describe your current plans for conducting your research as you see them now, understanding that if unexpected results require some changes, you can work with your program officer to modify your plans.

**Schedule.** Including a schedule with milestones is a good idea for two reasons: (1) it shows reviewers that you have a good idea of how you will accomplish your objectives within the 5 years of the project; and (2) it provides a concise summary of your research tasks to which reviewers can refer. Many PIs include the schedule at the end of the proposal and include both research and education tasks in the same chart. If you do this, mention the schedule at the end of your research plan so that reviewers can refer to it after they’ve read about your planned research.

*Next month, we’ll discuss writing the CAREER Education Plan.*

ARFS will present a Webinar for Junior Faculty:

**How to Write a Winning NSF CAREER Proposal**

Presented Tuesday, March 29, 2011, 2:00 pm - 4:00 pm EST

We are offering again this year a webinar for junior faculty on how to write a successful CAREER proposal based on nine years of experience helping scores of faculty compete for CAREER grants. The webinar will cover:

- How to decide when and if it's the right time to apply for a CAREER grant
- How to position yourself and your research to be competitive for a CAREER
- How to structure your proposal
- How to develop an educational plan
- Keys to success and common mistakes to avoid
- A step-by-step discussion of each section of the proposal and what it needs to tell the reviewers
- Questions and Answers
Additional materials, including example proposal sections, proposal outlines and helpful resources, are also included.

*If your institution purchases access to the webinar recording, you will be provided with an access code that will allow anyone in your institution (and as many people as you like) to view the streamed recording as many times as they would like for a period of 30 days after the purchase date.*

For more information and to purchase access to the recording and background materials, go HERE.

Webinar FAQ
The NSF Faculty Early Career Development (CAREER) Program:  
Writing Your Education Plan Section

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This is the fifth in a series of articles discussing various aspects of planning and preparing an  
NSF CAREER proposal. (Back to Page 1)

The largest single grant program specifically for junior faculty is the National Science  
Foundation’s CAREER program. (Note: the new CAREER solicitation was recently released, and a  
new FAQ has also been posted.) In the November issue, we covered the basics of the CAREER  
program and discussed how to select your research topic; in December we discussed the  
background and planning work you need to do to develop your education component; in the  
January issue, we discussed what NSF is trying to accomplish with the CAREER program and  
how that should influence how you write your proposal; in February we discussed various ways  
to structure the project description. In this month’s article we’ll discuss how to actually write  
your education plan section.

As we discussed in December, before you start writing, you should spend time  
researching and planning what you will do for your education plan. Once you’ve settled on your  
educational goals and objectives, done some background reading in the education research  
literature, decided what your educational activities will be and how you will assess their  
effectiveness, and perhaps recruited collaborators, it’s time to figure out how to present all of  
this information concisely in just a few pages.

Approach writing your education plan section in much the same way that you approach  
writing your research plan. NSF expects the education component to contribute to the body of  
knowledge in education research, not merely provide a collection of outreach and education  
activities that impact a small set of students. Therefore, the structure of your education section  
will mirror that of the research section, with clear goals and objectives, a discussion of the state  
of knowledge related to the proposed work, a discussion of your prior work and any preliminary  
results, and so on.

As we discussed last month, NSF gives PIs considerable flexibility in structuring their  
Project Description, including the education section. Below is an example outline of an  
education section, but you should feel free to modify it to fit your project, always keeping in  
mind that you need to address the review criteria and program goals. After the outline, we’ll  
discuss what you need to accomplish in each of the subsections of the education plan.

**Education Plan** (typ. 3 – 4 pages for research-intensive institution; may be more for PUIs or CCs)

- Educational Goals, Objectives, and Expected Outcomes
- Background (cite educational literature)
- Prior Work and Preliminary Results
- Education and Outreach Activities
- Assessment
- Dissemination
Goals, Objectives, and Expected Outcomes of Your Education Plan

You should already have given a brief overview of your educational goals and objectives along with your research goals at the beginning of your Project Description. In this section you’ll go into more detail about what you want to accomplish. As we discussed in the December article, education plans in successful CAREER proposals tend to involve several different activities that address different populations, for example, graduate students, undergraduates and K-12 students. Therefore, you’re likely to have several different educational goals – for example, 1) better prepare graduate students in your department to become excellent educators; 2) reduce attrition of first-year students in your department by improving the curriculum of a required introductory course; and 3) encourage middle schoolers to pursue careers in life science.

Your objectives will detail the specific things you will accomplish in this project in order to make progress toward your stated long-term educational goals. So, following the previous example, your objectives to accomplish the first goal might be to develop a series of lunchtime seminars on teaching for graduate students in your department, establish a wiki for graduate TAs to encourage them to share teaching-related issues and work together to solve problems, and work with your Center for Teaching Excellence to develop specialized training in curriculum development for graduate students planning to pursue careers in academia. You’ll go into more detail about exactly how you will accomplish these objectives in a later subsection, but by explicitly listing your goals and objectives up front, the reviewer will have a clear idea of what you hope to accomplish from the very beginning of your education section.

Background

Just as you discussed the background and significance of your research plan, you’ll need to discuss the background and significance of your education plan. What motivates your plan? What problem are you trying to address and why is it important? If possible, include appropriate data or statistics from the literature or from national studies such as those collected by NSF on their Science and Engineering Statistics webpage.

Describe what has been done by others to address these issues. What does the research literature say about the causes and possible remedies for the issues you’ll be working on? Is there a body of knowledge about what works and what doesn’t? Make it clear by citing this literature that you are aware of what has already been done and you will be building on this body of knowledge. The CAREER solicitation lists STEM education publications that NSF finds especially important. Be sure to cite any of these that are relevant to your project. Remember also that http://www.eric.ed.gov/ provides a searchable database of education research articles.

Prior Work and Preliminary Results

If you have already engaged in any activities related to your educational plan, be sure to mention it. For example, if one of your educational goals is to encourage more women to pursue studies in mechanical engineering, and you have mentored undergraduate women in your lab, or have visited local high schools to talk to students about mechanical engineering,
briefly describe these activities. If an undergraduate woman you mentored went on to graduate school or co-authored a paper with you, those would be considered preliminary results. Describing these prior activities and how you will build on them in your CAREER project will give you more credibility with reviewers.

Educational Activities

This section is analogous to the experimental plan in your research section. Describe each of the activities in detail, paying special attention to any logistical hurdles. If you plan to work with middle school students, how will you gain access to those students? Do you already have connections with local schools and teachers, or are you collaborating with others (e.g., faculty in your School of Education or staff in your institution’s outreach office) who do? If you will mentor undergraduates in your lab, how many undergraduates will be involved? How will they be recruited? How will they be mentored? How often will you meet with them? Including these details will demonstrate to reviewers that you have really thought these activities through and are therefore more likely to be successful. As a side note, be sure that you include the funding to support these activities in your budget.

Assessment

You may elect to have a separate subsection on assessment or you may decide to include a discussion of your assessment plans with each educational activity (in which case, be sure that the assessment discussion is easy to find by using a subheading or bolded or underlined text). Be sure to clearly connect your goals and objectives to your assessment plan. For example, if your goal is to encourage more girls to pursue careers in physics, you could administer questionnaires to measure the changes in participants’ awareness of careers in physics and their attitudes toward pursuing careers in physics. If your education plan includes innovative approaches to teaching a particular concept in a sophomore engineering class, you could test students’ understanding of the concept compared to students who pursued the standard curriculum. If your educational activities call for a more complex assessment plan, you may want to recruit a collaborator with assessment expertise (for example, if your goal is to improve students’ critical thinking skills, a collaborator familiar with assessment can point you to tools specially designed to measure critical thinking skills).

Dissemination

As we discussed in December, NSF expects that new knowledge generated by your educational activity be disseminated so that others can benefit from it. Try to make this paragraph more than just the standard, “We will publish our results in educational journals and put up a website.” Try to include at least one more innovative method for disseminating your results and making resources available to others who might want to build on your work, such as posting educational resources on an open education resource website. Again, specifics will strengthen this section so, for example, if you plan to present your results at an educational conference, name the conference.

Next month, the Department Head letter.
This is the sixth in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal.

The National Science Foundation’s CAREER program comprises the largest single grant program aimed specifically at junior faculty. In the November issue, we covered the basics of the CAREER program and discussed how to select your research topic; in December we discussed the background and planning work required to develop your education component; in the January issue, we discussed what NSF wants to accomplish with the CAREER program and how to use that information when writing your proposal; in February we discussed various ways to structure the project description; and in March we discussed how to actually write your education plan section. In this sixth article in the series, we’ll discuss other documents that are required in addition to the Project Summary, Project Description, and Budget, including the references cited, departmental letter, letters of collaboration, facilities and resources, biosketch and current and pending form.

References Cited

We’ve already discussed the importance of citing significant publications in both your research and education sections. Here, we’ll talk a little about formatting. NSF is flexible on formatting of references; use the format generally accepted in your field. The only requirement is that the page numbers for articles must include the beginning and ending page numbers (1 of 10, etc.). Proposals have been returned for failing to include the final page number, so be sure to do that. In addition, NSF now requests that you include the url for any reference available online. Be aware, though, that you are not allowed to include urls within the text of the Project Description – this is seen as a potential way to get around page limits. However, if you need to cite a webpage, for example, simply cite it as you would any other reference, and put it in the reference section. There are no page limits on the references cited section.

The Departmental Letter

The letter from the Department Head (or equivalent) is more than a formality; reviewers scrutinize these letters closely, and they are often a significant factor in the review process. According to the solicitation, this letter, which may be up to 2 pages long (up from a 1-page limit in previous years) must contain:

- An indication that the PI's proposed CAREER research and education activities are supported by and integrated into the educational and research goals of the department and the organization, and that the department is committed to the support and professional development of the PI;
- A description of (a) the relationship between the CAREER project, the PI’s career goals and job responsibilities, and the goals of his/her department/organization, and (b) the ways in which the department head (or equivalent) will ensure the appropriate mentoring of the PI, in the context of the PI’s career development and his/her efforts to integrate research and education throughout the period of the award and beyond; and
- A statement testifying to the PI’s eligibility for the CAREER program.

In order to do these things effectively, your Department Head must have a good idea of what you’re proposing and must support both your research and your education plan. You’re probably already pretty confident that your Department Head supports your research agenda, since that was probably discussed during your hiring process. Your education plan may be another matter. Be sure to think about what kind support you’ll need from the department to carry out your planned education activities and discuss that with your Department Head. If you’re planning to develop a new course, will the department give you teaching credit for teaching that course? If you plan to recruit underrepresented students into the graduate program, will the department’s recruiting program support what you’re doing? Just as importantly, does the Department Head agree that your proposed education activities (on which you’ll be spending a considerable amount of time and effort if you win the CAREER) are worthwhile activities? Reviewers know that the success of the proposed project as well as your success at the university will depend to a significant extent on the support you receive from your institution and the degree to which your goals align with the institution’s goals.

In addition to logistical support, your Department Head should describe the resources the institution is providing you. This could include your lab space, your start-up package, teaching relief, lab equipment, etc. NSF also wants to know how you are being mentored – is there a formal mentoring program? Have you been assigned one or more mentors? Are there other resources made available to junior faculty to help them succeed? All of these factors are indicators of the level of support you’ll receive and therefore the likelihood you’ll succeed. An example departmental letter appears at the end of this article.

**Letters of Collaboration**

If you’ll have collaborators on your project, be sure to get a letter of collaboration from them. As we discussed earlier, collaborators can help provide expertise that you need. For example, if you’re moving into a new line of research – particularly if it’s interdisciplinary – a collaborator can provide skills that you don’t yet have. Collaborators may also provide logistical support, such as access to an instrument you need. Many CAREER PIs recruit collaborators for their educational activities. For example, a faculty member from your College of Education might assist with designing and conducting your educational assessment. If you’ll be participating in an ongoing program, such as an NSF Research Experiences for Undergraduates (REU) Site, you’ll want a letter from the PI of the REU Site. If, for example, you will be hosting a teacher for the summer and you have identified the teacher, get a letter from her. If you’ll be visiting a school, get a letter from the Principal of the school (or your contact at the school).
No matter the circumstance, these letters of collaboration should state specifically what the collaborators will be providing to you or how they will be working with you. Include as many details as possible; for example, the dates they will be visiting your lab, or a description of the equipment to be made available. If the collaborator is providing expertise, they should discuss their qualifications.

It’s fine for the letters to also discuss how the collaboration will benefit them (for example, a teacher can talk about how her participation in research in your lab will benefit her teaching), but the letters should not become mere letters of support or letters of reference. A letter of support states that the PI’s project is a great idea, or it describes how the outcome of the project will benefit the letter writer, or it discusses the credentials of the PI, but it does not include a discussion of what the writer will contribute to your project. NSF is adamant that
letters of support should not appear in CAREER applications; if they do appear, the application will be returned.

An effective tactic for getting good letters of collaboration in a timely way is to write the draft letter yourself, leaving areas where the collaborator can fill in details. Indicate to your collaborator that you have provided the draft as a starting point, and they should feel free to modify it as they like. This makes the task of writing the letter easier for your collaborator and makes it more likely that the letter will contain the information needed. Be sure to ask for letters far in advance of the proposal due date.

Other Supplementary Documents

The other supplementary documents required are the same as those required for any NSF proposal. We have addressed these elsewhere, but a few additional comments are provided here.

Facilities, Equipment and Other Resources – Be sure to describe any facilities and equipment that you need for your project. Don’t expect the reviewers to assume that you have a needed instrument if you don’t list it. This is especially important if yours is a non-research-intensive institution. Remember that your reviewers may be from a different part of the country and may know very little about your institution, and you’ll need to confirm that you have the equipment and resources you need. Furthermore, if you’ll have access to additional resources provided by your institution, you can describe those resources in this section as long as you don’t mention a dollar amount. For example, if your college provides support for recruiting-related travel and you’ll be using those funds to help support your outreach activities, you can mention that here. This is a recent change at NSF; until recently, describing those resources was considered implicit cost share and wasn’t allowed. Now, you are allowed to include that information in this section (but not in the budget or budget justification). More information on this section is provided in NSF’s Grant Proposal Guide.

Data Management Plan – This is a new requirement for all NSF proposals starting in 2011. We’ll devote a separate article to developing a Data Management Plan in next month’s issue.

Biosketch – As with all NSF proposals, be sure to follow the required format religiously. NSF has been known to return proposals without review for relatively minor deviations from the required format. The format is given here.

Current and Pending Support – Include requested information on all pending proposals and current projects funded by any source outside of your institution (not just NSF-funded or federally-funded projects). You must include the CAREER proposal you are submitting as one of your pending proposals, so even if you don’t have any other outside funding, you will need to submit a Current and Pending Support form. Detailed instructions are given here.
As you can see, you must pull together a lot of information in addition to your Project Description, so it’s good idea to get documents that can be completed ahead of time, such as your biosketch and current and pending support forms, completed and out of the way early.

Next month: In the final article in this series on the NSF CAREER, we’ll discuss preparing the budget and budget justification.
The NSF Faculty Early Career Development (CAREER) Program: The Budget and Budget Justification

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This is the seventh and final in a series of articles discussing various aspects of planning and preparing an NSF CAREER proposal.

The largest single grant program specifically for junior faculty is the National Science Foundation’s CAREER program. In the November issue, we covered the basics of the CAREER program and discussed how to select your research topic; in December we discussed the background and planning work you need to do to develop your education component; in the January issue, we discussed what NSF is trying to accomplish with the CAREER program and how that should influence how you write your proposal; in February we discussed various ways to structure the project description; in March we discussed how to actually write your education plan section; and in April we discussed letters of collaboration and other supplemental documents. In this final article in the series, we’ll discuss the Budget and Budget Justification.

How Much to Request?

NSF specifies a minimum grant amount of $500K for CAREER grants from the Biological Sciences Directorate and the Office of Polar Programs and a minimum of $400K for CAREER grants from all other directorates. It’s unusual for a funding agency to specify a minimum rather than a maximum, and it leaves you as the PI in a quandary: how much should you ask for? Of course, budgets should always reflect how much funding you need to accomplish your project, but you need to have a budget target in mind as you determine the scope of your project.

The answer to this question, like the answers to so many questions pertaining to NSF, is that it depends on the culture of the directorate to which you’re applying. Some directorates like to fund near the minimum amount so that they can give a larger number of awards. This is typical of many programs in the Engineering Directorate, which generally receives the largest number of applications each year. On the other hand, the Math and Physical Sciences Directorate has given CAREER awards above $600K. You can use the NSF awards database to look at funding amounts, but since NSF now only lists the amount of funding awarded to date and funds are actually given out in increments, you’ll need to look at grants that have been completed in order to determine the full amount of the award (click on the “expired awards only” box). Throughout this series of articles we have repeated almost ad nauseum the importance of getting to know your directorate, division and program, and this is yet another example of the importance of this suggestion.

As you start working on your budget, you’ll find that $400K (or even $600K) over 5 years is not really that much money. This amount includes indirect costs (overhead) that go to your institution. Once you add in your summer salary for a month and support for a graduate student, there is not a huge amount of money left. This means you need to think carefully...
about how you’ll use this funding. Some researchers subscribe to the notion that PIs should pad their budgets, anticipating that NSF will come back and ask for budget reductions after deciding to fund the project. Certainly, it’s not uncommon for program officers to ask for budget adjustments, but keep in mind that reviewers are your peers and they are likely to spot obvious padding, and this can hurt your credibility. Moreover, it’s not unheard of for a program officer to ask a CAREER PI to add more money to her budget. This is usually done in response to reviewer comments recommending increased funding to ensure success.

In the end, developing a budget should be an iterative process. Decide on a rough target based on the typical CAREER award amounts for your program. Then, scope your project accordingly. As you add specifics, rework your budget to see how these various activities affect your budget, and make decisions accordingly.

Developing the Budget

Most universities provide assistance with developing grant budgets. This help can be invaluable, so be sure to take full advantage of the support your institution offers. If this is your first proposal, find out who to contact by talking to colleagues in your department. Budget preparation support typically is offered by a unit within the Office of Research, such as a Sponsored Projects Office, or a pre-award unit within your Research Foundation, if your university works with one. Contact the appropriate office (for convenience, we’ll call it the pre-award office) several months in advance to let them know you’ll be submitting a CAREER grant (some offices have online forms that you can fill out for this purpose), and start working with that office as soon as you have a rough outline for your project.

Your pre-award administrator will know the correct numbers for salary and benefits for you and your graduate students. They know how to calculate indirect costs, and they can often alert you to potentially troubling issues related to the budget. By working with them throughout the process of developing your budget, you’ll be able to identify potential problems early rather than two days before the deadline.

It’s especially important as you develop your educational plan that you include funding for those activities in your budget. Reviewers quickly notice ambitious educational and outreach activities without added funding for their development; those proposals don’t fare well. Conversely, thoroughly planning your educational activities and providing a carefully considered budget for them can convince reviewers that you know what you’re doing, providing you with a competitive advantage.

A budget form must be filled out for each year of your five-year CAREER project, along with a cumulative budget. Typical budget categories for a CAREER include:

- **Senior Personnel** – This includes only you, the PI (no other senior personnel can be listed on a CAREER). NSF will not allow more than two months per year of summer salary for faculty, and PIs at Research Intensive institutions typically ask for one month of summer salary per year. However, NSF understands that faculty at predominantly undergraduate institutions face larger teaching loads, and they are more open to funding up to two months of summer salary or release time for these faculty.
• **Other Personnel** – This category can include graduate students, undergraduates and postdocs. As mentioned in earlier articles, it’s expected that CAREER PIs will involve undergraduates in their research. This may be done for credit, if your department supports that, or you can pay them (a typical amount might be $10 - $12/hour for 10 hours a week during the academic year and more during the summer). Faculty at Predominantly Undergraduate Institutions without easy access to graduate students may make greater use of undergraduates, or they may hire a postdoc. Include that funding here. Remember that if you include any amount on the postdoc line, you’ll need to include a one-page **Postdoctoral Mentoring Plan** in your supplemental documents. You can also include funding for other professionals such as technicians under this category. NSF provides a line for secretarial personnel, but they don’t like to fund clerical help, feeling that this should be supported out of the indirect costs charged on the project. Request funding in this category only under very special circumstances, and be sure to justify it in your Budget Justification.

• **Fringe Benefits** – Your pre-award office knows the fringe rates for your institution and will help you with this.

• **Equipment** – This is for equipment exceeding $5,000. The amount you can request for equipment varies by discipline and directorate (there are no explicit rules, but there are accepted norms). If you need to buy an expensive piece of equipment on your CAREER project, be sure to discuss this with your program officer in advance.

• **Travel** – Be sure to keep this category reasonable. Including several trips to overseas conferences will annoy your program officer unless they are clearly needed for the project. This category often gets reduced in post-award negotiations. However, it’s also a good idea to include travel funds for your graduate student (and maybe an undergraduate) to travel with you to conferences to present research results.

• **Participant Support Costs** – This category supports activities such as bringing teachers in for research experiences, or hosting K-12 students for a summer camp. If you’re including activities such as these in your project, be sure to spend some time doing careful planning to determine costs. If you’ll have high school students staying in the dorms for a week, find out exactly how much that will cost. What about transportation and meals? Planning an ambitious educational activity and then realizing you don’t have enough funding to accomplish it can turn what would be a fun experience into a crisis. Furthermore, given that indirect costs aren’t charged on Participant Support, it’s difficult to transfer funding in and out of this category after you’ve been funded.

• **Other Direct Costs** – This category includes funding for Materials and Supplies, Publication/Documentation/Dissemination costs, Consultants, Computer Services and Subawards.

• **Indirect Costs** – This is the “overhead” rate that your institution has negotiated with the government. Your pre-award office will help you with that. One note: some faculty who are new to submitting grant proposals are horrified to see that so much of their grant (often 40 – 60%) will go to indirect costs, and some think they will get a competitive advantage by asking their institution to reduce the indirect charge (IDC) on their grant. Keep in mind that NSF has agreed to pay to your institution at this rate, they expect to pay it, and all
institutions charge IDC. This money funds the pre-award person who has been so helpful in putting together your budget, as well as the lights and facilities on which you depend.

- **Cost Sharing** – A line for cost sharing appears on the budget, but CAREER grants do not allow cost sharing. Be sure no funds appear on this line.

**The Budget Justification**

The NSF budget forms serve as a summary and don’t provide room for much detail. You’ll describe the details of your budget in the Budget Justification, which can run as long as three pages. Some PIs see this section as an unimportant formality, but that’s a mistake. The Budget Justification can, in effect, give you an additional three pages in which to make your case to reviewers. In your Budget Justification, provide enough detail to demonstrate to reviewers the thorough planning of your project. This is particularly important in cases where logistical challenges could arise.

Structure the Budget Justification as if you were sitting with the reviewer, explaining your budget line-by-line. If you request funds for a graduate student, describe what that student will do on the project. If you need equipment, give details on the model, vendor, use and importance to the project. For materials and supplies, describe what those materials will be and how they will be used. For travel funds, state how many trips will be taken, the destination, the travel expenses, number of people traveling, and the purpose of the trip.

For activities requiring participant support (most commonly education or outreach activities), be sure to discuss what the activity will be, the goal of the activity, and describe in detail the logistics and costs associated with the activity. Any PI can, for example, state in his proposal that he will host a high school science fair team on campus for three days and mentor them. If, however, you identify specifically in your Budget Justification the school from which they will come, how they will travel to campus, where they will stay, and how much it will cost, the amount it will cost to feed them, and the funds allocated to bring their teacher with them, you will have demonstrated to reviewers the kind of careful planning likely to achieve success.

If you have any unusual requests (for example, for extensive international travel, or costs for a consultant), be sure you have thoroughly discussed the need for these items both in your Project Description and in your Budget Justification.

*This concludes our CAREER series. In the fall, we’ll discuss how to interpret reviews. Good luck to all 2011 CAREER applicants!*