



Grant Writers' Seminars and Workshops

THE GRANT APPLICATION WRITER'S WORKBOOK

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National Science Foundation - FastLane Version

**GRANT WRITERS'
SEMINARS AND WORKSHOPS, LLC**

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WRITER'S WORKBOOK***

National Science Foundation Version

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CHANGES IN HOW NSF GRANT PROPOSALS ARE WRITTEN AND REVIEWED

Since the 2010 publication of *The Grant Application Writer's Workbook* – NSF Version, a series of important changes has been made in how NSF grant applications are written and reviewed. We have provided supplements to the 2010 *Workbook* as these modifications have appeared. Now that the full spectrum of changes has been finalized in the new, 2013 edition of the *Grant Proposal Guide* (NSF 13-1, effective January 14, 2013) we will be publishing a new NSF version of *The Grant Application Writer's Workbook*. In the interim, this last supplement to the 2010 edition of the *Workbook* will introduce you to the most important of the changes.

CHANGES IN MERIT REVIEW [Grant Proposal Guide, NSF13-1, Chapter III.A]

The NSF has summarized its changes in merit-review criteria in the above-referenced part of the 2013 *Grant Proposal Guide*. A similar summary is also being included in NSF's solicitations of research. The parts of the 2010 *Workbook* edition that will need to be revised in their entirety are the section of Chapter 5 that pertains to Merit Review, which has been renamed "Merit Review Principles and Criteria," and Chapter 13, which specifically addresses the Broader Impacts criterion. What follows should replace those parts of the 2010 *Workbook*.

With respect to changes in the review process, NSF has largely followed the input it received from its oversight agency, the National Science Board (NSB; see <http://www.nsf.gov/nsb/publications/2011/meritreviewcriteria.pdf>). Both of the former major review criteria, Intellectual Merit and Broader Impacts, will continue to be used to evaluate proposals. How they are applied by reviewers will change, however, based on three guiding principles recommended by NSB.

Paraphrased, the principles that will guide the merit review of future NSF grant proposals are:

1. The project must be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge;
2. NSF projects, in the aggregate, should contribute broadly to achieving societal goals. Broader impacts can be the result of the research, itself; research-related activities; or activities that are supported by and complementary to the research project. Regardless of whether such activities are based on established or innovative methods/approaches, they must be well justified.
3. Outcomes related to both major review criteria should be assessed/evaluated at either the individual- or aggregated-project level, whichever is more appropriate.

The last of the guiding principles is especially important, because it makes clear that future PIs will be more "accountable for carrying out the activities described in the funded project" than they have been in the past. In other words, PIs must follow through with and complete their proposed Broader Impacts, as well as research, activities.

Redefinition of Merit Review Criteria

GENERAL DIRECTIVES TO REVIEWERS. Effective January 14, 2013, reviewers of NSF proposals will be directed to consider: (i) what the proposers want to do; (ii) why they want to do it; (iii) how they plan to do it; (iv) how they will know if they succeed; and (v) what benefits will accrue if the project is successful? The first directive probably should not be "want to do" because

that overlaps with the third directive. Accordingly, we interpret the first of the five directives to be, 'what the proposers want to accomplish.'

If those are the questions, then in order to be responsive, applicants will have to include in their proposals: (i) a clear, attainable objective [What the proposers want to accomplish.]; (ii) a compelling rationale underlying the project [Why they want to do it.]; (iii) research and Broader-Impacts activities that are sound and feasible in the applicant's hands [How they plan to do it.]; (iv) a credible plan to evaluate both the research and broader-impacts outcomes [How will they know if they succeed.]; and (iv) a clear, credible listing of the payoffs of the research and broad-er-impacts components [What benefits will accrue if the project is successful.].

MAJOR REVIEW CRITERIA. Under the new approach it will be even more important for applicants to be equally strong with respect to each of the two major review criteria: "neither, by itself, is sufficient" (2013 *GPG*, page III-2). In the past, Broader Impacts activities could be integrated throughout the Research Plan. We have never agreed with that approach. Since this *Workbook* was first published we have recommended that Broader Impacts be a separate section of the Project Description. NSF now agrees: integration of Broader Impacts activities is no longer permissible. They must now be described in a separate, stand-alone section.

It has not always been clear to applicants, especially those newly applying to the NSF, what kinds of activities would produce acceptable Broader Impacts outcomes. Therefore, in the past, the National Science Foundation has provided examples of such activities on its Web site. All reference to them has been deleted from the 2013 edition of the *Grant Proposal Guide* because some applicants apparently regarded the examples as prescriptive, rather than illustrative.

The general definition of each major review criterion has also been changed:

- **Intellectual Merit:** the potential to advance knowledge.
- **Broader Impacts:** the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The Intellectual Merit definition is straightforward, as is the first part of the second, Broader Impacts definition. The second part of the Broader Impacts definition is more complex. Fortunately, NSF has provided examples of what it considers "desired societal outcomes" (see page II-9 of the 2013 *GPG*). "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) [Note that NSF's second core strategy – page II-1 of the 2013 *GPG* – takes fostering diversity several steps further: "Broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines"]; 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 and 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 intent in redefining the Broader Impacts criterion was to more closely relate such activities to the proposed research, i.e., to make clear that they should be closely integrated with the research and not separate, stand-alone undertakings.

Given that intent, it is not surprising that the new approach is to apply the same five considerations to evaluation of the project's Intellectual Merit and its capacity to have Broader Impacts. They include:

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/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?

We predict that clarification of the two major review criteria, coupled with understanding of how they will be applied, will greatly clarify how an applicant must write his/her proposal in order to be fully responsive to NSF's mission and granting philosophy.

CHANGES IN PREPARATION OF THE PROPOSAL

Preliminary Proposals: [Grant Proposal Guide, NSF13-1, Chapter I:D.2]

In the past, the National Science Foundation has used the preliminary-proposal approach only infrequently. That is primarily why the 2010 edition of *The Grant Application Writer's Workbook* – NSF Version does not contain a chapter on the subject; it wasn't that often that there was a requirement for a preliminary proposal. Now, some divisions of the NSF require preliminary proposals. For example, the Division of Environmental Biology (DEB) and the Division of Integrative Organismal Systems (IOS) have fully adopted this new approach: They now require preliminary proposals for all of their core-program solicitations. By contrast, the rest of the divisions in the Biological Sciences Directorate do not – so you should consider the requirement for a preliminary proposal to be both program and/or funding-opportunity specific.

The reason for this change in policy primarily centers on increased proposal workload – for applicants, reviewers and the Foundation's program staff – all in the face of diminishing resources (see NSF 11-078, <http://www.nsf.gov/pubs/2011/nsf11078/nsf11078.jsp>). In some cases, the increase has been dramatic: over the past decade the number of unsolicited proposals received into core programs by the Division of Integrative Organismal Systems has increased by 43%, while the number of awards made by that Division decreased by 11%. During that same time period, on average, the number of proposals each PI had to submit in order to acquire funding increased uniformly across NSF.

There is frequently a limit on the number of preliminary proposals that an applicant can submit in a given calendar year as either PI, co-PI, or Lead Investigator on a sub-award. For example, DEB and IOS limit the number to two. Those Divisions also restrict the submission of preliminary proposals to January of each year.

Preliminary proposals can also be required for competitive renewals, as well as for new applications. They must be submitted using FastLane, i.e., preliminary proposals cannot be submitted using Grants.gov or any other means – unless, of course, the funding opportunity to which you are responding specifies otherwise.

The Directorate for Biological Sciences has long prohibited established investigators from simultaneously submitting the same or a very similar research proposal to it and to any other Federal agency. That restriction does not pertain to preliminary proposals. It would, however, apply to a subsequent full proposal if the applicant were invited / encouraged to submit one.

To indicate that you are submitting a preliminary proposal, the "Preliminary Proposal" box on the Cover Sheet should be checked. The required content of a preliminary proposal can vary greatly with the funding opportunity. Therefore, you need to carefully read and closely follow the guidelines for preparation of a preliminary proposal that are contained in the solicitation to which you are responding. The major difference between preliminary and full proposals is that the former are significantly shorter. For example, the Project Description will usually be in the range of 4-6 pages, rather than the 15 pages that are allowed for a full proposal. An itemized budget is not required unless the funding opportunity specifies otherwise. Nor are institutional approvals required for such things as the use of vertebrate animals or human subjects. Neither a Data Management Plan nor a Postdoctoral Researcher Mentoring Plan (both discussed below) is required. And no supplementary documents are allowed unless otherwise specified.

With preliminary proposals being so short, relative to a standard application, there may be concern about overlap – the perception that there is redundancy – between the Project Description and Project Summary. That should not be a concern. First, if you were to address that 'problem' by making the content of the Project Summary and the Project Description different, a reviewer/NSF program staffer could potentially conclude that you were trying to get around the page limitation on the Project Description. Second, you can count on a large number of preliminary proposals being submitted. Each one will be reviewed by a panel of experts. Therefore, just as with full proposals, it is unlikely, in our opinion, that every reviewer will read every preliminary proposal. Rather, they will read in full only the preliminary proposals that are assigned to them. Every reviewer will read every pre-proposal's Project Summary, however, while the related preliminary proposal is being reviewed at the panel's meeting. Thus, the approach to writing the Project Summary for a preliminary proposal should be the same as that for a full proposal: it should be a comprehensive summary of the content of the Project Description, including Overview, Intellectual Merit and Broader Impacts subsections (see below). If the perception of redundancy still bothers you, that problem can be solved by paraphrasing, but the basic content of the Project Summary and Project Description must be the same.

Preliminary proposals are reviewed for both Intellectual Merit and Broader Impacts. Based on the outcome of such review, you will either be invited/encouraged or rejected/discouraged to submit a full proposal (see explanation of acceptance/rejection options, below). Therefore, because the preliminary proposal represents a true make-or-break step in the application process, we consider it to be as important as, if not more important than, the full-proposal step. Accordingly, your level of commitment to writing a preliminary proposal should be no less than that which you will bring to writing a full application.

The first of the two bullets in the text box, below, pertains to programmatic relevance. NSF does not want to receive and review full applications that are of little or no programmatic interest in terms of their priorities. This change in NSF's approach to accepting/rejecting applications

codifies what we have long recommended (see chapter 8 of the NSF version of *The Grant Application Writer's Workbook*), which is to determine early on in the proposal-development process – after the Overview & Objectives and Expected Significance sections have been written – whether or not what you want to do is programmatically relevant to NSF. Just as it makes no sense for you to invest time and effort writing and submitting an application that isn't what NSF wants to fund, it makes no sense for NSF to commit resources to review such proposals.

Reasons for Submitting Preliminary Proposals: [GPG, NSF 13-1, Chapter I:D.2]

The two predominant reasons for requiring submission of a preliminary proposal are to:

- reduce the proposers' unnecessary effort in proposal preparation when the chance of success is very small. This is particularly true of exploratory initiatives where the community senses that a major new direction is being identified, or competitions that will result in a small number of actual awards; and
- increase the overall quality of the full submission.

The second bullet, above, reflects the fact that you receive feedback on a preliminary proposal, which you should use to improve the full application if you are invited/encouraged to submit one. The feedback will be a summary of the discussion of your preliminary proposal by a panel of experts plus the independent written reviews of three of the panelists.

NSF's decision regarding a preliminary proposal will take one of two forms: (i) outright acceptance/rejection, or (ii) advisory, i.e., encouragement/discouragement. In the first case, either you will be unequivocally invited to submit a full proposal or you will receive notice that you cannot do so, i.e., unequivocal rejection. The former kind of decision tells you that you potentially have what NSF wants to fund, while the latter decision makes you ineligible to continue in the application process – i.e., you haven't proposed what they want to fund. Were you to go ahead and submit a full proposal after your preliminary proposal had been rejected it would be returned without review. In the second, advisory approach, you receive either encouragement or discouragement with respect to submitting a full proposal. Although discouragement does not preclude you from submitting a full proposal, we strongly recommend that you think twice before doing so. Only rarely would you be successful under such circumstances, so there are probably better ways for you to spend your time than to write and submit a full proposal to that program. Before doing so, at the least, consult the relevant NSF Program Officer to obtain his/her advice.

A full proposal must reflect the content of the related preliminary proposal. In other words, you cannot make substantive changes in a project after approval of a preliminary proposal.

If you submitted an unsuccessful application prior to the time that preliminary proposals were required, and the related NSF program to which you applied is now requiring preliminary proposals, you must go through the pre-proposal step before you resubmit the revised application. If you were invited to submit a full application but did not do so in the same cycle you wouldn't have to write another preliminary proposal in order to submit the full application in the next cycle. But you would have to contact the responsible Program Officer before making such a 'late' submission. If you are invited to submit a full proposal that is subsequently rejected you cannot resubmit the full proposal without again going through the preliminary-proposal step. In other words, you have to start over.

The text box that follows on the next page illustrates how the content of the 2010 *Workbook* can be utilized to prepare the Project Description of an IOS preliminary proposal.

NSF 13-506: The Project Description cannot be longer than 5 pages and must contain two sections, Personnel (up to 1 page) and Project (up to 4 pages). IOS recommends that the latter section consist of subsections with the following subtitles:

1. "Conceptual Framework" or "Objectives" or "Specific Aims"
2. "Rationale and Significance" or "Background"
3. "Hypotheses" or "Research Question(s)"
4. "Research Approach" or "Experimental Plan"
5. "Broader Impacts"

The subsection names that are suggested first connote best what each subsection is meant to contain. The fact that they are presented first suggests they are the subtitles preferred by NSF.

To write the first, Conceptual Framework subsection the instructions in the first part of Chapter 6 of the *Workbook* should be followed. In other words, this subsection should be the first part of the Overview & Objectives section. Begin with an attention-getting sentence. Then, briefly summarize current knowledge (two or three sentences that lead to the edge of the field). Then offer the gap in knowledge or need. Follow with a problem statement, i.e., why continued existence of the gap or need represents an important problem (it is what blocks the next vertical step in the field from being taken). Then, present the overall objective that you have for the research, which should be to fill the gap or meet the need previously described. Next, include the overarching central hypothesis for the project – i.e., your best bet out of all possibilities as to how to attain the objective – and how it was formulated (on the basis of your own preliminary data). Write the central hypothesis to have readily identifiable parts, which then serve to set up your aims later. Conclude with why you are well prepared to undertake the research. This subsection should be no longer than 1/2 to 3/4 of a page.

The second subsection, "Rationale & Significance," should be written by following the directions in Chapter 6 for writing the rationale and for describing why your project is creative, original and potentially transformative. Then, follow the instructions in Chapter 7 to convey why what you expect to contribute will be significant. The point is that the second subsection isn't meant to be just a review of relevant literature, as the "Background" subtitle would suggest. Begin the subsection by briefly citing literature that will increase detail regarding existence of the gap(s) in knowledge or need that will drive the research, as well as increased detail regarding why continued existence of the gap/need represents an important problem (it blocks advancement of the field). Follow with a statement of your rationale – why you want to do the research (to remove the gap/need that is blocking the next vertical step from being taken). Follow with a fully italicized statement of significance – why that contribution, filling the gap/meeting the need – would be significant. In other words, tell reviewers why your research contribution will have a positive impact on something that is of importance to NSF and its priorities. Follow with why what you are proposing is creative, original and potentially transformative. Conclude this subsection with tangible benefits that are likely to accrue to application of the new knowledge. No more than 3/4 of a page should be needed to make these points.

The third subsection – subtitled, "Hypotheses" – should be written by following the instructions for writing the aims that are contained in parts of the second half of Chapter 6 of the *Workbook*. It should be a combination of your specific aims and the hypothesis for each that will focus that part of the research. The latter are what will link this subsection to its subtitle. To relate this subsection back to the first subsection you should begin it with a sentence something like, 'To test our central hypothesis and, thereby, attain our overall objective, we propose to pursue the following specific aims and related focusing hypotheses.' List each specific aim. Each one should test a readily identifiable part of the central hypothesis. This part of the Project section should be about half a page.

The fourth subsection, "Research Approach" (1-1/2 to 2 pages) should be written following Chapter 10, "Research Plan." For applications with deadlines after January 13, 2013 the "Broader Impacts" subsection (again about half a page), should be written using the new approach that we have summarized in this supplement. In other words, after January 13 the Broader Impacts chapter in the 2010 edition of *The Grant Application Writer's Workbook* – NSF Version should not be followed.

Project Summary [GPG, NSF 13-1, Chapter II.C.2.b]

The Project Summary (Chapter 21 of the 2010 *Workbook* edition) remains up to one page in its length and will still be written in the third person. The 2013 changes pertain primarily to how the page will be formatted. If you are using FastLane to apply, the Project Summary page will have three, separate text boxes. If you are applying through Grants.gov you will be required to upload a page with three, separate subsections. In either system, the three subsections will be (i) an overview, (ii) discussion of your project's Intellectual Merit – how it will contribute to advancement of knowledge, and (iii) a description of how the proposed activities will achieve desired societal outcomes and, thereby, benefit society. The latter description will be based on the new, broader definition of Broader Impacts, which was summarized earlier in this supplement.

In the past, it has been a requirement that applicants provide a separate subheading in the Project Summary for each of the Intellectual Merit and Broader Impacts subsections. Effective January 14, 2013 separate subheadings will no longer be required for FastLane applications; the separate text boxes supplant the need for such subheadings. The Grants.gov *Application Guide* similarly states that the Project Summary must consist of three separate statements. Nothing is included about the need for separate subheadings, so they are presumably not a requirement. However, if you think that an identifying, bolded subheading at the beginning of the first line of each of the three subsections makes a clearer presentation, you should follow your instincts and use that approach when submitting through Grants.gov.

Our recommendations in Chapter 21 of the 2010 *Workbook* regarding the copy/paste approach to creating the first draft of your Project Summary need to be modified, given the change in the Project Summary's format.

- The overview subsection should summarize what will be done. Copy and paste the following components from the Overview & Objectives section: gap in knowledge/critical need that will drive the research; overall objective that you have for the project; central hypothesis, if any; rationale; why you and your research team are well qualified to undertake the research (remember to write in the 3rd person); the specific aims, including main methods/approaches; conclude with why what you are proposing is creative and original.
- The intellectual merit subsection should describe why your project has the potential to advance scientific knowledge. Copy/paste the statement from the Overview & Objectives section regarding why your project is potentially transformative – why it has the capacity to vertically advance and transform your field. The National Science Board has urged the NSF to sponsor preferentially research that is potentially transformative. If your project has that potential, flaunt it – but don't overreach in doing so. Follow with the 'contribution' sentence from the Expected Significance section. Conclude with the statement of significance from that same section.
- The Broader Impacts subsection should summarize potential societal benefits and the project's potential to achieve NSF's desired societal outcomes. What is summarized here should in most cases be organic outgrowths of the research, i.e., should not come across as stand-alone activities that are independent of the research. At the least, the proposed activities must be seen as supported by and complementary to the research. Without pandering, summarize how the proposed project will contribute to one or more of the desired societal outcomes that are listed on page 2 of this supplement and in Chapter II.C.2.d(i) of the 2013 *Grant Proposal Guide*. Conclude with how those outcomes will collectively benefit society.

Applications with a Project Summary that does not separately provide an overview and separately address Intellectual Merit and Broader Impacts will be returned without review.

Project Description [GPG, NSF 13-1, Chapter II.C.2.d]

Chapters 6 through 13 of the 2010 *Workbook* edition pertain to writing of the various sections of the Project Description. The change in approach to Merit Review that we have summarized earlier in this supplement has been integrated into how the Project Description should be written (see GPG, NSF 13-1, Chapter II.C.2.d[i]). For example, NSF's new directive that reviewers must ascertain what an applicant wants to accomplish, why s/he wants to do it, how s/he plans to do it, how s/he will know if s/he has succeeded, and what benefits will accrue if the project is successful is used here to tell applicants what they should provide in the Project Description. Making it easy for reviewers to find those things is a new part of making your proposal reviewer friendly.

As noted earlier, perhaps the most important structural change in the Project Description is the requirement that Broader Impacts be described in a separate, stand-alone section, rather than integrated into other parts of the Project Description. Chapter 13 of the 2010 *Workbook* – NSF Version recommends that exact approach, so no change in the *Workbook*'s recommended formatting is necessary. What is necessary, of course, is a change in the content of the Broader Impacts section. You must be responsive to the new definition of what constitutes Broader Impacts, i.e., you must follow the preceding instructions in this supplement, rather than those that are contained in Chapter 13 of the 2010 *Workbook* edition.

Chapter 11 of the 2010 NSF *Workbook* edition covers Results of Prior NSF Support. "Prior NSF Support" includes ongoing support, as well as that which terminated during the past 5 years. The Chapter 11 instructions remain largely unchanged – with one very important exception: The summary of results must now be presented in two separate subsections – one related to the results of Intellectual Merit activities and a second subsection that summarizes Broader Impacts results. This clearly reflects the increased emphasis that the NSF is putting on PI accountability for Broader Impacts activities. Past and ongoing NSF support was merited under the previous definition of Broader Impacts (integration of teaching and research, inclusion of underrepresented groups, enhancement of physical/intellectual infrastructure, wide dissemination, and broad societal benefit). The 2013 GPG does not state whether the old or new definition should be used to write the Broader Impacts subsection of Results of Prior NSF Support while applicants transition to the new approach. Therefore, rather than risking that you could make the wrong choice, we recommend that you query the appropriate agency contact (contact information can be found in section VIII of NSF solicitations).

Biographical Sketch [GPG, NSF 13-1, Chapter II.C.2.f]

The only change necessary to Chapter 16 of the 2010 edition of *The Grant Application Writer's Workbook* – NSF Version pertains to the subsection of the Biographical Sketch that was previously titled, "Publications." The comparable subsection in the new Biographical Sketch will be titled, "Products". As is implied by the new name, this subsection will now give a wider range of closely related and other significant products the same relative importance as peer-reviewed publications. In other words, the change broadens the range of indicators of the applicant's contributions to his/her field. Thus, while patents, copyrights and software systems could be substituted for publications previously, the implication was that they were less important than peer-

reviewed publications. That will no longer be the case. Any product listed, to include data sets, must be readily accessible to reviewers.

Budget and Budget Justification [GPG, NSF 13-1, Chapter II.C.2.g]

Chapter 14 of the 2010 *Workbook* edition pertains to preparation of the Budget and Budget Justification. Very little change will be needed to bring this chapter into line with the new approaches. The one exception, where there has been significant change, is that which deals with voluntary committed cost sharing.

Voluntary Committed Cost Sharing [*Grant Proposal Guide*, NSF 13-1, Chapter II:C.2.g(xi)] "Inclusion of voluntary committed cost sharing is prohibited and Line M on the proposal budget [Mandatory Cost Sharing] will not be available for use by the proposer. In order for NSF, and its reviewers, to assess the scope of a proposed project, all organizational resources necessary for, and available to a project, must be described in the Facilities, Equipment and Other Resources section of the proposal."

"Voluntary committed cost sharing", which will be discussed further under Facilities, Equipment and Other Resources (see below), is voluntary inclusion of resources in either the Budget and/or Budget Justification for which NSF is not asked to provide support. It also pertains to inclusion of quantifiable financial information elsewhere in the application (e.g., in the Project Description or Facilities, Equipment and Other Resources section) regarding project-related resources for which NSF will bear no financial responsibility.

The primary source of voluntary-committed-cost-sharing problems has been inclusion of person months of effort in the Budget and Budget Justification unaccompanied by commensurate salary support. Person months of effort for which there is no budgeted salary support can no longer be included in the Budget and Budget Justification. Nor can person months of effort be included for which the institution provides financial support. This does not preclude your ability to include in your project personnel with committed time, but no budgeted salary. You just can't include such individuals in the Budget or Budget Justification. Thus, personnel who hold 9-month appointments can still include up to two person months of total NSF salary support (i.e., all NSF sources) during the summer months in the Budget and Budget Justification, but they can't include time invested in the project during the academic year, when their institution is supporting them. That part of contributed effort must be included elsewhere in the application – BUT WITHOUT INCLUSION OF FINANCIAL DETAILS REGARDING EITHER SALARY OR FRINGE BENEFITS.

To be included in the Budget/Budget Justification, senior persons must have effort invested in the project that is accompanied by a corresponding salary request. Any member of the senior personnel set, including the PI/Co-PI(s), who has neither person months nor salary in the Budget, e.g., a person who has a 12-month appointment that is fully supported by his/her institution, cannot be included in Section A of the Budget. However, the name of such a person can still appear on the Cover Sheet. Their role in the project will be described in the Facilities, Equipment and Other Resources section, rather than in the Budget Justification.

Facilities, Equipment and Other Resources [GPG, NSF 13-1, Chap. II.C.2.i]

Substantial changes will be made in Chapter 17 of the 2010 *Workbook*, which is the one that describes how to prepare the Facilities, Equipment & Other Resources section. This component will be reformatted in the FastLane system to better accommodate “aggregated description” of the resources that will be available to support the proposed research (see text box, next page).

Facilities, Equipment and Other Resources [GPG, NSF 13-1, Chapter II:C.2.i]

This section of the proposal is used to assess the adequacy of the organizational resources available to perform the effort proposed. Proposers should describe only those resources that are directly applicable. Proposers should include an aggregated description of the resources that the organization 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).

“Aggregated” means a summary of all resources that will be provided, which includes personnel. It also means inclusion of other kinds of resources that would constitute voluntary committed cost sharing if they were included in the Budget/Budget Justification – providing that their description here is not accompanied by quantifiable financial information.

Current & Pending Support [GPG, NSF 13-1, Chapter II.C.2.h]

We call attention here, not to a change, but to two often overlooked aspects of this part of the application. First, the PI and each Co-PI must report for each current or pending source of project support the total amount of effort that s/he has committed to the project. That means NSF-salaried time AND time that is supported by any other non-NSF source. Thus, a faculty member who has one summer month of NSF salary support for a project that is augmented by three academic person months supported by his/her university would report a total of 4 months here, but would show only one summer month and the corresponding salary in the Budget/Budget Justification. Second, many applicants forget that the application being submitted must be listed in the Current & Pending Support section as “Pending.” By forgetting to include the application that is being submitted an applicant deprive him/herself of the opportunity to tell reviewers what the total amount of time invested in the project will be.

Postdoctoral Researcher Mentoring Plan [GPG, Chapter II:C.2.j-1st bullet]

If you request funding in the Budget of your research-grant proposal for the support of one or more postdoctoral researchers, regardless of their location (submitting institution, subaward institution or at an institution that is participating in a simultaneously submitted collaborative project), you must prepare and submit a Postdoctoral Researcher Mentoring Plan (PRMP) as part of your application. In the case of either a simultaneously submitted collaborative project [GPG Chapter II:D.4] or a sub-award only one PRMP is required. It must be submitted by the lead institution.

The Mentoring Plan, which is not included as part of the 15-page Project Description, is limited to no more than one page unless the funding opportunity to which you are responding instructs otherwise. If you exceed the page limit for the PRMP your application may be returned to you without review.

If you have included support for a postdoctoral researcher in your Budget and do not include a Postdoctoral Researcher Mentoring Plan, in almost all cases NSF will not accept your proposal. The one exception: You do not need to write a PRMP if the postdoctoral researcher is included as a member of the Senior Personnel group (line A of the Budget). To make such an inclusion credible, the project role for the individual, as described in the Budget Justification, should include scientific and/or technical responsibility for an important part of the project.

Regardless of the kind of electronic submission system you are using, the PRMP will not count as part of the 15-page Project Description. If you are using FastLane to prepare your application there is a dedicated field in the FastLane template for upload of the PRMP. It is under "Supplementary Documents" and is titled "Mentoring Plan." If you are submitting your proposal through the Grants.gov system your Plan should be uploaded into the "Add Other Attachments" field (#12) of the Other Project Information component.

During merit review of your proposal the PRMP will be evaluated under the second major review criterion, Broader Impacts - integration of teaching and research, not under Intellectual Merit.

The PRMP must not contain information that is relevant to your Project Description. If it were to contain such information you would run the risk of it being considered an attempt on your part to circumvent the 15-page limit for the Project Description.

The *Grant Proposal Guide* offers examples of what could be included in a PRMP: "Examples of mentoring activities include, but are not limited to: career counseling; training in preparation of grant proposals, [developing] publications and presentations; guidance on ways to improve teaching and mentoring skills; guidance on how to collaborate effectively with researchers from diverse backgrounds and disciplinary areas; and training in responsible professional practices." To develop this document, we recommend that you start with a bullet outline that uses the relevant activities in the preceding list as headers. Headers should also be created for activities you plan to include that aren't part of the GPG's list. Be sure to make full use of relevant activities that are already available through your institution, e.g., training in the responsible conduct of research or ethical use of vertebrate animals. After completing your outline, simply expand the bullets into complete sentences to produce the first draft of your PRMP.

Examples of PRMPs can be found by inserting "Postdoctoral Researcher Mentoring Plan NSF Example" into any Internet search engine.

Most individual postdoctoral fellowship applications do not require a PRMP. There are exceptions, however. Therefore, if you are either making such an application or are supervising someone who is, search the related solicitation to ascertain whether or not a PRMP is required as a part of the proposal. It is not necessary to submit a PRMP if you are preparing a conference, symposium or workshop proposal. In the latter circumstance you do need to upload a substitute supplementary document, however, which reads: 'Not applicable - Conference [or Symposium or Workshop] Proposal.'

Data Management Plan [GPG, NSF 13-1, Chapter II:C.2.j-2nd bullet]

The name for this part of the application, Data Management Plan (DMP), is an unfortunate choice because it doesn't really denote its full purpose; 'Plan for Data Management and Sharing'

would be much more accurate and informative. NSF has long had a policy requiring grantees to disseminate and share information and products of their research. (Relevant excerpts from the *Award & Administration Guide*, Chapter VI.D.4.b-e, are provided in the text box, below.) The policy just hasn't been enforced very often. The new requirement that applications **MUST** contain a supplementary DMP - *your specific plans regarding how you will conform to this long-standing policy* - is compelling evidence that NSF is now serious about implementing this policy. Further evidence of the seriousness of NSF's commitment is a new part of their Web site (see <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>) that is specifically dedicated to dissemination and sharing of results. A Frequently Asked Questions page is also available on the Web site (<http://www.nsf.gov/bfa/dias/policy/dmpfaqs.jsp>). If your application does not contain a DMP it will not be accepted by NSF. If you are using FastLane you won't even be able to submit your proposal until this section has been completed.

- 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.
- 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.
- e. NSF program management will implement these policies for dissemination and sharing of research results, in ways appropriate to field and circumstances, through the proposal review process; through award negotiations and conditions; and through appropriate support and incentives for data cleanup, documentation, dissemination, storage and the like.

In terms of how to include the DMP in your application, the approach has a lot in common with that for including a Postdoctoral Researcher Mentoring Plan. As with the PRMP, the Data Management Plan should be included as a supplementary document. The DMP is limited to a maximum of two pages. As with the Postdoctoral Researcher Mentoring Plan, your DMP will not be counted as part of the 15 pages allowed for the Project Description. A difference between the two supplemental documents is that, if the two pages allowed for the DMP are insufficient to explain how data and other products of the proposed research will be managed and shared, you can use part of the Project Description to provide additional relevant information. That is not allowed for the Postdoctoral Researcher Mentoring Plan.

As with the Postdoctoral Researcher Mentoring Plan, if you are simultaneously submitting collaborative project applications, or if you have a sub-award to another institution as part of your proposal, only one Data Management Plan should be written by the PI at the lead institution.

Also like the Postdoctoral Researcher Mentoring Plan, the Data Management Plan should be uploaded into the FastLane system under "Supplementary Documents." It has its own sub-

heading there, "Data Management Plan." For submission through Grants.gov the document should be uploaded into the "Add Other Attachments" field (#12) of the "Other Project Information" component.

Unlike the Postdoctoral Researcher Mentoring Plan, the Data Management Plan will be reviewed as part of Intellectual Merit, Broader Impacts, or both.

A one-size-fits-all approach to data management and sharing has not been possible at NSF. Therefore, the part of NSF to which you are applying may have its own specific instructions for the DMP that supersede those which are contained in the *Grant Proposal Guide*: "(1) the types of data, samples, physical collections, software, curriculum materials, and other materials to be produced in the course of the project; (2) 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); (3) policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements; (4) policies and provisions for re-use, re-distribution, and the production of derivatives; and (5) plans for archiving data, samples, and other research products, and for preservation of access to them." If there are additional requirements you can determine what they are by visiting <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>. Simply scroll down to the section that is titled, "Requirements by Directorate, Office, Division, Program or Other NSF Unit" and click on the relevant button. It is VERY important that you do this before you write your DMP.

As with the PRMP, we recommend that you draft this part of your application by starting with a bullet outline. Create subheadings using each of the preceding 5 points from the *GPG* that is relevant to your needs. In addition, be sure to create subheadings for any special considerations that are required by your Directorate, Office, Division, Program or other unit of NSF that are relevant to your proposal.

It is possible to include as your Data Management Plan only a statement to the effect that no such plan is needed. That statement will be subject to peer review. Therefore, if that approach is elected, it should be accompanied by compelling justification as to why that is the case. We strongly recommend against taking such an approach unless you are offering a project that won't produce data/products that require management and/or sharing.

Rice University provides generic examples of DMPs for the Physical Sciences and Engineering, Biosciences, and for the Social and Behavioral Sciences (see <http://osr.rice.edu/forms/dataManagementPlans.pdf>). While the examples are excellent with respect to data management, they are deficient, in our opinion, with respect to coverage of dissemination and sharing of data.

A number of useful links to other data-management resources are included in the Rice PDF document referred to in the preceding paragraph. Other examples of Data Management Plans can be found by inserting "Data Management Plan NSF Example" into any Internet search engine.

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PREFACE

This *Workbook*, which is available through *Grant Writers' Seminars and Workshops* (www.grantcentral.com), will help you to prepare a research proposal to the National Science Foundation. We want to emphasize from the outset that the approach we recommend is not the only one that can be successful. In fact, there are many ways to write a competitive research proposal. However, while our approach is not the only one, we can assure you that it works. It kept each of us continuously funded for over 25 years. It has worked equally well, with minor variations, for individual investigator-initiated, group-based, training, and center-grant applications to a variety of different funding agencies.

To avoid redundancy with NSF's instructions for preparing a grant application, every effort has been made to make this *Workbook* complementary to them. Thus, what we offer here should not be read in isolation. In other words, it should be seen as an extension of, not a replacement for, NSF's Grant Proposal Guide and the instructions for preparing your application for submission through either FastLane or Grants.gov.

As a well-trained person, there is no question but that you CAN write a competitive application. We will partner with you in this proposal-writing endeavor; however, it is unlikely to be a successful partnership unless you come to the table with three essential ingredients: a first-rate idea, time, and a strong level of commitment. As you will soon see, there is no substitute for the first of these. With respect to time, two different kinds are of equal importance: *lead time* before your deadline and *quality time* while you are writing. You must create the latter by having the discipline to say "No!" to all competing, nonessential activities. The third ingredient, commitment, is essential to getting the job done at a level that is commensurate with success. Most of those who write grant applications lack sufficient commitment to spend the time and take the steps that we are going to ask of you. In our opinion that is why most writers of grant applications fail.

In the theater, often the last encouragement that an actor hears before going on stage is, "Break a leg." We don't know what the equivalent remark is in grant-proposal writing — maybe, "Break a pen?" Whatever it is, it would translate as, "Best of luck." But, as you'll see, luck doesn't play much of a role in this process — unless, of course, it's the kind that Thomas Jefferson was talking about when he said, "I'm a great believer in luck, and I find the harder I work the more of it I have." We agree, so let's get cracking!

Stephen W. Russell

Stephen W. Russell, D.V.M., Ph.D.

David C. Morrison

David C. Morrison, Ph.D.

December 2008

OVERVIEW OF PART ONE:

Before You Begin to Write

The rate of funding for NSF proposals has historically been just over 25%. That means that approximately three of four applicants fail. To ensure that you will be the one who succeeds we strongly recommend that you do a number of things 'up front' that will better position you to be successful. In these days of fierce competition and scarcer and scarcer research dollars it is common sense to us that every conceivable developmental step that will potentially contribute to a successful outcome for your proposal should be taken. Part one of this *Workbook* - chapters one through five – covers those important preliminary steps.

CHAPTER ONE: What You Need to Know About NSF and Its Funding of Research

Understanding NSF's mission and what it is trying to accomplish by funding grant applications provides the foundation for development of your application.

CHAPTER TWO: How to Develop and Optimize the Idea for Your Grant Application

There is no substitute for a good idea – the linchpin of a successful application. The best ideas are usually the product of a step-by-step developmental process, which is the subject of this chapter.

CHAPTER THREE: How to Choose the Appropriate Funding Opportunity and Granting Mechanism for Your Idea

No matter how good your idea, if you package and present it in the wrong way you are pre-ordained to fail. This chapter will help you to avoid that trap.

CHAPTER FOUR: *FastLane* or *Grants.gov* for Preparation and Submission of Your Proposal

Two completely different electronic means of preparing and submitting a grant application to NSF are available for most funding opportunities. This brief chapter will help you to choose the one that best meets your needs.

CHAPTER FIVE: The NSF Review Process and Tips on How to Write for Reviewers

Understanding the criteria and process that will be used to evaluate your proposal will help you write it to maximize reviewer-friendliness. Similarly, how you write your application will greatly influence its chances for success (or failure). Chapter five will help you avoid many of the writing mistakes that are made by most applicants.

CHAPTER FIVE–ONLINE: Create a Writing Schedule and Timetable

This file provides a template that can be used to create your writing schedule.

CHAPTER 1

WHAT YOU NEED TO KNOW ABOUT NSF AND ITS FUNDING OF RESEARCH

To be successful, a grant application submitted to the National Science Foundation must be concordant with its mission. Translated, that means that by funding your proposal, NSF must come closer to realizing some aspect of its mission. It is important, therefore, that applicants understand NSF's mission and what it is striving to accomplish with its investments in research.

THE MISSION OF THE NATIONAL SCIENCE FOUNDATION

NSF's continuing mission is set out in the preamble to the National Science Foundation Act of 1950 (Public Law 810507):

TO PROMOTE THE PROGRESS OF SCIENCE; TO ADVANCE THE NATIONAL HEALTH, PROSPERITY, AND WELFARE; TO SECURE THE NATIONAL DEFENSE; AND FOR OTHER PURPOSES

The Act authorizes and directs NSF to initiate and support:

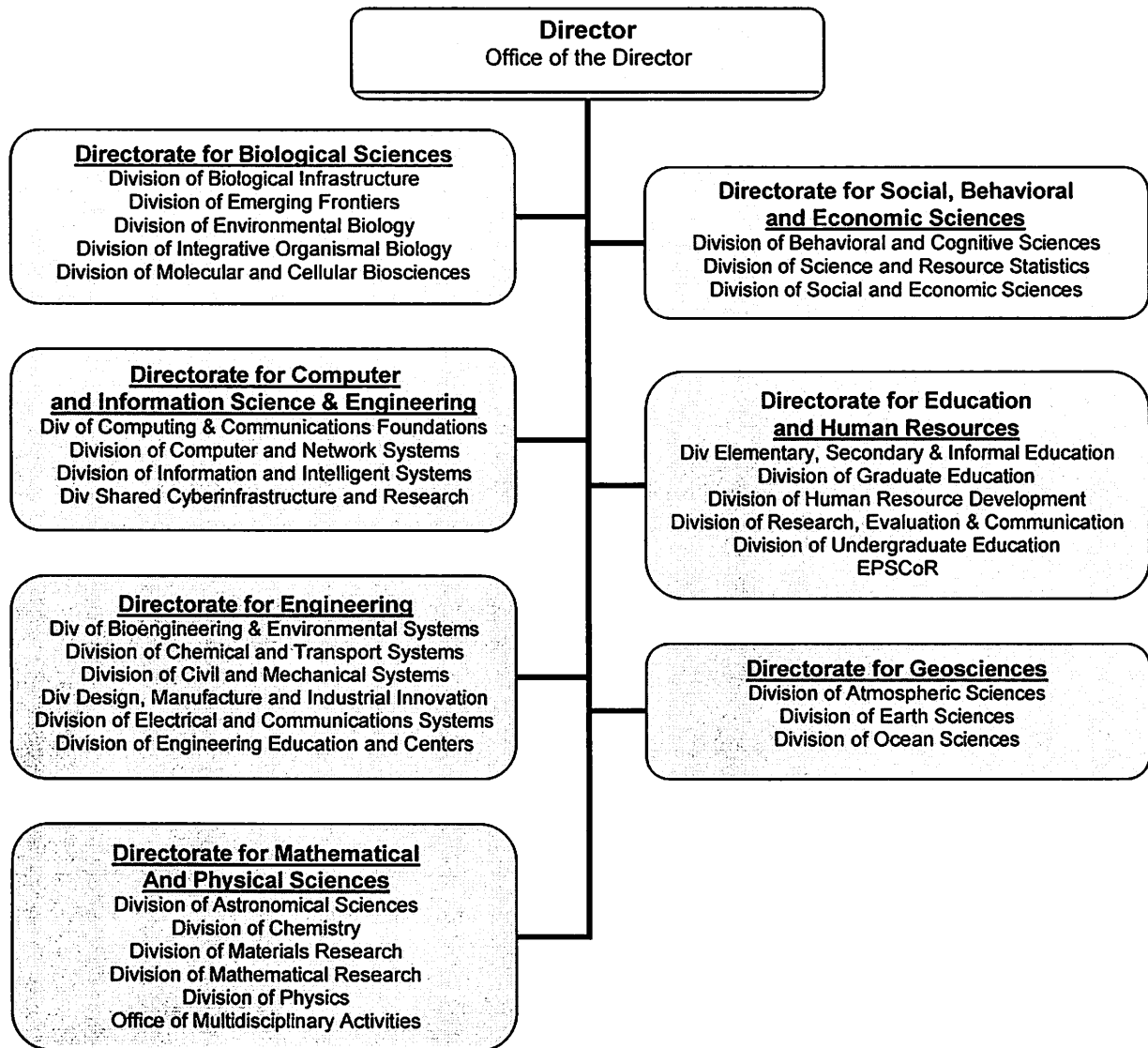
- Basic scientific research and research fundamental to the engineering process,
- Programs to strengthen scientific and engineering research potential,
- Science and engineering education programs at all levels and in all fields of science and engineering, and
- An information base on science and engineering appropriate for development of national and international policy.

Over time, the following additional responsibilities were added to the agency's mission: (1) foster the interchange of scientific and engineering information nationally and internationally; (2) support the development of computer and other methodologies; (3) maintain facilities in the Antarctic and promote the U.S. presence through research conducted there; and (4) address issues of equal opportunity in science and engineering.

Greater appreciation for what NSF is trying to accomplish with its dollars can be obtained by reading its current Strategic Plan (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf0648).

NSF is part of the Executive Branch of our government. Thus, both the director and deputy director are political appointees of the President, subject to confirmation by the U. S. Senate. The organizational chart, below, depicts how NSF is structured into seven directorates, each of which is headed by an Assistant Director and further subdivided into topical Divisions.

ORGANIZATION OF THE NATIONAL SCIENCE FOUNDATION



Within the Office of the Director, there are three entities that support research and researchers. They are: Office of Polar Programs; the Office of Integrative Activities; and the Office of International Science and Engineering. Other Offices under the Director's oversight, such as the Office of Budget, Finance and Award Management, have administrative functions.

NSF's FEDERAL APPROPRIATION AND HOW IT IS INVESTED

The following overview of NSF's legislative mandate comes from its Web site (<http://www.nsf.gov/about/glance.jsp>):

A. Initiate and support, through grants and contracts, scientific and engineering research and programs to strengthen scientific and engineering research potential, and education programs at all levels, and appraise the impact of research upon industrial development and the general welfare.

B. Award graduate fellowships in the sciences and in engineering.

C. Foster the interchange of scientific information among scientists and engineers in the United States and foreign countries.

D. Foster and support the development and use of computers and other scientific methods and technologies, primarily for research and education in the sciences.

E. Evaluate the status and needs of the various sciences and engineering and take into consideration the results of this evaluation in correlating its research and educational programs with other federal and non-federal programs.

F. Provide a central clearinghouse for the collection, interpretation and analysis of data on scientific and technical resources in the United States, and provide a source of information for policy formulation by other federal agencies.

G. Determine the total amount of federal money received by universities and appropriate organizations for the conduct of scientific and engineering research, including both basic and applied, and construction of facilities where such research is conducted, but excluding development, and report annually thereon to the President and the Congress.

H. Initiate and support specific scientific and engineering activities in connection with matters relating to international cooperation, national security and the effects of scientific and technological applications upon society.

I. Initiate and support scientific and engineering research, including applied research, at academic and other nonprofit institutions and, at the direction of the President, support applied research at other organizations.

J. Recommend and encourage the pursuit of national policies for the promotion of basic research and education in the sciences and engineering. Strengthen research and education innovation in the sciences and engineering, including independent research by individuals, throughout the United States.

K. Support activities designed to increase the participation of women and minorities and others underrepresented in science and technology.

If you want to maximize your proposal's chance of succeeding, you should have an appreciation for the amounts of research dollars that are available from NSF and how those dollars are spent (<http://www.nsf.gov/about/budget/>). Appropriations to NSF in FY 2008 were slightly more than \$6 billion, of which \$4.8 billion were for research and research-related activities. Approximately 10,000 awards were made (see <http://www.nsf.gov/about/glance.jsp>). During the same fiscal year, NIH's appropriation (over \$28 billion) allowed it to fund just under 50,000 awards – approximately five times more than NSF was able to fund. In spite of this great difference, NSF was the source of funding for approximately 20 percent of all federally funded non-medical basic research that was performed in 2,000 U.S. colleges, universities and other entities (see <http://www.nsf.gov/funding/aboutfunding.jsp>).

FY 2008 DISTRIBUTION OF NSF RESEARCH DOLLARS

EXPENDITURE AREA	DOLLARS (Millions)	PERCENTAGE OF TOTAL
Research and Related Activities	4,800	79.1
Education and Human Resources	725.6	12.0
Major Research Equipment & Facilities	220.7	3.6
Agency Operations & Award Management	281.7	4.6
National Science Board	3.90	<<1
Office of Inspector General	11.40	<1
TOTAL	6,065	100.0

NSF's appropriation was cut by 1.9% in FY 2005 – the first budget reduction since FY 2001 – but rebounded to FY 2004 levels in FY 2006. There was an increase of slightly more than 1% in FY 2007 and a little more than 2.5% in 2008. The latter allowed a 2.8% increase for research. However, these recent increases are insufficient to keep up with inflation, which means that dollars for research are becoming increasingly scarce. This important fact is why you need to do everything possible during the development of your proposal to maximize its competitiveness. This *Workbook* has been designed and written to help you accomplish that.

DEVELOPMENTAL STEPS FOR CHAPTER ONE:

1. Read and understand the mission of NSF as it relates to your proposal (<http://www.nsf.gov/pubs/2006/nsf0648/NSF-06-48.pdf>).
2. Read NSF's current Strategic Plan and determine how your projected proposal relates to it (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf0648).
3. Understand how NSF is organized and the Directorate/Division that would most likely sponsor your research.
4. Appreciate the scope and breadth of NSF's legislative mandate and what subcategory of it is most appropriate to your program of research.

CHAPTER 2

HOW TO DEVELOP AND OPTIMIZE THE IDEA FOR YOUR GRANT APPLICATION

The application you write can only be as good as the idea with which you start: If you don't have a compelling, novel idea that will drive your field vertically, you're unlikely to be funded. No amount of 'window dressing' — grantsmanship — can overcome lack of a good idea. Therefore, you (and we) need to do everything possible to ensure that your starting point — your idea — is nothing short of outstanding.

The best idea of which you are capable is usually the product of a step-by-step developmental process, i.e., it rarely occurs as a spontaneous event. These are the steps that we recommend you take to maximize the potential importance of your idea.

DEFINE THE PROBLEM THAT YOU WANT TO ADDRESS

First, within the scope of your overall research interest, select a niche area that is not over-worked, i.e., a subdivision of your broader interest that can be systematically and vertically developed by you. It is critical that you do so, because very few reviewers will care about funding your application if what is proposed only confirms or horizontally extends the work of others.

Second, identify the long-term goal you have within the niche area. It should be more than what could be accomplished under the auspices of a single period of grant support, but not so ambitious that it would be seen as unrealistic within the span of your career. Next, conceptualize the step-by-step continuum of research that would be required to attain the long-term goal you have identified.

Third, identify the next logical step that must be taken along the continuum of research that you have identified. In contrast to the long-term goal, the problem — the next step — that you select here should be one that can be resolved under the auspices of a single period of grant support. The problem that you select will become the subject of the proposal you write.

COLLECT AND CRITICALLY ANALYZE BACKGROUND INFORMATION THAT PERTAINS TO THE PROPOSED AREA OF INVESTIGATION

A comprehensive review of the literature is the next step in generating a fundable idea. This is necessary for at least three reasons. First, you need to determine what is already known. Second, the extent to which that body of knowledge is reliable needs to be critically examined. And, third, you need to determine who has been actively publishing in the field during the past ten years.

There are many different ways to explore the current and past literature of a field. Examples of some of the databases and services that may be helpful are included in the text box, below. Others can be identified by typing 'Literature Databases' into any Internet search engine.

Literature Databases and Services

Highwire Press (<http://highwire.stanford.edu/>)

759,333 full-text articles are free, with about 3,000 more free each month, making HighWire the largest archive of free life science articles in the world. Includes the biological, medical, physical and social sciences. A free e-mail alert service is available.

Thompson ISI (<http://www.isinet.com/cit/>)

Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index and more. These services offer a unique search method, cited reference searching (identification of authors who have cited a previous publication). Available through most university libraries.

Determining what is known and not known requires that you do more than read abstracts online; *detailed and critical analysis* of the pertinent past and current literature is required. One helpful approach is to photocopy the first page of any journal article that you want to evaluate. The first page will almost always contain the authors' abstract. As you read the paper, annotate the photocopied first page with any important information that was not included in the abstract. Also include remarks about the quality of the work, as well as the conclusions that were drawn from it. The annotated photocopy can then be filed / catalogued for future reference. *During the course of your literature review, create a list of key words that describe the field, as well as the names of investigators who have been active in the area during the last ten years* – the reason will become clear later in this chapter.

HOW TO GENERATE A PRELIMINARY IDEA PERTINENT TO THE PROBLEM THAT YOU HAVE CHOSEN

As you work your way through the literature, you will become increasingly aware of what is known and what is not. Invariably, ideas as to which gaps in the knowledge base are most important, and how they can best be filled, will begin to occur to you. Write such ideas down, but at this stage in the development of your idea, don't spend any more time than that. Why? Because many of your early ideas will probably prove to be sophomoric as you become more critically conversant with the literature. Also, major shifts in your insight will almost certainly occur as you continue your review. And finally, some of your early ideas may be ones that other investigators have had earlier – and written grant applications about them. For all of these reasons, at this point, just put your preliminary ideas in a computer or index-card file or notebook and continue with / complete your critical review of the literature.

Once you have completed your review, go back to the ideas that you have collected. As you review them you may find that inspiration strikes immediately – but almost surely it will be the case that no one of the ideas will be as important as what you synthesize by looking at them collectively. If the idea doesn't come, don't be alarmed and don't force it: don't settle for less than an outcome with which you are completely comfortable. If you're not satisfied, take a few days off and then approach them in an effort to establish better how the ideas and concepts you have generated relate to one another. Eventually, the proverbial 'light bulb' will come on. When

it does, you will know it, because you will be genuinely excited by the prospects that become apparent to you. Then, you need to ask yourself this last, two-part question: *'Will this idea impact positively on my field – will it enable a vertical advance in my field – and, if so, can I convince others of that fact?'* If your answer to both parts is, 'Yes,' you've crossed the Rubicon and you're on your way to the next step in the process. On the other hand, if you find that you can't say with conviction that your idea has the potential to advance your field substantively, then you have to accept that you are not yet ready to write a competitive, i.e., successful, grant application. You either need to keep trying to evolve a more novel, important idea in the same area, or shift to a new problem that has greater potential to pass this 'impact' test.

HOW TO ASSESS YOUR IDEA'S POTENTIAL FOR SUCCESS AND MODIFY IT, IF NECESSARY

Assuming that you have been successful in generating an exciting (to you) preliminary idea, its potential for success should be assessed before you ever put pen to paper. Three very important steps must be taken:

1. Assess your own ability to pursue the idea. Regardless of how good your idea is, it must to be one that is within your capabilities to pursue. For example, will you, as Principal Investigator, have sufficient time to devote to the project? If you are a senior person with many different kinds of scientific, educational, and administrative responsibilities, is it credible to take on more? If you are a Beginning Investigator (definition: Grant Proposal Guide, chapter 1G.2; http://www.nsf.gov/pubs/policydocs/pappguide/nsf09_1/nsf091.pdf), are you in a position to commit enough time? The latter is an important question, because reviewers usually expect a greater time commitment from junior, compared with more senior, investigators. Will you and your collaborators have the expertise necessary to accomplish the work? If not, can the missing expertise be acquired by engaging one or more co-principal investigators, co-investigators, consultants or collaborators? Do you and your institution have the resources that will be required to pursue the kinds of research that will be necessary? If not, will you be able to obtain them? If you are proposing at the most competitive level, i.e., NSF's standard research grant, do you have sufficient preliminary data to convince reviewers that the project is feasible in your hands – not someone else's – yours? The answers to those and similar kinds of questions either have to be answered convincingly in your favor or there is little point in going forward, no matter how good your idea may be conceptually.

2. Assess and use your competition to advantage. Good ideas are often generated independently by more than one person. You need to know, therefore, what research has already been funded in the area that you are considering. Clearly, you want to avoid writing an application that is similar to one that has already been funded — and, if such grants are out there, you want to know about them so that you can make use of them to stimulate and extend your own thinking and planning. You can electronically access NSF-funded research grants that have been funded since 1989 by going to: <http://www.nsf.gov/awardsearch/>. A similar database, CRISP (Computer Retrieval of Information on Scientific Projects), exists for federally funded biomedical research grants (<http://crisp.cit.nih.gov>). It covers projects funded by the National Institutes of Health (NIH; the majority of entries), Substance Abuse and Mental Health Services (SAMHSA), Health Resources and Services Administration (HRSA), Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDCP), Agency for Health Care Research and Quality (AHRQ), and the Office of the Assistant Secretary of Health (OASH). The United States Department of Agriculture maintains the CRIS (Current Research Information System) database (<http://cristel.csrees.usda.gov>), which contains information about agricultural-

ly relevant research grants that have been funded by the Federal government. You can also access most federally funded research grants at <http://fundedresearch.cos.com>, as well as grants that have been funded by the United Kingdom's Medical Research Council. This is a Community of Science Internet site to which either you or your institution must subscribe (<http://registration.cos.com/cos/basic.html>)

To retrieve information from any of these databases, you can enter the names of individuals who either are, or have been, active in your field (determined from your critical analysis of the literature, especially of the last 10 years). In addition, you can use key words that are relevant to the idea that you are seeking to fund. Through this approach you can obtain an extensive amount of information on already-funded applications that are related to your idea. For example, at NSF's Award Search database (<http://www.nsf.gov/awardsearch>), you would choose the "Awardee Information" tab (see below).

Award Search

[Send Comments](#)

Awardee Information	Program Information	Search All Free-Text	Search All Fields
----------------------------	----------------------------	-----------------------------	--------------------------

Hint: The text field below 'Search Award For' searches the title, abstract, and award number fields.

Search Award For:

Restrict to Title Only: ☐

Awardee Information

Principal Investigator

First Name:

Last Name: **PI Lookup**

Hint: Including CO-PI will result in slower searches.

Include CO-PI: ☐

Organization: **Organization Lookup**

State:

ZIP Code:

Country:

The key words you have generated would be entered into the "Search Award For" box. The names of investigators who have been active during the past ten years would be entered into the boxes that appear under the heading, "Principal Investigator." Not shown, at the bottom of the query form, is the "Search" button that you would click to find the grants that are related to the words / names you have entered. Just above it are boxes that can be checked to limit the search either to active, expired or historical (prior to 1976) awards. If none of the information you enter produces a result, you are probably querying the database during a time when it is closed to use (incremental data load update occurs every day from 2:00 am to 4:00 am ET, and full data load update takes place every Saturday. NSF may have network, servers and/or database maintenance on Sunday).

The results you obtain will look something like the example at the top of the next page:

667 awards found, displaying 1 to 50.

[First/Prev] 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 [Next/Last]

Award Number	Title	NSF Organization	Program(s)	Start Date	Principal Investigator	State	Organization
0522322	An Alternative Program for Recruiting, Certifying and Retaining Science and Mathematics Teachers from Underrepresented Populations in Teaching Science and Mathematics (PRECOUT)	EDU	SCIENCE,TECH,ENG&MATH TEACHER	05/01/2002	Abd-El-Fahad, Fouad	IL	University of Illinois at Urbana-Champaign
0121661	ITP/SL: The Aware Home: Sustaining the Quality of Life for an Aging Population	CNS	EMBEDDED & HYBRID SYSTEMS, EHS), ITS MEDIUM (GROUP) GRANTS, INFORMATION TECHNOLOGY RESEARCH	10/01/2001	Abood, Gregory	GA	Georgia Tech Research Corporation GA Institute of Technology
0521661	Workshop on CSP in Vehicular and Mobile Systems, Coimbra, Portugal, September 3, 2005	ITS	HUMAN LANGUAGE & COMMUNICATION, HUMAN COMPUTER INTER PROGRAM	03/15/2005	Abul, Hossain	CA	San Jose State University Foundation
0124878	Collaborative Research: Field Studies of Organizational Memory and Information reuse	ITS	DIGITAL SOCIETY/TECHNOLOGIES	08/01/2001	Ackerman, Mark	MI	University of Michigan Ann Arbor
0435370	NeTs-Pro: High Performance Cognitive Radio Platform with Integrated Physical and Network Layer Capabilities	CNS	EE IN NETWORKING TECH & SYS	09/15/2004	Ackland, Bryan	NJ	Rutgers University New Brunswick

Clicking on the column headings, with up / down arrows to their right, will allow you to search in either ascending or descending order. Clicking on either the award number or title will retrieve all of the information about that grant, including its abstract. All of the grants funded by an NSF organization, not just the ones related to your search, can be displayed by clicking on the acronym for that organization in the body of the table. Similarly, clicking on the name of an NSF program in the next column, the name of a principal investigator, a state, or on the name of an institution will cause all grants related to that entity to be displayed.

Some databases of funded grants (e.g., CRISP, but not NSF's Search Award Database) contain cataloging terms for each entry. When a grant is funded, someone at the funding agency creates a list of terms that reflect its content. Some of these descriptors often extend to information that is not covered in the abstract (e.g., a specific method). Careful consideration of these cataloging terms can lead to additional useful and new thoughts / approaches that will help you to develop and refine your own idea.

A day spent screening these databases can be invaluable!!! First, it will help you to avoid the trap that so many applicants fall into: it will prevent you from writing a 'me-too' application, i.e., one that has already been written. Second, and equally important, what you learn from your competitors' abstracts (and cataloging terms, if available) can be used to refine and improve your own research design. Most other writers of grant applications don't use these databases in the development of their applications. If you do, it will give you an important competitive edge.

3. Assess your idea's potential for funding. Even though you have probably already decided to submit your application to a specific Program at NSF, if you haven't done so already, you need to make certain that there aren't other, equally (or even more) applicable funding opportunities available to you. Grants.gov (<http://www.grants.gov>; see top of next page) is now the clearing house for all Federal granting opportunities. As such, it is an excellent place to search for other Federal sources of support.


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Find. Apply. Succeed.

Grants.gov is your source to FIND and APPLY for federal government grants. The U.S. Department of Health and Human Services is proud to be the managing partner for Grants.gov, an initiative that is having an unparalleled impact on the grant community. [Learn more](#) about Grants.gov and determine if you are eligible for grant opportunities offered on this site.

Grants.gov does not provide personal financial assistance. To learn where you may find personal help, check [Government Benefits](#), [Student Loans](#) and [Small Business Start-up Loans](#).

What's New This Week at Grants.gov

New Opportunities This Week

Adobe Reader 8.1.3 Resolves "Broken Pipe" Issue

"Broken Pipe" plus other Adobe Reader Error Messages 

Sign-up for our "Succeed" Quarterly Newsletter

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- [Resources](#)

Note that there is a tab at the upper left of the Grants.gov home page (above) that is titled "Find Grant Opportunities." Also note that, in addition to searching manually for sources of funding, you can subscribe to a free e-mail alert service that will notify you of future opportunities that match your research interests (see button on right under "For Applicants").

The Foundation Center Online (<http://fconline.fdncenter.org/>) is an excellent place to seek non-Federal sources of research-grant support.



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GO

The Grantseeker's Best Friend

Retrieve a wealth of information for your funding needs.



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Developed by the Foundation Center, a nonprofit organization with 50 years of experience connecting grantseekers and grantmakers, *Foundation Directory Online* is the nation's leading online resource for funding research.

More Accurate
Updated continually, *Foundation Directory Online* provides the most accurate details available on U.S. funders and their grants.

More Comprehensive
Over 92,000 U.S. foundations and corporate donors, 1.3 million recent grants, and more than 400,000 key decision makers.

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—Vice President, Development, Atlanta

While the Foundation Center is an excellent resource, its users must be either individual or institutional subscribers (https://fcsecure.fdncenter.org/fdo_signup_prof/register.php?setplan=start). If your institution isn't a subscriber and you don't want to make such an investment personally, try putting your key words, together with either the word 'grant' or 'funding' and then enter them into any good Internet search engine. You will be amazed at what can be unearthed with such an approach.

After you have completed your search, even if NSF continues to be your best bet for funding, other agencies that you have identified can become additional targets for applications. With competition what it is these days, not to send the same (or a very similar) application to multiple potential funding sources is almost unthinkable. It is usually not that much extra work to apply to more than one – and most agencies don't consider it to be a negative if you do so. For NSF all you have to do is acknowledge that you have done so in your application's *Current and Pending Support* section. There is one very important NSF exception, however. The Biological Sciences Directorate will not allow an established investigator to submit a research proposal to it if a duplicate (or very similar) proposal has been submitted for independent review to any other federal agency. However, those who qualify as beginning investigators (anyone who has not held a Federal research award as either principal or co-principal investigator) can submit the same /a similar application to the Biological Sciences Directorate and one or more other federal agencies simultaneously.

SEEK CONSTRUCTIVE CRITICISM FROM KNOWLEDGEABLE COLLEAGUES

Because the idea that underlies a grant application is so fundamentally important to its success, you need to do everything possible to ensure that it is as strong as you think it is. An essential part of 'doing everything possible' is seeking the critical feedback of knowledgeable colleagues; if problems exist with your idea, now is the time to find out about them — not later, from your reviewers. Once you have developed your idea to the fullest extent that you can, at least two persons should be consulted. They can either be at your own institution or at some other one. They could, for example, be members of the pre-submission review committee that you will ask to review the final draft of your application for scientific / technical merit before it is submitted (a process that is described in chapter 19 of this *Workbook*). You should present your idea in writing. To do so, once you have completed them we recommend that you give them the *Overview and Objectives* and *Expected Significance* sections of your application (see chapters 6 and 7). The two together constitute the 'master plan' or 'template' for your grant application.

The investigators to whom you show your overview should be chosen with several criteria in mind. First, they have to be ones in whom you have absolute trust, i.e., ones who you can be confident won't 'take the idea and run.' Second, it is essential that each of your consultants be intimately familiar with the field in which you have an interest. Otherwise, they will have difficulty assessing such things as novelty and potential impact. And, third, they have to be the kind of colleagues who can provide real, even painful, constructive criticism, should it be needed. With respect to this latter criterion, the kind of person you *don't* want is someone who would be afraid to hurt your feelings by pointing out a problem.

Critically consider the feedback that you receive from your colleagues and, *if you concur*, modify your idea to maximize its potential impact. If you don't fully concur, this can be a time of painful decision making. In such circumstances, you may want to seek the advice of additional colleagues before you make any changes. The bottom line is that you have to have total confidence that the final product — the idea that will drive your research proposal — is completely

sound and merits funding. If you don't, you won't be able to bring to your project the kind of enthusiasm and commitment that are necessary to write an outstanding application.

DEVELOPMENTAL STEPS FOR CHAPTER TWO:

1. Identify a relatively under-explored niche within the area of your broad research interest.
2. Identify the long-term goal you have within the niche area.
3. Conceptualize the step-by-step continuum of research that you would pursue to develop a research program in the niche area.
4. Identify the potential subject of the application you intend to write, i.e., the next logical step that needs to be taken along the continuum of research that you have just formulated.
5. Search and critically analyze the literature that is pertinent to the step you want to take.
6. While searching and analyzing the literature, develop a list of key words that are pertinent to the area and the names of investigators who have been active in the area during the last ten years.
7. Assess your own ability to pursue the idea, including such things as relevant expertise and resources.
8. Assess your competition and use information gleaned from databases of funded grants to improve your idea and the research design of your own proposal.
9. Assess which granting agencies are most appropriate to your idea, i.e., ones whose mission will be advanced by funding your idea.
10. Once you have brought the idea to the best level that you can, seek constructive criticism of it from knowledgeable colleagues. Use their feedback, if helpful, to maximize the idea's potential as the starting point for your application.

CHAPTER 3

HOW TO CHOOSE THE APPROPRIATE FUNDING OPPORTUNITY AND GRANTING MECHANISM FOR YOUR IDEA

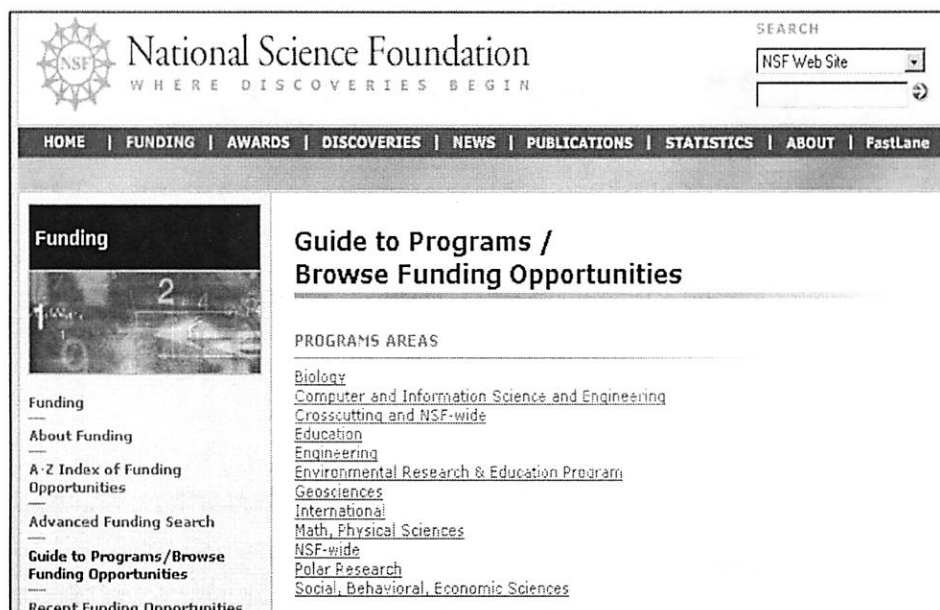
NSF has many different funding opportunities and granting mechanisms through which it distributes research dollars. No matter how good your idea, if you package and present it in the wrong granting mechanism, you are unlikely to be successful. Similarly, even if you have identified the appropriate mechanism, you will seldom be funded under it unless you give NSF what it is seeking through the funding opportunity to which you have decided to respond.

KINDS OF FUNDING OPPORTUNITIES

Generally speaking, there are two different kinds of funding opportunities, unsolicited and solicited.

Unsolicited Proposals

NSF consists of various Directorates and Divisions that sponsor the programmatic areas it is legislatively mandated to support (see chapter one). Each Directorate describes its research interests and funding opportunities on the NSF Web site under "Guide to Programs / Browse Funding Opportunities" (http://www.nsf.gov/funding/browse_all_funding.jsp).



If you were to click on "Engineering" under "Programs Areas" in the preceding figure, you would be taken to a list of active funding opportunities that are sponsored by the Directorate for Engineering.

The screenshot shows the NSF Directorate for Engineering (ENG) website. The header includes the NSF logo and the text "National Science Foundation DIRECTORATE FOR Engineering (ENG)". A search bar is located in the top right corner. Below the header is a navigation menu with links to "ENG Home", "ENG Funding", "ENG Awards", "ENG Discoveries", "ENG News", and "About ENG". The main content area is titled "Engineering (ENG) Active Funding Opportunities". It includes a sidebar with links to "ENG Home", "About ENG", "Funding Opportunities", "Awards", "News", "Events", "Discoveries", "Publications", "Advisory Committee", "Career Opportunities", "General Info", "Strategic Plans and Reorganization Docs", "See Additional ENG Resources", "View ENG Staff", and "Search ENG Staff". The main content area lists several funding opportunities, including "ACCELERATING DISCOVERY IN SCIENCE AND ENGINEERING THROUGH PETASCALE SIMULATIONS AND ANALYSIS (PetaApps)", "Active Nanostructures and Nanosystems (ANN) (ANN)", "ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers", and "Biomedical Engineering (BME)". Each listing includes a title, a program number, and a full proposal deadline.

Engineering (ENG) Active Funding Opportunities

Sorted by Title. Click column headings to sort. Status: Active

Key: ☒ Crosscutting | ☒ NSF-wide | ☒ Grants.gov submission required

Title	Program Guidelines	Due Dates
ACCELERATING DISCOVERY IN SCIENCE AND ENGINEERING THROUGH PETASCALE SIMULATIONS AND ANALYSIS (PetaApps)	07-559	
Active Nanostructures and Nanosystems (ANN) (ANN)	06-595	
ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers	07-582	Full Proposal: December 6, 2007
		Full Proposal: January 17, 2008
Biomedical Engineering (BME)		Full Proposal: March 1, 2008
		Full Proposal: September 15, 2008

Clicking on the title of a funding opportunity yields specific information about it. Note that some titles have a number to the right of them, while others do not. By investigating the unnumbered titles first – for example, by clicking on "Biomedical Engineering" – you would discover that each unnumbered title is a Program Description (see section I.C.2 of the *Grant Proposal Guide*). In the figure, below, note under "PROGRAM GUIDELINES," that "PD," which stands for Program Description, precedes the number of the program. Program descriptions pertain to broad, general areas in which NSF wants to stimulate research.

The screenshot shows the details of the Biomedical Engineering (BME) program. The header includes the NSF logo and the text "National Science Foundation DIRECTORATE FOR Engineering (ENG)". A search bar is located in the top right corner. Below the header is a navigation menu with links to "ENG Home", "ENG Funding", "ENG Awards", "ENG Discoveries", "ENG News", and "About ENG". The main content area is titled "Biomedical Engineering (BME)". It includes a sidebar with links to "ENG Home", "About ENG", "Funding Opportunities", "Awards", "News", "Events", "Discoveries", "Publications", "Advisory Committee", "Career Opportunities", "General Info", "Strategic Plans and Reorganization Docs", "See Additional ENG Resources", "View ENG Staff", and "Search ENG Staff". The main content area lists several funding opportunities, including "ACCELERATING DISCOVERY IN SCIENCE AND ENGINEERING THROUGH PETASCALE SIMULATIONS AND ANALYSIS (PetaApps)", "Active Nanostructures and Nanosystems (ANN) (ANN)", "ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers", and "Biomedical Engineering (BME)". Each listing includes a title, a program number, and a full proposal deadline.

Biomedical Engineering (BME)

CONTACTS

Name	Email	Phone	Room
Semahat Demir	sdemir@nsf.gov	(703) 292-7950	565 S

PROGRAM GUIDELINES

Apply to PD 08-5345 as follows:

For full proposals submitted via FastLane: standard Grant Proposal Guidelines apply. For full proposals submitted via Grants.gov: NSF Grants.gov Application Guide; A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf>)

DUE DATES

Full Proposal Window: February 1, 2008 - March 1, 2008

Full Proposal Window: August 15, 2008 - September 15, 2008

SYNOPSIS

The Biomedical Engineering (BME) program primarily supports fundamental, transformative, and discovery research applied to biological systems. The research projects should:

- Develop novel ideas integrating engineering and life science principles in solving biomedical problems that serve humanity
- Focus on high impact transforming methods and technologies and include models and tools for understanding and control of biological systems; fundamental improvements in deriving information from cells, tissues, organs, and organ systems; new approaches to the design of structures and materials for eventual

Applications made in response to program descriptions are considered “unsolicited” – you have an idea that fits within the general framework of what the program seeks to fund (review what is included under the “SYNOPSIS” heading). Delve more deeply into the priorities by clicking on the “For more information visit” link, if there is one, at the end of that section. If you decide that what you want to present fits within the framework of what this program wants to fund you write it up and you submit it without any kind of a formal ‘invitation.’

As can also be seen in the preceding figure, the name of the Program Director and his/her contact information are provided on the part of the Directorate’s Web site that summarizes the funding opportunity. This is the individual to contact regarding maximizing the programmatic relevance of your idea (see chapter 8, How to Maximize the Programmatic Relevance of Your Idea). If there is more than a single Program Director named, do the best that you can to choose the one who is most relevant to the idea that you plan to present. For example, sometimes they are identified with respect to Division within the Directorate. If there are no clues initiate contact with one of them using the approach described in chapter 8. If s/he is not the correct one s/he will refer you to the one who is.

Another important piece of information that is available to you from the Program Description’s Web site is the means that can be used to prepare and submit your proposal – either FastLane, Grants.gov (see chapter 4 regarding how to make the choice between the two if you have that opportunity).

The program announcement – a formal announcement of a specific NSF program – is an additional, less common mechanism for generating unsolicited proposals (see section I.C.3 of the *Grant Proposal Guide* for description).

Program descriptions and program announcements are the primary means through which NSF signals the availability of support for research and educational programs that are of general interest to it.

Solicited Proposals

Titles of funding opportunities that are accompanied by a number (see figure below) are program solicitations. Program solicitations are more specific with respect to programmatic area

Industrial Innovation and Partnerships (IIP) Proposals and Awards Proposal and Award Policies and Procedures Guide Introduction Proposal Preparation and Submission • Grant Proposal Guide • Grants.gov Application Guide Award Administration • Award Administration Guide Award Conditions Other Types of Proposals NSF Outreach Policy Office Website Additional ENG Resources ENG Committee of Visitor (COV) Reports	Broadening Participation Research Initiation Grants in Engineering (BRIGE)		07-589	Full Proposal: February 8, 2008
	Catalysis and Biocatalysis			Full Proposal: March 1, 2008
	Center for the Environmental Implications of Nanotechnology (CEIN)		07-590	Preliminary Proposal: December 10, 2007 Full Proposal: March 17, 2008
	Centers of Research Excellence in Science and Technology (CREST)		07-526	
	Chemical and Biological Separations (CBS)			Full Proposal: March 1, 2008

than program descriptions / announcements are. Such funding opportunities are usually availa-

ble for a shorter length of time, compared to program descriptions / announcements and competition is only among applications submitted in response to the solicitation. In addition, for a funding opportunity to be given the status of "solicitation" it must have one or more of the characteristics that are listed in the *Grant Proposal Guide* (see section I.C.4). A summary of the funding opportunity can be obtained, along with the name(s) of the contact persons by clicking on the title of the solicitation (see figure, below).



Engineering (ENG)

- ENG Home
- About ENG
- Funding Opportunities
- Awards
- News
- Events
- Discoveries
- Publications
- Advisory Committee
- Career Opportunities
- General Info
- Strategic Plans and Reorganization Docs
- See Additional ENG Resources
- View ENG Staff
- Search ENG Staff
- ENG Organizations

Centers of Research Excellence in Science and Technology (CREST)

CONTACTS

Name	Email	Phone	Room
Victor Santiago	vsantiago@nsf.gov	(703) 292-4673	815 N
James Powlik	jpowlik@nsf.gov	(703) 292-4681	815N
Toni Edquist	tledquist@nsf.gov	(703) 292-4649	815 N
Kesh Naranyan	knaranyan@nsf.gov	(703) 292-7076	590N
Juan Figueroa	jfigueroa@nsf.gov	(703) 292-7054	590N

PROGRAM GUIDELINES

[07-526 Solicitation](#)

SYNOPSIS

The Centers of Research Excellence in Science and Technology (CREST) program makes resources available to enhance the research capabilities of minority-serving institutions through the establishment of centers that effectively integrate education and research. CREST promotes the development of new knowledge, enhancements of the research productivity of individual faculty, and an expanded presence of students historically underrepresented in STEM disciplines. Awards are offered as new centers, supplements to existing centers, proposals for the CREST Historically Black Colleges and Universities Research Infrastructure for Science and Engineering (HBCU-RISE) initiative, or supplements to CREST/HBCU-RISE-eligible awardees for diversity collaboration in projects co-funded with NSF's Small Business Innovation Research and Small Business Technology Transfer (STTR) programs, which are administered by NSF's Directorate for Engineering.

The actual solicitation, itself, can be obtained by clicking on its number, 07-526 in the example, above, either on the summary page for the solicitation (above) or on the Web page that lists Active Funding Opportunities (figure at bottom of preceding page). The solicitation will provide you detailed information with respect to what NSF wants to fund under this program. A common mistake among applicants to solicitations is that they propose what they want to do, not what NSF wants to fund. Therefore, if you are responding to a solicitation you should read it over and over again until you are intimately aware of all of the 'hot buttons' that you would need to punch in order to be responsive to the solicitation. Applying to a solicitation with a project that is programmatically marginal or irrelevant makes no sense at all and is a waste of time. Additional detail about the contact persons is also provided in the solicitation. In the figure above, for example, you would discover that four of the five contacts are Program Directors and that Toni Edquist is a Program Assistant who is relevant only if you would have with questions about the use of FastLane in making your application.

GRANTING MECHANISMS AND KINDS OF SUBMISSIONS

Granting Mechanisms

NSF has created a variety of granting mechanisms through which to distribute its support for research. Each of these has a specific purpose.

Tip: Each granting mechanism exists for a purpose. To optimize your chances for success, you must understand the purpose of the mechanism you choose and then meet that purpose in the way that you write your proposal.

The commonly used granting mechanisms include:

Standard Research Grant

This is the 'work horse' of NSF funding because its purpose is to propose the 'usual' kind of research project. It is used, therefore, for most applications, in some cases with variations that are spelled out by the funding opportunity to which the applicant is responding. This *Workbook* is focused on the standard research grant because it is the granting mechanism that is used most often to apply for research support from NSF. Other granting mechanisms (such as the ones summarized below) will be the subjects of supplements to this *Workbook*. They will be designed to help applicants 'spin' their proposals to explicitly meet the purpose that each has.

Small Grant for Exploratory Research

This granting mechanism has as its purpose the funding of pilot studies into new areas, investigations that are characterized by the potential for high impact but have relatively high risk of failure associated with them, and projects that have a particularly urgent need for funds (such as studying a volcanic eruption or the immediate aftermath of a storm, like hurricane Katrina). The application is quite short (2-5 page Project Description), can be submitted at any time, and is reviewed directly by NSF program staff, not by the usual peer-review mechanism.

CAREER Award

The purpose of this highly prestigious granting mechanism is to help launch the career of an academician who wants to establish a life-long career as a teacher / scholar – someone who wants to use his/her research as a 'magnet' that will motivate students to learn more, better. In other words, it is not meant to be for career development in the usual sense of the word. One way to look at the CAREER Award application is as a standard research grant with an educational plan added. The secret to success with this granting mechanism is tight integration of the research and educational plans, such that an important educational problem is solved by integration of the candidate's research efforts. Many CAREER Award applications fail, even though they have excellent research and educational plans, because the two components are written as independent programs, not ones that are fully integrated.

Instrumentation and Equipment Proposals

The purpose of this granting mechanism is to facilitate research that is of importance to NSF by enabling it through the provision of needed equipment. Proposals of this kind usually compete for the same pool of money that research proposals do, so they have to be especially responsive to the purpose of the granting mechanism to stand a chance of success. Although applications can be submitted on behalf of an individual, in our experience proposals that support and benefit more than a single investigator usually stand a better chance of succeeding. If there are multiple investigators each one must describe how his/her research will benefit from use of the proposed equipment. These proposals often fail in our experience because those other than the Principal Investigator do a perfunctory job of projecting how their NSF-supported research will be facilitated if the equipment is awarded. A strong PI who can extract what is needed from

those who will supposedly benefit is essential to success, therefore.

Kinds of Submissions

Letter of Intent

This kind of submission is often confused with the preliminary proposal, which will be discussed in the next paragraph. The need for a letter of intent will be included as part of the instructions for a particular funding opportunity. Many applicants fail to appreciate that a letter of intent has nothing to do with the subsequent review of their proposals. The letter of intent is simply a device that NSF Program staff use to assess the numbers, origins and subjects of proposals that will be submitted in response to a given call, thereby allowing them to do a better job of orchestrating review of the tendered applications. The content of an LOI is brief and is stipulated by the *Grant Proposal Guide* (see section I.D.1).

Preliminary Proposal

If the funding opportunity requires a pre-proposal, in our opinion, it represents a major hurdle that must be cleared. All-out commitment to writing the pre-proposal is essential because, if the applicant is successful at this stage in the evaluation process and s/he is invited / encouraged to submit a full proposal, in our experience, s/he has an excellent chance of being funded. Depending on the funding opportunity, one of two different responses can be made to a pre-proposal by NSF: (i) Invite or Not Invite, and (ii) Encourage or Discourage. The funding opportunity announcement will stipulate which of the two will be in play. If it is the first of the two the response is final and affects the applicant's ability to subsequently submit a full proposal. The second of the two kinds of responses, by contrast, has no effect on an applicant's ability to write and submit a full proposal. In other words, NSF's response is advisory, only. However, in our experience, if NSF elects to discourage an applicant it is usually a waste of time to proceed. Greater detail about pre-proposals can be found in section I.D.2 of the *Grant Proposal Guide*.

Full Proposal

This refers to the standard research grant proposal that is the subject of Chapter II of the *Grant Proposal Guide*. The majority of this *Workbook* is devoted to writing and submitting this kind of proposal.

DEVELOPMENTAL STEPS FOR CHAPTER THREE:

1. Determine whether your application will be made as one that is solicited or unsolicited.
2. Under the NSF program that is relevant to your idea, identify the active funding opportunity to which you will respond (http://www.nsf.gov/funding/browse_all_funding.jsp).
3. Thoroughly read the funding opportunity announcement (FOA) multiple times to be certain that your idea matches the priority areas that NSF is seeking to fund through it.
4. Once you have chosen the FOA, identify the 'hot buttons' that must be punched in the application to be fully responsive to that FOA.
5. Determine from the FOA whether either a letter of intent or preliminary proposal is required. If so, understand what must be included and how the LOI/pre-proposal must be submitted (e.g., electronically through FastLane).

CHAPTER 4

FastLane OR Grants.gov FOR PREPARATION AND SUBMISSION OF YOUR PROPOSAL?

The federal government is in the final phases of completing the transition of 26 agencies to announcing all funding opportunities and submitting grant applications electronically through their new Internet clearinghouse, Grants.gov (www.Grants.gov). When the change to electronic submission was announced many in the academic community assumed that the federal government would take advantage of the extensive experience that NSF has had since 1995 with the FastLane system (<https://www.fastlane.nsf.gov/fastlane.jsp>). But no – this is the federal government with which we are dealing. While the organizers of the change certainly took notice of FastLane, they elected to take a completely different approach and created the Standard Forms 424 (SF 424) Forms Families system (http://www.grants.gov/agencies/approved_standard_forms.jsp), which is quite different from the FastLane system.

Most NSF funding opportunities, all of which are announced through Grants.gov, as well as the NSF Web site, allow you to choose between using FastLane and the SF 424/Grants.gov approach. This is the result of the federal government requiring that applicants have the opportunity to apply through Grants.gov, but also allowing agency-specific systems, such as FastLane. So which should you elect to use? If you are already familiar with FastLane through prior use of it, in our opinion, without question, you should stick with it. In addition to that, there are other, compelling reasons to do so, summarized by Alan Kotok in *Science Careers*; March 9, 2007 ([http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2007_03_09/caredit_a0700034/\(parent\)/104](http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2007_03_09/caredit_a0700034/(parent)/104)). For example, if you are a Mac or Unix/Linux user you will be able to avoid a lot of the problems that are associated with using Grants.gov. It is also a fact at this writing that NSF requires that FastLane be used for certain kinds of applications, such as Collaborative Proposals from multiple organizations (see *Grant Proposal Guide*, section II.D.3.b). Given these facts, as Kotok concludes, it is not hard to understand why only 760 (1.4%; <http://www.grants.gov/assets/AnnualReport2007.pdf>) of approximately 55,000 applications were submitted to NSF through Grants.gov.

If you are concerned that FastLane will ultimately be phased out in favor of Grants.gov, if you prefer the ability to work on your application and the related forms offline (which you cannot do with FastLane), or you have never used FastLane before, assuming that it is allowed for your FOA, you may want to make your application through Grants.gov. The instructions for doing so are contained in NSF's instructions for use of the SF 424 submission system (Grants.gov Application Guide; http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

Whether you decide to use FastLane or Grants.gov, it is essential that you read the instructions for your choice in detail and that you couple such preparation and submission instructions with the general requirements that are spelled out in the *Grant Proposal Guide*, as well as any specifics that are contained in the funding opportunity announcement to which you are responding (instructions in the FOA take precedence over the general instructions of the GPG).

CHAPTER 5

THE NSF REVIEW PROCESS AND TIPS ON HOW TO WRITE FOR REVIEWERS

When a grant application is written, the applicant is 'selling' something – his/her idea. Thus, writing a successful grant application is nothing more than clever marketing of a good idea. The 'consumer' of the applicant's product is the proposal review panel that will review his/her proposal. Thus, everything that the applicant knows about how his/her application will be reviewed is useful in maximizing its reviewer friendliness.

COMPLIANCE REVIEW

Proposals are received and processed by NSF's Proposal Processing Unit. They are initially examined to determine whether or not they comply with the instructions in the *Grant Proposal Guide*. Those that do not conform may be sent back to the applicant without review. Deviations from GPG instructions are permissible, but only if (1) a program solicitation stipulates that applications in response to it must differ in a specified way from what is set out in the GPG, or (2) written approval for a deviation has been obtained by the applicant from the relevant Assistant Director / Office Head or his/her designee. See additional details about formatting, below.

PROPOSAL REVIEW AND HOW REVIEWERS ARE CHOSEN

Qualified members of the extramural research community – scientists, engineers and educators – work in partnership with NSF staff members as reviewers. Members of proposal review panels are drawn primarily from academic institutions, research organizations, and industry. It is important to appreciate that the recommendations of proposal review panels are advisory to NSF. In other words, review panels recommend; NSF program personnel make the funding decisions. NSF is not obligated to follow the recommendations of panel members.

External reviewers are identified and asked to serve through a number of different avenues. First among these is the recommendation of a reviewer who is currently serving. The Program Officer's own knowledge of investigators is another source, as are the names of investigators that are on file at NSF. The references included in the application are another source. Search of databases of funded grants to identify principal investigators who are active in the same general area is another approach. Recommendations of the applicant in the proposal constitute another important means of identifying appropriate reviewers (see the next section in this chapter).

Three-to-ten external reviewers of each application are usually involved in the review of an application, together with an NSF Program Officer (who is a scientist, engineer or educator, whichever is appropriate). Your application will most likely be reviewed by a combination of both *ad hoc* reviewers and those who sit on the proposal-review panel that is most applicable to

the subject of your application. It is important to note, however, that some reviews are conducted on an *ad hoc* basis, only. Others are conducted only by panel members. You can ascertain which of the three options will be used to review your application by contacting the relevant Program Officer (see chapter 8 for suggestions regarding how this person can be identified). At either the *ad hoc* or panel level, each reviewer will evaluate your proposal independently. Reviewers prepare and submit their reviews in accordance with instructions that can be found in NSF's Proposal Review book, which can be downloaded from: https://www.fastlane.nsf.gov/a0/about/message_reviewers.htm). You owe it to yourself to read those instructions because they will let you know how your application will be evaluated. Having that information will allow you to craft your proposal in such a way that you give reviewers exactly what they need to fully and fairly review your proposal. In other words, such information will help you maximize the reviewer-friendliness of what you submit. Reviewers who are part of a panel will gather to collectively discuss and prioritize the applications that have been tendered to that Program. They do so with the Program Officer intimately involved in the review. Program Officers have extensive latitude in their approaches to the merit-review process.

SPECIFY WHO SHOULD AND SHOULD NOT REVIEW YOUR PROPOSAL

At the time you submit your proposal to NSF, you can name persons who would be qualified reviewers. It is optional to make such suggestions. However, you should definitely do so, in our opinion, because it is an opportunity to influence the review of your application positively.

Tip: Take the opportunity to recommend reviewers by name. It is a means of helping to assure that the full spectrum of expertise needed to evaluate your application completely and fairly will be included. This is especially important if the review of your application will be done entirely ad hoc.

To maximize the potential benefit of recommending who should review your proposal, at least two steps should be taken. First, list the full spectrum of expertise that is needed for a fair and complete review. Second, for each kind of expertise, list one or more qualified investigators. Once you have settled on the individuals that you will recommend, ensure that you do not compromise any of them later by including them as pre-submission reviewers of your proposal (see chapter 19): Anyone who is involved in any aspect of the development of your application has a conflict of interest and is, therefore, precluded from participating in its official review. Program Officers are not bound by the recommendations you make, but at the least, you will make clear what kinds of expertise are needed, in your opinion, for the fair review of your proposal. You should use descriptive headings to assure that the kinds of expertise are made explicitly clear. Relevant reviewers should then be listed under each heading.

You can also specify why someone should not review your application. The difference between the "Suggested Reviewers" and the "Reviewers Not to Include" subsections is that the names of individuals in the latter category must be accompanied by explanations as to why those individuals would not be appropriate reviewers. For example, anyone who has a conflict of interest like the ones that are listed after the certification form at http://www.nsf.gov/attachments/108276/public/Conflict_of_Interest_Information.pdf should not be a reviewer of your application. As another example, it would not be appropriate for your closest competitors to be privy to the ideas and approaches that are detailed in your proposal. You could list them, therefore, with that explanation. Whatever reason you offer, it should be credible and objective. You have

nothing to fear about making such recommendations, because reviewers will not see this part of your application.

REVIEW CRITERIA

NSF receives over 42,000 proposals per year (<http://www.nsf.gov/about/how.jsp>). Of these, currently, around 10,000 are funded (just under 25%). Two major review criteria, *Intellectual Merit* and *Broader Impact*, are used to help make funding decisions. Their use in the review process is detailed in chapter III.A of the *Grant Proposal Guide*.

***Tip:** To be successful, an application must be strong in both Intellectual Merit and Broader Impacts. Consideration of the latter cannot appear to be either 'canned,' predictable, or an 'afterthought.'*

Under each of the two major criteria there are points that reviewers are asked to consider. All considerations under each of the criteria may not apply to a given proposal. Accordingly, reviewers are asked to address only those that are applicable. It is also permissible for them to use additional considerations that they consider applicable.

Intellectual Merit

These are the considerations that reviewers will use to judge the scientific and technical merit of your proposal:

1. How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
2. How well qualified is the proposer (individual or team) to conduct the project and, if appropriate, what is the quality of previously performed research?
3. To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
4. How well conceived and organized is the proposed activity?
5. Is there sufficient access to resources?

Broader Impacts

The five potential considerations under this major review criterion are:

1. How well does the activity advance discovery and understanding while promoting teaching, training and learning? Note that mentoring activities provided to postdoctoral researchers on the project, as described in the Project Description, will be evaluated.
2. How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
3. To what extent will the proposed activity enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?
4. Will the results be disseminated broadly to enhance scientific and technological understanding?
5. What may be the benefits of the proposed activity to society?

How to score well in the Broader Impacts category will be detailed in chapter 13. It is important to make several points here, however. You should include as many of the five considerations as you can address credibly. It is permissible to include additional considerations that you be-

lieve reflect the broader impacts of your research. However, such considerations should be included in addition to, not as substitutes for, those that NSF stipulates. The Broader Impacts of a proposal are carefully reviewed by both reviewers AND NSF staff. The purpose of such emphasis is to assure that every dollar NSF spends on research also serves to advance its societal objectives.

HOW TO WRITE FOR REVIEWERS

You may be told by a well-meaning colleague that it makes no difference how you write in a grant application: "The science will shine through." Nothing could be farther from the truth! How you write can make a great deal of difference in the relative fundability of your grant application. It must be maximally reviewer-friendly. To ensure that your reviewers understand clearly what you intend to do, you must write with maximal clarity and precision. Every word must be the right word, and each must be chosen carefully to relate meaningfully to its neighbors. Every sentence must be crafted to convey exactly the message that you want it to impart. Every paragraph must flow logically out of the ones that have preceded it, so that the story builds clearly and vividly in the mind of the reviewer. It takes time and effort to write this way. It's really hard work. However, there is no alternative but to make the necessary investment, because poorly written proposals are almost always preordained to fail: rarely will reviewers take the time to decipher badly written, unclear material.

Formatting

You must adhere to the guidelines that are given in the *Grant Proposal Guide* that relate to formatting of your proposal (pages II-1 and II-2) unless the program solicitation to which you are responding stipulates otherwise. For most applications margins must be at least one-inch with no more than 6 lines of text per vertical inch. If you choose to double-space your proposal the 15-page limit for the Project Description still pertains.

Only a few typefaces are allowed. They include Arial (Helvetica if you are a Mac user), Courier New, and Palatino Linotype (Palatino for Mac users). All of these must be used at a size of 10 points or larger. You can also use Times New Roman but, if you do so, it must be at least 11 points in size. The Computer Modern family fonts can also be used at 11 points or larger. For routine use we recommend either Arial (Helvetica) or Times New Roman.

A font size of less than 10 points can be used to present mathematical formulas or equations, Greek symbols, as well as the print in figures, tables (including footnotes to tables) and "diagram captions." We interpret the latter to include the legends for figures. The only requirement where reduced font size is allowed is that it must be legible.

Avoid using a two-column format for text. Some reviewers will evaluate your application on the screen of their computer, i.e., without printing it. Two-column format requires the reviewer to read down the left column on the screen and then scroll back to the top of the page to begin reading the right column. That is not reviewer friendly.

One thing that will help greatly with respect to clarity is the way that you format your Project Description. We recommend that you adopt a hierarchy of titles, subtitles, and sub-subtitles, along with related indentation from the left margin that is used consistently throughout your Project Description. Our preference is illustrated in the example, below:

MAIN SECTION HEADING

Position section titles at the left margin. Use all capitalized letters that are bolded. Open a line between the title and the first line. Indent the first line by one tab. Continue with subsequent lines returning to the left margin, which prevents 'white space' from opening on the left side of the page.

Subheading

Indent subsection titles one tab. As above, open a line between the subtitle and the first line. Use bolded, italicized letters with the first letter of each main word capitalized. Indent the first line under the subtitle two tabs and continue subsequent lines from the left margin.

Sub-subheading

Sub-subsection titles should be indented two tabs. Again, open a line that separates the subordinate paragraph from the sub-subtitle. Underline the sub-subtitle with the first letter of each main word capitalized. Indent the first line of these paragraphs by three tabs. As before, return subsequent lines to the left margin.

The same approach would be used to create additional subordinate subsections, as needed. It is not necessary that you adopt exactly the same approach to formatting that we have illustrated here. However, it is important that you use a similar approach, because doing so will help reviewers establish effortlessly what is subordinated to what in your Project Description.

Clever Use of Repetition vs. Mindless Redundancy

Good teachers often use clever use of repetition to reinforce the points that they make. By contrast, use of repetition that comes across as mindless redundancy is counterproductive in a teaching venue. The same is true when writing grant proposals: clever use of repetition can help you to reinforce important points, while mindless redundancy is almost guaranteed to be a put off to reviewers. The secret to avoiding this problem is to paraphrase sufficiently that repeated points come across as fresh each time they are re-made.

Evaluate What You Write as Though You Are the Reviewer

Most applicants, especially those who have sat on a review panel before, will know as they write what reviewers will need to evaluate a proposal. For example, they will know the extent and kind of detail that is needed to convince reviewers that the various approaches are feasible in the hands of the applicant. They will know that reviewers will read the application, not with an eye to funding it, but with an eye to why it should not be funded. This makes acknowledgement of potential problems and solutions to them an essential part of the Research Plan (see chapter 10). They will also know that they have to 'sell' what they are presenting in an assertive, confident way. Assuming that you know these and similar things, read what you have written as though you were the reviewer. Does it give you what you would need to review the application in a form that is maximally useful? If you are not yet at a point where you can make such an assessment, seek the input of experienced colleagues who can.

Avoiding the Mistakes Made by Most Applicants

The following considerations are ones that you should keep in mind as you write. By doing so, you will avoid many of the 'avoidable' mistakes that are made by many unsuccessful applicants.

1. Write in clear, simple declarative sentences. By doing so, you will avoid the kind of tortuous, hard-to-understand, compound sentences that go on forever. When you consider using a comma and continuing the sentence, stop and ask yourself whether it would be clearer to use a period, instead. Would the smaller, less complicated sentence be more easily comprehended by the reviewer?
2. Avoid the use of clichés (e.g., state-of-the-art or cutting edge) and empty generalities. The latter are words and statements that, at first, look great, but when analyzed carefully, really convey little or nothing. For example, 'It is anticipated that the expected outcomes will advance the field significantly.' Another example: 'The proposed central hypothesis is based on strong preliminary findings.' These would be great beginnings for sentences that would then go on to support what is asserted, e.g., '... will advance the field significantly, because'. It cannot be underscored enough that 'Be specific!' is one of the cardinal rules of good grantsmanship. Specificity and precision are what build credibility with reviewers. Use of meaningless clichés and generalities accomplishes the opposite.
3. Avoid the use of nouns as adjectives. This is a particularly prevalent problem. Consider: 'lower respiratory tract iron burden' or 'total parenteral nutrition catheters.' What is actually meant is 'burden of iron in the lower respiratory tract' and 'catheters for use in administering total parenteral nutrition,' respectively. *It doesn't add that much more text to make things maximally clear.* The gain in understanding is well worth it. As will be noted in detail later, the same comments can be made about the use of non-standard abbreviations and acronyms: You don't gain that much space by using them and you run the risk of reducing comprehension.
4. Hyphenate compound adjectives (also called compound modifiers), which consist of two or more words that create a phrase to modify the meaning of another. For example, you would put a hyphen between 'long' and 'term' when they are used to modify 'goal,' i.e., long-term goal. An exception is made if the compound adjective follows the word that it modifies. For instance, no hyphen would be used if the preceding example were revised to read 'The goal long term is to ...' even though 'long' and 'term' still modify 'goal.' Another exception to the rule pertains to not hyphenating when one of the modifying words is an adverb, i.e., ends in 'ly,' as in 'greatly exaggerated response.' Nor is a hyphen used after the word 'very,' as in 'very exaggerated response.' Use of hyphens in compound adjectives is not just a grammatical nuance; it is very important in helping the reader to distinguish between a modifying phrase and words that modify the word independently. For example, 'reinforced-steel bridge' vs. 'reinforced steel bridge.' The first version means that the bridge is built with reinforced steel, while the second denotes a steel bridge that is reinforced.
5. Make certain that you avoid the use of 'weak' words, i.e., ones that inadvertently convey doubt in your ability to do something. By weak words we mean ones like: if (if we are able to do X, then we will be able to do Y); try (we will try to overcome the problem that is caused by ...); hope (we hope to be able to accomplish ...); believe (we believe [pray?] that we can); might (we might be able to prepare the antiserum); could/should

(we could/should obtain ...); and may (we may be able to extend our understanding to ...). In every one of those examples, the word 'expect' could be substituted (e.g., we expect to obtain, instead of we hope to obtain). Use of 'expect' is a much more confident way of asserting that you can accomplish what you propose. In addition, 'expect' prevents you from making a mistake on the other side of the issue, which is to assert that you will accomplish something. Very seldom can we absolutely guarantee a research outcome.

6. The word 'whether' can pose serious problems for proposal writers. Why? Because, although it is often used alone, it always means whether or something else. Most of the time it is whether or *not*. Just as is the case with weak words, use of 'whether' can unnecessarily create doubt in the mind of a reviewer (What happens if it comes out 'not'?). The next time that you find yourself about to use 'whether [or not],' try 'the extent to which' as a substitute. 'Whether or not' is black-and-white – one way or the other. 'The extent to which' ranges from 0 to 100%. Thus, the use of this phrase can avoid the problem of 'not' (i.e., failure) being the only alternative outcome.
7. Make certain that you use the correct word when there is a choice between two that are closely similar in spelling and/or meaning. Some of the words that are commonly misused by the writers of grant applications include:
 - affect vs. effect
 - alternative vs. alternate
 - because vs. since
 - complement vs. compliment (complementary vs. complimentary)
 - led vs. lead
 - principal vs. principle
 - rationale vs. rational
 - validate vs. prove (with respect to a hypothesis)
 - which vs. that

If you need to, consult a dictionary or style manual to make sure that you use these (and others like them) correctly. This suggestion also pertains to usage of singular and plural forms of the same word. The usual mistake is to use the plural form as though it were singular. Examples of words that are commonly misused in this way include:

- sera (plural) vs. serum (also antisera vs. antiserum)
- criteria (plural) vs. criterion
- data (plural) vs. datum
- media (plural) vs. medium
- phenomena (plural) vs. phenomenon.

Use of the correct word can make a big difference in the clarity of your writing and, equally important, can affect how your attention to detail is perceived by a reviewer.

8. Universal Resource Locators (URLs) should not be included in the Project Description. Referring reviewers to such sites for information that is relevant to review of your application can be construed as an attempt to circumvent the page limit for the Project Description (15) that NSF strongly enforces. In addition, they could be altered or eliminated

at the time that your application is reviewed. Finally, reviewers are under no obligation to view such sites if you include them.

9. When two or more words form a phrase that modifies another word they create what is called a compound modifier or adjective. There must be a hyphen between the words that form the compound modifier. Otherwise, the words modify independently, rather than as a phrase. Thus, for example, it should be long-term goal, not long term goal. And it should be African-American students, not African American students. Use of hyphens to link the words in a compound modifier/adjective will help increase the clarity of your writing.

ONE LAST IMPORTANT POINT ABOUT WRITING

It is rare that an applicant can drop everything else and do nothing but develop a grant application; competing priorities have to be dealt with. As a final and very important general tip, we suggest that you develop your application by doing a little bit on it every day during *formally scheduled* blocks of time. Those times should be entered in your calendar as 'appointments' with yourself. Having the discipline to do a little bit every day will allow you to write the best application of which you are capable while, at the same time, you manage all of your other competing priorities. To help you set up a writing schedule, please complete the timetable that has been provided online at <http://www.grantcentral.com/downloads-NSF.html>. Fill in the deadline dates for the various components realistically, i.e., taking into account all other personal and professional commitments that you have. It makes no sense to set up a writing schedule that can't be met. If you accept our recommendation and stick to it you will find that the daunting, intimidating process of developing an idea and writing a competitive grant application will be converted into a relatively comfortable process.

DEVELOPMENTAL STEPS FOR CHAPTER FIVE:

1. Understand the review process that will be used to evaluate your application.
2. Understand the two major review criteria that are used to evaluate NSF applications and the five specific points that are under each.
3. List the kinds of expertise that will be needed to give your proposal a complete, fair review.
4. Draft a list of potential reviewers for your application who would have the necessary kinds of expertise.
5. Exclude any recommended reviewers from the pre-submission review of your proposal (chapter 19).
6. Understand what constitutes conflict of interest for a reviewer.
7. Draft a list of persons who should not participate in the review of your application, together with credible justification why each would be an inappropriate choice (such as conflict of interest or that the person is a close competitor).
8. Know how to avoid making the kinds of errors in writing that are commonly made by unsuccessful applicants.
9. Set up a realistic schedule for developing your application using the timetable that has been provided online at <http://www.grantcentral.com/downloads-NSF.html>.

OVERVIEW OF PART TWO

Template/Master Plan for Your Proposal

A successful proposal creates advocacy among reviewers for funding it. Our approach to writing a grant application is based on the premise that, to maximize advocacy, reviewers must be converted from persons who have to read your application to those who want to do so. Thus, this part of the *Workbook* will help you to put the conceptual, exciting side of your proposal up front, where it will be used to 'hook' the interest of the reviewers. Our intent is to make them want to read the details, which will be presented in the rest of the Project Description.

The format for the 15-page Project Description is:

1. Overview and Objectives
2. Expected Significance
3. Relation to the Principal Investigator's Longer-Term Goals
4. Background:
 - Review of Relevant Literature
 - Results From Prior NSF Support
 - Preliminary Studies
5. Relation to Other Work In Progress:
 - By the Principal Investigator
 - By Investigators Elsewhere
6. Research Plan:
 - Develop each Specific Aim
 - Introduction
 - Approaches
 - Expected Outcomes
 - Potential Problems and Alternative Approaches
 - Timetable
7. Broader Impacts

Part 2 of this *Workbook* will help you craft the template or master plan for the Project Description (chapters 6, 6-Online, and 7), as well as to maximize the programmatic relevance that it has to the NSF funding opportunity you are targeting (chapter 8).

CHAPTER SIX: Overview & Objectives Section

This part of the Project Description will be a conceptual overview of everything that is important and exciting about your application. It is designed to win the interest of the reviewer and to set up the details that follow.

CHAPTER SIX–ONLINE: Create a Bullet Outline for Your Overview & Objectives Section

The online file at <http://www.grantcentral.com/downloads-NSF.html> will help you to develop the bullet outline that is the first step in developing your Overview & Objectives Section

CHAPTER SEVEN: Expected Significance

This chapter will assist you in writing what is arguably the most important part of your Project Description – the part where you spell out why what you are proposing is significant.

CHAPTER EIGHT: How to Maximize the Programmatic Relevance of Your Application to NSF

No matter how good the idea – no matter how well written the application is – if it doesn't mesh with NSF's programmatic priorities your chance of being funded is greatly diminished. Chapter 8 will help you propose what NSF wants to fund.

CHAPTER 6

OVERVIEW AND OBJECTIVES SECTION

For the purposes of this chapter, we will assume that your proposal will be evaluated by a combination of *ad hoc* and panel review, which is the most common approach for standard applications.

***TIP:** The purpose of the Overview and Objectives section is to introduce conceptually what you will detail in later parts of the application. It is intended to 'hook' the reviewer's interest, thereby making him/her want to read the details of how you plan to do what is proposed.*

In our opinions, the *Overview and Objectives* section is the key to writing a first-class NSF proposal. It is our conviction that the rest of the proposal will fall naturally into place if this section works well. It must engender enthusiasm and advocacy among reviewers. The *Overview and Objectives* section must be something that can be read and understood by reviewers easily and quickly – even while someone (at the review-panel meeting) is talking to them at the same time. Even if your application is reviewed entirely *ad hoc*, this section is important because, as the title of the section implies, it is the overview for – the introduction to – the rest of your Project Description. The flow of logic in this section must be absolutely compelling, such that it leads reviewers seamlessly through what is presented – without them knowing that they are being led.

***TIP:** Setting up appropriate linkages between the individual components that constitute the Overview and Objectives section is the key to establishing a linear progression of logic that will lead reviewers to a position of advocacy.*

The *Overview and Objectives* section in competitive applications is characterized by a linear progression of logic. Each component that we recommend as a part of this section must be linked logically to what comes before it and what comes after it. If a reviewer has to stop and think about how one component relates to another, you will have lost his/her concentration and will have made it unnecessarily difficult for him/her to grasp what you want to convey. Most writers of grant applications fail to develop the appropriate linkages between the components of this section, a mistake that is compounded by inclusion of too much explanatory detail. To avoid the latter trap, think of this section as an 'executive summary' of the application – everything that is important and exciting about your application at a conceptual level. The details will be presented in later parts of the Project Description. Citations of the literature should be included in this section, but only for the most important, linchpin publications.

APPROACH TO WRITING THIS SECTION

There are three general approaches to writing your proposal: (1) hypothesis-driven; (2) need-driven; and (3) a hybrid of the two.

HYPOTHESIS-DRIVEN APPLICATIONS

As will be detailed later, a well-written hypothesis serves to focus the research that is proposed. Thus, in our opinions, it is usually the best approach to use, because it helps avoid criticism that what is proposed is an 'unfocused fishing expedition.' When should an application not be hypothesis-driven? When it would be contrived to do so. For example, if you were requesting funds to build a building, it would be impossible to create a non-contrived hypothesis for such an application. You would be seeking the funds because you need the building. Therefore, the application would be driven by a strong statement of need. Similarly, you would not use a hypothesis, even if you could, if it would put your proposal outside the norm for your field.

NEED-DRIVEN APPLICATIONS

In addition to the bricks-and-mortar example, above, you would most likely use a statement of need to drive an application that proposes the development of methodology or technology. It is also the best approach in some kinds of applications that are written to fund engineering, social or behavioral sciences research. Increasingly, however, research in these areas is being driven by hypothesis. If you are unsure of whether your proposal should be need- or hypothesis-driven, seek the advice of colleagues who are experienced and successful proposal writers in the field. Another source of advice – perhaps the most authoritative advice – is the Program Officer who oversees the area that you are targeting at NSF. S/he is intimately familiar with what works and what doesn't in that program's review process.

'HYBRID' PROPOSALS

In many instances an application can be driven by either a hypothesis or a statement of need. Rather than choosing between them, an alternative and often very powerful approach is to make the proposal a 'hybrid' of the two. Using this approach, the *Overview and Objectives* section opens with a strong statement of need, after which the application switches to the hypothesis-driven approach. Greater detail regarding this alternative will be provided in later parts of this chapter.

UNDERSTANDING THE PURPOSE OF EACH PARAGRAPH AND COMPONENT OF THIS SECTION

Understanding the purpose of each component is essential to creating the linkages that will assure development of the linear progression of logic that is so important to the success of this section.

The purpose of the first, introductory paragraph is to assure that the reviewer: (i) knows that the research problem is program-relevant to NSF; (ii) is informed with respect to what is current knowledge in the field; (iii) understands precisely what the subject (gap in the knowledge base or unmet need) of your proposal is; and (iv) understands why that deficiency represents an important problem that needs to be resolved.

Introductory Paragraph

Opening Sentence. This should be a real 'grabber.' Its purpose is to immediately capture the attention of your reviewers and highlight the program-relevant, fundamentally important area that your application will address.

Current Knowledge. Not everyone at the review panel table will be an expert on the subject you are proposing. Accordingly, the purpose of this component is to inform all reviewers at the meeting with respect to what is currently known, thereby facilitating their ability to grasp the importance of the research you will propose. In essence, you are setting up presentation of the gap in the knowledge base / unmet need that will be the subject of your application.

Gap in the Knowledge Base / Unmet Need. You can offer either a gap in the current base of knowledge or an unmet need. The purpose of either approach – gap or need – is to define the subject of your proposal. The sentence must be simple, direct and must link back to the 'current knowledge' component as the deficiency that logically must be addressed next in order to advance the field vertically. As you will see, it is a very important sentence because all of the logic downstream will evolve from it.

Gap / Unmet Need as an Important Problem. The purpose of this component is to assure that reviewers grasp that continued existence of the gap / unmet need represents an important, fundamental problem.

'What- Why-Who' Paragraph

The purpose of the second, 'what-why-who' paragraph is to introduce reviewers broadly to what will be proposed and to convince them that you and your colleagues have a competitive advantage over equally qualified investigators elsewhere.

Long-Term Goal. The purpose of this statement is to define for reviewers the continuum of research that you are pursuing. The gap / unmet need delineated in the first paragraph must be encompassed by the continuum of research that your long-term goal defines.

Objective of this Application. The purpose of this component is to define what will be accomplished by *this* application. This objective must link back to the gap in the knowledge base / unmet need that you delineated in the first paragraph, because the objective of any application must be to fill the gap / meet the need that is offered there. The objective must also link to your long-term goal: it must be seen as the next logical step along the continuum of research that is projected by your long-term goal statement.

Central Hypothesis and How Formulated. The purpose of the central hypothesis is to focus the research that is being proposed. That is why it is referred to as a 'directional' hypothesis; it gives 'direction' to the proposed research. It must logically flow from the objective, because the hypothesis is what must be tested to attain the objective. That is the linkage which must exist between them. It must convey your 'best bet' as to what explains the phenomenon you will be investigating. The 'how formulated' sentence that follows the statement of your central hypothesis should project that your own preliminary data are the basis for the central hypothesis.

Rationale. The purpose of this component is to convey why you want to do the research. Cleverly written, that can be exciting. In most cases, it will be because you are seeking new knowledge that will allow you to do something that you can't do now. The rationale must link

back to the problem that is described at the end of the first paragraph because what will become possible after the research is completed is the vertical step in your field that is being blocked by continued existence of the gap in the knowledge base / unmet need.

Well Prepared. The purpose of this component is to tell reviewers why you and your colleagues (if any) have a competitive advantage over equally qualified investigators elsewhere, i.e., what distinguishes you from them.

Specific Aims Paragraph

The purpose of this paragraph is to present the specifics of what you propose.

Specific Aims. The purpose of your specific aims is either to test the parts of your central hypothesis or, if you are writing a purely need-driven application, to convey the tasks that will be undertaken in order to meet the need. With respect to linkage, your aims must grow out of, and be completely concordant with either your central hypothesis or, if yours is a need-driven proposal, the objective.

Payoff Paragraph

The purpose of the 'payoff' paragraph, as its name implies, is to tell reviewers what they can expect to get from their investment if they decide to fund your proposal. It is an especially important paragraph with respect to developing advocacy for funding your grant application.

Creativity, Originality and/or Transformative. The purpose of this component is to call attention to why the proposed research is apart from what is being done elsewhere. This is one of five considerations that are listed under the major review criterion, Intellectual Merit.

Expected Outcomes. The purpose of Expected Outcomes is to tell reviewers what each of your aims is expected to produce and how those products collectively attain the overall objective of the grant application.

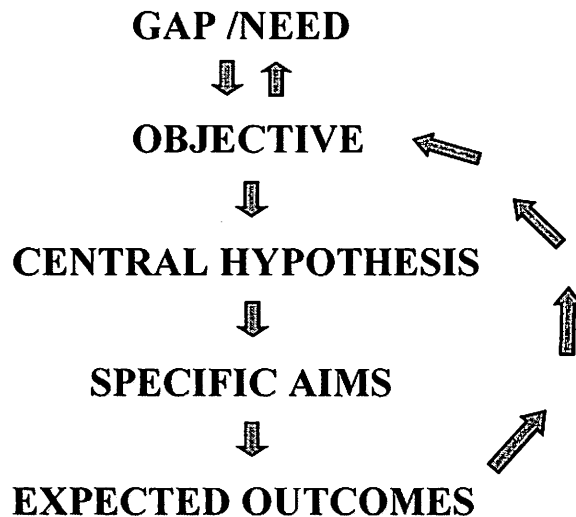
Generality Regarding Positive Impact. The purpose of this final sentence in the *Overview and Objectives* section is to point out that the expected outcomes will have positive impact on the field because they will collectively attain the overall objective of the application and, thereby, advance your field vertically. The statement should be relatively general, i.e., not contain a lot of detail that would set up redundancy with the next, *Expected Significance*, section. Thus, this last sentence should be designed to provide a transition or segue from the *Overview and Objectives* section into *Expected Significance*.

Now that you know the purpose of each of the components and how they should be linked, you are ready to develop the first draft of your *Overview and Objectives* section. We recommend that you do so by starting with a bullet outline. Accordingly, download the form at <http://www.grantcentral.com/downloads-NSF.html>. Follow the directions on it to develop and refine the bullet outline for this section.

EXPANSION OF YOUR BULLET OUTLINE INTO SENTENCES.

At this point, your bullet outline should be fully developed and refined. You should be satisfied that all of its elements relate to each other logically and well. The linkages should relate in such a way that they set up a linear flow of logic that is comparable to the one that is depicted in the figure, below, for either a hypothesis-driven or hybrid application. For a purely need-driven application the only change would be removal of the "central hypothesis" line from the figure.

LINEAR PROGRESSION OF LOGIC FOR A STRONG OVERVIEW & OBJECTIVES SECTION



Remember that we called attention earlier to how important phrasing of the gap in the knowledge base / statement of need is. Now you can see why in the figure, above: It literally sets up everything downstream with respect to the flow of logic.

The purpose of the remainder of this chapter is to help you expand the bullet outline you have created in your computer into the final version of your *Specific Aims* section. First, however, we want to introduce you to a very important concept.

Tip: As you write, 'label' each component in such a way that there can be no mistake as to why you have included the information. You should not allow reviewers to interpret the meaning of anything in your grant application; you should tell them what you want them to know.

Accomplished proposal writers walk a very fine line. The primary reviewer of your application will usually be the person on the panel who is most qualified to review the subject that you are presenting. If s/he is not an expert, s/he will be very close to being one. Many others on the panel will be far less qualified, because their expertise is in other areas for which the panel is responsible. You must get the latter, non-expert individuals up to speed with respect to the importance of what you are presenting. While doing so you cannot be perceived by your primary reviewer as either pedantic or patronizing / condescending. The strategy that we have developed, which serves both audiences while offending neither, is to 'label' each component in the section in such a way that there can be no mistake as to why it has been included. As will be

seen in the paragraphs below, that is accomplished either through the judicious use of highlighted (italicized) words or by phrasing the beginning of relevant sentences in such a way that the reviewer is 'told' what its purpose is.

First Paragraph

Opening Sentence:

Expand the bullet that you wrote as an opener into a complete sentence. Make sure that it is arresting and, as such, will immediately command the reviewer's attention. Be sure to use words that relate to what is being sought by the program description / announcement or solicitation to which you are responding.

Current Knowledge:

Working from the bullets that list the knowns in your field, create one-to-four complete sentences that succinctly describe what is currently known in your subject area. The progression of sentences should lead the reviewer from the oldest known fact that is relevant to the subject of your proposal to what is currently the edge of the field. 'Label' the first sentence in the series with something like, 'It is well known that ...'

Gap in the Knowledge Base / Unmet Need:

Create a sentence from the related bullet(s) that clearly and distinctly sets out what the subject of your grant application will be – the gap or unmet need that will be filled / met by the research you will propose. If you are using a gap in the knowledge base to drive your application, you will write a single sentence here. Open the sentence with something like, 'What is not known is ...' If you are writing a need-driven application, open with something like, 'Thus, there is an *urgent need* for ...' Note that "*urgent need*" is highlighted in italics. Use of such highlighting to call attention to things that you know reviewers will want to find is reviewer friendly and, therefore, good grantsmanship. The key is to highlight *subtly*, i.e., no bolding, underlining or changing of font. To us, the least obtrusive way to call attention to parts of your proposal is to present key words related to them in italics.

If you are offering an unmet need as the focal point of your proposal, you should have written bullets that summarize objective evidence that support existence of the need. Expand these into one or more sentences that complement and support the preceding statement of need.

Gap / Unmet Need as an Important Problem:

You should end the first paragraph by 'telling' the reviewer why the gap / unmet need represents an important problem. We recommend that you 'label' this last sentence in the paragraph with something like, 'Continued existence of this need is an important problem, because ...' or 'Lack of such knowledge is an important problem, because ...' The sentence should be completed by describing the vertical step that is being blocked – which is the problem.

The entire first paragraph should be no longer than one-third to one-half page.

Second Paragraph

Long-Term Goal:

Expansion of this bullet should create a sentence that conveys the continuum of research that you are pursuing long-term. We recommend that you highlight the words '*long-term goal*' in italics. Make sure that what you write is relevant to the program you are targeting.

Objective of This Application:

Now, expand the bullet you wrote to convey what the objective of this application is. Write a complete sentence similar to this example: 'The *objective of this particular application*, which is the next step toward attainment of our long-term goal, is to ...' The phrase, 'which is the next step toward attainment of our long-term goal' (or something similar to it) helps to link this component as a step along the continuum of research that is projected by the long-term goal sentence. Note how italics are used to highlight. Make certain that this sentence links back to the gap / unmet need that is presented in the first paragraph, because as noted earlier the objective of any application is to fill the gap / meet the need.

Central Hypothesis:

Next comes your central hypothesis and how it was formulated. Make sure that it is your 'best bet' as to how the objective can be attained. Thus, if your objective is 'to determine the mechanism of ...,' your central hypothesis must be your 'best bet' as to what that mechanism is. If your objective is to create an intervention that will ..., then your central hypothesis must be your 'best bet' as to what the intervention should be / consist of. Highlight the words, "*central hypothesis*," in italics. If possible, assure that it is written to have readily identifiable parts that will set up related aims (see *Specific Aims*, below).

Follow your central hypothesis by expanding the bullet that summarizes how your hypothesis was formulated, i.e., why it represents the 'best bet' out of all alternatives. For example, 'We have formulated this hypothesis based on preliminary findings (see *Preliminary Studies*), which suggest that ...' Create a comparable sentence that will complement and support your central hypothesis.

TIP: Your long-term goal, objective, and central hypothesis should be juxtaposed, thereby assuring that the flow of logic, one into the next, is seamless. Avoid the trap of interposing explanatory sentences. That detail will be provided by the rest of your application and, at the review-panel meeting, by the oral presentations of your assigned reviewers.

Rationale:

Next, expand the bullet that summarizes your rationale. Highlight *rationale* in italics. Once the sentence is written, apply the litmus test described earlier by asking yourself, 'Does this tell the reviewer what will become possible after I have completed the research that is not possible now?' Also, make sure that your rationale links back to how the gap / unmet need was described as a problem at the end of the first paragraph – without being repetitious of that earlier sentence.

Well Prepared – Physical & Intellectual Resources:

Next, based on the bullets you wrote earlier, write a complete sentence or two that summarize why you and your colleagues have the competitive edge in this area of research. In most cases, you will underscore the constellation of your research team's strengths as distinguishing, rather than one single point. Without being redundant, call attention again to your supporting preliminary data. Emphasize the conceptual and downplay specifics. You can allude to the latter by referring to the sections in which the details will be presented (see example, below). 'Label' the first sentence to specifically convey that you are well prepared. *Regardless of what you choose to write, you must be subtle.* The last thing that you want to do is inadvertently convey that you are overly impressed with your own credentials / accomplishments. An acceptable 'well prepared' component might read something like, 'In addition to our supportive preliminary data, we are particularly well prepared to undertake the proposed research because the assembled multidisciplinary research team has the range and depth of expertise needed to address the selected problem definitively (see Biographical Sketches). Its members have been working and publishing together for over five years (refs) and have jointly developed the model that will be employed. In addition, we will be conducting the research in an environment that contains numerous other investigators who are pursuing research that is complementary to what is proposed here (see Other Resources in the *Facilities, Equipment and Other Resources* section). Because of our complementary expertise, history of collaboration and shared resources, the setting is conducive to successful completion of the proposed investigations.' Now, write your comparable sentences.

At this point – the end of the second paragraph – you should have written no more than two-thirds of a page.

Third Paragraph

Tip: *The gap, objective, central hypothesis, and specific aims should create a focusing progression, with the greatest specificity about what will be done projected by the Specific Aims.*

Specific Aims:

Begin paragraph three with a sentence something like, 'We plan to test our central hypothesis and, by doing so, accomplish the overall objective of this application by pursuing the following *specific aims*:' Note that the words, "*specific aims*" are italicized for emphasis. We recommend that the aims, themselves, should be presented in bolded italics as a numbered series that is indented from the left margin. Make certain that each aim you write for a hypothesis-driven or hybrid application clearly relates to a part of the central hypothesis. Each aim should be accompanied by a subordinate paragraph that provides focus to that part of the research. In a hypothesis-driven or hybrid application the only words that should be highlighted in the subordinate paragraph are '*working hypothesis*.' For example, 'The *working hypothesis* for this aim, based on preliminary data that will be presented later (*Preliminary Studies*) is that ...' The aim should be broad and open-ended, with focus provided by the working hypothesis.

For a purely need-driven application, the aims should be the tasks that must be undertaken to meet the need. They should be presented in the order that they will be undertaken. Unlike hypothesis-driven or hybrid applications, the aims for a purely need-driven proposal can be descriptive. The subordinate paragraphs should briefly summarize the approaches that will be used to accomplish the tasks.

The third paragraph, including the aims and related subordinate paragraphs, should ideally fit on the first page of the Overview & Objectives section. At most, it should not extend much beyond the top of the second page.

Fourth Paragraph

Creativity, Originality and/or Transformative:

Expand the bullets that lay claim to creativity and originality as the opening to the fourth paragraph. Don't be shy. If you have such a claim, directly state it in a 'labeled' sentence – something like: 'The proposed research is *creative and original*, because ...' Note that the words, "*creative and original*" are highlighted in italics. Your claim may be based on a different approach that you are taking, or the fact that you are challenging entrenched dogma of your field. Alternatively, it may be because you are suggesting a true paradigm shift, in which case you may want to frame the work as 'transformative.' Whatever the reason, reviewers are usually appreciative of knowing why you think that the proposed work is creative, original and/or transformative because of the relatively subjective nature of this review criterion.

Expected Outcomes:

Continue by expanding the bullets that present your expected outcomes. Link the first sentence back to the 'creativity and originality' component by beginning it with something like: 'It is anticipated that this creative, original approach will yield the following *expected outcomes*.' Highlight the words, "*expected outcomes*" in italics.

Generality Regarding Positive Impact:

Conclude the fourth paragraph and your *Overview & Objectives* section with two very important sentences. First, expand the bullet that you wrote to summarize how the expected outcomes collectively attain the overall objective of the proposal. Thus, this component must reflect – link back to – the previously written 'objective' component. Second, follow that sentence with a general comment about how attainment of the objective advances your field vertically and, therefore, will have positive impact on it. Make sure that what you write in this last sentence sets up an easy transition into the next, *Expected Significance*, section. You can do so by ending the last, positive impact, sentence with something like, '...', as will now be detailed in the next section.'

The entire Overview & Objectives section should be no longer than 1.5 pages, max.

Finalizing Your Overview & Objectives Section.

At this point you will have your first rough draft of the *Overview & Objectives* section. Revise and refine the sentences until they flow well. Add material, if needed, to link the sentences appropriately and blend them into readable prose. If the compelling flow of logic that you need isn't there, you may have to completely rewrite the components that don't work. It may even be necessary to go back to the bullet-outline stage. Whatever it takes, invest the effort until the section meets the purpose of providing reviewers a compelling overview of what will be presented in detail in the rest of the Project Description. If you have more than 1.5 pages, prune what you have written until you meet that mark. Switching to a smaller font, narrowing the margins, or taking out the spaces between paragraphs to reach the goal of 1.5 pages should not be options.

We recommend that you cite references using author/year (one author = last name, year – e.g., Young, 1998; two authors = both last names, year – e.g., Abelson and Rafferty, 2003; more than two authors = last name of first author, *et al.*, year – e.g., Zaharias *et al.*, 2000). Your reviewers either will be experts on the subject you are offering or they will be close enough that they will recognize citations presented as author/year. This prevents them from having to flip to the *References Cited* section. No matter how intimately familiar a reviewer is with your subject area, s/he will not be able to recognize references that are cited by number (e.g., 24, 36, and 92). Asking reviewers to flip back and forth in the application to appreciate what you have cited to support your proposal is not reviewer friendly. If you are a beginning investigator and first author of most of your papers, another reason for using this approach is that it is a clever way to get across to reviewers that you did the work that is being cited – something that is impossible if numerals are used. You should avoid citing reviews to the greatest extent possible because doing so tells the reviewer nothing about your command of the field's primary literature. Please see additional discussion of how to cite the literature in chapter 11, under the Review of Relevant Literature subsection.

DEVELOPMENTAL STEPS FOR CHAPTER SIX:

1. Decide whether your proposal will be hypothesis-driven, need-driven or a 'hybrid' of the two.
2. Appreciate why it is necessary to strip this section – just this section – of unnecessary detail – to make it a conceptual 'executive summary' of all that is important and exciting about your proposal.
3. Understand the purpose of each of the four paragraphs that are recommended for the *Overview & Objectives* section.
4. Understand the purpose of each of the components that collectively constitute the *Overview & Objectives* section.
5. Understand the linkages that must exist between components of the *Overview & Objectives* section and how these must be used to set up a linear progression of logic that will lead reviewers through this section without them knowing that they are being led.
6. Understand how to avoid redundancy when creating linkages between components.
7. Appreciate why it is reviewer friendly to highlight key words and phrases in italics.
8. Understand how to 'label' sentences in such a way that reviewers will not have to interpret why you have included the information.
9. Create a bullet outline for this section using the online file at <http://www.grantcentral.com/downloads-NSF.html>.

10. Expand the bullet outline into sentences and the first draft of your *Overview & Objectives* section.
11. Revise and refine your draft until it reads well.
12. Cite references using the 'author, year' approach, rather than by using numerals.
13. Make certain that the entire section is no more than 1.5 pages long.

CHAPTER 7

EXPECTED SIGNIFICANCE SECTION

One of the five points under the Intellectual Merit major review criterion is: “How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?” This section is the one in which you will address that point.

An important part of our proposal-writing strategy is to gradually ratchet up detail as the reviewer reads further into the application. The idea is to get the reader ‘hooked’ on the conceptual, exciting parts of your proposal to the extent that s/he will want to read the details that are presented later. The second, *Expected Significance* section is where you begin to increase the level of detail that is included. It is meant to extend and validate with citations key parts of your *Overview and Objectives* section.

While the *Expected Significance* section is a brief one (a single paragraph of no more than 1/3-to-1/2 page), it is arguably the most important paragraph that you will write in your entire application. That is because of the importance that the related review criterion has: Even if all of the money in the world were available, who would want to spend any of it on a project that lacks significance? That is why it is so important to spend the time necessary to develop an idea that will catalyze a vertical step in your field (see chapter 2). If you don’t have that kind of idea as a starting point, in our opinion, you are wasting your time writing a grant application.

TIP: *The purpose of the Expected Significance section is to help justify the need for the research that will be proposed. The ‘spin’ that you put on what is written should be consistent with that purpose.*

Tips on Creating the Expected Significance Paragraph. We recommend that you write this paragraph to have three parts:

Part 1 should detail and expand upon the fact that a gap in the knowledge base (or unmet need) exists and that its continued existence is an important problem. It should conclude with a simple, direct sentence that describes the contribution you expect to make with the proposed research.

Part 2 is the statement of significance. It should be a single sentence that appears approximately in the middle of the paragraph. It should be a clear statement of why the expected contribution is important – why it is significant. This sentence is arguably the

most important one that you will write in the entire application and should, therefore, be highlighted by putting it entirely in italics.

Part 3 should validate your assertion of significance. Because significance derives from benefits that could be expected to accrue to application of the new knowledge, this third part should consist of a list of such benefits. In most cases, the benefits will relate to advancement of the relevant field. Any 'fringe benefits' that might accrue to the research should also be claimed. By fringe benefits we mean positive outcomes that can be extrapolated beneficially to other venues and/or fields. We also refer to fringe benefits that are related to the *Broader Impacts* major review criterion.

If you follow this three-part format, you will write a strong, compelling significance paragraph that will maximally support your application. Use the suggestions provided below to trigger your own ideas. Once you have a general feel for what you want to write, get it down on paper. *The major goal here is to produce a first draft, i.e., something that can be revised and embellished later.*

Part 1:

Opening sentences. You want to use these sentences to expand and underscore how fundamentally important the problem is that you have chosen to address. You have summarized this information earlier, in the *Overview and Objectives* section, with a sentence or two. Now, without being redundant, you should extend and embellish what was written earlier with specific details that are supported by citations of the literature.

Succinct statement of the problem. The preceding sentences should frame a clear and succinct statement of either the gap in the knowledge base or the unmet need that is the focus of the proposal. Paraphrase sufficiently that it does not seem repetitious of the less detailed statement of the problem that you offered in the preceding, *Overview and Objectives* section. If your proposal is either purely need-driven or a 'hybrid' of the need- and hypothesis-driven approaches, further justify and substantiate existence of the need with detail that is increased over what was presented in the *Overview and Objectives* section.

Statement of what your contribution is expected to be. This statement must be both strong and credible, i.e., not just a thoughtless cliché or empty generality that fails to highlight specifically what your contribution(s) will be. This is *not* meant to be a reiteration of the expected outcomes from your *Overview and Objectives* section. Rather, it should relate to accomplishment of the overall objective of the application. For example, 'The proposed research is expected to contribute in-depth understanding of' The sentence would be completed by specifically describing the new knowledge that you expect to obtain. As you will see later (chapter 20), this sentence helps to inform the writing of your title, which should project what the payoff of your research will be.

Part 2

Statement of significance. Near the middle of the paragraph you should specify why your contribution will be important. This is another one of those times when you can't be shy: figuratively, this sentence should knock your reviewers right out of their chairs. You don't want the reviewer to have to interpret for him/herself why your projected contribution will be significant. Rather, you should tell the reviewer, leaving no need for interpretation. This statement should be 'labeled' for what it is and, as noted above, should be highlighted in italics, thereby ensuring that

it can be found easily (e.g., *The proposed is significant, becausecontinue in italics....*). In almost all cases, the sentence will be completed by conveying that a vertical step in the field will result.

Part 3

Validation of the Statement of Significance With a Credible List of Benefits. The statement of significance you have just written will be a global assertion positive impact. Now, continue with specific points that will substantiate that the work will be significant. For example, what specific benefits will accrue to the vertical advance in the field that you expect to make? How will it enable subsequent thinking and research? What broader impacts will it have, such as broad societal value? Broader impacts should only be summarized here, because a later, independent section will be used to detail such benefits (see chapter 13).

DEVELOPMENTAL STEPS FOR CHAPTER SEVEN:

1. Appreciate that one of the review considerations under Intellectual Merit pertains to the importance – the significance – of what you expect to produce.
2. Understand that this section should be written to help justify the need for what you are proposing.
3. Cite the literature using author/year, rather than with numerals.
4. Understand and use the three-part approach that is recommended for the development of this critically important paragraph.
5. Review the considerations under Broader Impacts and make certain that any that are relevant to your project are project as part of the third, 'benefits' part of the paragraph.

EXAMPLE OF AN EXPECTED SIGNIFICANCE PARAGRAPH:

The following is based on an Expected Significance paragraph written by Qiang Cheng, Ph.D. of Wayne State University, who has generously agreed to our use of this modification.

Multimedia watermarking has emerged as a powerful technique in the protection of intellectual property rights, information content security, database retrieval, as well as data monitoring and tracking on the Internet. It has attracted increasing attention from many fields, such as signal processing (Jones & Coughlin, 1998), communications (Haughton *et al.*, 1999), information theory (Canfield, 2001) and computer science (Jason and Robards, 2003). Further evidence of the field's growing importance is the fact that several international conferences and workshops have recently been dedicated to it (International Watermarking Society, Lyon, France – 2000; International Copyright Protection Working Group, Los Angeles, USA – 2002). Many practical schemes have been designed, recently extending to information (Clark & Young, 2000), game (Makowsky, 2000), and decision-making (Chu *et al.*, 2001) applications. In spite of these important advances, there is still a critical gap in the knowledge base that pertains to use of joint encoder-receiver optimizations and uncertainties that are attributable to watermark spectra and attacking noise. These limitations have seriously hampered the utility of watermarking as a technology. The proposed research is expected to contribute a markedly improved watermarking system that both integrates joint encoder-receiver design and eliminates interfering variables that have compromised previous systems. *This contribution is significant, because it is expected to revolutionize use of watermark technology as a means of protecting transmitted information.* For example, the increase in watermark robustness, reliability and controllability is expected to have significant positive impact in the areas of copyright protection, automatic content tracking, and authentications. Through the dissemination plan that will be described later in this proposal, it is expected that it will become possible to widely deploy watermarking systems in consumer electronics, digital TV and radio broadcastings, and on the Internet for automatic royalty collections and prevention of illegal copies. The proposed research is also expected to enhance computer security and, therefore, national security. For the first time, it is expected that criminals or terrorists who use hidden information embedded in digital images will be readily open to detection and apprehension. Thus, the outcomes are not only expected to fundamentally advance the field of electronic communication, but also to have simultaneous broad and highly positive societal impact.

CHAPTER 8

HOW TO MAXIMIZE YOUR APPLICATION'S PROGRAMMATIC RELEVANCE TO NSF

You may not realize this, but program officials at every funding agency periodically inventory their portfolio of funded grants. They do so to assure that their funds have been distributed optimally to accomplish their overall mission; they want to avoid over-funding some areas and under-funding others, because all are important in terms of accomplishing their overall mission. Areas that they discover to be under-funded or that represent emerging areas of importance become future priorities. Ideally, your application should be in a priority area, not in one that is already well- or over-represented in their existing portfolio.

***TIP:** One of the most important things that you can do to position your proposal for success is to maximize its programmatic relevance to the NSF program you are targeting.*

The person who is most able to help you determine whether or not your idea is programmatical-ly relevant is the one who is in charge of the NSF program you have identified as your target. It is s/he who you should query at this stage in the development of your application. You have just completed the *Overview and Objectives* and *Expected Significance* sections, which constitute the 'template' or 'master plan' for your application. We recommend that you seek feedback on it from the relevant program officer.

You can identify your program officer through a number of different approaches. Unless you know specifically which program you are targeting, e.g., through a solicitation, you will most likely have to do a little detective work, drilling down to the "Guide to Programs / Browse Funding Opportunities" part of the NSF Web site, as was described in chapter 3. There, we told you how to reach the part of each program's Web site that would tell potential applicants which active funding opportunities were available at that time. By clicking on the title of one that is thought to be relevant to your idea you will reach the page that gives the contact information for the program official who is responsible for that funding opportunity. An example is given at the top of the next page. There, you will see that the relevant program official for the Engineering Program's Dynamical Systems funding opportunity is Dr. Eduardo A. Misawa. To the right of his name you have his e-mail address, telephone number and his room number at the National Science Foundation. The name, itself, is a hyperlink. In such cases, by clicking on the name you will acquire additional information about the individual. In this case, you would obtain Dr. Misawa's fax number and learn that he is a Program Director in two different areas and a Member of a third. You would also get a summary of his programmatic responsibilities. All of these things can be of importance to you.

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PROGRAM GUIDELINES

Apply to PD 05-7478 as follows:

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Full Proposal Window: September 1, 2008 - October 1, 2008

SYNOPSIS

The Dynamical Systems program supports fundamental and innovative advances in the understanding, design, and operation of dynamic systems, such as nonlinear, hybrid, time-varying, multi-energy domain and distributed dynamical systems; examples of application areas include acoustics and vibration analysis, noise and vibration control technologies, kinematic relationships, biological systems, micro and nano-scale systems, multi-scale dynamic systems, large-scale interconnected complex systems, integrated analysis and design of dynamic systems, theory and application of dynamical systems (modeling, analysis, simulation and synthesis), and simulation-based engineering and science.

Now, you have the contact information for the relevant program officer. To contact this person, don't initially use the telephone. First, program officers are very busy and it is unlikely that you will catch one of them if you just pick up the telephone and call. Second, and more important, if you do get lucky and reach the person, s/he will not know why you are calling and won't be prepared, therefore, to respond to your query. It is a far better approach to send an e-mail message, with the 'template' or 'master plan' of your application attached (i.e., the *Overview & Objectives* section and *Expected Significance* section). In the accompanying e-mail message you should include three very important words: maximize programmatic relevance. The program officer's job is, in part, to bring the best and most programmatically relevant ideas to NSF so that, by funding them, s/he can better accomplish that part of NSF's mission. If you query the program officer with something like the example in the text box, below, you present yourself as the rare applicant who is actually being considerate of an important part of the program officer's job. With this kind of approach you will almost always get the kind of feedback that you are seeking.

I am attaching a brief synopsis of what I plan to submit to NSF. I would greatly appreciate your feedback regarding what more I can do to maximize the programmatic relevance of what I plan to submit. If an e-mail response would not be convenient for you, please give me a time when I can call to talk briefly with you. Thank you in advance for considering my request.

Use the feedback you receive, if you think it is appropriate, to modify your template / master plan. By doing so you will hopefully increase the likelihood that it is something that NSF wants to fund.

DEVELOPMENTAL STEPS FOR CHAPTER EIGHT:

1. Confirm the funding opportunity that you are targeting.
2. Identify the program officer who is associated with the opportunity and obtain his/her contact information through the NSF Web site.
3. E-mail attach the 'template' or 'master plan' for your proposal (*Overview & Objectives* and *Expected Significance* sections) to the program officer.
4. In the accompanying e-mail message request either an e-mail or telephone response, whichever is most convenient for the program officer.
5. Be sure to include the words "maximize programmatic relevance" in the e-mail message.
6. Use the program officer's feedback to modify your approach, if appropriate.

OVERVIEW OF PART THREE

Developing the Rest of Your Application

The chapters that constitute Part Three of your *Workbook* will help you to optimize the quality of each additional part that must be prepared to complete the first draft of your entire application. Note that we recommend that you write them out of the order that they will be submitted in the final application. We urge that you take this 'out-of-order' approach to maximize internal consistency between related parts of the application, as well as to capitalize on momentum that writing one section can create with respect to writing another – not necessarily the next – section.

CHAPTER NINE: Relation to the Principal Investigator's Longer-Term Goals

This part of the application will help you project the continuum of research – the future directions – that you plan to pursue over multiple periods of grant support.

CHAPTER TEN: Research Plan – Narrative Description of What Will be Done

This chapter will help you to clearly and succinctly present the details of what will be done.

CHAPTER ELEVEN: Background Section – Review of Relevant Background Information, Results From Prior NSF Support, and Preliminary Studies Subsections

The three subsections of this part of the application will be written to help you justify the need for what you want to do and that the activities proposed are feasible in your hands.

CHAPTER TWELVE: Relation to Other Work in Progress

NSF needs to be assured that funding your proposal will be a good investment. This chapter will help you convince them of that fact.

CHAPTER THIRTEEN: Broader Impacts Section

This is where you 'punch the buttons' that are associated with the important "Broader Impacts" major-review criterion. Your application must be written to be as strong in this category as it is in the other major-review criterion, "Intellectual Merit."

CHAPTER FOURTEEN: Budget and Budget Justification

Many applicants lose money from their *Budget* requests unnecessarily and don't use the *Budget Justification* as a means of punching important Broader Impacts 'buttons.' This chapter will help you to do both.

CHAPTER FIFTEEN: Current and Pending Support Section

This straightforward section is often associated with needless mistakes that can undermine reviewers' perception of an applicant's attention to detail. This chapter will help you avoid that problem.

CHAPTER SIXTEEN: Biographical Sketch

This chapter covers one of the principal means of establishing that the proposed project will be feasible in your hands.

CHAPTER SEVENTEEN: Facilities, Equipment and Other Resources Section

This part of the application represents one of the opportunities you have to convince reviewers that the proposed research is feasible in your hands. Tips and strategies are provided in this chapter that will help you maximize the gain that this section potentially has to offer.

CHAPTER EIGHTEEN: Letters of Commitment

Letters of commitment must state precisely what is needed to underpin fully what you propose. This chapter tells you how to get and optimize such letters.

CHAPTER 9

RELATION TO THE PRINCIPAL INVESTIGATOR'S LONGER-TERM GOALS

This is the third section of the Project Description. It should be quite short and has the purpose of helping to establish feasibility of the research in your hands by describing how the current project fits into the continuum of research that you have been and will be following.

You should begin this section by stating your long-term goal. It must be consistent with, if not exactly the same as, the long-term goal that you offered at the beginning of the second paragraph of the *Overview & Objectives* section. This third section of the Project Description is not that far removed from the first, *Overview & Objectives* section. If you find that stating the long-term goal again here creates the appearance of redundancy our recommendation is that you not offer it in the first section. Save it for presentation as the beginning of this section.

As you have seen from the previous chapter, you can cite only ten publications in the Biographical Sketch – up to five that are relevant and up to five others that are of significance. If you have been involved in research for any period of time those publications may not be sufficient to fully document your past accomplishments, i.e., the continuum of research that has gotten you to this point. This section should be used to flesh out the details, to include references to relevant publications.

The current application represents the next step along your continuum of research. You should not summarize the proposal's content. Rather, you should describe briefly how the expected outcomes mesh with what you have done previously and how they provide the foundations for future research.

The final part of this section should be devoted to describing what the future directions of your research program are expected to be. In doing so you should assume that the investigations proposed in this application will work out as projected. The more specific that you can be, i.e., the more that you can avoid empty generalizations about the future, the better. What you must convince reviewers of is that your previous body of work, coupled with what is proposed here, underpin a well-thought-out, step-by-step continuum of research that will systematically develop an important area of research and attainment of your long-term goal.

***Tip:** Identify discrete steps that must be taken, as well as the sequence of them, that is necessary to attain your long-term goal. Those steps and their sequence should be the subject of the last part of this section.*

DEVELOPMENTAL STEPS FOR CHAPTER NINE:

1. Describe your long-term goal.
2. If repeating your long-term goal here after doing so in the *Overview & Objectives* section creates the appearance of redundancy, delete the earlier goal statement. Offer it here, only.
3. Assess your past research accomplishments and summarize how they have led you to propose what is in this application. Include references to your pertinent publications.
4. Summarize how the expected outcomes of the proposed research set the scene for future research.
5. Make a list of the specific steps and the sequence in which they must be taken in order to reach your long-term goal.
6. Expand the steps into a detailed description of the projected continuum of research that you will be following after completing this project, emphasizing its importance and that its systematic development will lead to attainment of your long-term goal.

EXAMPLE (TRUNCATED) OF RELATION TO PRINCIPAL INVESTIGATOR'S LONGER-TERM GOALS SECTION:

Our long-term goal is to identify the full spectrum of chemical interactions that is involved in BAMPHI-catalyzed oxidations of a diverse range of substrates. The importance of this area is acknowledged in a wide range of fields, including _____ (ref), _____ (ref) and _____ (ref). The work proposed in this application is the next vertical step along a continuum of research that my colleagues and I have been systematically pursuing for the last eight years (see 'Publications' section of the *Biographical Sketch*). During that time we have identified _____ (ref) and _____ (ref) as key early participants in the cascade of reactions that collectively lead to oxidation. The body of work to date has additionally confirmed that use of a mutant form of enzyme X (ref) will allow the characterization of intermediates that have been hypothesized to exist but not observed. These accomplishments, together with molecular characterization of the cleavage sites in three representative substrates (refs), have positioned us to now address _____, which is the subject of this application. Successful completion of this step is expected to inform subsequent studies that will focus on developing more detailed understanding of the intermediates that take part in the different reactions, as well as clarification of which factors control the relevant chemical interactions. Specifically, we project that _____ would be investigated next. This, in turn, would be expected to lead to _____. It is highly likely that accomplishment of those two steps would provide the foundation from which the final step of _____ could be taken. This progression of research is expected to ultimately yield the fundamental understanding of BAMPHI-catalyzed oxidations that is so widely needed.

CHAPTER 10

RESEARCH PLAN: NARRATIVE DESCRIPTION OF WHAT'S TO BE DONE

Providing you have been conscientious in the development of your *Overview & Objectives* section, although the *Research Plan* is the longest section of the Project Description, it will be one of the easiest to write. We recommend that you write it now, even though this section is near the end of the Project Description, for two reasons. First, the *Research Plan* section is primarily an expansion of the *Overview & Objectives* section that you have just written. By writing it now you can capitalize on the momentum that you will have developed writing that part of the Project Description. Second, writing the *Research Plan* section at this time increases the likelihood that there will be maximal continuity with the *Overview and Objectives* section, which may not be the case if it is written in sequence, later.

GENERAL TIPS ON WRITING THE RESEARCH PLAN SECTION

This section of the Project Description provides a detailed description of what will be done during the requested period of support.

Grant Proposal Guide: “...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 and plans for preservation, documentation, and sharing of data, samples, physical collections, curriculum materials and other related research and education products.”

You should develop your *Research Plan* using as its core the specific aims that you have already formulated. The approach here will be the same one that pertains generally to your application: get the reviewers ‘hooked’ with a conceptual overview and then, *and only then*, follow with details. The layout of this section will look something like the following:

Specific Aim #1: Title

- 1.1 Introduction
- 1.2 Research Design:
 - 1.2.1 Study #1 (explanatory heading)
 - 1.2.2 Study #2 (explanatory heading)
 - 1.2.3 Etc.
- 1.3 Expected Outcomes
- 1.4 Potential Problems and Alternative Approaches

Specific Aim #2: Title

- 2.1 Introduction
- Continue, using the format shown above for this, and any subsequent, aims.

Timetable

The title of all but the last subsection will be the eye-catching, interest-grabbing aim – copied verbatim from the *Overview & Objectives* section. It will be followed by a brief, conceptual overview of what will be done in an introductory paragraph, after which the details of what will be done will be presented under the Research Design sub-subsection. Expected Outcomes, the sub-subsection that follows Research Design, will briefly summarize anticipated results and pull them together to show the reviewer that they collectively achieve the aim's objective. A concluding paragraph, Potential Problems and Alternative Approaches, will address problems that could arise, as well as your proposed solutions to them (i.e., alternative approaches). As noted shown in the outline on the preceding page, this same format will be used to develop each of your subsequent specific aims. After the activities under each of your aims have been presented, a *Timetable* will be used to temporally relate all of the important activities during the requested period of support.

If any part of your Research Plan (or any of your Broader Impacts activities – see chapter 13) will require evaluation, it is essential that you create an effective and efficient evaluation plan. In most cases, both formative and summative approaches to evaluation should be proposed. If you have never created such a plan nor evaluated activities and research outcomes before, this is not the place to propose what you 'think' is adequate. Seek the advice of colleagues who are experienced in this area. Additionally, consult *The 2002 User-Friendly Handbook for Project Evaluation* (<http://www.nsf.gov/pubs/2002/nsf02057/start.htm>), which is published by NSF. It is a succinct treatment of the subject that we recommend it highly. Many universities offer evaluation resources – e.g., a fee-for-service group of experienced evaluators who are available to help plan and implement evaluation strategies. Determine whether or not your institution has such a resource. If not, are there individuals in other departments / colleges who would be willing to participate in your project as a consultant? Having a disinterested, outside person perform the evaluation is often a great asset. Such an approach overcomes the 'fox-guarding-the-chicken-coop' problem that can be associated with conducting your own evaluation. Finally, if your Research Plan will include an evaluation component, we strongly recommend that you invite someone who is a skilled evaluator to serve as a member of your Pre-Submission Review Committee (see chapter 19).

Finally, NSF encourages applicants to use metric weights and measures in their applications, as well as in the means that are used to disseminate results.

SPECIFIC TIPS ON WRITING THE RESEARCH PLAN SECTION

With these general points and the format just presented firmly in mind, begin by developing the subsection that will tell reviewers how you intend to accomplish aim #1. We recommend that you consider writing bullets first, which you then convert to text.

Using bolded Italics, write the title of your first aim — the 'headline' for this subsection.

Specific Aim #1: Title (Verbatim Repeat from Your Specific Aims Section)

1.1 Introduction sub-subsection. You should title the first paragraph, 'Introduction.' Your purpose here is to introduce what will follow in such a way that the reviewer will want to read the details. The sub-subheading should be indented and underlined. Continue writing text on the same line, as we have done here. Key words should be highlighted in italics to (e.g., *objective*, *working hypothesis*, *justification*, *approach*, *expectations*, etc.) to call reviewers' attention to them. This paragraph should be regarded as a conceptual overview of the aim. Its pur-

pose is to 'hook' the interest of the reviewers, so that they will *want* to read the details that follow.

The first sentence of the introductory paragraph should summarize the problem that aim #1 will address. It should be followed by a statement of the aim's overall *objective*, which should be to resolve the problem / question that is highlighted by the first sentence.

Next, if you are doing hypothesis-driven research, you should offer a *working hypothesis* for the aim. When you presented aim #1 in the *Overview & Objectives* section, you offered a working hypothesis in its subordinate paragraph. It should be repeated here, verbatim. You re-present the working hypothesis here, not only to remind the reviewer that the research is hypothesis-driven, but also to provide focus for what will be proposed. If you are proposing research that is driven by a statement of need, simply skip this component and write nothing here.

Next, summarize the *approach(es)* and/or *methods* that will be used to attain the objective.

The work to be proposed under this aim must be seen by reviewers as justified. Why is it necessary to do what is proposed? You should help them make that connection by offering a well-labeled *overall justification* as the next part of the introductory paragraph.

Finally, summarize what the *overall outcome* is expected to be. The outcome must be accomplishment of the aim's objective. However, you must paraphrase this last component in such a way that you are not simply restating the objective – it must come across as fresh.

To produce the first draft of the introductory paragraph for Aim #1, expand the bullets you have written into sentences. Revise and add transition sentences, as needed, to make what you have written read smoothly. When completed, the paragraph should occupy no more than ¼-to-½ page. The last sentence should be used to segue into the next sub-subsection, e.g., 'We propose to achieve this outcome through the studies / activities that are detailed in the next sub-subsection.'

1.2 Research Design sub-subsection. Here, your purpose is to detail the studies / activities that will be undertaken to accomplish specific aim #1. Note that this is where you detail what will be done. Each paragraph should be a conceptual unit, i.e., a related group of experiments designed to address a single point.

Begin by creating a bulleted list of the studies / activities that you plan for this aim. Create informative, interest-attracting titles for them — *headlines* — that can be used to introduce each of your Research Design studies / activities. Arrange the list so that one task / experiment flows logically into the next. Don't offer so many that you will have difficulty providing enough detail in the space that you have available for each of them. Assure to the greatest extent possible that there is not absolute dependence of any of the studies / activities on the expected outcome of an earlier one.

To the greatest extent possible, present each study / activity in a single paragraph. Then, make sure that you order the paragraphs in such a way that they create a compelling progression of logic that serves to lead the reviewer through what is proposed.

Detail is required for each study / activity that you propose, but it shouldn't be mindless detail, i.e., the kind that can be found in either a methods manual or the 'Methods and

Procedures' section of a journal article (see chapter 5 for an expanded discussion of this). What is needed for each study is meaningful detail, e.g., applicable parts of the following list:

Justification of the need for the particular study / activity

Approach to be used

Method(s) required

Critical reagents needed

Key equipment required (describe in the Facilities & Other Resources section)

Numbers of subjects / animals needed, and how these numbers were derived

How results will be interpreted

Statistical analyses to be used

Controls to be performed (VERY important)

Replicates that will be needed

Expected outcomes (VERY important)

Time required to complete the study / activity

Other considerations applicable to this study / activity

Use the approach described above to develop each of your aims in bulleted outline form. Then, expand the bullets for each aim into simple declarative sentences that are free of jargon and nonstandard abbreviations. Assert your confidence in being able to accomplish each study / activity by using a strong presentation format, like 'we expect to' and 'it is our conviction that.' Avoid weak words, i.e., those that unnecessarily plant a seed of doubt in the reviewer's mind regarding your ability to do what is proposed (e.g., 'hope,' 'try,' 'if,' 'might,' etc.). Emphasize the conceptual, because that is what is exciting and likely to attract the interest of the reviewer. Don't make the mistake of including too much detail; the reviewer will want to know what time it is, not how the watch was made. Methods that you have used in published studies don't have to be detailed; simply reference your use of them. Detail only those methods that either are new to you or unpublished ones that were created by you or members of your group. New investigators should generally include more detail – meaningful detail, compared to that which is required of established investigators.

With the preceding points in mind, ask yourself, 'Is there sufficient detail presented that a reviewer will have no question about feasibility of the approach(es) *in my hands*?' Also ask yourself, 'Does routine methodologic detail obscure conceptual aspects of the aim?' In other words, as recommended in chapter 5, read what you have written as though you are your application's reviewer.

If you have methods, procedures, subjects or anything else that is common to two or more aims, consider putting a 'Methods and Procedures' subsection at either the beginning or end of the Research Plan. There are pros and cons related to putting such a subsection first or last. If you put it first, the reviewer has the methodologic detail s/he needs when the subsections related to the aims are reached. The negative side to such placement is that the reviewer has to wade through a lot of methodologic detail before s/he reaches the exciting, conceptual parts. If the Methods and Procedures subsection is placed last, the reviewer doesn't have to do that, which is positive. However, this latter approach can leave the reviewer feeling anxious as s/he reads the preceding aims subsections, because s/he won't have an understanding of exactly how things will be done. Our recommendation, if you include a Methods and Procedures subsection, is that you locate it after all of your aims have been presented, i.e., just before the Timetable. If you do so, to prevent anxiety about lack of methods from developing, include a note in a very prominent text box at the beginning of the Research Plan subsection that informs the reviewer that a Methods and Procedures subsection will be presented later in the section. An approach that cannot be used is inclusion of a Methods and Procedures appendix. All information relevant to the application must be included within it – unless you have obtained a special deviation from this requirement from NSF (see the *Grant Proposal Guide*, page II-19).

1.3 Expected Outcomes sub-subsection. The purpose of this sub-subsection is to summarize the 'return on investment' that reviewers can expect. Under each study / activity you have detailed you will have included one or more expected outcomes. You should not simply list them again here. Instead, you should summarize them here and integrate them with a sentence that assures reviewers that they collectively attain the overall objective for the aim. The overview that you write here can usually be presented in a single paragraph that does not need to be extensive in its length – ¼-to-½ page, at most. To create this paragraph, we recommend that you, first, collect all of the outcomes for aim #1. After you have a good appreciation for how they relate to each other, write bullets of the kind that are suggested below.

- Summarize the first outcome and its importance
- Summarize the second outcome and its importance
- Continue summarizing outcomes and their importance
- Conclude with how the outcomes collectively attain the aim's objective

As the next step, expand these bullets into sentences, which will be the first draft of the Expected Outcomes subsection for the first aim. Repeat this process for each of your aims. Spend the time necessary to refine and optimize these subsections, because they represent another opportunity that you have to create excitement. Be enthusiastic in the way that you write this paragraph. However, at the same time, be realistic and provide appropriate caveats, if they are needed. You must not overstate your expectations to the extent that they (and you) lose credibility.

1.4 Potential Problems and Alternative Approaches sub-subsection. Your purpose here is to anticipate and then eliminate justified concerns of your reviewers. You do so by acknowledging potential problems that you could encounter, but probably won't, accompanied by alternative approaches that you would use to overcome such problems, should they occur. Reviewers will expect you to include such plans because they know as well as you do that no matter how hard one plans and prepares, research can unexpectedly take an entirely unexpected

direction. These are not meant to be big and/or unavoidable problems; those must be dealt with in the Research Design sub-subsection for the related aim. Instead, as noted above, these are meant to be problems that probably won't develop but, just in case they do, you have anticipated them and have the means in place to overcome them.

If you are proposing hypothesis-driven research, *first and foremost among problems that reviewers will expect you to address is the potential invalidity of your aim's working hypothesis*. Think about it: implicit in the fact that you are offering it as a hypothesis must be the potential for invalidity when it is tested objectively. Otherwise, what you are proposing is not a real hypothesis. You can't write this as though the sky were falling, however, or you will inadvertently make the aim appear problematic. What you want to do is honestly acknowledge that this possibility exists while, at the same time, you emphasize that such an outcome is unlikely. You would do so by writing something like: 'Although our preliminary data (see Preliminary Studies) and published studies by others (Wong et al., 2003; Logan, 2004) strongly support the working hypothesis for this aim, there is a remote possibility that it will prove invalid when tested objectively by the approaches described above. In this unlikely event, we would ...' You would go on to offer one or more credible alternative to which you would then turn. If you include this consideration under each of your aims you will convince reviewers that, no matter how your working hypotheses test, you will land on your feet and accomplish the aims' objectives. In other words, they will be impressed that you aren't naïve enough to believe that the outcomes of your hypothesis testing will be as expected – that you have alternative approaches that would 'defuse' that unlikely possibility.

As other examples of the kinds of things that should be considered in this sub-subsection, reviewers will be concerned about the availability of critical reagents: Will they be available and will they perform as expected? Will sufficient subjects be available to reach statistical significance? And will assays be as discriminating as you expect? You need to list equivalent kinds of problems and alternative approaches to them here. Begin with what you would do, should your working hypothesis for the aim prove to be invalid. List other potential problems as separate bullets. Follow each with a second bullet that succinctly states what the solution/alternative approach would be.

- Problem #1: Invalid working hypothesis
Solution:
- Problem #2:
Solution:
- Problem #3:
Solution:

Now, using the bullets that you have just created, write the related paragraph. In doing so, make certain that you have chosen only the most important and plausible problems that might occur, and make sure that the alternative approaches that you have offered are feasible and credible.

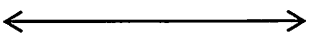
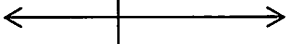
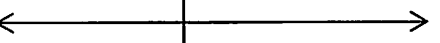
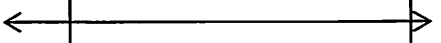
You should not belabor the problems that you identify. Rather, treat them with the brevity that they deserve. For each problem identified, address 1) the nature of the perceived problem; 2) the reason(s) why you don't think that the problem is likely to arise; and 3) what alternative approach(es) you would employ, should the problem be encountered. For example:

"In the studies described above, our working hypothesis is _____. Although the weight of our preliminary data (see *Preliminary Studies*) and complementary supporting evidence that is extant in the literature (Albright et al., 2004; Compton, 2005) strongly argue that our working hypothesis for this aim will test valid, there is a remote possibility that it will not. In that unlikely event, we would turn to _____ as the next most likely explanation for the phenomenon. This is a credible alternative because _____. Another possible problem is the way in which we have proposed to determine whether _____ will result in _____. We expect this new approach to work, because _____. As an unlikely possibility, this new technology may not prove sufficiently sensitive to detect _____ in 5% of the samples. Were this problem to arise, we would employ an alternative approach of _____, which is much more expensive and labor intensive. It has been used successfully by Wolf and her colleagues (1999) and Cantor *et al.* (2006) in similar kinds of studies to those proposed here at sensitivity levels are well above those that will be needed here. Were it necessary to employ this more expensive and time-consuming approach for a small number of samples, it is already available in our laboratory. Etc."

In writing this part of each aim, make sure that you paraphrase enough that the same choice of words and phrasing is not used in subsequent aims. A common mistake is to use exactly the same wording. Making this mistake detracts greatly from what is written because it makes it appear 'canned.' This sub-subsection should be no more than ½-page long.

Timetable.

This important section of the *Research Plan* section is not included by most grant writers. We recommend that you do so. It is important to include one like that which is depicted below, because a well-conceived timetable can give your reviewers perspective about your project that they would otherwise lack. It can't come across as an afterthought; it should be as *detailed* as is necessary to convince your reviewers that you have thoroughly thought through how long you expect that it will take to complete each component of your program. Enter years of support that are requested on the horizontal axis and your specific aims/proposed studies in the left column. The duration of each aim (bolded, double-headed arrows), and the expected duration of the major studies that will be conducted under each aim (non-bolded, double-headed arrows), should be indicated in the timetable.

AIMS/TASKS	YEAR 01	YEAR 02	YEAR 03
Specific Aim #1			
Title, Study #1.1			
Title, Study #1.2			
Title, Study #1.3			
Specific Aim #2			
Title, Study #2.1			
Title, Etc.			

The titles of studies in the left column should be sufficiently explanatory that the reviewer will understand the specific investigations / activities that will be required to accomplish the aim. If it

would make the timetable more understandable, substitute the titles of specific tasks for the arrows in the table.

This same timetable should be copied and pasted into the Budget Justification as a means of summarizing for reviewers why you are requesting the number of years of support that you are proposing (see chapter 14).

DEVELOPMENTAL STEPS FOR CHAPTER TEN:

1. Make sure that the formatting for your *Research Plan* section is consistent with that which you used to write the *Overview & Objectives* and *Expected Significance* sections.
2. For aim #1, write bullets that reflect the principal components of the 'Introduction' paragraph. In particular, make sure that there is a clear objective stated for the aim.
3. After making the list, expand each bullet into a sentence. Revise / add to the sentences that you have created in order to make a paragraph that reads clearly and smoothly.
4. Create a bulleted list of the studies / activities that will be undertaken under aim #1's Research Design sub-subsection.
5. Develop each of the studies / activities by first creating a bulleted list of specifically what will be done and the outcomes that can be expected.
6. Expand the bullets for each study / activity into sentences that create a single paragraph, if possible. Make sure that only meaningful detail is included.
7. Order the paragraphs to create a compelling flow of logic
8. Make a list of the outcomes that can be expected collectively from aim #1. Summarize them in as few sentences as possible.
9. Write an integrating sentence that tells reviewers how the outcomes collectively accomplish the objective for the aim.
10. Make a bulleted list of unlikely, but potential, problems that could be encountered while pursuing aim #1. If you are doing hypothesis-driven research, begin with the problem of potential invalidity of the working hypothesis for aim #1.
11. Develop a credible alternative approach that will solve each of the problems you have identified.
12. Expand your bullets into sentences that will collectively constitute the Potential Problems & Alternative Approaches paragraph for aim #1.
13. Repeat the process described, above, for each aim after #1.
14. Create a timetable that summarizes for reviewers when the main studies / activities under each aim will take place.
15. Copy and paste the timetable into the Budget Justification as a means of summarizing why you are requesting the years of support that you will propose.

EXAMPLE OF A RESEARCH PLAN:

RESEARCH PLAN

We will detail, below, the three specific aims that will be pursued to characterize induction of the gene that encodes the α subunit of the receptor for human interferon- γ .

Specific Aim #1: Identify DNA segments that regulate stimulated transcription of the human α chain's gene.

1.1 Introduction. Although the promoter for the human α -chain gene has been cloned (Goldwin and Homer, 2000), inferential analysis has failed to reveal the response elements that regulate transcription that is stimulated by either PGE₂ or TNF- α . The *objective* of this aim will be to identify the relevant response elements. Based on our own preliminary data (see *Preliminary Studies*), the *working hypothesis* is that stimulated transcription will be regulated by segments of the promoter that are chronically activated, such as XYZ, in concert with an additional set of stimulus-responsive elements. The *approach* will be to systematically narrow the focus to specific response elements in the promoter that will support regulatory activity when transfected *in vitro*. Principal methods will include primer-directed deletion, bead-assisted transfection, Elbert's optimized gene-induction strategy (Elbert et al., 1999), and *in vivo* footprinting. The *justification* for the approach is that there are too many computer-identified candidate sites to explore each of them by mutational analysis or electrophoretic mobility-shift assay (EMSA). At the conclusion of this specific aim, it is our *expectation* that we will know precisely which segments of promoter DNA regulate stimulated transcription of the gene that codes for the human α chain.

1.2 Research Design. We plan to accomplish the objective of this aim by conducting the following studies:

1.2.1 Establish the Least Amount of Promoter DNA That Will Support Stimulated Transcription. The approach will be the same as the one that we previously used in studies of the mouse inducible nitric oxide synthase promoter (Paterno *et al.*, 2003). Briefly, using the restriction map of the *Sau3A* I fragment (see Figure 6), unique restriction sites will be chosen that will allow the DNA to be shortened progressively. Each of the truncated DNA fragments will then be cloned into the GeneLight luciferase vector (pGL2-Basic). Alternatively, the entire 814 bp fragment will be introduced into the vector, after which combinations of uniquely cleaving restriction enzymes will be used to remove specific segments, followed by religation of the plasmid. Each of the resultant constructs (4 pmol of each) will then be transiently transfected by electroporation into human THP-1 cells as we have done before (Edwards *et al.*, 2001). To minimize differences, the cells from multiple electroporations will be pooled to obtain enough cells for constitutive and stimulated studies of the same construct. The cells will then be divided equally among 60 mm-diameter dishes ($\sim 1.5 \times 10^6$ /plate) and allowed to recover for 24 hr (which serves to reduce the background levels of luminescence to a minimum). Next, plates will be exposed either to medium alone or medium containing either PGE₂ or TNF- α . For studies of stimulated transcription, dose-response studies will be performed for each stimulus. The promoterless pGL2-Basic vector will serve as the baseline control for constitutive expression in unstimulated cells. The baselines for stimulated transcription studies will be the values obtained with each construct in cells incubated in medium alone, i.e., unstimulated cells. In all experiments, the positive control will be the amount of luminescence produced by the unaltered 814 bp insert. Luminescence produced by induction of the luciferase reporter gene (Enhanced Luciferase Assay, Analytical Luminescence Laboratory, San Diego) will be measured in a lumi-

nometer (Monolight 2010, also from Analytical Luminescence Laboratory; see Facilities & Other Resources section). At the conclusion of these studies we expect to have defined the minimal amount of promoter DNA that will support full expression of the luciferase reporter gene in human THP-1 cells under the conditions of stimulated transcription.

1.2.2 Characterization of Response Elements Most Likely Involved in Regulating Stimulated Transcription. The approach here will be footprinting via dimethylsulfate (DMS)-mediated methylation of living cells (either stimulated or unstimulated). *In vivo* footprinting is a powerful technique for directly demonstrating which response elements have bound transcription factor proteins in living cells. We have successfully used this approach in the past in similar kinds of studies (Ancien *et al.*, 2005). This technique minimizes binding artifacts that can occur with *in vitro* approaches because binding of proteins to DNA occurs prior to the time that the cells are harvested and lysed. Briefly, THP-1 cells (2×10^7) will be plated (150 mm-diameter dish) and incubated overnight to allow them to recover from passage. Cultures will then be exposed to either medium alone (for identification of chronically active sites) or to either PGE₂ or TNF- α (identification of stimulus-responsive candidates). Stimulated transcription will be analyzed at the peak effect of each stimulant, as determined in nuclear run-on time-course studies. We have also used this approach before (Campbell *et al.*, 2006). Pilot studies will also be performed to ascertain whether or not there are proteins that bind transiently at earlier times. This will ensure that transcription factors that are involved in the initial activation of the gene, but which do not contribute to prolonged transcription of the gene, will be detected (Hoffstetter, 2006). After an appropriate period of treatment, cultures will be treated for 5 minutes at room temperature with medium containing 0.2% DMS in the continued presence of stimulators. Genomic DNA will then be isolated, treated with piperidine to cleave DNA at methylated G residues, and then subjected to the ligation-mediated PCR amplification procedure of Garrity and Wold (1999). The control for each of these experiments will be the ligation-mediated PCR amplification of *in vitro* methylated, protein-free genomic DNA. This will provide a sequencing ladder of all G residues, to which the *in vivo*-treated samples can be compared. Completion of these studies is expected to yield direct proof in living cells of the response elements that are most likely involved in stimulated transcription.

1.2.3 Definitive Identification of Response Elements that Regulate Stimulated Transcription. Continue with description of next study.

1.3 Expected Outcomes. Accomplishment of this aim is expected to yield knowledge of the least amount of promoter DNA that will support transcription, which will allow identification of the most likely candidates for response elements that regulate stimulated transcription. That, in turn, is expected to set the scene for definitive analyses that are expected to confirm which of the candidate response elements are, in fact, actively involved in regulating stimulated transcription of the gene that codes for the α chain of the human IFN- γ receptor, thereby accomplishing the objective of this aim.

1.4 Potential Problems and Alternative Approaches. Although the possibility is considered remote, given the strength of our supporting preliminary data (see *Preliminary Studies*), our working hypothesis for this aim could prove to be invalid when it is tested objectively. Although we do not expect such an outcome, in that unlikely event we would shift our focus to the next most likely regulatory regions, which are the ABC response elements. As noted in the *Preliminary Studies* section, there are suggestions that these could be involved, probably as complementary regulatory regions, but they may, in fact, be the principal regulators. Other potential problems could include: (1) For deletion / transfection studies, the efficiency of transfection could vary sample to sample. To minimize this problem, relative luciferase values will be

normalized against a transfection control. We will use the one that we have used in the past (Omer *et al.*, 1998), i.e., human growth hormone. To do so, the plasmid, pXGH5, which contains the cDNA for human growth hormone, will be co-transfected with each of the luciferase reporter gene constructs. Amounts of human growth factor secreted into the medium will be radioimmunoassayed and relative light units normalized by dividing them by the relevant cpm from the human growth hormone radioimmunoassay. Results will be reported as relative luciferase activity. Should it become apparent that human growth hormone has an unwanted stimulatory effect on THP-1 cells, we are prepared to create a secreted alkaline phosphatase expression vector as an alternative transfection-efficiency control. (2) Although we expect most or all of the functional response elements to be in the 220 bp segment that is located immediately upstream from the coding region, they may not be. In such a case, a possible problem is the fact that there are segments in the flanking DNA that contain too few unique restriction sites for detailed deletional analysis. An alternative approach that will resolve this problem, if it arises, will be to PCR- amplify specific regions to be assayed, after which they will be cloned into the pGL2-Basic vector. To do this we will synthesize an oligonucleotide based on the sequence adjacent to the Sau3A I site located within the coding sequence (the rightward Sau3A I site in Fig. 8). Additional oligonucleotides will be synthesized according to sequences upstream and will define the 5'-most endpoint of the region to be assayed. (3) Should little or no reporter-gene activity be obtained with the 814 bp fragment that we have cloned (an outcome that we consider highly unlikely but possible), larger fragments cloned from our primary 70-100 kb genomic clone will be analyzed. These will include the first intron, as well as sequences upstream of the 814 bp fragment.

Specific Aim #2: Identify the DNA response elements responsible for regulation of constitutive transcription of the α chain's gene.

- 2.1 Introduction.
- 2.2 Research Design.
- 2.3 Expected Outcomes.
- 2.4 Potential Problems and Alternative Approaches.

Timetable:

TIMETABLE FOR THE RESEARCH PROGRAM			
	YEAR 01	YEAR 02	YEAR 03
<u>Specific Aim #1:</u> RESPONSE ELEMENTS: STIMULATED TRANSCRIPTION	Deletion / transfection <i>In vivo</i>	footprinting	
<u>Specific Aim #2:</u> RESPONSE ELEMENTS: CONSTITUTIVE TRANSCRIPTION	Point	mutational analyses Combinatorial	Mutation EMSA supershifts

CHAPTER 11

BACKGROUND – Review of Relevant Literature, Results From Prior NSF Support, Preliminary Studies – and REFERENCES CITED SECTIONS

BACKGROUND SECTION

This section of the application will help you to both justify the need for what you intend to propose (*Review of Relevant Background Literature* subsection) and establish that the studies are feasible in your hands (*Prior NSF Support* and *Preliminary Studies* subsections).

REVIEW OF RELEVANT LITERATURE SUBSECTION

Grant Proposal Guide: “*The Project Description ... must include [a clear statement of] the relation ... the proposed work has to the present state of knowledge in the field, ...*”

General Points. In our opinion, this subsection is one of the least well understood parts of the grant application. Most applicants don't appreciate that the purpose of this subsection is to help *justify the need* for what they want to propose. Not understanding that, they incorrectly assume that the purpose is to impress reviewers with the comprehensiveness of their grasp of all aspects of the field's literature, which is virtually impossible when you think about practicalities. As a rule of thumb, this part of the proposal should be approximately 10% of the total page allocation for the Program Description, i.e., approximately 1½ pages. It is simply not possible to be comprehensive in such a small amount of space. Thus, the review that must be written here should be a highly selective one – use of the existing literature to support the need for what you will propose.

This subsection must substantiate all of the relatively unsubstantiated assertions that you made in the first, introductory paragraph of the *Overview & Objectives* section. What you want to do here is detail and expand upon the fact that there is a gap in the knowledge base / unmet need, and that such a gap / need represents an important problem. For example, if you are writing a purely need-driven application, this is where you will provide much more detail regarding evidence published by others that objectively supports existence of the need that you assert is a problem. This approach is another example of gradually ratcheting up detail as the reviewer reads more deeply into the proposal.

Specific Tips. We recommend that you write this subsection *after* you have written the *Research Plan* section. Why? Because, if you think of the *Research Plan* as the ‘plug’ that will fill

the gap in the knowledge base, once you know what that part of the application contains it makes it much easier to pick and choose the primary literature that supports the need to do it. If you follow this approach your *Review of Relevant Literature* subsection will maximally support the case that you are making by tailor making the gap that the 'plug' is designed to fill. It will also be devoid of all of the irrelevant, extraneous information that is usually found in this part of the proposal.

We additionally recommend that you title this section ***Review of Relevant Literature***, as shown above, rather than 'Background.' Put this title in bolded, italicized letters and then continue to write on the same line with text that is not highlighted. The phrasing of the title *anticipates*, and helps to deflect, any erroneous criticism by an inexperienced reviewer that your literature-review subsection is not a comprehensive.

Because the *Review of Relevant Literature* subsection will vary greatly depending on the application, our recommendations here will, of necessity, be general ones regarding what should be written here. For example, this should be a *critical analysis* of what has been published. By that we don't mean that you should be trenchantly critical of the accomplishments of researchers who have published earlier in the field. Rather, we mean that your review should not a passive one, i.e., one that simply recounts who did what when. As an example of what is needed: 'Gonzales and his colleagues concluded _____ in 1968. However, at that time they did not have access to _____, which prevented them from addressing _____. We, by contrast, will _____. ' Thus, *this subsection should be written to build toward the contributions that you expect to make.*

You should not rely on review articles and books when you write this subsection. By including such citations you can inadvertently convince reviewers that you are a five-minute 'expert' based on your reading of such sources. Rather, what reviewers want to know is whether or not you have a grasp of the primary literature to the extent that you can selectively use it to support the case for what you will propose.

Your treatment of the relevant literature needs to be fully up to date. This is almost never a problem for new applications. To assure this, however, we recommend that you update this subsection while your pre-submission reviewers are evaluating your final draft (chapter 19). During that time you should visit the current-journal shelves in your library and/or on-line versions of journals that are pertinent to your field. Review the tables of contents of issues that have been published in the past three-to-six months. Any article that is pertinent to the subject of your application should be cited in your proposal. Reviewers often are impressed by an applicant who selectively cites literature that is only 6-to-9 months old at the time that his/her proposal is reviewed.

Currency of citations often does become a problem when applications are resubmitted after being rejected when first submitted. Applicants forget to update the *Review of Relevant Literature* subsection. It is definitely not impressive to reviewers when this part of the application is a year or more out of date.

Providing it does not appear contrived to do so, make certain that you cite the contributions of investigators who you will suggest as reviewers. No reviewer likes to think that his/her contributions have been overlooked or dismissed by an applicant.

Be careful not to over-cite your own contributions. Make sure that your treatment of the field is equitable and balanced. In particular, don't shy away from work that runs counter to your views; one of the individuals in that camp may be a reviewer of your proposal. Acknowledge that there

are differences of opinion in the field, citing one or more of the researchers in the other camp, and present your expected contribution as one that will help to resolve such legitimate difference of scientific opinion.

At the conclusion of this subsection, there should be a final sentence that segues into the two subsections that follow this one. Their purpose is to help establish feasibility of the project in your hands. What you will have written here will identify legitimate gaps / needs. The segue to the next subsections should make clear that you and your colleagues have already made progress toward filling those gaps / meeting those needs, 'as will now be detailed in the following two subsections.' The latter phrase is what provides the seamless transition.

Using this approach, your *Review of Relevant Literature* subsection will consist of six-to-eight highly focused paragraphs. At the end of each one we strongly recommend that you do something that we consider to be very reviewer-friendly: include a fully italicized sentence that will tell the reviewer why what you have just presented helps to justify the need for what is proposed in the application.

At this point, refine what you have written by inserting additional information or transitional sentences that are needed to improve readability and the flow of logic from one point to the next. Have you brought your reviewers fully 'up to speed' with respect to what is current knowledge? Have you clearly defined the problem that will be the subject of the application? Does the flow of information build logically and persuasively toward what your contribution will be? Is the final paragraph written in such a way that it is a good transition into the remaining two parts of the *Background* section? If your answers to these questions are affirmative, you have accomplished your goal for this subsection and are ready to go on to the next one.

RESULTS FROM PRIOR NSF SUPPORT SUBSECTION

Grant Proposal Guide: "If any PI or co-PI identified on the project has received NSF 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 [our emphasis] be provided:"

General Points. You should think of this part of the application as a 'progress report' on prior NSF research support that you and your colleagues have had in the past five years (from the date that this application will be submitted). If none of you has had such support, include this subsection heading in your proposal with "None" entered under it. Otherwise, reviewers and program staff may conclude that you overlooked including it.

Specific Tips. If either you or one or more of those on the application with you have had NSF support during the last five years, but it was completely unrelated to the project that you are proposing, you must acknowledge receipt of such support and describe it using the first five mandatory requirements that are listed in the *Grant Proposal Guide* (page 11-8). *Be as brief as possible in describing such a project and what it produced* because the space taken counts against the 15 pages that you are allowed for the Project Description. In other words, try not to 'waste' any more of those pages than necessary in describing unrelated research.

A strategy that will save a little space while acknowledging receipt of unrelated-project support

is to provide the required information in a continuous, not bulleted-list, format. For example: 'NSF award number, amount and period of support; title of the project; very brief summary of the results, including any human resources created that are relevant to science and engineering (e.g., students/post-docs trained); publications produced (e.g., citation for publication #1; citation for publication #2; etc.); and description of any products not described elsewhere (e.g., in publications).

If the formerly supported project is either relevant or directly related to the one that you are offering in the current application (e.g., it is a renewal of the same project), you need to take an entirely different approach. If it is a renewal, the appropriate box on the Cover Sheet must be checked. Then, provide sufficient detail in this subsection that reviewers will be able to assess the quality of the research and what it produced; they will be asked to comment on these two points in their reviews. To assist them fully you need to be sure that you have succinctly, but fully, described the project, as well as how the previous results and publications relate to what you are now proposing. As with the preceding subsection, it is reviewer-friendly to include fully italicized sentences that tell reviewers how related projects have provided the foundations for the research that is the subject of the current proposal.

As with unrelated support, what you write about related former support will count against the total pages you are allowed for the Project Description. As a way of gauging how much to write about related projects, consider that the *Results From Prior NSF Support* and *Preliminary Studies* subsections should, together, not exceed one-third of the total you are allowed for the Project Description, i.e., no more than 5 pages. It is a judgment call on your part regarding how to distribute those pages to support maximally what you are proposing.

You can provide *Results From Prior NSF Support* after the Project Description as a separate section. We recommend against using this approach, however. First, it accomplishes nothing; the pages in the separate section would still count against the 15-page limit for the Project Description. Thus, if your separate *Results From Prior NSF Support* section would contain 4 pages, the page limit for your Project Description would be reduced to 11 pages. Second and more important, following the Project Description with *Results From Prior NSF Support* disconnects this important information from the progression of logic that is so essential to a competitive application, especially if it is relevant to your current application. What you want in the *Background* section is a progression of logic that starts with what is current and missing knowledge (*Review of Relevant Literature* subsection), how you and your colleagues have contributed to current knowledge and filled previously existing gaps using NSF support to do so (*Results From Prior NSF Support*), followed by the results of unpublished work that establish the feasibility in your hands of the next steps that need to be taken to advance the field vertically (*Preliminary Studies* section).

PRELIMINARY STUDIES SUBSECTION

General Points. As just noted in the preceding paragraph, the purpose of this subsection is to help establish that all of what is proposed in the current application is feasible in your hands, i.e., that you have the experience and technical skills needed to complete the proposed work.

The relative importance of this part of your application is underscored by the fact that we recommend it be approximately ¼-to-⅓ of the total page allocation for the Project Description, i.e., 4-to-5 pages. As noted earlier, if you have had NSF support during the last five years the results of such support must also be described within those 4-to-5 pages.

We are often asked, 'What constitutes enough preliminary data to be competitive at the level of the standard NSF research grant?' The answer is, to meet the purpose that the section has you must have enough to support the feasibility of every aspect of what you propose. Thus, if you are proposing hypothesis-driven research (or the 'hybrid' approach – a combination of need- and hypothesis-driven research) you must have sufficient data to support the central hypothesis and the working hypothesis for each aim. If you are proposing research that is purely need-driven you must have enough preliminary data that the feasibility of each proposed task will be supported, as well as objective evidence for existence of the need you have identified. If your preliminary data are insufficient to support every aspect of what you are proposing it makes no sense to submit an application, in our opinion. In such an instance you must have the discipline to not submit your proposal until you can adequately support the feasibility of the research it proposes.

As a means of assuring that you have sufficient preliminary data we recommend that you formulate a central hypothesis and lay out your specific aims well before you are able to submit the proposal. Doing so will help to focus your research on just that which is necessary to support the projected application.

Organize your preliminary data as you generate it. Doing so will not only assure that you ultimately have enough data, it will also prevent you from having more than you need. For each data set that you generate write a statement regarding what those data show and why they are important in helping to establish feasibility. If you have pre-existing data, analyze and organize it similarly. Throughout the process constantly winnow the studies on your list to retain only the ones that are the most relevant and complete. At the point that you decide that you have enough, arrange what you have under each sub-subsection (see below) in an order that will present the data in a logical and persuasive progression.

Specific Editorial Tips. This section is not meant to be an outpouring of raw data from your laboratory notebook. Nor is it meant to be a section wherein you extensively describe your own published work. And it should *never* contain work that has been done by others, unless those individuals are intimately connected to the proposed research (e.g., as a Co-Principal Investigator, Co-Investigator, collaborator or consultant).

To help reviewers appreciate that your application is fully supported by preliminary data we recommend that you format this subsection in such a way that that point will be crystal clear. The approach is similar to the one that we recommended for your *Research Plan* section (see chapter 10): subdivide the subsection into parts that correspond to your central hypothesis and specific aims. Present data under the part – the sub-subsection – to which they are most relevant. Title each sub-subsection in a way that will remind reviewers of the purpose of the subsection, e.g., 'Feasibility of the Central Hypothesis,' 'Feasibility of Specific Aim 1,' and so on. If you have data that are pertinent to two or more of the parts you should offer them in a first sub-subsection that is titled something like, 'General Support of Feasibility.'

Write the text of each paragraph with clarity, specificity, and impact in mind. Avoid 'empty generalities.' Use simple declarative sentences and stick to the point. Don't detract from your presentation by including material that is tangential to the point that you want to make and avoid extensive descriptions of routine methods in the text.

Descriptions of methodology belong in figure legends and the footnotes to tables, not in the text. Save the text to emphasize concepts and the feasibility of what you are proposing. By putting methodology into figure legends and footnotes you provide it to reviewers only if they choose to

read it, which isn't the case when it is incorporated into the text. There is another reason for such placement: smaller font can be used (*Grant Proposal Guide*, page II-2). The only restriction is that it must be legible. Thus, by using this approach you can get a lot of methodology into a relatively small amount of space, thereby preserving precious space for more important things in the page-limited Project Description.

Figure legends should have two parts. The first of these should include whatever description is necessary to make the point of the figure and to explain any symbols that are used in presenting the data. The second part of the legend should describe the method(s) used to generate the data. Precede the second part with the title, 'METHODS.' The legend should be referred to in the text if a methodological point needs to be made there.

Tables should have a title that conveys whatever point the tabulated data are intended to make, and can be annotated with footnotes, but sparingly. If it is necessary to describe how the tabulated data were generated, a methods footnote can be included.

Assure that no irrelevant or extraneous data are included. Thus, if you have a pre-existing figure consisting of two panels, if you need only one of the panels for the application have the initiative to re-draw the figure; don't include both panels and discuss only one of them.

Make the presentation of your data as simple as possible but not so simple that it is 'dumbed down.'

Each data set should be organized to make a single important point. As noted earlier in chapter 5, paragraphs should make a single point. Thus, in the *Preliminary Studies* subsection each set of data should be associated with a single paragraph that discusses those data.

Design this section so that data and the related paragraph will be closely juxtaposed. Ideally, a reviewer should be able to glance back and forth between the data and the accompanying text without having to turn pages to do so.

Make sure that data are presented after they are first mentioned in the text, not before. If necessary, move data to the top of the next page if they will not fit below where they are first mentioned. If it becomes necessary to create such a disconnect, direct the reviewer to the location of the data with something like, '...', as is illustrated in Figure 4 (see top of next page).'

If you decide that some of your research team's published data are necessary as the foundation for unpublished data that you plan to present, decide how it will best fit into the presentation sequence. In almost all cases it will appear at the beginning of the relevant sub-subsection.

Lead reviewers through your data. The usual and less effective approach is to provide a conclusion in the text and then refer the reviewer to a table or figure to determine for him/herself how that conclusion was reached. That makes the reviewer do all of the work, which is not reviewer friendly. That approach also risks that s/he either won't make the effort or, worse, will do so and come to the wrong conclusion. The appropriate approach, in our opinion, is to give the reviewers the conclusion, refer them to the data, and then lead them through those data. For example, 'As can be seen from Figure 1, the conclusion is that _____. Note that there is a band in column one that is missing from column two. This means _____. By using this approach, you can be assured that the reviewer will come down in the same place that you did. That doesn't mean that s/he will agree with your conclusion, but at least you can be confident that s/he will have the best chance possible to do so.

In each paragraph of this subsection, usually near the end, you should write a fully italicized sentence that tells reviewers why the data just presented support feasibility. Doing so assures that reviewers will connect to that point. It is also extremely reviewer-friendly to do so, because it makes interpretation of what is being presented effortless. Such a sentence might read something like: *'These preliminary data support feasibility because they strongly support the working hypothesis that is proposed for specific aim #2.'* or *'Collectively, these data provide a key part of the foundation for aim #3 because they unequivocally confirm that the approach proposed to block transcription is both feasible and fully effective in our hands.'*

Specific Technical Tips. Carefully examine each figure/table, including legends/footnotes, to ensure that *everything* is fully legible. This is particularly important for figures or tables that have been photo-reduced. A very common error is to reduce a figure or table until it fits the space that you want it to occupy without realizing that, in the process, some of the related print has become illegible.

Most reviewers, in our experience, will print your proposal to review it. For that reason, you must assure that every figure that contains color will still be interpretable if it is printed in black-and-white. To assure this choose colors for your figures that have distinct grayscale differences. Then, in the legend denote not only the color but also the grayscale equivalent, e.g., 'red (black), yellow (gray) and pink (light gray).'

Vary the format in which you present data; table after table becomes boring. Histogram after histogram does too. Present a table, then a pie chart, then a line drawing, then a histogram, etc., to keep the presentation of data as fresh and appealing to reviewers as possible.

REFERENCES CITED SECTION

Everyone is aware that an application can be compromised by under-supporting it with citations of the literature. However, few are aware of the fact that over-citation of the literature can be a problem, also. Those who are guilty of over-citation are usually applicants who are erroneously trying to be comprehensive. For the reasons given earlier in this chapter, citation of references should be selective, not comprehensive. Thus, if eight, similar publications exist regarding how a gene was cloned you would not cite all eight. You would cite only the one (or the few) that best makes the point. As a general rule, standard NSF research grant applications should be supported by 50-100 citations.

Only bibliographic citations are allowed in the *References Cited* section. Do not use this part of the proposal to include descriptions of methodology, as some journals allow. If you make this mistake you will almost surely be seen as trying to circumvent the 15-page limit for the Project Description, in which case your proposal could be returned to you without review.

Citations must be complete. All authors must be named in the order that they appeared in the publication. The title of the publication should appear next, followed by the name of the journal or book it appeared in. Next, give the volume number, full pagination and the year of publication. If necessary, have your references retyped to make sure that they conform to this format. If you know the URL for a publication that is available on-line it can be included in the citation, in contrast to what is allowable in the Project Description (page II-7 of the *Grant Proposal Guide*). To include URLs in the *References Cited* section is optional.

We recommend that you arrange your references in alphabetical order by the first author's last

name. This is maximally reviewer friendly when you cite references in the text using author, year. We additionally recommend that you use hanging-indent format, i.e., first line of each reference beginning at the left margin with subsequent lines indented one tab. This approach saves space by individualizing references without opening a line between each of them.

DEVELOPMENTAL STEPS FOR CHAPTER ELEVEN:

BACKGROUND SECTION

Review of Relevant Literature:

1. Title the subsection *Review of Relevant Literature*, not 'Background.'
2. Write this subsection after you have written the *Research Plan* section.
3. Use this subsection to justify the need for what you are proposing, i.e., make sure that it supports the need for the contributions that you expect to make.
4. Cite primary literature in this section, not review articles or book chapters.
5. Assure that this subsection is completely up to date, especially if you are submitting a revision of a previously reviewed proposal.
6. Be sure to cite the work of researchers who you will recommend as potential reviewers of your application.
7. Make certain that your citations of the literature are balanced, i.e., not too many of your own or that support only your point of view.
8. At the end of the subsection create a segue that will provide a seamless transition into the next two subsections.

Results From Prior NSF Support:

9. Determine whether either you or colleagues on the application with you have had NSF research support during the last five years (from the date of submission of this proposal).
10. If you have had such support, describe it within the Project Description, not as a separate part of the application.
11. Describe prior NSF support using the mandatory points stipulated by the *Grant Proposal Guide* (page II-8).
12. Describe unrelated prior support as briefly as possible. Present the mandatory information sequentially, not as a bulleted list.
13. Develop the mandatory points more extensively for related prior support, especially if the current application is a renewal of prior support.
14. Be aware that the pages used to describe prior NSF support count against the 15-page total for the Project Description.

Preliminary Studies:

15. Organize existing preliminary data that you have.
16. Establish what is missing and needed to support the feasibility of what you intend to propose.
17. Focus your research on producing the missing data.
18. Organize this subsection along the lines of your central hypothesis and specific aims.
19. Title each sub-subsection in such a way that the purpose of the *Preliminary Studies* subsection is emphasized, i.e., that it reflects establishment of feasibility in your hands.
20. Organize and present each data set to support a single point. Accompany those data with a single paragraph which discusses that point.
21. Make sure that all of the print associated with tables and figures is legible, especially if you have photo-reduced a table / figure.

22. Write this subsection in such a way that the text leads reviewers through the data you present.
23. Include a fully italicized sentence at the end of each paragraph that tells reviewers how the data just presented support feasibility of some part of the project.
24. Vary the data-presentation format as a means of making the subsection maximally appealing to reviewers.

REFERENCES CITED SECTION

25. Be selective in your choice of supporting literature. Strive for something between 50 and 100 references.
26. Make sure that each reference is accurate and complete. It is optional to provide the URL for publications that are available on-line.
27. If necessary, have your references retyped to assure that they conform to the format for presenting them that is given by the *Grant Proposal Guide* (page II-8).
28. Do not use the *References Cited* section to present methodology or anything else that isn't a bibliographic citation.
29. Order your references alphabetically on the basis of the last name of each first author.
30. Use hanging-indent format to present your references without an open line after each.

CHAPTER 12

RELATION TO OTHER WORK IN PROGRESS

As was noted in chapter 1, the National Science Foundation has only approximately one-fifth of the money to invest in research that NIH has. Thus, NSF is particularly intent on making sure that every dollar it invests is invested well. The purpose of this section is to assure reviewers and program staff that your proposal represents a sound investment. The section should do so by helping to justify the need for what you are proposing and the potential return on investment that it represents.

Momentum that you will have created during preparation of the *Review of Relevant Literature* subsection of the *Background* section can be used to help you write this part of the proposal, especially that which deals with work in progress elsewhere. We recommend, therefore, that you write *Relation to Other Work in Progress* immediately after you have completed the *Background* section.

Grant Proposal Guide: “*The Project Description ... must include: ... [a clear statement regarding how the present project relates] to work in progress by the PI under other support and to work in progress elsewhere.*”

This part of the Project Description should have two subsections, one for each of the two parts of the mandate that is quoted in the textbox, above. They are: (i) Other Work in Progress by the Principal Investigator, and (ii) Work in Progress Elsewhere.

OTHER WORK IN PROGRESS BY THE PRINCIPAL INVESTIGATOR

The purpose of this subsection is to allay any concerns that reviewers or program staff might have regarding conflicts that could be created by funding the present project. By “conflicts” we mean things like competition with currently existing projects for space, equipment, subjects, etc.

Don’t be confused by the wording, “under other support,” that is quoted in the textbox, above. That does not restrict consideration here to research that is extramurally funded. If you are conducting any kind of other research there must be some form of support for it. Thus, any project that has longevity associated with it should be described. If one or more of the projects is extramurally funded, refer reviewers to the *Current and Pending Support* section for details. Don’t detail the projects here, because doing so counts against the 15-page limit for the Project Description. There is no page limit for the *Current and Pending Support* section.

First, briefly describe what other research projects are ongoing in your operation. Then, if it is legitimate to do so, make the point that, not only will no conflicts be created by funding the proposed project, doing so will complement your other, already-existing endeavors. If you can make the point without stretching credibility, describe how the new project will actually synergize

with your other, ongoing avenues of research. It is a strong point if you can convincingly convey that sharing resources among all the projects will foster more research for less money.

If there really is a legitimate reason for concern about conflicts that might be created by funding this project, the thought process associated with developing this subsection will crystallize the specifics of those concerns. We strongly recommend that you resolve any such problem(s) before the application is submitted, so that you won't have to discuss it(them) here. If there is no way to solve the problem(s) in advance of submitting the proposal you will be left with no alternative but to use this subsection to describe in concrete terms how you will overcome it(them) before the application is funded.

WORK IN PROGRESS ELSEWHERE

NSF is not interested in funding an application that proposes something that is already being done – even something similar to what is being done – elsewhere. Your task in this subsection, therefore, is to convince reviewers and NSF program staff that what you propose is not even remotely duplicative of work that is already being done by others.

In addition to insights that writing the *Review of Relevant Literature* subsection will provide, you should have a good appreciation for what members of your scientific network are doing. It is very persuasive if you can credibly make the case here that, not only is the proposed research not duplicative, the projected results are expected to enable the research of others, thereby having 'catalytic impact' on the field. In other words, a dollar invested with you will have more than a dollar's worth of return / impact for NSF because it will likely produce an amplification effect. Naming names is an especially important means of adding credibility to this assertion (see second subsection in the example, below). It is especially compelling if one or more of your colleagues will provide a letter of support attesting to the fact that your expected outcomes will have specific positive impacts on their research.

An important 'fringe benefit' of describing such immediate dissemination to colleagues is that it is highly relevant to the Broader Impacts consideration that pertains to dissemination of new knowledge (see chapter 13).

DEVELOPMENTAL STEPS FOR CHAPTER TWELVE:

1. Write this section after you have written the *Background* section.

OTHER WORK IN PROGRESS BY THE PRINCIPAL INVESTIGATOR

2. List other research projects that are ongoing in your operation.
3. For each project, assess whether or not conflicts with it will be created by funding the research you intend to propose in this application.
4. Resolve any conflicts identified before the current application is submitted.
5. Address conflicts in this subsection that cannot be resolved. How will they be overcome prior to the time of the award?
6. For projects that have no conflicts associated with them, search for sources of complementarity – even synergism – with the project you intend to propose.
7. Emphasize such complementarity / synergism in the way that the first subsection is written.

WORK IN PROGRESS BY OTHERS

8. Use information developed in writing the *Review of Relevant Literature* subsection to identify potential linkages to other investigators.
9. Analyze how the work of members of your scientific network could be enabled by results that you expect to produce.
10. Write this subsection to emphasize lack of duplication with work that is ongoing elsewhere, as well as the potential for catalytic impact on your field (amplification due to your results enabling the research of others).
11. Confirm the potential for catalytic impact by requesting letters of support from colleagues whose work will be facilitated by your expected results.
12. Plan to use immediate dissemination of your results to members of your scientific network as one way to punch the dissemination 'button' in the Broader Impacts section.

EXAMPLE: RELATION TO OTHER WORK IN PROGRESS SECTION

Other Work in Progress by the Principal Investigator

Signaling control of cell quiescence is a primary research focus for the Principal Investigator. As such, it is related to his overall research interest, which is developmental biology. The specific investigations proposed, which are integral to the overall continuum of research, do not overlap with the two other projects that are currently ongoing in the laboratory. One of these deals with signaling through a related receptor and the other focuses on mechanisms that are related to cellular escape from the quiescent state (see *Current and Pending Support* section for more extensive descriptions of each). In fact, what is proposed here is highly complementary to these two other projects, making extensive sharing of technology, reagents and equipment possible, thereby increasing the efficiency of all three projects; no conflict of any kind is anticipated. It also assures that input and constructive criticism from the personnel working on the two ongoing projects will be available to the investigators proposed here.

Work in Progress Elsewhere

The focus of the proposed investigation is on an under-explored area of cell-cycle research. To the best of our knowledge, we are alone in investigating the area proposed here. In other words, what is being proposed is not duplicative of what is being investigated elsewhere. Given the expected impact of the outcomes, it is anticipated that the interest of other investigators will be sparked by the published results, resulting in a subsequent amplification of productivity in this highly significant, new area of research. Thus, at the least, the results are expected to be complementary to what is being done elsewhere and, more likely, to be synergistic. In particular, the expected outcomes are expected to synergize with the work of Jorge Gonzales and his colleagues at the University of Candelabra (see recent review, Gonzales et al., 2001) and that of Margaret Kinch at the Founders Research Institute (Kinch et al., 2003). Both of these investigators have provided letters of commitment that accompany this application. The letters confirm that our expected results will likely enable aspects of these investigators' research. (The plan to directly disseminate results to Drs. Gonzales and Kinch are detailed under the 'dissemination' consideration of the Broader Impacts section.) Through such amplification what is produced in the proposed research is expected to have catalytic impact on the field.

CHAPTER 13

BROADER IMPACTS SECTION

We recommend that you write this section after you have completed after you have completed all of the other parts of the Research Plan. They pertain almost exclusively to the research that will be proposed and will be evaluated, therefore, under the first, Intellectual Merit major review criterion. This section, as its name implies, will speak to the second, Broader Impacts major review criterion.

Unlike many, the National Science Foundation is a socially aware granting agency. For every dollar invested in discovery, NSF wants that dollar to yield social benefits, as well. This is an important part of your application – to the extent that, if the Broader Impacts aspect of it is not comparable in strength and quality to its Intellectual Merit side, it is highly unlikely that your application will be funded, even with a perfect score for Intellectual Merit.

There are five Broader Impacts considerations (see page III-1 of the current *Grant Proposal Guide*). Address as many of the five as you credibly can, using the approaches that are described, below. However, if one or more of the considerations is/are clearly not applicable to your project it is not necessary that you address it/them. Including something that is patently contrived will hurt, not help. If you are unsure of what constitutes a viable Broader Impacts activity, NSF has provided examples at: <http://www.nsf.gov/pubs/2004/nsf042/bicexamples.pdf>. We strongly recommend that you refer to these.

This section of the Project Description should be at least one page long. The activities proposed must be thoughtful and creative. It is the kiss of death to offer what appears to be either 'canned' or 'tacked on.'

While it is essential that meaningful activities be proposed, they cannot be of such a scale that they will interfere with your capacity to conduct the research that is proposed in the other parts of the Project Description. Thus, to the greatest extent possible, propose activities that aren't going to take that much additional effort to implement – i.e., they should be intimately linked to and, ideally, grow out of the research that is proposed.

As with the parts of your proposal that pertain to Intellectual Merit, empty generalities should be avoided in this section. Enough specifics must be provided to give reviewers and program staff (both will evaluate this section of your proposal) a clear idea of what is being proposed. Program staff will focus especially on integration of research and education, as well as on integration of diversity.

ADVANCEMENT OF DISCOVERY AND UNDERSTANDING WHILE PROMOTING TEACHING, TRAINING AND LEARNING

Grant Proposal Guide: *"One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives."*

One cannot read the quote in the textbox, above, and not appreciate the importance that NSF places on the integration of research and education. This aspect of Broader Impacts is such a critical issue with NSF that, in our opinion, you should not regard this consideration as optional; it is mandatory that you address it, in our view. There are predictable things that won't count for much in terms of creativity but should definitely be included, anyway. We refer to strategies such as including the results of your research in your lecture material, or employing undergraduate and graduate students in your research enterprise. The proposal here to employ students should be accompanied by a line item for that purpose in your budget. Otherwise, such an assertion will be totally lacking in credibility.

So how do you inject creativity here? Let's go back to the employment of undergraduate students. Read the second sentence in the textbox again: ... infuse education with the excitement of discovery ...' So, rather than just giving them purely menial tasks you will additionally give them small research projects of their own. In addition, you will give them the opportunity to present their results at meetings of your research group and, possibly, at scientific meeting to which you would propose to take them. If you include the latter strategy, make sure that you include that activity in your budget. You would also propose to evaluate the impact that such exposure to research would have on their career decisions (see prior discussion of evaluation in chapter 10).

Now let's revisit including research results in your lectures. As noted above, that statement alone wouldn't count for much. To take that activity to a higher level you might propose to meld presenting such results with an invitation to become involved in your research program, perhaps even with a budgeted stipend. In other words, you would be using your research as a 'magnet' to attract and motivate students to become involved in ways that could lead to career opportunities that they might not otherwise consider. Again here, you would propose to evaluate the impact of such a strategy.

Another example might be to propose partnering with one or more local science teachers to bring aspects of your research to their science classes. You could create projects based on your research that would be pursued in the science classes. Participating students would report their results to their classmates and, perhaps, to members of your research group while visiting your institution. Such activities would again be an example of using the excitement of discovery to interest / excite students and potentially influence their career decisions. An evaluation plan would be a part of the proposed activity. Were you to design such an 'export' project you would deliberately keep it small – perhaps one high school or only one science class – rather than targeting so many that the project would be seen as unrealistic and in potential conflict with the research proposed in other parts of your application.

In our opinion, the preceding three examples of integrating research and education would likely

be seen as creative and innovative by both reviewers and program staff.

INCLUSION OF UNDERREPRESENTED GROUPS

This is the second Broader Impacts consideration that is of particular interest to NSF program staff. The quote in the textbox, below, substantiates that it is of great importance to NSF.

Grant Proposal Guide: “Broadening opportunities and enabling the participation of all citizens, women and men, underrepresented minorities, and persons with disabilities, are essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.”

Therefore, as long as what is written appears to be a natural and creative outgrowth of the overall project, you should address this consideration, in our opinion. If what you write here comes across as a contrived and/or disingenuous it will hurt, not help, your competitiveness.

A common mistake is to assume that this consideration pertains only to minority persons. While they are definitely included, this part of the *Broader Impacts* section applies to more than minorities – to even more groups than those that are listed in the textbox, above. For example, rural persons represent an important underrepresented group in terms of science and engineering. Socio-economically disadvantaged inner-city persons represent another.

Another common mistake that many applicants make is to simply make a general statement that they will ‘make every effort to include underrepresented persons in the proposed research.’ Such an empty promise is of no value. First, you must clearly state what group or groups you will proactively target. It is better to focus on a specific group, in our experience, rather than to try to include underrepresented persons of all kinds. Whatever the group selected, it should become the subject of the objective that you have for this consideration, e.g., to influence the career decisions of such individuals by introducing them to research. Second, how will you target them, i.e., how will you identify, recruit, and retain such persons? In other words, a proactive plan is needed that also includes an evaluation piece that will enhance (formative evaluation) and quantify (summative evaluation) the effectiveness of your efforts.

Let’s use undergraduate rural students as an example. What creative strategy would you use to identify candidates? One way would be to have your institution’s Admissions Office help you to identify students at your institution who are graduates of rural high schools. If feasible, a letter of commitment from that Office should accompany your application. Having such a letter would validate that part of the plan, preventing it from being seen as an unsubstantiated assertion.

Tip: Letters of commitment that validate programmatic plans are very persuasive to reviewers. They confirm that you really intend to undertake the proposed activity and that the approach will be accepted when the time comes to implement it.

If the Admissions Office either could not or would not help, directly targeting seniors through career days at one or more rural high schools would be an alternative, but more labor-intensive, approach. Such a tactic should be supported by letters from appropriate authorities at the participating schools. Enticing descriptions of career opportunities and what students could gain

through the curriculum at your institution would be offered, together with information about participating in your research program. If participation in your research were associated with a stipend it could enable university attendance for students that might not otherwise be able to afford it. An invitation to contact you, together with your contact information, would be distributed at such career days. Another strategy for identifying rural students would be to volunteer to speak to student organizations and clubs at your institution that have a rural focus. Your research program and what could be gained by participating in it would be the subject of such presentations. Again, you would distribute contact information.

At the next, recruitment level, you might propose to attract students by approaching them directly, i.e., as follow-up on students who make use of the contact information that was distributed earlier. Cleverly packaged offers of employment and/or research experiences would be offered. The credibility of this approach would be increased by accompanying the description of whatever the recruitment strategy is with objective evidence that it works: you have used it before and were successful in attracting one or more students, each of whom would be named in the application.

Tip: Successfully piloting things like identification and recruitment strategies greatly increases the credibility of related activities.

As to your plan for retaining students who become part of your research program, you could offer to pay them, with a line item in the budget to cover that cost. Not including such costs in the *Budget* would detract from the credibility of your plan – unless you could refer reviewers to an alternative source of funds that would be described in the *Budget Justification* for that line item. Such an alternative source, e.g., departmental funds, would be offered as tangible evidence of institutional commitment to your project. Another retention approach could be to offer course credit for pursuing a project related to your research program. To make such a strategy credible you would accompany your proposal with a letter of commitment from the appropriate authority approving the award of course credit.

Both formative and summative evaluation would be applied to your efforts to include and influence the career decisions of rural students.

ENHANCEMENT OF INFRASTRUCTURE FOR RESEARCH AND EDUCATION

This consideration is not as intuitively obvious as the former two. We recommend, therefore, that you refer to the examples of activities that NSF would consider relevant (see URL listed at the beginning of this chapter). As you will see, developing a course or laboratory syllabus isn't the kind of infrastructure that NSF has in mind. One approach that would be relevant would be to request a new piece of equipment in your budget that you would share with others. Obtaining letters that testify to the need for that piece of equipment would be essential to the success of such an approach. An alternative would be to include funds in your budget to upgrade an existing piece of shared equipment. The upgrade would have to have relevance to the research that you propose in your application; however, that same upgrade would also benefit and enable the research of others, which is the point that you would make here. Another possibility is to use your research program as the centerpiece for a new network that you would propose to create – one that would increase interaction and cooperativity between academic, industrial and governmental investigators, both domestically and internationally. Having an evaluation plan asso-

ciated with such an effort that would maximize its efficiency and effectiveness would increase its attractiveness to reviewers. In addition to increasing interaction and collaboration, you could tout such a network, once created, as having the potential to contribute to accelerated dissemination of research results, which is the subject of the next Broader Impacts consideration.

BROAD DISSEMINATION OF RESULTS

NSF expects you to share the outcomes of your research – data and more tangible products, such as newly created resources (e.g., a software program), inventions and reagents – as quickly as possible. Publishing in journals and speaking at meetings must be part of your response to this consideration, but it shouldn't be all that you offer. Having additional creative strategies for rapid dissemination, such as the network of investigators referred to above, is essential. Even that isn't all that is relevant here, which is a point that many applicants overlook.

In addition to the more obvious approaches described above, you can score points here by disseminating information to target audiences that might not immediately come to mind – like 'the public.' How you creatively propose to target an unconventional audience like, 'the public,' can be very impressive to reviewers and program staff. For instance, service clubs, such as Kiwanis International and Rotary Clubs, need noon speakers for their weekly meetings. Packaging your research results, together with information about your field, in such a way that it would be palatable as a 30-minute presentation to such groups would be the kind of unexpected, innovative approach that would likely impress reviewers. It wouldn't take that much time to implement such a program, which would effectively educate a segment of the public that is proactive in society. Pre- and post-presentation questionnaires could be used to evaluate the effect of the program on knowledge of, and attitudes about, the content presented. A follow-up questionnaire six-months later could be used to evaluate retention. Credibility of such a plan would be increased by accompanying the application with at least one letter of commitment from a service-club president expressing interest in the program. Such an educational approach could also have applicability to the next consideration, benefits to society.

BENEFITS TO SOCIETY

The most obvious approach to punching this 'button' is to describe credible ways in which your expected results are likely to have applicability as a whole. For example, if one of the major outcomes of your project were a better means of reinforcing steel, extending that to structural applications where that would be important is very straightforward; public safety would be improved in ways that you would describe. Not so obvious would be things like the influence that your results might have on the making of public policy or how your results could be extended to help members of society better understand and appreciate research programs supported by NSF. For the latter reason, something like the service-club program described under the preceding consideration would have equal applicability here.

DEVELOPMENTAL STEPS FOR CHAPTER THIRTEEN:

1. Understand that this part of your application, which addresses the second major review criterion, Broader Impacts, must be just as strong as the part that pertains to research (Intellectual Merit major review criterion) if you expect your application to be competitive.
2. Review the example activities at <http://www.nsf.gov/pubs/2004/nsf042/bicexamples.pdf> to become aware of what kinds of things are appropriate for each of the considerations under the Broader Impacts major review criterion.
3. Include only specifics in this section. Avoid the use of empty generalities.
4. Appreciate that the Inclusion of Underrepresented Groups consideration pertains to more than underrepresented minorities.
5. Inventory infrastructure needs at your department / institution. Assess whether it is realistic to address any of those needs through your application.
6. Assure that the Broader Impacts activities proposed are realistic in scope, i.e., that they aren't of a magnitude that they conflict with the research that is proposed, and that real plans are associated with them.
7. Pilot test things like recruitment plans on which the rest of an activity is dependent. These must be seen by reviewers as effective for the overall activity to be seen as credible.
8. Review how to prepare an appropriate evaluation plan by reviewing NSF's publication, *The 2002 User-Friendly Handbook for Project Evaluation*, which can be downloaded from <http://www.nsf.gov/pubs/2002/nsf02057/start.htm>.
9. Make sure that you provide sufficient detail in this section that reviewers and program staff will fully appreciate and be able to evaluate what is being proposed.
10. Address as many of the five Broader Impacts considerations as you credibly can. Be certain, however, to address the two that will be scrutinized closely by NSF program staff, Integration of Research and Education and Inclusion of Underrepresented Groups.
11. Understand that activities proposed in this section cannot appear 'canned' or 'tacked on.' While predictable activities, like dissemination through publication and speaking at meetings, must be included, what is proposed must be creative and original.
12. Obtain and include with your application letters of commitment that confirm the participation of other individuals and/or institutions. They are essential to make activities that are dependent on such participation credible.
13. This section of your application should be at least one-page long.

CHAPTER 14

BUDGET AND BUDGET JUSTIFICATION

The *Budget* and *Budget Justification* are anachronisms in most grant proposals. Applicants work diligently on all other parts and, then, when they come to the *Budget* and *Budget Justification*, they delegate preparation of them to a secretary or administrative assistant. After the award is made they wonder why their budget request was cut. If you follow the tips and strategies that follow, in our experience it is unlikely that your request will suffer that fate.

GENERAL CONSIDERATIONS

A detailed budget for each year of requested support must be prepared. The usual duration of a standard NSF research grant is three years. However, it is possible to request as many as five years. If either four or five years are requested there must be compelling scientific justification provided for such a request in the *Budget Justification*. In our experience, if more than three years are contemplated, it is extremely helpful to have the relevant Program Officer informed and accepting of the idea before the application is submitted.

There are two levels of budgetary review. The first is by your peers – reviewers who are sufficiently experienced with the kind of research proposed that they know what it should cost. Reviewers make budgetary recommendations to NSF program staff as part of their evaluation of the proposal. The second level of review is by program staff: how does the quality of the project and its programmatic relevance relate to the priorities of the program? Based on all such appraisals and recommendations, possibly complemented by negotiations between the applicant and an NSF Program Officer (see discussion of negotiated budgets, below), an amount is awarded for a specific scope of work. All of these potential levels of review must be taken into consideration when formulating your budget request.

The research that you want to do should drive the budget, never the other way around – unless either a formal or operational cap has been placed on the amount that can be requested. A formal cap could be found, for example, in the program solicitation to which you are responding. With respect to an operational cap, you might be made aware of one through discussions with the relevant Program Officer: operationally, the program doesn't fund over a certain amount. If you have either kind of authoritative feedback, you must offer a scope of work that can be accomplished within that capped amount. If no such restriction is identified you should design the project to accomplish your objective, prepare a hard-nosed budget, and then propose what the research will cost – nothing less. 'Low-balling' a budget request as a means of increasing the likelihood that a proposal will be funded is not only wrong-headed thinking (it doesn't help, in our experience), it is potentially dangerous to your subsequent fundability; what happens if the request is granted? Inability to complete all of the research proposed because of self-inflicted budgetary shortfalls will almost surely undercut the success of your subsequent renewal application.

***Fact: Most budgetary cuts are the fault of the applicant,
not the reviewer!***

There is a myth in proposal writing that reviewers will invariably cut something. The myth exists because budgets are so frequently cut. However, in our experience, such cuts do not occur because of an innate desire on the part of reviewers to trim the budget but, rather, because of *lack of adequate justification of what is requested*. “Adequate” can be defined as sufficient detail to justify the need for and appropriateness of each budget request. Thus, as the textbox, above, emphasizes, most cuts are actually the fault of the applicant, not the reviewer. In our opinion, as long as you stay within the three-page limit that NSF sets for the *Budget Justification*, there is no such thing as too much budgetary detail.

Grant Proposal Guide: “The amounts requested for each budget line item should be documented and justified in the budget justification.”

A common mistake made by applicants, in spite of the very explicit directive quoted in the textbox, above, is to not provide line-by-line justification for all requests. Without such justification it is understandable why cuts are made; *you can’t just ask for money, you have to justify the need for it*.

In addition to extensive justification, everything requested in the *Budget* must be fully credible. You should never propose anything that you cannot fully justify in the context of the proposal because, once any part of the request, no matter how small, is viewed as lacking credibility everything else becomes suspect. Under such circumstances, major cuts can – and probably will – occur in parts of the budget that should never have become an issue.

With respect to credibility, remember that you can lose it by proposing *either* too much or too little, and that once *any* figure becomes suspect, *all* will be scrutinized more closely. What you must strive for is a budget that is so well justified, line by line, that it will be accepted as credible by your reviewers without discussion.

TIPS AND JUSTIFICATION STRATEGIES FOR SPECIFIC LINE ITEMS

Compared to FastLane’s budget form, the SF 424 *Research & Related Budget* component used to submit budgetary information through Grants.gov differs slightly with respect to the inclusion and lettering of some sections. Because the former approach is used much more frequently by applicants to NSF we have chosen to present this chapter as though the budget will be submitted through FastLane. If you will be using Grants.gov to submit your proposal, letter the subsections in accordance with the SF 424 instructions and use the section titles given in this chapter to transpose the instructions, below, as appropriate.

Regardless of the preparation / submission system used, each line-item request in the *Budget* should be identified in the *Budget Justification* by its section and subsection designation, e.g., as B.1 – Other Personnel: Post-Doctoral Associates.

Details related to what can and cannot be proposed are contained in the *Grant Proposal Guide*, chapter II, Proposal Preparation Instructions (pages II-10 through II-17), and NSF's *Award & Administration Guidelines*, chapter V, Allowability of Costs (pages V-1 thru V-12). The latter can be downloaded from: http://www.nsf.gov/pubs/policydocs/pappguide/nsf08_1/aag081print.pdf.

Salary and Wages, Section A: Senior Personnel

This section is where you list senior personnel – faculty – at your institution who will be intellectually involved in the research. Refer to the definition of senior personnel offered by NSF on page II-36 of the *Grant Proposal Guide* and in chapter 16 of this *Workbook*. The names entered here should be exactly the same as they appear at other locations in the application.

Your name should be listed first as the Principal Investigator. Co-Principal Investigators and other faculty members (e.g., co-investigators and collaborators) without whom some part of the project would become problematic should be listed next, in alphabetical order.

Post-doctoral fellows at your institution can be included in this section, but only if they hold a faculty position, either tenure or non-tenure track.

A *Biographical Sketch* for each person who is named in this section must accompany the proposal.

Only those who have a legitimate and substantive intellectual role in the research should be included. The litmus test to use is what will be written in the *Budget Justification* about the person's role in the project. If you can't provide a specific and credible scientific reason why a person has been included – for example, because the person can provide an essential kind of expertise that you and others in the Senior/Key Person group can't provide – the individual in question should not be included. Thus, for example, no one should be included as 'window dressing,' i.e., because of their prominence, especially if that person's expertise overlaps someone else's on the team who is less well known. Including such a person is usually a strategic mistake, because it can undercut the perception that the less prominent investigator is capable. That is a particularly serious mistake if the less-prominent person is the Principal Investigator. Nor should anyone be included out of respect, e.g., a Beginning Investigator's former mentor who the applicant would like to honor and/or acknowledge. Including such a person in our experience can give reviewers the perception that a Beginning Investigator (defined on page I-7 of the *Grant Proposal Guide*) is still dependent on the former mentor.

The most vulnerable position in this part of the *Budget* is the 'TBA' (To-Be-Appointed; also called TBR, To-Be-Recruited). Such positions are especially concerning to reviewers if they are associated with expertise without which some part of the Research Plan would become problematic. For that reason, it is our recommendation that you not consider submitting a proposal until you have the full complement of senior personnel in place. Additional discussion of this point is included, below, under section B.

NSF considers that faculty members are paid by their institution, in part, to do research. Thus, with a few exceptions that are listed in the *Grant Proposal Guide* (page II-11), it is not permissible to request salary support from NSF that either replaces or augments institutional salary support. For those who have nine-month appointments it is acceptable to request up to two-ninths of the base salary during the summer months, based on percentage effort during that time. If you have more than one NSF grant the summer-salary request can be divided among them but cannot exceed the two-ninths maximum. If you have an appointment at a university or research

institute for which no 'hard-money' salary is provided, i.e., you are supported entirely by grant funds ('soft' money) you can request support commensurate with effort across the entire year, in which case effort and salary should be requested under "calendar months." If you make such a request, be certain to describe the nature of the appointment in the related part of the *Budget Justification*.

When summer-salary support for an individual is requested in the *Budget*, a common mistake made by applicants is to forget to tell reviewers about time that will be invested in the project during the academic year. Don't make that mistake because, if you do, it will appear that you intend to work on the project only during the summer. Overcome this problem by telling reviewers in the *Budget Justification* how many academic person months will be devoted to the project, even though no salary support for those months is requested.

It is possible to submit a *Budget* that does not include the base salaries and salary requests for members of the Senior Personnel set (*Grant Proposal Guide*, page 11-12). If this course is taken, the box on the Cover Sheet that denotes that the application contains proprietary or privileged information must be checked. A separate document that will be seen and used only by members of the NSF program staff must also be submitted as a single-copy document on which complete salary information is provided (*Grant Proposal Guide*, Proprietary or Privileged Information, page 1-4). Reviewers and other non-governmental personnel will not have access to such information. However, NSF does not guarantee that.

Senior personnel from other institutions who are involved in the project are not reported here. They are treated separately, in subsection G.5 (see discussion later in this chapter).

EXAMPLE OF SENIOR PERSONNEL JUSTIFICATION

A. SENIOR PERSONNEL:

A.1 Sheldon, Connie J., Principal Investigator: 2 summer person months, for which salary is requested. In addition, during the academic year Dr. Sheldon will invest 3 person months, for which no salary is requested. Her scientific responsibilities will be the design and implementation of all structural biological investigations. She will supervise one spectroscopy technician and one post-doctoral research associate (Mallaby – see Other Personnel). She will additionally oversee all other aspects of the research, dissemination of the results, and the two undergraduate students employed by the project (see Other Personnel). She will also be the primary evaluator of activities that have been subcontracted to Dr. James Cantor at the University of XXXXXXXX (see section G.5, below), thereby ensuring that they are implemented in a timely way that is coordinated with complementary research performed at the primary performance site.

A.2 Jennings, Alfred F., Co-Principal Investigator: 1 summer person month, for which salary is requested, and 2 academic person months for which no salary has been requested. Dr. Jennings will head the proposed molecular biological investigations, especially those associated with Specific Aim #2. He will work closely with the PI to design and implement experiments in this area, interpret resultant data and contribute to publication / dissemination of results. In this capacity he will supervise a full-time molecular biology technician and one graduate student.

Salary and Wages, Section B: Other Personnel

The definition of Other Personnel is located in the *Grant Proposal Guide* (page II-36). As with the preceding section, only Other Personnel from your institution should be included here. Those at other institutions are treated separately (see subsection G.5, below). Examples of the kinds of personnel reported here are post-doctoral fellows not listed in section A, graduate and undergraduate students, technical personnel, and some kinds of clerical / secretarial personnel.

The "some-kinds-of" qualifier in the paragraph, above, is applied to clerical / secretarial personnel because most would be considered 'general-purpose,' a category that is usually funded by indirect, not direct, costs (see discussion of indirect costs, below). Thus, even if such persons are doing things that are related to the proposed research, such as preparing purchase orders and/or manuscripts, they cannot not be included in the *Budget*. Administrative personnel can only be included if they are dedicated to some facet of the research, such as recruitment of subjects. To emphasize that role, such an individual should be given a research-related, not general-purpose, title (e.g., 'Project Coordinator' or 'Subject Coordinator,' rather than 'Secretary' or 'Administrative Assistant'). With respect to justifying a request for personnel who might otherwise be considered 'general purpose and, therefore, not allowable, more guidance regarding what should and shouldn't be included can be found in section F.6 of Office of Management and Budget Circular A-21 (http://www.whitehouse.gov/omb/circulars/a021/a21_2004.html).

The major difference in how Other Personnel requests are made, compared to Senior Personnel, is that the individuals are not named in the *Budget*. For individuals classified as "other professionals" and post-doctoral fellows not named in section A you indicate the total number of individuals requested, the total amount of effort (person-months to the nearest tenth) and the total amount of support requested under each category. The names and rate of pay for each, together with a description of each individual's role in the project should be included in the *Budget Justification*. Because such individuals will not have a *Biographical Sketch* accompanying the proposal you should also summarize any credentials that are of relevance and importance to the project. An example of the kind of justification that is needed for such individuals is given at the top of the next page. For graduate and undergraduate students, as well as administrative and technical personnel, only the total number of full-time person equivalents (to the nearest tenth) and the total amount of the request is required for each category; effort in person months for each individual is not required. Nor is it necessary to name them and provide rates of compensation in the *Budget Justification*. However, if there is room in the *Budget Justification* to provide such information, i.e., it won't cause you to exceed three pages, we recommend that you provide it together with a description of each person's role in the project.

As noted earlier, TBA (to-be-appointed) positions are especially vulnerable to being cut. They are particularly vulnerable if the duration of support requested is relatively short, e.g., two years, because reviewers are likely to conclude that there just isn't enough time to recruit and train someone. Even on three-year projects, if no name is included in the *Budget Justification*, reviewers have no 'guilt' recommending that the request be cut; no one will be put out on the street. A much better strategy is to figure out some way to include the name of a real person. For example, one approach would be to ask your department / institution 'invest' in your research project by providing the salary of a needed person until you can assume responsibility for it using grant funds. Another strategy, if you are a Beginning Investigator, would be to use part of your start-up funds to hire someone who would then be switched to the grant after it is funded. Either of the two preceding approaches can also be highlighted elsewhere in the application as tangible evidence of institutional commitment.

EXAMPLE OF 'OTHER PERSONNEL' JUSTIFICATION

B. OTHER PERSONNEL:

B.1 Mallaby, Curtis R., Post-Doctoral Research Associate; 12 person months, for which \$43,000 in annual salary is requested. Dr. Mallaby will be working closely with the PI to conduct and interpret the results of all interviews that are designed to identify sources of environmental pollutants. These are expected to total 250-300 interviews per year, some at other institutions that have agreed to participate (see accompanying letters of support). He is superbly qualified for this role, having done his post-graduate training with one of the leading figures in the field, Prof. Seymour Cantrell. One of Dr. Mallaby's publications with Cantrell (*Journal of Environmental Analysis*, 2005: 74, 296-312) is considered a landmark in the field. Dr. Mallaby has had both formal training and practical experience in conducting the kinds of investigative interviews that are proposed in this application. In addition, he is culturally sensitive to the subjects with whom he will be dealing, being a member of the same minority group that many of them are.

Section C: Fringe Benefits

The accounting practices of almost all research organizations allow applicants to claim fringe benefits as a direct cost. Check to make sure, but it is almost a certainty that you will be able to do so.

If you are requesting fringe benefits, make sure that the amount is commensurate with the salary request that you are making and the category of the employee. For example, including a contribution to retirement for graduate-student fringe benefits would not be appropriate in most cases. If it were appropriate, justification of that fact based on institutional policy would have to be included in the *Budget Justification*.

Determine from the appropriate administrative authority at your institution (e.g., sponsored-programs office) whether you should either use a set percentage to request fringe-benefit support for each personnel category or break out actual costs (e.g., medical, retirement, etc.) for each person for whom salary support is being requested.

Be sure to provide a description in your *Budget Justification* of how fringe benefits have been calculated for each personnel category.

Section D: Equipment

Grant Proposal Guide: 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.

Despite the name of this budgetary category, you should think of it as being appropriate only for requesting major equipment. As is noted in the text box, above, "equipment" is defined by NSF as anything that costs more than \$5,000 and has a useful life of more than one year. That definition is superseded by your institution's definition, should it differ. Whatever the operational definition is, it is important that you be aware of it. Why? Because items that cost less than the

defined value don't qualify as "equipment." Therefore, most such items can be requested under subsection G.1, Materials and Supplies, which is much less vulnerable to cuts, in our experience, than the Equipment category is. Computer hardware that costs less than the operational definition of equipment and is dedicated to the project, i.e., is not general purpose (see below), should be requested under line-item G.4, Computer Services (see the GPG, page II-14).

There are two kinds of equipment: special-purpose, which can only be used for research, and general-purpose, which could have other uses (examples of the latter kind include, but are not limited to such things as computers, automobile, and office furniture / equipment). Equipment that will have general-purpose uses is not eligible for inclusion in the *Budget* of NSF research grants. For example, a large photocopier that would be used as part of your dissemination plan, but would also be used for general-purpose photocopying would not be allowable. To make such a piece of equipment eligible for inclusion you would have to provide a compelling argument in the *Budget Justification* as to why and how it would be dedicated to the research project and not used for other purposes. As with general-purpose personnel, additional insight regarding what can and cannot be included can be found in section J.18 of Office of Management & Budget Circular A-21 (http://www.whitehouse.gov/omb/circulars/a021/a21_2004.html).

The Equipment category is vulnerable to cuts because reviewers have a tendency to consider provision of equipment as an institutional responsibility – part of institutional support for the research project. Because of the relative vulnerability of this category, particular thought and effort must be invested in justifying equipment requests. For example, equipment requested on a grant must be directly related to the research that is proposed. That point needs to be made strongly in the *Budget Justification*. Another point that must be made there is that similar equipment is not available to you within your department or, for that matter, your institution.

Equipment requested should be complementary to what has already been provided by your institution. In other words, if you are just getting started, you should not expect NSF to provide all of the equipment needed to set up your research program. That is your institution's responsibility. Whether you have been provided a basic equipment package will be used as one means of assessing institutional commitment – or the lack thereof – to you and your research program.

Do not forget to include in the purchase price of equipment the costs of any modifications, accessories, or auxiliary apparatus that are required to make it usable. Shipping, installation costs, tax, and the cost of in-transit insurance may be eligible for inclusion in the purchase price, depending on the policies of your institution. Make certain that you include them, if they are. Service contracts and other costs of equipment maintenance/repair should not be requested and justified in the Equipment section of the *Budget Justification*. Those costs should be included under subsection G.6, "Other," of the Other Direct Costs section.

Willingness either to share new equipment or proposing to upgrade existing shared equipment can decrease the vulnerability of an equipment request, in our experience. Such shared use should be described in the *Budget Justification*. It should be addressed again in the *Broader Impacts* section of your Project Description as an example of how funding your project will positively impact institutional infrastructure.

If you need a set of something that has an aggregate value that exceeds the operational definition, don't request it as a set; purchase each piece individually. Of course, that approach can't be extended to the purchase of a large piece of equipment, component by component, e.g., separate purchases of the wheels, the frame, the motor, etc.

Success in having your equipment request approved is often attributable to anticipating reviewers' concerns and then prospectively providing justification that will overcome such apprehensions. Some of the commonest concerns that reviewers have about equipment requests follow. Knowing what they are will help you understand how to better justify your request.

The Claim of Dedicated Need for Expensive Equipment is False. The mindset of most reviewers, in our experience, is that it is no longer appropriate for an individual investigator to request an expensive piece of equipment for which s/he has only part-time need. Given that fact, if you are going to request such an expensive piece of equipment for which you will not have a full-time need, as noted earlier in this section, you should state that you will share it with other investigators. As noted above, you can use that fact to advantage in the 'infrastructure' part of your Broader Impacts section. As an alternative strategy you can make the case that your need is not part time, i.e., that it has become so great that it is no longer feasible for you to use core equipment or share equipment owned by other investigators. If the latter argument will be the basis for your request, i.e., that you will virtually monopolize the equipment, it is likely that there is an objective means of demonstrating that fact. You probably had to use similar equipment to generate your preliminary data. Create a table, using the log book for that equipment, to summarize your use during that time versus others' use. Include the table with your justification. If you truly do have a full-time need, the data in the table will objectively validate that fact, i.e., that you did effectively monopolize the equipment during the period that you were using it.

The Amount Requested is Not Correct / Inflated. To shore up your request, provide a valid bid as part of your justification, especially for an expensive item. Describe the bidding process and how it resulted in the lowest possible cost. Don't use catalog price as a 'bid,' because it will damage your credibility: reviewers know that almost all institutions receive substantial discounts from equipment vendors. If you have to use the catalog price, reduce it by an amount that is commensurate with the discount that your institution usually receives from the relevant vendor. Get a validating letter of support from a purchasing agent.

The Purchase Price is Not Appropriately Prorated. If an expensive piece of equipment has a life expectancy of 10 years, why should a three-year grant pay the full cost of purchase? If you are lucky enough to have an alternative source of support for acquisition of equipment (e.g., another grant, start-up funds, endowment money), proposing to cost share the purchase of a piece of equipment is a very powerful and persuasive means of increasing your budgetary credibility. For example, you would request 30% of the purchase price in the example given. The 70% contribution could then be entered under section M of the *Budget, Cost Sharing*.

The Requested Equipment is More Sophisticated than What is Needed. When applicants request unneeded 'bells and whistles' on a piece of equipment they are often caught out. Your reviewers will be peers who will know what is needed and what is not. If they suspect you of making an excessive request, one of two things will usually happen. Either the reviewers will become sufficiently annoyed to recommend cutting the entire piece of equipment from your budget or, at the least, will cut you back to the lesser model that is justified. Even if the second scenario is the outcome, you potentially lose, because your credibility will be damaged and other parts of your budget request will become suspect. To allay such concerns you need to include in your justification why the characteristics of the requested model are necessary to accomplish the proposed research, i.e., why what you have requested is appropriate to the need and nothing more.

Existing Equipment Isn't Really Worn Out. The mindset here is that the applicant can still get along with what s/he has, i.e., that the claim that existing equipment is no longer reliable

is exaggerated. Reviewers' concerns about replacement equipment are often exacerbated by the perfunctory justifications that applicants provide ("Replacement of worn-out equipment: \$????"). To decrease the vulnerability of such a request, use the same strategies to justify replacement equipment that are listed above, but with an added wrinkle: Get a letter from the company that made the old equipment certifying why it is worn out (e.g., lack of replacement parts, inability to provide a service contract, no longer providing repair service, etc.). Vendors will often provide such support, especially if you plan to purchase the replacement equipment from them. Include such a letter with your other letters of support. Refer reviewers to it in your justification.

EXAMPLE OF 'EQUIPMENT' JUSTIFICATION

D. EQUIPMENT

Centrifuge (Hettich Rotanta [Advanced Model]), Refrigerated, Large Capacity, with Swing-Head Rotor: \$2,088 (20% of \$10,440 [\$9,877 + \$563 shipping]). This centrifuge is required to conduct experiments described under each of the three aims, all of which require a bulk-processing step that has an extended run time. Estimated use over the course of the project will be 4-6 hrs daily on a 7-day-a-week basis, which is validated by the accompanying usage table that was generated during our preliminary studies. The centrifuge used for those studies is the only one to which the PI has access. It is used extensively by NSF-supported investigators in two other departments. During the time required to generate our preliminary data many of those investigators had to postpone use of this shared centrifuge, which negatively impacted their programs. To help alleviate such problems in the future, the centrifuge requested here will be made available as research infrastructure, i.e., shared with other investigators (see *Broader Impacts* section of the Project Description). In addition to conflicts related to usage, the centrifuge is located in another, unconnected building. This makes our use of it hazardous with respect to transport of samples to and from its location. The price of the centrifuge was established by competitive bid, the lowest one of which accompanies this proposal. It has an expected useful life of 15 years. Therefore, we are requesting 3/15ths (20%) of the cost in this 3-year proposal. The remainder will come from the PI's endowment funds (see accompanying letter of commitment from the Endowment Association).

Section E: Travel

Travel, including lodging and subsistence during the times of travel, can be requested on an NSF grant providing it contributes to the project's potential for success in a relevant way. How it will contribute needs to be described in the *Budget Justification* (see below).

This is one of the few sections of your *Budget* for which reviewers will often have a predetermined figure in mind. Unfortunately, this amount is usually much less than the real cost of proposed travel; if you haven't experienced the actual cost of attending a 3-day meeting in an urban setting lately, believe us, it is a significant amount of money. Therefore, unless you either have an alternative source of travel funds or are willing to re-budget from another category, you need to provide the kind of objective description in your *Budget Justification* that will persuade reviewers to recommend your full request for travel funds.

All costs for the travel, housing and *per diem* allowance of consultants should be included here. Consultants' *per diem* costs for food and lodging should be those allowed by your institution, a

point that should be made in the justification here. Subsection G3, discussed below, should include only consultant compensation.

There are two categories of travel, "domestic" and "foreign." Each is a separate line item and should be justified separately, therefore, as 'E.1 Domestic Travel' or 'E.2 Foreign Travel,' respectively. Although it is counterintuitive, travel to Canada and Mexico is not considered to be foreign. It is classified as domestic, along with travel within the fifty states, to U.S. possessions and to Puerto Rico. Foreign travel – to everywhere else – is particularly in need of compelling justification (see below).

Proposed air travel should be economy class and on a U.S. carrier, if possible. If a foreign carrier must be used, the reason(s) why should be included in the *Budget Justification*.

This part of the *Budget* should be used to support the *Broader Impacts* section of your proposal. For example, taking students to a professional meeting is a means of integrating research and education, as well as a way of helping to disseminate results. Request the necessary funds here and describe the implications of doing so in both the *Budget Justification* and in the *Broader Impacts* section of your Project Description.

Reviewers' concerns about travel can usually be overcome with strong, detailed justification. Again here, anticipate their concerns – think like a reviewer:

Where Do You Propose to Travel and Why? Applicants commonly make the mistake of not specifying to where they will travel. "Travel for the PI and one postdoc to one national meeting, each." is not adequate. Most of the time, travel on research grants is to a specific societal meeting that has been chosen because of the opportunity it provides to gain from the experience. You should specify which meeting you expect to attend and succinctly explain to reviewers why it has the potential to contribute to success of the project. For example, attendees represent: the best audience for dissemination of recent results; the most qualified investigators to offer constructive criticism and provide pertinent feedback; the best sources for high-quality post-doctoral scholars; etc. In addition, this forum offers you the greatest potential to keep up with the latest developments in your field, i.e., before they are published. It is not hard to provide such justification, but few applicants provide it.

Who Will Travel and Why? "Travel for members of the research team to ..." is not sufficient justification, either. Greater objective detail is absolutely essential because there is no 'God-given' right to travel under the auspices of an NSF research grant. You, as the PI, are the easiest to justify. But is it necessary in terms of tangible return to the project for all of the Co-PIs to also attend the same meeting? Should each of them go to a different meeting with the plan that each would then inform other members of the team of what transpired there? If you have such a plan it should be described here as a way of getting more positive impact from the travel dollars requested. Should your post-doc go? Absolutely, because you would justify this on the basis of disseminating his/her results, contributing to scope and breadth of his/her grasp of the field, and as an opportunity for you to network him/her with your senior colleagues. How about graduate and undergraduate students? Certainly, but only one or two each year. The justification would be to expose them to the excitement of a scientific meeting, thereby helping to influence their future career decisions and, if they are at a stage when they have something to report, to disseminate the results of their research. As noted earlier, you would refer to reasons for taking these students in the Broader Impacts section of your Project Description when you consider integration of research and teaching.

What Will It Cost and Why that Amount? Most societies have their annual meetings scheduled years in advance. Let's say that you plan to submit an application for three years of grant support. Call the society that will sponsor the meeting you have decided to attend. If you don't know the locations already, ask where the meeting sites will be for the next three years. From a travel Web site or your travel agent, determine what a full-fare coach ticket to each of the convention cities will cost. Why full fare, which is undoubtedly higher than the cut-rate fare that you will use? Because that meets the NSF criterion of traveling in economy class while, at the same time, it almost surely covers any increases that may occur between the time that the application is submitted and the travel funds are used. While you are on the line with the society also ask what the registration fee will be, as well as what the room rate will be at the convention hotel. Also ask whether or not transportation to and from the airport has been arranged and, if so, what those costs will be. If they cannot provide that information for you, make a reasonable estimate, based either on calls to cab companies in the convention cities or by visiting relevant transportation Web sites. You can readily find out what your institution's *per diem* allowance is for meals and lodging. By taking this 'cost-accounting' approach, you can come up with a very accurate and *unassailable* estimate of what the cost of attending each meeting will be. With such itemization, providing that you have convincingly justified why it is important to the project and/or NSF for the specified individuals to make the trips, how can reviewers argue against recommending approval of the request?

EXAMPLE OF 'TRAVEL' JUSTIFICATION

E. TRAVEL

Travel to the annual meeting of the American Society Nanotechnology, which will be held in Denver, is requested for the PI, Dr. Kendell. Funds for the post-doctoral research associate, Harvey Collins, to attend the meeting are also requested. This meeting is an important scientific venue related to the subject of this proposal. Results of the proposed research will be presented at the meeting. Constructive feedback will also be obtained from colleagues and it is expected that new ideas and collaborations will be developed as a result of the travel. The cost of attending has been derived by a cost-accounting approach based on actual quotes: coach-fare ticket = \$540; convention hotel rate \$90/night X 4 nights = \$360; transportation to & from airport = \$86; university per diem = \$87/day X 4 days = \$348; meeting registration = \$200. Total per individual = \$1534 X 2 individuals = **\$3,068**.

Travel to the National Nanotechnology Consortium in Cincinnati is requested for one Co-Principal Investigator, Dr. Hubert. Funds are also requested for one of the graduate students, Gerald Ellis, to accompany him. Mr. Ellis is in the last year of his training and is ready to present the results of his dissertation research. This meeting is a second important opportunity to disseminate results of the proposed research and to gain from interactions with colleagues at different institutions. It is also a chance for Dr. Hubert to introduce Mr. Ellis to potential post-doctoral mentors. The cost of attending this meeting has been derived from actual quotes. They are:

The cost-accounted amount for travel in each out year should be provided on the relevant budget form. Justification should be provided in the last subsection of the *Budget Justification*, where recurring direct costs that vary year to year are discussed (see below). Justification there doesn't have to be as extensive as for the first year. All that is needed is: meetings to be attended, where they will be held, who will attend, the total cost for each, along with a statement that the requests were derived by the same cost-accounting approach used for the first year.

Section F: Participant Support

This category is not used in formulating the budget for a standard research grant. Its purpose is to support the costs of participants in NSF-sponsored conferences, meetings, symposia, training activities and workshops. Thus, even though this line item can be used to support some kinds of training, this is not where things like tuition remission for graduate students should be included. Those costs should be entered under G.6, "Other," in the next section.

Section G: Other Direct Costs

This part of the *Budget* consists of a series of line items:

G.1: Materials and Supplies. This category should include expendable items that are needed for the conduct of the activities that are proposed in your application. This category should be created with an appreciation for what constitutes the definition of 'equipment' at your institution. Unless the operational definition at your institution is less than NSF's, materials and supplies are tangible items costing \$5,000 or less. Thus, as noted above, small pieces of equipment should be requested here. It is possible to include reference books and periodicals in this category, but only if there is a dedicated need for them in the project.

There is room on the *Budget* form for only a single, composite figure. How that figure was derived should be detailed in the *Budget Justification*. We recommend that you group materials and supplies into subdivisions there, each of which is \$1,000 or more. Such categories constitute the "general types of expendable supplies" that are referred to in the *Grant Proposal Guide* (page II-14). The most common mistake made in this part of the *Budget Justification*, in our opinion, is use of 'made-up' numbers for these categories, i.e., ones that have no real basis in fact. This lapse is often inadvertently signaled to reviewers by applicants who offer only round numbers for their various categories. As an alternative, and much more persuasive, approach, we suggest that you make your request much more credible (and accurate – which will benefit you after the award is made) by cost accounting. The majority of items for which requests are made will likely be the same as those that you have purchased previously (both in terms of kind and quantity). Use your file of purchase orders to determine for *exactly* what you spent for each category during the previous year. Increase such figures 3-4% to adjust for inflation. *Make clear in your justification that you have used this approach to derive your figures.* Using this approach shows a level of commitment to accuracy that is not often seen by reviewers; our experience is that it impresses them. If your proposed research will differ significantly from that of previous years, to the extent that it would preclude your use of previous purchase orders, develop your new supply budget by a careful needs analysis. Reflect that you have done so in the *Budget Justification*.

EXAMPLE OF 'MATERIALS & SUPPLIES' JUSTIFICATION

G.1 Materials and Supplies: \$16,863 total. The amount requested in each of the following categories has been derived by cost accounting using actual expenditures over the past year (determined from purchase orders) increased by 4% for inflation. Iododeoxyuridine: \$4,608 (4 mCi; sp. act. ~2,000 Ci/mmol in buffered aqueous solution). This radiochemical is required for radiolabeling RNA, as proposed in specific aim 3. Plasticware: \$1,860 etc.

G.2: Publication/Documentation/Dissemination. Funds requested on this line are for documenting, preparing, publishing, disseminating and sharing of results you expect to produce.

This line is overlooked by many applicants, in our experience. That is an important oversight, for at least three reasons. First, if nothing is included on this line it inadvertently suggests to reviewers that you don't intend to publish. Second, the cost of publishing is substantial, especially if color illustrations are included and/or the journals in which you intend to publish levy page charges. If you don't request the necessary funds here, unless you have an alternative source of support, the costs of publishing have to be re-budgeted from other line items. As with travel, having to do so can compromise your ability to do all of what is proposed. Finally, requesting funds here can be used to support a plan for broad dissemination of results, which is pertinent to the Broader Impacts consideration that pertains to that activity. For these reasons, we strongly recommend that you make full use of this line item.

Justification of this line is often scant or nonexistent. That is another important oversight, because reviewers may be taken aback by the real costs of publication / dissemination, which continue to escalate. First, make a realistic estimate of the number of papers that you and your colleagues on the application with you expect to publish per year (based on past rates of publication, if you are an established investigator). Second, identify the journals in which you intend to publish. Third, estimate what the cost of publishing in those journals will be, including submission and/or review fees, page charges, reprint charges, the cost of color illustrations, and any other publication costs that are applicable.

EXAMPLE OF 'PUBLICATION/DOCUMENTATION/DISSEMINATION JUSTIFICATION

G.2 Publication Costs: \$5,680 Our rate of publication has been 5 papers/year, each averaging 10 pages with one color and four half-tone figures. The *Journal of Chemistry* is preferred. On average, one 10-page publication in that Journal is estimated to cost \$1,136 (submission fee \$60; half-tone figure charge \$25/figureX4 = \$100; color figure (1) charge = \$300; page charges \$50X10 = \$500; etc.) X 5 = \$5,680.

The same approach should be used for dissemination / documentation costs. If you plan to offer a creative, innovative plan for either, the total estimated costs should be followed by a summary of the essentials of the plan, together with the estimated cost for each part. The final justification would look something like the one given for publication in the textbox, above.

G.3: Consultant Services. Compensation for consultants is included here, not under either the Senior or Other Personnel sections (A & B, respectively). Consultants have important but limited roles in a proposed research project. Each should have an established reputation and unassailable expertise in an area for which there is limited need. By the latter we mean that the need is insufficient to create such expertise *de novo* within your own group. Thus, consultants should usually be justified on the basis that it will be more time- and cost-effective to have an already established individual meet the limited need, rather than train a member of your own group.

Requests for compensation of outside consultants (those from somewhere other than

your own institution) should be "reasonable," according to the *Grant Proposal Guide* (page II-14). Reasonable compensation is defined by NSF as "comparable to the normal or customary fees charged and received by the consultant for comparable services, especially on non-government contracts and grants" (*Award & Administration Guidelines*, page V-5).

Travel for outside consultants should be requested and justified as part of section E, *Travel*. The *Grant Proposal Guide* is unclear and confusing on this point, in our opinion, in that the costs of consultants' travel are mentioned as allowable under discussion of subsection G.3. This apparent discrepancy is clarified by the *Award & Administration Guidelines*, which clearly and unequivocally specifically states that travel costs for outside consultants (e.g., transportation, lodging and subsistence) should be requested under section E (see page V-4).

Federal employees, *other than those employed by NSF*, can serve as paid outside consultants, providing that their employing federal agency is made aware of such activity and it is outside of their regular working hours.

Intramural consultants, i.e., those from your own institution, cannot be paid from an NSF grant except in unusual circumstances. Such consulting is usually considered to be within the scope of university activities that is supported by the intramural consultant's institutional salary and is an example of institutional commitment to the project. Exceptions to this could include such things as consultation across unit boundaries (e.g., from one school to another or even one department to another within a school) or at a remote location, providing work is performed *in addition to* what is covered by the individual's institutional appointment. Such additional compensation would also have to fall within the salary-supplementation policy guidelines of your institution to be eligible for inclusion in the *Budget*.

Even though consultants are not members of the Senior Personnel set (*Budget* section A), we recommend that you include a *Biographical Sketch* for any one of them who will have a substantive role in the project, i.e., without whom some part of the research would become problematic. The *Grant Proposal Guide* requires that evidence supporting a consultant's expertise be provided (see page II-14). We think that is best done through the individual's *Biographical Sketch*. A consultant's Biographical Sketch should be constructed to highlight the reputation and expertise that have caused you to engage him/her. Including such documentation is not precluded by either the *Grant Proposal Guide* or the *Award & Administration Guidelines*.

In addition to including a *Biographical Sketch*, you should accompany the application with a letter of support that attests to each consultant's willingness to provide what is needed, especially if the individual will have no measurable time invested in the research. It may seem paradoxical that a person with no measurable time could have the kind of importance that we ascribe to consultants here. To illustrate how that might be so, take the example of someone who will provide access to an essential database or reagent. It doesn't require measurable time to provide such things, but without that access part of the research project could not be performed. Reviewers would want to know what the qualifications of the individual are, because that is pertinent to assessing the quality of the database/reagent, and would certainly expect to see a letter that confirms the person's willingness to provide access.

The justification provided for each consultant should include the individual's name, organizational affiliation, daily compensation rate, the number of expected consulting days, and a summary of the individual's expertise. Reviewers should be referred to the individual's *Biographical Sketch* for details. In addition to such a narrative description for each consultant, if you have room to do so, we recommend that you provide a summary table as part of this justification. It is reviewer friendly to do so.

EXAMPLE OF 'CONSULTANT SERVICES' JUSTIFICATION

G.3 Consultant Services:

SUMMARY OF COSTS FOR CONSULTANT SERVICES

	<u>Sandoval</u>	<u>Oliver</u>
Affiliation	Univ. of Michigan	[Applicant's Institution]
Duration of consult	9 days	-0-
Consultation fee	\$8,550	-0-
Expertise	Nanosome Isolation	Collection Access

Consultant #1 (\$10,649), Maximillion Sandoval, PhD, Regents Professor, University of Michigan. Dr. Sandoval is an international expert on the extremely demanding process of isolating nanosomes from fruit-fly mitochondria (see accompanying *Biographical Sketch*). We have a very limited but important need to isolate such organelles in order to accomplish a key experiment under Specific Aim #1. It is most cost-efficient, therefore to use a consultant for this purpose. Professor Sandoval has agreed to assist us in accomplishing this part of the work (see accompanying letter of support). He estimates that his involvement will be needed for 9 days. His daily compensation rate as a consultant is \$950, for which there is an historical basis. Thus, the request for compensation is $950 \times 9 = \$8,850$. Support for his projected travel costs is requested under section E of this *Budget*. No other expenses are anticipated.

Consultant #2, (\$0.00), Ernestine Oliver, PhD., Professor, [Applicant's Institution]. Dr. Oliver, who will have no measurable effort on the project, has agreed to provide us with access to a specimen collection that is critical to completion of Specific Aim 3. Her accompanying *Biographical Sketch* attests to the content, quality and widespread use of the collection. Her accompanying letter of support confirms her willingness to provide us access.

G4: Computer Services. This line item should only be used for services, such as computer-based retrieval of scientific, technical and/or educational data, that your institution treats as a direct cost. Clarification of this point, if necessary, can be obtained from your sponsored-programs office. Justify requests here by relating them closely to the research that is proposed and why it is necessary / cost efficient to have others perform the services for you. If applicable, be sure to include the computer service rates that have been established at your institution. The cost of leasing computer equipment, if justified, should be included here.

Although the "Services" part of this line-item's title would seem to preclude it, as noted above, computer hardware that costs less than your institution's operational definition of 'equipment' can be requested here – providing it is dedicated to the proposed research. Dedicated software can also be proposed. If you request either hardware or software under this category you must go out of your way in the *Budget Justification* to convince reviewers and NSF program staff that none of it is general purpose, i.e., will be used for purposes other than the proposed research (see *Budget Justification*, below).

Objective breakout detail provided in the justification of this category should be sufficient to allow reviewers to understand how the total figure requested was reached. A table may be helpful in this regard if many different needs will be met by the requested funds.

G5: Subawards (Subcontracts): No part of an NSF-sponsored research project can be 'farmed out' without prior NSF approval. Thus, if another institution or entity will play an important and meaningful role in the proposed research, the costs of that relationship must be requested here and be supported by an accompanying, separate breakout *Budget* and *Budget Justification* that is created by the investigator(s) / sponsored-programs administrators at the other institution.

It is common, in our experience, for applicants to overlook the importance of this section of the *Budget*, not only from the standpoint of informing NSF of the existence of a subcontract, but also as a means of avoiding problems later. With respect to the latter, if either outside personnel or resources will be substantively involved in the proposed research, the outside provider will almost always expect to receive its share of indirect costs. If you haven't budgeted for them, worst case scenario, either you or your institution would have to come up with the funds post-award. If that weren't possible, the part of the research related to the other institution could be terminated – a disaster for all concerned. Even if the funds could be made available, taking the other institution's indirects from your part of the *Budget* could compromise all or part of the research project. Alternatively, getting them from either your department or your institution's research office isn't going to endear you to whoever heads such an entity. For all of those reasons, if you contemplate the need for outside expertise and/or resources, as a form of 'insurance,' make sure that you or the appropriate officials at your institution contact the outside provider to clarify and formalize the relationship prior to submitting the application. Once that is done, use this part of the *Budget* to support the relationship fully.

Remember when requesting funds here that reviewers will often worry that investigators at other, particularly distant, institutions will not really be involved in the research, i.e., that there is no real working relationship with them. The fear is that they will be disconnected from the project. To offset that kind of concern you must present compelling and credible reasons in your justification for including such investigators as part of your research team and convince reviewers that this is the most effective, efficient way to get the job done. To do so requires three things. First, you need to present evidence that the expertise is otherwise unavailable, i.e., it isn't readily available at your own institution. Second, that the relationship is a working one. To do so, the best evidence to present is that you have been publishing together. Thus, if you anticipate the need for a subaward in your application, it is smart business to begin working with the distant investigators prior to submission of the application. Ideally, as a result of such activities you will have at least one peer-reviewed publication (in press is OK) that attests to the productivity of the relationship. If you don't have any, and there is sufficient time to write an abstract or review together, we recommend that you do so. At the least, jointly produced data should be included in the *Preliminary Studies* subsection of the Project Description. The third thing is a management plan that will orchestrate and coordinate the efforts of the distant investigators with those at the primary site. Such a plan should be presented as part of the *Research Plan* in the Project Description and referred to here, in your *Budget Justification*. For example, regular, face-to-face meetings through teleconferences should be a part of such a plan. Almost all institutions have teleconferencing facilities. The one at each institution should be described in detail in the Facilities, Equipment & Other Resources section and a request to support the costs of such teleconferencing should be included under the G.6 subsection of Other Direct Costs in both your *Budget* and the one for the other institution.

When creating the justification for this part of your *Budget*, don't make the common mistake of justifying the other institution's costs, line by line. That's what the investigators at the other institution will do in their *Budget Justification*. What you must justify is the need for the subaward. If a subaward is intended, but the subawardee has not yet been identified (a very

weak position, in our opinion), the estimated cost of the relationship should be entered on this line. Include the criteria that will be used to select the individual / institution in the *Budget Justification*.

EXAMPLE OF 'SUBAWARDS' JUSTIFICATION

G.5 Subaward: (\$28,754; see accompanying separate *Budget* and *Budget Justification*). Marc Owens, PhD, University of Colorado, has agreed to lead the evaluation of the proposed research, both from a formative and summative perspective. He is internationally recognized for his expertise in this area (see accompanying *Biographical Sketch*). Evaluation is critical to the success of our project and we lack the kind of in-depth understanding at our institution that Dr. Owens will provide. A management plan that will ensure his effective interaction with us is provided under the *Research Plan* section of the Project Description. For example, he will meet with us regularly, both on-site (see request for travel funds, section E of this *Budget*) and by weekly teleconference (see *Facilities, Equipment & Other Resources* section, as well as subsection G.6 of this *Budget*, under Communication Costs). We have worked together effectively in the past, as is confirmed by our joint publication in the *Journal of Management Practices* (28, 2007: 763-778).

G6: Other. This catch-all category should be used to request funds for any allowable item that doesn't fit under one of the other lines; entertainment, meals and coffee breaks, as well as alcoholic beverages are not allowable anywhere in the *Budget*. Such requests could include, but are not limited to, such things as tuition remission (not under section F, Participant Support), research space rented off campus, some kinds of relocation costs (see the *Award & Administration Guidelines*, page V-8), payments to human subjects, construction of equipment that cannot either be purchased or purchased for less than the rental cost, and service charges (other than those related to computers). Thus, if you project the intermittent need for statistical support on a fee-for-service basis, you would request such funds here. Another example of a 'service' would be the need for a service contract to support the operation of a piece of equipment needed for the research. Support for that cost would be requested here. Any services you plan to use should be justified on the basis of why it is more efficient / cost-effective / dependable to use this approach rather than to do those things yourself. Along these same lines, in some cases it is more cost effective / efficient to rent equipment or temporarily occupy space than to purchase it / occupy it permanently. The funds related to such strategies would be requested here. Funds for minor alterations can be proposed here. However, such modifications are usually considered to be the institution's responsibility. Therefore, we recommend that you not include such costs in your *Budget* without the prior approval of your Program Officer. If that person approves, his/her name and the fact that you queried him/her about this request should be included in your *Budget Justification*. This is also where you would request funds to defray animal-care costs. If you will be using animals make certain that you query the head of your animal-care office to ensure that no increases in maintenance fees are projected for future years. If such increases are anticipated, obtain a letter from that individual documenting that fact, and include the projected increases in your budgets for future years. Additional information regarding the kinds of things that can be included under this line item can be found in the *Award & Administration Guidelines*, pages V-7 through V-8. Whatever is requested in this category must be detailed and justified in the *Budget Justification*.

Section H: Total Direct Costs

This is the total of all costs for the proposed research, i.e., the sum of *Budget* sections A through G.

Section I: Indirect Costs (also known as Facilities & Administrative Costs [F&A])

Indirect costs are those not directly associated with conduct of the proposed research. They are funds in addition to the direct costs used to support research. They are used by your institution to pay for things that indirectly support research – things that you and we usually don't think about – such as heating and air conditioning, secretarial and janitorial services, depreciation on buildings, etc. Details regarding indirect costs are provided by the *Grant Proposal Guide* (pages II-15 & -16) and the *Award & Administrative Guidelines* (pp. V-9 through V-12).

Most institutions have negotiated an indirect-cost rate with the federal government. It can vary depending on specifics that are related to your research project. For example, there is usually an on-campus rate and an off-campus rate. Our advice is to seek the advice of your sponsored-programs office or obtain similar administrative input to assure that this part of the *Budget* is completed correctly. Whatever the basis for calculating your indirect costs is, it should be summarized in the *Budget Justification* for this line.

Some NSF solicitations stipulate that indirect costs either will not be paid or will be limited if an applicant is successful. Should you encounter that situation, before preparing your proposal, clear the stipulated indirect-cost rate with your department chairperson and the appropriate representative in your sponsored-programs office. You do not want to complete an application in response to such a solicitation only to find that institutional authorities will not allow you to submit it because F&A will not be paid in full.

A little known fact is that your institution can re-budget indirect costs received in order to increase your direct costs for research if you and institutional authorities deem that necessary (see chapter V.D.2, page V-12, of the *Award & Administrative Guidelines*). You should not make such a request of your institution unless there is a compelling reason to do so, such as a project that NSF wants to fund at an amount substantially below what was proposed in the application's *Budget* (see *Negotiation of Budgets*, below).

It is also possible for an institution either to waive receipt of indirect costs or to reduce the amount that they will accept. Either option can be a form of cost sharing, should the institution decide to offer such a contribution (see below). However, the decision to waive or reduce F&A must be entirely voluntary. Thus, it is not appropriate for an NSF Program Officer to require or even suggest changes in the indirect-costs request during a budget negotiation.

Section J: Total Direct and Indirect Costs

As the title for this line suggests, the total direct (line H) and total indirect costs (line I) are added to produce this figure.

Section K: Residual Funds

This line is not explained well in the *Grant Proposal Guide*, probably because it is not relevant to new standard research grant applications. Rarely, if ever, will you have to use it; the line isn't

even included on the new R&R Budget component for preparing and submitting applications through Grants.gov.

Section L: Amount of This Request

Line L should be the same figure as the one entered on line J unless you are working with instructions that stipulate otherwise.

Section M: Cost Sharing

Cost sharing is no longer required by NSF, but an institution can volunteer such savings if it desires to do so. For example, if you would request only 30% of the cost of an expensive piece of equipment, as described above under section E, you could confirm here that you have the 70% from other sources (e.g., by providing the number of an existing grant that will share the cost of purchase or a letter of support that confirms some other source). The additional funds constitute cost sharing. Before electing to offer cost sharing clear that approach with your Sponsored Programs / Research Office. There is an administrative burden associated with cost sharing that your institution may not want to shoulder.

JUSTIFICATION OF DIRECT COSTS AFTER YEAR ONE

The last part of the *Budget Justification* is used to justify the proposed duration of the project, as well as increases / decreases over first-year direct-cost amounts. A reviewer-friendly approach is to title the subsection something like, 'Justification of Direct Costs for Subsequent Years,' which clearly conveys where this information is located. Within this subsection include the following sub-subsections:

Inflationary Adjustments. Describe here how recurring direct costs have been adjusted upward for inflation. Currently, the rate of inflation is 3-4%, which you should compound across the years requested. Some institutions have a specific figure that they require applicants to use. Check with your sponsored-programs office to determine if there is such a figure at your institution. If not, use a reputable measure of the rate of inflation and cite that source of information here.

Significant Increases / Decreases. Use this subsection to justify any significant increase (greater than what is attributable to inflation) / decrease in recurring direct costs in years after the first. Travel is an example of one that almost surely will vary year to year. Other common causes are the purchase of equipment or the addition / deletion of personnel in an out year. If there are no such increases / decreases, don't include this subsection in your *Budget Justification*. If there are such increases / decreases, describe the reason(s) and justify scientifically why that change is necessary and appropriate. A frequent error is to forget that decreases, as well as increases, must be justified.

Duration of the Project. The years requested must be justified by the content of your Project Description. As an aid to doing so we recommend that you copy and paste the timetable from the end of your Research Plan (chapter 10) into this part of the *Budget Justification*. It summarizes for reviewers what will be done when and, therefore, why the years requested are appropriate. Accompany it with a brief narrative description that embellishes the information that is contained in the timetable.

NEGOTIATION OF BUDGETS

As we are sure that you appreciate, budgetary times are tough for federal granting agencies like NSF. In times like these such agencies activate strategies that are designed to 'stretch' the dollars that they have to invest in research projects like yours. One such strategy, which is employed by NSF, is to negotiate budgets with applicants. If your proposal is deemed by reviewers to be among the *crème de la crème* you won't have to worry about this; you will receive the full amount that you requested (modified as reviewers recommend and NSF program staff decide is appropriate). Budgets for applications after these first few will be negotiated. Thus, if your proposal isn't among the *crème de la crème*, you could receive a call from a Program Officer telling you that NSF wants to fund you but can't give you all that you are requesting. At that point, the negotiations begin. You have the right to argue that you need more than they initially offer. If you need to do so, you should thank the Program Officer and ask to speak with him/her at a later time after you have gotten your thoughts together. If you take such an approach, we recommend that you enlist the aid of your sponsored-programs office. They deal with such things regularly and have experience that you will likely find very valuable. Part of the negotiation will be the scope of work that NSF expects you to undertake with the funds that they offer you. After having made your best effort to increase what NSF is offering, you will be at a decision point: shall I accept or reject the offer? Don't even think about it: accept!!!! However, after you have done so, if the negotiated amount you will receive is $\geq 10\%$ of your original request, using FastLane and the format prescribed by your Program Officer, send notification through your sponsored-programs office that acceptance is contingent on NSF's acceptance of the reduced scope of work that you will have negotiated with the Program Officer. You do this in concert with your sponsored-program officials to ensure that the reduced scope of work becomes an official university document; they are the 'real' recipients of the award.

DEVELOPMENTAL STEPS FOR CHAPTER FOURTEEN:

General Points:

1. Identify a project duration that is justified by your *Research Plan* – usually three years.
2. Based on the electronic submission system you have elected to use for the proposal, choose either the FastLane or Grants.gov (SF 424) *Budget* form; they differ slightly.
3. Prepare the *Budget* and *Budget Justification* yourself. Don't delegate their preparation to administrative personnel.
4. Use administrative personnel to check the accuracy and completeness of what you have proposed and justified.
5. Assure that you have requested what it will cost to accomplish the research that is proposed. Never low-ball a budget request.
6. Each line item on which you request funds should be fully explained with respect to both appropriateness and need in your *Budget Justification*.
7. Ensure that each budgetary request is credible and scientifically justified.
8. Remember that credibility can be lost by proposing either too much or too little.

Line-Item Requests:

9. Make sure that all members of the Senior Personnel Set are scientifically justifiable, both with respect to role and extent of effort proposed.
10. If you are requesting summer-salary support, make sure that effort to be invested during the academic year is described in the *Budget Justification* in addition to effort that will be devoted to the project during the summer.
11. If you are a Beginning Investigator, do not undercut the perception of your independence by including a former mentor on your application in an intellectual capacity.
12. Make sure that only Senior Personnel from your institution are included in section A. Senior Personnel from other institutions should be proposed in section G.5.
13. Make sure that any clerical / secretarial personnel included in section B can be justified as dedicated to the project that you are proposing, i.e., that they do not qualify as 'general purpose.'
14. Do everything possible to avoid including To-Be-Appointed positions in your *Budget*.
15. Determine what the proper approach to requesting fringe benefits is.
16. Assure that the fringe benefits requested are appropriate for each personnel category.
17. Determine what the definition of 'equipment' is at your institution.
18. Make sure that equipment that could be construed as 'general purpose' is thoroughly justified as dedicated to the research that you are proposing.
19. Do not forget to include in the purchase price of equipment the costs of any modifications, accessories, or auxiliary apparatus that are required to make it usable. Shipping, installation costs, tax, and the cost of in-transit insurance may be eligible for inclusion.
20. Use the equipment justification, in part, to illustrate how the request relates to the 'infrastructure' consideration under the major review criterion, Broader Impacts.
21. Identify specific locations to which you plan to travel.
22. Obtain accurate estimates for each cost category that contributes to a total estimate for travel. Illustrate this cost-accounting approach in the *Budget Justification* as the basis for your travel request(s).
23. Include travel to meetings for students, if possible. If you do, use the travel justification, in part, to illustrate how the request relates to the 'integration-of-research-and teaching' consideration under the major review criterion, Broader Impacts.

24. Do not include tuition remediation for graduate students under section F, Participant Support. Such requests should be made under subsection G.6.
25. Cost account your request for materials and supplies. Subdivide the request into categories that are $\geq$ \$1,000 for presentation in the *Budget Justification*.
26. Make sure that publication / dissemination costs are supported by a *Budget* request.
27. Describe in the *Budget Justification* how the publication / dissemination request is supportive of the 'dissemination' consideration of the major review criterion, Broader Impacts.
28. Request only consultant compensation under subsection G.3. Travel costs for outside consultants should be requested under section E.
29. Justify consultants on the basis that it is the most cost-effective approach, compared to creating that kind and level of expertise within your own group.
30. Provide a *Biographical Sketch* for consultants, even though such individuals are not members of the Senior Personnel set.
31. Computer hardware that is not general purpose and costs less than the amount that operationally defines equipment should be requested and justified under subsection G.4.
32. Most services that are needed for conduct of the proposed research should be requested and justified under section G.4. Computer services are the exception; they should be requested and justified under subsection G.3.
33. Make sure that you work with the relevant sponsored-programs offices – yours and others – to set up an appropriate subaward (subcontract) if a substantial part of the work proposed will be done at another institution.
34. In your *Budget Justification* justify any subaward on the basis of appropriateness and need. The investigator(s) and sponsored-programs officials at the other institution must prepare and justify their line-item requests in a separate *Budget* and *Budget Justification*.
35. Items included under subsection G.6, "Other," must be listed and justified separately in your *Budget Justification*.
36. Seek help from your department / sponsored-programs office in calculating and justifying indirect costs that are associated with your proposal.
37. Justify recurring direct costs in years after the first on the basis of inflationary and any extraordinary increases / decreases over previous years.
38. Use the timetable from the *Research Plan* in your Project Description to help justify the number of years you are requesting.
39. If you are put in the position of negotiating a budget with NSF don't do so alone. Seek help from officials in your sponsored-programs office.

CHAPTER 15

CURRENT AND PENDING SUPPORT

This is a very straightforward, but important, part of your proposal. In spite of its importance, applicants often make mistakes in it because they fail to read and follow the instructions (*Grant Proposal Guide*, page II-17).

The *Current & Pending Support* section allows reviewers and NSF program staff to ascertain the total time commitment that an investigator has to sponsored projects, as well as to ascertain what his/her total grant support is. Each member of the Senior Personnel set must provide a *Current and Pending Support* section.

The title of this part of your proposal doesn't always reflect its content, which is one of the reasons why you need to read the instructions carefully. For example, if the project being proposed has previously been supported by an agency other than NSF, the final year of that past support must be detailed here. Another example is planned submission in the near term of an application by any member of the Senior Personnel set.

With those exceptions, everything else entered here should be research support – either ongoing or pending – to which the individual has a commitment of time. Support from any source, not just federal ones, must be listed, even if no salary support is derived from the subject project. Thus, if you have an application pending to an industrial source and it is for a project to which you have committed time, it must be reported. If you received a start-up package when you were recruited and that research support is ongoing, that, too, should be reported as a departmental / institutional grant. Clearly, you would have time invested in the research it supports. If you serve on a project as a consultant without a time commitment, that activity would not be reported. Thus, the criterion for deciding which projects must be reported under the Current and Pending Support section is whether or not time is committed: If you have a time commitment it must be reported. If you have no time committed it should not be included.

For each project to which you or another member of the Senior Personnel set have time committed you must provide its title; the source of the support (granting agency); the location of the project; the total award amount; the starting and ending dates (MM/DD/YY); whether it is current, pending, planned (near-term submission), or transferred support; and the person months per year committed to the project. *A very common mistake made by applicants is to forget to include the application they are preparing as a pending source of support.* Other mistakes are to enter direct, rather than total (direct + indirect), costs or to enter total costs for only the first or current year, rather than for the entire project period.

With one exception, which will be described in the next paragraph, it is possible to submit the same, or essentially the same, proposal simultaneously to other agencies. During these competitive times it is smart business to send applications to as many sources of support as are applicable. Thus, if your proposal to NSF could potentially have public health relevance if spun differently, do so and send it to NIH. If the subject could be of agricultural relevance, spin it that

way and also send it to USDA for consideration of funding. If you decide to send the same application to other agencies that intent must be reflected in the *Current and Pending Support* section. You don't have to worry that doing so will prejudice the review of your NSF proposal; the *Grant Proposal Guide* explicitly states that it will not (see page II-17).

The one exception to sending your application elsewhere pertains to the Biological Sciences Directorate. If you are an established investigator you cannot send the same application to both the BSD and another *federal* agency unless there is joint agreement between the agencies that it is OK for you to do so. If you are a Beginning Investigator, however, you can (see pages I-7 & -8 of the *Grant Proposal Guide*). Note that we have highlighted *federal* in italics. Thus, if you are an established investigator and want to send the same application to a private foundation at the same time that it is being considered for funding by BSD, that would be permissible. You would simply signal your intention to do so by listing such a planned application in the *Current and Pending Support* section that is part of the application submitted to NSF.

DEVELOPMENTAL STEPS FOR CHAPTER FIFTEEN:

1. If the project you are proposing to NSF has been previously supported by another agency, report the final year of such past support, even though the title of the section suggests that details of past support are not required.
2. Determine which, if any, of your ongoing or pending / planned projects are eligible for inclusion in this section. The criterion for inclusion is time invested. If you have time committed the project must be reported here. If you have a commitment to a project that does not require time (e.g., supplying access to a database or providing a reagent) there is no need to include it under Current & Pending Support.
3. Make a similar determination for other members of the Senior Personnel set, including any applications that they plan to submit in the near future.
4. Even if you and/or other members of the Senior Personnel set don't have ongoing or other pending / planned projects, each of you must complete this part of the application; *the proposal you are writing for submission to NSF must be reported here as pending support.*
5. Make sure that the amount included for each project is total, not just direct, costs.
6. For each entry, make sure that you enter total cost for the entire project period, not just for the current (ongoing grants) or first (planned proposals) year.
7. Submit the same or a very similar proposal to other non-federal agencies to which it is applicable.
8. Submit your proposal to other federal agencies, as well, except when you are targeting NSF's Biological Sciences Directorate. In that case you must either be a Beginning Investigator or have NSF's and the other agency's agreement to do so.
9. If you have submitted, or plan to submit the application being developed here to other agencies, be sure to include that information in the Current and Pending Research support section for each member of the Senior Personnel set.

CHAPTER 16

BIOGRAPHICAL SKETCH

The purpose of the *Biographical Sketch* is to help establish that the proposed project is feasible in your hands. It is one of the principal means of doing so. It is also an often-overlooked opportunity to punch important 'buttons' that are related to the Broader Impacts major review criterion.

A *Biographical Sketch* should be prepared for each member of the Senior Personnel set (see NSF's definition of Senior Personnel on page II-36 of the *Grant Proposal Guide*). Generically, "Senior Personnel" are those members of your research team who would be very difficult to replace and without whom some part of the research would become either problematic or undoable. Thus, they include you and other members of the faculty at either your institution or another one. Postdoctoral fellows who have faculty appointments can be included in this category. In the *FastLane Budget*, these individuals will be listed in section A (see chapter 15).

As the name implies, NSF's category of "Other Personnel" includes everyone else who has a role in the project (see complete definition below and on page II-36 of the *GPG*). While you should not include a *Biographical Sketch* for such persons, there is a means of providing information about them, which will be discussed, below. Individuals in this category will be listed in the *FastLane Budget* under section B.

SENIOR PERSONNEL

The *Grant Proposal Guide* (pages II-9 and II-10) stipulates what the format of the *Biographical Sketch* for each senior person should be and what it should (and should not) contain. It is common, in our experience, for many avoidable mistakes to be made in this part of the proposal, simply because the applicant has not read and closely followed the explicit instructions that NSF provides. Such mistakes are completely avoidable and, if present, can reflect negatively on your attention to detail.

TIP: All biographical sketches included in the proposal should be identical in format and typeface to the Principal Investiga-

You have the opportunity here to reinforce the fact that a cohesive, fully integrated research team has been assembled. Uniformity in the appearance of the biographical sketches reinforces that image. Biographical sketches that differ in appearance can inadvertently project the opposite image, i.e., that the 'team' is actually just a bunch of disparate parts that have been cobbled together in order to make the application. To assure that there is uniformity, we recommend that you, as the PI, contact each member of the Senior Personnel set to request an electronic copy of his/her most recently prepared NSF *Biographical Sketch*, as well as an updated copy of his/her complete curriculum vitae – the whole thing, even if it is 50 pages long. After obtaining them, review the *Biographical Sketch* to remove anything that is irrelevant to the support of your project and to correct any formatting or other errors. Then, carefully go through the up-

dated CV. Move anything into the *Biographical Sketch* that supports your case, but which was missing from the original version of the biosketch. Review the bibliography in the CV to assure that the publications cited in the *Biographical Sketch* are the ones that best reflect why you have chosen the individual for the role that s/he will have in the project. Also use the CV to assure that there aren't synergistic activities that are more relevant for your purposes than the ones listed in original *Biographical Sketch*. After making all such changes, have all of the biographical sketches retyped so that each has exactly the same format and typeface as your own.

The *Biographical Sketch* for each individual can be up to two pages and should not contain personal information of any kind. It should consist of the following subsections:

Professional Preparation

Education and training that have prepared the individual for his/her role in the project should be detailed here in chronological order. Beginning with the undergraduate degree, for all academic degrees list the institution, major, degree and year that it was conferred. Post-doctoral training, including fellowships, internships and residencies, should be similarly described as the last entries, with the exceptions that the area of emphasis and inclusive dates of each such training experience should be provided.

Appointments

While the preceding subsection was presented in chronological order, this one must list entries in reverse chronological order. Begin with the current appointment and list all others that preceded it. Do not repeat any 'appointments' that were actually part of the individual's training, such as post-doctoral experiences.

Publications

If the individual has a large number of publications, the ones presented in his/her *Biographical Sketch* should be those that are most relevant to the evaluation of your proposal. As the Principal Investigator, your publications should maximally support why you are best qualified to lead the research team. The publications chosen for other members of the group should support the specific role that each is proposed to have in the project. Publications should be listed under two separate sub-subsections titled: (i) Closely Related Publications, and (ii) Other Significant Publications. The latter may or may not be related to the project. Up to five citations – and only five – are allowed under each category. We recommend that these should be primarily, if not exclusively, peer-reviewed publications. It is permissible to cite book chapters and reviews. We recommend against inclusion of these kinds of publications because they do not reflect original work that has been rigorously scrutinized by other members of the academic community. Citations should include the names of all authors in the order in that they were published, the title of the article / chapter, title of the journal / book, volume number for journal articles, inclusive pagination, and the year of publication – in that order. Although the instructions don't stipulate one way or the other, we recommend that you offer your citations in reverse chronological order.

It is counterintuitive, considering the title of this sub-subsection, but submitted manuscripts and ones that have been accepted for publication can be included in this subsection, along with your best estimate of what the publication date for each will be. Under no circumstances should manuscripts that are 'in preparation' be included. In our experience, such check's-in-the-mail promises are a real put-off to reviewers, and, more important, they are not allowed by NSF.

Invited lectures are not allowed as 'publications.' We recommend that you extend this genre to include conference proceedings, abstracts and poster presentations, even if they were published. Such 'publications' don't meet a high standard for peer review.

Also counterintuitive is the fact that this sub-subsection can contain more than just classical publications. Patents, copyrights and software systems are examples of other kinds of intellectual property that can be cited. While they are not peer reviewed in the same way that a journal article is, they are subjected to other kinds of rigorous review that make them acceptable.

Synergistic Activities

In our experience, this sub-subsection is seldom used by applicants to its fullest potential. In most cases, applicants think only about the Intellectual Merit major review criterion when they create it, forgetting entirely that this is an opportunity to make important points that are related to the second major review criterion, Broader Impacts. The current *Grant Proposal Guide* specifically directs applicants to list "examples that demonstrate the broader impact of the individual's professional and scholarly activities that focus on the integration and transfer of knowledge as well as its creation." It then goes on to offer excellent examples of kinds of activities that would be considered appropriate (page II-9). Not one of the examples pertains to the Intellectual Merit major review criterion. Up to five entries are permissible.

Anticipating the need to prepare this part of the *Biographical Sketch*, it is smart business for you and members of your research team to prospectively and proactively participate in activities that can legitimately be included as "synergistic."

Collaborators & Other Affiliations

In our experience, this is the subsection of the *Biographical Sketch* that is most often either incomplete or done incorrectly. It is very important to NSF program staff because it is one of the principal means of avoiding conflict-of-interest problems in the review of your application. It should consist of the following sub-subsections: (i) Collaborators and Co-Editors; (ii) Graduate Advisors and Postdoctoral Sponsors; and (iii) Thesis and Postgraduate-Scholar Sponsor. To prevent this subsection from taking up any more space than necessary, present the required information under each of the three sub-subsections sequentially, not as bulleted lists. Separate entries with either commas or semi-colons, whichever is appropriate.

Collaborators and Co-Editors. Begin entering names and the organizational affiliation for each (often overlooked) on the same line as the title. The names should be alphabetical and include anyone with whom the person who is the subject of the *Biographical Sketch* has collaborated or co-authored anything – even an abstract – during the last four years (from the date of submission of the application you are preparing). Also include in the list the names and organizational affiliations of persons with whom the person has edited or co-edited anything during the two years preceding submission of your proposal. If the person has had no collaborators or co-editors during the prescribed period the sub-subsection must included with 'None' under it.

Graduate Advisors and Postdoctoral Sponsors. List the names and current organizational affiliations of those who were involved in the post-graduate training of the individual who is the subject of the *Biographical Sketch*. Only those who had a major role should be included.

Thesis Advisor and Postgraduate-Scholar Sponsor. Members of the research team who have not read the instructions carefully sometimes re-list their own mentors here. This subsection is meant to list the names and organizational affiliations of persons who have been trained by the individual who is the subject of the *Biographical Sketch*. All persons for whom the person has been a thesis advisor must be included. In contrast, only postdoctoral scholars sponsored within the last five years should be named. A very commonly overlooked requirement is the need to also provide the *total numbers* of graduate students who have been advised and of postgraduate scholars who have been sponsored by the subject individual.

OTHER PERSONNEL

If any members of the Other Personnel set have special qualifications that particularly recommend them as participants in your research team, those qualifications should be called to the attention of reviewers. To do so, we recommend that you list all such individuals, describing for each only that which distinguishes him/her, on a separate page that follows the biographical sketches. You would do so for postdoctoral fellows who lack faculty appointments; "other professionals," a subcategory that includes technicians and computer programmers, among others (see page II-36 of the *Grant Proposal Guide*); graduate students; and undergraduate students. Qualifications of individuals who will be listed in the *Budget* section as Other Personnel, but who are not in a research capacity (e.g., clerical / secretarial personnel and animal caretakers), should not be described in this part of the application. They will be described in the *Budget Justification* (see chapter 14).

DEVELOPMENTAL STEPS FOR CHAPTER SIXTEEN:

1. Obtain an electronic copy of the latest NSF *Biographical Sketch* from each member of the Senior Personnel set.
2. Also obtain an updated version of each senior person's curriculum vitae.
3. Review each individual's *Biographical Sketch* to correct errors in its preparation. At the same time, delete anything that is not relevant to the support of your project.
4. Review the related curriculum vitae. Anything in the CV that is supportive of the person's role in your project, but which was missing from their version of their *Biographical Sketch*, should be moved into the biosketch that will be submitted with your application.
5. Use each person's CV to assure that the publications and synergistic activities that have been chosen for his/her *Biographical Sketch* are the ones that will maximally support your proposal.
6. Do not include personal information in the biographical sketches.
7. Have all of the biographical sketches retyped to assure uniformity of appearance.
8. List all members of the research team who will be included in section B, Other Personnel, of the *Budget*. Group them with respect to whether their roles are research related, or not.
9. For Other Personnel who are research related, single out any who have qualifications that particularly recommend them for inclusion as members of your research team.
10. Create a separate page on which research-related Other Personnel with distinguishing qualifications are listed by name. Describe the distinguishing qualification – and only the distinguishing qualification – for each.

CHAPTER 17

FACILITIES, EQUIPMENT AND OTHER RESOURCES

The purpose of this part of the proposal is to help establish that the proposed research is feasible in your hands: do you have the resources needed to accomplish the goals of the project? Again here, applicants make mistakes, usually of omission, that are attributable to not reading the instructions closely enough. Most also miss the opportunity to make points about Other Resources that aren't intuitively obvious.

There are three subsections to this component: (i) Facilities, (ii) Major Equipment; and (iii) Other Resources. There is no page limit for this part of the application, so make the most of the opportunity that gives you. Rather than providing detail regarding facilities and/or equipment in the Project Description, as many applicants do, refer reviewers to this section, thereby salvaging space in the Project Description for details that can't be provided elsewhere.

GENERAL TIPS

The descriptions for facilities, equipment and other resources must be specific, objective and complete. Present only relevant items, and do so in such a way that it will be clear why each is important and sufficient to accomplish the work that is to be undertaken. Avoid subjective assessments and clichés, such as 'adequate' office space, and 'cutting-edge' or 'state-of-the-art' equipment, respectively. Such subjective assertions provide no objective detail, which reviewers must have in order to evaluate for themselves what is available to the project.

Be sure to include relevant resources that colleagues on the project with you will provide, especially if they are located at other Performance Sites.

FACILITIES SUBSECTION

There are six sub-subsections: 1) Laboratory; 2) Clinical; 3) Animal; 4) Computer; 5) Office; and 6) Other. Any of the six that are not applicable to your project should have 'Not Applicable' entered in the related field. The descriptions under relevant fields must be responsive to what NSF wants.

***FastLane Instructions:** Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies.*

It is reviewer friendly to divide each relevant subsection to reflect what each member of the research team will contribute. To do so, create a subtitle for each contributor and enter his/her relevant facilities under it. If different performance sites are involved we recommend that you make them the main subdivisions under each category, with investigators and their relevant resources listed under the appropriate performance site.

Laboratory: This subsection is meant to describe the laboratory facilities that are assigned to members of the research team, not core laboratories. Core facilities should be described under the last subsection, "Other," not here. Describe the location, size, configuration and relevant contents of each laboratory. Be specific. For example, if a laboratory is divided into three sections, each of which has a distinct purpose, describe the physical characteristics and contents of each separately. 'Minor' equipment should be detailed here as part of the contents. 'Major equipment' should be described under that specific subsection (see below).

Clinical: If your proposal is one that will require patients or patient-derived materials, there is no such thing as too much detail: One of the principal causes for the failure of clinical applications is insufficient documentation of access to the quantity and quality of clinical material that will be needed to complete the study. Description of relevant physical facilities should be included, as well. Last but not least, if there are other complementary clinical programs and/or investigators in your environment, describe them and the relevance that they have to the proposed project.

Animal: If you will be using animals there are two sources of information that should be read and used to formulate the information that is provided here. They are the Animal Welfare Act and the National Academy of Sciences publication, *Guide for the Care and Use of Laboratory Animals*.

The information provided here should be complementary to the summary of animal use that is provided in the Project Description. By complementary we mean that what is presented here should embellish the summary that is provided in the Project Description with specific details. Such details should be presented in five parts, in our opinion: 1) detailed description of use, to include species, strains, ages, gender, and numbers needed; 2) detailed justification of those choices; 3) details regarding the quality of the facilities/veterinary care that will be associated with maintenance of the animals (If your institution's animal-care facilities have been accredited by AAALAC [Association for Assessment and Accreditation of Laboratory Animal Care, International], you should provide that fact.); 4) details regarding steps that will be taken to limit discomfort, pain and injury to the least amount necessary; and, if relevant, 5) pertinent details regarding the method of euthanasia that will be used. If the animals are vertebrates the method of euthanasia should conform to recommendations of the American Veterinary Medical Association's Panel on Euthanasia. If the method of euthanasia is not compliant, justification for why it is not should be provided.

If the animals are vertebrates and the project has already been approved by your institution's Institutional Animal Care and Use Committee you will have entered the IACUC approval date on the Cover Sheet. Alternatively, you will have entered "Pending," if it hasn't been. If an approval date is provided, you will also have entered your institution's Animal Welfare Assurance Number. None of this information should be repeated here.

Computer: Provide detailed information about hardware and software that are in your laboratory and office. Include access to the Internet, as well as your levels of access to relevant databases. Also include information about your local area network. The administrator of your LAN is a very important resource. Therefore, his/her credentials should be described here, especial-

ly if computers and your LAN are particularly relevant to the proposed research. Finally, if you are a member of a wider-area network that is relevant to the project, e.g., one that includes colleagues at other institutions, describe that resource here. If it will be part of a plan to rapidly and widely disseminate results of your NSF-supported research to specific recipients who will benefit most from early knowledge of them, discuss that use of the WAN in the 'dissemination' subsection of the *Broader Impacts* section of your Project Description. Refer reviewers from there to the details about the WAN here.

Office: Provide relevant details about your office and its proximity to the other parts of your operation. If you have a 10 ft X 12 ft office that is adjacent to your laboratory and is equipped with telephone, fax and a copy machine, that is the kind of detail that should be included here. Many applicants make the mistake of describing only their own office space, neglecting to describe that which will be occupied by other members of their research team. All relevant office space should be described in detail, to include that which is used by technical personnel and/or students who will be related to the project.

Other: The instructions provided on the FastLane form page are not clear regarding what "any other performance sites" are (see text box, above), and neither the *Grant Proposal Guide* nor the *Award & Administration Guidelines* is helpful in clarifying them. We interpret the first mention of performance site to mean the principal performance sites, i.e., those where most of the research will be performed. Facilities related to them should be described in the subsections that precede the "Other" subsection. "Any other performance sites" we interpret to mean things like core facilities or the various locations at which off-site interviews will be conducted.

With respect to core facilities, in addition to their physical characteristics your proximity to them and the extent to which you will have access should be described. Your description should include sufficient detail regarding how each relevant core is managed that reviewers will clearly understand that access will not be restricted in some way. Make certain that you include all relevant core and shared facilities. For example, don't forget things like your institution's library and relevant specialized Centers (e.g., a Cancer Center, a Center for the Study of the Family, or a GCRC [General Clinical Research Center]). If you are including an evaluation piece in your proposal and there is a group on campus that assists with the design and implementation of such programs, be certain to describe that resource here. Major equipment found in core facilities should not be described here. Thus, for example, if you were proposing to use a flow-cytometry core facility, you would describe its physical characteristics here, together with relevance to your project, its proximity to your research operation and the extent to which you and your colleagues would have access to it. You would then describe the major equipment in it under the Major Equipment subsection, below.

MAJOR EQUIPMENT

FastLane Instructions: "List the most important items [of equipment] available for this project and, as appropriate, identify the location and pertinent capabilities of the items."

We interpret "Major Equipment" to be any piece of equipment that is essential to conduct of the proposed research. Relatively inexpensive items that are readily available and which can be replaced easily should be described in the pertinent subsections, above, not here. Thus, the things that are described here will usually, but not always, correspond with NSF's definition of equipment: cost $\geq$ \$5,000 and that have a useful life of more than one year. Include equipment

that you will provide, i.e., that which is yours; relevant items that are owned and will be contributed by other members of the research team; and relevant equipment that your research team either will share with other investigators or that is found in institutional cores to which you and your colleagues have access. Note the repeated use of the word "relevant." Do not describe major equipment here that is unrelated to the proposed project – no matter how contemporary or 'sexy' it may be.

OTHER RESOURCES

FastLane Instructions: "Provide any information describing the resources available to the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations."

This part of the Facilities, Equipment and Other Resources section rarely benefits applicants to the extent that it could, primarily because they fail to read and follow the instructions that are quoted in the textbox, above. For example, rarely in our experience are administrative services and the extent to which they will be available to the team described.

Consultant services and subawards ("consortium/contractual arrangements" in the textbox) are separate line items in the *Budget* and, as such, are discussed in detail in the *Budget Justification*. The extent of detail about them that is included here should be less, therefore, than what is included for other services. In other words, nothing that is detailed in the *Budget Justification* should be repeated here. Accordingly, to prevent redundancy we recommend that consultant services and subawards, if any, be included here but summarized only briefly, after which reviewers are referred to the *Budget Justification* for details. However, if you have a space problem in the *Budget Justification*, which is limited to three pages, the reverse approach can be used: summarize consultant services and/or subawards in the *Budget Justification* and provide the details here, to which the reviewers are referred in the *Budget Justification*. There is no limit on the length of the *Facilities, Equipment and Other Resources* section.

Intellectual resources are also important to the success of your project. They are investigators outside of the research team who are extramurally funded to do work that is complementary to what you are proposing. These are persons in your research environment with whom you will discuss ideas and from whom you will seek feedback and constructive criticism regarding the results of your research. We recommend that you include a subtitle, 'Intellectual Resources,' under the Other Resources subsection. Under it, list the names, granting agencies, and grant titles of the relevant investigators. Doing so gives reviewers an objective means of assessing the quality of the intellectual environment in which the research will be conducted. If you have regular interactions with colleagues at other institutions via teleconferencing, e-mail, and/or telephone, particularly if they are substantive relationships through which data are exchanged and evaluated, include them as intellectual resources. Be sure to list as a resource any communications equipment that is used in these interactions.

DEVELOPMENTAL STEPS FOR CHAPTER SEVENTEEN:

1. Make a list of facilities, major equipment and other resources that are relevant to your project.
2. Be sure to include the facilities, major equipment and other resources that will be contributed by all members of the research team.
3. Be sure to include relevant shared and core facilities in the list.
4. Write an objective description of each item listed; avoid subjective characterizations.
5. Subdivide each field on the FastLane form by performance site and then by the project members who will be at each of them.
6. List Intellectual Resources – researchers at each performance site who are not members of the research team you have assembled but who are funded to do research that is complementary to what you plan to propose.
7. Obtain grant-support information – granting agency and grant title – for each member of the Intellectual-Resources group.
8. If you will have consultants and/or subawards associated with your project, develop a presentation strategy that will allow those items to be detailed without setting up redundancies with the *Budget Justification*.

CHAPTER 18

LETTERS OF COMMITMENT, SPECIAL INFORMATION, SUPPLEMENTARY DOCUMENTATION & APPENDICES

NSF requires that all supporting information related to the project be included between the Cover Sheet and the *Facilities, Equipment and Other Resources* section. There are exceptions to this requirement, however, which are covered in the subsections, below.

LETTERS OF COMMITMENT

General letters of support are not allowed and, if included, could cause your application to be returned without review (see pages II-18 and -19 of the *Grant Proposal Guide*).

Letters of commitment, on the other hand, must accompany your proposal to document unfunded collaborations, if any (see page II-8, Unfunded Collaborations, of the *Grant Proposal Guide*). Thus, if you were proposing interactions with the faculties of several middle schools, you would accompany your application with letters of commitment from the principals of those schools attesting to the fact that their faculties have agreed to participate. As another example, if a researcher were to agree to supply a reagent that is essential to part of the research that you propose, providing that the individual is not included in the *Budget* as a consultant, you would have to provide a letter of commitment from that individual confirming that you have access to the needed reagent. By contrast, if that person is included in the *Budget* as a consultant, you would not include such a letter. Letters of commitment are submitted by uploading them as a single document into the Supplementary Docs field of the FastLane system.

Letters of commitment should not accompany an application for collaborations that are funded, i.e., included in the *Budget*. The means of handling funded collaborations are covered on pages II-21 and -22 of the *Grant Proposal Guide*.

SPECIAL INFORMATION AND SUPPLEMENTARY DOCUMENTATION

Other kinds of information should be uploaded into the FastLane Supplementary Docs field. They are listed on pages II-17 and -18 of the *Grant Proposal Guide*. The most straightforward of these pertain to programs that have special requirements, such as RUI, REU, ROA, or FASED, or any other that makes special stipulations in the related solicitation. Others aren't quite so straightforward. For example, if you are proposing that part of the research be done off-site, you must provide a rationale as to why that is necessary. Doing so here eliminates the need to do so in either the Project Description or *Budget Justification*, both of which have page limitations. The same point pertains to projects that will / could have a negative environmental impact. Explaining and justifying that here would have no impact on the length of the Project

Description / Budget Justification. Other parts of the list include research that will be conducted in certain foreign countries, Greenland, Antarctic, or historical sites; research that involves field experiments involving genetically engineered organisms; documentation that involves human subjects, hazardous materials, vertebrate animals or endangered species; and certain kinds of projects that involve technology utilization / transfer or that require a management plan or that require special reports or final products.

Another example of the use of the Supplementary Docs field would be to alert NSF to any kind of special handling that is required for your application, such as in the case that proprietary or privileged information has been included.

If you have questions about any the use of the Supplementary Docs field or the appropriateness of what you are considering as eligible for inclusion we recommend that you contact the relevant Program Officer for guidance.

APPENDICES

All information that is relevant to your grant application must be contained within the body of your proposal – section A through I in the *Grant Proposal Guide* (pages II-4 through II-17, Cover Sheet through *Facilities, Equipment and Other Resources* section). Appendices to NSF applications cannot be included unless you have obtained a deviation from this prohibition before your application is submitted. Guidelines regarding how to obtain such a deviation are contained on page II-1 of the *Grant Proposal Guide*.

DEVELOPMENTAL STEPS FOR CHAPTER EIGHTEEN:

1. List any unfunded collaborations that are associated with your project.
2. Obtain a letter of commitment from each unfunded collaborator.
3. Combine all letters of commitment into a single document and upload into the Supplementary Docs field of the FastLane system.
4. Determine whether or not your application must be accompanied by any kind of special information or supplementary documentation of the kind listed in the *Grant Proposal Guide*.
5. Combine into a single document with any other material to create a single document for upload into the Supplementary Docs field of the FastLane system.
6. Do not plan to include appendix material with your application – unless you have obtained a special deviation from NSF prior to submitting your application.

OVERVIEW OF PART FOUR

Maximizing the Competitiveness of Your Proposal

We are now down to the final steps. Often, these are taken in haste at the last minute before the application is submitted. For that reason, they are often done poorly and, in some cases (e.g., seeking pre-submission review) not done at all. We urge you not to fall into that trap because each of the three steps that will be described can help to make the difference between success and failure of your application.

CHAPTER NINETEEN: Pre-Submission Review of Intellectual Merit and Broader Impacts

It is our conviction that pre-submission review of your application by knowledgeable colleagues is one of, if not the, most important steps that you can take in developing your application. Your colleagues – fresh sets of eyes – can help you find scientific and technical mistakes in your proposal that would otherwise be found by the official reviewers. If you can find and eliminate those prior to submitting your application it is a foregone conclusion that what you submit will be more competitive than it otherwise would be.

CHAPTER TWENTY: How to Create an Eye-Catching Title for Your Proposal

Your title will create the first impression of your application. In addition, many important decisions are made on the basis of someone's interpretation of your proposal's title. This chapter will help you get the most mileage possible from this part of your application.

CHAPTER TWENTY-ONE: How to Write the Project Summary

In our opinion, the Project Summary is the most important part of your application *vis à vis* its review. Every reviewer, without exception, will read it – even those who won't have read your proposal before it is considered at the meeting of the review panel. The copy-paste approach recommended in this chapter will ensure that yours contains all information necessary and that it is presented in a clear, coherent way with a compelling progression of logic.

CHAPTER 19

PRE-SUBMISSION REVIEW OF INTELLECTUAL MERIT AND BROADER IMPACTS

GENERAL CONSIDERATIONS

If we could offer you only one thing that would make the difference between success and failure it would be pre-submission review of your application by knowledgeable colleagues. Your colleagues have the capacity to pick up the same scientific and technical errors in your proposal that would otherwise be caught by the official reviewers. Why allow review-panel members to detect mistakes that could be removed prior to submission?

If pre-submission review is so important, why don't most applicants take advantage of what this step has to offer? Usually, it is because they haven't planned to have sufficient time before the deadline in order to do so. *Ideally, you should allow members of your pre-submission review committee two weeks to evaluate your draft, after which you should give yourself at least one week to respond to their constructive criticisms.* Even if you are following a compressed schedule because of a close deadline, don't make the mistake of eliminating this important part the developmental process. You may have to shorten the time that your committee members and you have for this part of the developmental process, but don't delete this step.

CHOOSING THE MEMBERS OF YOUR PRE-SUBMISSION REVIEW COMMITTEE

There should be at least three reviewers on your pre-submission review committee. We recommend that they have experience with NSF and are familiar with the considerations under the two major NSF review criteria, Intellectual Merit and Broader Impacts. Two of them, as a minimum, should be very close to your own area of expertise, because they are the ones who will be most able to pick up scientific and technical errors that you may have made. They will be the ones who can best assess whether or not the research proposed is significant and responsive to NSF's review criteria. They do not necessarily have to be from your own institution. Take advantage of your network and utilize colleagues at other institutions if they are the most qualified ones to help you. The third member of the committee should be a strong academician but more of a generalist, i.e., someone who is not intimately familiar with what you are proposing. They shouldn't be clueless with respect to your field. Rather, they should be at the edge of the spectrum of expertise that you expect to be represented on the official review panel. Having such a member of the committee is important because, if you have written a grant application that can only be understood and appreciated by an expert, you have written a poor proposal. The 'generalist' will often notice things that are not a problem for the 'expert' members e.g., jargon, unclear abbreviations / acronyms, the necessity to read between the lines to interpret what is being presented, etc. S/he may miss scientific and technical nuances, but the idea driving the

proposal and its significance should be clear. S/he should be able appreciate that, when your idea is acted upon, it will make a vertical difference in the field.

In addition to their disciplinary expertise, the reviewers on your pre-submission review committee must have several other characteristics. They must be colleagues who you can trust. You will be giving them one of your best ideas, and you want to be as certain as possible that they won't 'take it and run.' In addition, each of them has to be the kind of individual who will be unafraid to give you sharp, even trenchant, constructive criticism if it is necessary to do so. If you have an 'ugly baby,' you want to know it now – and it is very difficult to tell someone that s/he has an 'ugly baby.' So, when you give them your draft to review, you must make very clear that you truly want *meaningful* constructive criticism. You need to underscore that your feelings won't be hurt, even if they are sharply critical. It is much better to hear of problems from members of your pre-submission review committee, rather than from the official NSF reviewers.

OBTAINING PRE-SUBMISSION REVIEW

While the primary responsibility of members of your pre-submission review committee should be to review your final draft, if you select its members early enough, you should ask the two 'expert' members to critique your idea as the starting point for the proposal. The next step should be to seek input from the entire committee on the template or master plan for your Project Description (*Overview & Objectives* and *Expected Significance* sections). If there is something fundamentally wrong with these foundational sections, the time to discover that fact is early on, not after you have built a complete application on that base.

The colleagues who you select as pre-submission reviewers must be willing to take / make the time to provide a thorough review of the Intellectual Merit and Broader Impacts aspects of your proposal. You need to assure them that they will not have to provide editorial input because it is your best and most complete effort, i.e., what would normally be submitted to NSF. You also should advise them that you aren't seeking input on grantsmanship: There is more than one way to package and present an idea successfully and you have chosen to use the approach that is described in this *Workbook*. All they will need to do is identify scientific and technical errors that you may have made in the proposal, which shouldn't require that much of their time. Urge them to review the entire application, not just the Project Description: The other parts of the proposal must be seen by reviewers as being fully supportive of what is proposed in the Project Description.

How do you convince colleagues to invest such effort in the review of your proposal? Some institutions, for example, offer compensation for pre-submission input. Check with your upper administration (e.g., department, college, Research and/or Sponsored Programs Office) to determine whether or not your institution is one of them. If not, the 'compensation' that you offer is that, if they do it for you, you are willing to provide equally sharp constructive criticism of their proposals at some future time. Our experience is that the latter approach works in most cases because it is so compellingly obvious that the outcome of pre-submission review is a much more competitive application.

There are several ways in which to approach getting the results of pre-submission review. For example, you might distribute your draft with a request that members of the committee evaluate it independently before meeting as a group to discuss it. You would then receive both their individual critiques and a collective opinion, i.e., basically the same things that an NSF review panel would provide. If you and the committee members agree that it would be helpful, you might

even meet with them after they have completed discussion of your draft. While this approach works well, it requires that the pre-submission reviewers coordinate a time and place to meet, which may be difficult within the time that they have to perform the review. As an alternative approach that we have found to work well, seek a brief written review from each member (a summary of the most important problems), together with handwritten annotations on your draft. After analyzing each reviewer's comments seek verbal clarification of anything that is unclear or with which you disagree.

If English isn't your first language and you suspect that there may be minor problems with your written English, obtain help pre-submission in eliminating those mistakes. You want your official, NSF reviewers to concentrate exclusively on the content of your proposal, not on distracting mistakes in written English. Helping you to remove such problems should not be a responsibility of members of your pre-submission review committee; they have enough to do in helping you to identify and eliminate scientific and technical errors. Therefore, before giving your final draft to them, we recommend that you turn to another of your colleagues who is a native English speaker for help in correcting mistakes in your written English. Another approach is to make use of a graduate student or junior faculty member in your institution's English department who wants to make a little extra income by providing English editorial assistance. As a third possibility, some institutions have one or more English editors on staff. Check with your Research and/or Sponsored Programs Office to determine if such support is available. As a final source of such support, there are commercial organizations that are comfortable editing scientific and technical documents. They offer revising, editing and proofreading services that will help you to overcome problems that are related to grammar, vocabulary and style. Three that are recommended by the *Journal of Biological Chemistry* can be accessed at: (1) www.biosciencewriters.com; (2) www.bostonbioedit.com; and (3) www.prof-editing.com.

FINAL REVISION AND SUBMISSION

After receiving the comments and suggestions of your pre-submission committee members, you should make the revisions that you think are indicated before submitting your proposal to NSF.

DEVELOPMENTAL STEPS FOR CHAPTER NINETEEN:

1. Choose the members of your pre-submission review panel early in the developmental process – at least two experts and one generalist.
2. Offer to repay your pre-submission reviewers at some later time by acting as a pre-submission reviewer of applications that they are developing.
3. Obtain their independent, informal feedback on the significance of the idea you plan to develop into a grant application.
4. Submit the two-page template or master plan (*Overview and Objectives* and *Expected Significance* sections) to members of your committee. Revise, if necessary, to eliminate any flaws that are found to exist at this early stage.
5. If English is not your native language, consider obtaining editorial assistance to remove errors in grammar, choice of wording and style. Do so before submitting your final draft to your pre-submission review committee.
6. Obtain critical evaluation of your final draft by the members of your pre-submission review committee. Emphasize that you want serious criticism and set up the way that you

will receive their feedback. Ideally, give them two weeks in which to perform their reviews.

7. Revise your final draft based on their feedback. Give yourself approximately one week to do so.
8. Submit your application electronically through your Sponsored Programs Office using either FastLane or Grants.gov.

CHAPTER 20

HOW TO CREATE AN EYE-CATCHING TITLE FOR YOUR PROPOSAL

Creating the title for your application is one of the things that you should do while members of your Pre-Submission Review Committee are evaluating the final draft of your proposal.

You are probably asking yourself, 'Why has an entire chapter been devoted to writing the title?' The answer is, 'It's that important!' Think about it. The title will give reviewers their first impression of your proposal. Then remember that you only get one chance to make a good first impression. Clearly, that old cliché is applicable here. You want the immediate response to your proposal to be positive.

Another reason that titles are so important is that they contribute to a lot of important decisions that will be made about your application by those who process your proposal at NSF. Those individuals won't read your entire application – just parts of it – and the title is one of those parts. For example, a well-written title you can help steer your proposal to the correct review panel.

GENERAL CONSIDERATIONS

TIP: *Your title should emphasize the payoff – the product of the research.*

An especially important point is to emphasize with your title what the research will produce, not the process that will produce it. You should never offer a generic, process-oriented title like, 'Investigations of *Bacillus megaterium*.' Rather, your title should immediately convey to the agency and its reviewers what the mission-relevant payoff from the proposed research will be.

Another important point is that the title should reflect the purpose of the program to which you are responding. For example, the purpose of CAREER awards is to create teacher-scholars – faculty members who will closely integrate their research with teaching. Thus, the ideal title for such a proposal should reflect integration of teaching and research in a specific area.

Read the solicitation you are responding to for any special instructions that pertain to creating the title. One that is commonly included is a stipulation regarding a specific prefix that must be used. Using CAREER awards again as an example, the title must be preceded by "CAREER:".

Grant Proposal Guide: *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. NSF may edit the title of a project prior to making an award.*

Unlike most agencies, there is no limitation placed on the length of the title. As is noted by the instructions in the text box, above, all that is required is that it be brief and clear to all audiences who will make use of it. If it is overly long and/or not clear enough, NSF reserves the right to edit it, as the instructions in the preceding text box point out. At first blush you might conclude that that's not such a bad thing. However, they probably won't do so before the title is seen by reviewers, which goes back to the need to make a good first impression; long, complex, difficult-to-interpret titles often make just the opposite kind of impression.

"Scientifically or technically literate" doesn't refer only to colleagues. That phrase also includes the highly qualified laypersons who will be involved in the processing of your application. The title must be intelligible to them, as well as to the general public. With respect to the latter, nothing in the title should be offensive to that audience. Finally, you need to assure that there is nothing in the title that could be misunderstood if it were taken out of context.

TIPS ON CREATING YOUR TITLE

Titles with the kind of positive impact that you want yours to have aren't often created with the small amount of time and thought that are usually invested. As a strategy, we recommend that your title be created using a modification of an approach that is often used by marketers to develop advertising slogans. They often begin the selection process with as many as 100 'catchy' candidates that they have created. Then, they narrow the number down to the most appealing one using focus groups. That kind of effort is invested in identifying the final catchphrase because often millions of dollars will be riding on its capacity to capture the interest and attention of the audience they are targeting. *Your stakes as a proposal writer are no less great.* In our opinion it is smart business, therefore, to apply the same strategy to development the title that will catch the interest and attention of your target audience, the reviewers of your proposal.

Steps in Creating a Set of Titles

1. To begin, review your application and list all words/phrases that convey important information, significant impact, and/or the novelty of your project. Put variants of the same word (e.g., engineer, engineers, engineering) on the same line. Many of these words and phrases will be highlighted in the text with italics. Pay particular attention to the application's objective in the *Overview & Objective* section and the description of your expected contribution in the *Expected Significance* section. The adjacent statement of significance in the latter section may be of use, as well.
2. Of these words and phrases, do any of them have standard abbreviations / acronyms that would be understood by the general public? A good example is DNA for deoxyribonucleic acid. Another is & for and. Note that wide understanding at the level of colleagues is not sufficient; the abbreviation / acronym must be understood when used in the public press (see preceding textbox). List such abbreviations and acronyms.
3. Once you have listed all words and standard abbreviations / acronyms that could have a role in conveying information about your application, begin arranging them (or variants of them) in combinations and permutations to create a set of titles. For example, were your application about writing successful grant proposals to NSF, and you had listed such key

words as success/successful, format, proposal writing, grantsmanship, NSF, creativity, and competitive, you might formulate titles like:

Creative Formats for Writing Competitive Grant Applications to NSF

NSF Proposal Writing Made Simple: Creative Formats for Successful Applications

Creative Ways To Develop Competitive NSF Proposal-Writing Skills

Keys to Success for Writing Creative, Competitive NSF Grant Proposals

Competitive NIH Grantsmanship Skills Made Simple & Successful

4. Create as many titles as you can in an hour. Then, reduce the number to what you think are your 'Top 10.' Print them.

Steps in Identifying the Best Title – Use of the 'Focus-Group' Approach

1. Show your list of titles to colleagues, both those who are closely related to your field and those who are good scientists but not members of your field. Ask each of them to select the one (or at most two) title(s) from the list that s/he thinks is maximally informative and evocative of interest. It has been our experience that most of your colleagues will select the same one or two, which should tell you that there is something especially appealing about those particular titles.
2. Because titles have to be understood when used in the public press, also take your list of titles to several laypersons -- a spouse or a neighbor, for example. If necessary, do 'person-on-the-street' interviews. Ask such individuals to make their choice. You probably will find that they select the same title(s) that your colleagues chose.
3. Use the information that you have gathered in this manner to narrow the possibilities to no more than three titles. Further refine them until one begins to stand out clearly over the others because of its informative, novel, stimulating character. You will know it when you see it, because it will convey succinctly and compellingly what the payoff of the proposed research program will be. That's your title!

DEVELOPMENTAL STEPS FOR CHAPTER TWENTY:

1. Appreciate that your title should emphasize the payoff from the proposed research.
2. Appreciate that the title must be understood by a broad spectrum of audiences, including the general public.
3. Make a list of words and standard abbreviations that are candidates for use in your title.
4. Create a set of approximately ten titles, using combinations and permutations of the words and abbreviations you have selected.
5. Ask a series of colleagues and laypersons to select the title from the list that is most informative and evocative of interest.
6. Refine the final candidate(s) until it is possible to settle on one of them as your title.
7. Enter the title you have selected in the "Title of Proposed Project" field of Cover Sheet for your application.

CHAPTER 21

HOW TO WRITE THE PROJECT SUMMARY

The *Project Summary* will be read by every reviewer, most especially by those who will be seeing your application for the first time at the review-panel meeting. In our opinion, therefore, this part of your proposal is the most important one in terms of developing advocacy for funding your proposal. In addition, other readers of the *Project Summary* will make important decisions related to your application, based on their interpretation of its content. These will include NSF staff members who will assign your application for review – both in terms of the review panel that will receive it and the persons who will be appointed as your reviewers – as well as those who need to convey to various constituencies (e.g., Congress) what NSF is funding. Your *Project Summary*, probably with some embellishment by NSF, will be included in the agency's public Awards Search database, where it will be read by whoever wants to. Thus, you walk a fine line when you write this part of the proposal. You must include enough to excite your reviewers but not so much that you give away information that can be used to advantage by your competitors.

GENERAL CONSIDERATIONS

The *Project Summary* must not exceed one page. It should be written last, but not at the last minute. The same restrictions on font size, margins and line spacing that apply to the Project Description apply here. With respect to formatting of the page there must be two subsections within the *Project Summary*, one for each of the two major review criteria, ***Intellectual Merit*** and ***Broader Impacts***. To that point, the statement in the textbox, below, is a direct quote from *The Grant Proposal Guide*:

"Proposals that do not separately address both merit review criteria within the one-page Project Summary will be returned without review."

We recommend that the *Intellectual Merit* subsection constitute approximately 2/3rds of the page, with *Broader Impacts* considerations summarized in the remainder. Don't worry about staying within these limits for your first draft; there will be an editing phase as the last step.

In addition to being fully informative of the proposal's content, the *Project Summary* must communicate this information with contagious enthusiasm. Along with the title, this part of your proposal will give reviewers their first impression of your application. Thus, it is potentially an important means of helping to create advocacy for funding your proposal, especially among members of the review panel who have not read your proposal before it comes up for evaluation at the meeting.

The instructions that guide preparation of the *Project Summary* are contained in chapter II.C.2.b

of *The Grant Proposal Guide*. They are, in part:

The Project Summary must be "a summary of the proposed activity suitable for publication ... a self-contained description of the activity that would result if the proposal were funded. ... It should be informative to other persons working in the same or related fields and, insofar as possible, understandable to a scientifically or technically literate lay reader."

Note that what you write must be understandable by a lay person. You should not interpret this to mean 'any' layperson. The operational part of the instruction is "scientifically and technically literate" lay readers. Such persons will primarily be the NSF staff members who will process and assign your application for review after it is received by the agency. Many of their decisions will be of great importance to you, so ensure that you consider their need to understand when you write this part of your proposal.

Note also that the instructions direct that, unlike the rest of the proposal, the *Project Summary* must be written in the third person.

A great deal of information must be coherently distilled into the one page that is allowed. Everything that is included should be about what will be done. There isn't room enough to include descriptions of past accomplishments. For the same reason, background information is not appropriate. Don't worry if the *Project Summary* duplicates some of what is contained in other parts of your application. It has to. Such duplication can't be – shouldn't be - avoided because the *Project Summary* must be a stand-alone, "self-contained" document that does not need the rest of the proposal to be understood.

RECOMMENDED STEPS FOR DEVELOPMENT OF THE *PROJECT SUMMARY*

We recommend that you use two bolded, italicized subtitles to convey that you have complied with the directive to summarize your proposal with respect to the two major review criteria. To save a little space, we additionally recommend that you offer only a single paragraph under each subtitle with the first line of the related paragraph on the same line as the subtitle, as is illustrated below.

Intellectual Merit Subsection. Rather than following a summary of what will be done with a separate statement regarding the project's Intellectual Merit, we recommend that you combine the two. They are inseparable, in our opinion. Accordingly, both should be presented in a single, integrated paragraph.

To write this subsection of the *Project Summary* we recommend that you follow these steps:

1. Open with a sentence that succinctly describes the gap in the knowledge base or unmet need that will drive the application.
2. Follow with the sentences from the *Overview & Objectives* section in which you highlighted key words with italics. They are designed to set up a compelling progression of logic when they are juxtaposed, one after the other. Retain the italicized key words.
3. Insert the project's specific aims and the primary methods/approaches that will be used to accomplish each between the 'rationale' and 'creativity / originality' components.

4. Conclude this subsection of with the 'contribution' sentence, followed by the 'statement of significance' sentence, from the *Expected Significance* section.
5. Edit the file to be approximately 2/3rds of a page.

Broader Impacts Subsection. This subsection must be as well conceived and crafted as the subsection that addresses Intellectual Merit. It cannot come across as a tacked-on afterthought. Use the same general approach that you used to create the Intellectual Merit subsection, i.e., copy and paste the highlighted sentences from your Project Description's *Broader Impacts* section, one after the other, into this subsection of the *Project Summary*. Embellish with enough detail to optimize readability and comprehension. Edit what you have written to fit within the remainder of the *Project Summary* page, i.e., the space that follows the Intellectual Merit subsection.

PROPRIETARY / PRIVILEGED INFORMATION

Patentable ideas, trade secrets, privileged / confidential commercial or financial information should never be included in the *Project Summary* because, if you do, when your proposal is funded that information will likely be included in NSF's public Awards Search database. In other words, it will likely enter the public domain.

If you must include sensitive information in your application in order to give reviewers a full appreciation of it, you must first check the Proprietary or Privileged Information box on the Cover Sheet. You then have two options. You can mark the parts of the text that are sensitive by preceding it with the following statement:

"The following is (insert either proprietary or confidential) information that (name the proposing organization) requests not be released outside the government, except for purposes of review and evaluation."

While this is helpful, reviewers of your application – other scientists with closely related expertise – will have access to the material. In addition, you have to remember that any funded federal grant can potentially be obtained in its entirety through the Freedom of Information Act. Therefore, putting the sensitive information in the body of your proposal, even when accompanied by the above statement, doesn't necessarily protect it from access by those outside the review and evaluation system. *The Grant Proposal Guide* indirectly reflects this fact by closing this part of the instructions with the following caveat: "While NSF will make every effort to prevent unauthorized access to such material, the Foundation is not responsible or in any way liable for the release of such material."

An alternative approach is to send sensitive material to NSF as a separate, single-copy document (see section II.C.2 of the *Grant Proposal Guide*). Doing so is detailed on the FastLane Web site (<http://www.fastlane.nsf.gov/help/proprietary.htm>) through which the material must be submitted. If you utilize this approach reviewers will not receive the material; only Program staff will have access to it. This approach may also make it easier for NSF to safeguard what you submit because, technically, it is separate from the grant application (and, therefore, the grant, after the proposal is funded). We recommend that you closely coordinate your use of this approach before using it.

In addition, because of the potential risk that is associated with either of the approaches referred to above, before providing sensitive information in, or in association with, your grant application we recommend that you first discuss doing so with the person at your institution who is responsible for protecting intellectual property. If s/he is not concerned, you probably shouldn't be, either. If s/he is, we recommend that the two of you directly contact the relevant NSF administrator to discuss your concerns. If that administrator cannot answer your questions satisfactorily, keep asking higher levels of authority until you are satisfied that the NSF-recommended approach will (or will not) safeguard what you want to include. Then make your decision regarding whether to submit the material, or not.

DEVELOPMENTAL STEPS FOR CHAPTER TWENTY-ONE:

PROJECT SUMMARY

1. Write the *Project Summary* after the entire Project Description has been completed.
2. Make sure that the *Project Summary* follows the same instructions for formatting that are applicable to the Project Description.
3. Make certain that the two major review criteria, Intellectual Merit and Broader Impacts, are summarized in two, separate subsections. The former should constitute about 2/3rds of the page allowed in the final, edited version, with the latter subsection comprising the remainder.
4. When you first draft the subsections of the *Project Summary* don't worry about staying within the one-page limit. Write what you think is needed using the approaches described above. Then, edit the content to make it fit the space available.
5. Show the final draft of your *Project Summary* to several knowledgeable colleagues (other than members of your Pre-Submission Review Committee). Ask whether or not: the flow of logic is clear; the gap or need to be addressed is well delineated; the intellectual merit of the proposed work and its impact on the field is evident; the broader impacts of the research are clear and credible; and whether or not the *Project Summary*, overall, engenders enthusiasm.
6. Use the feedback you obtain, if any, to finalize the *Project Summary*.

PROPRIETARY/PRIVILEGED INFORMATION

7. Assure that nothing sensitive is included in your *Project Summary*.
8. Decide whether or not it is really necessary to include proprietary / privileged / confidential information in the body of your application.
9. If so, select the approach that you propose to use – either marked sections within the body of the proposal or submission of the sensitive material as a separate, single-copy document. Then, consult the official at your institution who is in charge of protecting intellectual property. Does your approach meet with his/her approval?
10. If necessary, together with your institution's intellectual-property officer, contact the relevant official at NSF to determine the extent to which the material that you would like to include will / will not be protected.

PROGRAMS AVAILABLE FROM GWSW

SPONSORED SEMINARS:

Institutional or societal sponsorship is required. Emphasis is on principles and fundamentals, as well as practical tips and strategies that are relevant to writing successful proposals or manuscripts. Seminars are tailored to meet audience needs. There is no limit on attendance.

Write Winning Grant Proposals

This all-day seminar is designed to address practical and conceptual considerations that are critical to the proposal-writing process. It is designed for faculty members and administrative staff who have had some exposure to writing grant applications.

Strategies for Maintaining NIH Funding Long Term

A half-day seminar that focuses on writing renewal applications, as well as other strategies for maintaining long-term grant support.

Getting Started as a Successful Proposal Writer

This all-day seminar provides new investigators with detailed strategies on how to write a grant application. Appropriate for senior graduate students, post-doctoral research fellows, and new assistant professors (both tenure and non-tenure track).

How to Write a Successful Career Development Award Application

This half-day seminar focuses on Career Development Awards in general, but primarily targets NIH K Awards and F32 Individual Postdoctoral Fellowship proposals. The program is designed to be of value to both candidates and their mentors.

Write a Successful NSF CAREER Award Proposal

In this half-day seminar, participants are guided in the preparation of a competitive NSF CAREER Award, with emphasis on effective integration of research and educational components, as well as on how to avoid mistakes that cause most CAREER proposals to fail.

Writing for Biomedical Publication

In this full-day seminar, attendees receive detailed instruction on all aspects of manuscript preparation, choosing appropriate co-authors and journals, copyright issues, plagiarism, effective revision and resubmission strategies, as well as how the review process operates.

WRITE AND SUBMIT A COMPETITIVE GRANT APPLICATION:

- 1.) ***Comprehensive Workshop:*** Designed for up to 30 persons, minimum of 15. Includes on-site group exercises and individual guidance, ranging from inception of the idea to submission of the fully completed application.
- 2.) ***Grouped Individual Consultations:*** Up to 30 persons, no minimum. Similar to the Workshop except that on-site group work is not included. Allows greater individual flexibility in setting writing schedules. The outcome is a fully completed grant application.

ON-SITE AND ELECTRONIC CONSULTATIONS:

- 1.) ***Individual:*** One-on-one interaction by e-mail, telephone and Skype with one of Grant Writers' consultants in the development of a new or revised application.
- 2.) ***Institutional:*** On-site and/or electronic consultation on the writing of large, multi-investigator proposals to any federal or non-federal agency – program projects, training grants, center proposals, and construction applications.

For a detailed description of each program, please visit our Web site at www.grantcentral.com . If you would like to approach your institution to sponsor one or more of our programs, just contact us at info@grantcentral.com. We can help you make your request.

About the authors...

Dr. Morrison and Dr. Russell bring to Grant Writers' Seminars and Workshops a commitment to excellence along with an extensive record of success. Each has a history of continuous funding by NIH throughout his research career, beginning in the early 1970s. This has included Research Career Development Awards for both, and a ten-year MERIT Award to Dr. Morrison. Other sources of their funding have been USDA, The American Cancer Society, various foundations and industry. Both have served on multiple national review panels, including NIH study sections. In addition, each has been recognized for teaching excellence and innovative approaches to instruction. Presently, their successes continue to be reflected in the number of funded grants received by their ever-expanding list of clients.

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*University of Florida (Professor and Chairman, Department of
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*University of Kansas Medical Center (Wilkinson Distinguished
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Stephen W. Russell

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*Ph.D. (Molecular Biology and Biophysics) Yale University
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