

**Final Report of the Committee of Visitors**  
**for the**  
**Faculty Early Career Development (CAREER) Activity**

**Meeting Dates:**  
**May 2-4, 2001**

**Timothy Tong**  
**Committee Chair**

**Submitted July 30, 2001**

**Prepared by:**

**SRI International**  
**Center for Science, Technology,**  
**and Educational Development**

**1611 North Kent St.**  
**Arlington, VA 22209-2111**



July 30, 2001

OFFICE OF THE DEAN

Dr. Rita Colwell  
Director  
National Science Foundation  
Arlington, VA 22230

Dear Dr. Colwell:

It is my pleasure to transmit to the Foundation the final report of the Committee of Visitors that met May 2-4, 2001, to examine the Faculty Early Career Development Program, also known as CAREER.

This was the first COV review of CAREER since its beginning in FY 1994, and covered six years of the program, through proposal decisions made in FY 2000. The Committee was comprised of 18 members representing fields of research and education throughout the Foundation, including one member from each Directorate's advisory committee and one member from the Committee on Equal Opportunity in Science and Engineering. Membership was balanced with respect to gender, race, and geography, and included individuals with all levels of experience, ranging from deans and senior researchers and educators to CAREER awardees.

The Committee was pleased to have the opportunity to review CAREER. As you will see, we fully support its purposes and goals, and our comments and recommendations are offered in the spirit of making this important activity even more successful. We urge the Foundation to give full consideration to the recommendations, and stand ready to discuss any of them if you or your staff wishes to do so.

I would like to recognize and thank all the members of the CAREER Coordinating Committee, particularly its Chair at the time of the meeting, Dr. Alison Flatau; Ms. Patricia Goheen of the Office of Integrative Activities, without whose thoughtful and timely assistance our meeting would not have taken place; and Jim McCullough and Steve Perakis of SRI International, who provided all the necessary analytic information and drafted our report.

I would especially like to thank you and Dr. Martin-Vega for helping to get the Committee's meeting off to a good start, and Dr. Bordogna for his clear and constructive discussions about our recommendations at the end of the meeting.

Sincerely,

Timothy Tong, Ph.D.  
Committee Chair

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**Report of the Committee of Visitors**  
**Faculty Early Career Development (CAREER) Activity**  
**May 2-4, 2001**

**I. Executive Summary**

**CAREER is NSF's most prestigious program for newer investigators. The Committee fully supports its purposes and goals. CAREER should continue to receive high priority for funding across the Foundation.**

The fundamental concept of CAREER -- integrating research and education -- addresses an important and timely issue for colleges, universities, and school systems. All levels of education will have to be infused with the excitement, methods, and findings of cutting-edge research if our nation is to meet its needs for large numbers of people who are well educated in the sciences, mathematics, engineering, and technology. Some investigators, through CAREER and similar efforts, are integrating their research in various ways with undergraduate and/or K-12 education. At the same time, NSF is expanding its support for integration by means other than CAREER, such as the Integrative Graduate Education and Research Traineeships program. Compared to the size of the national education enterprise, however, these individual and organizational efforts are still on a small scale -- but they are seminal, and the Committee encourages NSF to support and propagate them.

The Committee was pleased to have the opportunity to review CAREER. Our comments and recommendations are offered in the spirit of making this important activity even more successful, by: (1) helping proposers and reviewers better understand how research and education can be integrated usefully; (2) broadening the base of applicants; (3) encouraging submission of more proposals and funding of more awards in programs where much smaller awards are the norm; (4) strengthening the processes used to decide which proposals to fund; and (5) continuing to gather the information needed to

understand the underpinnings and impacts of CAREER so as to better manage it as a Foundation-wide activity.

Our recommendations are presented in five categories that parallel the five purposes presented above. The explanation for each recommendation may be found in section III of this report. Several other observations and discussion topics that did not become committee recommendations are presented in Attachment A.

**NSF should:**

**1. Strengthen the emphasis on integrating research and education, by:**

- **making selected examples accessible on the web and presenting them at workshops, and further clarifying proposal solicitations, so as to provide better information to prospective applicants about the intent of CAREER and possible methods of integration;**
- **developing assessment indicators for awardees to use over the course of their award and within the missions of their institution, to assess the progress, impact, and outcomes of their education and career development plans;**
- **once assessment indicators are disseminated, instructing program directors to return annual and final reports that do not contain sufficient information about progress, impact, and outcomes;**
- **strengthening institutional buy-in and respect for awardees' education plans during the award, and afterwards; and,**
- **designing a declination letter for CAREER proposals that does not leave the impression that the proposal was reviewed on its research merits only.**

**2. Achieve broader diversity of proposing individuals and institutions, by:**

- **staging regional workshops for eligible investigators, specifically including those whose CAREER proposals have been declined;**
- **reaching out to types of institutions other than the major research universities, such as minority-serving institutions, predominantly undergraduate institutions, and those in EPSCoR jurisdictions; and,**

- **assisting professional societies in presenting sessions or workshops about CAREER as part of their regular meetings.**

**3. Encourage submission of more proposals and funding of more awards in divisions and programs where much smaller or larger award sizes are the norm, by addressing the gap between their CAREER award amounts and the amounts for their normal research grants.**

**4. Improve effectiveness of award selection, by:**

- **requiring reviewers to apply review criterion two to CAREER proposals;**
- **ensuring that CAREER reviewers and panelists are diverse in terms of geography, type of institution, gender, disability, and minority status; and,**
- **including reviewers for each CAREER proposal who are qualified to assess plans for integration of research and education.**

**5. Continue its efforts to assess program impact and management effectiveness, by, for example:**

- **understanding the perceptions of eligible applicants who choose not to apply, (e.g., faculty at minority-serving and/or predominantly undergraduate institutions who may be hesitating because they believe that they are at a disadvantage);**
- **determining the degree to which CAREER awardees succeed in obtaining follow-on awards from NSF and other funding sources;**
- **determining CAREER applicants' prior award/decline profiles with NSF, including earlier submissions to CAREER, and with other funding sources;**
- **and assessing the long-term impact of CAREER in light of the goals NSF has set for it.**

## **II. Meeting Summary**

The CAREER Committee of Visitors (COV) met at NSF in Arlington, VA, on May 2-4, 2001 (Attachment B is the meeting agenda). CAREER proposals are extraordinary in that they support applicants' integrated plans for research and education and are managed by all the research-supporting divisions of the Foundation. The composition of the COV reflected the special nature of this activity, in terms of both their fields of membership and their range and depth of experience. Members were provided a unique opportunity to examine review methods, proposal files, and reports for CAREER across a broad range of funding programs in every directorate.

This was the second COV review coordinated by a contract firm, in this case, SRI International's Center for Science, Technology, and Educational Development, in Arlington, VA. Members of NSF's internal CAREER Coordinating Committee (CCC) served as an advisory panel for the SRI project manager. The CCC also served in important roles as liaison with their individual directorates by providing lists of nominees, commenting on preliminary versions of the charge and other documents, and providing information to COV members during the meeting.

SRI organized the COV by contacting candidates nominated by each NSF directorate. Membership was designed to be balanced across fields of research and education, across career stages (i.e., from deans and department chairs to recent CAREER awardees), and with respect to gender, race/ethnicity, geography, and where possible, type of institution. Moreover, at least one member representing each directorate was a current or past member of that directorate's advisory committee.

The CCC determined that, based on relative CAREER proposal loads, three directorates (ENG, CISE, MPS) would each be represented by three members; three directorates (BIO, SBE, and GEO) by two members; and the Office of Polar Programs by one member. The EHR directorate would also be represented by three members, in view of the importance of education plans to CAREER. Before the meeting, however, the third representative of the Engineering directorate withdrew. Attachment C contains the qualifications of the 18 members.

Since this was the first COV review of CAREER, the time period for assessing results was the six years from its initiation (FYs 1995-2000) rather than the standard past

three years. The period chosen for assessing review processes was FY 2000, the most recent year for which all proposal actions had been completed. Review of one year of proposal management instead of the standard three years was determined by the CCC to be sufficient in view of the very large volume of CAREER proposals received annually, and because the terms of the program had changed over the years, so that past proposal requirements and review processes were not entirely consistent with present ones.

Prior to the meeting, SRI e-mailed to members the COV guidelines and the committee “charge,” as modified by the CCC to address CAREER issues. Hard copies of those documents, along with program data, an evaluation of the program’s early years by Abt Associates, and other information were included in a notebook mailed to members. During the meeting, additional information involving “closed session” matters was provided at various times. To facilitate the entry of information into the modified COV report template, each member was provided with a personal computer.

On Wednesday morning, May 2, Dr. Louis Martin-Vega, Assistant Director for Engineering and NSF’s Senior Management Integration Group’s CCC liaison, opened the meeting with welcoming remarks and observations on the development of CAREER and its relevance to NSF’s mission and strategic plan. Dr. Colwell, NSF Director, welcomed the committee, noted the unusual breadth of membership and responsibilities, and highlighted the importance of CAREER for helping promising new researchers become the academic leaders of the 21<sup>st</sup> Century.

Dr. Tong, Committee Chair, described the general responsibilities of COVs. He emphasized the importance of confidentiality and laid out rules for avoiding conflicts of interests. Mr. Burt of the Office of Integrative Activities briefed members about the Government Performance and Results Act (GPRA) and its relationship to COV reports. Dr. Flatau, Chair of the CCC, briefed members about the purposes of CAREER, the manner in which proposals are handled and coordinated, and the results of various data analyses that SRI had prepared for the meeting. Mr. McCullough of SRI briefed the committee about the core questions and reporting template, the contents of proposal jackets, and the process by which the report would be developed.

The Committee agreed to be divided into two teams, one responsible for developing views about Part A of the template (review processes and management), and



the other for views about Part B (program outputs and outcomes). For assessment of Part A, SRI had prepared an indexed collection of more than 120 proposal file “jackets” representing all NSF research divisions. Likewise, for assessment of Part B, SRI had prepared an indexed collection of 70 final reports (or in a few cases, latest annual reports) from awards made in fiscal years 1995 and 1996. In addition, Dr. Flatau worked with the NSF Division of Information Systems to establish password-protected on-line access for the COV members to all CAREER electronic jackets and annual and final reports.

Using worksheets, each member of Team A examined a minimum of ten proposal files, according to the following formula: four from the directorate he or she was representing; one each from BIO, CISE, ENG, and MPS; and two at the member’s choice. This method ensured that each member would see files from several directorates while focusing on those from the directorate with which he or she was most familiar. As time allowed, each Team A member also reviewed some number of final reports. Conversely, each member of Team B began by reviewing final reports according to the formula described above, and then reviewed proposal files as their time allowed.

On Thursday morning, May 3, teams A and B met separately to develop their preliminary reports. On Thursday afternoon, the Committee met as a whole to hear and comment upon the report of Team A, then that of Team B. By mid-afternoon, members began discussing their general observations and developing preliminary recommendations. (The reports of both teams have been incorporated into the common COV report format, using the reporting template. See Attachment D.)

On Friday morning, May 4, the Committee met to review, synthesize, and categorize their recommendations. The recommendations and the reasons for them are described below. In late morning, Dr. Joseph Bordogna, NSF Deputy Director, met with the Committee to hear and discuss their findings. Dr. Bordogna stated that he found the discussions useful and thought provoking, and that the Committee’s findings would be given serious consideration by top management. Following that session, Dr. Tong briefed CCC members and other NSF staff. He then adjourned the meeting approximately at noon. Members agreed that the report should be completed using e-mail.

### **III. Recommendations. NSF should:**

#### **1. Strengthen the emphasis on integrating research and education, by:**

- **making selected examples accessible on the web and presenting them at workshops, and further clarifying proposal solicitations, so as to provide better information to prospective applicants about the intent of CAREER and possible methods of integration;**
- **developing assessment indicators for awardees to use over the course of their award and within the missions of their institution, to assess the progress, impact, and outcomes of their education and career development plans;**
- **once assessment indicators are disseminated, instructing program directors to return annual and final reports that do not contain sufficient information about progress, impact, and outcomes;**
- **strengthening institutional buy-in and respect for awardees' education plans during the award, and afterwards; and,**
- **designing a declination letter for CAREER proposals that does not leave the impression that the proposal was reviewed on its research merits only.**

The current guidelines for CAREER proposal submission<sup>1</sup> state that the intent of the program is to enable new faculty to develop careers as outstanding teacher-scholars in the context of the missions of their institutions. It goes on to emphasize the importance that NSF places on “early development of academic careers dedicated to stimulating the discovery process in which the excitement of research is enhanced by inspired teaching and enthusiastic learning.” The aim of the program is to effect social change within departments, research departments especially, in order to broaden the perspective on the integration of research and education.

The means to integration of research and education is knowledge transfer, principally achieved by teaching students – a much different emphasis than research training *per se*. In this light, the Committee was disappointed to find many proposed and funded education plans that were either mundane (i.e., nothing more than usually

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<sup>1</sup> NSF 01-84 (<http://www.nsf.gov/pubs/2001/nsf0184/nsf0184.htm>)

expected of a new researcher), unrealistic in their broad scope and complexity, or uninformed about current ideas and practices in education.

NSF's message about the value of transferring knowledge in the classroom, as differentiated from research training, has not been made entirely clear to proposers. While the annual proposal guidelines have evolved to list many types of education activities for proposers to consider, the concept of integration needs further clarification. Additionally, with several years of programmatic experience, NSF is now in a better position to help proposers broaden their thinking about realistic plans for integrating research and education by making available a range of models and examples.

Many of the final reports mentioned course and curriculum reforms but did not describe them in detail. We are concerned that PIs without real knowledge of current practices may have been "re-inventing the wheel." It is important that CAREER PIs invest their time in education in a way that is consistent with research and best practices in curriculum, pedagogy, and evaluation. We would value plans that connect to successful educational work (i.e., for which there are research results that demonstrate their effectiveness), rather than plans that reinvent solutions or use limited resources and energy to create poor imitations.

Developing new pedagogies is not the purpose of the program. Many PIs would benefit from trying something that is not necessarily a new pedagogy, but one that is different for their institution. In any event, the program should not encourage educational innovations that are disconnected from the body of research in education.

Consistent with NSF policy, multidisciplinary work should be done in partnership with experts in the field. The program already permits partnering and collaboration, as long as a collaborator is not a co-PI or equivalent. We would strengthen this aspect to strongly encourage proposers to include among their collaborators, advisors, and mentors individuals with expertise in the area of education that they wish to address. Again, the current guidelines do support this sort of partnership – but it is a novel idea that needs to be encouraged more explicitly.

Many annual and final reports contained sufficient information to assess the contribution of the awardee's research. They did not, though, have enough information to properly assess the awardee's progress, or the impact and outcomes of his or her plan.

NSF should develop assessment indicators and a “user-friendly” process for awardees to use – one that does not require extensive reporting or much training in evaluation methodology. Once that has been done, and all awardees informed about how they are expected to use the indicators, program directors should begin returning reports that do not contain adequate assessment information. Development of indicators for this purpose would also provide NSF with better tools for determining the overall value of CAREER.

Finding effective ways to create and strengthen true institutional partnerships with awardees throughout the duration of their awards will strengthen the groundwork for continuing those partnerships afterwards, thus greatly fostering sustainability of integration efforts. One problem reported to us, though we do not know its extent, is that some CAREER awardees at smaller institutions, once in the spotlight, are lured away by major institutions. We did find an example among completed awards, where the PI transferred to a major state research university from a Historically Black University, only a few months after the CAREER proposal was awarded. Such transfers are hardly an incentive for smaller institutions to commit to future CAREER proposals. And, arguably, one or two CAREER awards at a smaller institution may have more relative impact than one or two more to a research university that has many of them. NSF should determine the extent to which this practice occurs, and explore strategies to provide institutional support to smaller institutions to increase the likelihood that investigators will remain at those institutions once the award has been received or completed.

Finally, the Committee noted that most research divisions send unsuccessful PIs the standard proposal declination letter, which in effect states that the proposal had been judged on its research merits, and does not comment in detail about education or career development plans. Along with the verbatim reviews and panel summary, which also presently focus mainly on the research aspects, the declinee may be led to conclude that the other aspects of the proposal were not important. NSF should draw up a declination letter for CAREER proposals that makes clear that all aspects of the proposal were reviewed.

**2. Achieve broader diversity of proposing individuals and institutions, by:**

- **staging regional workshops for eligible investigators, specifically including those whose CAREER proposals have been declined;**
- **reaching out to types of institutions other than the major research universities, such as minority-serving institutions, predominantly undergraduate institutions, and those in EPSCoR jurisdictions; and,**
- **assisting professional societies in presenting sessions or workshops about CAREER as part of their regular meetings.**

The Foundation should make special efforts to reach prospective applicants beyond those in the major research universities. Over the first six program years (FY 1995 to FY 2000), 14 universities each submitted 100 or more proposals, and one of them submitted 195 proposals. During that same period, almost 300 institutions submitted either one or two proposals. Talented people who should be encouraged to apply for CAREER support are spread throughout all levels of higher education. Moreover, the leaders of academia in the 21<sup>st</sup> Century will not all be products of large research and doctoral universities; many will emerge from primarily undergraduate and minority-serving institutions. Unlike the major research universities, some of these institutions do not have the benefit of large sponsored project offices to inform and assist their faculty – all the more reason for increased outreach efforts. Where individuals do not have such resources, another strategy would be to encourage former and current CAREER awardees to make themselves available for one-on-one consultation.

**3. Encourage submission of more proposals and funding of more awards in divisions and programs where much smaller or larger award sizes are the norm, by addressing the gap between their CAREER award amounts and the amounts for their normal research grants.**

The experiences of some of our members, conversations with their colleagues, and NSF staff's responses to the Committee's questions on this point lead us to believe that stipulating the same minimum amount for CAREER awards across all programs may

be working against the broader purposes of CAREER. Across programs, the average size of CAREER awards now ranges from about \$200K to about \$400K, and the minimum is scheduled to rise to \$300K for FY 2002 awards. The existence of a Foundation-wide minimum places greater burdens on some program budgets than on others. In our review of proposal files we saw that arguably fundable CAREER proposals had been declined because of their size relative to the funding program's norms – and this applied to proposals that were both larger and smaller than the norms.

Although it has not been studied systematically, in programs having relatively small median awards (e.g., social sciences, mathematics), it appears that the tradeoff for funding one CAREER award is to decline several non-CAREER proposals involving other new, or senior, investigators. This type of tradeoff is true of all programs, of course, but is much more difficult when the minimum CAREER award size is far more than that usually awarded to a senior investigator in that field.

We recommend that measures be taken to equalize the burden across programs. In keeping with the prestige of CAREER, NSF should develop a guideline that permits uniformity in approach but diversity in results. Addressing this issue could be approached in a number of ways. One would be to increase the size of normal research awards in the various small-median-award programs rather than reducing the CAREER award minima. A contrasting approach would be to completely remove the constraint of a minimum. If a minimum must be identified to ensure the prestige of the award (other than doing so through the five-year duration) then make the minimum for each program a multiple (e.g., 1.5 or 2.0 times) of its median award size for the past fiscal year (excluding non-comparable items such as awards for groups, centers, and departmental equipment).

Without an index CAREER in some sectors will be forever hampered by the relatively low or relatively high awards normally given in other sectors. If this recommendation is adopted, medians and multiples should be calculated using a standard set of rules (preferably by a single responsible party) and promulgated to program directors before the annual CAREER proposal receipt deadlines.

#### 4. Improve effectiveness of award selection, by:

- **requiring reviewers to apply review criterion two to CAREER proposals;**
- **ensuring that CAREER reviewers and panelists are diverse in terms of geography, type of institution, gender, disability, and minority status; and,**
- **including reviewers for each CAREER proposal who are qualified to assess plans for integration of research and education.**

As a recent *Science* article<sup>2</sup> points out, many reviewers of NSF proposals are not paying sufficient attention to the “new” review criterion two, namely, broader impacts of the proposed work. Since by definition each CAREER proposal is designed to meet criterion two considerations, there is no reason for reviewers to ignore it. Nevertheless, we found that in many cases, reviewers paid considerable attention to criterion one but took a superficial approach, or none at all, to criterion two topics.

The Committee applauds the Foundation’s recent step to divide the review module in FastLane into two parts, to focus reviewer attention on each criterion. Still, instructions to CAREER reviewers and panelists should be strengthened specifically to promote more attention to reviewing the proposer’s education and career development plans and their integration with research plans. Program directors must also be vigilant in ensuring that panel summaries include evaluations of both criteria.

The review process would be much more effective if program directors more actively sought panelists and mail reviewers among educators, education researchers, earlier CAREER awardees, and others whose experience and outlook with education considerations can be brought to bear. All CAREER proposals should be assessed by at least two such reviewers, whether by mail or in panel. As a first measure, program directors in the Education and Human Resources directorate could be asked to help their counterparts in the research directorates by suggesting qualified reviewers.

Also in terms of better informing the review process, the Committee recommends that program directors more actively seek diversity among reviewers and panelists by drawing from the full range of eligible institutions and geographic areas (particularly including EPSCoR states), and among women, the disabled, and members of

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<sup>2</sup> *Peer Review: NSF Scores Low on Using Own Criteria*, *Science*, Vol. 291, 30 March 2001.

underrepresented minority groups. We recognize that these are existing general Foundation policies, but we wish to re-emphasize the importance of involving such reviewers and panelists in CAREER.

Given the lack of data on the race/ethnicity of individual reviewers, we were not able to assess the extent of participation of reviewers and panelists from underrepresented minority groups. We understand that NSF is considering approaches to collecting such information, and we support the Foundation's efforts in this regard

The Committee also noted that it is the practice in some divisions for program directors simply to convey information to the proposer about the mechanics of a panel review, and rely on the panel summary and the verbatim reviews to convey the reasons for the recommendation. Where it is not the practice now, we urge program directors when preparing recommendations to set forth their own independent analysis of the proposal, on each of the criteria.

**5. Continue its efforts to assess program impact and management effectiveness, by, for example:**

- **understanding the perceptions of eligible applicants who choose not to apply, (e.g., faculty at minority-serving and/or predominantly undergraduate institutions who may be hesitating because they believe that they are at a disadvantage);**
- **determining the degree to which CAREER awardees succeed in obtaining follow-on awards from NSF and other funding sources; and,**
- **determining CAREER applicants' prior award/decline profiles with NSF, including earlier submissions to CAREER, and with other funding sources; and,**
- **assessing the long-term impact of CAREER in light of the goals NSF has set for it.**

A considerable amount of analytic information was generated expressly for our meeting. We strongly encourage NSF to continue to build on this base of information, and to use it continually to assess CAREER.



FY 2002, for which proposals are now being solicited, will be the program's eighth year. Although its aims and management processes have evolved, some matters of programmatic interest remain for which there is little or no good data. An example of interest to program managers and applicants alike is the extent to which CAREER declinees persist and eventually get a CAREER award, or decide instead to pursue non-CAREER NSF research awards. Another is the extent to which PIs who have completed their CAREER awards are successful in obtaining a subsequent grant.

Importantly, some parts of the higher education community perceive that CAREER exists mainly or exclusively for the benefit of a relative handful of large research universities. NSF should find out whether, and if so, why, applicants from predominantly undergraduate, minority-serving, and EPSCoR institutions hesitate to submit CAREER proposals, especially where their departments have well-regarded research efforts. Available information can be taken into account when planning the workshops proposed in recommendation #2 above.

Awardees from the early years of CAREER, FYs 1995 through 1998, have or will soon be completing their projects. There are probably enough of them, in diverse fields and institutions, that a useful outcomes study can be designed. By surveying and interviewing a sample of these PIs, the Foundation would be able to have a much clearer picture of the effects of CAREER on research, education, personal advancement, and institutional change.

In addition to providing a better basis for program management and decisionmaking, the kinds of analytic and evaluative information described above can also prove to be very valuable to the Foundation in explaining and defending its programs to OMB and Congress.

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In conclusion, the Committee was gratified to have had the opportunity to review this important activity by examining files and decisions from programs all across the Foundation, and to offer our views on how to strengthen and broaden CAREER. We look forward to learning of the Foundation's responses to our recommendations, and the actions that flow from them.

## **Appendix A: Other Discussion Points**

Several Committee members suggested additional topics in the course of the meeting, but these were not fully discussed. They are presented here, in no particular order.

1. Awarding planning grants to eligible applicants at less-endowed institutions would allow them the time and financial resources to devise sound CAREER proposals.
2. Designing reward and recognition mechanisms for successful implementation of CAREER plans would focus more attention on the results of awardees' work, and provide additional models for applicants to consider.
3. Permitting CAREER budgets to pay a share of support for education partners would make it easier for awardees to arrange collaborations.
4. Creating a mid-CAREER program would offer a boost to successful investigators who are no longer eligible for CAREER but who are interested in integrating research and education. This point arose from the observation that more senior scientists are sometimes more open to broadening their scope than junior ones, who still may be driven by research-oriented promotion and tenure guidelines. Moreover, having senior faculty involved in integration of research and education would help effect institutional change.
5. Broadening the terms of CAREER to include co-PIs could allow investigators to synergize their separate strengths, and open the door to situations where a PI at a major research university could work directly with one at a smaller institution. Along the same lines, perhaps it is time to reconsider the entire mode of investing in single PIs. Is this approach becoming outmoded in an age of interdisciplinary work and teaming?

**Attachment B to Final Report dated July 30, 2001 for CAREER COV**

**AGENDA**

**Faculty Early Career Development (CAREER) Program  
Committee of Visitors Meeting**

**Wednesday, May 2 and Thursday, May 3, from 8:30 a.m. to 5:30 p.m.  
Friday, May 4, from 8:30 a.m. to 12:00 p.m.**

**Room 1295 (Director's Conference Room)**

<b>Date</b>	<b>Time</b>	<b>Activity</b>	<b>Speaker</b>
<b>May 2</b>	8:00-8:30	Refreshments	
	8:30-8:45	Welcome, Introductions	Timothy Tong, Chair, COV Rita Colwell, Director, NSF Louis Martin-Vega, CCC Liaison to Senior Management
	8:45-9:45	Overview of GPRA	Joseph Burt, Senior Staff Associate, OIA
		Confidentiality and Conflicts of Interest	Alison Flatau, Chair, CCC
		Review of COV Process and Mechanics	Jim McCullough, SRI
		Review Core Questions and Report Template	
		Overview of Jacket Contents	
	9:45-10:00	Break	
	10:00-11:15	Overview of CAREER Program & Discussion	Alison Flatau, Chair, CCC
	11:15-12:00	Review/Revise Agenda for Remainder of Meeting	Timothy Tong, Chair, COV
	12:00-1:00	Working Lunch	
	1:00-3:00	Begin Discussing Topics Relating to Report Part A and Part B; begin review of jackets and annual/final reports (Closed Session)	
	3:00-3:15	Break	
	3:15-5:30	Continue Report Part A & B/Review of Jackets, annual & final reports (Closed Session)	
	5:30	Adjourn	
5:30-6:30	Informal reception with COV members and CCC members-room 530		
7:00	Dinner		

**Attachment B to Final Report dated July 30, 2001 for CAREER COV (concluded)**

<b>Date</b>	<b>Time</b>	<b>Activity</b>
<b>May 3</b>	8:00-8:30	Refreshments
	8:30-9:00	Executive Session-COV members and invited staff
	9:00-10:00	Part A and Part B teams meet separately & discuss topics related to report and begin drafting report
	10:00-10:15	Break
	10:15-12:00	Continue Drafting Part A & Part B Reports
	12:00-1:00	Lunch
	1:00-3:15	Begin discussing issues related to report and overall CAREER issues
	3:15-3:30	Break
	3:30-5:30	Integration of Drafts for final report
	5:30	Adjourn

<b>Date</b>	<b>Time</b>	<b>Activity</b>	<b>Speaker</b>
<b>May 4</b>	8:00-8:30	Refreshments	
	8:30-10:00	Finalize Report Draft	
	10:00-10:15	Break	
	10:15-11:15	Executive Session Report to NSF Senior Management	Joseph Bordogna and Assistant Directors
	11:15-12:00	Overview of COV Findings Closing Remarks	Timothy Tong Alison Flatau

## Attachment C to Final Report dated July 30, 2001 for CAREER COV

### **Brief Member Biographies**

**Dr. Peggy Agouris** has been with the Department of Spatial Engineering at the University of Maine, where she is an Associate Professor, since 1995. She received the Dipl. Eng. in Surveying Engineering (1986) from the National Technical University of Athens, Greece, and the M. Sc. in Digital Photogrammetry and Remote Sensing (1988) and Ph. D. in Digital Image Processing and Analysis (1992) from the Ohio State University. Her experience includes three years (1993-95) as Senior Scientific Associate at the Swiss Federal Institute of Technology. Dr. Agouris' research interests are in Digital Image Processing and Analysis, Digital Photogrammetry, Remote Sensing, and Geographic Information Systems. Her 1997-2001 CAREER award is for work on Geospatial Database-Driven Extraction of Information from Digital Aerial Imagery.

**Dr. Efraim P. Armendariz** received the B.A. (1960) and M.A. (1962) in Mathematics from Texas A&M University, and the Ph.D. (1966) in Mathematics from the University of Nebraska-Lincoln. He has been at the University of Texas - Austin since 1966 with the exception of a couple of years at the Universities of Southern California and Southern Louisiana. His interests include the structure theory of noncommutative rings and the development of K-16 instructional programs that promote access to mathematics and science. His most recent connection to the CAREER program was as a member of the COV for the Division of Mathematical Sciences in January 2001, which included a review of the Division's CAREER activity.

**Dr. Kenneth E. Barner** is Associate Professor at the University of Delaware in the Department of Electrical and Computer Engineering and an Adjunct Scientist at the du Pont Hospital for Children. He received the B. S. (1987) from Lehigh University, and the M.S. (1989) and Ph. D (1992) from the University of Delaware. His research interests are in signal processing and human-computer interaction, and his 1999 CAREER award addresses the broad challenges of designing every-citizen interfaces to the National Information Infrastructure so as to fully integrate individuals with disabilities into the education and employment mainstream. Dr. Barner is a member of NSF's Committee on Equal Opportunities in Science and Engineering (CEOSE), and serves as the CEOSE liaison to the Advisory Committee for the CISE Directorate.

**Dr. Kathryn M. Borman** received the doctorate in Sociology of Education from the University of Minnesota in 1976. She is currently Professor of Anthropology and Associate Director of the David C. Anchin Center at the University of South Florida. Dr. Borman has extensive experience in educational reform and policy as well as evaluation studies. She has held two awards from NSF. The first focused on the transition to high tech jobs from community colleges in Florida's Space Coast area. The second (ongoing) award, "*Assessing the Impact of the NSF's Urban Systemic Initiative,*" investigates reforms in K-12 math and science in four cities: Chicago, El Paso, Memphis and Miami.

**Dr. Jean Camp** is Assistant Professor at the Kennedy School of Government, a Senior Member of the IEEE, and an elected Director of Computer Professionals for Social Responsibility (CPSR). Prof. Camp's core interest is in the interaction of technology, society, and the economy. Her interest usually fits within the “design for values” rubric or under the “electronic civil liberties” umbrella. It was this interest that led her from graduate electrical engineering research in North Carolina to the Department of Engineering and Public Policy at Carnegie Mellon. It remained her core research interest at Sandia National Laboratories, and continues at the Kennedy School. Dr. Camp received a CAREER award in 2000 on the topic of human values in protocol design.

**Dr. Fiona Goodchild** has been Director of Education at the NSF Materials Research Laboratory (MRL) at University of California, Santa Barbara since 1993. She holds the M.A. from Glasgow University, M.Ed. from the University of Western Ontario, and Ed. D. in cognitive psychology from the University of Toronto. She has published on the topic of learning strategies in math and science and is currently investigating how research scientists partner with science teachers to develop teacher expertise and to enrich the K-12 science curriculum. In 1999 she won a Pre-College Winning Program Award for K-12 science education outreach from the Industrial Research Institute. Dr. Goodchild serves on the Advisory Committee for NSF’s Directorate of Mathematical and Physical Sciences.

**Dr. Martin Jeffries** received the B.A. (1979) from the University of Sheffield, England; the M.Sc. (1981) from the Victoria University of Manchester, England; and the Ph.D. (1985) from the University of Calgary. He joined the Geophysical Institute, University of Alaska Fairbanks, in 1985 as a post-doctoral fellow and is now a Research Professor of Geophysics. In 1998-99 he occupied the Office of Naval Research Chair in Arctic Marine Science at the Naval Postgraduate School, Monterey, CA. His interests include snow and ice research experiences for teachers, to promote teaching and learning in the local context. He has also served six times as Chief Scientist aboard the Antarctic research vessel *Nathaniel B. Palmer*, and is the chairman of the Advisory Board for Teachers Experiencing Antarctica and the Arctic (TEA).

**Dr. George H. Jones** is Professor of Biology at Emory University. He received the B. A. in Biochemical Sciences (1963) from Harvard and the Ph.D. in Biochemistry (1968) from the University of California, Berkeley. Following postdoctoral training at the National Institutes of Health and the University of Geneva, Switzerland, he took a faculty position at the University of Michigan, where he received the University's Teaching Award in 1989. Dr. Jones came to Emory as 1989 as Dean of the Graduate School of Arts and Sciences, serving also as Interim Dean of Emory College in 1990-91. He became a full-time member of the Biology department in 1995 and was awarded the Goodrich C. White Chair in 1996. His research deals with the mechanism and regulation of antibiotic synthesis in *Streptomyces*, with specific emphasis on the relationship between RNA degradation and antibiotic synthesis. Dr. Jones received the Emory Scholar/Teacher Award in 1998. He is a member of the Advisory Committee for the Biosciences Directorate.

**Dr. Marcia Linn** has been a Professor in the Graduate School of Education at the University of California, Berkeley, since 1989. For more than 30 years she has researched ways to improve science education and to use educational technology effectively. She received the B. A. (1965) in Psychology and Statistics, and the Ph. D. (1970) in Educational Psychology from Stanford University. She pursues numerous research projects, including the Computer as Learning Partner (CLP), the Center for Innovative Learning Technologies (CILT), and the Web-based Integrated Science Environment (WISE). Her honors include the American Educational Research Association's Willystine Goodsell Award for contributions to gender equity in education, and the Council of Scientific Societies Presidents' Award for Excellence in Educational Research.

**Dr. Todd Livdahl** is Professor of Biology at Clark University in Worcester, Mass. He received the B. A. (1973) from St. Olaf College, and the Ph. D. (1987) from the University of North Carolina. He joined the Clark faculty in 1980, following postdoctoral work at Princeton and a teaching position at Ohio State University. His teaching and research interests are in ecology and population biology, particularly life history evolution and species interactions in container-breeding mosquitoes, and ecological factors affecting the invasion of North America by the Asian Tiger Mosquito.

**Dr. Ellen Martin** has been a professor in the Department of Geological Sciences at the University of Florida since 1994. She received the B.A. from Wesleyan University in Middletown, CT, the M.S. from Duke University, and the Ph.D. from Scripps Institution of Oceanography at UC-San Diego. Prior to her current position, she spent nine months at the University of California, Santa Cruz on an NSF Postdoctoral Fellowship. Dr. Martin received a CAREER Award in 1995 for her work using Nd isotopes from fossil fish teeth in marine sediments to track changes in deep ocean circulation. The education component of that award was targeted at developing exercises for students to provide experience working with and interpreting data using datasets available on the Web. In the fall of 2000 she served on a CAREER proposal review panel for the Ocean Sciences Division.

**Dr. Paula D. McClain** is Professor of political science and law at Duke University. A Howard University Ph.D., her primary research interests are in racial minority group politics, particularly inter-minority political and social competition, and urban politics, especially public policy and urban crime. Her most recent articles have appeared in the *Journal of Politics*, *American Political Science Review*, and *American Politics Quarterly*. In 1999, Westview Press published the second edition update of her most recent book, *"Can We All Get Along?" Racial and Ethnic Minorities in American Politics*. Dr. McClain is a past vice president of the American Political Science Association and a past president of the National Conference of Black Political Scientists. She is currently Program Co-Chair of the 2003 International Political Science Association World Congress to be held in Durban, South Africa, and serves on the Advisory Committee to NSF's Directorate of the Social, Behavioral and Economic Sciences.

**Dr. James L. Melsa** has been Dean of the College of Engineering at Iowa State University since 1995. He received the B.S. (1960) from Iowa State, and the M.S. (1962)

and Ph. D. (1965) from the University of Arizona. After two years on the Arizona faculty, he went to Southern Methodist University, where he was named Professor in 1970. In 1973 he became Chair of Electrical Engineering at the University of Notre Dame. Dr. Melsa began a second career in 1984, as Vice President of Tellabs in Lisle, Illinois, where he built the company's first research organization. As his responsibilities broadened and the company prospered, he assumed various executive positions, culminating with his 1993 appointment as Vice President of Strategic Quality and Process Management. Dr. Melsa's research interests include quality, productivity, global competitiveness, electronic networks, and signal processing. He has been recognized by the American Society of Electrical Engineers as one of the outstanding electrical engineering professors in the United States.

**Dr. Lynette Padmore** retired from Florida A & M University in July 2000 after a tenure of thirty years, during which she served as director for projects supported by NSF, the Office of Naval Research, the Department of Education, and the State of Florida. She completed the B.S., M.S., and Ph.D. at Howard University; her graduate work was in developmental genetics. In 2000 she chaired the COV for the Experimental Program to Stimulate Competitive Research (EPSCoR), and the EHR Directorate sub-committee on the Government Performance and Results Act (GPRA). Dr. Padmore recently completed a three-year term as a member of the Advisory Committee for the Education and Human Resources Directorate.

**Dr. Judith Parrish** has been Professor of Geosciences at the University of Arizona since 1988. She received the B.A. and M.A. in Biology, and the M.S. and Ph.D. in earth sciences, from the University of California, Santa Cruz. From 1981-87 Dr. Parrish was a research geologist with the US Geological Survey. In 2000 she was named Associate Dean, College of Science, in which capacity she is responsible for shepherding many and varied educational programs. She has received a Faculty Award for Women in Science and Engineering from NSF, has reviewed CAREER proposals for the Foundation, and has served on other COVs. Dr. Parrish is a member of the Advisory Committee for the Geosciences Directorate.

**Dr. Constance M. Pechura** joined the Robert Wood Johnson Foundation as a Senior Program Officer in May 1998 after 10 years at the Institute of Medicine (IOM), part of the National Academy of Sciences (NAS). From 1995 to 1998, she directed the IOM Division of Neuroscience and Behavioral Health, and from 1988 to 1995 she directed a number of IOM projects on a range of topics including assessing health affects of chemical weapons exposure, ethical and public policy issues of cross-species organ transplantation, and integrating computer technologies to map the human brain. Dr. Pechura received a B.S. in psychology (1980) from Virginia Commonwealth University and a Ph.D. in anatomy (1987), from F. Edward Hebert School of Medicine, Uniformed Services University of the Health Sciences (USUHS), and completed a postdoctoral fellowship at the National Institute of Neurological Disorders and Stroke. She has received the NAS Special Achievement award (1993), USUHS Outstanding Teaching Award (Class of 1988) and an NSF Graduate Fellowship (1981). Dr. Pechura has taught medical school courses at USUHS, held an



adjunct faculty position at the George Washington University School of Medicine, and was the Health Policy Tutor in the Stanford in Washington Program from 1993-1998.

**Dr. George B. Richter-Addo** is Associate Professor, Department of Chemistry and Biochemistry, at the University of Oklahoma, where he has been designated as University Presidential Professor 2000-2004. He was awarded the Dip. Ed. in Science Education (1982) and the B. Sc. with honors in chemistry (1982) by the University of Cape Coast, Ghana, and the Ph. D. in chemistry (1988) by the University of British Columbia. Dr. Richter-Addo was a Postdoctoral Fellow at the University of Utah (on an NIH Minority Postdoctoral Fellowship), and at the University of Alberta. His research interest is in the field of bioinorganic chemistry of nitric oxide and organic nitroso compounds. He recently completed work under a 1996 CAREER award, and won a follow-on award from NSF for work through 2003. Dr. Richter-Addo served as a panel member for reviewing CAREER proposals in 1997.

**Dr. Timothy Tong** has been Dean, School of Engineering and Applied Science, at The George Washington University, since September, 2000. He received his Ph. D. in mechanical engineering from the University of California at Berkeley in 1980, and taught at the University of Kentucky and Arizona State University before being named to head the Department of Mechanical Engineering at Colorado State University in 1996. His research entails theoretical and experimental work in heat transfer. From September 1996 through August 1997, he also served as a program director for NSF, during which time he conducted a panel review for CAREER proposals in his field. He is now a member of the Advisory Committee for the Engineering Directorate.

**Attachment D to Final Report dated July 30, 2001, for CAREER COV**

**FY 2001 REPORT TEMPLATE FOR  
NSF COMMITTEES OF VISITORS (COVs)**

**Date of COV: May 2-4, 2001**

**Program Activity: Faculty Early Career Development (CAREER)**

**Directorate: All Directorates**

**Number of actions reviewed: 120+ proposal files and 70+ final and annual reports**

**Part A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES & MANAGEMENT**

**I. Effectiveness of use of merit review procedures:**

a. Overall design, including appropriateness of review mechanism (panels, ad hoc reviews, site visits): Approaches to merit review differ across directorates, but in general sufficient emphasis is not placed on using criterion two to assess CAREER proposals. Predominant use of reviewers who are not well informed about education and career development issues can lead to naïve decisions. Depending on the nature of the education plan, reviews should include, as appropriate, persons knowledgeable about the results of recent research in undergraduate and K-12 education, and others with experience in integrating research and education, such as previous CAREER awardees. Where feasible, CAREER-specific panels should be used. If there are not enough CAREER applicants to create a panel at the program level, such panels should be created at the directorate or division level.

b. Effectiveness of review process(es), and c. Efficiency, time to decision: The efficiency of the review panels varies across directorates. Time to *return* (i.e., when the proposer receives reviewers' comments) varies greatly from 4 months to a year. Time is critical for declines to revise and resubmit proposals. We applaud the effort made by the Career Coordinating Committee to reduce considerably directorate processing times from FY 2000 to FY 2001. Seventy per cent of the proposals were processed in six months or less. Nevertheless, all programs should strive to meet the six-month deadline.

d. Completeness of documentation making recommendations: Most of the reviews we sampled did not elaborate about criterion 2.

e. Consistency with priorities and criteria stated in solicitations, announcements, and guidelines: There is a lack of clarity about methods for integrating education and research. Also, use of routine declination letters, with their emphasis on research merit, can make it appear to the applicant that the education and career development plans were not seriously considered.

## **II. Use of the NSF Merit Review Criteria (intellectual merit and broader impacts):**

a. Performance Goal: Implementation of Merit Review Criteria by Reviewers: Some reviewers may have not addressed criterion two in part because of the design of the electronic review form. We understand that the Foundation has changed the format to provide separate modules for use in addressing both of the criteria. Also, many reviewers seemed not to understand the implications of the request or how to respond to it. Better ways to educate reviewers regarding the integration of education and research should be developed.

b. Performance Goal: Implementation of Merit Review Criteria by Program Officers: Although most program officers do explain criterion two to panelists, they should strongly insist that all CAREER proposals be given a thorough review on both criteria. The program officers themselves must consistently address criterion two in the communication to the applicants.

c. Discuss any concerns the COV has with respect to NSF's merit review system. The letter that goes out with the request for reviewers should call for significant attention to criterion two. Also, the proposal declination letter should address *both* criteria.

## **III. Reviewer selection:**

a. Use of adequate number for balanced review: When there are only three reviews, and they vary widely, additional reviews should be obtained.

b. Use of reviewers having appropriate expertise/qualifications: See comments above on panel organization and *ad hoc* reviewers.

c. Use of reviewers reflecting balance among characteristics such as geography, type of institution, and underrepresented groups: There is no way to identify the racial/ethnic background of participants. For each panel there should be aggregate data on reviewers' gender, race/ethnicity, and institution type. This will permit program coordinators and future COVs to see the degree to which proposals from various types of institutions are assessed by reviewers affiliated with comparable institutions.

d. As appropriate, recognition and resolution of conflicts of interest by NSF staff and adequacy of documentation justifying actions taken: Many jackets did not have all the COI forms (or copies) from the panelists and *ad hoc* reviewers. Perhaps this could be handled through appropriate links within Fastlane.

## **IV. Resulting portfolio of awards:**

a. Overall quality of science/engineering and/or education: The overall quality of the research part of the proposals meets the standards for NSF. The education part may be lacking; however, as discussed elsewhere, there is not adequate information for this determination.

b. Appropriateness of award scope, size, and duration: Since traditional funding levels vary widely across disciplines, the Foundation should not set absolute minima or maxima. There is more than one approach to closing the gap between a smaller program's median award size and CAREER awards. One is to increase the former, but that is difficult to do in times of strong budgetary pressures. Another is for the Foundation to develop a process where divisions or programs can award differing amounts that nevertheless assure prestige in their fields, e.g., a factor or index by which a minimum would be calculated, relative to that program's median award size (adjusting for differences in duration).

A five year duration is appropriate for CAREER, across disciplines.

c. Effective identification of and support for emerging opportunities: the Committee did not have sufficient time or information to examine CAREER on this point.

d. Appropriate attention to maintaining openness in the system, for example, through the support of new investigators: The number of applicants from minority-supporting institutions is unacceptably small. Program directors should take care that matching grants not be considered *even from the proposer's own institution* as this might bias in favor of applicants from well-endowed schools. That no matching funds are required is not adequate, but rather inclusion of matching funds should not be permitted.

e. Evidence that proposers have addressed the integration of research and education: See above with respect to criterion two.

f. Evidence of increased numbers of applications from underrepresented groups: The information available is not adequate to determine this; however, the previous observation suggests that more outreach to minority-serving institutions is needed.

g. Balance of projects characterized as high risk, multidisciplinary, or innovative: CAREER funds innovative, multidisciplinary projects by young faculty trying to establish themselves in very competitive situations. We did not have sufficient information or time to assess the degree to which the projects awarded were especially high-risk compared to NSF projects generally.

## **B. RESULTS: OUTPUTS AND OUTCOMES OF NSF INVESTMENTS**

### **General observations:**

A problem in evaluation of CAREER project outcomes is how to determine if projects are really carrying out their applied/educational activities. If the culture does not encourage young faculty to carry out these activities, they are unlikely to be done.

Based on cases examined at the meeting, faculty at predominantly minority institutions have been less successful than others in receiving CAREER awards. We recommend that NSF investigate this disparity and consider possible remedies.

There are competing goals at work in CAREER awards: is the major emphasis placed on developing individuals or upon institutional change? One award in a given institution is not likely to make for institutional change. This process will take a generation. "Seeding the field" by developing individuals may be a more productive strategy in the final analysis.

PIs provide little reference in their final reports to outcomes of education and career development plans. This may be partly a consequence of reviewer lack of understanding of, or neglect in commenting on, criterion two matters in their reviews.

A set of indicators for PIs to use for self-assessment over the course of the period of CAREER funding should be developed, consonant with both the goals of the program and the culture of the awardee's institutional setting. Other approaches: provide sample successful practices for awardees; require an accounting of education and other criterion two activities in annual reports; consider including funds for visitors to assist awardees.

### **Overall Promising Practices/Strengths/Recommendations:**

CAREER is supporting faculty who are addressing many of the bulleted items under the strategic outcome goals. In terms of institutional change, the program is supporting the right kinds of activities (and a lot of other activities as well), but whether the larger program goal of changing institutional culture is being accomplished at this point is not clear, and will not be without a well-conducted study of outcomes and impacts.

CAREER funding continues over the course of several years. The longer funding period compared with usual NSF awards makes it more likely that integration of research and education will be accomplished. These awards are also likely to get more undergraduates involved in research activities.

The integration of education and research must be fully addressed. This is not a two-track program. All awardees should be able to discuss the value added by their CAREER grants. The final reporting process must target this area and emphasize it.

Most education plans we examined looked like add-ons to the research plan, and many were to support undergraduate and graduate research in the ways that any NSF research grant would. Many simply were not thought through. Investigator difficulties in this area can be overcome through professional development. Workshops for those considering applying for CAREER awards should be considered, and should involve current CAREER awardees. To promote submissions from individuals who may not have sufficient local educational resources or contacts at hand, NSF should consider strategies such as urging them to link up with previously-funded CAREER grantees.

NSF for its part should go out of its way to support activities that go beyond the usual mentoring and course preparation by new faculty. Proposals should reflect the applicant's attention to the sustainability of the integrative effort throughout the period of

funding. Applicants should have a realistic idea of the capacity of their department to support and sustain their efforts.

CAREER awardees should strive to ensure that the teams they hire are diverse. The final report requirements should address their efforts in this regard. Also, the annual and final report forms should be revised to give equal stress to education and facilitate reporting on integrated research and education.

The CAREER program has allowed people to create an integrative approach to research and education. It should be continued with specific improvements. Each division and directorate should examine how CAREER fits into their portfolios, and the Foundation as a whole should examine differences and similarities across programs that fund CAREER awards.

**The PEOPLE Strategic Outcome Goal:** *Development of a diverse, internationally-competitive and globally-engaged workforce of scientists, engineers, and well-prepared citizens.*

FY 2001 Performance Goal: The program is successful when, *in the aggregate*, results reported in the period demonstrate significant achievement in one or more of the following indicators:

a. *Integrating ideas with individuals.*

We stress the need for an outcomes evaluation that would examine the actual effects of CAREER activities on awardees, their institutions, and their students.

b. *Improved mathematics, science, and technology skills for students at the K-12 level.*

The potential exists for much more effort by CAREER awardees directed toward improving skills of K-12 students in collaborating schools, but evidence for this sort of work will remain weak unless NSF insists on seeing it. Some activities (e.g., summer labs) may require supplemental funding for teachers to participate.

In some directorates relatively few projects referenced K-12 work. In the sample of final reports we examined, relatively more GEO, ENG, and SBE projects reported it, but relatively fewer CISE projects did -- although many CISE projects could accommodate K-12 hands-on activities very well.

One excellent example is found in award # GEO 9521170, where the PI established a summer program to introduce high school girls to research, and also taught a course for high school teachers. Another is MPS 9875897: the PI was working to establish a virtual pen pal program matching physics graduate students with grade school students. Among the approaches being developed were web pages, slide shows, and local Astronomy nights. A third is found in GEO 9521039, where lectures from an honors course were videotaped for distance learning delivery to advanced high school students.

*c. Improved mathematics, science and technology skills for citizens of all ages.*

CAREER was not designed specifically to achieve this goal, and few proposers addressed it other than at the K-12 level. In furtherance of this subgoal, NSF should consider specifically encouraging collaborative education activities at the two-year college level, which is the fastest growing sector of higher education and becoming increasingly important for supply of future science, mathematics, and engineering majors at the four-year level.

*d. A science and technology workforce that reflects America's diversity.*

This is a goal that all grantees should be expected to address. In terms of minorities, we did see some particular examples, such as SBE 9600724, where the PI specifically recruited African-American research assistants; and BIO 9508559, where the awardee at a major doctoral research institution sponsored two undergraduate students from a historically black university a considerable distance away. In GEO 9506558, the PI's team included a woman postdoc and several women undergraduate and graduate students.

Awardees' progress reports should continue to include information on workforce diversity.

*e. Globally engaged science and engineering professionals who are among the best in the world.*

Some COV members saw strong evidence that this is occurring, e.g., GEO 9506558, where the PI is collaborating with researchers from three other countries and two US research organizations; and BIO 9508559, where the awardee made good use of REU supplements to sponsor undergraduates.

Others question the intent of this item and wonder what is meant by the term "globally engaged." How well is this component to be integrated over the course of the award ?

*f. A public that is provided access to the processes and benefits of science and engineering research and education.*

CAREER does encourage public outreach, though it is not a major requirement. We saw several good examples, including: an awardee who required students to write thesis chapters in lay language (CHE 9983715); one who made presentations to the public about such topics as plate tectonics and earthquakes (GEO 9628872); and one (SBE 9511894) who was interviewed by NOVA, Scientific American, US News and World Report, etc.

**The IDEAS Strategic Outcome Goal:** *Enabling discovery across the frontier of science and engineering, connected to learning, innovation and service to society.*

FY 2001 Performance Goal: The program is successful when, *in the aggregate*, results reported in the period demonstrate significant achievement in one or more of the following indicators:

a. *A robust and growing fundamental knowledge base that enhances progress in all science and engineering areas including the science of learning.*

CAREER awardees are contributing significantly to this goal through their publications in well-recognized journals, and other products such as databases and web pages. The majority of the progress reports we examined showed substantial contributions to the knowledge base, and much of the research was innovative, solid, and productive.

b. *Discoveries that advance the frontiers of science, engineering, and technology.*

Generally, yes. This is, of course, program-specific.

c. *Partnerships connecting discovery to innovation, learning, and societal advancement.*

One awardee (ENG 9501877) provided work experience for graduate students through partnerships with a major oil company, an automobile firm, a manufacturer, and a Federal agency. Another (CISE 9624106) collaborated with four industrial firms, nine U.S. universities, two overseas universities, and two Federal agencies. One product was commercialized, and another was adopted by fifteen colleges and universities.

d. *Research and education processes that are synergistic.*

A key question is defining integration. NSF should provide applicants with specific, concrete examples to consider. In one successful case (SBE 9506892), the PI, based on his research, developed two new courses and revised another, helped acquire computer workstations for undergraduates, managed an undergraduate research conference, and gave a seminar to a city medical examiner's office about how to use the findings in forensics. In a more typical but nevertheless significant case (MPS 9502389), the awardee improved an analytic lab, developed a new course, and brought new involvement of undergraduate students in research.

**The TOOLS Strategic Outcome Goal: Providing broadly accessible, state-of-the-art information-bases and shared research and education tools.**

FY 2001 Performance Goal: The program is successful when, *in the aggregate*, as a result of its investments, results reported in the period demonstrate significant progress in achieving one or more of the following indicators:

*a., b., and c: shared use platforms, facilities, instruments, and databases that enable discovery; shared use platforms, facilities, instruments, and databases that enhance the productivity and effectiveness of the science and engineering workforce; and networking*



*and connectivity that takes full advantage of the Internet and makes SMET information available to all citizens.*

Development of shared instruments, platforms, facilities, and databases, as this goal is usually understood, is not an aim of CAREER. Many awardees did develop web sites and some developed computer programs that were shared.

*d. Information and policy analyses that contribute to the effective use of science and engineering resources.*

The meaning of this indicator for CAREER was not clear, which led to some confusion in reporting. We have since been informed that it is meant to refer to NSF-generated data reports, policy analyses, and program evaluations (and thus generally not relevant to CAREER). This specialized meaning should be made clearer to future COVs.

**Areas of Emphasis:** For each relevant area of emphasis shown, determine whether the investments and available results demonstrate the likelihood of strong performance in the future. Explain and provide NSF-supported examples that relate to or demonstrate the relevant strategic outcomes.

The available results clearly demonstrate the likelihood of strong performance in the future. Examples are provided throughout this Attachment and in the body of our report.

**Please comment on areas that the COV believes need improvement.**

CAREER is an important initiative that should continue to receive significant emphasis. Areas of improvement are spelled out here and in the body of our report.

One basic problem is that expectations for integrating education are not particularly well defined. CAREER proposals that excel at education should be provided as examples to future CAREER awardees. There should be a clear distinction between normally required faculty activities (e.g., training graduate students, teaching classes) and what is exemplary of integration between research and education (e.g., working with high schools, interdisciplinary classes, program development).

Department commitments do not appear well served by the form letter, and that decision should be reconsidered. CAREER guidelines or related information should include a model letter, or a set of questions to answer within a certain page length. Also, the department chair may wish to identify a senior faculty member or equivalent who will serve as a mentor for the junior faculty member.

Permitting CAREER budgets to pay a share of support for education partners would make it easier for awardees to arrange collaborations. A partner may be a practicing professional in education, a senior faculty member who excels at teaching, a scholar from a school of education, or a former CAREER awardee who has achieved success in the area of the proposer's education plan.

Because of the significant impact that a CAREER award can have on an institution that is not a major research university, program managers should seek to increase the number of institutions that are successful in achieving CAREER awards.

Additional ideas:

- Design reward mechanisms that recognize both educational work and institutional service for the purposes of institutional change.
- Invite soon-to-be-eligible persons to CAREER workshops so they can anticipate applying. This could be one way to overcome what some see as a program bias in favor of elite institutions.
- Award small grants for proposal planning to prospective PIs at minority-serving and primarily undergraduate institutions.

**Comment as appropriate on the CAREER activity's performance in meeting its specific goals and objectives. They are:**

- To foster partnerships between faculty members who are most likely to become the academic leaders of the 21<sup>st</sup> century, and their institutions, to develop their careers as researchers and educators.
- For that purpose, to provide support, at a sufficient funding level and duration, for the research, education, and career-development activities of those faculty members.
- To select awardees on the basis of their specific, well founded plans for creative, integrative research and education activities.
- To foster greater recognition, within academic institutions, of effective teaching and learning activities and their integration with current knowledge in fields of research.

See the body of our report, and prior remarks.

**Please comment on other CAREER-related topics:**

NSF is interested in the COV's views about the following topics:

- Does the most recent (FY 2002) solicitation allow sufficient latitude to encourage the submittal of, and support of, high-quality proposals from diverse fields?
- Does CAREER as a whole draw a reasonable number of high-quality proposals, and are there reasonable explanations for the variance in submittal rates among divisions ?

- Do the award sizes, durations, scopes and past provisions for industrial fund matching properly suit the goals of the program ?
- Is NSF as a whole investing enough in CAREER ?
- Do different Directorates have different preferences for types of educational activities for which they make awards ?
- Do different Directorates prefer different types of plans for integrating research and education ?
- How appropriately do the educational components of awardees' plans seem to reflect the current state of knowledge about effective teaching and learning in the awardees' fields of study ?
- Based on their education and experience, how well trained and prepared do awardees appear to be to carry out the education and career-development aspects of their plans?

Our earlier remarks covered many of these topics from several points of view, so we will not repeat them. Here are additional comments:



- The five-year duration of CAREER awards should be continued.
- There is no assessment of the quality of course materials and instructional strategies in courses devised by awardees.
- It is difficult to discern what are the priorities of each directorate for CAREER. Different directorates place different emphasis on having an education/career development plan at all.
- Awardees clearly need help to understand their limitations and needs, and to get support to meet those needs. Here is one place that collaborators and senior mentors could provide real assistance.

Since traditional funding levels vary by order of magnitude across disciplines, the Foundation should not set an absolute amount, maximum or minimum. The Foundation should set the process by which the amount is determined, along with the process for evaluating CAREER proposals, and standards to ensure prestige.

Finally, NSF would appreciate your feedback on the COV review process, format, and key questions. Not all performance goals, and few of the cross-cutting activities listed, fit CAREER. This resulted in some confusion regarding interpretation of the format. Some questions seemed repetitive. In some cases, the goals and subgoals can be taken to favor elite institutions, given their capacities. Is this outcome format useful in all cases?

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