# Developing a Competitive Education Plan for Your NSF CAREER Proposal: A Toolkit for Berkeley Proposers

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The NSF Faculty Early Career Development Program (CAREER) is a single investigator, five-year award to help junior faculty establish themselves as outstanding researchers and educators. CAREER is a *career development award*. Competitive proposals must include innovative, integrated, and ambitious research and education plans.

This toolkit focuses on the *education component* of your CAREER proposal, since this component is often challenging for early-stage investigators. We offer specific guidance here to prepare you to develop an education plan that is well integrated with your research and meets NSF's expectations.

### Inside this toolkit:

- -Five steps to developing a competitive CAREER proposal
- -Components that are critical for success
- -Common pitfalls
- -Examples of integrated CAREER research and
- education plans from Berkeley
- -Proposal development timeline
- -Frequently asked questions

NSF uses two merit review criteria to evaluate all proposals: intellectual merit and broader impacts. "Intellectual Merit" refers to the potential to advance knowledge; "Broader Impacts" refers to the potential to benefit society and advance desired societal outcomes. These criteria apply equally to both the research and education components of your proposal.

The BRDO website provides a number of resources to help you with your CAREER education plan and to ensure that it is responsive to NSF's review criteria, including:

- Understanding broader impacts;
- <u>Resources for education and outreach</u> (including literature on evidencebased practices);
- Potential campus partners for education activities;
- <u>Evaluation resources</u> for education activities.

The <u>Berkeley Research Development Office</u> (BRDO) provides a range of free proposal-related services to expand research funding on campus. We help faculty identify promising funding sources for their research area, interpret agency guidelines, assist with proposal planning and strategy, and provide writing and editing support. For questions and guidance on your CAREER proposal, contact us at <u>brdo@berkeley.edu</u>.

# Five Steps to Developing a Competitive CAREER Proposal

**Step 1: Familiarize yourself with NSF and its expectations.** First, read the CAREER solicitation carefully from beginning to end. You can find the latest solicitation on the agency's <u>CAREER program page</u>. Beyond the contents of the solicitation, it's important to get a sense of what a successful CAREER project looks like *in your specific field*, as expectations vary widely across NSF directorates. You can do this by using the NSF Advanced Search Tool. Here's how:

- Navigate to the NSF Search Tool (nsf.gov/awardsearch/advancedSearch.jsp).
- Under "Element Code," type <u>1045</u> (the CAREER code), and make sure the "Active Awards" box is checked. Scroll to the bottom of the page and click "search."
- Once the search has been performed, export results to Excel and sort records by Directorate, NSF Organization (division), and Program.

The results will now be grouped to make it easier to find clusters of programs, including those similar to yours. Review abstracts for information about each projects' goals and the scope of activities; also take a look at the PI, institution, award amount, and the assigned NSF Program Manager.

**Step 2: Plan/strategize.** Begin with big-picture considerations: What are your strategic, long-term career goals? What steps do you need to take to get there? Identify a gap in knowledge in your field or a problem that has the potential to significantly advance your field. Brainstorm ideas for complementary high-impact educational activities that you can integrate with your research. Then ask yourself: What do I need that I don't already have in order to conduct the proposed research and education activities? How much do I need? Who do I need to help me?

Outline your ideas and prepare a one-page abstract that includes rationale, goals, specific and measurable objectives, and expected outcomes and deliverables for both research and education.

**Step 3: Get feedback.** Discuss your ideas with leaders in your department and colleagues in your field (both at Berkeley and at other institutions) who have received CAREER or other NSF awards. Set up a meeting with an NSF program officer, ideally one who manages projects similar to yours (per Step 1). NSF's <u>CAREER program page</u> provides contact information for each division's cognizant program officers. Send the program officer of your choice a short email introducing yourself and requesting a phone consultation to discuss your ideas and suggest several dates/times that you are available. Attach your project abstract.

**Steps 4 and 5: Write, edit, get feedback, revise, finalize.** The "<u>NSF CAREER Award: Writing</u> <u>Guide</u>," accessible on the BRDO CAREER page, can be a useful resource as you begin to write. It provides an outline for your proposal that is compliant with all the requirements of the solicitation, and it includes an itemized checklist of required proposal attachments.





# The Education Plan: Components, Integration, and Common Pitfalls

### Components that are critical to success

• Your education plan should be integrated with your research plan, and achievable within the 5-year project period.

• Your education plan must be as innovative as your research plan. It should focus on one major goal with 2-3 complementary activities. Having more activities will reduce the effectiveness and clarity of your proposal.

• Develop specific and *measurable* objectives for each activity and create a simple plan for evaluating the effectiveness and impact of your efforts.

• Emphasize your strengths as a teacher-scholar. Convey interest and enthusiasm. Describe successful outcomes of past educational initiatives or activities you have led or been involved in.

• Partner with existing programs or initiatives at UC Berkeley, in the community, or in your field that are relevant to your research. A well-chosen partner/collaborator can contribute valuable expertise and resources that can broaden your project's impact and lighten your workload. (See link to campus partners, page 1).

• Provide evidence of the expected impact of your proposed activities. Don't make claims you can't back up.

### Integration of research and education

• Involve diverse individuals (postdocs, graduate students, undergraduates, K-12 students, high school teachers, members of the public) in your research using new tools, laboratory methods, field components, web outreach, cyber networks, etc.

• Partner with underserved communities, especially those traditionally underrepresented in your discipline.

• Find ways to translate your research into educational content at all levels. Think outside the box; tap non-traditional audiences and use evidence-based approaches to reach them.

• Use novel methods to deliver your research results to a broad audience beyond the immediate research community.

• Involve broader communities in data creation/gathering/reporting.

### **Common mistakes**

• The education plan is a laundry list of disconnected activities.

• The plan does not provide sufficient detail about what you propose to do, why you are wellpositioned to do it, how you will do it, and what outcomes you expect.

• Proposed activities are generic (just another blog, website, hackathon, science fair) and/or don't go beyond what is expected of any faculty member in your department (i.e. teaching, mentoring, publishing).

• Goals and objectives are unrealistic, vague, not measurable.

• The plan fails to demonstrate an understanding of what is effective in education. Relevant literature is not cited or is out of date.

• The education component lacks a timeline and evaluation mechanism.

• Research and education plans are not aligned or integrated with each other.

### Abstracts of Integrated CAREER Research and Education Plans from UC Berkeley Investigators

**Scott Moura (Civil and Environmental Engineering).** The goal of this project is to enable highperformance energy systems through advancements in control and estimation. The proposed research will advance knowledge on electrochemical-thermal model-based battery management systems, resulting in batteries with long life, fast charge times, and low cost. <u>Education Plan</u>. The goal of the education program is to inspire and educate a new generation of energy and control engineering leaders. The researcher will develop and lead a 22-hour intensive short course, Maker Design Studio (MDS), that will be the centerpiece of a week-long summer bridge program for 120 incoming engineering freshmen and transfer students each year (600 students during the project period). Most of these students are underrepresented, economically disadvantaged, and/or firstgeneration-to-college students. MDS will teach students to ideate, design, and prototype engineering systems rapidly, using "making" tools and the "Sprint" design process popularized within the start-up community. Additional complementary activities include a Berkeley Cleanweb Hackathon themed on Smart Energy Storage and undergraduate research opportunities.

John Dueber (Bioengineering). Microbes can be engineered with new and/or modified metabolic pathways to make a wide variety of compounds, including flavors and fragrances, therapeutics, plastics, and biofuels. This project aims to investigate the manner in which engineered protein assemblies within living cells can improve the sustainable production of these desirable chemicals. Education Plan. The educational goal of this project is to inspire and teach undergraduates to design novel biological systems. The researcher will develop a team-based undergraduate research program at Berkeley inspired by an international competition called iGEM (International Genetically Engineered Machine Competition). During ten weeks each summer, the researcher will constitute and lead a research team composed of three UC Berkeley students and two community college students and involve them in an intense, graduate-level research experience in which they will work together to plan, execute, and present a new project under the direct supervision of the researcher and an advanced graduate student. The team will present their work in at least one campus-wide seminar series and ultimately aim for a publication. Community college students will be recruited through the UC Berkeley Transfer Alliance Program (TAP).

**Erica Bree Rosenblum (Evolutionary Biology)**. The goal of the proposed project is to conduct an integrative study of the factors that promote adaptation and speciation in 3 species of lizards in the novel environment of the White Sands National Monument in New Mexico. <u>Education Plan</u>. The research and education efforts of this project are integrated through a conceptual focus on "Evolution in Action." The researcher will develop a set of high impact activities to teach core evolutionary biology concepts to the general public, park rangers, educators, and local students in grades 4-8. Activities include a two-day "Lizard Camp" for underserved local students, park ranger and educator training, public lectures, and a bilingual English-Spanish museum exhibit about evolution, and dissemination of research results in textbooks, magazines, and the popular press.

Laura Waller (Electrical Engineering and Computer Science). The knowledge developed by the proposed research project will lead to new imaging techniques for commercial products and research instrumentation tools. Education Plan. The researcher will engage undergraduates and graduate students in the creation of a large collection of hands-on optics-themed demos and activities. Examples include computer generated holograms, gradient index sugar lenses, and SLMs made from torn-apart projectors. The collection will be featured on the researcher's website laurawaller.com/optics-fun and will be deployed for use across the region in existing and new outreach venues such as Cal Day, the Lawrence Hall of Science, and the Bay Area Science Festival. The researcher will also train postdocs, graduate students and undergraduates and will integrate research findings into new college courses.

# Frequently Asked Questions about the CAREER Education Plan

### Does NSF assign weights to the Intellectual Merit and Broader Impacts criteria?

NSF guidance: Weights are not assigned to the review criteria. Both are important.

<u>BRDO comment</u>: NSF expects a high degree of rigor and innovation in both your research and education plans. Both of NSF's review criteria will be used to evaluate the two components. However, expectations vary widely across NSF programs and directorates; to get a sense of these, explore the NSF website and use its search tool to identify recently awarded proposals.

### What number and scope of educational activities are expected?

<u>NSF guidance</u>: For the CAREER education plan, quantity isn't as important as quality and the integration of research and education.

<u>BRDO comment:</u> Center your plan on one overarching goal that is integrated with your research goal. Develop 3-4 high impact educational activities that support that goal and are interrelated with one another. Activities should:

- have the potential to make a significant impact in teaching, broadening participation, and/or workforce development in your field, college/department, or community;
- draw upon your unique expertise, skills, interests, and resources;
- be achievable within the 5-year CAREER project period;
- make use of available resources and collaborators;
- involve members of underrepresented and/or underserved groups in your discipline.

### How important is originality versus the "tried and true"?

<u>NSF guidance</u>: Education activities should be a balance between existing evidence-based practices and innovative plans.

<u>BRDO comment</u>: Your education plan should be as innovative and potentially transformative as your research and should be grounded in evidence-based practices. Familiarize yourself with relevant literature in the science of teaching, learning, and broadening participation and include appropriate citations in your plan. NSF encourages proposers to take advantage of education and outreach resources and expertise available in their departments and communities, and to develop partnerships with existing programs and well-matched collaborators where applicable.

#### What level of effort and financial commitment does NSF expect?

<u>NSF guidance</u>: While excellence in both research and education is expected, activity of an intensity that leads to an unreasonable workload is not. The project budget should be consistent with the scope of the research and education activities.

<u>BRDO comment</u>: When budgeting for education activities it may be necessary to obtain outside expertise to determine realistic costs for certain activities. For example, if you plan to work with K-12 schools, consult others who work with local teachers regarding teacher stipends and substitute pay. Your requested budget may include costs for materials, participant stipends, travel, and other associated costs. Consult the <u>NSF Proposal & Award Policies & Procedures Guide</u> (PAPPG) to ensure that *all costs are allowable*. You can significantly reduce your out-of-pocket costs by leveraging available resources and/or developing collaborations with on- and off-campus partners. Such resources should be clearly described in the project description and in the Facilities, Equipment, and Other Resources attachment.