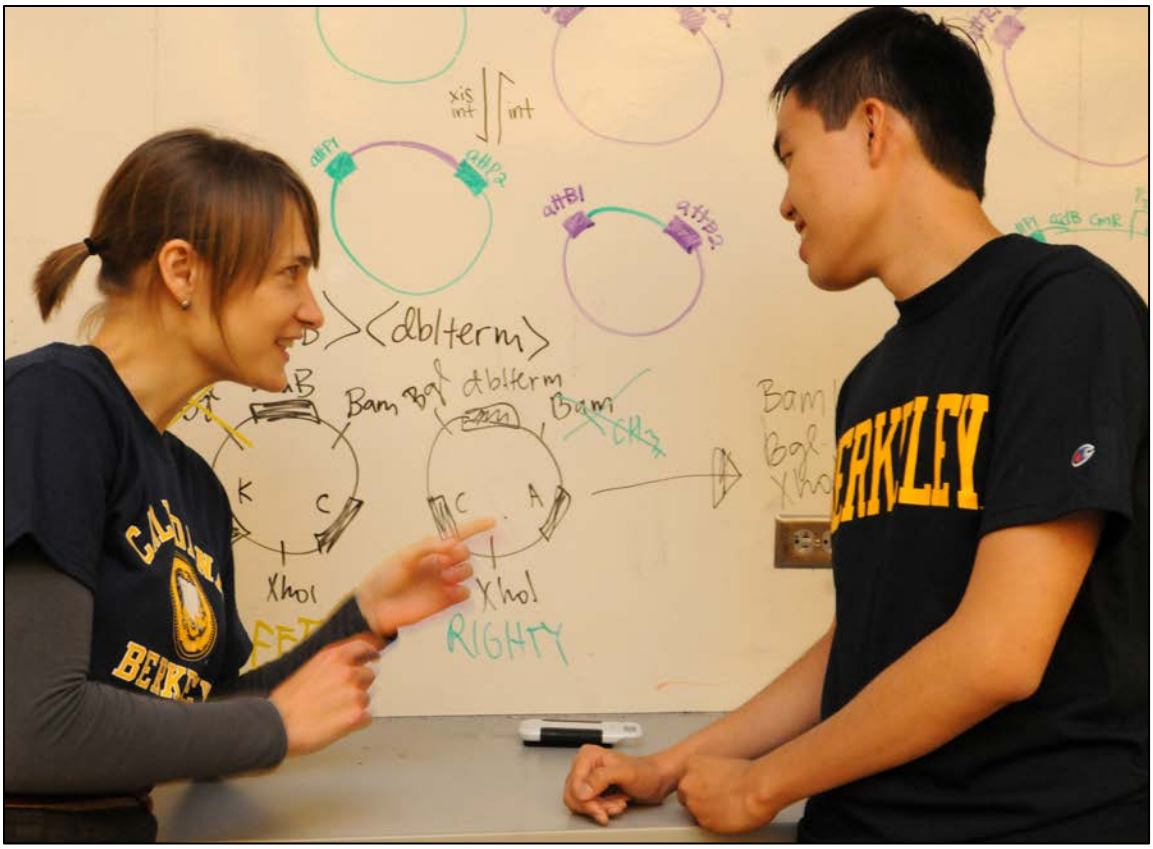
UC Berkeley Broader Impacts Toolkit for Early Career Faculty



This toolkit was developed by the Berkeley Research Development Office. It is intended to assist faculty in creating education and outreach project ideas and proposals, identify potential partners to work with, and facilitate information and resource sharing among UC Berkeley's science outreach programs.

The Berkeley Research Development Office (BRDO) provides a range of free proposal-related services aimed at expanding research funding on campus. We help faculty identify the most promising funding sources for their research area, provide training in funding databases, interpret agency guidelines, assist with proposal planning and strategy, provide writing and editing support, and help to conceptualize Broader Impacts plans. Please visit us at vcresearch.berkeley.edu/brdo.

NSF broader impacts themes

- Advance discovery while promoting teaching, training, and learning.
- Broaden participation of underrepresented groups.
- Enhance research and education infrastructure.
- Broadly disseminate results to enhance understanding.
- Provide benefits to society.

Examples

Advance discovery while promoting teaching, training, and learning:

- Integrate research activities into the teaching of science, math and engineering at all educational levels (e.g., k-12, undergraduate science majors, non-science majors, and/or graduate students).
- Include students (e.g., k-12, undergraduate science & non-science majors, graduate students) as participants in the proposed activities.
- Participate in the recruitment, training, and/or professional development of k-12 teachers.
- Partner with educators to develop effective means of incorporating research into learning and education.
- Encourage student participation at meetings and activities of professional societies.
- Establish mentoring programs for high school students, undergrads, grad students, or postdocs.
- Involve grad students and postdocs in high school/community college/undergrad teaching activities.
- Develop, adopt, adapt, or disseminate effective models/ pedagogic approaches to STEM teaching.

Broaden participation of underrepresented minority (URM) groups:

The NSF recognizes women, African-Americans, Hispanics, Native Americans, and Pacific Islanders as underrepresented in science, technology, engineering and mathematics.

- Establish research and education collaborations with URM students and/or faculty.
- Include URM students as participants in the proposed research/education activities.
- Establish collaborations with community colleges, colleges for women, historically black colleges & universities.
- Mentor early-career scientists and engineers who are from underrepresented groups.
- Participate in developing new approaches (e.g., use of information technology and connectivity) to engage underserved individuals, groups and communities.
- Participate in conferences, workshops and field activities where diversity is a priority.

Enhancing research and education infrastructure:

- Establish collaborations between disciplines and institutions, industry, government, and international partners.
- Stimulate and support the development and dissemination of next-generation instrumentation, multi-user facilities, and other shared research and education platforms.
- Upgrade the computation and computing infrastructure, including advanced computing resources and new types of information tools (e.g., large databases, networks and associated systems, and digital libraries).
- Develop activities that ensure that multi-user facilities are sites of research and mentoring for large numbers of science and engineering students.

Broadly disseminating results:

- Partner with museums, nature centers, or science centers to develop exhibits, workshops, hands-on demos, etc.
- Involve the public or industry in research and education activities.
- Give presentations to the broader community (e.g., museums, libraries, festivals, science cafes, radio shows).
- Make data available in a timely manner by means of databases, digital libraries, or other venues.
- Publish in diverse media (e.g., non-technical literature, websites, blogs) to reach broad audiences.
- Present research and education results to policy-makers, members of Congress, and industry.
- Participate in multi- and interdisciplinary conferences, workshops, and research activities.
- Integrate research with education activities in order to communicate in a broader context.

Benefits to society:

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

Broader Impacts Examples from Berkeley

Jie Yao (Electronic/Photonic Materials): The research objective of this CAREER project is to enhance our basic understanding of the interaction between light and materials with high and/or tunable dissipative losses. The research will contribute a new materials physics framework on optical losses. In parallel with the research component of the project, the proposed education plan will teach students critical thinking and problem solving skills that are key to innovation in STEM. At the graduate and undergraduate level, the PI will develop ThinkingStorm, a new competition for materials innovation that will challenge students to explore transformative ideas and novel approaches to materials design. At the high school level, the PI will create an annual half-day High School Engineering Immersion Lab in partnership with the UC Berkeley Pre-College TRIO Upward Bound program, a federally-funded program for first-generation, low-income 9th-12th grade students. The Lab Immersion will introduce students to materials science and engage them in interactive presentations, discussions, demonstrations, and problem-solving activities.

Dana Carney (Psychology/Business): The research project examines the link between power and corruption by systematically testing the extent to which power provides a physiological immunity to stressors. The education plan maximizes the impact of the research through the creation and deployment of an ethics module for undergraduate and graduate level business students using interactive, role-play based business cases. The module is being created in partnership with a leadership and ethics center at HAAS Business School and will be integrated into the HAAS core MBA curriculum. It will also be made freely and widely available to anyone at any school interested in enhancing ethics training. The project also involves rigorous training of undergraduate and graduate students who will gain expertise in social neuroscience methods.

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. The core educational effort for this proposal is the creation of a new team-based undergraduate research program inspired by iGEM (International Genetically Engineered Machine Competition), which challenges undergraduate teams all over the world to design novel biological systems. During ten weeks each summer, the researcher will constitute 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 research objective of this project is to conduct an integrative study of the factors that promote adaptation and speciation in a novel environment. Research will be integrated with educational outreach activities that use the dramatic landscape of White Sands (NM) to teach core evolutionary biology concepts to the general public and to students of all ages. Outreach activities include a two-day "Lizard Camp" for underserved middle school students, park ranger training, public lectures, development of a bilingual English-Spanish museum exhibit about evolution, and dissemination of research results in textbooks, magazines and in the popular press.

Laura Waller (Electrical Engineering and Computer Science): The knowledge developed by this work will lead to new imaging techniques for commercial products and research instrumentation tools. The researcher will engage undergraduates and graduate students in the creation of a large collection of hands-on optics-themed 'science tricks'— for example, computer generated holograms, gradient index sugar lenses, and SLMs made from torn-apart projectors. The collection will be featured on the 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.

NSF CAREER Program Broader Impacts FAQs

Download full document at: http://www.nsf.gov/pubs/2011/nsf11038/nsf11038.jsp

Q: How much space in the proposal should be devoted to education vs. research, and how much depth is required for the education component? A: No page number is specified (*BRDO note: Typically at least 3 pages are devoted to the education plan*). Use the 15 pages allowed the Project Description, including any results from prior NSF support, to your best advantage. A major objective of the CAREER Program is to encourage the integration of research and education. The research and educational activities do not need to be addressed separately, if the relationship between the two is such that the presentation of the integrated project is better served by interspersing the two throughout the Project Description. Remember that reviewers that are subject experts in your field will be mostly familiar with your research component. Some NSF disciplinary programs may send your proposal for review to education experts in your field, and for that reason, you should make sure that your education component is solid and well argued.

Q: I am not an education expert. Must I cite the education literature to the same extent as I would for my area of research expertise? A: You should read and cite some of the most relevant education publications. As an academic, you should develop some knowledge of the education and human-resource needs in STEM and some of the well-documented means of addressing these needs through education, training and outreach. If you have not already done this, you should do so before you develop your education plan. When you begin to write, demonstrate that you have this foundation by identifying needs and developing a solid plan to address them. Note that the Solicitation includes a list of relevant publications to get you started. If you plan to work with k-12 students or teachers, become familiar with the local curricula and state education standards and explain how your plan will fit with these. (*BRDO note: We can help with references if needed*).

Q: Do I need to involve an outside evaluator for the education component? A: You do not need to utilize an outside evaluator. However, you should have an evaluation plan to provide evidence and feedback that could lead to project improvement. Most academic institutions have an education department where you might find collaborators, or an evaluation system in place that could be modified to suit your needs. In some disciplines, investigators have had success by charging an expert advisory board with the evaluation of research and the education components.

Q: How independently should I work on my education component? My institution has an outreach effort in place and I would like to contribute to it. Would it be better for me to develop something completely new? A: Your plans should reflect your own disciplinary and educational interests and goals, as well as the interests and needs of your organization. Because there may be different expectations within different disciplinary fields and/or different organizations, a wide range of research and education activities may be appropriate. The intent of NSF is to be inclusive, to make it possible for any academic PI to leverage his or her research in an educational context, and to ensure the PI's education goals are in line with his or her organization's goals so that the PI's work is highly valued in promotion decisions. Therefore, you should work with your institution to find the appropriate balance in this context. You are encouraged to make connections with appropriate education experts, and be sure to provide the necessary statements of commitment if and when you do. Collaborate with or seek out and utilize educational/outreach resources at your home institution, in the local area, or resources that are generally available to the community (such as, but not limited to, other NSF supported projects). (*BRDO note: We can provide help in this area if needed*).

Q: What are the expectations for the level of activities in the education component? A: While excellence in both education and research is expected, activity of an intensity that leads to an unreasonable workload is not. For instance, teaching additional courses or taking on additional duties is not expected. A justification for released time may be appropriate for extraordinary curriculum development or education innovation. What is expected is a well-argued and specific proposal for activities over a 5-year period that will build a firm foundation for a lifetime of integrated contributions to research and education.

Campus Education and Outreach Resources

Public Service Center (http://publicservice.berkeley.edu) is a connecting point for faculty, students, and staff who want to get involved in the community surrounding campus. PSC partners with over 150 community organizations, including schools in Berkeley and Oakland, and offers a range of services and resources to support faculty and graduate students in their outreach goals. The Public Service Center can support you in developing community partnerships and help you determine the best ways to incorporate community-based work in your teaching and scholarship. Contact Suzan Akin, suzanakin@berkeley.edu.

Center for Educational Partnerships (http://cep.berkeley.edu) is the main campus portal for information on more than 70 UC Berkeley programs serving students from kindergarten to college. It is the primary unit on campus charged with developing and implementing programs and strategies to improve academic preparation and access to higher education for low-income and educationally-disadvantaged k-14 students. CEP provides a Toolkit for Working with k-12 and Community College and can provide strategies and support for Berkeley faculty, students and researchers who wish to conduct education and outreach in schools and community colleges. Contact Marsha Jaeger, mjaeger@berkeley.edu.

Lawrence Hall of Science (www.lawrencehallofscience.org) designs, publishes, and disseminates award-winning curricula, provides teacher professional development events, and engages the public in interactive exhibits and public programs. The LHS Center for Technology Innovation team of project managers, developers, graphic designers, science educators, and learning scientists specialize in high quality, research-driven educational technology products. Dr. Porcello has led multiple projects to build digital libraries for the informal science education community, incorporate hands-on activity modules on nano/green technologies into community college science courses, provide health sciences content on mobile devices, and develop websites and exhibits to help scientists communicate their research to the public. Contact Rena Dorph, rdorph@berkeley.edu

Coalition for Education and Outreach (http://scienceatcal.berkeley.edu/coalition-for-education-and-outreach/) is a membership organization consisting of dozens of campus groups, institutes, and research centers that have active education and outreach programs and staff who can provide expert guidance to faculty about available outreach opportunities and potential partnerships. Contact Kate Spohr, kspohr@berkeley.edu.

Science@Cal (http://scienceatcal.berkeley.edu/) is a networked, cross-disciplinary effort to inform and engage the public about the diversity and depth of science research at Berkeley and the resulting contributions to society. Science@Cal fosters opportunities to engage the public at all levels in the scientific enterprise. Contact Rachel Winheld, winheld@berkeley.edu.

Berkeley College of Engineering (http://coe.berkeley.edu) has outreach programs that include research experiences for undergraduates, research experiences for community college students, research experiences for teachers, and a variety of special programs, such as Intro to Research Workshops, formalized Graduate Research Mentoring, and engineering design. Contact Oscar Dubon, oddubon@berkeley.edu.

Community Resources for Science (http://www.crscience.org) is a non-profit partner for connecting UC science and engineering with local K-8 schools. CRS has a network of over 1,000 educators at 100 schools in Berkeley, Emeryville, Oakland, Richmond, and other nearby districts, and it handles placement logistics for lab groups to bring science activities directly to local teachers and students. CRS provides lesson and activity development, alignment with state curriculum, training and coaching of grad students on teaching and communicating science, scheduling outreach presentations, and post-presentation data collection and evaluation. Over 400 grad students, postdocs, and faculty members currently participate in outreach with CRS. Contact Teresa Barnett, Teresa@crscience.org.

Office of Undergraduate Research (http://research.berkeley.edu/) has a comprehensive listing of undergraduate research opportunities on campus. Many programs have funding for students and need faculty, postdocs or graduate students willing to mentor young researchers. Contact Sean Burns, burns@berkeley.edu.

YouSTEM (http://YouStem.org) is a free web resource that provides a comprehensive listing of local pre-college programs in science, technology, engineering and math. The list can be filtered based on discipline, grade level, or type of program. Many programs offer opportunities for partnerships with faculty labs, departments and institutes. Contact http://youstem.org/main/contact/.