

Broader Impacts Toolbox

NSF now requires a section in all proposals that addresses one or more of five broader impacts. This document includes ideas, examples and resources to help faculty conceptualize their proposals and meet NSF's new requirements. The NSF Grant Proposal Guidelines (GPG) contain more information in Chapter 2: http://www.nsf.gov/pubs/policydocs/pappguide/nsf13001/gpg_2.jsp#IIC2d

Broader Impact Themes:

- I. Advancing Discovery While Promoting Teaching, Training and Learning
- II. Broaden Participation of Underrepresented Groups
- III. Enhancing Research and Education Infrastructure
- IV. Broadly Disseminating Results
- V. Benefits to Society

I. Advancing Discovery While Promoting Teaching, Training and Learning

Ideas from NSF

- 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 graduate students).
- Include students (e.g., K-12, undergraduate science majors, non-science majors, and /or graduate students) as participants in the proposed activities as appropriate.
- Participate in the recruitment, training, and/or professional development of K-12 science and math teachers.
- Develop research-based educational materials or contribute to databases useful in teaching (e.g., K-16 digital library).
- Partner with researchers and educators to develop effective means of incorporating research into learning and education.
- Encourage student participation at meetings and activities of professional societies.
- Establish special mentoring programs for high school students, undergraduates, graduate students, and technicians conducting research.
- Involve graduate and post-doctoral researchers in undergraduate teaching activities.
- Develop, adopt, adapt or disseminate effective models and pedagogic approaches to science, mathematics and engineering teaching.

Resources @ Stanford

- Tap into Stanford's RET program to host a teacher; you design the project and select the teacher from a pool of candidates (and where possible, provide stipend funding); the OSO does the rest. <http://oso.stanford.edu/programs/6-summer-research-program-for-teachers>
- Tap into one of Stanford's many high school internship programs. Internships arranged in all areas of STEM. <http://oso.stanford.edu/programs/audiences/5-high-school-students/categories/5-research-internships>

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- Tap into one of Stanford's many Research Experiences for Undergraduates (REU) programs. <http://oso.stanford.edu/programs/audiences/9-undergraduates-from-other-schools/categories/5-research-internships>
Or host an undergraduate on an informal basis, with a checklist and documents the OSO can provide.
- NSF often provides supplemental **funding** for all of these internships to PIs with active projects. The OSO can help you request this funding.
- Participate as a speaker in a summer workshop for teachers. There are many on campus; OSO can get you linked in.
- Encourage your students to teach a course in SPLASH! <http://oso.stanford.edu/student-outreach/12-educational-studies-program-splash> or participate in dozens of other student-run outreach programs. <http://oso.stanford.edu/student-outreach>



Examples @ Stanford

- David Camarillo hosted three high school interns to work on a special project assembling and testing sophisticated mouth guards used by Stanford athletes to monitor head injuries.
- Christopher Chidsey and Jennifer Schwartz Poehlman hosted high school chemistry teachers for a number of summers to develop and test low cost, standards-aligned chemistry labs suitable for high school students. They then partnered with the Graduate School of Education to offer summer workshops to chemistry teachers and published the labs online at chemoutreach.stanford.edu. Their graduate students also partnered with specific high schools to co-teach the labs to students.
- Jonathan Payne in Earth Science hosted a high school teacher and many of his students each summer to develop a long-term project studying the role of environmental change in controlling long-term evolutionary patterns.
- Christopher Scott developed a suite of instructive and lab-based materials focusing on stem cell biology and research for use in undergraduate courses in community colleges and four-year schools. The products of this project include a suite of classroom and laboratory-based teaching and learning resources and evaluative materials that can stand-alone or be joined to create new courses.

II. Broaden Participation of Underrepresented Groups

What are "Underrepresented Groups?"

Underrepresented groups in math, science and engineering (MS&E) are those groups whose demographics in MS&E do not reflect their representation in the general population. The NSF recognizes women, African-Americans, Hispanics, Native Americans and Pacific Islanders as underrepresented groups.

This theme should infuse your broader impacts strategy. You can address this priority with many of the activities provided as examples here, by targeting the teachers, schools or students with whom you partner. The OSO can help you find a partner to meet this criterion.

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III. Enhancing Research and Education Infrastructure

Ideas from NSF

- Identify and establish collaborations between disciplines and institutions, among the U.S. academic institutions, industry and government and with international partners.
- Stimulate and support the development and dissemination of next-generation instrumentation, multi-user facilities, and other shared research and education platforms.
- Maintain, operate and modernize shared research and education infrastructure, including facilities and science and technology centers and engineering research centers.
- 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.

Examples @ Stanford

- Nick McKeown's team developed the NetFPGA platform, making makes it easy for students and researchers to build and deploy high-performance networking systems using Field Programmable Gate Array (FPGA) hardware. NetFPGA hardware is being deployed in backbone networks, other research laboratories, and classrooms in EPSCoR states.
- If a piece of equipment is large enough that an NSF award is needed to buy it, it's large enough to serve as the basis for building research infrastructure. This document from Purdue is a good example of how to show the instrumentation builds infrastructure: http://www.purdue.edu/strategic_plan/whitepapers/Large%20Scale%20Research.pdf

IV. Broadly Disseminating Results

Ideas from NSF

- Partner with museums, nature centers, science centers, and similar institutions to develop exhibits in science, math, and engineering.
- Involve the public or industry, where possible, in research and education activities.
- Give science and engineering presentations to the broader community (e.g., at museums and libraries, on radio shows, and in similar venues).
- Make data available in a timely manner by means of databases, digital libraries, or other venues such as CD-ROMs.
- Publish in diverse media (e.g., non-technical literature, and websites, CD-ROMs, press kits) to reach broad audiences.
- Present research and education results in formats useful to policy-makers, members of Congress, industry, and broad audiences.

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- Participate in multi- and interdisciplinary conferences, workshops, and research activities.
- Integrate research with education activities in order to communicate in a broader context.

Note: “Broader” doesn't necessarily mean non-scientists; sharing information outside your immediate field counts.

Resources @ Stanford

- The OSO website lists a number of courses, workshops and resources at Stanford for scientists and engineers who wish to refine their skills to present research verbally and in writing for a lay audience. Check it out at <http://oso.stanford.edu/resources/faculty>.
- OSO staff can help you develop an activity or program to reach a broad audience.
- The *Communicating Research to Public Audiences* program at NSF (NSF 03-509) (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5362&from=fund) provides **funding supplements** of up to \$75,000 to existing grants specifically for activities that will disseminate the results and process of research to the public. No deadline, but they need at least six months for processing.



Examples @ Stanford

- Many faculty and their grad students have provided lectures, demos and hands-on activities for the community by tapping into the [Bay Area Science Festival](#), Engineering Day ([eDAY](#)), or [Wonderfest](#).
- Stanford PIs have created materials for use in a K-12 classroom such as learning modules, videos, virtual labs, or computer simulation. Examples include Steve Palumbi's [Microdocs: The Short Attention Span Science Theater on Ecological Sustainability](#), the [Virtual Labs Project](#), Vijay Pande's [Folding@Home](#), and Andrew Spakowitz's [LABSci](#) Curriculum Modules for Impaired or Hospitalized Students.
- [Stanford at the Tech](#) trains Stanford biology graduate students and postdocs in how to effectively communicate science to the public and then have them serve as docents at the Tech Museum of Innovation's *Understanding Genetics* exhibit.
- George Hilley's team is constructing a real and virtual educational driving tour through the Santa Cruz Mountains that teaches the general public about the landscapes produced by plate-boundary deformation over thousands to millions of years.

V. Benefits to Society

Ideas from NSF

- 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 the private sector on both technological and scientific projects to integrate research into broader programs and activities of national interest.

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- Analyze, interpret, and synthesize research and education results in formats understandable and useful for non-scientists.
- Provide information for policy formulation by Federal, State or local agencies.

Examples

- A powerpoint presentation on the Broader Impacts of the Long-Term Ecological Research (LTER) program can be found here: <http://www.nsf.gov/pubs/2005/nsf0533/nsf0533.pdf>

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