

NSF Criterion 2 – Broader Impacts

Resources for Researchers Writing NSF Proposals

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I. INTRODUCTION

What are the broader impacts of the proposed activity?

- Advance discovery and understanding while promoting teaching, training, learning
- Broaden the participation of underrepresented groups
- Enhance infrastructure for research and education
- Broadly disseminate results to enhance scientific and technological understanding
- Benefits of proposed activity to society

NSF summary of ideas

- (www.nsf.gov/pubs/gpg/broaderimpacts.pdf)

II. EXAMPLES/IDEAS/RESOURCES

Promote Teaching, Training, and Learning

- Continuing Education and Professional Studies OUTREACH (www.colorado.edu/ContinuingEducation/outreach.htm) – The CU Boulder Outreach Committee focus on extending knowledge for the benefit of external audiences
- Science Discovery Program (www.colorado.edu/sciencediscovery) – An experienced-based outreach program of the School of Education to stimulate scientific interest among Colorado’s youth
- CIRES Outreach program (cires.colorado.edu/education/k12) – K-12 education outreach on topics of earth science and environmental studies
- ReSciPE: Resources for Scientists in Partnership with Education (cires.colorado.edu/education/k12/rescipe/) – A project of CIRES Outreach and Science Discovery to assist scientists with K-12 education
- Integrated Teaching and Learning Laboratory (itll.colorado.edu/ITLL/) – Encourages hands-on learning experiences and practical application of engineering theory
- Space Sciences Institute (www.space-science.org) – A non-profit corporation in Boulder that integrates scientific research with science education and outreach

- Simply the Best (spot.colorado.edu/%7Eeisenhar/fivepoints.html) – An after-school program in science and technology for African American and Latina middle school girls in the Five Points community of downtown Denver
- Constructing Physics Understanding Project (CPUP) (www.colorado.edu/education/outreach/outreach-projects.html) – An NSF supported program in the School of Education to develop a physics curriculum for practicing and prospective elementary school teachers

Broaden Participation of Underrepresented Groups

- AGEP: Alliance for Graduate Education and the Professoriate (www.colorado.edu/graduateschool/DiversityInitiative) -- Part of Colorado Diversity Initiative to provide comprehensive support for diversity-based graduate training grants in Sciences, Math and Engineering
- IMSD: National Institutes of Health Initiative for Minority Student Development (www.colorado.edu/graduateschool/DiversityInitiative) -- Part of Colorado Diversity Initiative to provide comprehensive support for diversity-based graduate training grants in Sciences, Math, and Engineering
- SMART: Summer Multicultural Access to Research Training (www.colorado.edu/engineering/MEP/gsprep.htm) – Supports students coming to the Boulder campus to do research on a topic of their choice with CU Professor.
- SOARS: Significant Opportunities in Atmospheric Research and Science (www.ucar.edu/soars) – Offers summer research internships to undergraduates exploring a career in an atmospheric science or related field such as biology, chemistry, computer science, earth science, engineering, environmental science, mathematics, meteorology, oceanography, physics, or social science
- LEAP (<http://advance.colorado.edu/>) – Aims to improve the retention of women faculty in science and engineering by increasing faculty collegiality and effectiveness

Enhance Infrastructure

- Multi-user equipment and facilities
- Improve ties between disciplines, institutions, and international partners
- Support Science and Technology Centers and Engineering Research Centers
- Upgrade computing facilities
- Products (lasp.colorado.edu/products/) – Along with publications, LASP grants have produced data and software products available for use by others

Broad Dissemination

- The University of Colorado Museum (cumuseum.colorado.edu/) – Offers a wide range of special events and educational programs
- CU Wizards (<http://www.colorado.edu/physics/Web/wizards/cuwizards.html>) – Provides informal, entertaining, and interactive introductions to chemistry, physics, astronomy, and biology
- Make data available electronically to possible users – IT website development can help (<http://www.colorado.edu/its/docs/webct/facultysup.html>)

- Information to decision-makers – The Center for Science and Technology Policy Research focuses on providing usable science information to policy makers (sciencepolicy.colorado.edu/)
- Digital Libraries (cslr.colorado.edu/beginweb/ngsw/ngsw.html) – The Center for Spoken Language Research has received funding from NSF to create a digital library of the spoken word that can be used for teaching, outreach, and information retrieval

Benefits to Society

- Translation/partnership of research into operational/commercial entities (<http://leeds.colorado.edu/brd/resources>)
- Information for policy formulation (IPCC, assessments, etc)
- Community involvement (www.colorado.edu/ContinuingEducation/outreach.htm)

III. EXAMPLE: CIRES SUPPORT

CIRES Education and Outreach Group Capabilities

- Strong existing partnerships (e.g. school districts, teachers, professional societies, other geoscience educators.
- Robust science, education and evaluation expertise (Ph.D. and M.S. degrees)
- Efficient logistics and infrastructure support (website, administrative assistance)

The Way it Works

- Researchers initiate collaboration.
- Project design depends upon:
 - Educational potential of research
 - Interests and ideas of researchers
 - Existing projects that could be leveraged
 - Extent of agency interest, available budget and time

Example: Earthworks

- Annual summer workshop
- CIRES-sponsored
- Researchers may be instructors, develop field protocols, lead evening sessions
- Available at no cost or low cost for short time period

Example: Ocean Interactions

- Teacher at sea, Classroom visits, ship-shore email Q&A
- Driven by researcher interest
- Requires logistics, networking and administrative support

- Requires budget

IV. PRACTICAL SUGGESTION (Tom Perkins, JILA and MCDB)

Amount of Broader Impact (BI) depends on grant

- NSF Centers: required 5-10% budget.
- Multi-PI grants: 1-3% for a \$1.5 million grant.
- Include specific line items in budget.
- Recent NSF conference: every PI had slides on BI.
- Single PI grants: variable, but include line items.
- For smaller grants, don't promise what is not reasonable.

Lessons from my first NSF grant

- It takes lots of time (4 weeks).
- Have a senior colleague read the grant (someone familiar with format).
- Trade a clever, but complex idea for well written BI (how many people will understand the clever idea?).
- Summary page is crucial: use well written, good quotable sentences.

Suggestions

- Spend time on Broader Impacts: It represents one half of the review criteria.
- Make it genuine: Demonstrate has a real contribution, not just going along for the ride.
- Make it specific.
- Don't suggest outreach to a high school.
- Example: I will work with Teacher Smith at Winchester middle school biology class for 7th and 8th graders. We will spend several classes showing students how nematode worms develop.
- Example: I will develop an undergraduate experiment that demonstrates kinesin walking along microtubules for only \$30k worth of hardware. We will write up our protocol for the American Journal of Physics (a teaching journal).
- For physics and engineering: tie to biology.
- Demonstrate the ability to do the BI: Give same level of attention as experiments.
- Be realistic and be explicit.
- Real money = real commitment.

Common mistakes

- Suggests BI as training your graduate students.
- Not thought out: Do your homework.
- Summary page not balanced.
- BI should not be last one or two sentences.
- Aim for at least $\frac{1}{4}$ to BI and $\frac{3}{4}$ Research .
- Overstating promises.