

# NSF BROADER IMPACTS

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## WHY YOU NEED TO CARE ABOUT BROADER IMPACTS

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The two major review criteria for NSF are Intellectual Merit, and Broader Impacts. NSF has recently placed great emphasis on the “Broader Impacts” of scientific research grants they fund, in part, because the public wants to be sure their money is being spent wisely. The link between the research being conducted, and the benefits to society, are not often apparent to the lay observer, and this is where Broader Impacts becomes critical. There are now numerous requirements for Broader Impacts to be included in all sections of the proposal, from the Project Summary, to a separate section within the Project Description, down to another separate section in the Prior Results from NSF Support. This push to emphasize Broader Impacts encourages universities to provide training and support, particularly for those who would otherwise not have the opportunity to take part in these activities. The information presented is to assist faculty with Broader Impacts Statements.

## WHAT ARE BROADER IMPACTS

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- ADVANCE DISCOVERY AND UNDERSTANDING
- PROMOTE TEACHING, TRAINING AND LEARNING
- BROADEN PARTICIPATION OF UNDER-REPRESENTED GROUPS
- ENHANCE THE INFRASTRUCTURE FOR RESEARCH AND EDUCATION, FACILITIES, NETWORKS AND PARTNERSHIPS

### What should Broader Impacts Include?

- EDUCATION
- UNDER-REPRESENTED GROUPS  
(GENDER, GEOGRAPHY, INDIVIDUALS OR INSTITUTIONS)
- INFRASTRUCTURE FOR RESEARCH AND EDUCATION
- DISSEMINATE RESULTS TO THE PUBLIC TO ENHANCE THEIR SCIENTIFIC LITERACY
- SOCIAL AND SOCIETAL BENEFITS

### Broader Impacts should focus on:

- FACILITATION - create novel ways for basic research and broader impacts to intertwine, and feed the public's thirst for knowledge
- LEVERAGING - to increase the impact, be it on a local or national scale
- COHERENCE - to align the mission of the institution with the broader impacts, to have an overall greater impact

## What should Broader Impacts NOT include?

One MAJOR criterion for NSF in their implementation of Broader Impacts is to specify that these activities must be outside of the PI's normal teaching duties and faculty commitments. So they should NOT include:

- Faculty's normal teaching duties
- Publishing research in peer reviewed journals
- Undergraduate advising

## EXAMPLES OF BROADER IMPACTS

Broader impacts do not need to be limited to Cornell, or the immediate area, in fact, it will probably enhance your BI statement if they're far-reaching. This is especially true if they aid in dissemination of results to the public, or have added social benefits. Examples of this include:

- Broader impact activity closer to home could be through partners such as the [Science Center](#), where opportunities for K-12 outreach are numerous.
- The [4-H Youth Development Program](#), the Nation's largest youth development and mentoring program.
- The [Paleontological Research Institution](#) (including The Museum of the Earth and Cayuga Nature Center) is formally affiliated with Cornell, and the staff there are always interested in eager participants to aid in their mission to improve education and outreach.
- [TED lectures](#), are a prestigious public stage on which faculty may be asked to present. In the same vein, any public lectures, op-ed pieces in general publications or interviews with media outlets about your research could be included. Basically, anything that gets your research into the public spotlight is fair game.
- [Science outreach](#) can be accomplished through design and implementation of science policy. Dr. Chris Schaffer, in the Department of Biomedical Engineering, has taken this role to another level, as the [Cornell Chronicle states](#) "Chris also has a strong interest in science policy and spent a sabbatical in Washington, DC, working as a science policy advisor for Representative Edward Markey in the United States Congress". Again, a wonderful example of public outreach and attempting to help the public understand the science. As long as this kind of activity can be related to your NSF project, it can be included in your Broader Impacts statement.

## WHAT RESOURCES ARE THERE FOR ME AT CORNELL?

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Knowing what is already in place within your institution, and how to leverage existing facilities to drive home an innovative and integrative Broader Impacts statement is key. For instance, do not re-invent the wheel; already at Cornell, there are many collaborations between faculty and organizations to encourage individuals from all backgrounds to become involved in the research undertaken at Cornell.

- The [Cornell Institute for Biology Teachers](#) provides training for K-12 biology teachers in NY State, and offers Summer and Academic workshops for this training
- The [BEST program](#), an NIH-funded initiative, gives young scientists a taste of careers outside of the traditional tenure-track, and involves many academic faculty at Cornell
- The [Engaged Learning and Research Center](#) focuses on community engagement and cultivating connections with Cornell's community partners
- The [Bronfenbrenner Center for Translational Research](#) has a unique mission within Cornell, to "expand, strengthen, and speed the connections between cutting-edge research and the design, evaluation and implementation of policies and practices that enhance human development"
- [Cornell Cooperative Extension and the 4-H Youth Development Program](#), which work towards providing research and training experiences for youth
- [Cornell Public Service Center](#), a service organization with a major goal of connecting Cornell staff and students with local community organizations
- [Engaged Cornell](#), which aims to promote innovative and community-engaged learning
- The [Academic Diversity Initiatives](#), a campus-wide program to ensure students of all backgrounds can achieve their goals
- [Center for Teaching Excellence](#), a center committed to the advancement of teaching and learning at Cornell, and the ideal opportunity to engage with students in an entirely new way, as some faculty have managed to do very successfully
- [Cornell University Center for the Integration of Research, Teaching, and Learning \(CU-CIRTL\)](#) prepares Cornell graduate students and postdocs to implement effective teaching and mentoring practices for diverse learners through participation in a national community dedicated to excellence in undergraduate education
- [Graduate School Office of Inclusion & Student Engagement \(OISE\)](#) leads the Graduate School's efforts to recruit, retain, mentor, and support a diverse graduate student body
- [Diversity Program in Engineering \(DPE\)](#) provides an institutionalized approach for meeting the needs of students and faculty by leading educational, professional development, and networking opportunities
- [Cornell Center for Materials Research \(CCMR\)](#), [Cornell Laboratory for Accelerator-Based Sciences and Education \(CLASSE\)](#) and [Cornell Nanoscale Facility \(CNF\)](#) all have educational outreach programs focused on local community learning opportunities
- [Cornell Prison Education Program](#) provides a liberal arts curriculum, leading to an Associate of Arts degree for the men incarcerated at Auburn and Cayuga Correctional Facilities. Cornell faculty and doctoral students serve as instructors for all courses, and a community college accredits the degree conferred upon eligible prisoners

## BROADER IMPACTS OPPORTUNITIES OUTSIDE OF CORNELL

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- [National Coordinating Centre for Public Engagement](#), an organization devoted to helping universities engage with the public
- [Alan Alda Center for Communicating Science](#), a company working towards helping to enhance the public's understanding of science by training scientists to communicate more effectively
- [NSF merit review criteria resource site](#), provides very clear instructions as to what NSF expect from Broader Impact statements and useful resources to assist faculty
- [National Alliance for Broader Impacts](#), is a collective of various institutions working together to foster the development of institutional engagement in Broader Impacts
- [NSF perspective on Broader Impacts](#), is a document outlining the NSF goals for Broader Impacts, and some useful examples and resources

## WHAT MAKES A SUCCESSFUL BROADER IMPACTS STATEMENT?

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- Use facilities and components already established at Cornell and leveraging these existing strengths and expertise to integrate with the partners, to teach a traditionally under-served population, e.g. females within the Engineering disciplines
- The reach needs to be beyond just Cornell University, e.g. national recognition, widespread media
- The impact statement should provide a future sustainability and use beyond the length of time of the proposed project
- The statement should propose to support trainees of the highest caliber, who may not only be underserved in terms of ethnicity and background, but perhaps also through gender, e.g. a female training in a traditionally male-dominated field
- The Broader Impacts statement is usually heavily laden with educational outreach and teaching opportunities
- The statement should have clear social benefits associated with the Broader Impacts of the proposal or possible practical benefits
- Above all else, the statement should be project-specific

## SUMMARY

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Broader Impacts mean many things, to many different people, and as such, are probably one of the most subjective parts of the review criteria and are thus subject to significant variation. Above all else, however, the broader impacts should be specific to the project requiring funding, and should show an ongoing commitment to improving education, outreach and scientific infrastructure, while informing the general public about the research ongoing under the awarded funding.

## EXAMPLES OF SUCCESSFUL BROADER IMPACTS STATEMENTS

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Chris Schaffer- taken from “Nanoparticle Transport in the Brain” (awarded):

“Schaffer has served as a faculty project advisor for the Cornell College of Engineering’s Curie Program. This weeklong event brings to campus 30 high-school girls who are interested in engineering to learn more about engineering applications. For example, students use optical techniques to characterize blood flow and oxygenation in tissue, which provides them with an introduction to optics-based measurements, medically relevant physiology, and medical diagnostics.

Schaffer and Olbricht both participate in the biomedical engineering department’s NSF-sponsored GK-program called Cornell’s Learning Initiative in Medicine and Bioengineering (CLIMB) that teams graduate students and faculty members with science teachers in middle and high schools in the Ithaca area. Both PIs will use the activities proposed here as a basis for developing additional modules for Curie and related programs as well as new graduate student/teacher curriculum projects for CLIMB”.

Catherine Anderson-taken from “CAREER: Maximizing Renewable Energy Integration” (awarded):

The project and the PI’s research group will continue to encourage full participation of women, persons with disabilities and underrepresented minorities in STEM. The current research group is 50% women including the PI, with graduate students and a postdoctoral associate representing backgrounds from nearly all regions of the world: Africa, China, India, North and South America.

This project will also provide education and educator development at the middle and high school levels through partnership with the Bioenergy and Bioproducts Education Program (BBEP). Each summer, the BBEP program offers a funded professional development on-site at Cornell entitled “Train-the-Trainer” Fellowship. The PI has been involved in the BBEP for the past three years, through teacher professional development sessions on the importance of systems thinking in science and sustainability. [BBEP also includes] professional development activities for teachers, and follow-on classroom activities to support teachers, including this new focus in the curriculum.

New activities will be tested annually with BBEP participants beginning in June 2016, to be subsequently shared with BBEP participants with state-level professional development groups. This method of hierarchical professional development is effective in reaching a large number of teachers and classrooms in a cost effective and time efficient manner.

Steven Strogatz- taken from “Non-linear Dynamics of Oscillator Networks” (awarded):

As I have in the past, I will try to convey the results and significance of our research to the general public, through magazine articles, op-ed pieces, television and radio appearances, public lectures, YouTube videos, and online posts and tweets. I was awarded the 2014 Public Engagement with Science Award by the American Association for the Advancement of Science, and the 2007 JPBM Communications Prize, a lifetime achievement award for communicating about mathematics to the general public, awarded jointly by the four major American mathematical societies.

I am committed to training my students to write for a broad audience, for example, my former student Sam Arbesman (Ph.D. 2008, Computational Biology) and I co-authored a New York Times opinion piece in which we explained how Monte Carlo methods could be used to estimate the probability of Joe DiMaggio’s celebrated 56-game hitting streak. Sam realized he had a taste and flair for this sort of public outreach. He went on write a number of science pieces for the Boston Globe Ideas section, and now writes the Social Dimension blog for Wired.com, about the applications of mathematics to society and the social sciences.

[My graduate student] is an African-American woman, originally from Cameroon and now a US citizen, in the fourth year of her doctoral studies in applied mathematics. She comes from a family whose income is equivalent to \$6000 per year. Neither of her parents finished high school. Apparently her talent was recognized early on. After graduating from high school at 16, she was sent to the United States—by herself—to live with her uncle’s family. She worked her way through college, did brilliantly at University of Delaware, spent the summer of 2011 at the Mathematical and Theoretical Biology Institute at Arizona State, and has been working as my advisee since then. She is extremely bright and resourceful, talented at both computation and analysis, well-versed in both mathematics and biology, and has a winning personality. She will assist me with the fourth project above.

## RESOURCES

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Click on the teal colored links to access more information about a particular resource.