TEXAS TECH UNIVERSITY™

Broader Impacts

Texas Tech University

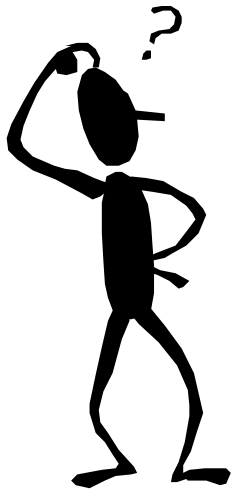
- *Research Development Team*
- *STEM CORE*

March 2018

Broader impacts:

The potential to benefit society and contribute to the achievement of specific, desired societal outcomes

While most researchers know what is meant by Intellectual Merit, experience shows that many researchers have a less than clear understanding of the meaning of Broader Impacts



What Broader Impacts Typically Are NOT:

- *Teaching your students lab, etc. procedures*
- *Going to conferences to disseminate results*
- *Sending your researchers to conferences*
- *Employing Undergraduates in Research, unless it benefits a specific, perhaps underrepresented, population or is part of a broader (university) effort or agency*

The History of the Broader Impacts Criterion at NSF

The purpose of review criteria at NSF has always been to ensure that excellent research was being supported and to distinguish among the many proposals worthy of support, given that only a fraction can be funded. Although NSF revised, refined and clarified its review criteria over the years, it appears that broader impacts were considered from at least the 1960s. It did not, however, become a separate and distinct criterion until 1997, when NSF simplified the merit review criteria for proposals from four to two—intellectual merit and broader impacts. In 2007, NSF further clarified these two criteria to emphasize transformative research.

https://www.nsf.gov/od/oia/publications/Broader_Impacts.pdf

In 2011, the National Science Board (NSB) issued a report on the National Science Foundation's Merit Review Criteria: Review and Revisions. In addition to reaffirming the two merit review criteria, the report set forth three merit review principles:

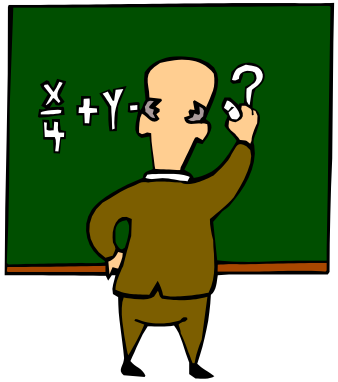
• *All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.*

• *NSF projects, in the aggregate, should contribute more broadly to achieving societal goals.*

• *Meaningful assessment and evaluation of NSF projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful.*

Broader impacts may be accomplished through

- *the research itself*
- *the activities that are directly related to specific research projects*
- *activities that are supported by, but are complementary to the project.*



Societal Outcomes Desired by NSF

1. Full STEM participation of women, persons with disabilities and underrepresented minorities;

2. Improved STEM education and educator development at any educational level;

3. Development of a diverse, globally competitive STEM workforce;

4. Enhanced [STEM] infrastructure for research and education;

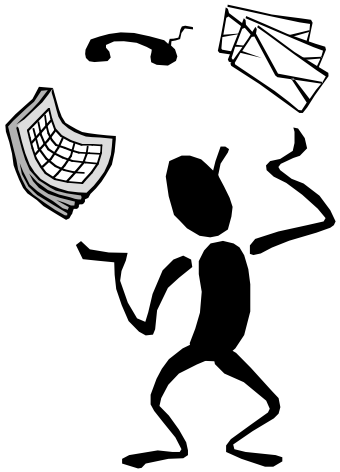
5. Increased partnerships between academia, industry and others;

6. Increased public scientific literacy and public engagement with [STEM] science/technology;

7. Improved national security;

8. Increased economic competitiveness; and

9. Improved well being of individuals in society.



Review Criteria

- *How well does the activity advance discovery and understanding while promoting teaching, training and learning?*

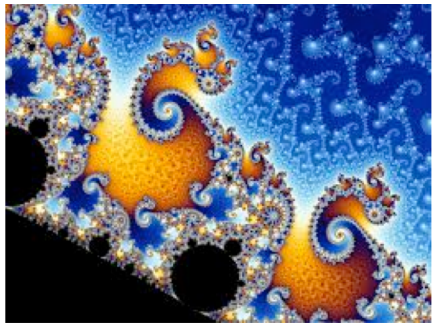
- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?*

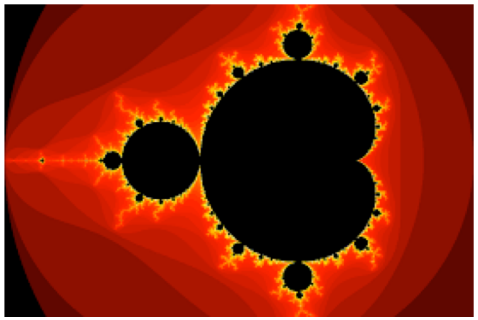
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?*

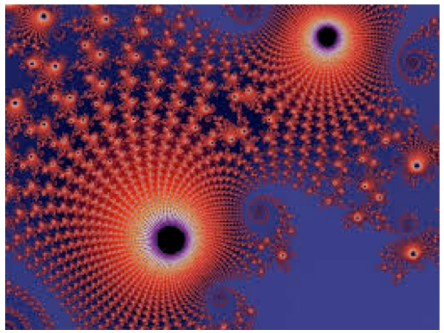
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

- *What may be the benefits of the proposed activity to society?*

These questions help to assess the potential of the proposed activity - beyond the research, per se - to benefit the Nation. Thus, the Broader Impacts criterion speaks directly to the mission of the National Science Foundation, "To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense." (NSF Act of 1950).







Example Activities

- *Undergraduate research (included in 10/15)*
- *Research findings developed into case studies for existing courses*
- *Bridge program for high school students from underrepresented groups*
- *K-12 teacher training workshops targeted at underrepresented groups in rural Texas*

Example Activities

- *Scientific exhibits at local museums*

- *K-12 summer camp program*

- *TTU-wide undergraduate research competition – "Student Research Days"*
- *Science – It's a Girl Thing (3-week long summer session for 5th-11th grade girls)*

- *Research internships with private sector partner*

Example Activities

- *Recruiting undergraduate researchers from PEGASUS*
- *Undergrad/grad researcher exchanges between partner labs*
- *Artistic renditions of data*

Potential Partners

- *The Institute for the Development and Enrichment of Advanced Learners (IDEAL)*
- *PEGASUS (first-gen college students)*
- *STEM CORE and CISER (K-12 Outreach)*

Potential Partners

Cooper ISD
Frenship ISD
National Wind Institute
Lubbock Aquarium
Lubbock ISD
National Wind Institute
Science Spectrum
Slayton ISD
Texas Tech Museum
TLPDC
TTU& TTU HSC GLEAMM
Whitacre College of Engineering (Robotics, etc)
Slayton ISD

Potential Partners

Boys and Girls Clubs
Carillon
Children's Home of Lubbock
CVPA, etc.
Fox
KCBD
KLBK
KMAC
LHUCA
Lubbock Senior Center
Raider Ranch
United

STEM CORE

What Can STEM CORE Do for YOU?

- *Furnish Letters of Support for Grants*
- *Distribute Boilerplate Information and Templates for Grants*
- *Help Develop Broader Impact Statements for Proposals*
- *Partner with Grant Writers in STEM disciplines*
- *Encourage Grant Teams Highlighting STEM*
- *Help to Develop Grant Sustainability*

Example Statements

Attending lightning are recreational, commercial and environmental impacts, which makes lightning an area of interest to individuals and formal decision support services provided by and between businesses and government agencies. This project will help clarify the distribution of electrical potential in storms, which controls to a large extent whether a flash strikes ground. The field campaign and its results will be shared at local high schools to stimulate interest in science and mathematics. During the project, artists will produce an immersive gallery exhibit derived from field data. This exhibit will include a survey component to test its effectiveness in presenting lightning data with the rich texture as it actually exists in storms, countering notions of lightning as singleton storm-wide discharges between simple vertically stacked charge layers. Data collection, analysis, and publication of results in a team setting will provide students with scholarly and methodological training through a project that is rich in cross-disciplinary theory and in practical skills tied to observational work. In an era of increasing computational resources and emphasis on data management and digital knowledge dissemination, this project will train students to adopt best practices in reproducible scientific research using open, pan-disciplinary tools enabled by dispersed, diverse internet-based communities.

Example Statements

The research effort is partnered by comprehensive teaching, mentoring, and outreach plan. The results from this project will be featured in the graduate course on "nanomanufacturing" developed by PI. Nanoimprinting facilities in PI's lab will be leveraged to students for providing hands-on experience. Participation of undergraduate researchers will be promoted by showcasing our research at the annual undergraduate research conference (URC) at Texas Tech. To broaden the diversity in engineering, a bridge program for high school students from the underrepresented groups will be implemented. Four minority students from local high schools will be recruited for two weeks in the summer to experience the university engineering environment. They will get a snapshot of university-level course requirements to better prepare for a smooth transition. This will be accomplished through lectures on foundational engineering courses, lab activities, and career mentoring organized by the PI and graduate researchers. The students will make a short movie which will be featured at the respective schools to share the excitement of engineering career with the community at large. The ultimate goal is to develop this initiative into a successful minority engineering bridge program at Texas Tech. Public outreach activities are planned through contribution to scientific exhibits at the local museums and dissemination of results and materials through "Impact of Materials on Society" branch of Materials Research Society (MRS).

Example Statements

Since there are two broad areas of chemistry and materials science that are involved in the research described in this proposal, multiple avenues for the integration of education and research are potentially available to the student. The students involved in this grant will be required, as a first step into the integration of education and research, to develop a website explaining the application of light to chemistry, with a special emphasis on the potentials of photonics and molecular electronics. They will also be required to maintain an updated annotated database of articles produced in photochemistry (with special emphasis on Cu(I) photochemistry) during the grant period, which will be listed on the PI's Chemistry Department website.

Example Statements

As part of a Howard Hughes Medical Institute grant, Texas Tech University has developed a nationally-recognized program for science teacher training involving undergraduate Science Education Fellows (SEFs) and a Traveling Lab Program. Among other activities, these students help to design, maintain, and update science education modules in cooperation with in-service K-12 science teachers that can be used by other K-12 science teachers in a region covering a 150 mile radius. There are currently twenty such modules that have been developed by curriculum development teams that include the SEFs, science faculty at Texas Tech (for content), science education faculty at Texas Tech (for curriculum writing), and high school science teachers. The SEFS are also responsible for taking these modules (using two vans which were purchased with HHMI funds as part of the Traveling Lab program) to the teachers (who are often in rural, underserved, and historically disadvantaged school districts), training the teachers in module implementation, and monitoring module use (which may involve becoming an active participant along with the teacher in the use of the module in the classroom). During the first year of the grant, we will require that the students involved in this grant partner with the SEF and Traveling Lab program to develop a module related to light and optics.

Example Statements

Among the topics to be discussed will include waves, wave characteristics, energy transmission, the electromagnetic spectrum, imaging (including microscopy), and photochemistry (especially related to photosynthesis). These topics are included as part of the Texas Essential Knowledge and Skills (TEKS) base, and, as such, are required learning for students in primary and secondary schools in Texas. As indicated above, the module that the graduate students will develop with the SEFs will be used primarily for the education of rural and economically disadvantaged students. The graduate students will be required to go out with the SEFs to at least two rural school districts (one per semester) to present the module and for teacher training in the module.

Example Statements

The third activity will require that during the summer of the second year of the grant the students prepare a two-day workshop on nanotechnology to teach K-12 science teachers in a Multidisciplinary Science Masters (MSCI) program at Texas Tech. This four-year program, which began in 2000 has graduated approximately 35 teachers in two cohorts (the third cohort is currently in the sequence) with advanced science content training for use in the classroom. The fourth cohort will be taking Conceptual Chemistry for Teachers II during the summer of 2008. As part of this class (taught by the PI), the graduate students will have to present their workshop on nanoscience. As part of the workshop, the students will have to develop a lab in nanomaterials synthesis which can be used by the upper-division teachers. This exercise will provide the members of the research group with a personal context in materials chemistry beyond the lab as well the opportunity to mentor the development of a nanoscale-conscious generation of younger students.

Dissemination Practices

Local K-12 Schools

Education Journals

Engaged Scholarship Journals

Local Media Sources

Twitter

Instagram, Facebook

Video Journals

Industrial Partners

TEXAS TECH UNIVERSITY
STEM Center *for* Outreach, Research & Education
Seminar Series

Final Thoughts…

Don't be afraid to be creative with broader impacts, and to use the resources available within the university, the region, and outside your area of expertise. Two good question to ask are

- *"How can I make the really cool research that I am doing accessible and understandable to people who are not experts in my field so that they can understand the excitement that I feel when doing the research?"*

and

- *"How can I excite people to think about maybe making a career in the XXX?"*

The broader impacts should be just that – broad, beyond the research and activities which make an impact in the lives of people who are not experts in your field

Texas Tech University™