



Designing Broader Impacts How to Prepare an Excellent Plan

April 21, 2021

Bryan Rebar, PhD Associate Director, STEM CORE Science, Technology, Engineering, and Math Careers through Outreach, Research, & Education

stemcore.uoregon.edu





Science, Technology, Engineering, and Math Careers through Outreach, Research, & Education

Services for Faculty and Natural Science Departments:

- Help faculty develop <u>competitive proposals</u>, with systematized emphasis on <u>Broader Impacts</u>
- 2. Recruit K-12 and community college students to the undergraduate program, emphasizing students from underrepresented groups
- 3. Organize and expand **outreach efforts** to all audiences
- 4. Support evidence-based teaching approaches and science communication skills by faculty, GTFs, and learning assistants
- 5. Collaborate in developing the undergraduate **teaching track serving majors** interested in teaching secondary science





What are Broader Impacts?

- Your Ideas?
- What are your BI activities?



stemcore.uoregon.edu

Early microscope





What are Broader Impacts? Often considered in categories:

- 1.Teaching, training, and learning (integrating research and education)
- 2. Broadening participation of underrepresented groups
- 3. Enhancing infrastructure for research and education
- 4. Disseminating results broadly
- 5. Providing societal benefits





1. BI: Teaching and Training

- Improved education and educator development at any level;
- Increased public literacy and public engagement with research and scholarship;



stemcore.uoregon.edu





2. BI: Broadening Participation

- Full participation of women, persons with disabilities, and underrepresented minorities;
- Development of a diverse, globally competitive workforce (also education & training and providing societal benefits)



stemcore.uoregon.edu





3. BI: Enhancing Infrastructure for Research & Education:

• Increased partnership between academia, industry, and others

\leftarrow \rightarrow C (a futres.org/dashboard/ \square (II) \diamond (Update (Upda								Update :		
FUTRES			Но	ow It Works 🔻	Products 🔻	Workshop	s ▼ Projects	Team	Query	
Data Dashboard										
Charts									•	
Projects									•	
Summary Tables									•	
▲ Year Collected	▲ Count	▲ Species	▲ Count	▲ Country	⊾ Cour	nt 🔺	Measurement Typ	9	▲ Co	
1547	1	Peromyscus maniculatus	211401	USA	176308	44 {b	ody height}		1	
1689	1	Myodes rutilus	89960	Canada	126461	{b	ody length}		5197	
1700	586	Sorex cinereus	75593	Mexico	67610	{b	ody mass}		3493	

stemcore.uoregon.edu





4. BI: Disseminating Results

• Use of science and technology to inform public policy



Science Comics Fellowship program

stemcore.uoregon.edu





5. BI: Societal Benefits

- Improved health and well-being of individuals in society
- Improved national security
- Increased economic competitiveness of the United States



stemcore.uoregon.edu





Characteristics of Effective Broader Impacts

- Achieveable
- Substantive
- Assessible
- Personal





Consider Broader Impacts as an opportunity to:

- Help advance your research and research agenda
- Add to your university service record in engaged scholarship
- Benefit your students and mentees in their careers
- Contribute to your fulfillment as a scientist and educator

stemcore.uoregon.edu





What is Your Broader Impacts Identity?

- Reflect on your current and previous BI activities--is there a theme?
- What are you passionate about?
- Over the course of your career, what do you aim to accomplish?





Advice for Developing your BI Plan (1)

- Use your BI identity and BI agenda to guide your plan
- Identify clear, achievable and measurable goals
- Support with evidence-based practices cite literature
- Connect with research plan
- Detail plan: who, what, how





Advice for Developing your BI Plan (2)

- Build on existing activities and infrastructure
- Involve others, including lab team & partners with needed expertise
- Maximize impact, e.g., via dissemination
- Include assessment plan and identify who will report
- Budget appropriately demonstrate commitment with \$
- Balance creative and tried-and-true aspects
- Refer to <u>BI Guiding Principles</u>

stemcore.uoregon.edu

O UNIVERSITY OF OREGON



"The broader impacts criterion is pushing members of the research community to think beyond the boundaries of their science to a broader mindfulness of their work in the context of the nation's future."



- Arden L. Bement, Jr., NSF Director 2004-2010

stemcore.uoregon.edu

O UNIVERSITY OF OREGON



"It is now more vital than ever for us, the research community, to make a convincing case to the public about the tangible



societal benefits that flow from science and technology, and the importance of investing adequately in research and education."

–Neal Lane, NSF Director 1993-1998

stemcore.uoregon.edu





NSF merit review criteria:

- 1. What is the potential for the proposed activity to: (a) Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and (b) Benefit society or advance desired societal outcomes (Broader Impacts)?
- 2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
- 3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
- 4. How well qualified is the individual, team, or organization to conduct the proposed activities?
- 5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

stemcore.uoregon.edu







stemcore.uoregon.edu

O UNIVERSITY OF OREGON



Leverage established connections and education expertise...

Example Projects and Opportunities

- Partner with our Teacher Programs
 - Teacher Workshops (virtual and face-to-face)
 - GTF roles supporting teachers (GK-12 model)
- Contribute to our library of teaching materials
 - E.g., table top scanning electron microscope
 - Offer remote access to scientific equipment
- Offer research internships for undergrads, teachers, or future teachers
 - Teachers can join the community supported by STEM CORE

stemcore.uoregon.edu



O UNIVERSITY OF OREGON



Leverage established connections and education expertise...

Example Projects Continued

- Organize bridge to college programs
 - Build on existing partnerships with K-12, CCs
- Citizen science projects involve students
 - Recruit and involve underrepresented groups



- Develop courses blending science and pedagogy content
- Partner with after school programs, museums, & local education providers and involve UO students via coursework or paid roles

stemcore.uoregon.edu



Resources



STEM 105

Perspectives on Broader Impacts

National Alliance for Broader Impacts Broader Impacts Guiding Principles and Questions

for National Science Foundation Proposals

The National Association for Broader Impacts (MABI) Broader Impact Working Group has developed a guiding document for the National Seinese Faundation's (NSF) broader impacts (BI) crimons. The purpose of this document is to assist (NSF) program managers, proposal reviewars, and review panels in evaluating the BI component of NSF propasals and to associ proposers with developing their broader impact plans. This document is inserted by provide a meant for consistency in the way review panels in evaluating that or propased BI plans.

Types of Broader Impacts: According to the current NSF Merit Review Criteria published in the Grant Proposal Guidelines (See page III-2 HERE), the following BI goals may be considered:

- Full participation of women, persons with disabilities, and underrepresented minorities in STEM
- Improved STEM education and educator development at any level
 Increased public scientific literacy and public engagement with science and technolony
- Improved well-being of individuals in society
- Development of a diverse, globally competitive STEM workforce
 Increased partnerships between academia, industry, and others
 Improved national security
- Increased economic competitiveness of the United States
 Enhanced infrastructure for research and education

The list above is not exhaustive, and it is not necessary to address more than one goal in a proposal, as long as the broader impact goal is fikely to have a desired societal outcome and is very laterned. However, the following five elements should be considered in the review process for broader impact activities. Each element has recommended Guiding Principles and Guiding Constrons for proposes and review rev.

- TERMS/KEY WORDS
- Broader Impact (BI) Activity, A list tithy is a planed segarity engagement, along includes, or a structure set. The includes of one and an advance is undergoalter or graduate transition. If the is advance is undergoalter or graduate transition, the advance is a subgraduate or graduate transition. The subgraduate is advance in the subgraduate or graduate transition is advanced as a subgraduate and the subgraduate and advance is a subgraduate and advance is a subgraduate and advance is a subgraduate and advanced as a subgraduate and advanc
- Engagement: The PI and/or project team mutually and actively involves target audience participants in the proposed BI activity(s).
- Evidence-based practices: Refers to any concept, model, or strategy that is based on or informed by evidence- such as some type of research, metrics, performance, educational research, and already established best practices.
- Goals: Goals are the purposes toward which the activity(s) is directed.
 Impacts: Benefit(s) within or to the target audience(s)(society due to the Bl activity(s) as evidenced by measurable or articulated outcomes.
- Bl activity(s) as evidenced by measurable or articulated outcomes.

 Models: How the identified strategies or interventions will be
- implemented/used.

 Dutcomes: Outcomes are the result of analy being successfulb
- Unicomes: Unicomes are ine result or guast terms soucestanty achieved. They should be necessated and messured. Outcomes domainstate changes in avaenness, knowledge, skills, attitudes, behavior, northantons, beliefs, values, capacities, or conditions of individuals, groups, capariations, or scalar source and the source short term, intermediate, and/or knowle net outcomes.
- Practice: The strategies selected to achieve stated goals.
- Scalability: Scalability defines the potential of a broader impact activity to be useful in other locations, with diverse audiences, or across a wide spectrum of contexts.

Any optimum, Indiage, and conclusions or recommendations argument in the material are those of the authorital and do not necessarily reliest the instant of the Hatorial Science Foundation. This work is supported by the National Science Foundation under grants MCB-448726, MCB-131317, and 34-142705. C

stemcore.uoregon.edu

brebar@cas.uoregon.edu

National Science Foundation





Resources

- Broader Impacts Guiding Principles and Questions for NSF Proposals – guide for PIs, program managers, and reviewers
- Perspectives on Broader Impacts Report from the 2014 Broader Impacts Infrastructure Summit including:
 - Perspectives from NSF
 - Perspectives from university leaders
 - Perspectives from university participants including example activities

Education Plan: CAREER



"Broader Impacts" must be a separate section

Example Objectives (1)

The Broader Impacts plan includes five complementary objectives:

- 1. Improve middle school students' attitudes toward math
- 2. enhance students' awareness of how math is used in different STEM careers
- 3. increase students' interest in pursuing careers involving math
- 4. improve teaching and communication skills of graduate students, and
- 5. support teachers' professional growth and development.

Example Logic Model (1)



Figure 10. Logic model for Broader Impacts showing relationships between Objectives, Activities & Practices, and Outcomes.

Panel Summary Example #1

The educational plan was excellent. Participation in the STEM lab school was very highly rated. The methods applied were also expected to have high impact on the broader field of human neuroimaging.

Reviewer Comment Example #1

This appears to be an excellent broader impacts plan. The goal of improving middle school students' attitudes to math is of high societal relevance and desirability. The program will also enhance the training of graduate students in terms of teaching/mentoring and public engagement, and the training of teachers in terms of cutting edge scientific research. The results could be transformative, providing a model for math-attitude-improvement programs elsewhere. The plan is very detailed and based on a solid rationale. The concrete plans to measure the success of the program are commendable. The PI seems to have adequate resources and appropriate collaborators within the Oregon community to implement the plan.

Example Objectives (2)

The overall goal for all broader impacts efforts is to increase interest and understanding of biochemistry broadly and protein evolution specifically among high school age students, especially among students who identify as members of underrepresented groups.

The phases are as follows:

1) host 2-4 teachers for immersive summer research experiences;

2) collaborate with teachers to develop innovative and authentic lesson sequences;

3) support the delivery of lessons drawing on the NSF GK-12 model in which graduate students and the PI co-lead high school lessons;

4) revise, document, and share research-connected lesson plans;

5) conduct teacher professional development workshops...

Panel Summary Example #2

Broader Impact Strengths: The broader impacts of this proposal are a strong combination of graduate training and K-12 STEM outreach. The graduate student training is well integrated into the research program. The STEM outreach takes advantage of a STEM Core program to provide teacher training and curriculum development. Importantly, the PI plans on co-delivery of developed curriculum which is critical for curriculum updates and CAREER training. There is a strong approach to software development and distribution with a clear commitment to open access via GitHub.

Broader Impact Weaknesses: No weaknesses in the broader impacts were noted by the panel.

Example Objectives (3)

This CAREER proposal has two primary <u>educational</u> broader impact goals: 1) to have (primarily female) STEM majors *broaden* their understanding of what a scientist is and does to *recognize* the importance of history of science and social studies of science; and 2) to *expose* these female STEM majors to social science research methods (primarily historical and anthropological) and *train* them to use these methods in their future careers.

Goal	Activity	Audience	Outcome/Evaluation
AWARENESS Broadening the understanding of role of history in global health interventions	 Writing and submission of: Monograph to Duke or Cornell UP 4 academic articles published in STS, history, global health, ethics journals Co-authored blog posts with undergrads Op-ed or article in mainstream media/magazine article Conference papers at STS, History of Science, Global Health, and Global Health Ethics Conferences Presentations at universities, global health organizations, think tanks 	 STS, African Studies, History of Science, Global Health scholars Global Health Policy Makers Undergraduate & Graduate Students General Public 	 Publication of monograph with academic press Book reviews of the monograph in history, STS, anthropology, global health journals Publication of articles in targeted academic and mainstream outlets References in STS, history, global health books, articles, policy papers Number of conferences & think tank presentations
KNOWLEDGE/IDENTITYBroaden understanding of what scientist isRecognize importance of history of scienceExposure to social science methods	Develop 3 new courses for Honors College and History Department on STS, History of Science, African Studies topics Syllabi & research packages of primary source materials (archival, oral, visual, epidemiological)	 High School Students (SAIL) Undergraduate & Graduate Students Honors College Female STEM Majors Writing theses on STS, Global Health, African Studies 	 Teach 3 new classes, estimated 14 times during grant with estimated 500 students taught Have undergraduates choose to write theses on Global Health, STS, African Studies topics using data collected for this project
SKILLS Train to use historical & anthropological methods in future research careers of STEM students	 Run weekly global health research group for 12-15 students Hire and mentor undergraduate research assistants Advise undergraduate theses integrating primary source data Archival research trip to WHO with undergraduate RA Co-write, submit, & present blog post or peer- reviewed article with RAs Student presentations to high school students 	 812 undergraduate research assistants (2- 3/year) 12-15 research group participants/year (estimated 36 total) -3-5 primary advisees/year 	 Run weekly global health research group for 12- 15 students/year Publication of blog piece or article co-authored with RA Undergrad presentations to high school students, research symposiums, conferences Female STEM majors able to incorporate historical & anthropological skills in future research and careers

Panel Summary of Example 3

The panel found that proposal does a **good job of** integrating the research into the teaching mission of the undergraduate honors program. The goals of reaching female STEM students and exposing students to STS and history research methods are especially good. The PI will also develop new courses, advise a post-doc on public health and Africa, and make connections to public health agencies with the goal of raising the ethical implications associated with concluding intervention and bringing to light lessons from past failures. The panel thought there were opportunities for enhancing the broader impacts by developing connections to relevant NGOs and public health agencies.





What are your ideas for your BI plans?

- How does your idea align with departmental and university priorities?
- What existing programs and resources can you tap?
- Does your plan include creative and established BI components?



Bryan Rebar, Ph.D. Associate Director, STEM CORE Email: <u>brebar@cas.uoregon.edu</u> Phone: 541-346-4773 Office: 148 Willamette Hall



If you are considering a proposal, start considering broader impacts early in the process and engage potential partners in the conversation. Just as great research plans take time to develop, so too do great broader impacts plans!

stemcore.uoregon.edu



NSF Panel Summary Comments



- "Broader impact is very strong, including mentoring in lab, undergraduates in lab, high school advisory board and inclusion of high school students in research, and STEM CORE participation for training high school teachers. No weaknesses were noted by the panel."
- "The broader impacts of the proposal are generally quite strong.... We appreciate the partnership with the university's STEM CORE program to facilitate effective outreach. The involvement of several undergraduates is commendable."
- "As a CAREER proposal, the broader impacts of the project, particularly those associated with education, should be extensive and excellent. Those proposed met these expectations. Contacts have been made with a STEM Laboratory middle school that serves an under-represented group. The project would develop a summer teacher workshop, followed by regular interactions during the year to develop curricula materials. Students would have access to the data being generated by the project and maintain blogs to develop their language skills. The curriculum would be based on state and national standards."





What are Broader Impacts More Specifically?

- Full participation of women, persons with disabilities, and underrepresented minorities;
- Improved education and educator development at any level;
- Increased public literacy and public engagement with research and scholarship;
- Improved health and well-being of individuals in society;
- Development of a diverse, globally competitive workforce;
- Increased partnership between academia, industry, and others;
- Improved national security;
- Increased economic competitiveness of the United States; and
- Enhanced infrastructure for research and education

stemcore.uoregon.edu





Your Turn to Review BI Plans!

Use the Guiding Principles

Be prepared to report out to the group



https://broaderimpacts.net/wpcontent/uploads/2016/05/nabi_guiding_principles.pdf

https://tinyurl.com/yc4ug2bm

stemcore.uoregon.edu