Overview

Broader Impacts (BI) are a critical component of the National Science Foundation’s mission and are integral to competitive research programs across the country. BI criteria aim to ensure that scientific knowledge and the scientific enterprise remain relevant and provide direct benefit to society. Special attention is given to increasing access and opportunity in STEM fields to communities that are persistently underrepresented, including most minority groups, women, first generation college students, as well as under resourced rural and urban communities. BI criteria aims to promote greater public engagement with science, increase scientific literacy, improve STEM education at all levels, and prepare a new and diverse generation of scientists.

One major aim of our work has been to develop a program model that increases teacher confidence in teaching this content using scientific inquiry through collaboration and interaction. (Adapted Lally et. al., The Plant Cell 2007)

Methods for Meaningful Program Design

Ensure that all participants benefit from collaboration in multiple ways, and that benefits are measurable (Figure 1)

Align Program Elements and Goals with Adult Learning Theory and Best Practices (Figure 2)

Program Elements

- Summer Learning Institutes
- Teacher Workshops
- Curriculum Development
- Classroom Experiment Kits
- Citizen Science Projects
- Teacher Leadership
- Alumni Collaboration

Teacher Institutes Goals

- Increase teachers knowledge in STEM, emphasizing science and society issues including genetics, heredity, and genomics, biotechnology, agriculture, bioenergy, systems thinking, sustainability and climate change
- Increase teacher confidence in teaching this content using scientific inquiry
- Support teachers that aim to lead change by engaging students in authentic STEM inquiry through the develop lesson plans, web-based resources, methods, and materials with teachers and scientists and facilitate feedback and data sharing between schools and BI scientists.
- Create a professional learning community through careful selection of annual teacher cohorts and includes multiple interactions to engage and interact over time, including, curriculum development, lesson implementation, experiments in the classroom, national conferences, and publication

Program Models

Figure 1: A Program Design Model for Meaningful Engagement identify the unique and measurable benefits that all participants will experience through collaboration and interaction. (Adapted Lally et. al., The Plant Cell 2007)

Figure 2: A Cohort-Based Long-term Professional Development Model to Support Teacher Change in the STEM Classroom

Results

1. Teachers report increases in their confidence to teach STEM concepts as a result of teacher institute seminars, lab experiments, and collaborative curriculum development activities (See Figure 3).
2. Over 4,000 individuals participated in BTI’s BI Programs in 2015, with STEM teachers extending the impact to 3,442 secondary students across the country. (See Figure 4). Partner teachers are recruited from urban and rural communities. In 2016 69% of these projects were integrated in “high needs” schools.

Future Directions

Demonstrate Impacts Unique to Each Participant Type

Form focus groups, surveys and assessment tools to determine how these Broader Impacts Model Program supports each participant type in the ways outlined in Model 1, Figure 2. In particular, what benefits do students experience as a result of participating in extended inquiry-based projects in the STEM classroom? Literacy gains? Scientific identify, persistence?

Community Building

Continue to strengthen and interact with the teacher network through social media, to exchange STEM teaching ideas, methods, classroom and BI lab results... See #BTIscience

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Figure 3: BEP Teacher Institute Pre/Post-Survey Results, Confidence in teaching Biomass, Bioenergy and Bioproducts STEM topics increased for the 57 participating teachers.

Figure 4: 2015 EO Program Participants

Partner Classroom in Buffalo, NY

Teacher Leadership, Alumni Posters