

# NSF's Broader Impacts

## AND YOUR RESEARCH

Mark E. Hauber, PhD — CUNY Interim University Vice Provost for Research

John Tsapogas, PhD — Director of Office of Award Pre-Proposal Support (APPS), RF CUNY

Linda Vigdor, MFA, PhD — Associate Director of Proposal Development, ASRC

# Introductions

MARK

# Objectives (Anticipated Take-aways)

## *Improved understandings of:*

- ▶ Definition & history of BIs
- ▶ Rationale behind BIs
- ▶ Relationship between your research & BIs
- ▶ Significance of BIs for peer/panel reviews
- ▶ Ingredients of a competitive BI plan
- ▶ Resources for developing a strong BI plan

# Definitions & History of Broader Impacts Criteria

JOHN

# What are Broader Impacts?

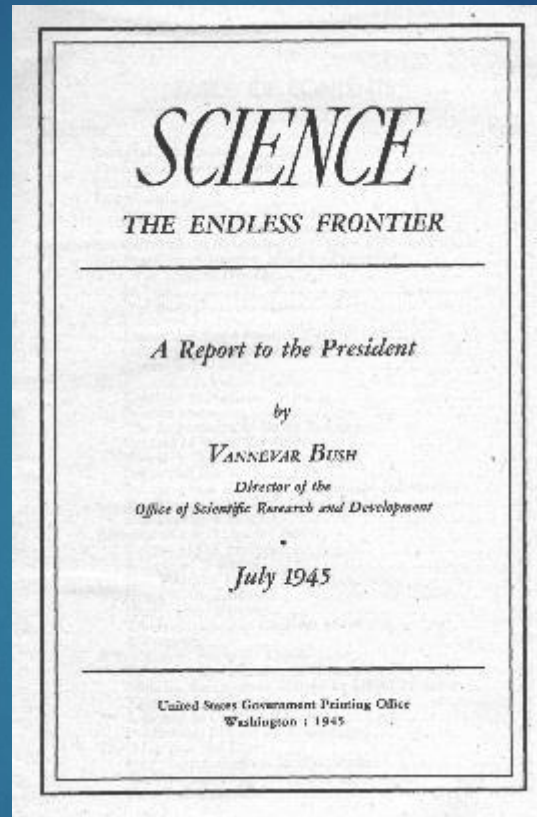
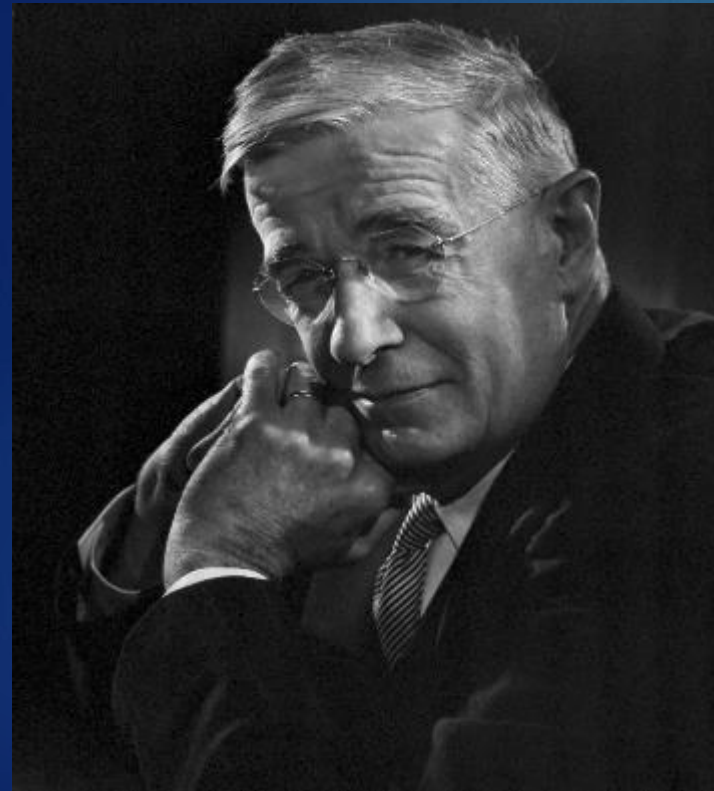
## NSF's definition

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

# BIs = An Explicit Societal Benefit of the Proposed Research

- ▶ **BI activities must have the potential to produce positive societal impact of a kind that is relevant to NSF.**
  - ▶ Through the research itself
  - ▶ Through activities that are directly related to specific research projects, or
  - ▶ Through activities that are supported by, but complementary to, the project
- ▶ BI activities may be based on previously established and/or innovative methods and approaches...must be well justified.

**Vannevar Bush**  
**First US Science Advisor**



Science offers a largely unexplored hinterland for the pioneer who has the tools for his task. The rewards of such exploration both for the Nation and the individual are great. Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress..

“to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...”  
NSF Act, 1950

# History in a Nutshell

- ▶ BIs became a separate and distinct criterion in 1997
  - ▶ NSF simplified the merit review criteria for proposals from four to two
    - ▶ Intellectual merit
    - ▶ Broader impacts.
- ▶ The “America COMPETES Reauthorization Act of 2010 reaffirmed the importance of the broader impacts criterion



# America COMPETES Act- 2010

- ▶ SEC. 526. BROADER IMPACTS REVIEW CRITERION.
- ▶ **GOALS.** The Foundation shall apply a Broader Impacts Review Criterion to achieve the following goals:
  - (1) Increased economic competitiveness of the United States.
  - (2) Development of a globally competitive STEM workforce.
  - (3) Increased participation of women and underrepresented minorities in STEM.
  - (4) Increased partnerships between academia and industry.
  - (5) Improved pre-K–12 STEM education and teacher development.
  - (6) Improved undergraduate STEM education.
  - (7) Increased public scientific literacy.
  - (8) Increased national security.

# The Importance of BIs

JOHN

# NSF's 2 Merit Review Criteria

## ① Intellectual Merit

- Potential to advance knowledge
- The science / discovery

## ② Broader Impacts

- Societal benefit of the research / project
- Make obvious the relevance of funded research.

## ③ Weighting:

- “Both criteria are important and should be given full consideration during the development of the proposal, its review, and the decision-making process”

# “Broader Impacts” Across Federal Agencies

- ▶ **NIH** – core benefit is improvements to health
- ▶ **Dept. of Defense** – national security
- ▶ **Dept. of Education** – an educated populace
- ▶ **NSF** – benefits are both (1) knowledge discovery & (2) societal impact

# Why Does NSF Insist on BIs?

- ▶ Public funds (taxes) are used to pay for research
- ▶ When the public pays for science research, science funding becomes political
- ▶ Research (especially basic science) can be perceived as abstract and ‘disconnected’ from real people’s lives
- ▶ BIs are a way to make the connection between science and people’s lives more transparent
- ▶ If the public sees how it benefits from your research:
  - ▶ A greater appreciation for the science
  - ▶ Better use may be made of the science
  - ▶ It becomes more likely that funding will continue
  - ▶ Scientists learn from “users”

# The Politics of *Basic* Science When Funded by the Public

NSF Director, France Córdoba, 2014

“As a federal agency, **we need to stay relevant with those who entrust us with taxpayer funds.** We need to reach out to Congress and other stakeholders and **be proactive in explaining what NSF is about and why we are vital to the nation’s future... Not enough of our fellow citizens understand how relevant the research... conducted is to their daily lives...**”

# Overview of BIs Video

## Center for Ocean Sciences Education Excellence (COSEE)

JOHN

# Overview of Broader Impacts





# BIs from a CUNY Perspective

MARK

# Advice & Examples of BIs

LINDA

# BIs Designed for a Specific Audience

- ▶ Activities should not be generic
- ▶ They should be designed for the specific audience
- ▶ Meaningful BIs will add value to society and people's lives

# Target Specific Audiences



# NSF is **not** prescriptive as to what BIs should be

The only constraints are that BIs promote NSF's big-picture goals:

- ▶ To fund innovative science
- ▶ Not be prescriptive about what qualifies as 'broader impacts.'
  - ▶ "NSF projects, in the aggregate, should contribute more broadly to achieving societal goals."

# Examples of BI activities<sup>1</sup>

- ▶ Design curricula for K-12 classrooms
- ▶ Host a professional development workshop for teachers
- ▶ Visit a K-12 classroom or host students on campus
- ▶ Encourage your undergraduate students to participate in summer research activities
- ▶ Host a student in your lab
- ▶ Incorporate innovative use of technology and media in your classroom
- ▶ Develop or participate in an educational talk or program that is free and open to the public
- ▶ Contribute to a blog or digital library
- ▶ Design an exhibit for a museum

<sup>1</sup> <https://research.fas.harvard.edu/broader-impacts>

# Polymer Nanostructures as Thermal Interface Materials

**Awarded Amount to Date:** \$233,279.00

*Georgia Tech School of Mechanical Engineering*

## **Broader Impacts** *[Project Summary]:*

“The success of this project could enable cost-effective materials for thermal management of advanced electronic systems and devices leading to new technologies and applications in the computing, communications, electronics, aerospace and defense industries. New discoveries will be disseminated through patents, technical publications and potential technology transfer to a start-up company ... Integration of research, teaching, and outreach programs across multiple disciplines, including polymer science and nanotechnology, will impact the education and training of a diverse student body covering the undergraduate, graduate and post-graduate level at Georgia Tech. Finally, the PIs will engage high school teachers and students from Dekalb County in outreach activities involving hands-on exposure to advanced materials and thermal technologies.”

**Athletics Does It.**

**The Performing Arts Do It.**

**What If Science Routinely Welcomed the Public to Campus?**

# **Wednesday Nite @ The Lab**

**A Public Science Series Offered Every Wednesday Night--  
50 Times a Year**

Thomas M. Zinnen, PhD  
Cooperative Extension Specialist  
Biotechnology Center  
UW-Madison & UW-Extension

## **Activities**

- Faculty & staff presenters
- Audience of 40-50 people
- 50 minute talks. Data expected.
- Controversy encouraged.
- Talks recorded by Wisconsin  
Public Radio
- \$0. cash budget; time & talent  
donations

## **Impacts**

- 400+ researchers honed skills in distilling their data & listening to / explaining their science to the public
- Learners gain science savvy through experiencing sagas of science directly from researchers
- Extends definition of science outreach to include active retirees & other adult learners
- Underscores that the University has a stake in all of Wisconsin & everyone has a stake in the research enterprise



# Virtual Lab Tours for Middle School Classrooms



- ▶ Scripps and COSEE CA - multifaceted collaboration with the San Diego Unified School District to support earth and ocean science education throughout the district.
- ▶ Scripps researchers and district educational technology specialists work together to promote science and technology literacy by engaging in innovative approaches to bringing Scripps research directly into middle school classrooms
- ▶ Scripps and ESETT piloted virtual lab tours for students in 6<sup>th</sup>-8<sup>th</sup> grade.
- ▶ Aim to establish a relationship with 1 or more science teachers at district middle school that is participating in the ESETT program.
- ▶ Together with the teacher(s) -- develop strategies for delivering content targeted at existing curriculum and for supporting ongoing or upcoming classroom projects or activities.
- ▶ SKYPE and a simple video camera hook-up will allow direct interaction with students
- ▶ Students will get a guided look around our lab as well as a chance to ask graduate students questions about their research and life as a scientist.
- ▶ Total costs including IDC: \$5,430

[www.coseeca.net/files/coseeca/TextBroaderImpactOpportunities.doc](http://www.coseeca.net/files/coseeca/TextBroaderImpactOpportunities.doc)

# CATCH ME IF YOU CAN: T(R)AP-DANCING WITH THE ELUSIVE RARE ISOTOPES

## BROADENING-PARTICIPATION MISSION: CREATE PUBLIC AWARENESS & DEEPEN LEARNING ON NUCLEAR PHYSICS & THE ROLE OF MICHIGAN STATE UNIVERSITY'S FRIB (Facility for Rare Isotope Beams) AS A WORLD-LEADING SCIENTIFIC LAB



### Research Questions:

- How does integrating an art form (dance) with an academic subject (nuclear physics) deepen and enhance learning?
- How do the arts increase student engagement in science learning?

- A collaborative effort between MSU partners and a nationally known dance organization to demonstrate that art can be used to facilitate scientific understanding.
- Art-science collaboration to highlight that both involve research, discovery, imagination, discovery, observation, & interpretation rather than a collection of facts & principles.
- Dance used to translate MSU research producing rare isotopes to be understandable by the general public.
- An aim is to stimulate ideas for using the rare isotopes and processes used to make them as possible engines for stimulating local economic development

# Exploring How to Communicate Polar Science More Broadly: Polar-ICE Science Communication Workshop

C. Ferraro<sup>1</sup>, J. McDonnell<sup>1</sup>, L. Hotaling<sup>2</sup>, A. Daniel<sup>3</sup>, J. Middendorf<sup>4</sup>, C. Garza<sup>5</sup>, P. Van Dyk<sup>6</sup>,  
K. Hunter-Thomson<sup>1</sup>, G. I. Matsumoto<sup>7</sup>, O. Schofield<sup>1</sup>

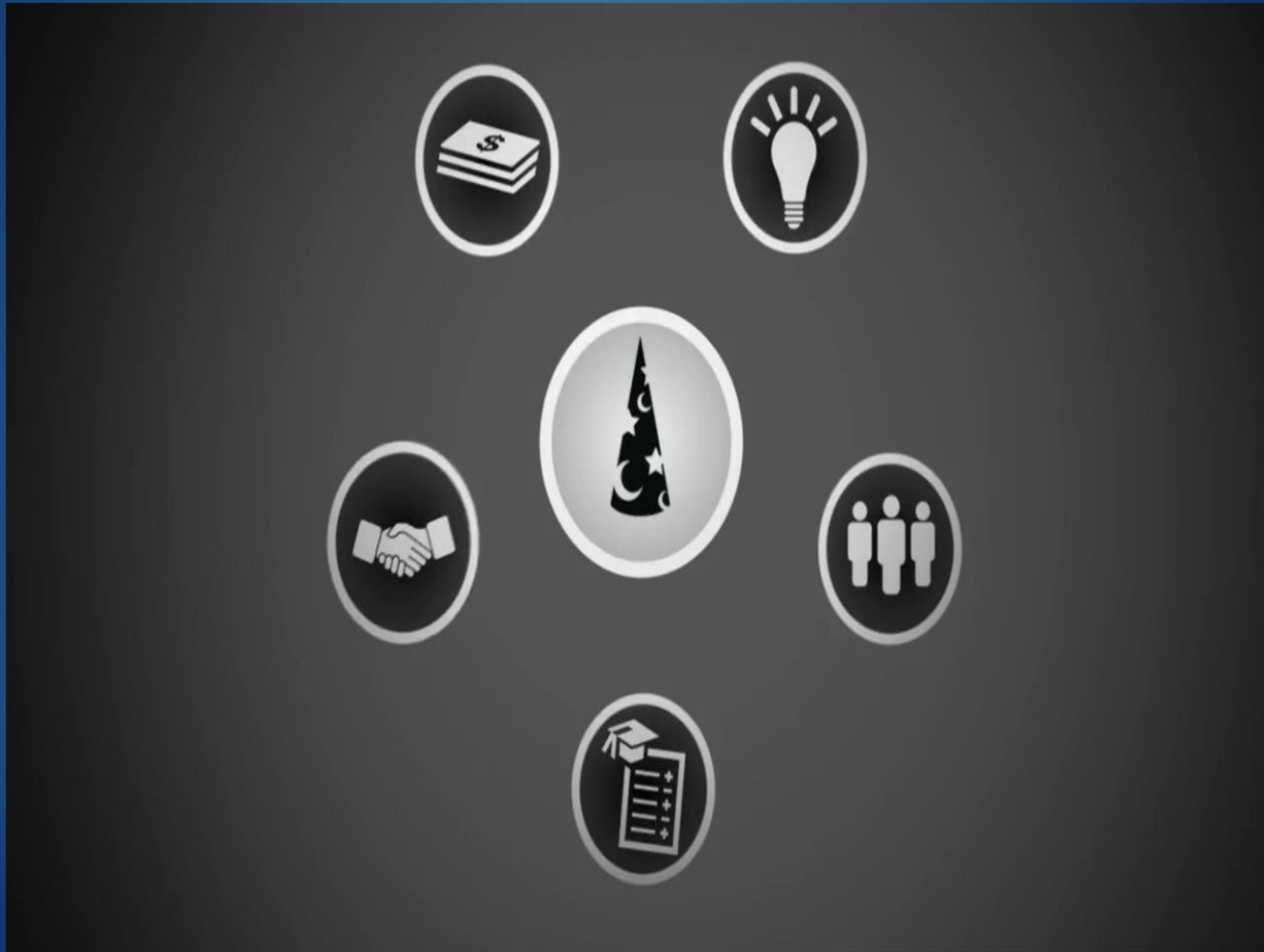
<sup>1</sup>Rutgers University, New Brunswick, NJ <sup>2</sup>Eidos Education, Highlands, NJ <sup>3</sup>Mind Open Media, Somerville, MA <sup>4</sup>Indiana University, Bloomington, IN <sup>5</sup>California State University, Monterey Bay, Monterey, CA <sup>6</sup>Evaluation Resources, LLC., Raleigh, NC, <sup>7</sup>Monterey Bay Aquarium Research Institute, Monterey, CA

- **The Polar-Ice team** – scientists and educators working together to share scientific research from the Arctic & Antarctica with broader audiences.
- **Objectives:** To help scientists communicate the importance of these regions to larger audiences & engage students in polar research, including climate & environmental changes.
- **Workshop sessions:**
  - **Deconstruct your science:** participants identify bottlenecks to learning, decode their expertise, & share strategies to make their mental moves available to audience members; come up with analogies to help overcome these bottlenecks
  - **Tell your science story:** learn how to take the analogies to frame it within a story
  - **Connect with diverse audiences:** employ culturally responsive communication strategies
  - **Broader impacts:** how to use these strategies in designing Broader Impacts
  - **Application:** worked with an educator to discuss how to more effectively convey research to an intended audience

# BIs Are Collaboration Opportunities

- ▶ Scientists and media professionals or students
- ▶ Science + art
- ▶ Science & communication
- ▶ Citizen science
- ▶ K-14 Teacher development
- ▶ Community building
- ▶ Policy groups
- ▶ ...

# Find Collaborators



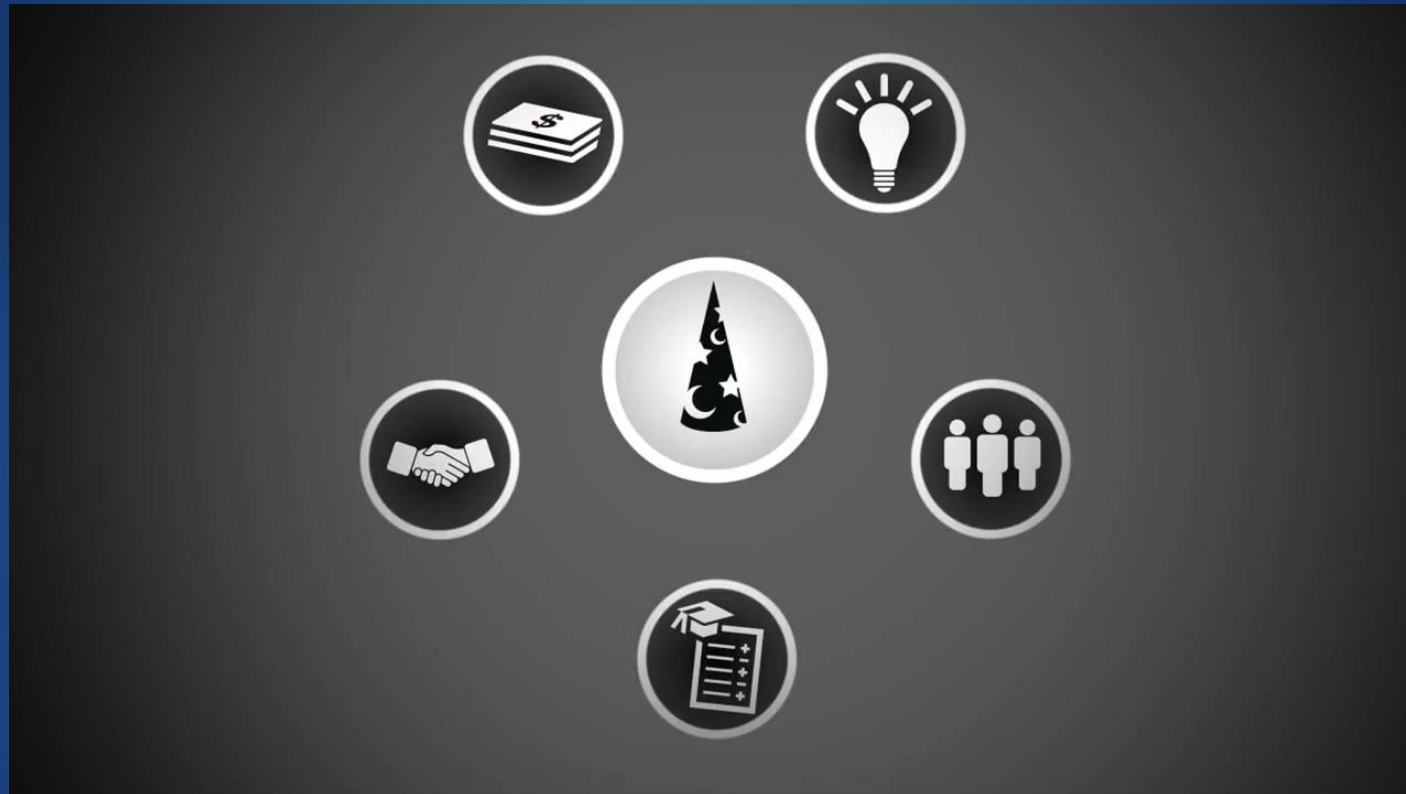
# Tips and Strategies for Developing BIs

LINDA

# BI Activities Evolve from the Proposed Research

- ▶ 1- 2 of the fifteen pages that are allowed for the Project Description
- ▶ Meaningful but not of a scale that they would interfere with ability to conduct the proposed research.
- ▶ **BI section must be comparable in strength and quality to the application's Intellectual Merit side.**
- ▶ Follow-through is important. Don't propose anything under Broader Impacts that you can't/won't be able to deliver.

# Do Something Unique





# Ingredients of a Good BI Plan

- ▶ A distinguished activity
- ▶ Include a means to assess success (evaluation plan).
- ▶ Budget for the BI activities and evaluation
- ▶ Ensure that adequate resources will be available to the PI (either at the home organization or through collaborations) to carry out the proposed BI activities
- ▶ Include a dissemination plan.

# Understand how BIs are Reviewed!

- ▶ What is the potential for proposed activity to benefit society or advance desired societal outcomes?
- ▶ To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
- ▶ 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?
- ▶ How well qualified is the individual, team, or organization to conduct the proposed activities?
- ▶ Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

# Broader Impacts Activities Must be Distinguished

- ▶ BIs should not be predictable, “canned,” or appear to be tacked on to what is obviously a pure research proposal.
- ▶ Do the same kind of literature review for the BIs section that would be done for research-related sections.
- ▶ If you claim transformative potential for the BI activities, credibly defend that assertion
  - ▶ Show that implementation of the BIs will literally revolutionize the area of your focus.

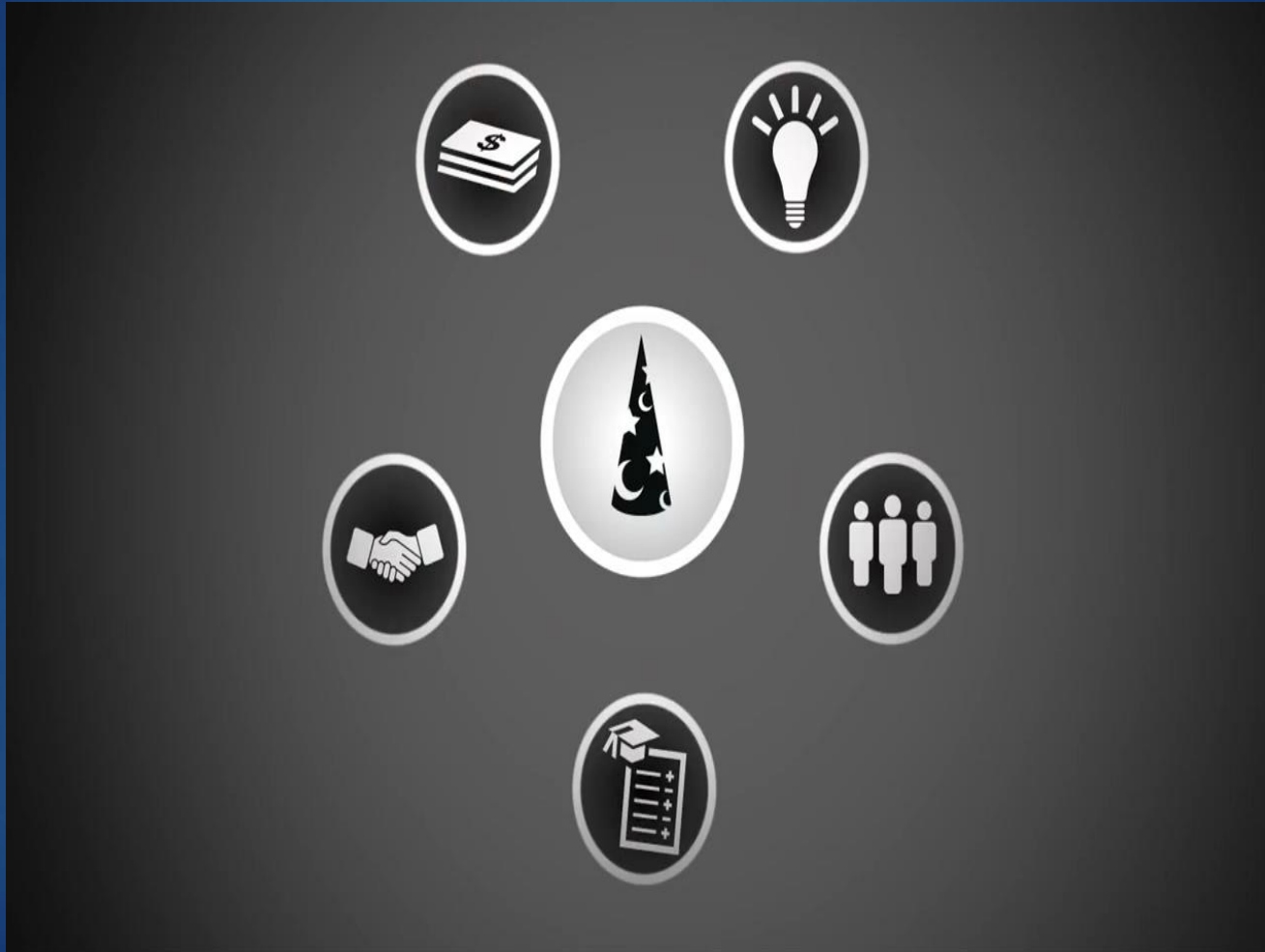
# Be Qualified to Conduct the Proposed BI Activities

- ▶ Everything that you propose under Broader Impacts must be within your/your team's capabilities.
- ▶ If unpaid outside services are required to make the project feasible, letters of collaboration / committed expertise are required.
- ▶ Paid-for services need to be included in the budget.

# A BI Budget is Essential

- ▶ To be credible to reviewers, broader impacts activities will likely have budgets for:
  - ▶ Personnel
    - ▶ e.g., videographers, education consultants, other collaborators
  - ▶ Supplies and activities
  - ▶ Assessing student learning
  - ▶ Evaluating the BIs
    - ▶ Formative and/or summative

# Perspectives on Budgets



# Provide an Evaluation and/or Assessment Plan

- ▶ Based on appropriate metrics
- ▶ Logic models are helpful
- ▶ Most BIs will have objectives/expected outcomes
- ▶ The evaluation plan should
  - ▶ Fit the proposed activities and be designed to assess (“measure”) how/whether objectives were achieved
  - ▶ **Evaluate whether your BIs led to the desired outcomes**
- ▶ Invest sufficient resources in evaluation plan if you want the proposal to succeed.

# Propose BIs you are Passionate About

- ▶ Propose educational or outreach activities that build on what you are passionate about
- ▶ BIs that mirror your interests will be easier to write and execute
- ▶ Your own enthusiasm for your BIs will probably generate more reviewer enthusiasm



# Wizard to Help You Develop and Budget a BI Activity

<http://coseenow.net/wizard/>

The screenshot shows a web browser window with the URL [coseenow.net/wizard/wizards/step/5](http://coseenow.net/wizard/wizards/step/5). The browser's address bar and tabs are visible at the top. The website's navigation bar includes links for Home, My Plans, About this Site, Updates, and Help, along with a user profile for Linda Vigdor. The main content area is titled "Step 2: Budget" and provides instructions on allocating a portion of the total research budget to BI activities. A text input field shows a total research budget of \$300,000. Below this, a slider allows users to select a percentage of the budget for BI activities, with the current selection set at 8%. A summary box displays the selected percentage and the resulting total budget for BI activities as \$24,000. Navigation buttons for "Previous" and "Save & Continue" are located at the bottom of the form. A sidebar on the left lists the wizard steps, with "Step 2: Budget" highlighted. Project information is also displayed in the sidebar, including the project name, audience, venue, budget, and activity description.

COSEE BI Wizard Home My Plans About this Site Updates Help Linda Vigdor

## WIZARD STEPS

- Project Information
- Step 1: Audience
- Step 2: Budget**
- Step 3: Activity
- Step 4: Project Description
- Step 5: Evaluation
- Summary

## PROJECT INFORMATION

**Project:** April 2017 test  
**Audience:** K-12 Students  
**Venue:** Multimedia (Websites, Podcasts, Print)  
**Budget:** \$24,000  
**Activity:** Work with media producers (video and/or radio) to develop a product on your topic

## Step 2: Budget

After selecting an audience and venue, you need to decide what portion of your proposal's total research budget to allocate for BI activities. Factors to consider include whether you will require full funding, utilize in-kind funding, or if are you leveraging an existing program.

In our experience, a BI budget is commonly in the range of 8-10% of your total research budget.

Enter the total budget for your proposed research project:

Total research budget

Use the slider to indicate what percentage of the budget you would like to dedicate to your BI activities.

0% 5% 10% 15%



Selected percentage: 8%

Your total budget for BI activities: \$24000

[← Previous](#) [Save & Continue →](#)

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# National Alliance for Broader Impacts (NABI): *Example BI Guiding Principles and Questions*

- ▶ Is the targeted audience clearly described and the rationale for engaging them well justified?
- ▶ What is the value added by your proposed activity?
- ▶ How well grounded is the idea in relevant literature, or by what is known about research in learning (not just the infrastructure at the PI's university)?
- ▶ What are the creative/original elements of the proposed activity?
- ▶ Is there a documented justification / need for the proposed activity or program?
- ▶ Are the goals and objectives clearly defined with measurable outcomes?

# Resources

- ▶ **NSF:** <https://www.nsf.gov/od/oia/special/broaderimpacts/>
- ▶ **Perspectives on Broader Impacts (NSF, 2015)**  
[https://www.nsf.gov/od/oia/publications/Broader\\_Impacts.pdf](https://www.nsf.gov/od/oia/publications/Broader_Impacts.pdf)
- ▶ **National Alliance for Broader Impacts**
  - ▶ <http://broaderimpacts.net/>
- ▶ **Ocean Scientist Broader Impact Wizard**
  - ▶ Informative video – but the wizard itself may no longer work
  - ▶ <http://coseenow.net/wizard/>