

“Project Description” as submitted to the National Science Foundation, but updated with the substantial modifications negotiated with the NSF in June 2012. In 2013, an additional cohort of four partnerships was added with support from the Noyce Foundation.

October 2013

SENCER-ISE II: Shaping an Infrastructure for the Partnership of Informal Science Education and Higher Education

The SENCER-ISE (Science Education for New Civic Engagements and Responsibilities- Informal Science Education) conference project, sponsored by the National Center for Science and Civic Engagement with support from the NSF (Award DRL-1001795) and the Noyce Foundation, has struck a chord by identifying a way to bring together science educators across formidable disciplinary and organizational divides. Based on the March 2011 meeting between 20 undergraduate education leaders and 20 informal science education leaders; the documentation of that meeting by Cathy McEver (McEver 2011) and its evaluation by Randi Korn & Associates (Korn 2011); continuing correspondence among those 40 educators and SENCER-ISE staff; and a follow-up meeting held in November 2011 with five of the newly- formed teams preparing projects that grew out of the March meeting; it is evident that *civic engagement* can serve as a bridge across two science education realms. Focusing on matters of civic consequence transforms science learning in higher education (HE) and informal science education (ISE) “from nice to necessary”—to echo a phrase popularized for the ISE realm by Ann Bowers of Noyce (Trautmann 2011). Engagement with global challenges, such as sustainability and climate change, is made real by examining local sustainability practices and policies, energy usage, and the regional consequences and effects of climate change.

The National Center is now requesting funds to explore and evaluate ways to support these budding projects by developing infrastructure to grow and efficiently sustain multiple cross- organizational civic engagement initiatives between informal science educators and those in higher education. SENCER-ISE II will: 1) create a joint organizing “secretariat,” to provide communications and support through low-cost shared services for six civic engagement partnerships; 2) provide modest “partnership support awards” and technical assistance to seed the ~~eight-six~~ HE-ISE civic engagement partnerships, and 3) share evaluation and analysis services across all the partnerships. We are seeking NSF support for this effort for a three-year term.

The *intellectual merit* of this project will be to enable movement beyond one-time, asymmetric partnerships bridging science education silos, to the creation of self-sustainable, balanced, and mutually beneficial relationships among HE and ISE institutions. The project will evaluate and report to the field the relative costs and benefits of each of the proposed mechanisms to nurture and maintain these partnerships. The project will provide faculty members in HE with tools from the ISE world to help improve undergraduate education. It will provide ISE institutions with ongoing refreshment and contact with scientists and teaching faculty in the HE community, including their extensive civic engagement course experiences, most of which involve issues of sustainable practices and policies like studying energy usage and investigating effects of climate change. This will in turn assist ISE institutions in sharing current research by providing civic engagement opportunities for their diverse public audiences.

The *broader impacts* of this work fall in two areas: first, the creation of knowledge towards modeling one

dimension of the dream inspired by NSF's "OneNSF" direction of a STEM learning community of mutual appreciation and collaboration; and second, reaching and connecting the "audiences" of these two realms, HE and ISE. For the first area, the project's practitioners will learn the potential for developing ongoing institutional relationships so that the different but complementary strengths of these two areas of science education achieve a level of trust and mutual reliance. For the second area, the undergraduates (at the colleges) and the general public (through the science centers and other ISE organizations) will learn science through their involvement with civic issues that matter to the learners. All of these learners will have increased opportunities to become science-enabled citizenry.

Introduction

An industry focused on the public understanding of STEM and STEM research has been developing for over a century (Falk and Dierking, 2010; Friedman 2010). Many specialties have emerged, including K-12 education, higher education, graduate education, and informal science education, of which the latter has many sub-specialties, including museums, living collections, mass media, and the Internet. As seems to be natural, each of these sectors, specialties and subspecialties has formed a silo around itself, an understandable response to an large and diverse set of endeavors generating more projects, programs, policies, and proclivities than any individual can hope to track, let alone understand deeply and learn from. Thus there are only sporadic exchanges of hard-won education lessons between these sectors, for example between higher education and museums, or between mass media and K-12. One-shot communications, conferences, and projects, and highly asymmetric offerings of curricula materials across the silos arise continuously, but sustained partnerships or ongoing communities of practice across silos represent a miniscule percentage of the activity within the science learning industry.

SENCER, the signature program of the National Center, has ten years of NSF-supported faculty development and dissemination efforts behind its body of findings about using civic engagement to produce undergraduate learning about STEM. SENCER helps college students connect STEM learning to their other studies, and strengthens students' STEM understanding and capacity for responsible work and citizenship. SENCER faculty members have developed hundreds of courses, including forty-four model courses many of which focus on sustainability issues (<http://www.sencer.net/Resources/models.cfm>). SENCER has a well-established positive affect of increasing undergraduate participation in science courses. A 2006 study found that ten percent of the students who were not interested in taking additional science or mathematics courses at the beginning of a SENCER course, were interested in doing so by the end of the course. More than 6% became interested in exploring careers in science (Weston, Seymour, and Thiry 2006).

The National Center reaches undergraduate faculty through a variety of methods that will enhance the SENCER-ISE II initiative. An annual SENCER Summer Institute offers intensive faculty development opportunities and an annual Washington Symposium allows for the dissemination of the results of this faculty development. SENCER has reached over 2,000 faculty around the country at 438 institutions of higher education. It continues to reach educators from all sectors through its bi-weekly electronic newsletter (circulation, 2,500) and its peer reviewed on-line journal, *Science Education and Civic Engagement, an International Journal*. SENCER also has a network of seven regional centers (New England, MidAtlantic, South, Midwest, Southwest, Central Plains, and West) that offer at least two meetings per year on topics of interest related to science and civic engagement.

While SENCER has been stimulating and supporting civic engagement in college and university formal education, the Informal Science Education (ISE) world was also discovering the potential for civic

engagement to advance their missions, outside of the formal education system. The Liberty Science Center reinvented itself starting a decade ago to focus on "...experiences that connect audiences to the science and technology behind the opportunities and challenges faced by society." The Science Museum of Minnesota created its Science and Social Change Program to explore science and social issues through civic engagement. The *Communicating Climate Change* consortium paired 12 science centers with 12 climate research programs to engage the centers' local publics with citizen science climate change projects. Hundreds of independent citizen science projects, around civic engagement with issues such as water pollution, energy efficiency, conservation, and climate change have been implemented with the help of materials developed by the Cornell Laboratory of Ornithology.

In light of these parallel trends in formal and in informal education, SENCER sought funding for a conference, "SENCER-ISE," to expand collaboration between SENCER faculty members and the ISE community to further the civic engagement approach towards strengthening science literacy, broadening participation in the workforce, promoting research and evaluation, and making use of cyberlearning strategies to enhance STEM education. The long-term goal of that project was that leaders in the ISE and SENCER communities would develop ongoing partnerships for using civic engagement across the formal/informal education divide.

The results of the SENCER-ISE conference project validated, in the short term, the concepts behind the proposal. The project evaluation by Randi Korn & Associates (Korn 2011) found:

...new learning and perspectives resulted from conference participation; about three-quarters of interviewees said the conference had created an awareness of the value of the other sector, empathy for the challenges the other sector encounters, and/or concretized potential opportunities for collaboration between the two sectors. And, the remaining one-quarter of interviewees said the conference had confirmed and reinvigorated an existing belief that collaboration among the two sectors is a valuable endeavor.

Encouragingly, findings show that there is much consensus between the two sectors when considering how best to collaborate around civic engagement in science, as most responses to interview questions represented equal numbers of those from ISE and SENCER; and initial collaborative steps have been taken by some interviewees. As such, findings demonstrate that the SENCER-ISE conference successfully achieved its two main goals of bringing ISE and SENCER professionals together to discuss civic engagement in science and inspiring ideas for collaboration between them. The challenge now is to help participants continue and build on the relationships and momentum that were started at the conference.

Continued discussions by SENCER-ISE staff, and a follow up meeting held in November 2011 with five newly-formed teams of HE and ISE professionals, all inspired by the earlier conference and including new potential partners who had not attended the earlier conference, confirmed that barriers to getting these partnerships underway and sustaining them were essentially those raised at the conference and identified by the Korn & Associates evaluation:

First, findings suggest a continued need to build awareness of the value of using civic engagement as a platform to advance science understanding, including what each sector brings to a potential collaboration that would help achieve this end. Second, because findings suggest that maintaining the momentum of the conference may pose a challenge to participants, other platforms for collaboration might need to be considered. Interviewees suggested maintaining communication online and hosting regional conferences to address the barrier of geographic distance.

Need for SENCER-ISE II

While SENCER-ISE was a promising beginning, the two challenges Korn & Associates identified must be addressed to allow the seeds planted to germinate:

- a continuing need to build awareness of the value of HE-ISE sectors for each other's missions
- finding additional platforms for these collaborations to communicate with each other and the broader HE and ISE communities

In addition, we undertook a review of literature on the barriers to sustainable partnerships between ISE and HE institutions, and between non-profit organizations in general. There is a substantial literature of survey findings, case studies, and advice on the formation for successful non-profit partnerships (Alpert 2010; Dierking et.al. 1997; Hyman 2005; Kihl 2010; La Piana n.d.; La Piana 2010; New York Hall of Science 2011; Schatz and Russell 2008). Much of this literature discusses non-profits broadly, but other analyses and case studies focus specifically on ISE organizations partnering with higher education and research institutions, such as the "Communicating Climate Change" (Friedman 2012) and "Portal to the Public" (Schatz and Russell 2008) NSF-supported HE-ISE partnership projects. Essentially all of the literature and case studies we reviewed described a similar list of the specific challenges to forming and sustaining non-profit partnerships. Five of these challenges are directly relevant to SENCER- ISE II:

- Non-profit partnerships are almost always more difficult to establish and sustain than the partners imagine they will be at the time a proposal is written. There is rarely enough thought and time given to forming partnerships before the proposals are written or before work begins. Initial responsibilities, decision-making prerogatives, and commitments from both sides need to be clearly defined well before the work plan is underway. Some flexibility must be expected and negotiated as conditions change.
- The differences in cultures between ISE organizations and research or higher education institutions are significant but rarely accounted for initially in forming partnerships. These differences can lead to misunderstandings and disappointments throughout the run of a partnership. For example, participants from higher education institutions are subject to very different constraints than those of the smaller, more nimble, but less well endowed ISEs. Both sides need to appreciate the positive and negative consequences of these differences. This takes time visiting each other's operations and understanding their values and limitations.
- Time and other resource commitments must be defined and agreed to in writing at the beginning. The absence of these written commitments is a common cause of friction.
- Institutional vs. individual commitments to a partnership produce very different outcomes that are often not appreciated at the beginning of a relationship.
- Organic relationships can lead to sustainable partnerships, while ad hoc partnerships rarely do. Organic relationships are distinguished by goals that meet key institutional mission needs of both partners, each partner having mutually-appreciated strengths the other does not, and a consistent process of communication and decision making.

The SENCER-ISE II plan

A suite of eventually self-sustaining HE-ISE communication vehicles and partnership initiation services must be built to answer the challenges identified above. While much of this work involves informing the potential HE-ISE partnerships of what is known about forming partnerships, much is also required in the form of relatively simple mechanisms for communication infrastructures, both within and across partnerships. The action plan for SENCER-ISE II addresses these needs by providing four kinds

of services to be shared efficiently across six partnerships during the duration of this grant, and designed to be sustainable by these and additional HE-ISE partnerships after the end of this grant. We propose to:

1. Create a Joint Organizing “Secretariat” that will, in conjunction with the project management team, provide communications and support through low-cost shared services for multiple civic engagement partnerships through video conference services, meeting logistics facilitation, convening one national meeting, commissioning common evaluation instruments and databases, and acting as an institutional matchmaker. These common infrastructure needs are not difficult to design, but are expensive and inefficient if each partnership must act on its own to obtain the needed services. Setting up and maintaining a website, or selecting and contracting for a video conferencing service, including helping the participants become familiar with these tools and solving problems they have, frequently involves a painful learning curve. Having a small central office that provides these services for all the partners reduces the cost to each partnership.
2. Provide Partnership Support Awards and Technical Assistance for six cross-sector civic engagement partnerships, to be awarded in the first year of the grant. Each project would develop its own long-term funding, but SENCER-ISE II would help them get started by awarding start-up funds of \$50,000 to each partnership on a competitive review basis, with the SENCER-ISE Advisory Board acting as a review panel. While this is a relatively small sum for each partnership, it will be enough to cover travel and out-of-pocket costs for the potential partners to meet, become familiar with each other’s needs, ideas, and resources, and to engage in the kinds of partnership building activities widely identified as being crucial to the formation of sustainable enterprises.
3. Share Evaluation and Analysis Services across all of the partnerships, leading to cross-project problem-solving and identification of those aspects of science learning through civic engagement experiences of other HE-ISE partnership programs like *C3* and *Portal to the Public* demonstrate that valuable findings come from each partnership’s experiences, and that sharing these findings and putting them into practice promptly is key to deriving maximum benefit. SENCER-ISE II will provide a common set of tools and services for all the partners. While each partnership may also wish to have its own internal or local evaluators, the existence of a common service, with training and follow-up support from the SENCER-ISE II project’s external evaluation team, will lower start-up costs and increase the speed and value of sharing across the partnerships.
4. Create a Collaborative Network to undertake these services in an interactive, participatory manner, through a working website for cross-project communications, regular meetings, webinars, and reflective practice opportunities. The goal of these vehicles will be that the multiple partnerships learn from each other, feel responsibility for each other's success, and eventually take ownership over the shared resources and activities as a network in order to sustain them after the completion of the SENCER-ISE II grant. As the partnerships mature during the SENCER-ISE II grant period, representatives of the partners themselves will take over guiding these services. As the partnerships establish their viability and value to their host institutions, eventually they will also take over the cost of the shared services.

During the project we will continue to investigate peer-reviewed research on ISE-HE collaborations in national and international publications and base our work on the best resources available. We will also publish the results of our continuing literature review on the project’s website in order that it can serve as a resource to the field.

Project Workplan and Timetable

To implement SENCER-ISE II, we have developed a workplan and timetable outlining key activities for each year of the proposed project.

Year I (September 15 2012 – August 30 2013)

December 2012	Hold in-person Leadership Meeting of the management team, Advisory Board members, and Evaluator to review implementation plan and evaluation, including the first competition for the Partnership Support Awards
January 2013	Announce competition for Partnership Support Awards through SENCER/CAISE/ASTC/other websites
May 2013	Announce 6 awardee partnerships
June 2013	Evaluation webinar offered by RK&A for awardees
August 2013 <i>1.5 days, 15 attendees, SSI2014</i>	Hold meeting of awardees at the annual SENCER Summer Institute (SSI) 2013, including an evaluation working session offered by RK&A for awardees

Year II (September 1, 2013 – August 30 2014)

April/May 2014	RK&A conducts formative evaluation
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Year III (September 1, 2014 – August 30 2015)

January 2015	Begin to implement sustainability plan discussed at Leadership Meeting in December 2014
March 2015 <i>2 days, 41 attendees</i>	Hold national conference to present the work of the partnership teams, held in conjunction with the NCSCE Washington Symposium, including a Learning Circle facilitated by Randi Korn for awardees

March 2015 <i>2 days, 17 attendees</i>	Hold on-line Leadership Meeting of the management team, Advisory Board members, and Evaluator
April/May 2015	RK&A conducts summative evaluation

In addition to the above, other activities will include (on a yearly basis, unless noted differently):

- Organizing monthly management teleconference meetings (minimum) and additional in-person meetings of management team (at the Washington Symposium or SENCER Summer Institute).
- Offering programs for the wider SENCER community at the Washington Symposium (March)

and SSI (August).

- Present at two national or regional HE or ISE professional association meetings for dissemination purposes.
- Developing and maintaining a database of civic engagement activities, a website for inter-project and public communication, and webinars on topics of interest to partnerships.
- Engaging in Formative (Years I-II) and Summative (Year III) evaluation activities (Please see schedule from Randi Korn & Associates in Supplemental Documents).

Selecting Higher-Education/Informal Science Education Partnerships for SENCER-ISE II

The information below on three of the five teams inspired by the original SENCER-ISE project demonstrates the types and range of possible partnership groups. However, these groups are not necessarily the final pilot projects, which will be recruited and selected in the first year of the project. In any event, we will stay in contact with original five teams and invite them to contribute to the project overall.

We will review and analyze potential inter-institutional partnership types when we receive the initial applications and then determine the range of collaborations to fund. We believe this approach will help us achieve a broad range of institutional partnerships and is the most appropriate means given our timeline and financial resources.

Our team will discuss and develop selection criteria at the first project planning meeting. We will use challenges discussed on pp. 4-5 of the proposal to frame application questions. We will strive to achieve diversity since it is a shared goal, within the practical constraints of time and financial support.

Based on the Center's previous sub-grant making history and experience and following our discussion with potential project collaborators, we believe the \$50,000 sub-grant for each partnership is modest but sufficient to achieve the goals set out in the proposal over the three year grant period.

The following examples were presented at the November 2011 follow-up meeting by individuals from HE and ISE institutions who had attended the March 2011 conference, along with new institutions they had recruited and may be candidates for the Partnership Support Awards.

Arkansas State University, Arkansas Fish and Game Commission, and the Trout Nature Center wrote a full Pathways proposal to the NSF. Their project aims to increase the interest and scientific knowledge of kids in the 10-15 year-old age range and their parents through their interest in fishing. They plan to hold a series of one-day workshops at their field stations (all have aquatic components) that will educate the kids and their parents about the ecosystem issues, ecological interactions between fish and other species, and how this affects their feeding patterns. There will be follow-up sessions online to see how any interest and knowledge gained changes over time.

University of Maryland Center for Environmental Science and the National Geographic Society are exploring efforts to support citizens and K-12 students in studying and addressing local and regional environmental issues using an online digital mapping and analysis tool developed by National Geographic (FieldScope). They are interested in examining how this tool can be used to support and enhance different types of existing citizen science and related projects—especially those that link citizens and students to environmental science research and resource management. For example, this online

visualization tool could be used for entering data, mapping and analyzing datasets, sharing conclusions, and exploring new questions and solutions. They would also like to explore how best to support leaders of these diverse efforts in integrating this tool into their existing education programs and are particularly interested in expansion of this Internet program to mobile devices to broaden its application and accessibility.

Longwood University and Clean Virginia Waterways want to build a strategic partnership based on the development of a Center for Excellence in Environmental Education and have a leadership role in environmental education in Virginia. They would provide new opportunities for students to develop as citizen leaders, support educational efforts for K-12 students in selected regions of the state, and engage citizens in learning about the Chesapeake Bay watershed's environmental issues.

SENCER-ISE II Leadership and Organization

The same team that developed and operated the SENCER-ISE Conference project will manage SENCER-ISE II, with additional partners described here.

- Wm. David Burns, Executive Director of the National Center for Science and Civic Engagement and co-founder and principal investigator of SENCER, will serve as the Principal Investigator for the SENCER-ISE II project. In December 2008, the American Society for Cell Biology honored Burns and SENCER co-founder, Karen Oates, with the Bruce Alberts Award in recognition of the impact of SENCER on STEM education.
- Alan J. Friedman will serve as the Project Director and ISE coordinator. A consultant in museum development and science communication, Friedman was Director of the New York Hall of Science for 22 years and has worked in ISE for 36 years. He served for three years as a co-PI of the CAISE project, evaluating the partnership aspects of the C3 project, and serves on the National Assessment Governing Board, the Board of the Noyce Foundation, and the Board of the Cornell Laboratory of Ornithology.
- Ellen Mappen, Senior Scholar at the National Center for Science and Civic Engagement, will serve as the SENCER coordinator. Mappen was the founder and long-time director of the Douglass Project for Rutgers Women in Math, Science, and Engineering at Rutgers University, an initiative that received the 1999 National Science Foundation's Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring.
- Randi Korn & Associates, Inc. (RK&A) will serve as the project evaluator and provide evaluation guidance for each of the partnerships involved. A full-service museum planning, evaluation, and research firm, RK&A was selected to join our team in part because Randi Korn, Founding Director, authored an article on evaluating collaborations in *Framework for Evaluating Impacts of Informal Science Education Projects* (Friedman, 2008). Korn has a solid understanding of how to structure collaborations so they work effectively.
- Jonathan Bucki of Dendros, Inc, will facilitate and Catherine McEver will document the SENCER-ISE II National Meetings, as they did for the March 2011 SENCER-ISE conference. McEver's records of NSF-ISE meetings such as the 1999 Outdoor Exploratorium Design Workshop have become standard references in the ISE field (McEver 2000). Bucki's work for the March 2011 conference was greatly appreciated by the attendees, several of whom have engaged him to work on individual projects they have underway.
- Amanda Moodie and Danielle Kraus Tarka, from the National Center for Science and Civic Engagement, who provided administrative and logistical support for the SENCER-ISE Conference project, will similarly support SENCER-ISE II, including operating the

- secretariat services, as well as organizing the national and management team meetings.
- The Koshland Science Museum of the National Academy of Sciences (the Koshland) will join the SENCER/ISE II effort and share its experience collaborating across the academic and informal education sectors, engaging young adult audiences in both online and on-site programming, and informing the community of practitioners about relevant policy work of the National Academies. Patrice Legro, director of the Koshland, will join the SENCER-ISE II management team to participate in the overall planning and implementation of this effort. She will be the PI on the sub-award to the museum and her team will take prime responsibility for establishing, supporting, and maintaining the online workspace for the partnership and a public facing online presence for SENCER ISE II in the Koshland’s “Collaboratory” in order to expand the dissemination and encourage greater cross-institution participation and evaluation.

The management team for SENCER-ISE II will consist of Burns, Friedman, Mappen, Kraus Tarka, Moodie, Legro, and Korn. An external Advisory Board will consist of HE, ISE, and foundation officers who have an interest in the outcomes of SENCER-ISE II and have skills to assist the project’s ongoing planning needs. In addition to providing expert advice to the project, this committee will also serve as a review panel for partnerships to be supported by SENCER- ISE II, with individuals recusing themselves if they are connected with one of the proposed partnerships. The Advisory Board will have one in-person meeting in Year I and also communicate through teleconferences throughout the project’s life. The table below summarizes the current positions and areas of expertise of the ten Advisory Board members, many of whom have experience in both academia and in informal and K- 12 education. (Letters of Commitment and detailed biosketches are in the supplemental documents section):

Name	Institution/Title	Expertise brought to the project
Royce Engstrom	University of Montana/President	Perspectives of higher education administrative leaders on faculty roles civic engagement
Julie Johnson	Science Museum of Minnesota/John Roe Distinguished Chair of Museum Leadership	Museum planning, programming, and collaboration
Gil G. Noam	Harvard U/Dir. of PEAR(Program in Education, Afterschool & Resiliency) Assoc. Prof.-Med. School	Assessment of science learning in informal settings
Carlo Parravano	Merck Institute for Science Education/Exec. Director	Improving science education and national assessment activities/building strong professional communities
Eliza Reilly	Phillips Museum of Art/Franklin & Marshall Coll./Director	Strong knowledge of SENCER curriculum as SENCER Model Series Editor
Elizabeth Stage	Lawrence Hall of Science/Berkeley/Director	Research & evaluation/professional development/assessment in both ISE and academia
Ann Staton	Woman’s Texas U/Dean, College of Arts & Sciences/Co-Director, Southwest -SCI	Instructional communication, enhancing student science education/fostering social responsibility & civic engage

Mercedes Talley	Keck Foundation/Program Director	Public participation in environment planning and knowledge of funds development opportunities
H. Joe Witte	NSA Goddard/Natl Environmental Education Foundation/outreach consultant about NASA climate science research	Experience in mass media and meteorology
Tom Wood	New Century College, George Mason University/Assoc. Prof. of Conservation Studies	Education and research, programs in Conservation and Environmental Studies

Beneficiaries and Outcomes of SENCER-ISE II

Our primary goal is to build the knowledge base by looking at six partnerships as research sites for improving the field's understanding of the nature (challenges and high potential) of HE-ISE partnerships. A valuable side benefit will likely be to build durable, sustainable partnerships that will continue beyond the project term.

The outcomes of this project will serve five categories of beneficiaries, as underlined below. As a direct result of SENCER-ISE II, we project that:

1. Faculty at the higher education institutions will learn skills in communicating with the public (and even their own students) through their partnerships with ISEs, allowing the faculty to advance their own broader impacts. Understanding more about how informal science educators attract and retain their audiences, which can vote with their feet, will help faculty attract and retain non-science majors. *Portal to the Public* provides strong evidence for how much faculty can learn from an ISE, and how highly they value their associations with ISEs (Pacific Science Center 2012). Higher education will get a chance to practice and learn the benefits that can come from applying the principles of informal education to formal educational settings.
2. ISE staff will develop ongoing relationships with faculty at the higher education institutions. Instead of working with researchers on a more typical once-a-year Advisory Board meeting, they will develop deeper trust and understanding, resulting (we hypothesize) in the ISE's staff being more engaged with current research, engagement that they can use in their own organization's work.
3. New institutional partnerships beyond the individual students, the public, faculty, and ISE staff, will be built. These new institutional links possess high potential for generative collaborations strengthening a continuum to support lifelong learning. Individuals in both higher education institutions and ISEs are always in flux, but we hypothesize that institutional relationships between these education organizations can be sustained if the mutual benefits are demonstrated to be sufficiently valuable over a sufficiently long period of time.
4. Undergraduate students will learn more STEM content and how to explain that content to others. SENCER has clearly demonstrated that using civic engagement with STEM-related issues brings more undergraduates into science courses and enthuses them about learning science. We have persuasive evidence that the SENCER approach helps college students achieve these intellectual and affective outcomes. A recent study based on SENCER faculty responses shows the type of "21st Century" skills that are learned in SENCER courses. These faculty believe their students can make connections between

science and civic problems, make interdisciplinary connections, and identify scientific problems and questions (Ballou 2012).

SENCER's attractiveness for undergraduates will be further enhanced, we hypothesize, by having public involvement through the ISEs. It is great to learn for your college degree, to please your peers and parents; but how much more exciting to share what you are doing with the public through exhibits and presentations at science centers, where tens of thousands of people can see what you are doing on STEM-related issues that matter to the public.

For undergraduates, learning how to explain their work to the public enhances the students' own learning (you do not know what you know until you try to teach it). "Explainer" programs at hundreds of science centers around the world, and internships for college students at museums, media organizations, and community organizations such as after-school providers demonstrate the popularity and value of undergraduate involvement with the public. Civic engagement adds to these opportunities for involvement for large numbers of undergraduates, who, we believe will retain longer-term involvement with public education, as demonstrated by longitudinal evaluations of programs like the Science Career Ladder at the NY Hall of Science (Gupta and Siegel 2007). Graduates who do not major in science or another technological field, will see also that they can turn to ISEs when science questions arise after they complete their undergraduate studies.

5. Publics served by ISE organizations will be attracted to learn STEM by the new civic engagement activities that the ISEs present and in which the ISEs offer participation opportunities to the public. We see strong evidence for this in the extraordinary growth of citizen science activities, which now involve millions of people a year. Citizen science is new for the ISE community however, with C3 being a pioneering effort to spur citizen science at twelve science centers. SENCER-ISE II has learned deeply from C3's successes and problems. SENCER-ISE II, by building ongoing, more equal partnerships between higher education and ISEs, will result in the ISEs being able to attract more public participants for longer periods of time, and will allow even non-citizen-scientists to appreciate and to learn about STEM through the important civic engagement projects presented by the ISEs for their audiences.

There is one other potential beneficiary, which is the NSF, itself. We think this is true especially if we demonstrate, as we think we have the high potential for doing, the value of a "one NSF" approach that, through our focus on important civic issues, combines, in one program, science from several disciplines, educational and scientific research, and delivery to key constituencies through formal and informal education.

Evaluation Plan

The SENCER-ISE II evaluation efforts as a whole will deal with audiences 1, 2, and 3. The individual partnerships will evaluate audiences 4 and 5, with guidance from the SENCER-ISE II's staff and its evaluator, Randi Korn & Associates, Inc.

Randi Korn & Associates, Inc. (RK&A) is delighted to work with the National Center for Science and Civic Engagement (NCSCE) as its project evaluator for the Science Education for New Civic Engagements and Responsibilities Informal Science Education II (SENCER-ISE II) project. The evaluation plan for the overall project includes professional development in the form of an evaluation webinar, in-person working session, and Learning Circle, and formative and summative evaluations of the project's collaborative infrastructure. The summative evaluation will indicate how well the project achieved its impact, as per the Impact Framework in Figure 1, among HE and ISE professionals and their

organizations—the three direct beneficiaries of SENCER-ISE II. The professional development component of this project will build capacity among HE and ISE professionals to reflect on their own collaborative practice and evaluate how well their individual projects achieved impact among HE students and ISE audiences—the other two beneficiaries of the project.

Planning for Evaluation (Year 1 & Year 3)

The planning stage includes an **initial meeting** to discuss the project so RK&A can begin to build a deeper understanding of the project's expectations and challenges. Since the overall goal of any evaluation is to provide team members with the right information from which they can make informed decisions, this meeting is an important first step in working together. RK&A will use the proposal narrative and Impact Framework to explore expectations and build a common understanding of what will be accomplished with the project and evaluation. RK&A will facilitate planning meetings at two points in the project—in Year 1 to plan for formative evaluation and in Year 3 to plan for summative evaluation. These meetings will coincide with in-person and online SENCER-ISE leadership meetings so RK&A can solicit feedback from staff and other project stakeholders integral to the planning process.

Formative Evaluation (Year 2)

In Year 1, NCSCE staff will begin developing a collaborative infrastructure to support the project cohort. In Year 2, formative evaluation will explore how effectively this infrastructure supports the cohort in developing their individual SENCER-ISE II projects. Prior to data collection, RK&A will meet with the project team to discuss the infrastructure, including how it intends to support collaboration, and design the proper protocol and data collection tools accordingly. Once all tools are approved, RK&A will collect data via telephone during one round of formative evaluation in April/May 2014. Data collection will last about two weeks.

RK&A proposes conducting **in-depth interviews** with 12 cohort participants and up to 4 additional individuals who have contributed to the collaborations (16 total). In-depth interviews encourage and motivate individuals to describe their experiences and express their opinions. Additionally, the open-ended nature of the interviews follows the natural trajectory of a conversation, which can produce insightful information that may not be top of mind. RK&A will audio-record interviews with interviewees' permission and transcribe them to facilitate analysis.

Summative Evaluation (Year 3)

Summative evaluation will provide concrete data about the effectiveness of the SENCER-ISE project's collaborative infrastructure in the context of the Impact Framework. RK&A proposes implementing two methods: a standardized questionnaire and in-depth interviews.

RK&A will design a standardized questionnaire for online administration to all 12 members of the project cohort and individuals in their respective institutions, once before they begin their projects, and once at the end of the grant. Standardized questionnaires are selected for this project because of the potential sensitive nature of questions, recognizing that some individuals may feel uncomfortable sharing their thoughts about the collaboration during an interview. Standardized questionnaires are also useful for measuring professionals' knowledge and attitudes as well as their interest in sustaining the collaboration. We will apply statistical procedures to the data to provide numerical ratings about the effectiveness of the project's collaborative infrastructure. RK&A will design the questions, including closed-ended questions such as multiple choice, rankings, and scales. After approval, we will post it on SurveyMonkey® and solicit participation from HE and ISE professionals via e-mail. In Year 3, when the cohort's individual projects are well established, RK&A also will conduct **in-depth interviews** with all 12 members of the

project cohort and up to 4 additional individuals who have contributed to project collaborations (16 total). RK&A will analyze data according to the project's Impact Framework.

Professional Development (Year 1 & Year 3)

As part of the cohort's professional development, two RK&A staff will offer a webinar and in-person working session on evaluation. The cohort will participate in a webinar, followed a month later by an in-person working session at the Summer SENCER Institute in Year 1. In Year 3, one RK&A staff will facilitate a Learning Circle at the National Meeting.

Webinar

Two RK&A staff will facilitate one 3-hour webinar in Year 1 (June 2013). The purpose of the webinar is to provide participants with an orientation to evaluation, including how clarifying impact can guide planning and evaluation. While the SENCER-ISE II project has an Impact Framework that envisions the impact on the HE and ISE professionals, the professionals also envision impacts that their individual project will have on audiences such as undergraduate students or the visiting public. RK&A will help HE and ISE professionals think about why their project is important to individual audiences and identify their project's unique value as a way to envision intended impact. The webinar may include advanced readings, presentations, facilitated discussions, and a group exercise depending on the capabilities of the web interface.

In-person Working Session

At the Summer SENCER Institute in Year 1, two RK&A staff will conduct an in-person working session with cohort participants to help them further clarify their intended impact and identify concrete indicators that transform the impact statements into something observable and measureable. The final deliverable from the working session will be a refined impact framework and indicators that serve as important guideposts for project planning and implementation. RK&A also will provide additional support to the cohort via telephone as they fine tune their impact framework and indicators. Further, RK&A will help the cohort identify common impacts and indicators that can be utilized to gauge success across projects, resulting in a framework that applies to the wider SENCER-ISE II project network.

Reporting

RK&A will prepare two reports detailing findings from the formative (Year 2) and summative (Year 3) evaluations. Interview data will undergo a content analysis, and we will present general trends. Verbatim quotations from the interviews will be used to support trends and illustrate interviewees' opinions and experiences. Numerical data generated from the questionnaires will be presented using text, graphs, and tables. All reports will include a summary and methods description.

Data Management

The evaluation design and instruments will be sent to and approved by an Institutional Review Board (IRB) prior to collecting data. All RK&A staff and contractors have completed human subject research training through the National Institute of Health. RK&A will thoroughly pretest all instruments, assessing their validity and reliability prior to use. All data will be confidential and aggregated for reporting, and individual subjects will be identified by ID numbers generated and maintained by RK&A in password protected files on password protected computers. At the end of the project, data will become the property of NCSCE staff, and they will disseminate report findings per NSF guidelines.

Figure 1			
PROFESSIONAL IMPACTS			
Category	Impacts	Indicators	Evidence
<i>Knowledge, Awareness Understanding</i>	ISE and HE professionals increase their understanding of each other's field of expertise.	<p>ISE and HE professionals describe new understandings of how to attract each other's primary audiences (e.g., visitors, undergraduate students)</p> <p>ISE and HE professionals describe knowledge (e.g., current research) and teaching strategies (e.g., using inquiry) they have learned from each other to engage audiences.</p>	<p>At least ½ of ISE and HE interviewees describe ways of engaging a specific audience that they learned from the other sector and incorporate in their daily work.</p> <p>At least ½ of ISE and HE interviewees name a piece of knowledge or teaching strategy they learned or improved on as a result of their collaboration with the other sector.</p>
<i>Knowledge, Awareness Understanding</i>	ISE and HE professionals increase their knowledge of how to plan for and evaluate the impact of their work.	<p>ISE and HE professionals define "evaluation" and "impact."</p> <p>ISE and HE professionals define "indicators" or "outcomes."</p>	<p>At least ½ of ISE and HE interviewees define "impact" and provide an example of an impact for a specific audience.</p> <p>At least ½ of ISE and HE interviewees define "indicator" and provide an example of a concrete and measurable indicator they want to achieve for a specific audience.</p>
<i>Attitude</i>	<p>HE and ISE professionals appreciate the value of each other's work and expertise.</p> <p>HE and ISE professionals not directly related to the project will realize the value of the formal / informal education collaboration.</p>	<p>HE and ISE professionals name ways in which the work and expertise of the other is important for advancing science education.</p> <p>HE and ISE professionals express a desire to continue working with each other on their civic engagement projects.</p> <p>HE and ISE professionals express an interest in creating a project with a HE (or ISE) professional.</p>	<p>At least ½ of HE and ISE interviewees name specific knowledge and skills that the other used to successfully engage audiences in science education.</p> <p>At least ½ of HE and ISE interviewees discuss concrete ways they will continue to work with each other to sustain their project.</p> <p>At least ½ of HE and ISE questionnaire respondents' attitude ratings about HE (or ISE) professionals are improved.</p> <p>At least ½ of HE and ISE questionnaire respondents indicate a desire to work with HE (or ISE) professionals.</p>

Dissemination

The plan described below includes embedded dissemination throughout. In particular, the national conference in Year III, sessions at SENCER national meetings, participation in CAISE PI meetings and/or ISE Summits, and the project website managed by the Koshland Museum are primary dissemination channels for SENCER-ISE II. The national conference documentation by Cathy McEver and the evaluation by RK&A will be published on the website. The management team will submit articles and conference presentation proposals to CAISE, ASTC, and the most relevant higher education meetings. Project and evaluation reports will be submitted to InformalScience.org.

In addition to national conferences, sessions at national SENCER meetings, participation in CAISE PI meetings and/or ISE Summits, and the public website managed by the Koshland Museum, we will also publish national conference documentation and project and evaluation reports to the website. We will also submit articles and conference presentation proposals to CAISE, ASTC, and other relevant higher education meetings. Our dissemination efforts will also include NSTA, education committees of scientific professional societies (e. g., Geological Society of America, National Association of Biology Teachers, American Chemical Society and additional groups).

Sustainability

Our project will provide the pilot partnerships time and resources for travel and out-of-pocket costs for the potential partners to meet, become familiar with each other's needs, ideas, and resources, and to engage in the kinds of partnership building activities widely identified as being crucial to the formation of sustainable non-profit partnership enterprises. As part of the partnership development activities and discussions, sustainability will be a critical topic and focus of their work. Our recommendations on sustainability will emerge from these activities and discussions and will be incorporated in our final report.

Results of Prior Support (DUE 0088753, 0618431, 0717407, 1122578)

The scale of the SENCER initiative is large. To date, representatives from nine percent of all accredited two- and four-year US colleges and universities have participated in formal workshops. At least 600 courses have been created or redesigned with direct financial support from SENCER. Hundreds more have been created with institutional financial support following SENCER participation.

An evaluation, prepared by Weston, Seymour, and Thiry (2006) utilized responses from more than 10,000 students enrolled in about 345 SENCER courses, concluded: "SENCER's goal of encouraging faculty to teach courses with civic content and innovative pedagogy is a reality." The authors found that statistically significant learning gains were made by underperformers and women, regardless of past performance and that almost 90% of courses created with sub-awards entered the "permanent" curriculum. More recent results, gleaned from a comprehensive survey, audits of sub-award and Fellows reports, the Student Assessment of Learning Gains, and other sources demonstrate that SENCER is achieving goal of faculty empowerment and STEM education community building.

Strategic Impacts in Faculty Development To examine faculty and academic leaders' perceptions and reports of impacts, the National Center's assessment team constructed and conducted an on-line inquiry of a census of SENCER alumni in Fall 2010. More than 600 faculty members and academic leaders (response rate=45%) completed the nearly 70 item instrument; 37.6% provided rich verbatim comments following questions about SENCER's contributions to their work (Ballou 2011 for methodology). Among

other things, the data show that faculty participation in SENCER made them successful in the areas of new course or new program development and involving their students in civic engagement activities. Involvement in SENCER has also influenced their image of students as science learners able to take knowledge gained and apply it in a civic/community setting.

The results (activities and evaluation results) from (DRL-1001795), which supported the SENCER-ISE Conference project, have primarily been discussed in pp. 1 and 3-4. Conference proceedings and the evaluation report are available to the public on the Internet <http://www.ncsce.net/Initiatives/SENCERISE.cfm>. An overview of the background leading to the March 2011 conference and preliminary results was published in project report in *Science Education & Civic Engagement: An International Journal* (Friedman & Mappen 2011).

Conclusion

SENCER-ISE II, an outgrowth of the NSF's investment in the SENCER-ISE Conference project, will develop and evaluate a model of sustainable partnerships across two sectors of STEM education that will benefit a broad audience and have a long-lasting impact on both the ISE and HE sectors. The partnerships and support infrastructure created by the SENCER-ISE II initiative will reach a diverse audience in different regions of the country and at the national level. By bringing ISE methods into the classroom, we intend to create a generation of adults who appreciate the value that the ISE approach will offer them throughout their lives as they grapple with new environmental and social challenges. At the same time, by embracing the framework of civic engagement that the SENCER approach to learning science offers, we also intend that ISE institutions will increase the interest of the general public in scientific issues that concern all citizens.