

## **Addressing *Broader Impacts* through Research Center - Science Museum Partnerships**

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### **ABSTRACT**

Education outreach partnerships between science and engineering research organizations and informal science education institutions (ISIs), such as science museums, can help research organizations to fulfill their “broader impacts” criteria as well as to advance their institutional interests in forging meaningful connections through the community. For the ISIs, such partnerships can help them serve their mission to public and school constituencies, providing more robust opportunities for increased engagement with current research. Because of the greater latitude for experimentation in ISI environments than typically found in formal education environments, these collaborative efforts can often produce innovative science education products and experiences that can also nourish and inform K-12 teaching practice and professional development. The NSF Nanoscale Informal Science Education Network is pursuing a strategy of fostering community-based partnerships between materials and nanoscale science and engineering research centers and ISIs in order encourage widespread collaborative development of effective science and engineering educational experiences for public and school audiences on an ongoing basis.

### **INTRODUCTION**

The National Science Foundation requires investigators to address the “broader impacts” of research on science, education, and society. NSF considers significant contributions in this area to include education and outreach activities designed to enhance scientific and technological understanding and to foster connections between research and service to society. Yet, organizations optimized for research and teaching often lack the expertise, tools, and resources for carrying out these activities, and lack connections to community-serving organizations and audiences intended for these kinds of engagements. It is for this reason that NSF offers the suggestion of partnering “with museums, nature centers, science centers, and similar institutions to develop exhibits in science, math, and engineering,” to “involve the public...in research and education activities,” and to provide “science and engineering presentations to the broader community.” [1] This sensible-sounding advice nonetheless offers little guidance to materials science and engineering researchers in the actual planning, design, implementation, and evaluation of effective educational outreach partnerships with informal science education institutions such as science museums.

NSF and other granting organizations have begun to support new efforts to provide guidance in this area; these include the NSF-funded *Portal to the Public* project, headquartered at the Pacific Science Center, the IMLS-funded *Volunteers Try Science* project headquartered at the New York Hall of Science, the AIP-funded *Workshop on University – Science Center*

*Partnerships*, headquartered at the Franklin Institute, and the *Research Center – Informal Science Education* partnership initiative (RISE) being pursued by the NSF *Nanoscale Informal Science Education Network* (NISE Net), headquartered at the Museum of Science, Boston. It is important to note that these efforts, while maintaining distinct agendas and areas of emphasis, are also attempting to cross-fertilize and collaborate with each other as much as possible; for example, the author is a Co-PI of the NISE Net, in charge of its RISE initiative, yet also keeps in close touch with and sometimes participates in development activities of the other initiatives. This paper, however, will focus on the specific objectives of the NISE Net's RISE initiative.

## BACKGROUND

In an unprecedented move, several NSF science and engineering directorates joined with the NSF informal science education program, contributing funding for a collaborative agreement supporting the development of a Nanoscale Informal Science Education Network (NISE Net) over a period of five years. Museums were encouraged to provide leadership for the Network, and a proposal from the Museum of Science, Boston - in partnership with the Exploratorium of San Francisco and the Science Museum of Minnesota - was funded beginning in the fall of 2005 [2]. NSF had written in the program announcement, "This effort is intended to foster public awareness and understanding of nanoscale science and engineering through the establishment of a Network, *a national infrastructure, that links science museums and other informal science education organizations with nanoscale science and engineering research organizations.*" [3] For the initial NISE Net proposal, the three science museums chose to invite the Materials Research Society to participate as a subawardee in the development of the NISE Net infrastructure, recognizing that the MRS includes among its leaders and members many investigators pursuing nanoscale materials science and engineering research.

The MRS is extremely proactive in education and public outreach and also has had extensive experience working with science museums, most notably with the Ontario Science Centre on the co-development of the very successful *Strange Matter* exhibit and website [4]. Over 1.8 million people have visited this exhibit in 25 science museums across the U.S., Canada, and Puerto Rico. Collateral student-teacher materials and a website extend its impact, and the MRS mobilizes its extensive network of volunteers to provide enriching face-to-face encounters between researchers and visitors at every science museum site. MRS has an extraordinarily large and diverse and dedicated corps of volunteers who are willing to join with museum staff in providing demonstrations and talks on a variety of materials science and engineering topics.

As a NISE Net subawardee, the MRS also has been active in contributing to the growth of the Network. The MRS NISE Net subcommittee, led by Jim DeYoreo, Richard Souza, Bob DeGroot, Greta Zenner and Eric Marshall, has done much to connect MRS volunteers with science museums in their communities. This partnering effort will become increasingly important as a greater number of science museums begin to use NISE Net-developed programs and exhibits, and as the date for the first annual NanoDays approaches: March 29 - April 6, 2008. NanoDays is an explicit attempt to spur at least short-term collaborative efforts between science museums and research centers; after this initial breakthrough, it is hoped that more ongoing collaborations and alliances will result.

The first two years of the NISE Net collaboration focused on several experimental ISE initiatives, including the development and production of exhibit, program, and media products

that could be duplicated and adapted at partnering science museums around the country. The Network also initiated capacity-building programs providing continuing education in nanoscale research and nano exhibit/program professional development for science museum staff, as well as training in inquiry-based education techniques to early-career researchers. However, as the NISE Network PI's began to plan for the second phase of work, for years three to five, they saw the need to place more attention on the implementation of a strategy for sustained Network growth through partnership-building and infrastructure development. Just as research and applications in nanoscale science and engineering will continue to develop at a rapid pace, so will the knowledge and practice of nano formal and informal science education, as well as the market for relevant and updated nano education products, programs, and services.

The NISE Net Research Center – Informal Science Education partnership initiative was launched to more directly serve the NSF agenda of linking “science museums and other informal science education organizations with nanoscale science and engineering research organizations,” [5], now on a more granular and regional basis, alongside the overall national research organization partnership forged with the MRS. Several examples of these regionally-based partnerships between research centers and science museums have already produced significant nano informal science education experiences. For example, a partnership between the Ithaca Science Center and the Cornell Nanobiotechnology Center produced two traveling exhibits, “It’s a Nanoworld, and “Too Small to See,” which proved entertaining enough to earn bookings at the Epcot Center. [6] A partnership between the Lawrence Hall of Science and the Center of Integrated Nanomechanical Systems headquartered at the University of California - Berkeley produced “Nanozone,” a popular exhibit and website. [7] A partnership between the Nanoscale Science and Engineering Center (NSEC) based at Northwestern University and the Chicago Museum of Science and Industry fostered the development of a nanotech area of the MSI’s new technology exhibit hall. Partnerships between the Museum of Science, Boston, and the NSF NSEC based at Harvard and the Center for High-rate Nanomanufacturing NSEC based at Northeastern University and the University of Massachusetts-Lowell have produced an exceedingly robust program of ongoing public presentations, demonstrations, cablecasts, podcasts, forums, and professional development workshops. [8]

Of key significance in some of these examples is that the museum partners’ informal science education efforts were supported through the research centers’ NSF research awards. In other words, the principal investigators formulating the proposals for these research centers chose to address NSF’s “broader impacts” criterion in part through strategic partnerships with science museums. All of these organizations are now involved in some capacity in the Nanoscale Informal Science Education Network, contributing their experience, the knowledge gained from their research and evaluation efforts, and their dissemination capacities to other research and ISE organizations involved in the NISE Net. Through the leveraging power of the Network, the “broader impacts” of these regional partnerships have become national in scope.

At this moment in time, the NISE Net is also developing new exhibits and programs and nano informal science education know-how, building on lessons learned from many of these prior efforts, and with direct NSF support. At some point, however, whether it be three years or eight years from now, direct NSF funding for NISE Net will necessarily sunset, leaving, we expect, an infrastructure in place for the continued sharing of knowledge, products, and techniques. A strategy for the continued development and growth of new knowledge, products and expertise is therefore required, as well as a legacy of bridge-building between the research community and the community at large, through the practice of forging effective research center

– informal science education partnership efforts, and continued networking of the resulting knowledge, experience, and dissemination models they develop. This is a sustainability plan and it is *the* focus of the NISE Net's RISE efforts.

## DISCUSSION

It is a common experience of those in the management ranks of science museums to receive last minute phone calls from researchers who must submit proposals within days to NSF or other funding agencies, and who have left to last the planning of their “broader impacts” or educational outreach activities. The investigators have realized that through science museums they can gain access to large audiences and diverse audiences, including families, students on field trips, and science attentive adults. They imagine that they can easily get their graduate students to design a small exhibit kiosk portraying their research efforts and they can send some researchers over to the museum to give talks. They mention these ideas to the museum manager and ask for a letter of support to include in their proposal. While apologetic for the short notice, they promise to work out the necessary details in the future, if and when the grant is awarded.

Such calls leave the science museum manager in a quandary. He or she is usually cognizant of the value to the museum and its audiences in partnering with nearby research centers, and quite eager to do so. However, the museum manager is also cognizant of the following: (1) The researcher is probably unaware of the actual cost, effort, and expertise involved in designing, testing, building, and hosting even a small museum exhibit that would be appropriate and effective in an informal science education setting, or, in curating, publicizing and hosting a series of talks or other programs; (2) The researcher probably assumes that the Museum has abundant staff time and resources to supply on its end of the deal; and (3) The researcher is unaware that, like most universities, the science museum has procedures in place for internal budgeting and vetting of partnership agreements and commitments of staff time and resources that require the manager receiving the call to shepherd the partnership offer and plan through varying levels of oversight.

As science museums have become more systematic and more professional in their practice of informal science education, incorporating visitor studies and iterative design and testing procedures through all stages of product and program testing, they have also become more wary about falling into the trap of agreeing to host an exhibit or program designed solely by researchers or graduate students with no prior training or experience in informal science education. An active collaboration with the researchers to design an effective public engagement experience is the desirable approach, but it takes time and money on the part of the museum. Except for the federally supported Smithsonian Institution, U.S. science museums rely mostly on entry ticket sales to fund their staff and operations, and on federal grants to fund major new exhibits, and they are often overstretched just to maintain their existing buildings and programs. It is of utmost concern to science museum managers to ensure that the visitor experience they provide, for a fee, is comfortable, enjoyable, and educational and that their offerings are of high quality and effectiveness in these demanding and varied environments.

Because the impact of a successful, well-planned and even modestly-budgeted educational outreach experience developed through partnerships between research center and informal science education institutions can be so beneficial for the institutional partners, their constituencies, and the ideal of a science-literate, science-engaged public, it is in all our interests

to promote the development of “best practices” in the area of effective partnerships. The NISE Net offers a guide, designed for researchers, called, “Bringing Nano to the Public: A Collaboration Opportunity for Researcher and Museums,” written by Wendy Crone of the University of Wisconsin at Madison Materials Research Science and Engineering Center and edited by Sue Koch of the Science Museum of Minnesota. This booklet provides an overview of informal science education and discusses various partnership models. [9]

In the next few years, the NISE Net RISE initiative will be making an effort to reach out to current and future investigators with suggestions for beginning partnership and education outreach planning discussions early in the grant proposal development process, before the budget has been fully allocated. RISE is also reaching out to a variety of large and small science museums, offering guidance and resources for building their capacity for working with nanoscale and materials science research partners to serve public, school, and professional audiences. Finally, RISE is offering to help broker appropriate partnerships between research centers and nearby science museums. Readers of this article interested in inquiring about these no cost consulting services are encouraged to contact the author or nisenet@mos.org. [10]

## CONCLUSIONS

The NISE Network’s research center – informal science education partnership fostering strategy (RISE) is based on the hypothesis that through the development of such ongoing partnerships, there will be a measurable increase in the combined impact of regionally-based nanoscale educational outreach and professional development efforts over the next several years. The results of the partnership fostering efforts will be tracked, and the impacts to be measured and assessed for correlation include numbers of people reached, growth in the development of public and professional programs incorporating nanoscale science and engineering education concepts, and growth in public awareness of nanoscale science and engineering, sampled locally. The assessment strategies for these efforts are being designed and implemented by Multimedia Research, Inc., and by Inverness Research Associates.

Although beyond the scope of this current plan, a further effort to track the potential “spillover effect” of the NISE Net’s efforts in forging closer nano research center – science museum ties, providing for effective public engagement with other important areas of current research, beyond nano, might prove quite useful.

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## REFERENCES

1. *NSF Merit Review Broader Impacts Criterion: Representative Activities*, published at <http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>
2. <http://www.nisenet.org>
3. NSF 05-0543 program solicitation.
4. <http://www.strangematterexhibit.com/>
5. NSF 05-0543 program solicitation.
6. <http://www.sciencenter.org/nano/>
7. <http://www.nanozone.org>
8. [www.mos.org/nano](http://www.mos.org/nano). Over the past six years, more than 40,000 people attended over 1,000 staff presentations and guest researcher events; between 9,000 and 19,000 New England households viewed each of the 50 nano “SciTech Today” cable TV segments; between 5,000 and 7,000 people downloaded some 30 nano podcasts; and 260 teachers attended the Museum’s yearly Nanotech Symposium for Educators.
9. W.C. Crone, *Bringing Nano to the Public: A Collaboration Opportunity for Researchers and Museums*, edited by S. E. Koch (NISE Network, 2006).
10. [nisenet@mos.org](mailto:nisenet@mos.org), [calpert@mos.org](mailto:calpert@mos.org)