NISE Network

Overview of the NISE Network Evaluation

Mark St. John
Jenifer V. Helms
Pam Castori
Judy Hirabayashi
Laurie Lopez
Michelle Phillips

With assistance from:
Mary Regan
Laurie Senauke

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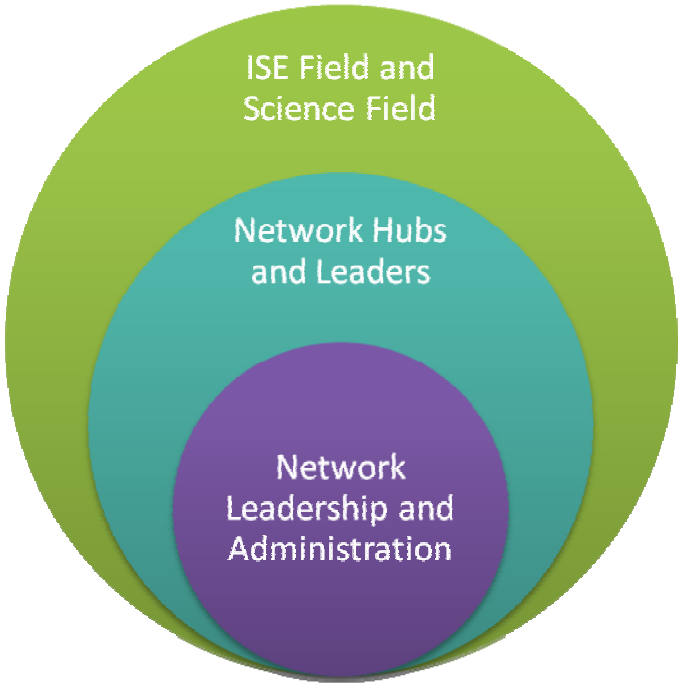
The documents enclosed in this report provide a comprehensive and systematic review of the progress made in developing a network organization capable of supporting nanoscience education for the public on a national scale.

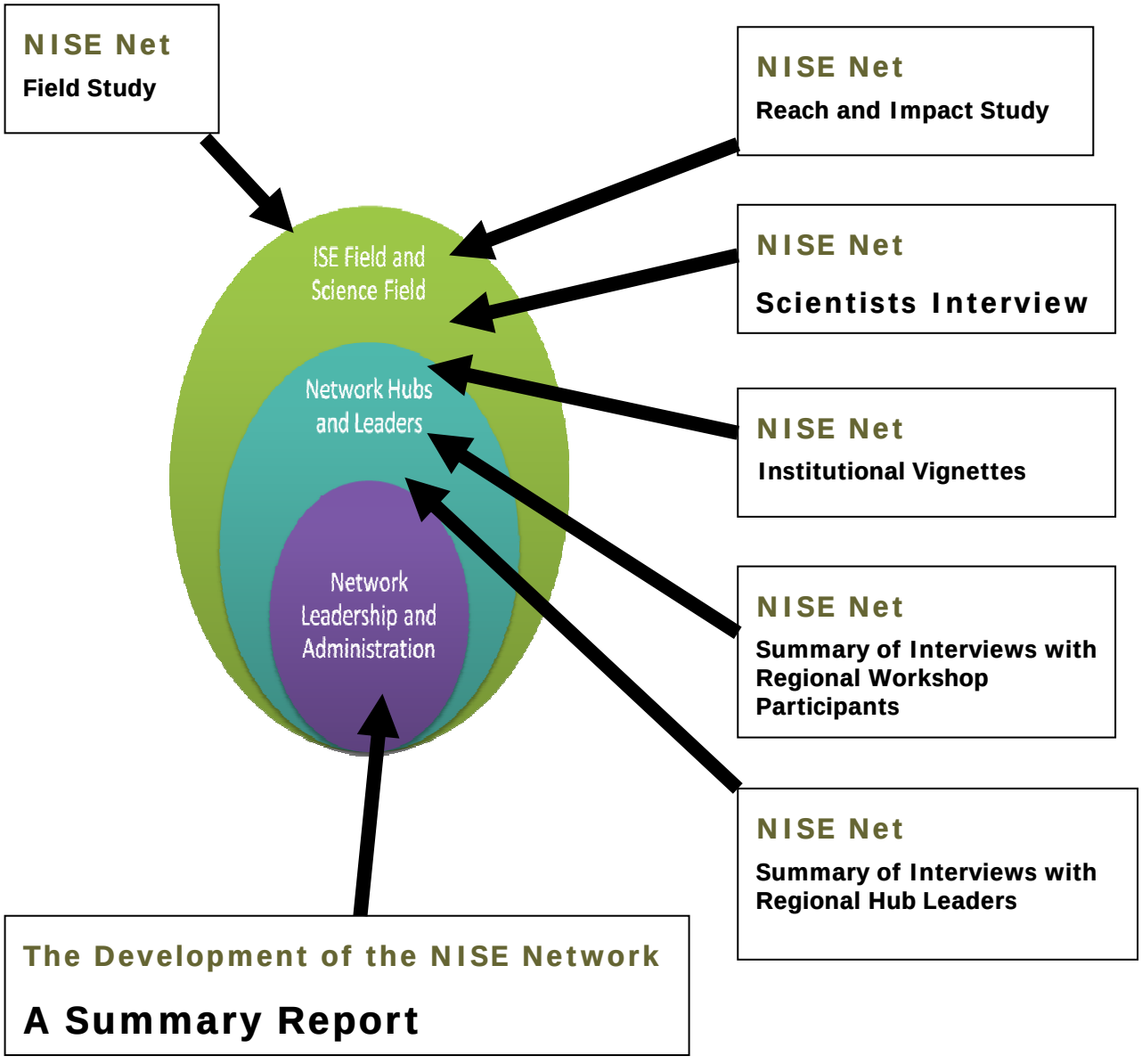
There is a logic to the studies that were done and to the reports that are included in this notebook. The diagram below highlights the dimensions of the network our evaluation addressed:



At the center and the heart of the network is the network organization with its leadership and administration. This network organization supports a set of "hubs" that connects to the more than one-hundred institutions that form the broader NISE Network membership. And, finally, the entirety of the NISE Network interfaces with the much broader fields of informal science education institutions and science research institutions.

The reports are similarly organized in this notebook, moving from the center outwards, to provide perspectives on the NISE Network.

The Inverness Studies of the NISE Network



NISE Network Evaluation

The reports that comprise the NISE Network evaluation are:

1) **The Development of the NISE Network - A Summary Report**

2) ***Supportive Reports***

   A) Interview Summary with Hub Leaders

   B) Summary of Interviews with Regional Workshop Participants

   C) Vignettes: Stories of Institutions Engaged with NISE Net

   D) Interview Study with Scientists

   E) Reach and Impact Study

   F) Field Study

The Development of the NISE Network

A Summary Report

May 2009

INVERNESS RESEARCH

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The Development of the NISE Network
A Summary Report

I. Introduction

Nanoscience[1] is an emerging scientific field, and therefore an increasing amount of funding is flowing into nanoscience and nanotechnology research, including money from the federal government[2]. Several studies of public understanding and public attitudes toward nanoscience have shown that most of the public is generally uninterested in and unmotivated to learn about nanoscale science and technology[3]. Because this emerging interdisciplinary field of science offers so much promise, and because it will have an increasing presence in everyday life, the NSF is committed to increasing public awareness and understanding of nanoscience: what it is, how it works, and the potential social and ethical implications for its development and use.

The challenge for NSF then is to find ways to invest relatively small amounts of funds to create mechanisms that effectively communicate with the public on a large scale about an abstract topic of current scientific research and development. Not only does NSF wish to communicate this science research on a timely basis, but they also would like to create an ongoing capacity for future communication of nanoscience as well, and perhaps, other areas of emergent science topics. NISE Net is an investment in building a large scale and continuing capacity for communicating with the public.

In addition to the NISE Net, the NSF has funded the National Center for Learning and Teaching in Nanoscale Science and Engineering (NCLT), The Power of Small project, and various museum exhibitions on nanoscience, among others. These efforts are collectively intended to build awareness and contribute to a national infrastructure for nanoscience education.

The NISE Network was funded with the intention of being an ongoing mechanism for educating the public at a national scale. *The approach of NISE Net is to connect the scientific*

[1] The term nanoscience throughout this report is meant to refer to the wide range of activities that span the spectrum from basic science research to nanotechnology applications.
[2] An estimate for the 2009 National Nanotechnology Initiative investment is $1.5 billion, up from $1.4 billion in 2007.
[3] For example, see Front-End research report commissioned by NISE Net http://www.nisenet.org/sites/default/files_static/evaluation/NISEFrtEndPart1Text.pdf

research community with the nation's informal science education institutions for the purpose of developing expertise and resources that can address the challenge of communicating with the public on a very large scale.

Network theory

NSF made the strategic decision to invest in a national network of institutions and individuals. As stated in the request for proposals:

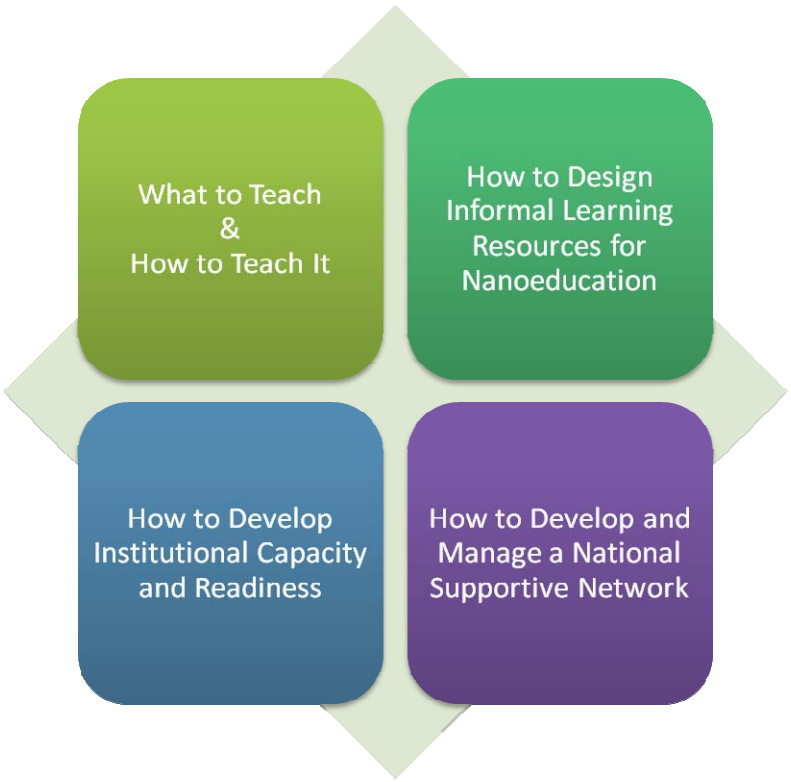
> *This effort is intended to foster public awareness, engagement, and understanding of nanoscale science, engineering, and technology through establishment of a Network, a national infrastructure that links science museums and other informal science education organizations with nanoscale science and engineering research organizations.*

NSF viewed a network as a way to create synergy among different efforts, and to create capacity through connectedness. A network, guided by a strong central network organization, could create a functional interconnection of educational assets that are mutually reinforcing and aligned around a shared mission: bringing awareness and excitement about nanoscience to the public.

The scale and nature of NISE Net reflects an investment (vs. expenditure) that goes to building a network and capacities of institutions that is ongoing and will bring future returns.

The Challenges NISE Net Has Faced

As noted, NISE Net represents one of several national strategies that are working within this problem space and its associated challenges. Even though NISE Net is not the only strategy, it is attempting to address many challenges simultaneously; thus it is undertaking a complex and difficult effort! The graphic below depicts our formulation of the four key contextual challenges that NISE Net has had to address simultaneously:



1) **The content and pedagogy of Nanoscience education is emerging; consequently, NISE Net has been challenged with determining what is important to teach about nanoscience, and how to teach it**. This is not a domain of science education with a lot of history: It is not even clear what is included or not included in the domain of nanoscience and nanotechnology. There are emerging constructs but no real clarity about what the "big ideas" of nanoscience are. There is little known about people's ability to understand the scales or complexities involved. There is no known and tested "pedagogy" for teaching nanoscience to the public. NISE Net had to learn firsthand how to do nanoscience education for the public. It had to figure out approaches, pedagogies, and supports that are effective in the informal science education domain. It needed to determine what can be taught and how it should be taught in free-choice learning environments.

2) Based on decisions about what to teach and how, NISE Net has also had to **design and develop high quality informal learning resources** for others to use. Unlike teaching some topics in physics or earth science, the ISE field does not have decades of experience in developing exhibits, programs and media in the domain of nanoscience. There are some earlier efforts, but there is not a large extant base of exhibits, programs, films etc. to learn from and to use as a basis for next designs. The topic of nanoscience is relatively new and the "curriculum" for teaching it largely undeveloped. Hence NISE Net had to find ways to design new exhibits,

programs, media, etc. These designs not only have to communicate clearly to the public, but they also have to be attractive and feasible to the ISE and research communities.

3) At the ISE institutional level, there is little expertise, experience and incentive to do nanoscience education for the public. In other words, NISE Net was starting from scratch, essentially, in **developing institutional capacity and readiness to implement nanoscience education**. Neither science museums nor science research institutions have all the requisite capacities (leadership, knowledge, resources, tools) to carry out high quality nanoscience education. Also, they currently find little incentive to develop such capacity, as it is not clear that their audiences have a driving interest in the topic. Hence, NISE Net faced the challenge of building capacity in a field for a task where there is little initial interest and motivation.

4) At what might be called the level of the "ISE field," there is **limited experience in developing and operating a national supportive network**. A network of this scale and scope is virtually unknown in the ISE field. NISE Net was charged with putting in place a national network of science museums while simultaneously engaging in the hard work of figuring out the content and developing the curriculum. The challenges of creating an administrative structure, governance processes, and communication systems for NISE Net have been significant. There were no existing structures or any analogs available for reference. Not only did NISE Net have to create a network rich in working relationships but also had to form an organizational governance system capable of growing and guiding the Network.

NISE Net is essentially a "push" initiative in that it was not created out of grassroots demand for more nanoscience education resources. In the past four years NISE Net has worked hard to organize and galvanize the field around nanoscience education, build the capacity of the field to offer nanoscience education to their audiences, create resources that can engage the field and their public, and keep the institutions connected with new ideas, support, and encouragement.

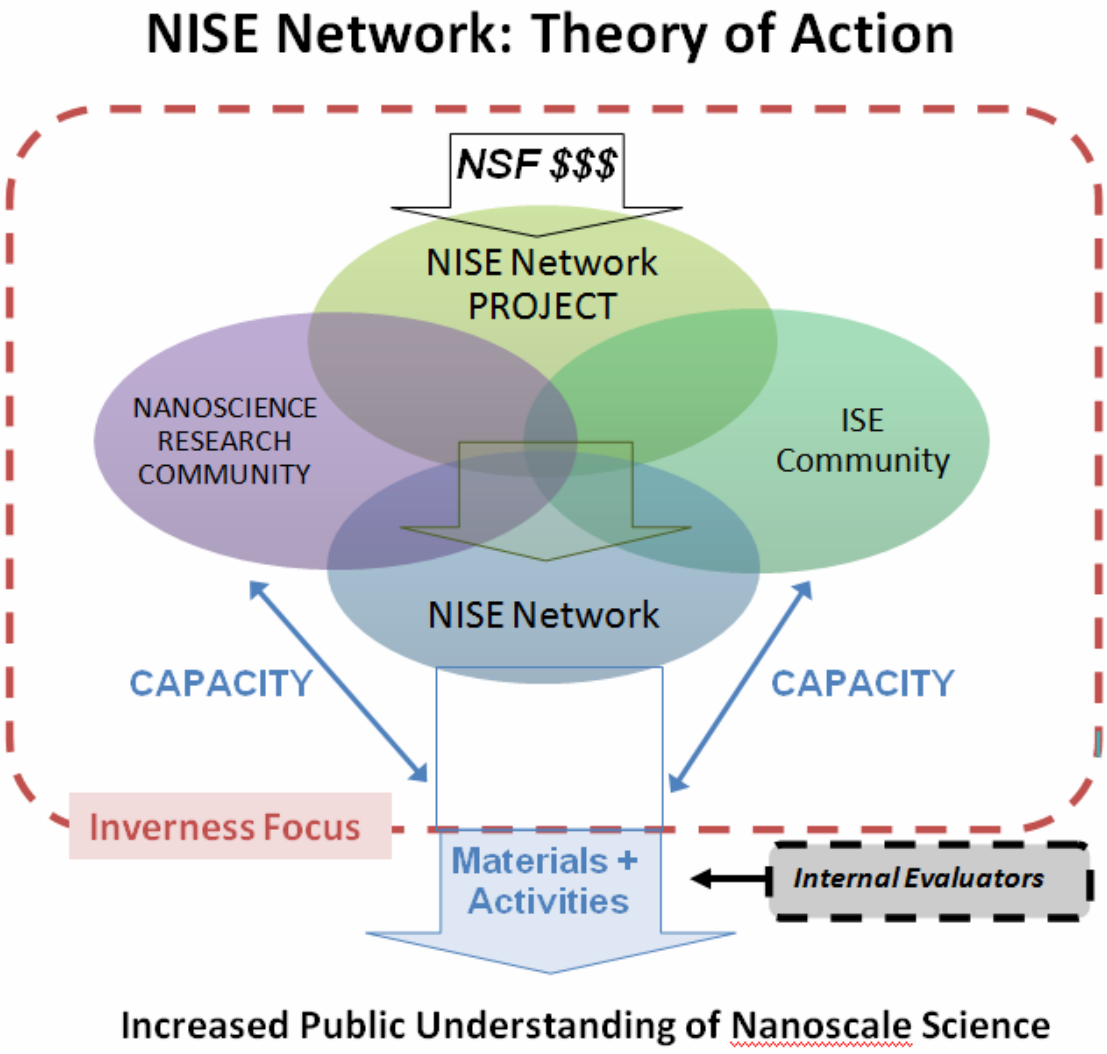
With NSF's theory of investment and the challenges facing NISE Net in mind, we describe next our approach to network evaluation.

The evaluation design

The approach of Inverness Research for any evaluation is to study the theory of action of the investment. Our interpretation of the NISE Net theory of action can be summarized as follows:

to create a network of institutions (ISEs, research centers, professional organizations, universities, others) and individuals (researchers, artists, others) to build capacity and support the field to provide more and better nanoscience education for the public on a national scale

This summary statement provides the starting point for our evaluation design and foci. The diagram below helps illustrate the NISE Net Theory of Action:



Our mandate within the larger evaluation plan was to focus on the development of the network and to document the ways in which the network built capacity in the individuals and institutions involved. It was not our mandate to study the quality and value of the resources, or the impact on the public. Nor did we directly study the quality and value of the professional development activities (e.g., the NEO program, the annual meetings, or the regional workshops) These evaluation tasks were carried out by the internal evaluators

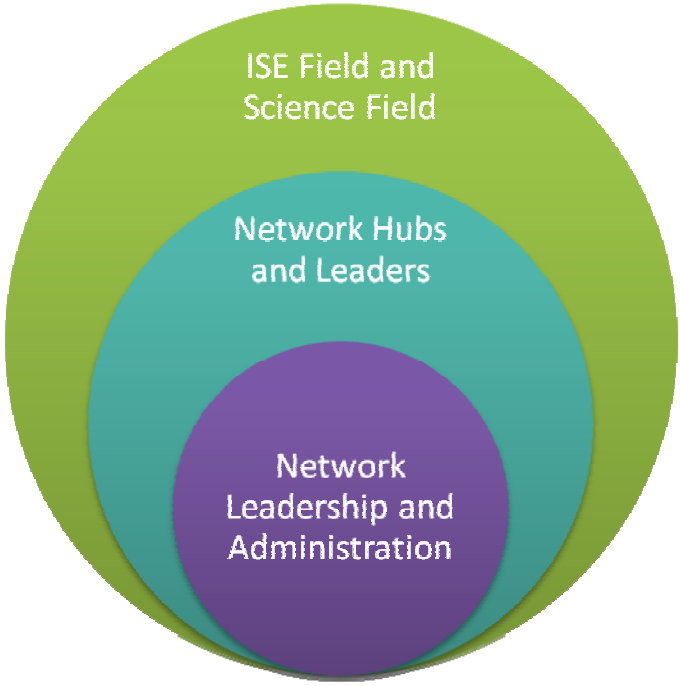
and, initially, by Barbara Flagg and her staff. This report, then, provides multiple perspectives on the progress of the network and its potential for doing future work.

Our evaluation seeks to document this aspect of the overall return on the NSF investment. We are focusing on the building of a network organization, and the related relationships, knowledge, and capacities that are assembled and which can provide a strong platform for providing ongoing nanoscience education for public audiences. In other words, we are assessing the degree to which and the ways in which NISE Net has created a strong foundation for doing future work.

II. The Organization of this Report

Following loosely the structure and theory of the NISE Network, this report provides feedback from a range of participants. We also include our own insights as the external evaluators of the Network.

The diagram below highlights the dimensions of the network our evaluation addressed:



Network leaders and network administration serve to support the coordination of the project and the internal management and growth of the network. Network growth is in turn managed and supported by a regional "hub" structure and hub leaders. These regional hubs and leaders interface with the field—informal science centers, scientists, and others.

Our work has examined the work and perspectives of participants in each of these spheres. We have looked at and received feedback on the management structure and administration

of the network. We have multiple studies of the hub structure and how it is perceived by hub leaders and workshop participants. In terms of the field we have multiple studies of the museums, and individual educators and scientists who have engaged with the NISE Net. Finally, we have monitored an anonymous sample of museums in the field to determine the extent to which they have become knowledgeable of and engaged with the NISE Net in the past three years. This report, therefore, is organized by the following sections:

A. **Developing a Network Organization: The Leadership and Administration of NISE Net**. This section examines the evolution of NISE Net's leadership strategy and administrative structures.

B. **Developing Strategies and Structures to Grow the Network and Support Nanoscience Education on a Broad Scale**. This section describes and assesses the Network's theory of expansion and growth, focusing on the recent development of the "hub" structure and associated activities (workshops) In addition, key centralized events—like NanoDays and the Annual meeting—are highlighted.

C. **Engaging the Museum and Science Research Fields**. In this section, we examine the extent and ways NISE Net has been successful in reaching the ISE field and nanoscience researchers and outreach specialists.

D. We conclude with a **Summary of Findings and Implications for the Future**.

A. Developing a Network Organization: Leadership and Administration of NISE Net

Creating a Network Organization: What This Is And Why It Is Important

Over the last four years, NISE Net has evolved a management and administrative structure that involves several layers of overlapping leadership groups. The Network Executive Group consists of the three co-PIs Larry Bell, Paul Martin, and Rob Semper. This group meets on an as-needed basis. Next in terms of leadership and decision-making power is the PI+ Group. This group was established in the second year and has now grown to include representatives of the core institutions as well as the North Carolina Museum of Life and Science (NCMLS), Sciencenter, and Inverness Research. The PI+ group meets weekly on the telephone, and largely functions to share information, coordinate cross-network activities, and discuss current pressing work and future opportunities. Some meetings are devoted to allowing each group represented on the call to provide a five to ten minute update on their current work and to receive feedback from the group.

The Sub-awardee Group includes the PI+ group and the other sub-awardees on the grant, which would include anyone leading a piece of NISE Net work at their institution (there are currently 58 individuals on the sub-awardee listserv representing 16 different organizations or institutions). The entire Subarwardee Group meets once each month via conference call, and a smaller representation of this group meets annually face-to-face. The conference calls invariably involve spending a brief amount of time discussing each sub-awardee's current work and issues.

Other groups that lead and manage key dimensions of NISE Net work include the Diversity, Equity and Access (DEA) group, led by MOS; the NISE Net Community (formerly the network expansion group), led by Sciencenter; Evaluation, led by MOS; Programs, led by Sciencenter; Exhibits, led by SMM; Forums led by NCMLS; and nisenet.org, led by the Exploratorium.

In 2008, a hub structure was developed whereby leaders of ISE institutions in regions around the country are responsible for network activities in that region. Some of the members of this hub group are also members of the PI+ group. All of the hub leading institutions are sub-awardees of the NISE Net grant.

Over the years, the NISE Net management structure has evolved from a structure of "strands" of work based at individual institutions to cross-network multi-institutional working groups. A growing and distributed leadership structure was necessary to accommodate a growing and distributed network. The network is evolving and fluid; hence, it is less and less depending on heavy central management and more and more depending upon distributed leadership and provides considerable autonomy for each working group.

Evaluation of the Administration and Management Structure

In 2008, prior to the hub structure, Inverness Research conducted a survey of 40 NISE Net leaders. The survey was sent to people who were, at that time, assuming considerable responsibility for network activities both at their institutions and with the network writ large. Thirty people responded for a return rate of 75%.

While we acknowledge that the survey data are now one year old, we believe the majority of these findings are still relevant, based on subsequent data collection and analysis.

With respect to the administration and management of NISE Net[4], the 2008 survey concluded that the leaders at that time generally felt positive about the network's development. A large majority (93%[5]) said that the core institutions provided a strong nucleus for growth, and about 4 in 5 saw good progress in reaching out to others in the field. Overall, leaders felt quite positive and optimistic about the potential of NISE Net to impact the field.

However, the news at that time was not all positive. Almost half of our survey respondents said that there is mixed evidence as to whether members of the network shared a vision of the identity, purpose and work of the network, and slightly more than half had some concerns about the strength of the administrative team. Areas for future development for NISE Net include generating more opportunities to participate and interact with the network (which may well be addressed by the recent development of the hub structure), overcoming some initial skepticism and perceptions of hierarchy within the network, and the network's ability to identify critical issues, problems, and emerging needs.

In terms of capacity to lead nanoscience education work at their institutions, we learned the following:

- **NISE Net has positively contributed to the individual professional capacity of its leaders**. A large majority (90%) of NISE Net leaders find value in belonging to the network. 83% say that it has made a major contribution to their own capacity to assume increased responsibility for nanoscience education at their institutions, and 77% say NISE Net has contributed to their interest in doing so. Further, nearly all NISE Net leaders feel most confident in explaining the work of NISE Net to others in the field (93%), and say overwhelmingly that NISE Net has contributed to

[4] The survey focused on NISE's impact on individual and institutional capacity to develop and deliver nanoscience education to their public audiences, in addition to reflections about the management and structure of the network.

[5] Unless otherwise noted, percentages cited in this document are based on those who responded to the question and reflect the percentage that marked "agree" or "strongly agree."

that ability. Additionally, about three-quarters of the group say that they feel confident advocating for nanoscience-related work at their home institution, and that NISE Net has contributed to their ability to do so.

- **NISE Net has developed and provided multiple professional development experiences for participants across the network that have resulted in real products**. The tenet: "Build the network by doing work together" has played out very strongly in these experiences. For example, the mode of operation within the exhibits and programs strand as well as the forum strand has been collaborative development and critique of products; an iterative learning and working process. This strategy has resulted in a suite of products that have been carefully reviewed and evaluated by both the partners and the public, and that include guiding materials for potential users who may have multiple or different purposes and contexts for their use.

- **NISE Net has provided valuable, varied, and multiple opportunities for professional development and networking among leaders in the ISE field and scientists from research institutions.** NISE Net leaders report that the main incentives to and benefits of being involved in the network are related to the opportunities for professional development and to make new and stronger connections with others in their home institutions and in the field.

- **NISE Net is committed to sharing the knowledge and products they have developed with the field through a variety of professional development offerings in various venues.** These offerings take advantage of other networks and their systems for dissemination and education. The lessons learned from this workshop are now being incorporated into future NISE workshops.

- **There are cases of individuals who, after participating in several NISE Net activities and experiences, have taken on more responsibility with network leadership and in their home institution's efforts to incorporate nanoscience**. The survey of NISE Net Leaders/Partners revealed that the majority have markedly increased their involvement in the network since the beginning. Some of these people have become "go to" individuals within the network and their institutions.

- **NISE Net has contributed to the growth in institutional capacity to deliver informal nanoscience education**. Most NISE Net leaders report that their institutions have substantial capacities related to nanoscience (e.g., strong leadership for nanoscience (83%), greater ability to incorporate nanoscience (83%), commitment to nanoscience (70%), and nanoscience seen as important area of focus (60%)) and that NISE Net has contributed to those capacities.

- **NISE Net partner institutions have incorporated nanoscience education within their own institutions**. Nearly all NISE Net leaders report that their institutions have mounted new programs (90%) related to nanoscience. 67% have created new exhibits, and 73% have added new or revised forums related to nanoscience.

- **NISE Net has facilitated the creation of new or increased institutional relationships/partnerships across the informal field and between the informal field and science research institutions**. According to the leaders survey:

Relationships	
Increased relationships with nanoscience researchers	90%
New relationships with informal science institutions	87%
Increased connections with nanoscience research institutions	87%
Other (e.g., science education advocacy groups)	13%

Today, the PI+ group and hub leaders carry the major responsibility for expanding and running the network, distributing its resources and engaging people in events and meetings. The leaders of these hubs provide support for nanoscience education at their own institutions, as well as institutions in the region that respond to their outreach efforts. (More about the hub strategy and leaders is below.)

Summary of Progress to Date

NISE Net has come a long way in developing and honing a network organization and administrative structure that is both functional and flexible, adapting to the changing landscape of the work itself. In our study of the network since this survey was administered, we have seen great progress in some areas—such as reaching out to the field in a systematic and shared way—while other areas that held promise for organizing and managing the work—like nisenet.org, discussed below—have not kept pace with the needs of the network. Overall, the NISE Net management has responded to critics and learned from itself. The network organization appears capable of coordinating the work of the network, supporting future growth, and providing strategic direction for the network as a whole.

B. Developing Strategies and Structures to Grow the Network and Support Nanoscience Education on a Broad Scale

Growing the Network and Working at a National Scale: Two Major Strategies - Hubs and Network-Wide Activities

As the NISE Network sought to grow itself, it needed to find a way to connect new informal science education and research institutions to the network without all the communication and work coming through a single central node in the network. NISE Net needed to develop a structure that could keep hundreds of museums and dozens of research institutions connect to the network in an effective and efficient manner. The Network has now developed a system of regional or geographic "hubs" (formerly called "nodes") as a strategy and as an infrastructure for expanding the number of its partners and the reach of its impact and work. In addition, NISE Net has developed network-wide activities that draw in a larger, even international audience. Each of these approaches is discussed below.

A) The regional hubs as a strategy to expand the network

In 2008, NISE Net developed 7 regional community hubs as a strategy to expand the network.

(In addition there are three audience-focused hubs that focus on children's museums, international audiences, and ASTC members.) These hub institutions (and their associated leaders) are responsible for reaching out to institutions in their region (or topical area) and (for some) hosting regional events to draw in and support other institutions.

Because the development of regional hubs is a major strategy for supporting and growing the NISE Network, Inverness interviewed the leader of 8 of the hubs (the 7 regional hubs and 1 of the audience-focused hubs) to get a better sense of the leaders' reflections and assessments of the promise of the hub strategy for building the network.

Building the capacity of the hub leaders

Hub leaders describe being supported by each other and by the leading institutions in the Network. In addition to weekly meetings, hub leaders share ideas and resources with one another on an ongoing basis, and some specialize in areas (such as hosting public forums) enabling them to offer tools and knowledge to other hub leaders. The hub leaders also described how the leading NISE Net institutions have stepped in to provide support in helping them to design and implement regional meetings.

Perhaps most importantly, the hub strategy is providing multiple ways for museums to connect to and work with the NISE Network. It is a highly effective way for a large network led by three large urban institutions to reach out to additional partners across the country, including smaller, lesser-known, rural partners. It increases the diversity of

institutions and perspectives involved in the work of the Network and allows for more equitable participatory structures for many institutions and individuals. The personal connections, face-to-face contact and relatively easy access to NISE Net Resources that are available through the hub strategy have been key to recruiting and maintaining support for new partner members.

The work and contributions of the hubs

The relationships that formed between individuals and institutions during the first two years of the network were critical in laying the groundwork for identifying future hub leaders. Our interviewees reported that they believed the current set of hub leaders were well suited for and up to the challenges of the work. They were good choices because of their prior experiences partnering in developing other topic areas, or because of their previous experience doing nanoscience education programming and exhibit development. The hub leaders serve primarily as liaisons between the members in their region and the national Network but they also serve as an important mechanism for getting feedback to the leading institutions in the NISE Network. Hub leaders bring different strengths to the network, and some hub leaders play highly specialized roles from which other hubs can benefit (e.g., work with smaller museums, work with diverse audiences, etc.)

The hub leaders we spoke with shared their perceptions regarding the value of the hub system as a strategy for expanding the NISE Network. Most often mentioned was the value of providing museums a personal connection to the vast numbers of individuals and institutions involved in the Network. Part of this personal connection comes in the form of the relationship with the hub leader, but it also derives from the face-to-face contact that takes place in the regional hub meetings. Interviewees also confirmed that the hub structure has helped to establish more equity across diverse institutions by providing resources to museums that might not otherwise have access to such support. The distributed leadership that is an inherent part of the hub structure has strengthened the robustness of the overall network—the future of the network is less dependent now on the continuing presence of a few key individuals and institutions.

Regional workshops as a major outreach strategy of the hubs

The first and major activity of each hub was to conduct a multi-day regional workshop that would introduce nanoscience and NISE Net to the institutions that were invited to the workshop. Each invited institution was also encouraged to participate in NanoDays and order a NanoDays activity kit from NISE Net. Prior to leaving the workshop, each institution was required to draft a plan for how they might attempt to incorporate nanoscience education into their exhibits and programs.

To date, 7 regional workshops have been held at the 7 regional hubs. In 2008, 4 workshops were held at 4 hubs, and in early 2009, 3 more workshops were held at 3 additional hubs, serving a total of approximately 73 individuals from approximately 58 different

institutions[6]. The internal evaluator at the Science Museum of Minnesota conducted evaluations of each workshop based on the goals of the workshops. She concluded that the 2008 workshops strengthened participants' relationship with the NISE Network and its staff, and provided valuable opportunities for networking and building relationships with other institutions. Further, the workshops provided an opportunity to build the foundation of regional collaborations to carry out nanoscience education programming. The workshops also influenced participants' desires to interact more with researchers and scientists, as well as their comfort level in creating these relationships.

Finally, the workshops helped participants become more comfortable with the content. After the workshop, participants reported that they felt more comfortable answering visitors' questions about nanoscience.

Participant Interviews

In addition to the internal evaluation report, IR conducted 31 telephone interviews with participants of the 2008 workshops.[7] The purpose of these interviews was not to evaluate the workshops, but to gauge the extent and ways NISE Net has increased their interest in and capacity to implement nanoscience education in their institutions.

Map of Regional Workshop Interview Sites:

[6] The network administration reports a total of 93 institutions are associated with the regional hubs.

[7] A more detailed report of these interviews is provided in the separate report "NISE Net: Scientist Interviews."

A summary of findings is provided in what follows:

- In general, the participants in the regional workshops we interviewed reported that NISE Net had made significant contributions to their individual capacity and practice vis-à-vis nanoscience education, that they feel connected to a community of other interested people through the network, and that the professional development in which they participated was implemented and designed well. Further, a large majority (87%) say the exhibits, programs, forums, and web materials (kits) are designed well and seem useful.

- When we looked at NISE Net's contributions to participants' institutions to date, we found that three fourths of the participants (74%) we interviewed said their institutions are currently interested in and committed to nanoscience education and are incorporating nanoscience in their programs and exhibits. Eighty percent of the institutions are committed to participating in NISE Net specifically.

- Our interviewees are universally confident that their institutions are now better able to incorporate nanoscience education than they were three years ago. The great majority (83%) also agree that their institutions are more interested in incorporating nanoscience education than they were three years ago.

- All of the workshop participants we talked with said they expect NISE Net to continue supporting their efforts to do nanoscience education in the future, and almost all (94%) expect to contribute to the network in the future.

- They all agree that NISE Net is making a significant contribution to the strength and quality of leadership for nanoscience education in the ISE community. The strength of their agreement is made even cleared by looking at the highest rating ("strongly agree," 5 on a 5 point scale), where we see that the very strongest ratings were given to: 1) their interest in continuing to work with NISE Net (77% agree strongly), 2) assessment of the quality of NISE Net events (66%), and 3) the judgment that NISE Net is making a significant contribution to nanoscience education (63%).

- We asked each participant to offer any additional comments about how NISE Net could better support their efforts to offer nanoscience education. A large number of those participants who answered this question raised the issue of the need for materials that could be adapted for special audiences. Other comments reflected issues related to a call for a better flow of information and communication, and the desire for more materials to be developed and disseminated.

- NISE Net has been more successful in facilitating institutions' connections with other informal science institutions than in facilitating connections with scientists/researchers (81% and 55%, respectively, agree that NISE Net has helped facilitate these connections)

- As with the questions about individual capacity and practice, we also invited interviewees to offer any comments about ways NISE Net could better support their institution in cultivating or developing new and deeper relationships related to nanoscience education. Comments here were quite diverse, but notably there were several comments about the desire for NISE Net to assist in "match-making" with other ISEs or scientists/universities. There were also several comments about the desire for more and/or frequent face-to-face meetings.

So far, the workshops are the major activity of the regional hubs. Overall, the hub strategy for expanding the network appears to be working well and should be able to provide a foundation for expanding the network and disseminating its products and services.

B) The Use of Centralized Support and Cross-Network Events to Support the Work

NanoDays

In addition to the local hubs, NISE Net has created events that are open to institutions across the nation. One key event is NanoDays—a week in the early spring when NISE Net encourages institutions and individuals to draw on NISE Net and other resources to engage their public audiences in nanoscience education activities. Our surveys of workshop participants, institutions in the field, and scientists suggest that the NanoDays kits developed by NISE Net are of high quality, valuable and useful. For those in the PI+, sub-awardee, and hub groups, NanoDays is a way to organize, focus and catalyze their local activities and programs. For many institutions new to nanoscience education, NanoDays serves as the "gateway" activity to further interaction with the NISE Net.

Annual Meetings and Other Events

In addition to NanoDays, NISE Net has also offered three NISE Net Annual Meetings of the larger NISE Net community and other invited guests, held in the San Francisco Bay Area. (Another meeting is scheduled for the Fall of 2009)

NISE Net Annual Meetings are one of several critical components in the NISE Network designed for: 1) making and strengthening connections and finding opportunities for collaboration, especially between researchers and informal science educators; 2) advancing the core work of the Network and capturing/disseminating critical knowledge across different kinds of work and different fields; and 3) supporting the building of the larger Network through a national, very high-visibility professional outreach effort. The Annual Meeting also provides the only opportunity where the diverse constituents of the NISE Network community can come together in-person at one time.

The evaluations of these meetings, conducted by the Exploratorium suggest that the annual meetings allow for important cross-pollination and the sharing of different disciplines and perspectives. The annual meetings, the internal evaluation have helped strengthen the networking of people and institutions. In addition to hosting its own annual meeting NISE Net leaders have also conducted workshops at ASTC and the MRS meetings in Boston and San Francisco. NISE Net core leaders have made presentations at numerous other meetings and venues.

Summary of Progress to Date

In summary, the strategies and structures created by NISE Net to support and grow the network have evolved and continue to be refined. The move away from institution-based structures to cross-network structures has strengthened the overall fabric of the network. The hub structure and hub leaders have been effective in drawing in interested individuals and institutions and are providing important support for their efforts in nanoscience education. The cross-network activities—particularly NanoDays and the Annual Meetings—have proven to be catalyzing and energizing opportunities for network-wide growth and learning.

C. The Reach and Impact of NISE Net

INTRODUCTION

As mentioned previously, NISE Net set itself the goal of "getting nano in 100 places." In the past three years, the development of hubs, the regional workshops, the implementation of NanoDays, and meetings at ASTC and MRS have all served to build the network—with the result that hundreds of institutions have engaged with the NISE Net.

To study the nature, depth and significance of the interactions of NISE Net with these institutions we conducted four complementary studies of museums and science research organizations:

NISE Net Field Study. In 2006, IR identified 17 ISE institutions across the country unknown to NISE Net ("blind") that would help us track the penetration of nanoscience education and NISE Net into the field over the course of the next three years.

Reach and Impact Study. For another look at the field, IR sent an invitation to the all-inclusive8 NISE Net database to complete a very brief on-line survey about the reach and impact of NISE Net.

Scientist Study. To understand the extent and ways NISE Net had been able to engage scientists or researchers in the Network, we interviewed 21 scientists identified by the NISE Net leadership as being engaged on some level with the Network. We also included scientists in our Reach and Impact survey, and analyzed their answers separately from the rest of the respondents to get a sense of the perspectives of scientists with perhaps a more casual connection to NISE Net.

Vignettes. To understand in greater detail how informal education institutions connect to, interact with, and benefit from NISE Net, we conducted in-depth interviews with staff at 6 ISE institutions which resulted in 'vignettes' or cases.

Key findings from each of these studies are summarized below.

A) The NISE Net Field Study: A "Blind" Study of Changes in the Field Over Time

Introduction

In this section we summarize the major findings from a more complete report, NISE Net Field Study.

In 2006 Inverness Research initiated a multi-year "NISE Net Field Study" to gauge the extent to which and ways in which the NISE Network is able to reach into the ISE field and to track changes in the interests and capacities of the field with respect to nanoscience education during the life of the NISE Net project. Our approach was to select and recruit a set of institutions around the start of the NISE Net initiative and then track them to see if and how they interacted with the NISE Net over time.

The first round of data gathering in 2006 served as a baseline study at the beginning stage of the NISE Net work. We were interested in ISEs' general knowledge of nanoscience and nanoscience education efforts; their interest in bringing nanoscience to their programming; ideas about what they would need to bring nanoscience education into the work of their institutions, and their familiarity and engagement with the NISE Network.

[8] At the time we were administering the survey, the NISE group responsible for expansion of the network was in the process of merging several databases. We received what we were told was the most accurate and complete database possible at that time.

Map of Field Study Sites:

Positive shifts toward nanoscience education

Over the course of the three years, familiarity or interaction with NISE Net among our sample grew significantly. Almost all of the institutions were familiar with NISE Net by 2009 compared with less than a third in 2006. By 2009, only two of the fourteen sites had not heard of the NISE Net. Eight of the 14 institutions in 2009 (57%) had had some level of interaction with NISE Net[9]. In 2006, only 4 of the 17 (24%) sites had had contact with NISE Net. Of those that have not had any interaction, the majority indicate they are interested in being involved.

There was a significant increase in the number of institutions that offered (and were planning to offer) nanoscience exhibits and programs over the course of the three years. The percentage of Field Study institutions that have never had exhibits or programs related to nanoscale science/technology was halved over the three years, from 59% that had never had exhibits or programs in 2006 to 31% in 2009. Over the three years, *programs* about nanoscience spread more rapidly than *exhibits* about nanoscience. The percentage of institutions having possible or definite plans for a nanoscale exhibit or program rose from 30% in 2006 to 50% in 2009. The rest are interested in having exhibits or programs, but have no plans.

Nanoscience education is increasingly seen as feasible and consistent with the missions of these institutions. We found a 24% decrease in reporting that Nanoscience

[9] We also discovered that there were 8 Field Study sites that were also included among the respondents for the Reach and Impact survey, names provided by the NISE Net as sites that had been engaged with the work of the network.

was not consistent with their mission. We also found a 25% decrease in the percentage of institutions reporting that they had not even considered nanoscale science and technology (from 53% in 2006 to 28% in 2009) **The perceived barriers to offering nanoscience in these institutions are also lessening.** The percentage of institutions that said that they lacked the expertise to mount nanoscience exhibits or programs fell from 41% to 21%.

Most field study respondents who have had contact with NISE Net report that they have benefited from the interaction. A majority say that their involvement in NISE Net helped them understand something new about nanotechnology (72% agree to a great or very great extent) and that they have gained important new relationships with others as a result of NISE Net (54% agree to a great or very great extent). Further, in 2009, two-thirds of these field sites judged NISE Net to be effective or very effective in connecting nanoscience research and the public.

Very little shift or neutral findings

We saw virtually no change in the overall level of interest in nanoscience education. The overall interest remained quite high over the three years, with about 75% reporting great or considerable interest and the rest having some interest.

There was almost no change in either the roles that scientists play at the Field Study institutions or the types of affiliations of involved scientists over the course of our study. Our average Field Study institution engages the set of scientists with whom it has relationships in four roles. The most frequent roles played by scientists did not shift, with nearly all institutions having them provide expertise for exhibit or program development (true for 93% of the institutions) and public programs (86%)

Areas of concern or challenge for nanoscience education

Not surprising, the most common barrier to hosting nanoscale exhibits and programs is budgetary issues and constraints (a barrier for 85% of the institutions) Another barrier is having alternative higher priorities. Finally, there is a perception in some institutions that nanoscience is not likely to be of interest to their audience. (In fact, **s**ome institutions are seeing less interest by their audiences now than three years ago; In 2006 18% said nanoscience would probably not be of interest to their audiences, and in 2009, the percentage rose to 36%.)

About half of the institutions said that in order to bring nanoscience education into their museum, they would most likely contract for a traveling exhibit if the size and fee were right. Another quarter was not sure how much they would create in-house and how much they would augment with outside sources. The rest say that they would most likely create an exhibit entirely in-house or augment in-house resources with outside resources.

Summary of Field Study findings

What these field study sites tell us is that over the course of the last three years, the NISE Net has established a presence, made itself known, and engaged ISEs who had little or no knowledge of the network prior to the study. The reach of the NISE Net into the field is quite extensive as many of our field study institutions became engaged with and supported by the initiative. But the study also tells us that the growth of nanoscience education is not instantaneous or linear. For many of these institutions nanoscience education remains a challenging draw for their audiences, and many institutions still have questions about the centrality of nanoscience education to their mission. But it is clear that for those institutions that learn about nanoscience and that become interested in bringing nanoscience exhibits and programs to their audiences, there are resources and supports for doing so.

B) Reach and Impact Survey: A Widespread Study of People Connected with the NISE Net

Introduction

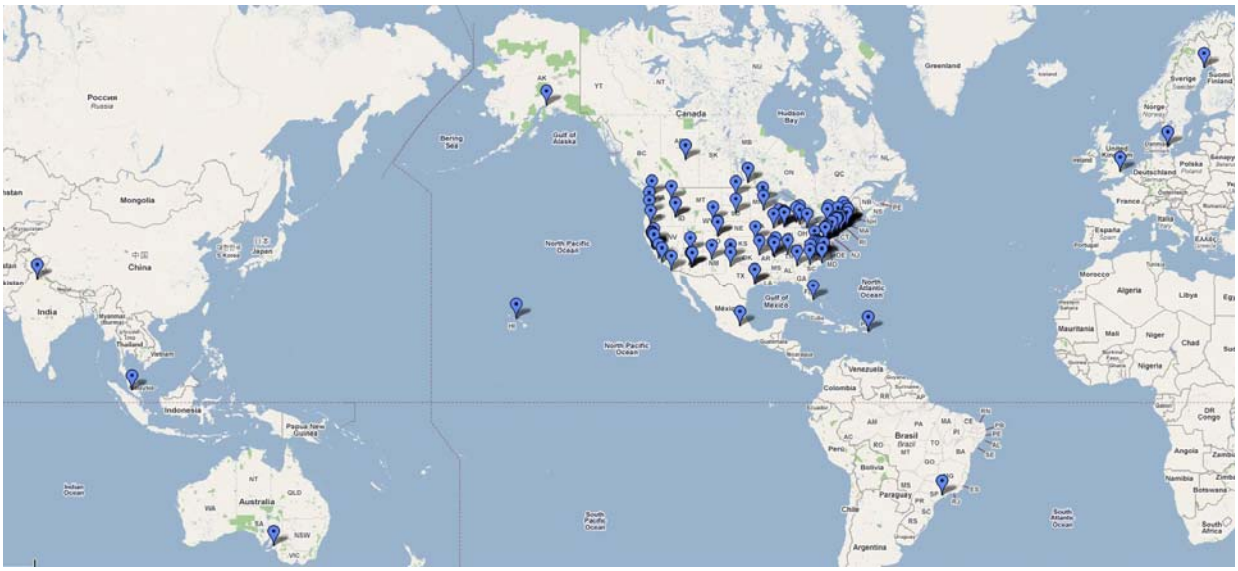
In this section we summarize the major findings from a more complete report, Reach and Impact.

In February 2009, Inverness Research invited 695 individuals listed in the NISE Net database to complete a short survey about the reach and impact of NISE Net.[10] The names were selected because the database indicated that at least one NISE Net leader or key partner had "collaborated on some level" with each person. However, we did not include people who had attended a regional workshop, since they were participating in a concurrent interview study we were conducting. It is important to note then that this sample consists of individuals who comprise "the next layer out" from those people who have participated in the regional workshops.

The purpose of the survey was to determine the nature and depth of involvement with NISE Net, and anticipated future involvement; perceptions of the extent to which NISE Net is contributing to their individual capacity to conduct nanoscience education for their audiences; contributions their institution's capacity to incorporate nanoscience into their current practices; whether they were using NISE Net resources or some other nanoscience education resources; and the extent to which NISE Net has enabled collaborations within the ISE field and with scientists. The survey asked respondents to rate their level of agreement or disagreement with a series of statements about NISE Net and offered a few spaces for respondents to qualify or explain their ratings.

[10] 175 individuals responded to the survey, for a return rate of 25%. To determine whether or not the respondents were appreciably different from the non-respondents, we conducted a non-responders study. We feel confident that the respondents are representative. Please see separate report "NISE Net: Scientist Interviews" for a more detailed explanation of our non-responder study.

World Map of Reach & Impact Survey Sites:



A Summary of the contributions and benefits of NISE Net

- In general, our survey results indicate that NISE Net is contributing to respondents' individual and institutional capacity to engage in and offer nanoscience education. A majority of respondents believe **NISE Net is making a contribution to the field** (89%), and has contributed to an increased interest and commitment to nanoscience in their institutions. A majority are **interested in continuing to work with NISE Net** (89%)

- Most respondents (89%) believe **NISE Net events are designed and implemented well**, are positive about **NISE Net's contribution to nanoscience education in the future**, and are **interested in continuing to work with NISE Net**.

- Most respondents (80%) also say that **NISE Net has contributed to their own capacity to assume increased responsibility for nanoscience education** at their institution. Most (71%) expect to **contribute to NISE Net in the future**.

- A majority (75%) of respondents believe their **institutions are interested in and committed to nanoscience,** and are **actually incorporating nanoscience** into their programs and exhibits. Over two-thirds say their **institution is now better able to incorporate nanoscience than it was three years ago**.

- Respondents also reported that **NISE Net resources are designed well (85%)** Many respondents commented in particular about the **quality and usefulness of the NanoDays kits.**

- Further, NISE Net has played a role in **connecting respondents with other ISE professionals (62%) and with scientists (41%)**, although they indicate that more could be achieved in this area, especially connecting scientists with ISE professionals. Four fifths say that they feel **better connected to others who are interested in nanoscience education.**

Challenges or concerns

- The comments regarding the **NISE Net website (nisenet.org) were mostly negative**. According to those surveyed, the website is critically important, but it is not sufficiently well designed to be effective yet. While the majority of survey respondents had noted positive changes in NISE Net as a project over time, the website does not appear to be keeping pace with the development of the network or with what people need.

- The respondents reported that the major **barriers to involvement in NISE Net** centered around factors such as **lack of public interest in nanoscience** (and therefore not a priority for their institutions), and challenges related to **funding**. **Communication** about the activities of NISE Net, what resources are available, and how to stay connected with others was a concern for some.

- A few commented on a **perceived exclusivity or sense that NISE Net was not open to outside input or feedback**. A few scientists in particular wrote comments that indicated a need for NISE Net to be more open to external critique, or to include more expert input at the beginning of development work.

Summary

Overall, the respondents to this survey had very high regard for NISE Net and what it has accomplished so far. They felt they had benefited from their experiences with NISE Net, and have hope for future interaction. They feel NISE Net has so far made a positive impact on the field, and increased commitment to nanoscience education. Areas that are less strong in their view are the usefulness of the website, ease of communication with and across the network, the extent of connection with scientists and nanoscience experts, available funding, and the perception that NISE Net is perhaps too "NISE Net-centric" and not easily accessible enough to those not participating in the workshop.

C) Engaging Scientists In NISE Net: The Connection With and Engagement of the Scientific Community

In this section we summarize the major findings from a more complete report (NISE Net-Summary of Interviews with Scientists).

Introduction

According to the NISE Net theory of action, NISE Net is meant to be a bridge—a kind of interface—between the science research community and the public. And as a bridge, the connections on both sides must be carefully engineered. NISE Net is intending for informal science education institutions (ISEIs) to serve as this bridge largely because, NISE Net leaders argue, the ISEIs are capable of making connections with both the research community and the public, and translating between the two.

One key goal of the network, therefore, has been to connect the public with scientific research. We sought to learn the extent and ways this was happening in two ways: 1) we included scientists in our Reach and Impact survey, and disaggregated their responses. This gave us a sense of what scientists who are perhaps not deeply engaged in network activities had to say about NISE Net; and 2) we interviewed 21 scientists who had been engaged in NISE Net work on some level.

Scientists' Responses to the Reach and Impact Survey

- In general, scientists did not differ greatly from the rest of the respondents of the Reach and Impact survey in terms of contributions from their NISE Net participation to their individual capacity and practice. The one area where the two groups differed (that is, scientists vs. all others) is that **a higher proportion of scientists (85%) than others (62%) say that they expect to continue to contribute to NISE Net** in the future.

- Also, a **higher percentage of scientists than others say that their institutions are committed to nanoscience education and to incorporating nanoscience into programs and exhibits** (87% and 85% for the scientists, vs. 67% and 66% for all others) Conversely, a lower percentage of scientists than others say that their institutions are better able or more interested in incorporating nanoscience than they were 3 years ago (56% and 37% respectively vs. 78% and 70%)

- **A minority of scientists (41%) has interacted with other scientists through NISE Net**. However, to keep this in perspective it is useful to note that slightly more scientists have interacted with other scientists than have other respondents (41% vs. 31%) Also, scientists have interacted more with informal science educators than have the other respondents (76% vs. 51%)

- **Scientists are somewhat more likely to learn about NISE Net from colleagues,** while other respondents are somewhat more likely to learn about NISE Net by attending a conference or workshop.

Interviews with Scientists

In the Fall/Winter of 2008-2009, Inverness Research contacted NISE Net leaders to solicit names of scientists who have been working or have worked with the Network in some substantial way. Our purpose for the interviews was to determine the extent and ways NISE Net has been able to create and support "win-win" relationships with scientists. We wanted to learn: 1) how they got connected to NISE Net; 2) what kinds of benefits they accrued as a result of their relationship with NISE Net; 3) what contributions they feel NISE Net makes to their work (and vice versa); and 4) their overall sense of NISE Net's effectiveness in communicating nanoscience to the public. Overall, our researchers conducted 21in-depth telephone interviews. Each interview lasted between 30 and 60 minutes. The roles of the scientists we interviewed ranged from university professor, to outreach coordinator, to doctoral student.

Map of Scientist Interview Sites:

How they are getting involved

Scientists are hearing about and getting involved in NISE Net from a variety of different sources, but mostly from personal relationships and the Materials Research Society (MRS) The table below summarizes the nature of their initial contact.

Personal prior relationship	9
Through MRS	5
Contacted by a museum	3
Invited by NISE Net leadership	2
NEO	2

It appears that NISE Net has created multiple contact points or openings for scientists/researchers to engage in the Network.

Reasons for getting involved

The scientists we spoke with became involved for a variety of reasons. Most all of them have some reason to engage in outreach, either because it is mandated as a part of their research grants, or because they are interested in contributing to a better public understanding of science. The NEO participants were interested in an opportunity to expand their expertise in science communication, as were a few others. Some had prior relationships with their local museum, and getting involved in NISE Net was a way to strengthen that relationship. Several of them reported that they viewed NISE Net as a way to meet the NSF "broader impacts" requirement.

What scientists are getting out of connecting with NISE Net

Opportunities to work directly with the public: We were interested in hearing more about the kind of work scientists were doing with NISE Net, particularly work with the public. Fifteen of the 21 we interviewed have interacted directly with the public as a result of their work with NISE Net. The large majority has given talks or presentations at NanoDays or a public Forum. Others have done more interactive activities, like presented at a teacher workshop, or interacted with parents at a NanoDays event, while their children engaged in an activity. For those who have interacted directly with the public, they found the experience extremely gratifying (albeit at times "terrifying"!) While some of these scientists have worked with the public before, others were newcomers to this kind of activity and were grateful for the help and coaching the museum staff gave them.

Professional Benefits: We asked the scientists to talk specifically about the professional benefits they accrued as a result of their collaboration with NISE Net. The most often cited benefit was the opportunity to learn how to better communicate their science with public audiences. Second to this benefit, also previously noted, was fulfilling the broader impacts requirement for NSF grants.

Numerous other benefits were mentioned, including but not limited to:

- Creating a better informed public
- Learning how to be a better communicator of science
- Being a part of the development of a national infrastructure for raising public understanding
- Networking/relationships with other scientists
- Learning about science education, effective practices in museums

- Professional advancement, new opportunities
- New opportunities to engage in outreach (eg local library)
- Learning from the public—what the questions, issues, concerns are about nanoscience

Additionally:

- 15 of 19 said that they feel to a great or very great extent that they can contribute more and more effectively to efforts in nanoscience education.
- 13 of 17 reported that they now feel they have an increased knowledge about how to conduct and get involved in outreach to a great or very great extent.
- 13 of 19 reported that, to a great or very great extent, that they have an increased interest in and motivation to engage in and make contributions to outreach activities.
- Nearly all of the scientists we interviewed agreed that they are gaining or have gained important relationships with others in either their own or the education field.

The Support of NISE Net

On average, scientists rated the extent to which they feel supported by NISE Net in their educational outreach experiences a 4.1 of a total possible 5 on a likert scale.[11] It is noteworthy that eight scientists chose the highest possible ranking. We also asked them to rate the extent to which they believed that NISE Net succeeds as a "service organization" for scientists seeking to engage in outreach in nanoscience education. About 50% said they agree to a great or very great extent that NISE Net is succeeding in this role.

Finally, according to the scientists we spoke with, NISE Net is succeeding in its attempts to encourage good matches between scientists and ISEIs. That is, these scientists, for the most part, made solid connections with their local ISEs and have worked with them in appropriate ways, engaging in meaningful activities.

[11] The scientists were asked to rate their experiences with NISE along several dimensions as part of the interview. Please see separate report "NISE Net – Summary of Interviews with Scientists" for protocol for the list of questions.

Barriers scientists are facing

We wanted to hear about any barriers the scientists were facing in their attempts to work with NISE Net, or in carrying out the nanoscience education work itself. For the most part, they did not find any barriers other than constraints that were external to the relationship with NISE Net, such as finding the time required to participate in activities.

A significant minority raised a concern about the extent to which NISE Net has been able to successfully engage enough scientists, or the extent NISE Net knows enough about potential scientists who might be interested or willing to participate in the network. NEO participants lamented the demise of that program, and hoped that NISE Net would be willing to support some kind of ongoing participation, at least for the alumni of the workshops.

Summary of progress to date

Overall, NISE Net has evolved mechanisms and resources for reaching and impacting ISEs and scientists in the field. The large majority of individuals who responded to our surveys or interviews highly value the work NISE Net is doing and the impact it is having on the field, and appreciate the support NISE Net offers regarding their own efforts to engage their audiences in nanoscience education. While there remain growth areas—such as improving the scientists-ISE connections, and the access to and use of nisenet.org—NISE Net appears to have made significant progress in its efforts to reach the field.

Scientist involvement

While the responses of scientists on the Reach and Impact survey do not stand out for the most part, it is also clear from their responses that (1) NISE Net seems to be reaching scientists in the field, and that (2) these scientists anticipate staying involved in the work of the network. Moreover, they say they are committed to nanoscience education. For these reasons we believe that NISE Net is tapping a scientist audience that is pre-disposed and already poised to engage in the kinds of activities that NISE Net has been developing. Since many scientists learn about NISE Net through word of mouth from their colleagues, it makes sense for NISE Net to continue its active relationship with the Materials Research Society (MRS) and to expand relationships with other professional organizations.

In our interviews, scientists' revealed that their reasons for initially becoming involved in NISE Net vary, but primarily they relate to the fact that the scientists are personally interested, professionally committed, or compelled by the NSF's broader impacts requirements. For this group, NISE Net provides several avenues and is a source of motivation for scientists being involved in outreach. Scientists feel strongly that they (and their colleagues) should be involved in efforts to increase public understanding of science.

While barriers for engagement in NISE Net on the part of our sample are either non-existent or minimal, there was some concern that NISE Net is not known broadly as an opportunity for scientists to conduct outreach. Most of the relationships are forged through personal connection. Several scientists we spoke with felt NISE Net could do more to make itself known and easily accessible to scientists who may not work with MRS or already know someone involved in NISE Net. Finally, those scientists who participated in NEO found it extremely valuable, and lamented that it seemed to no longer be a priority for NISE Net.

D) The Vignettes: Stories of Institutions Engaged with NISE Net

In this section we summarize the major findings from a more complete report, Vignettes: Stories of Institutions Engaged with NISE Net.

Introduction

In an effort to provide more detail about the range of ways NISE Net has impacted institutions in the ISE field, IR investigated the NISE Net history of six institutions in slightly more depth. We wanted to know how they got engaged in NISE Net, the kind of work they have been doing, how NISE Net has supported them, and what they envision for their future. These vignettes provide a rich and diverse set of perspectives on the ways and extent NISE Net is reaching institutions in the field. Each site and vignette is described below.

Map of Vignette Sites:

Vignette Highlights

The story of **Bradbury Science Museum** is one in which, through NISE Net, the public face of a classified research institution (Los Alamos National Laboratory) is able to present

cutting-edge science research that is relevant to the research being conducted at Los Alamos. While the mission of Bradbury involves translating Los Alamos' research for the public, Bradbury is often challenged to learn about the top-secret research to begin with, much less figure out how to translate it for the public. Nanoscience education is a perfect interface for Bradbury and Los Alamos labs. In addition, the NanoDays activities served as a concrete mechanism for scientists from the Center for Integrated NanoTechnology (CINT) to become actively involved with the science museum.

Reuben H. Fleet Science Center is a case of a relatively large institution with multiple audiences and a mission to present a range of science topics to those audiences that expanded their interest and capacity to present nanoscience through a connection with NISE Net. While nanoscience is not high on the list of priorities for Fleet, there is now a solid repertoire of resources and human capacity to continue to build and offer special events. Moreover, they have initiated connections with local nanoscientists, and are hopeful to create more.

The **North Carolina Museum of Life and Sciences** vignette tells the story of how, through its participation in NISE Net, a medium-sized museum in a prime location has been able to access and leverage partnerships with nearby research institutions, as well as with distant fellow informal science education institutions to broaden the public adult audience for the museum and for research institutions. Prior to its involvement in NISE Net, this museum functioned in relative isolation with no focus on nanoscience or adult learning, or connection with cutting edge science research. The additional partnership projects and collaborations NCMLS has formed through NISE Net are numerous, will last well beyond this project, and will serve as evidence of the lasting legacy of NISE Net.

The **Children's Museum of Indianapolis** is a case of a large, urban children's museum with a dedicated space to a related topic—biotechnology—that was catalyzed to take on nanoscience because of its relationship to biotechnology and because of the NISE Net's readily available resources. Without NISE Net, it is not likely that The Children's Museum would have so easily incorporated nanoscience into its programming.

The **DaVinci Science Center** is a case of a small science center with a small budget that has been able to expand and improve its existing programs through the resources available through the NISE Network, and through the new relationships and connections with local research scientists and universities that it has established as a direct result of NISE Net. While the DaVinci had taken steps to address nanoscience in their museum prior to learning about NISE Net—they collaborated with Lehigh University to develop an in-house nanotechnology exhibit and key personnel attended a series sponsored by the Penn State Center for Nanotechnology Education and Utilization—their involvement with the NISE Network truly catalyzed their efforts. The NanoDays kit was a no-cost, already vetted option for DaVinci to extend their current nanoscience offerings. Other resources, such as the nanoscience expertise available through MRS and MRSEC allowed DaVinci to

further improve their activities and programs. Perhaps most importantly, NISE Net provided an existing structure for a materials science professor from Lehigh to collaborate with the DaVinci Science Center—something he had long wanted to do but didn't know how to orchestrate.

Oregon Museum of Science and Industry's involvement with the NISE Net is a story of a relatively large museum that was already well-respected, particularly in the areas of collaboration and exhibit development, but still had much to gain through it's involvement in a national network of museums. The museum was able to develop programs and products for nanotechnology, an area that had remained untapped and was difficult to initiate working in isolation. OMSI continues to serve as a bridge among small and large museums as a hub leader and exhibit developer. Furthermore, it will continue to advance its work in diversity and access, and societal implications of nanoscience and technology, while it explores other outreach opportunities such as after-school and community programs.

The museums represented in these vignettes were able to use the resources, knowledge, and capacity available through NISE Net to revise and improve their programs, and to create new programs. It is worth noting that the primary avenue through which four of the six vignette institutions accessed the Network was through NanoDays, which were reported as "hugely successful." The other two vignette institutions have since taken on roles as hubs, which means they are now, in turn, contributing to the leadership of the Network itself.

What these vignettes tell us about NISE Net

Each of the six vignettes portrays the value-added of the NISE Network in the museums' efforts to bring nanoscience education to their communities and audiences, and importantly, the value-added takes different forms at different institutions, demonstrating the diverse options and resources available through NISE Net. The Network increased the capacity of all of the vignette institutions to provide nanoscience education, and it has enabled nanoscience education efforts that would not have existed had the support and materials not been available. In other words, NISE Net provides enabling factors that catalyze the nanoscience education work and improve it.

Enabling factors include:

- NISE Net's connection to local research scientists, often through its relationship with MRS and the local MRSECs

- The reputation of NISE Net for providing scientists with opportunities to fulfill the Broader Impacts requirements of their own grants

- The NanoDays kits, which are consistently reported to be high-quality, useful materials

- No-cost or low-cost resources available online

- Face-to-face contact and support available through hub meetings

- Specialized interest groups tackling subjects such as: diversity, equity, and access; programs; and public forums

D. Summary of Findings and Implications for the Future

In this section, we summarize our findings and reflect on implications for the future of NISE Net. Note that these summary statements draw upon data collected over the last four years, and therefore are not limited to the findings in this report.

STRENGTHS AND ACCOMPLISHMENTS

- NISE Net was successful these first 4 years in accomplishing its primary goal: **to establish a network that has been able to reach one hundred Informal Science Institutions with nanoscience education resources and supports**.

- NISE Net has **developed the capacity to serve the institutions they are reaching**. They have created the mechanisms necessary to engage, communicate, and share resources with participating institutions.

- **The creation of hubs and regional leaders is proving to be a successful strategy for expanding and deepening the work of the network**. Participants report that the hub leaders are responsive to their needs and requests, and hub leaders report that they are well-supported by the network and believe it is a good strategy for expansion.

- NISE Network has developed **a strong network organization that is able to manage the work of the network and that provides the foundation for future work and expansion**. It has evolved an effective administration structure—a NEG group, a PI+ group, sub-awardees, hub leaders—that has enabled the network to manage its hubs and communicate with hundreds regional institutions, scientists, and other stakeholders.

- NISE Network has **enhanced both individual and institutional capacity to deliver nanoscience education to the public among the lead and sub-awardee institutions**. Through the work of NISE Net the leading individual and institutions

have developed stronger abilities and propensities to offer nanoscience education to the public. Further, the workshops offered by the hubs are beginning to develop such capacity in over one hundred other institutions.

- National NISE Net efforts, in particular **NanoDays, have been catalytic in engaging new ISEs and scientists to enter into nanoscience education**.

- NISE Net has made **progress in finding ways to engage a diverse pool of nanoscience researchers in the development and delivery of resources for public learning of nanoscience**. To date most scientists involved in NISE Net were drawn to the Network through personal connections and communications. Scientists report that they have had positive and valuable experiences with NISE Net. It should also be noted that the **Materials Resource Society (MRS) has played a pivotal role in establishing and promoting connections** throughout the network.

- In general, NISE Net product **"consumers" are pleased with the completeness, flexibility, and the user-friendliness of the materials available**. Most ISE educators report that the materials made available through NISE Net for NanoDays activities are of high quality and very useful, in large part because they are flexible and easily adapted to their context.

- **Overall, NISE Net has created a large scale functioning network that is capable of promoting nanoscience education for the public across the nation. In the past four years NISE Net has developed strong and distributed leadership, built relationships with hundreds of individuals and institutions, created functional organizational and communication structures, and developed an initial collection of programs and resources that are flexible and valued by the field. In these ways NISE Net has established itself as a knowledgeable and valuable resource for both informal science educators and nanoscience researchers**.

CHALLENGES AND CRITICISMS

- Many **scientists support the underlying NISE Network concept, but feel that NISE Net is not yet optimal in providing well-designed opportunities for scientists to engage in the work of the initiative**. More focused effort is needed to create opportunities for scientists to contribute to and benefit from the Network.

- **Some scientists voiced strong concerns about the scientific quality of some of the materials** NISE Net has produced.

- Outside of those directly involved in NISE Net, there is a **perception among some in the scientist and ISE fields that NISE Net is a relatively closed system**. (They refer to this as "NISE Net being too NISE Net-centric".) Over the years, we have heard from people outside the network that NISE Net is not responsive enough to the broader field, doesn't seek materials, resources, or input from outside itself, and is a bit opaque in its goals and activities.

- The website for the NISE Net (nisenet.org) is a critical component of the network and its future success. The website is intended to be a major channel for the distribution of materials, a forum for community discussion, and a source of professional learning. At the time of our review[12], **the website had not met these expectations or the needs of many of the network participants**.

- **Participants of the NEO program (and others who supported it) were deeply disappointed by the elimination of the NEO program**. Everyone we spoke with about this program who was either a participant or an affiliate of a participant at a research institution considered it a good investment. NISE Net did not share this perspective as they eliminated funding for the program. The NEO program, to date, appears to be the most institutionalized and systemic way to impact new scientists about nanoscience education—a program that could (and did) impact careers.

- Finding ways to **document and assess the public impact remains a challenge**. The decentralized nature of the network, and non-linear growth rate of nanoscience activities reaching the public, makes the assessment of public reach and impact quite difficult.

EMERGING QUESTIONS

- A central assumption underlying the NISE Net strategy is that resources can be distributed though a web-based catalogue. This approach has not yet been proven on a large scale. **What will it take to make the catalogue concept a working, fully-functional reality?**

- We learned from our studies of the field that other informal learning efforts exist that are attempting to improve public understanding of nanoscience. There are now many sources of nanoscience materials. To what extent and in what ways **will NISE Net be able to incorporate products, services, and resources from other nanoscience education efforts around the nation**?

[12] We note that a recent major modification of the website may help to alleviate some of these concerns.

- Nanoscience and technology are ever-changing fields. Is it important that NISE Net stay current on the content? If it is, **how will NISE Net keep up with the nanoscience as new discoveries are made, or applications are discovered**?

- An upcoming challenge for NISE Net is **maintaining a vital network where institutions will continue to expand their involvement and engagement.** How will NISE Net keep the network vital after initial connections are made with new institutions? What will be the incentive for institutions to maintain a connection to the regional hubs, attend meetings or workshops, or revisit the website?

- How will NSIE Net **continue to evolve and strengthen the network organization so there is strong leadership, clear governance and decision making, and efficient communication throughout the network as it grows**?

Total NISE Net World Inverness Research Sites:

Total NISE Net U.S. Inverness Research Sites:

NISE Network

Interview Summary with Hub Leaders

May 2009

INVERNESS RESEARCH

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NISE Network
Interview Summary with Hub Leaders

I. Introduction

As the NISE Network sought to grow itself, it needed to find a way to connect new institutions to the network without them all coming through the central node of the network. NISE Net needed to develop a structure that could keep potentially hundreds of museums connected to the network in an effective and efficient manner. The Network has now developed a system of regional or geographic "hubs" (formerly called "nodes") as a strategy and infrastructure for expanding the number of its partners and the reach of its impact and work. Because the development of regional hubs is a major strategy for growing and supporting the NISE network, Inverness interviewed the leader of seven regional hubs and one thematic hub to get a better sense of the leaders' reflections and assessments of the hubs as a strategy for building the network.

Our interviews

Our interviews began with background questions including how they became involved in NISE Net, how their institution became a hub, the nature of the roles and responsibilities of a hub leader, the costs and benefits of being a hub, and the characteristics of the hub of which they are in charge. Most importantly, our interviews focused on hub leaders' perceptions of the hub structure as a strategy for expanding the NISE Network. We asked interviewees about their understanding of the goals and purposes of the regional hub structure, its strengths and challenges, and its effectiveness. We encouraged interviewees to provide concrete examples wherever possible of the key activities their hub has been engaged in and the quality and value of those activities. We were particularly interested in learning how their hub is connected to the wider NISE Network: what kind of support does the Network provide the hub; how, if at all, the hub contributes to the larger network; and what processes are involved in communication between the hubs and the Network.

We asked for the interviewees' forecast for the future of the NISE Network, their hub's future participation in the Network, and what changes they would like to see take place. Finally, we completed each interview by asking two questions which required interviewees to assign a quantitative rating on a scale from 1 – 5 (with 1 being not at all effective, 3 being somewhat effective, and 5 being very effective) for two different dimensions of the hub structure:

1) Overall, how effective is NISE Net in connecting nanoscience research and the public?
2) How effective is the hub strategy as a way to grow the NISE Network?

We informed all of our interviewees that all responses would be summarized and reported anonymously.

We conducted interviews with eight hub leaders at the following institutions:

- Museum of Life and Science, Raleigh-Durham, NC
- Ft. Worth Museum of History and Science, Fort Worth TX
- Sciencenter, Ithaca, NY
- Franklin Institute, Philadelphia, PA
- ASTC, Washington DC
- Science Museum of Minnesota, Minneapolis, MN
- Oregon Museum of Science and Industry, Portland, CA
- Lawrence Hall of Science, Berkeley, CA

II. Findings

Our findings are detailed in the following sections:

A. Essential Descriptive Information

B. Hub Leaders' Perceptions and Reflections on the Value of the Hub System as a Strategy

A. Essential Descriptive Information

THE BEGINNINGS OF THE HUB STRUCTURE AND STRATEGY

In the first two years of the NISE Net project, each sub-awardee (seven museums at the time) was strongly encouraged to reach out to ten additional museums that would be new to the network. One hub leader explained how these initial steps were the beginnings of the hub strategy:

> *Everyone did the expansion work at their site a little bit differently. Some people did it half-heartedly because they were mandated to do it. We learned a lot in those early days about reaching out to other museums—but we didn't have a clear direction for how to do it or why to do it, or what we were offering people.*[1]

The original goal was to expand the reach of the Network to get nanoscience education into 100 museums; however, soon the number of institutions involved in NISE Net extended well beyond 100 to over 200—well over the number that could be carefully and thoughtfully overseen by the three lead institutions (Exploratorium, Science Museum of Minnesota, and Boston Museum of Science).

One hub leader described the "200 wide/50 feet deep" strategy for growing the network:

> *Obviously, we don't have the resources to work at a certain depth with all 200 institutions, nor do all 200 institutions want that depth. So the idea was to identify those institutions who do want to commit further, out of those first 200, and those are the '50 deep' institutions that we then pursue further relationships with… helping them with exhibits and programs and keeping them continually involved in the future development of the network—more than simply being participants in NanoDays. The regional hub is a step in developing that kind of continuing relationship…. The regional hubs are really important for achieving the goal of a network that is 200 institutions wide … because 200 is a lot of partners to manage and I think decentralizing it into hubs makes the management of it more feasible.*

HOW INSTITUTIONS BECAME HUB LEADERS

1. Personal relationships and prior partnerships.

The work of NISE Net in the early years created many opportunities for people to work together. The personal relationships that individuals developed with each other—as well as the relationships that developed between their institutions—played an important role in determining how particular museums first became hub leaders. Seven of our eight interviewees referred, unprompted, to their relationships to other museums, universities, libraries, or other organizations as powerful reasons and relevant experience that eventually led to their position as hub leaders.

[1] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker.

One hub leader recalls:

> *We have a small museum collaborative. That sub-network was attractive to NISE Net, since they had the network idea, and they were looking for people who already had connections. So we were pretty involved in the first year in a lot of the prototyping that went on. Because our institution had taken on a lot of work, NISE Net approached us and asked us if we'd be willing to lead the hub work. I remember having a debate about it and having people ask, "do we have the resources to take this on?" And I was advocating for it because I thought it was such a great opportunity. We have a lot of good connections, we were in a good position to find people all over the country and identify people who had an interest in becoming involved.*

Another interviewee explained why a particular institution was an appropriate choice as a hub leader:

> *We were one of the original sub-awardees and we have a good relationship with a lot of other institutions in our state. We were a natural fit.*

2. Prior experience with nanoscience education programming and exhibit development.

Regional hub leaders also brought to their positions particular specialties or areas of expertise that made useful contributions to the network as a whole. Several institutions had already engaged in nanoscience education programming and exhibit development.

One hub leader said:

> *Our institution has been involved in NISE Net since its inception. We were what is called a thinking partner in NISE Net for several years and then at a meeting, maybe about a year or not that long ago, [they] talked to a couple of us that were not in the NISE Net sub-awardee structure and asked us if we would be interested in being hub leaders. [Our museum] is responsible for one of the first hands-on exhibits of nanotechnology at a science museum.*

Another interviewee explained how her institution evolved from being a sub-awardee to also taking on the role of hub leader:

> *When each of the sub-awardees were first organized, we were supposed to pick friends, not in the region, who you thought might be interested in nanoscience education in some way and to contact them. So I did that the first year and that was a logical thing for me, because I had been involved with our previous nanoscience projects that were already finished or were ongoing at the time. Through our marketing and traveling exhibitions, we had relationships with other museums. So these were a logical choice based on our history together…*

An individual from a different hub had a similar tale to tell of how her institution was already experienced in doing nanoscience education:

I think one of the main reasons that they approached us about becoming a hub was that we have a standing partnership with the state university that has been going on for the last eight years involving nanoscience programs. It is pretty well established. As part of that partnership, we have developed kits of activities that we then distribute to 15 to 20 other museums. So we had our own network going already, with those museums that partnered with us for that project. Also, as part of that project, we have training sessions for each round of kits, so we had experience running workshops as well. I think those factors and the fact that we were already significantly invested in doing nanoscience programming was something that made it a good choice for us to become a hub.

THE CHARACTERISTICS AND WORK OF THE HUBS

Each hub has connections with and provides support to 20-30 institutions (and/or individuals). Each regional hub has also hosted a regional meeting this past year (year 3 of the project).

- **The Fort Worth Museum** hub in Fort Worth, Texas provides connection to museums in Texas, Oklahoma, and Arkansas. Specifically, these include Austin Children's Museum, the Health Museum in Houston, Texarkana Museum, the Museum of Discovery in Arkansas, the Science Museum of Oklahoma, the Art and Science Center for Southeast Arkansas, Mid-America Science Museum, Arkansas State University Museum, Arkansas NASA Educator Resource Center, the Arkansas Discovery Network, Children's Museum of Houston, the Science Spectrum, Imaginarium of South Texas, the University of Texas in Dallas, and Texas Christian University.

- **The Science Museum of Minnesota** hub in Minneapolis Minnesota provides connections to institutions on the Great Plains down to Texas, over through Indiana, stopping at Ohio, and then over to Colorado, including North and South Dakota, Nebraska, and Kansas. Their constituents are from urban areas, such as Minneapolis-St. Paul, Chicago, St. Louis, and Louisville, but also smaller museums from very rural areas. The hub leader said:

  We have a whole lot of smaller museums that frankly I had never heard of and it has made me excited about what is going on in rural areas.

- **The Sciencenter** hub in Ithaca, NY provides connection to museums in New York and New England. According to the hub leader:

  I think in general, we have a lot of very savvy museums that are already involved with nanoscience researchers. We also have a lot of nanoscience research going on in New York State, more than a lot of other states. In Albany is the first nanoscience college in the United States and so we have several museums that are already collaborating with people there. We have a lot of collaborations with people at

Cornell, since we have four different nanoscience centers here. And there is a nanoscience center at Columbia University, so there are museums connected with that and also the University of Buffalo.

- **The Lawrence Hall of Science** hub in Berkeley connects to institutions in California, Arizona, Nevada, and Hawaii.

- **The Franklin Institute** hub in Philadelphia, PA connects to museums in Pennsylvania, New Jersey, Ohio, West Virginia, Maryland, and Washington DC (to some degree, since ASTC also hosts a regional hub).

- **The Association of Science and Technology Centers** hub in Washington DC is primarily responsible for working with the science center and museum members of ASTC.

- **The North Carolina Museum of Life and Sciences** hub in Durham, NC connects with museums in all states in the southeast, with the exception of Texas, Arkansas, and West Virginia.

- **The Oregon Museum of Science and Industry** hub in Portland, OR includes museums in Oregon, Washington, Alaska, Montana, and Wyoming.

ROLES AND RESPONSIBILITIES OF THE HUB LEADERS

Primarily, the hub leaders serve as liaisons with the hub members in their region. This liaison role entails contacting and maintaining communication among the museums, science centers, universities, and researchers in their area. At times, the idea is to recruit new members to the NISE Net. One hub leader said:

My main responsibility is to go out in search of museums and assess their willingness to participate in the NISE Network. I get contacts at each museum and develop a rapport with those people at the museum who would be taking responsibility for NISE Net. That relationship building can be done through phone calls or emails. Mainly, it's about being the point person for those museums interested in NISE Net, to inform them and provide them with any information they want. If they ask me a question, I will either answer it or field questions to others who know about NISE Net. I try to be a mentor to them as they become an expansion site.

Other times hub leaders spend a substantial amount of their time communicating with the institutions and researchers who are already members of their hub. One hub leader reported:

A lot of the work of the hub leader involves correspondence between other institutions in my region and myself—basically just trying to introduce them to the NISE Network and trying to help facilitate anything that they need. If they need products, if they need things for NanoDays, and if they need content, that type of

thing, we are there. We are also there to provide support as well—this is a natural follow up to our hosting the regional workshop here. We are in charge of making sure that people within our network, in our hub, get the products that they requested from the NISE Network—and we try to do troubleshooting for them as well. If they haven't received something, then we let the network know and try to get that remedied.

Being a hub leader can also involve putting individuals in touch with other resources in their areas. For example, one hub does a lot of work connecting science centers with researchers involved in the Materials Research Society (MRS). Other hub leaders help their museums find nanoscience education resources. One interviewee described his responsibilities in the following way:

You are trying to push out the message of NISE Net, push out the good word and let people know that there are a lot of great materials out there… These materials have been developed through a pretty intense process—leaders in the field have created some decent stuff…Using these materials and doing nanoscience education is a good way for museums to get on the new 'technology work force development' bandwagon that potentially some of their visitors are interested in.

One hub is particularly focused on reaching out to smaller or relatively unknown museums, which is useful for a network that had its beginnings in personal connections:

It is a concern to make sure that we integrate small organizations in a large infrastructure project like this—it is an equity issue. Many smaller museums don't have access to the same kinds of resources as the large ones do… and the small museums serve different kinds of communities. The rural museums may serve communities in different economic brackets and have different kinds of outreach programs in place. I have tried to identify partners that may not have been on the map. Much of the expansion in NISE Net has involved working through connections that you already have and grabbing the lowest hanging fruit… But that approach doesn't always reach the greatest variety and diversity of organizations, because big organizations know big organizations. I feel like I was able to help strike a balance in that expansion process between finding old friends and discovering new ones. The rest of the network has appreciated it.

B. Hub Leaders' Perceptions and Reflections on the Value of the Hub System as a Strategy

THE VALUE OF THE HUB SYSTEM AS AN EXPANSION STRATEGY FOR NISE NET

All eight of the hub leaders we spoke with were able to articulate several benefits of using the hub system as a strategy for expansion.

1. Primarily, the hub structure provides a more immediate, personal connection for the vast number of individuals and institutions involved in NISE Net. Through a regional hub, each individual or organization that is interested in participating in NISE Net is able to access a leading institution that is either nearby geographically, and/or similar in character and purpose:

> *I see the hub to be a personal connection to the NISE Net. It is good for the museums in our area to have somebody who is an integral and leading part of the network, to act as a mentor and to help them in becoming more of a partner in the network… The hub leader is the one who provides that personal link to the network. I think it's so important that the museums have somebody who they are familiar with and can talk with, instead of just a place on the web they can go visit and where they can apply for programs.*

> *As a hub leader I do a lot of the communication that the network wants to get out to the partners, and that puts a little bit more of a human face on the communication—having it come from the regional hub… There is somebody that people can identify with, somebody that they can meet at a workshop because we are close together. Then, likewise, any questions or issues that our museum partners in our hub have, I filter and communicate those back to the network.*

2. The hub structure has, to date, allowed institutions to be supported in attending regional meetings. This support has helped to address some of the inequities among institutions in terms of their great variation in funding, resources, and other capacity.

Several interviewees spoke of the value of face-to-face time with other partner museums:

> *We all have challenges and we all have successes as we try to do nanoscience education with our public audiences—and I just thought it was fantastic to be in the same room talking about what it is like at our place, what is it that we are doing, what is it that you are doing. I thought that the actual face-to-face time was really great. As a hub coordinator, I think it is important to maintain some level of that enthusiasm and energy.*

3. As mentioned above, the hub structure allows venues for small museums to access resources that are often typically most available to larger museums:

> *Some of the small museums were pretty disconnected from ASTC or other conferences. Smaller museums don't often have the resources needed to attend and participate in those national events. NISE Net opens that door to allow them to see that they can get resources, and that there is a new way for them to participate and*

communicate and share things with other institutions. This couldn't have happened if NISE Net hadn't been there.

4. The hub system provides greater stability for NISE Net's nanoscience education enterprise. With a highly centralized system, if one key individual leaves, the work of the system is at risk. However, the distributed nature of NISE Net's hub structure means there are several individuals and organizations committed to and responsible for the work. The hub structure has facilitated the institutionalization of NISE Net's nanoscience education efforts.

I do think that we have already weathered changes in staff within the group of hub leaders and it has been good to have the work dispersed. If we were centralized and that one person left, we wouldn't have anything after they left. With the hub structure, we have been able to get through things as a group.

HUBS PROVIDE CONNECTIONS AND ACCESS TO THE NETWORK

The hub strategy allows museums at least two major ways to connect and work with the NISE Net. One is through the hub itself. The other is to have direct contact with NISE Net leadership and with network-wide national activities such as NanoDays, the Annual meeting, and sessions at ASTC. Having two major points of access and avenues for becoming involved in the Network is beneficial, in that one might work better for a particular museum than the other. The built-in redundancy ensures that all museums that want to can become involved.

We asked our interviewees whether they thought the museums within their hub were more aware of NISE Net primarily due to their involvement in the regional hub or due to their familiarity with the broader Network. In other words, we wanted to know what the most important interface with the Network seemed to be. The responses we heard seemed to depend on whether the member institution came to know about NISE Net by accessing the network online (in which case, they accessed the Network through the network-wide national activities, rather than through the regional hub) or whether they were contacted by a hub leader and attended a regional meeting (in which case, they accessed the Network through their regional hub, rather than through the network-wide activities). Two of our eight interviewees said they believed people are more connected to the NISE Net through the national network than through their hub.

For example, one hub leader who is largely responsible for organizing and orchestrating the orders for and delivery of NanoDays kits said:

I think people are more connected nationally because of the website than they are through their hub. I think it would be interesting to ask people, 'do you even realize you are part of a regional hub?' People who have attended a regional workshop will know that, obviously. But for some people, the only way they are connected

to NISE Net is that they find it on the web and they apply for a kit, or they download some activities so they may not know the way that the regional hubs are set up.

In contrast, three interviewees suggested that the regional hub is the more important way for partners to access the Network, particularly because of the regional meetings or workshops:

Their knowledge of NISE Net started here at the hub, on the first day of the workshop. I would say 80% to 90% knew nothing about NISE Net previously. I called these people all individually to get them to come to these meetings. A lot of them were working on a very low level of knowledge or familiarity with NISE Net. I would say the vast majority of their knowledge about NISE Net came from the regional workshop.

They are mostly familiar with just me and my hub. This makes personal connection all the more important. We've really tried to create this local connection—keep the region together and really try to build those partnerships.

Another interviewee suggested that as NISE Net incorporates topical hubs, in addition to regional hubs, the focus might shift slightly from regional to national:

I think at this point, it is largely true that their connection to the network is through and more or less limited to the hub. But, as a network tries to develop these parallel groups, I think that will change… when we develop some of these other topical hubs, there will be multiple ways that institutions can get involved.

Developing topical nodes will provide yet another specific means to access the Network. All of these multiple avenues for individuals and institutions to learn about and connect with NISE Net are important and should continue to be cultivated so there is overlap and redundancy in the system, ensuring that any museum can easily learn more about the Network. This structure is similar to that of membership in both national and state affiliations of organizations like the National Science Teachers Association.

NISE NET'S SUPPORT FOR THE HUBS

The hub leaders described that the majority of the support they receive from the NISE Network is from other hub leaders and from leading NISE Net institutions. The nature of the support received is practical, concrete assistance, as well as support on more conceptual levels.

In terms of the hub leaders themselves, this group has weekly telephone calls, during which they discuss current challenges and successes and share ideas for moving forward. This group of people (formerly called the "Expansion" group, now referred to as the "Community" group) is becoming central to the leadership of the network, as they take charge of this expansion effort and identify places and resources in their regions that will become future keystones in the NISE Net work. Some hub leaders in the Network are specialized in particular areas and can provide associated support to other hub leaders. For

example, one hub leader serves as an expert in documenting how to implement a forum, while another specializes in writing activity sheets for the kits, and another has substantial experience in partnership. A hub leader described how other hub leaders in the network influence the practice of partner museums:

> *I definitely feel listened to in the network, which is great, and we have really changed some of the things that we are doing based on what we have learned over time.*

Together, the hub leaders have worked with the NISE Net leading institutions (particularly the Museum of Science in Boston and the Science Museum of Minnesota) to create and maintain a group that specializes in designing and implementing regional workshops. This core group travels to other hubs to help with the workshops, allowing the other museums to avoid re-inventing the wheel each time they run a new workshop. One hub leader explained the ways in which her hub has been supported by the Science Museum of Minnesota, one of the leading institutions in NISE Net:

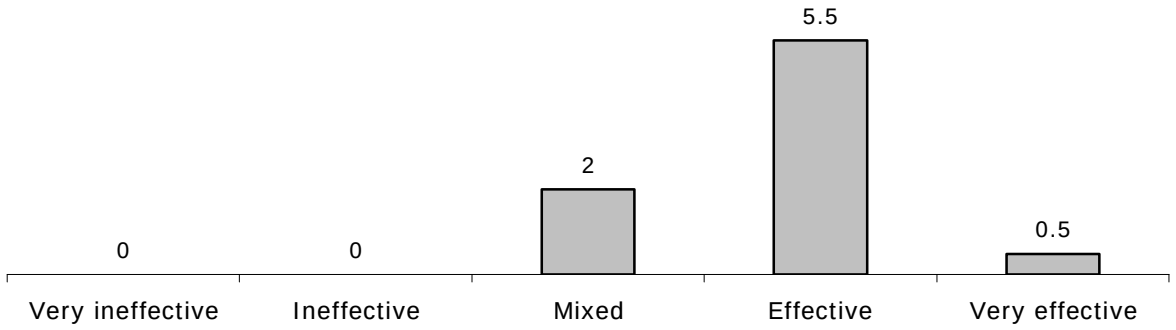
> *Basically, we have always had contact with [SMM]. They help out logistically when we need it, putting together some of these regional workshops for example, putting together the flights and hotel reservations and that type of thing. Also, they have been very helpful in allowing us to come in and work with other sub-awardees, at these planning meetings and just in general, what the NISE Network is. I think they have been very helpful.*

The hub structure allows for resources and tools that were carefully developed to be shared and disseminated throughout the Network in an efficient way.

QUANTITATIVE ASSESSMENT OF THE HUB STRATEGY

As we described in the beginning of this report, we concluded the hub leader interviews by asking two questions, which required interviewees to assign a quantitative rating on two different dimensions of the hub structure, on a scale from 1 – 5 (with 1 being not at all effective, 3 being somewhat effective, and 5 being very effective). The questions were: 1) Overall, how effective is NISE Net in connecting nanoscience research and the public? and 2) How effective is the hub strategy as a way to grow the NISE Net network? This section summarizes the responses to these two ratings questions.

Figure 1. How effective would you say that NISE Net is in connecting nanoscience research and the public?



Average rating = 3.8 on a 5-point scale where 1= "very ineffective" and 5 = "very effective." Bars represent the number of ratings given. One rater gave a rating of 4.5; .5 was allocated to both points.

Explanations for the lowest ratings were actually not related to the capacity of NISE Net itself for connecting to the public but rather the public's current lack of capacity for engaging in NISE Net education. For example:

> *I would say a 3—not for lack of trying but for lack of interest on the other side. That is just a brick wall and is not something that we have control over. The minute there is a killer application, either positive or negative, the whole balance is going to change and the public will be more interested.*

Another interviewee alluded to the challenges of making the topic interesting or relevant to the public but still rated NISE Net highly for what it has been able to accomplish:

> *I would say a 4. I don't think it is 5 because there are inherent challenges to the topic, to the science. You could do this at double the scale and it is just not going to get the same pull and interest as other topics that museums deal with day to day. I don't think it could be 5. I think 4 because they are trying their best and for doing this for almost 6 years, I am happy at the level they are at.*

On the other hand, most interviewees rated NISE Net quite highly in terms of its ability to connect nanoscience research in the public. One hub leader said:

> *I would say a 4 ½. I don't want to give it a perfect score because there is still work to be done. We are still figuring out how to engage the public but we have the most talented people in the museum field in this Network working on it.*

A few interviewees mentioned the relative newness of NISE Net as one reason they didn't provide a rating of 5:

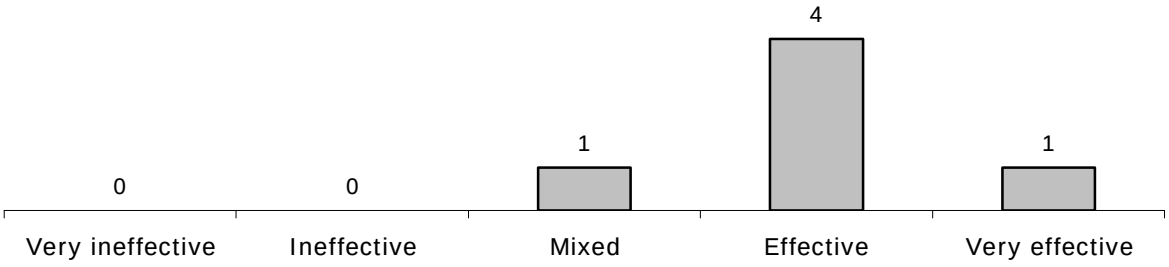
> *I would say 4. I think they are doing a lot of good work and they do have a fair number of research and informal science institution relationships built, and the working collaborations are in place. But I still think*

it is pretty hard and the results have been mixed. I think they have been doing a good job. It is better than average but I don't think it is as high as it could be.

And one interviewee pointed to the hub structure as having improved NISE Net's ability to connect nanoscience research and the public, even though the Network is relatively young:

I think compared to what we were doing before with the crisscross arrangement (as opposed to the regional hubs) I think it is way more effective. Where we are now is like a 3 or a 4 and where I think we can be is a 5. What is hard is, I think some people view the Network as really mature and I think it is in its infancy. We keep changing things as we are going along so it wasn't set up as a clear process. It is definitely a work in progress. We are getting better and are much happier than if we had just started out and never changed—so much happier.

Figure 2. How would you rate the overall effectiveness of the hub strategy for growing and strengthening the network?



Six hub leaders responded to this question. Average rating = 4 on a 5-point scale where 1 = "very ineffective" and 5 = "very effective."

In terms of the effectiveness of the regional hub strategy for growing the Network, most interviewees rated NISE Net quite highly. Hub leaders feel the hub approach has been much more effective than the first strategy the Network employed, which essentially amounted to each museum telling ten friends, anywhere in the country, about NISE Net.

One interviewee described the regional hub strategy as not only an effective way to recruit partners but also as an effective way to support them in an ongoing capacity:

I would say 4. I don't know if there is a better way to do it—it is just we are trying right now. I would say we need to work on trying to get more people into the network, making sure we retain those institutions, and showing our support for them. I think we have a fair number of people doing that.

The fact that several of the hubs have had prior experience in collaboratives or networking in other contexts has facilitated the work of the NISE Net hub leaders. One said:

I think we do a huge amount given the resources we have. For most of us, this is one little part of our job and so in that way, we are being very effective with leveraging off of other networks where people already have other collaborations, and the knowledge that people already have. In general, the hub people are really great because they are people who are already networked and we really try to pick people who are already networked and especially when we added the new people.

One interviewee was particularly impressed by the regional hub strategy for growing the Network:

I would give it a 5, because I think the hub strategy is one of the standouts of all of NISE Net that has worked. I think it has created a cohesive team of very different individuals. It is a very different institution and it is not something easily done at science museums.

CHALLENGES

When we asked our interviewees to describe how they might improve the work they do as hub leaders, or what some of the challenges of their current position might be, the most common response had to do with limited time, since the majority (all but one) of member museums do not have a full-time staff member devoted to NISE Net. One individual said:

I think that within my own institution, it would be nice to actually have a part-time person to help more, invest more of their time in the NISE Network. We have so many things going on right now and this is a small part of my work. We could probably be doing a whole lot more if we had more personnel to help with that.

Ideally, hub leaders would be responsible for going out into the community, building partnerships with researchers and industry in nanotechnology. However, not all hubs have the capacity to take on such community work. Many are busy with the immediate work of their existing members and in some cases, administrative work. One interviewee lamented:

I really want to be going over to the university and seeing all of the stuff they are doing, but I don't have time because I am transferring data from one spreadsheet to another. I am spending more time doing administrative kind of things, and keeping track of what we are doing, rather than going out and building those partnerships.

III. Summary

Through our observations and in-depth interviews, we have watched the network expansion strategy evolve from an early effort that had each museum contacting ten other museums. While not successful as a long term strategy, the early relationships that formed between individuals and institutions during the first two years were critical in laying the groundwork for identifying future hub leaders. Our interviewees reported that they believed the current set of hub leaders were good choices for the work. They were good choices because of their prior experiences partnering in developing other topic areas, or because of their previous experience doing nanoscience education programming and exhibit development. The hub leaders serve primarily as liaisons between the members in their region and the national Network but they also serve as an important mechanism for getting feedback to the leading institutions in the NISE Network. Hub leaders have different strengths they each bring to the network, and some hub leaders play highly specialized roles that other hubs can benefit from (e.g., work with smaller museums, work with diverse audiences, etc.)

The hub leaders we spoke with shared their perceptions regarding the value of the hub system as a strategy for expanding the NISE Network. Most often mentioned was the value of providing museums a personal connection to the vast numbers of individuals and institutions involved in the Network. Part of this personal connection comes in the form of the relationship with the hub leader, but it also derives from the face-to-face contact that takes place in the regional hub meetings. The hub structure has also served to establish more equity across diverse institutions by providing resources to museums that might not otherwise have access to such support. The distributed nature of the work that the hub structure facilitates also helps to build institutional capacity to do the work of nanoscience education. The knowledge and skill required to do the work is shared among several individuals in several institutions—the ability to do the work is not dependent on just a few key players.

Hub leaders describe being supported by each other and by some of the leading institutions in the Network. In addition to weekly meetings, hub leaders share ideas and resources with one another on an ongoing basis, and some specialize in areas (such as hosting public forums) and can offer tools and knowledge to other hub leaders. The hub leaders also described how the leading NISE Net institutions have stepped in to provide support in designing and implementing regional meetings.

In sum, the hub strategy is providing multiple ways for museums to connect to and access the NISE Network. It is a highly effective way for a large network led by three large urban institutions to reach out to additional partners across the country, including smaller, lesser-known, rural partners. It increases the diversity of institutions and perspectives involved in the work of the Network and allows for more equitable participatory structures for a variety of institutions and individuals. The personal connections, face-to-face contact and

relatively easy access to NISE Net Resources that are available through the hub strategy have been key to recruiting and maintaining support for new partner members. As one interviewee put it:

> *I think the hub leaders have become a very efficient team. I think this structure has expanded the network in a relatively short time. We are only in year four and it has grown pretty big—and from the activity I have seen, I think it has done a good job of accomplishing that growth. I don't know of a competing structure or strategy that would have been more successful.*

NISE Network

Summary of Interviews with Regional Workshop Participants

May 2009

INVERNESS RESEARCH

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NISE Network
Summary of Interviews with Regional Workshop Participants

Overview of Study

Early on in the project, NISE Net set the goal for itself of "getting nano in 100 places", meaning that the network wanted to connect with (at least) 100 informal science education institutions (ISEIs) across the nation and support their implementation of nanoscience education programs for their public audiences.

In 2008, NISE Net established a strategy for expanding the network. It identified and supported regional "hubs" (formerly called "nodes") that would be responsible for reaching out to and developing relationships with informal science education institutions, as well as research institutions in their geographical region. Each hub hosted a regional workshop, which served to kick-off this strategy.

In January and February of 2009, Inverness Research (IR) conducted 31 interviews of individuals who had attended one of the 2008 NISE Net Regional Workshops. The purpose of these interviews was to determine the perceptions of the regional workshop participants, and to gauge the extent to which NISE Net was contributing to their individual capacity to conduct nanoscience education for their audiences, as well as contributing to their institution's capacity to incorporate nanoscience into their current practices. Each interview lasted 15-20 minutes, and was conducted over the telephone.

Participants were asked about their institutional roles, current level of involvement with NISE Net, expected or hoped for level of future involvement, and the general nature of the activities they have engaged in through NISE Net. They also responded to questions about their perceptions of the quality of the material resources developed by the NISE Net, the quality of the professional development offered by NISE Net, and NISE Net's support in connecting them to others in the field (ISEIs and scientists). Finally, we asked them about their sense of whether or not NISE Net has influenced their institution's interest in and commitment to nanoscience education, and the ability of their institution to incorporate nanoscience in their future programming.

Map of Regional Workshop Interview Sites:

Overview of Findings

The Sample

Almost 3/4 of the respondents represented science museums. Other institutions represented in the sample include universities (4, or 13%), and children's museums (2, or 6%). Other individual interviewees are affiliated with a high school, a library, and a natural history museum.

Ten (or 42%) of the NISE Net regional workshop participants we interviewed are science educators. The professional roles of the remaining participants span the range of the informal science education institution spectrum: ISEI director (13%), program/project manager (13%), exhibit staff (10%), outreach director, consultant, director of education, or science interpretation coordinator (3% each).

PARTICIPATION IN NISE NET ACTIVITIES

Three quarters of the people we talked with have interacted with NISE Net several times (61%) or even more often (13%) and anticipate further interactions. Nearly all of the rest (19%) have had a single interaction, but anticipate having more. Six percent have had several interactions but anticipate none in the future. More than 9 in 10 anticipate further interactions.

The large majority of the regional workshop participants we interviewed have engaged in NanoDays (90%), a NISE Net Regional workshop (87%)[1], and/or using the nisenet.org website. About a third of them have used the NISE Net catalogue (32%) or participated in Forums (29%). Thirteen percent attended a NISE Net national workshop (at ASTC or elsewhere) and 19% have engaged in other activities (such as hosting a teacher workshop, sending out a newsletter, and advising NISE).

Most (84%) of the participants in our interview study have connected with informal educators and nearly half (48%) have connected with scientists through NISE Net.

NISE NET'S CONTRIBUTIONS TO INDIVIDUALS' CAPACITY AND PRACTICE

Participants we interviewed all rated NISE Net's contributions to their own individual capacity and practice in nanoscience education very highly, and all are interested in continuing to work with NISE Net in the future. All of them reported that the professional development workshops with which they were familiar were designed and

[1] All of the interviewees should have attended a regional workshop. However there were a few cases where the person who attended the workshop left the institution and left the NISE work to another colleague.

implemented well, and that the research the NISE Net has disseminated about nanoscience education appears to be valuable to the field.

Almost all (87%) reported that the NISE Net exhibits, programs, forums, and web materials are designed well and seem useful. Even more of interviewees (94%) agreed that NISE has contributed to their own individual capacity to assume increased responsibility for nanoscience education at their institution, and nearly as many (84%) feel connected through NISE Net to others who are interested in nanoscience-related education.

All of the regional workshop participants we spoke with expect NISE Net to continue supporting their efforts to do nanoscience education in the future, and almost all (94%) expect to contribute to the network in the future. They all agreed that NISE Net is making a significant contribution to the strength and quality of leadership for nanoscience education in the ISE community. Looking closely at the most positive rating ("strongly agree", 5 on a 5 point scale), we see that the very strongest ratings were given to their interest in continuing to work with NISE Net (77% agree strongly), their assessment of the quality of NISE Net events (66%), and their judgment that NISE Net is making a significant contribution to nanoscience education (63%).

We asked each participant to offer any additional comments about how NISE Net could better support their efforts to offer nanoscience education. A large number of those participants who answered this question raised the issue of the need for materials that could be adapted for special audiences. Other comments reflected issues related to a call for a better flow of information and communication and the desire for more materials to be developed and disseminated. Sample comments[2] below:

Special audiences:

[NISE Net could help me] by expanding offerings for rural populations and residents, or expanding the efforts to include the rural areas.

As we are Spanish speakers, we would like the materials to be in Spanish, and we would be willing to be the translators. I am willing to do this for the network.

Many of the programs that come out of NISE Net are geared toward an older audience than we target at our museum. We need a group to design activities for younger audiences. There are a lot of children's science

[2] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker.

centers and we've been able to modify the NISE Net stuff, but it would be good if NISE Net could help us do that.

Third-quarters of the materials are not applicable to us because we are a children's science museum.We need resources that are appropriate for a younger audience, or possibly specific skills highlighted that they can be taught so kids can understand nanoscience when they get older.

Communication issues:

Making sure that I know where I should direct questions would be helpful. I always go to the hub leader who first recruited me, but as the network grows, it seems like there might be a better way to match the concerns with the right person. And if I leave my institution, who would they contact?

We would like the communications to flow even better.

Through the website it would be nice if there was a different way to get in touch with other ISE institutions. An online community gathering place would be beneficial.

NISE Net could check up to see how I am doing by email.

The best thing would be some type of regular newsletter to keep me focused and thinking about the network.

Materials issues:

NISE Net should continue to be flexible in how we use the programs. I would love to see other ISEI's get their programs and activities onto the catalog as well.

They are already contributing in a lot of meaningful ways with background and content, but what is missing is figuring out how to develop sustainable funding at each site. Also, it will be helpful if they can continue to identify the framework underlying each program so I can modify it to meet my needs. If it is too pre-packaged and really pretty then I can't use it because I have to change it to meet our needs. We need a set of really basic information about what nano-technology is. The basic of basics class programs. The basic definitions.

At the current time, I like the resources that are available (the kits) and other materials that are available. And continuing to make more materials available even if we have to pay for them would be helpful. I know a lot more about nanotechnology then I used to, but I don't have the time to design the materials myself. If I can just order materials, that simplifies things.

[NISE Net could help me by] providing more and more detailed hands-on activities.

CONTRIBUTIONS TO INSTITUTIONAL CAPACITY AND PRACTICE

When we looked at NISE Net's contributions to institutional capacity and practice to date, we found that three quarters (74%) of the regional workshop participants we interviewed said their institutions are currently interested in and committed to nanoscience education and are incorporating nanoscience in their programs and exhibits. Eighty percent (80%) of the institutions are committed to participating in NISE Net specifically. Our interviewees were universally confident that their institutions are now *better able* to incorporate nanoscience than they were three years ago. The great majority (83%) also agreed that their institutions are *more interested* in incorporating nanoscience than they were three years ago. According to our interviewees, NISE Net has been more successful in facilitating institutions' connections with other ISEIs than in facilitating connections with scientists/researchers (81% and 55%, respectively).

We also invited interviewees to offer any comments about ways NISE Net could better support their institutions in cultivating or developing new and deeper relationships related to nanoscience education. Comments here were quite diverse, but notably there were several comments about the desire for NISE Net to assist in "match-making" with other ISEIs, scientists, and universities. There were also several comments about the desire for more frequent face-to-face meetings. Typical comments include the following:

It would be great if we had more frequent gatherings or regional trainings or something like that. It wouldn't have to be as big, but more often.

NISE Net has a lot of good stuff out there, especially connecting us with local universities... that has been really, really helpful. It would be nice for us to connect with the local science companies in the area, and find out what it is that they do that relates to nanoscience technology.

From my perspective, building relationships has to be face to face... so more opportunities to get together and meet new people would be good. And possibly sending someone to our institution, sort of like The Guest Speaker Tour.

I really liked the workshop. It was good to meet people there. We need to find the time to establish the partnerships. I'm not sure there is a lot more NISE Net could do unless there was a way to find someone to mediate and act as a "match maker" to help us get together with other partners that would be a good fit for us.

I attended one of the regional workshops and that was very useful. As much face to face time as we can get is always good, and if NISE Net hears about other museums in our area, it would be good if they could connect us.

NISE Net could help me connect more with scientists in my local community.

To provide more opportunities to bring people from the same area into the same physical space. It is way easier to connect face to face than it is to connect by wandering around all over the internet.

For us to connect more with the scientists and the people doing the research. I need to work more on this myself. I'm not sure who is doing nanotechnology in my state. Being able to find out who is local and who is doing stuff and who I can connect with would be great. I would like to see a searchable directory of nanoscientists in my region on the NISE Net website.

I haven't thoroughly looked through the NISE Net website, but if I could find partner institutions who were interested in the same thing, that would be helpful. Maybe NISE Net could do an email blast to let them know that this info is available somewhere.

After attending the regional workshop, I was responsible for coming back and seeking out folks in the nanoscience world in my community. If NISE Net were somehow able to supply me with some names of nanoscience experts in my area then it might make it easier to build the relationships.

NISE Net could allow more opportunities for scientists and teachers to participate in workshops together.

OTHER COMMENTS

At the close of the interview, participants were asked to provide any further comments about NISE Net. The large majority of the comments were positive, expressing enthusiasm for the work and interest in continuing their association with NISE Net.

NISE Net has been a valuable tool for us and we've enjoyed working with the program and meeting a lot of people and we look forward to working with the network and the informal science educators we meet through it.

We've enjoyed our interactions with our hub museum and that's how we got connected. It is always great for us to connect with others who are doing this kind of work. Creating that network is valuable, although we're not a museum and we don't have a museum network. Sometimes we hear more about the regional happenings and not the national big picture.

I've really enjoyed NISE Net and I think that it was a brilliant decision on the part of NSF to start looking at cutting edge tech that embraces the non-specialist!

We look forward to more NISE Net developments. It's an exciting time to be involved with nano-science technology and bringing this information to the public.

NISE Net is doing a great job for us, for the short time that they've been in existence. They have really helped us make sure that we are getting accurate information out to the public.

The NISE Net programming is good and the materials are interesting and useful. I plan on continuing with participation.

NISE Net has been a great opportunity for a small institution like ours to be part of, and to be a part of the larger network of ISEIs.

Prior to attending the NISE Net regional workshop, my knowledge base was extremely limited, but the workshop opened my eyes tremendously and made me more excited about the nanoscience world. In the ISE world, we try not to reinvent the wheel so it's great to have the opportunity to share ideas with each other.

More than any other network I feel at home with these guys. I was with my peers (at the regional conference) and I didn't want to leave! I'd let go of all my other network memberships, but not this one!

Only a few people raised concerns about the network or their involvement in it. These comments are below:

One thing that NISE Net has not done is figure out how to build institutional commitment throughout the institutions. You have to get buy-in from the top.

NISE Net is doing a great job and if we could just get more staff to work on it, that would be wonderful.

I have really enjoyed being a part of NISE Net and it has a strong sense of building community, but since we're such a large institution, it is hard for us to implement all of the things they offer because we have to look at the big picture for the entire institution.

The face to face and meeting people was valuable (at the regional workshop) and I liked that, but some of the materials were a little confusing and that is where I think the website could be better. Maybe it's because we're not a museum, and that is why things seem more confusing.

I'm impressed by how professional and organized everything is. I think the challenge is professional motivation. How do you motivate people to do more?

Summary Statements

In general, the regional workshop participants we interviewed were very positive about the value of the regional workshops themselves and the opportunity for subsequent networking. Participants spoke very favorably regarding the importance of a network such as NISE Net for connecting informal science education institutions to each other, in addition to other resources, such as universities and libraries in their area. Some respondents said the connections with other ISEIs were well supported but were concerned about the challenge and lack of support for connecting with scientists and researchers. Our interviewees also said the materials and resources that NISE Net develops and provides are useful; yet, they would like to see more materials and resources developed for specialized audiences such as children's museums and rural populations.

Some participants commented that they felt they knew less about NISE Net's national efforts than its regional efforts, and some were concerned that NISE Net has not yet addressed how to cultivate top-level institutional support for nanoscience education. On the whole, our interviewees were positive, reporting that their institutions were not only better able to offer nanoscience education and incorporate nanoscience into their existing programs, they were more interested in doing so as a result of NISE Net.

NISE Network

Vignettes: Stories of Institutions Engaged with NISE Net

May 2009

INVERNESS RESEARCH

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NISE Network Vignettes
Cross-Vignette Analysis and Discussion of Themes

Overview

Telling the story of a select group of museums that have been involved with the NISE Network can provide powerful, concrete examples of what NISE Net has accomplished and how it has increased the capacity of individuals and institutions to provide nanoscience education. Inverness Research chose six institutions to focus on for mini case studies, or "vignettes," that represented a range of sizes, missions, goals, and audiences, and differed in the nature of their involvement with the Network.

For each site, we spoke with different individuals, usually a museum staff member and sometimes a scientist. In our interviews, we asked them to describe the beginning of their involvement with NISE Net, the nature of their current involvement in the network, and their anticipated future involvement in NISE Net. We asked them to describe what they had been doing or offering in the area of nanoscience education, if anything, prior to their involvement with NISE Net, and what motivated them to become involved in the Network. We asked whether their role with NISE Net had changed over time, how they may have collaborated with others in the Network, whether their work with NISE Net has resulted in any off-shoot opportunities, and for their impressions of the quality and value of NISE Net. Finally, we asked how they planned to build on the capacities they've developed through their work with NISE Net. To complete our research on each vignette site, we read particular documents that some interviewees sent our way and reviewed the websites for each institution.

The six museums we selected for mini case studies were:

- Bradbury Science Museum, of Los Alamos National Laboratory in New Mexico
- Ruben H. Fleet Science Center in California
- North Carolina Museum of Life and Sciences in North Carolina
- Children's Museum of Indianapolis in Indiana

- DaVinci Science Center in Pennsylvania
- Oregon Museum of Science and Industry in Oregon

FINDINGS

The six vignette institutions ranged in size from those serving over one million visitors from all over the world per year, to a very small science museum with a total of only nine employees. They also represented a range geographically, with museums located in rural, suburban, and urban areas, including the Pacific Northwest, Southwest, Mid-West, Northeast, and Southeast regions.

Map of Vignette Sites:

The missions of these institutions also varied markedly. One was a children's museum. Another promoted adult and life-long learning. One served as the public face of a top-secret research institution, while another focused on biotechnology. Even with such a wide range of goals and purposes, each interviewee described how their involvement with NISE Net enabled them to further the mission of their institution in some notable way. The Network provided opportunities for institutions to access the cutting-edge research in their region, and to connect with research scientists they had previously been unable to collaborate with. In addition, these institutions were able to develop programs and products for nanotechnology, an area that had remained untapped and was difficult to capture working in isolation. For scientists we spoke with, NISE Net and their collaboration with museums increased the public audience for the scientists' work, while allowing them to address the Broader Impact requirements for their own research grants.

EACH VIGNETTES SERVES AS A DIFFERENT CASE OF THE VALUE-ADDED OF THE NETWORK

Each vignette concludes with a brief synopsis of what we believe the story is a case of. This section provides a preview of the six cases presented in the vignettes.

The story of **Bradbury Science Museum** is one in which, through NISE Net, the public face of a classified research institution (Los Alamos National Laboratory) is able to present cutting-edge science research that is relevant to the research being conducted at Los Alamos. While the mission of Bradbury involves translating Los Alamos' research for the public, Bradbury is often challenged to learn about the top-secret research to begin with, much less figure out how to translate it for the public. Nanoscience education is a perfect interface for Bradbury and Los Alamos abs. In addition, the NanoDays activities served as a concrete mechanism for scientists from the Center for Integrated NanoTechnology (CINT) to become actively involved with the science museum.

Reuben H. Fleet is a case of a relatively large institution with multiple audiences and a mission to present a range of science topics to those audiences that expanded their interest and capacity to present nanoscience through a connection with NISE Net. While nanoscience is not high on the list of priorities for Fleet, there is now a solid repertoire of resources and human capacity to continue to build and offer special events. Moreover, they have initiated connections with local nanoscientists, and are hopeful to create more.

The **North Carolina Museum of Life and Sciences** vignette tells the story of how, through its participation in NISE Net, a medium-sized museum in a prime location has been able to access and leverage partnerships with nearby research institutions, as well as with distant fellow informal science education institutions to broaden the public adult audience for the museum and for research institutions. Prior to its involvement in NISE Net, this museum functioned in relative isolation with no focus on nanoscience or adult learning, or connection with cutting edge science research. The additional partnership projects and collaborations NCMLS has formed through NISE Net are numerous, will last well beyond this project, and will serve as evidence of the lasting legacy of NISE Net.

The **Children's Museum of Indianapolis** is a case of a large, urban children's museum with a dedicated space to a related topic—biotechnology—that was catalyzed to take on nanoscience because of its relationship to biotechnology and because of the NISE Net's readily available resources. Without NISE Net, it is not likely that The Children's Museum would have so easily incorporated nanoscience into its programming.

The **DaVinci Science Center** is a case of a small science center with a small budget that has been able to expand and improve its existing programs through the resources available through the NISE Network, and through the new relationships and connections with local research scientists and universities that it has established as a direct result of NISE Net. While the DaVinci had taken steps to address nanoscience in their museum prior to

learning about NISE Net, their involvement with the NISE Network truly catalyzed their efforts. The NanoDays kit was a no-cost, already vetted option for DaVinci to extend their current nanoscience offerings. Other resources, such as the nanoscience expertise available through MRS and MRSEC allowed DaVinci to further improve their activities and programs. Perhaps most importantly, NISE Net provided an existing structure for a materials science professor from Lehigh to collaborate with the DaVinci Science Center—something he had long wanted to do but didn't know how to go about it.

Oregon Museum of Science and Industry's involvement with the NISE Net is a story of a relatively large museum that was already well-respected, particularly in the areas of collaboration and exhibit development, but still had much to gain through it's involvement in a national network of museums. The museum was able to develop programs and products for nanotechnology, an area that had remained untapped and was difficult to capture working in isolation. OMSI continues to serve as a bridge among small and large museums as a hub leader and exhibit developer. Furthermore, it will continue to advance its work in diversity and access, and societal implications of nanoscience and technology, while it explores other outreach opportunities such as after-school and community programs.

SUMMARY

The museums represented in these vignettes were able to use the resources, knowledge, and capacity available through NISE Net to revise and improve their programs, and to create new programs. It is worth noting that the primary avenue through which four of the six vignette institutions accessed the Network was NanoDays, which were reportedly hugely successful. The other two vignette institutions have since taken on roles as hubs, which means they are now, in turn, contributing to the leadership of the Network itself.

Each of the six vignettes portrays the value-added of the NISE Network in the museums' efforts to bring nanoscience education to their communities and audiences, and importantly, the added value takes different forms at different institutions, demonstrating the diverse options and resources available through NISE Net. The Network increased the capacity of all of the vignette institutions to provide nanoscience education, and it has enabled nanoscience education efforts that would not have existed had the support and materials not been available. In other words, NISE Net provides enabling factors that catalyze the nanoscience education work and improve it.

Enabling factors include:

- NISE Net's connection to local research scientists, often through its relationship with MRS and MRSECs

- The reputation of NISE Net for providing scientists with opportunities to fulfill the Broader Impacts requirements of their own grants

- The NanoDays kits, which are consistently reported to be high-quality, useful materials

- No-cost or low-cost resources available online

- Face-to-face contact and support available through hub meetings

- Specialized interest groups tackling subjects such as: diversity, equity, and access; programs; and public forums

NISE Net has served as an established and structured mechanism for any institution or individual interested to become involved with nanoscience education and collaboration, and to further leverage its work in the Network to create new opportunities.

Bradbury Science Museum, Los Alamos National Laboratory

The Bradbury Science Museum in northeastern New Mexico is unique among museums in a few ways. It is a small museum with only nine employees, located in a relatively remote area—there are only three science museums in the whole of the state. The mission of the Bradbury Science Museum is to serve as the interface between the public and a top-secret research institution, Los Alamos National Laboratory. Generally, the museum attempts to develop and implement exhibits and programs that are engaging to the public but also inform the public about the research at the lab. While nanoscience is indeed a subject of research at Los Alamos, it had not been addressed by the Bradbury Science Museum prior to its involvement in NISE Net. According to one of the two science educators at the museum[1]:

> *We were looking for something new, something different that we hadn't done before and we are connected to Los Alamos National Laboratory. Some information came in the mail and I thought 'this is new, we haven't done anything like this before'. Since I knew that the Los Alamos Labs does work on nanotechnology, it was a nice tie-in for us.*

The other science educator added:

> *Because we have the Center for Integrated Nanotechnology (CINT) here at the laboratory, we are always encouraged to tie what we teach to the laboratory and I thought well, this is one that we haven't tried to tackle yet.*

The specialty of the CINT, which is a collaboration between Los Alamos National Lab and Sandia National Laboratory in Albuquerque, is working in the micro to nanoscale interface, so there is a great deal of atomic force microscopy and nanotube work being conducted at the Labs. The topic of nanoscience is one of relatively few that the Bradbury Museum could present to the public. Because of the high security clearances needed to obtain almost any information about research being conducted in the Lab, the Bradbury Science Museum faces a continual challenge of figuring out what to present. One of the science educators confessed to us:

> *We have a hard time as educators at the museum and the museum is what we call out of the fence up here, and what that means is, we don't have security clearances and a lot of the scientists work behind the fence. We are in front of the fence. We are a public institution and so we have trouble bridging that gap at times—milking information out of the lab. We have to go out into the world to find out what they are doing on the other side of the fence.*

[1] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker.

The other science educator added:

> *There are about 20 programs that we do and of them, only 2 or 3 have a really nice connection with what the Lab does. The laboratory is involved in Stockpile Stewardship, maintaining nuclear weapons, what are we supposed to do with that? This is something that was really exciting to us because, we do 'do nanotech' here and it is something we can talk about.*

Yet figuring out how to reveal the topic of nanotechnology was daunting for the Bradbury Science Museum without NISE Net:

> *I don't think we would have probably attempted the nanoscience topic without the support of this network. We are very busy and we have only three educators and we have to choose what we want to spend our time on. I think NISE Net really gave us a jumpstart. It never really occurred to us.*

Upon receiving a NanoDays kit, the science educators at Bradbury began to read background information on nanoscience, which according to one educator, they "hadn't done before." They went online to learn what was happening within the Los Alamos Lab and how they could tie it in with the kit. After developing some of their own activities, they ran a one-day NanoDays event. Importantly, the event motivated approximately 12 volunteers and scientists from CINT to visit the museum and run a few of the activities. According to one science educator, scientists from Los Alamos only participate in events at Bradbury about once or twice a year:

> *The scientists are very busy, and so it really has to be something that they feel is important.*

The kit proved to be particularly useful for the Bradbury Science Museum, as one educator reported:

> *We used everything in the kit. Actually that summer, after we did the one NanoDays, we did demos on our museum floor and the whole entire topic for the whole summer was nano. Every week we took a different part of that kit basically and most of them were in the kit. Each week we would do something different.*

Since the NanoDays of last year, Bradbury has continued to be involved in NISE Net, attending the regional hub meetings, which they found particularly helpful, and collaborating and sharing activities online with the Science Museum of Minnesota, Pacific Science Center, and the Children's Museum in Seattle.

One science educator at Bradbury summed it up by saying:

> *We are really excited about how well we have stepped up to the plate. Our NanoDays went off really well and the way that all things sort of bloomed and took on a life of their own… it was really something that happened way beyond our expectations. Really the question at first was, 'how on earth can you teach*

something you can't see?' Nanoscience is really very high tech but also impossibly small, and these are two really big problems when you are dealing with a general audience.

The story of Bradbury Science Museum is one in which, through NISE Net, the public face of a classified research institution is actually able to present cutting-edge science research that is relevant to its mission. In addition, the NanoDays activities served as a concrete mechanism for the scientists within the Center for Integrated Nanotechnology to become actively involved with the science museum.

Ruben H. Fleet Science Center

The Ruben H. Fleet Science Center is located in Balboa Park in the city of San Diego, California. Balboa Park is considered a "hot spot for cultural attractions" in San Diego—in addition to Fleet, there are numerous art museums, a natural history museum, an air and space museum, a zoo, a history museum, a performing arts center and many other pulbic cultural organizations.

Fleet hosts approximately 550,000 visitors each year, with 100,000 of them education or school group visits. Of the school visits, approximately 12,000 of them are paid for via scholarships. Fleet features a wide variety of science topics, and has an ongoing partnership with the Exploratorium, whereby the Exploratorium develops exhibits for Fleet that they display temporarily. Fleet also offers a host of public and school programs, such as lecture series, Family Night, and summer camps.

NANOSCIENCE EDUCATION AT FLEET

In 2006, the (now former) Education Program Coordinator at Fleet viewed a television program created by Dr. Ivan Schuller, a scientist Fleet has collaborated with in the past. This program, "When Things Get Small," prompted the program director to contact Dr. Schuller, and from there they collaborated on creating an event in December of that year. The event—called "Nano Tech Day"—involved airing the video throughout the day, and presenting two lectures—one geared toward families on the topic of nanoscale science, and one for a more science-attentive audience on quantum physics. They were pleased with the event, but were not sure where to go next.

In October of 2007, a few staff members from Fleet noticed the NISE Net booth at ASTC and gathered information about NanoDays, which they held at Fleet in March 2008. In addition to using the resources contained in the NanoDays kit they received, they had planned to receive the traveling exhibition "Strange Matter" during the same time frame, and their exhibits team connected with a German exhibit developer that created a CD about nanoscience that could be uploaded to a kiosk. And, they still had the video "When Things Get Small" from their 2006 event. In all, they were able to draw from several sources—including, but not limited to NISE Net—for their NanoDays event that year.

Nanoscience was of interest to Fleet because of its commitment to keeping up with new ideas and emerging science, as the current Program Coordinator explains:

> *Nanoscience was new and it wasn't something that you heard about every day at that point. That is something that always appealed to us, presenting information to the public that is new and sometimes controversial and making them aware of what is going on and making it accessible to them in a way that they are able to understand.*

Following ASTC in 2007 when the first contact with NISE Net was made, representatives from Fleet attended the November 2007 NISE Net Annual Meeting in San Francisco where they became further connected to the Network and other institutions getting involved in nanoscience education. In September 2008, the program manager attended the regional workshop at OMSI and became part of the Lawrence Hall of Science-led regional hub.

In December of 2008, Fleet held its usual Family Science Day event on the third Saturday. The topic was slated to be math, but the program staff wanted to incorporate some of the new nanoscience education activities they received following the regional meeting. They changed the theme of the day to "scale," and decided to use some new and previously implemented activities to determine what they might do for NanoDays 2009.

This year, a private citizen group in San Diego launched the Science Festival in San Diego, which spans the month of March. As part of the culminating activities in early April, Ruben Fleet will be participating in an event run by faculty in the bio and nanoscience engineering departments at the University of California San Diego called "Small Wonders." Activities for high school students will be developed, and the program director at Fleet is planning on attending to learn about the activities and perhaps make new contacts with other researchers in the area to expand their nanoscience activities.

THE NETWORK AS A RESOURCE

The nanoscience education activities at Fleet have been strongly influenced by the Fleet's staff interactions with NISE Net. After the NanoDays activities in 2008, the Program Coordinator searched the reports that were posted on nisenet.org to learn more about how other institutions implemented their activities. Later in the year when she and a colleague attended the regional workshop in Portland, she was able to meet and discuss strategies further. Then, in December when she was planning their Family Science Day, she reconnected with people she met through the workshop and the website to get ideas and inspiration.

About the value of NISE Net as a resource, she stated:

> *I think that everything has been improving over time. Their ability to collect everyone's data and compile it, adapting and providing these tools and resources, it just keeps getting better and better. Providing more and more resources and researchers and information on forums and science cafes—they just keep expanding the amount of the support that they provide. I am continuously surprised by all that they are able to offer, both through the online community and network as well as the kits and their support at the conferences and workshops. I have already gotten 2 or 3 emails from people making sure we received all of our materials. They definitely are on top of things and provide the right support and the materials do just keep getting better and better.*

They have tried many of the activities from the kits and other resources with their audiences, and most of what they tried was adapted from its original version. Like many other institutions we have surveyed or interviewed, the core ideas in the activities are a useful foundation upon which program staff have built for their particular audiences. She explains:

> *At our first nanoscience event, we tried all of the activities from the kit and there were some that we decided that we didn't really feel the need to try again. They didn't work with our audience or we weren't able to really utilize them in the way they should be utilized. Whether it be our ability to explain it to the audience without that background, or the age range of our audience, and whatever those limitations were, we just decided it wouldn't be a good fit for us the following year. So we adapted and chose those activities that we wanted.*

The Program Coordinator anticipates further interaction with NISE Net and looks forward to following the progress of the Network and new resources that are developed.

Fleet is a science center that attempts to feature a wide range of science topics, which means the extent of nanoscience education programming offered outside of special events like NanoDays will likely be limited. While the program director would like to do more, nanoscience education is not as high a priority as other science topics. However, according to the Program Coordinator, there is no doubt that the nanoscience work they have done since connecting to NISE Net is far superior to the programs they tried before. She explains:

> *For our 2006 event, when we weren't connected with the NISE Net, there was a clear distinction between what we were able to do at that event. We had no hands-on activities. In 08, we had that direction and that guidance in terms of the hands-on activities. Now this year, we know what we like and what works, and so we are able to really provide those activities that we think will be best for our audience, as well as some new activities which the NISE Net has developed over the past year. We also then expanded beyond that to include UCSD. The co-chair of the Department of Nanoengineering is going to be taking us on a virtual tour of their electron microscope facility. Our patrons at the presentation will be able to see these demonstrations*

that relate to activities that they already did and actually interact with this professor and talk to him about what is going on.

Reuben H. Fleet is a case of a relatively large institution with multiple audiences and a mission to present a range of science topics to those audiences, and expanded their interest and capacity to present nanoscience through a connection with NISE Net. While nanoscience education is not high on the list of priorities for Fleet, there is now a solid repertoire of resources and human capacity to continue to build and offer special events. Moreover, they have initiated connections with local nanoscientists, and are hopeful to create more.

North Carolina Museum of Life and Science (NCMLS)

The North Carolina Museum of Life and Science (NCMLS) occupies more than 70 acres of Durham, with 90,000 square feet of indoor space and 13 acres of outdoor exhibits. The museum also boasts an auspicious location within the "Research Triangle" of Raleigh, Durham, and Chapel Hill. Within or near the Research Triangle are four research universities (North Carolina Central University, Duke University, North Carolina State University, and University of North Carolina at Chapel Hill) as well as over 60 research companies and institutions, such as IBM, Dupont, the CDC, the EPA, Merck & Co, National Semiconductor, GlaxoSmithKline R&D, and Verizon.

The museum changed its mission in 2005 and it is currently stated as: "to create a place of lifelong learning where people, from young child to senior citizen, embrace science as a way of knowing about themselves, their community, and their world." To achieve this mission, the museum has an "unyielding commitment" to providing experiences that allow people to "recognize that the results of scientific inquiry and technological innovation profoundly influence the way we work, communicate with one another, stay healthy and play…" Despite changing its mission to achieve life-long learning, prior to NCMLS's involvement in the NISE Network, the museum offered very few, if any, programs or products focused on adult learning; traditionally, the science center was oriented toward families with young children. Also, despite its goals, prior to NCMLS's involvement in NISE Net, the museum had not leveraged its prime location among these research institutions to enhance museum programs and exhibits in nanoscience. The museum had not been able to access entry points that would allow or facilitate its partnering with the very universities and research institutions that surround NCMLS. Finally, the museum was "doing nothing about nanoscience prior to NISE Net" according to the museum director.

NCMLS became involved in NISE Net through the museum's current CEO Barry Van Deman, who came to the museum from the National Science Foundation where he promoted the concept of investing in a network of museums to communicate nanoscience research. Arriving at NCMLS, Van Deman sought out opportunities for NCMLS to engage with NISE Net. During its first year of involvement in NISE Net, NCMLS was able to

collaborate with the University of North Carolina (UNC) to develop the NanoManipulator. The NanoManipulator was born when a team of UNC computer science researchers met with physicists and together with a team from Harvard, developed software that enabled a computer to talk with—and control, via a joystick—an atomic force microscope at another location. Through the nanoscience connection, NCMLS was able to leverage its partnership with these researchers and create new and improved programs and exhibits. First, the museum bought a high-powered desktop computer on a cart that would be rolled onto the museum floor and allow museum visitors to actually see and "feel" a virus and other nanoscale images. Then the museum loaded the software onto a laptop and now NCMLS can offer a mobile program so students off-site can share this same experience. Finally, they've created a live link to an atomic force microscope on UNC's campus that allows visitors to manipulate carbon nanotubes that are 15 miles away, in real time. This extraordinary experience has been very popular with visitors and is now becoming part of the NanoDays event at NCMLS. In addition, another museum educator at NCMLS borrows NanoDays kit items and an adapted NanoManipulator and conducts nanoscience programs on the floor for visitors on a rotating basis every two weeks.

When we asked the scientist from the University of North Carolina who worked with the museum staff on this project to describe the relationship he has with NCMLS, he described his experience in a very positive light:

> *I really feel like it is a collaboration. I get a lot out of it. First of all, this project that I just described to you, that was a lot of fun and that was truly a partnership. The museum staff were coming over here and meeting with me, another scientist, and the scientist's graduate student, to think about how we could do this. We drove that project with the museum staff's input of course. It was a 50-50 thing. Their input was, 'how is this going to work within a museum setting?' and our input was, 'let's put some science into this interactive'. That was really fun and we actually created something from scratch. Because it is not a one-shot deal, where they are just inviting me over for a forum… this is ongoing and I talk with them periodically and so it really does feel like a collaboration. They are awesome and they are really great to work with.*

When we asked the NISE Net program manager at NCMLS whether this partnership with researchers in the Triangle would have happened regardless of NISE Net, his immediate reply was, "it would *never* have happened without NISE Net because we didn't have the money… we certainly didn't have the contacts or would have even known about this program." In fact, the museum's involvement in NISE Net prompted the museum to start thinking more strategically about partnerships in general. Then:

> *As we became more involved in NISE Net and we realized the potential of hooking up with scientists in our area and what we could gain from it, we created this whole new department, which is the Innovation and Learning Department. We are really out there now just going after these scientists and saying, 'you know, here is what we have done with the NISE Net and we have partnered with these folks and we found that it is just a really great match, to partner with these scientists and we have the public and you have the knowledge, lets put the two together and create some really engaging programs and exhibits'. And we have done that.*

Not only has involvement in NISE Net allowed NCMLS to access and partner with the rich resources in the immediate area, it has also proved to increase the public audience for researchers' work. The NISE Net Program Manager at NCMLS said:

> *In the past, it was like, 'this would be neat to do' and maybe here or there we would do something small but now, partnering is what we have been focusing on for the past four years, and there has been money there to back it up and allow us to go out. Three years ago, when I first started in this position, we were really struggling to connect with folks and trying to find out what was going on. Now they are all coming to us and they are just popping up everywhere saying 'hey we want to work with you.' Three or four years ago, it was us going out to them. I think it is because they are starting to see the potential in what we can do and they see the numbers of the public that we can reach.*

A scientist from the University further described the potential benefits of working with NISE Net to engage the public:

> *When I sit down to write, you can imagine when I sit down to write my NSF broader impact statement, when I am writing a proposal, I have pretty impressive things to write about, right? I have all of this interaction with the museums and not only the Museum of Life and Science, but the museum here on campus, this other outreach stuff, and then the NISE Network, it is all over the place in those paragraphs that I write. It is a symbiotic thing. I think for those that are willing to take advantage of it, there is a lot there to use… Efforts like the NISE Network are easy avenues for folks to go out and do that, and they will become more skilled at interacting with the public.*

The museum's Vice President of Innovation and Learning provided another concrete example of how NCMLS' work with NISE Net has led to other projects that help researchers engage with the public, as if to further emphasize the point:

> *We've developed a model for engaging researchers as a result of NISE Net. It's not just getting proposals but bringing researchers in and creating models for the public to engage with those researchers. For example, we've collaborated with the Institute for Genome and Science Policy—which is funded through the National Institutes of Health—at Duke University. This program brings together 7th graders and their families with genomics researchers over a meal. Our project is looking at how interacting with the public influences the researchers and also looking at how interacting with the researchers influences the public. The potential implications are huge.*

Through its involvement and work with other museums in NISE Net, NCMLS has further developed expertise in public programming with its public Forums work. According to the museum's Vice President of Innovation and Learning:

As a result of the Forums work, we developed expertise in public programming, and how to communicate current issues around technology and society and nano. We've learned about this from the work of MOS, OMSI, SMM, and Exploratorium. That programming never existed here before. Now we run a once-per-month Science Café, which brings the community together on the 2nd Tuesday of each month. We bring together researchers who talk with about 60 people. Then the people engage each other. It's a whole new area of endeavor for us.

Very importantly, when asked whether the museum's involvement in NISE Net had influenced the work of the institution in other ways, the Director of NCMLS said, "oh yes, you would not believe the number of projects and grants we are a part of now that are directly attributable to NISE Net" and proceeded to describe over seven different grant proposals, projects, and collaborations with other museums (such as Science Museum of Minnesota and Pacific Science Center) and research institutions (such as Duke University, UCLA, and Michigan University) that came about specifically because of the museum's participation in NISE Net.

When asked whether NISE Net is functioning as a network—whether there is true collaboration and value-added through the NISE Net—the program manager at NCMLS said:

Yes, to a large extent and I think there are two different networks that are being formed. One I alluded to earlier, and that is the network of the scientists and the researchers in our area who are starting to know of us and hear of us and want to work with us. We have got two young nano scientists—one came to NC State and one came to Duke—and they both sought us out because they had heard about the network, wanted to be a part of it, wanted to help us with NanoDays, and wanted to help us create programs. So, I definitely think that this network between the scientists and our museum right here in our little niche is definitely taking off and growing.

The NISE Net program manager at NCMLS described how the museum has increased its own capacity to provide nanoscience education but also how NISE Net increases the capacity of other museums to provide nanoscience education in general:

Then I think there is also a network of museum professionals who are really gaining a lot from this network and working with different museums. We have all become really good friends, which is unique. We don't consider ourselves colleagues so much as we do friends. When I wanted to create this Periodic Tables program, I called the folks up at [another museum] and was like 'hey, do you mind sharing your budget with me and what you guys do?' I really felt like I could place that phone call, because I knew that person really well and we have met many times. Otherwise, I would be kind of sitting here, and I may never have had the idea, but even if I did have the idea, who would I contact? I wouldn't even know who to contact and so there are all of these museum professionals that I have become aware of and I know what they are doing outside of NISE Net and that can lead me into creating contacts. Even with other folks here at the museum that are doing stuff I hear about and I am like' oh, I heard about this other museum doing this same program and you

should talk to so-and-so who is a really good friend of mine who works there'. So I have created those connections with some of our own staff here who may have never had that connection otherwise.

The museum's vice president explained his view that NISE Net offers specialized benefits to smaller and medium sized museums:

The larger museums are engaged in so much innovative behavior already, and have budgets that allow them to experiment in a way that smaller museums just don't have. It is really important not to lose sight of the fact that we couldn't have made those decisions and transformations without the experience of the larger museums. We are making some contributions through the regional workshops… but we needed their [the larger museums'] experience and help to get us where we are now.

This particular vignette tells the story of how, through its participation in NISE Net, a medium-sized museum in a prime location has been able to access and leverage partnerships with nearby research institutions, as well as with distant fellow informal science education institutions to broaden the public adult audience for the museum and for research institutions. Prior to its involvement in NISE Net, this museum functioned in relative isolation with no focus on nanoscience or adult learning, or connection with cutting edge science research. The additional partnership projects and collaborations NCMLS has formed through NISE Net are numerous, will last well beyond this project, and will serve as evidence of the lasting legacy of NISE Net.

The NCMLS Vice President of Innovation and Learning concluded by saying:

This NISE Net grant has been truly transformative for my museum. It's changed the way we practice, the way we think, the way we view our audiences, and who we can support and serve. It has succeeded for us far beyond what we imagined.

Children's Museum of Indianapolis

The Children's Museum of Indianapolis (CMI) is located in the heart of downtown Indianapolis. As the "largest children's museum in the world," the CMI houses 11 major galleries in a facility measuring over 400,000 square feet located on 19 acres of land. The museum receives over 1 million visitors per year from all over the world.

In addition to the exhibit space, the museum also contains several classroom or lab spaces for school groups and public programs. One of these spaces is the Biotechnology Learning Center, sponsored by Dow AgroSciences. In this Center, visitors experience hands-on biotechnology lab activities primarily related to plant science. The Learning Center serves both school groups and the general public.

In early 2008, the Science Museum of Minnesota shared information about the NISE Network with the CMI education staff, who in turn passed the information on to the

Biotechnology Learning Center Supervisor. Consequently, he explored nisenet.org, and learned about upcoming NanoDays opportunities. Too late to receive a physical kit of materials for that year, he registered himself on the site and downloaded the digital kit.

Using the kit as a resource, this supervisor and his staff developed activities that they implemented during NanoDays 2008. Over the course of five days during that week, he and his staff ran five programs each day, primarily investigating the properties of stain-resistant nanopants. The success and popularity of the lab with the visiting public motivated them to continue offering the program on a monthly basis, which they continue to do today.

In the summer of 2008, he and one of his colleagues attended the Science Museum of Minnesota regional workshop. At the workshop, they met other informal educators who were attempting to implement nanoscience in their museums. While they found the networking opportunity useful, he admitted he has not had the time or opportunity to follow-up with anyone since the workshop.

This year, the Learning Center supervisor ordered the physical NanoDays kit for 2009, and has also applied for a program kit (as of this writing, he has not heard if he will receive one). For NanoDays this year, he plans to train more staff on using the materials, and will offer more activities for the full week. Also, he is working with the gallery manager within which his lab is housed to offer table-top activities and demonstrations on the museum floor. In preparation for NanoDays, up to 10 staff and volunteers will be trained to deliver nanoscience programs and activities at CMI.

He finds the most value in the resources and materials that the NISE Net has developed. Typically, he modifies activities or programs for his audience, and NISE Net's materials provide a useful starting point. If he needs input or feedback, he knows he can contact the Network and will find someone who could assist him. With respect to connecting with local scientists, he understands that it is an important part of what NISE Net is trying to accomplish, but doesn't currently have the capacity to follow up on the suggestions that were made at the regional workshop (such as Purdue). Further, he does not feel connecting with nanoscientists is his highest priority. Most of his time is spent maintaining relationships with the corporations that fund his lab space, like DOW and Eli Lilly.

Within the context of a large children's museum, there are many competing priorities. For example, February is Black History Month, and he is planning programs focused on George Washington Carver and his contribution to southern agriculture. There is also a new Lego exhibit in the museum that he is connecting to through the concept of modeling.

While there has been some talk of bringing in permanent nano-related exhibits, at this time his priorities are connecting to other themes present in the galleries. There has also been a

discussion about using some of the NanoDays activities with teachers at educator nights at the museum, showing teachers how to incorporate nanoscience in their classroom teaching. The Science Programmer, who also attended the regional workshop, reported that the extent to which nanoscience is included in school programs depends on how "creative" they can get with respect to making the connections from their exhibits to nano. She explains:

> *I think one thing that we have to do is be a bit more creative and look for connections. We have a great dinosaur exhibit. We have a water exhibit. We are taking a look at ways we can connect nanoscience [to those exhibits]. It might be a loose connection, but can we find some research that somebody is doing using fossils in nano, or water in nano? It is just figuring out an exhibit element, [and asking] is anybody doing anything related to that. We just haven't taken the time to do that.*

The Children's Museum of Indianapolis is a case of a large, urban children's museum with a dedicated space to a related topic—biotechnology—that was catalyzed to take on nanoscience because of its relationship to biotechnology and because of the NISE Net's readily available resources. Without NISE Net, it is not likely that the Learning Center Supervisor would have so easily incorporated nanoscience into the programming in his lab space. As he explains:

> *It is hard to come up with ways to explain nanotech to children, it is an abstract concept and something you can't see, so when you get into those fields, it is hard to come up with stuff on your own and useful to have ready resources.*

DaVinci Science Center

The DaVinci Science Center is located in a new 29,000 square foot facility at Cedar Crest College in Allentown Pennsylvania. Prior to moving there in 2005, the Center existed for 10 years in a former Bethlehem Steel Plant office building in Bethlehem, PA. An independent nonprofit organization, the DaVinci Science Center promotes hands-on science through inquiry, and highlights career opportunities in science. "The Seven Principles" as named by Michael Gelb as traits that made Leonardo da Vinci one of the most influential geniuses in history, provide a framework for design and promotion of inquiry science at the Center.

In 2008 the Center served more than 75,000 people. The exhibit floor boasts 200 hands-on exhibits, and programming targets a range of community audiences including professional development for school teachers such as its "signature Da Vinci Teacher Leader Institute for elementary teachers," public programming such as its Seniors Workshops, and a host of K-8 after school programs including science camps for kids.

NANOSCIENCE EDUCATION AT DAVINCI–PRE-NISE NET

Efforts to bring nanoscience and technology to the DaVinci Science Center audiences began prior to their knowledge of the NISE Network. Through collaboration with Lehigh University four years ago, and with funding from NASA, the DaVinci Science Center created an in-house exhibit about nanotechnology. And in 2006, two years before they knew about the NISE Net, one of the science educators at the Center, attended a series of programs at the Penn State Center for Nanotechnology Education and Utilization. She had this to say,

> *Our center itself is very supportive of doing nanoscience education. I went to the first conference, with Penn State and I came back with some information and general excitement. We are always looking for professional development for our educators because if you get excited about something, we can turn it into a program here that may help the community. So when I wanted to go to the second one, which would take me out of the building for 3 days, even at no cost, it was still a decision, because it is staffing time. They were definitely willing to do that with the understanding that I would come back with some way of turning this into programming, which I was able to do with our classroom and also turned a lot of nanoscience education into summer camp. We actually had a Dragonfly grant that we did a summer nanoscience education camp program.*

This experience was instrumental in terms of supporting efforts to bring nanotechnology into the programming at DaVinci. In 2007, the DaVinci Science Center offered its first nanotechnology Senior Monday event. The Penn State program also resulted in developing a nanoscience education program for their middle school student programs including their summer camps, which also received funding through Dragonfly TV.

At about the same time, in 2006, at nearby Lehigh University, a professor in the materials science and engineering department was invited by a colleague at Cornell University to join the Materials Research Science (MRS) subcommittee that would work with NISE Net. This was the beginning of his ongoing commitment to nanoscience education through NISE Net.

AN INTRODUCTION TO, AND ENGAGEMENT WITH, THE NISE NET

Then in 2007, posted on an ASTC list serve was an article about the NISE Net 2008 NanoDays. This caught the attention of one of the science educators at DaVinci and she contacted NISE Net to receive the first NanoDays kit:

> *We are always looking for any kind of outside programs that we can bring into something that we haven't done in the past... We were in the process of doing a nanoscience exhibit and so it fit hand in hand. The other thing that was really favorable for NanoDays was that the kit is included at no-cost, and since funding is always an issue for us, it allowed us to program without any extra cost. That was a really big plus.*

She notes that this is when and how she first learned about the NISE Net. The NanoDays kit materials and other NISE Net resources were also used to modify their existing nanoscience programs.

> *Before NISE Net, through my two programs with Penn State, I had developed a nanoscience program for middle school student. With the help of NISE Net, we modified that. I have used NISE Net and some of their suggestions to improve it… I was able to find the website in Madison University of Wisconsin (MRSEC); there is a lot of nano stuff on there, which I know is tied directly into NISE Net, and so I used a lot of that.*

At Lehigh, the professor had a strong interest in connecting with DaVinci, but without a specific, concrete way to do that had not made the move.

> *I got here at Lehigh in 1998 and for a number of years I had wanted to establish connections like this, but for various reasons, inertia being the primary one, I never really got around to cold calling… "Hey I'm here I'd like to play, is there something we can do together?" I was excited about having a structured mechanism to introduce myself… NanoDays was really the catalyst for all of this. I'm personally just thrilled that NanoDays exists because we needed an excuse to form a relationship and it needed to be very specific about what we were going to do and how long it was going to last, rather than some sort of nebulous connection like "I'm on a list of experts should you ever need to call me, which just doesn't get anywhere. The list just goes in a drawer and everybody's busy and you just never talk.*

NanoDays 2008 therefore was a concrete reason and event that instigated a new and motivated collaboration between the DaVinci Science Center and Dr. Rick Vinci, the materials science professor at nearby Lehigh University and a member of the NISE MRSEC committee. As another science educator at DaVinci describes it,

> *We got in touch with him through NanoDays. He knew he wanted to do NanoDays and we knew we did, and he contacted us because we didn't know him at the time and said, 'I have got some people and I would like to come over and do it with you all and we said 'okay'.*

The event was a success. Staffed by DaVinci personnel and Lehigh faculty and seventeen undergraduate and one grad student, the event was a combination of the kit-based activities and current materials science research and activities from Lehigh. An estimated 200 participants of all ages attended and found activities and information tailored to their levels of knowledge and interest. DaVinci staff talked about how the way they organized the event reached their audiences:

> *The kits are geared more towards children, which is exactly what they should be, but when Lehigh brings their research, they are bringing things on a different level and the parents are usually interested in that. That is right out of NISE Net and that is from NanoDays.*

We got in touch and we met face to face (at DaVinci). What we ultimately settled on was a one-day exhibition of activities on a Saturday that would be put on by Lehigh undergraduate students in the materials science and engineering department for the target audience of kids K-6. It would emphasize nanotechnology as it relates to nanomaterials because that is something that we have some pre-existing knowledge about and demos.

Additionally, one of the staff described her first encounter with nanotechnology and the role the NISE Net kits and support played in bringing her up to speed.

My background in nanotechnology was at zero when I first started, and Ruth here, she walked me through them, matter-of-factly, easily, and I definitely understood how to use them and what I was trying to get across. The kits for the NanoDays are amazingly well put together with background and usability.

Since NanoDays 2008, two DaVinci science educators have participated in two regional "hub" workshops. In September one attended the workshop at the Sciencenter in Ithaca, and in January another attended the regional conference at the Franklin Institute in Philadelphia. The Powerpoint® presentation Ruth received at the September meeting was particularly useful for their Seniors Workshop, which had more registrants than they had room for, and also attracted local Channel 2 News coverage:

When I went to the conference at the Sciencenter in September, they gave us a PowerPoint of how to teach nanoscience to the general public. I took that PowerPoint and modified it slightly to fit some of our needs and presented it. I also used some NanoDays materials and some materials that I had from Penn State, and it was very well received. The senior citizens asked some amazing questions, were extremely interested in it and I think it went really well. That was really based almost 100% out of the work that I got out of NISE Net.

The Center and Lehigh are now in the midst of planning for this year's NanoDays, which will involve 30 undergrads. Resources ordered from the catalogue just arrived (five cart demos) and the new NanoDays kit came earlier this year, the timing for which was appreciated. Resources and support through NISE Net and the collaboration with Dr. Vinci at Lehigh have also resulted in revisions of courses offered through the Center camps, including a middle school course. When asked about the quality of the NISE Net resources, like the NanoDays kits, one DaVinci staff member had this to say about the materials and the support for the materials:

I think they are very self-explanatory. But I know just from going to the conference, that there are people I can call and they will answer me. They are very, very good at replying and answering questions. If I feel like I need help, I know I can get it very quickly, very promptly.

We were impressed with how thorough and thought-out the kits were. If there was water involved with the activity the kits came with a drop cloth and a sponge to clean up. Somebody who got the kit the day before could, in principle, open it up read it over, get familiar with it and without having to go shopping or anything like that could present the demo the next day. That was terrific... Some of the activities work better than

others… Having them ahead of time, the undergraduates were able to find out themselves which were the nifty ones and which were more on the duller side. They were able to augment the duller ones in many cases to make them more exciting.

CHALLENGES, SUPPORTS AND NEXT STEPS

A small Center with a small budget, DaVinci staff are encouraged by the management to bring new and exciting ideas into programming, but dollars are tight. Support for the work at the Center from NISE Net and institutions like Lehigh University and Penn State have been an essential ingredient in their ability to offer high quality nanoscience education programming.

Most of the stuff that we do here is all developed in-house, and our management is very supportive of our developing this kind of program. Nanotechnology is something for the future… However, without support from institutions like the Penn State programs and NISE Net, this never would have happened…

I don't think we would have the success we are having right now if it hadn't been for NISE Net and the support…We would probably not have done NanoDays if we hadn't received the kit at no charge.

From Lehigh's point of view:

One of the great things that's worth mentioning after we did this last year, my undergraduates were tired, but the vast majority of them were elated. They had a great experience working with the little kids, and most of them have come back to do it again this year and they brought their friends along with them. So if nothing else my own undergrads have had a great experience from doing this. I'm hoping that for many of them maybe this will give them a lifelong interest in doing this sort of thing, whether professionally or just on the side.

From a professional point of view, I have plenty of service activities on my resume, so in terms of advancement at the university it wasn't really going to do anything for me. But from the national perspective, the NSF encourages and even requires that there be broader impact through which outreach can play a role. I thought this would be a nice way of having a larger impact than I could usually have as an individual.

And they also guess they would not have established the win-win relationship with the professor and the materials science and engineering department and Lehigh University if it weren't for NISE Net.

We were both nervous last year about how this was going to go. We decided to trust each other and each other's organizations, give it the old college try. I was so happy at the end that she was happy that things had gone well…At that point we had established a certain level of trust and mutual respect. They know what they're doing down there. They're very good at delivering this kind of information to the public and they had a lot of good advice for us. We know what we're doing with regard to the actual nanoscience and we're learning how to connect that to the public, and we can deliver. We say we're going to do something we can do it. At that point we had a strong but young relationship.

When asked about their sense of what NISE Net is trying to accomplish, they stated:

> *Their goals are to (help us) understand what we are talking about first, to improve nanoscience education, and to encourage collaboration between informal science education and research… I think those are great goals.*

> *The general concept of connecting specialists, scientists, engineers with informal science institutions seemed to me to be a very good idea and something I thought was worth supporting.*

And finally, in thinking globally about NISE Net, they had this to say,

> *I wish there were more networks like this on other topics like space… or the ocean.*

Oregon Museum of Science and Industry

One of the museums to embrace the work of NISE Net most enthusiastically is the Oregon Museum of Science and Industry. Currently, OMSI plays a prominent role in several strands of the NISE Net work. OMSI has served as an important bridge between large and small museums, particularly given their expertise in partnerships and collaborations with rural organizations.

The staff at OMSI had been discussing how to bring nanoscience and technology education into their programs prior to learning about NISE Net. According to OMSI's Director of Research and Development (who has been at OMSI for about 13 years):

> *It was a direction that we needed to go… nanotechnology is one of those things that you will have a void if you don't get into it eventually. We had conversations where we were really interested in… where we talked about being up-to-date and making sure our technology hall, which was renovated shortly before NISE Net started, was up to date. We talked about how could we get some nanotechnology education at OMSI.*

OMSI was contacted by several institutions during the NISE Net proposal stage and determined to participate based on their experience with the three core institutions involved. They began the work with NISE Net relying on their expertise in exhibit development and fabrication and partnerships with rural libraries and small museums, as well as their desire to forge ahead in the area of public forums.

It might come as a surprise to some—since OMSI is well-regarded for its exhibit development process—that the institution has benefited from NISE Net in part by being able to come up with more development ideas. When the Director of R&D was asked how NISE Net has contributed to OMSI, she replied:

> *Being really pushed into an area that was hard [has been a contribution]. I think that nanotechnology is a hard topic to come up with programs and exhibits for, and to be able to work collaboratively, communally,*

with a bigger group, and be in key meetings in the early days, the NISE Net meetings, all helped. [Without NISE Net] we wouldn't have had the brains of all of the other partners, and we wouldn't have had the pilot trials in Minnesota when we took the exhibits there.

In terms of evaluating their products and programs, the Director described the value of having a collaborative of institutions that can try similar things and pool their sample sizes to give their data more power:

We wouldn't have known the meaning of our results, because our programs serve relatively small groups and so we have these small samples sizes. But when you have the same sample size in five institutions around the country, it begins to become meaningful data and you have got someone to talk to about it.

OMSI's role in the expansion efforts of NISE Net and as a hub leader has resulted in regional benefits as well.

I think we would be a little more silo-ed because we wouldn't have been doing expansion, and we wouldn't have been reaching out to all of these partners, which have helped us grow as we learn from them. At some level, I think that it has really enriched us a lot intellectually and pushed the field and how you delve into something that is really difficult. It really helped to have all of the feedback.

Politically, OMSI has benefited by a heightened profile among organizations such as the Oregon Nanoscale and Microtechnology Initiative (ONAMI), a collaborative of all the universities and businesses in Oregon that are working in nanotechnology. The Director of R&D described OMSI's deeper relationship with this group:

It is a fairly powerful political body here. We have given forums for one of our congresswomen, one of our senators, and one of our congressmen, that we have done on site with the Under Secretary of Technology, Robert Cresanti, who came out with Senator Wyden and did a roundtable here. You can't buy those kinds of opportunities.

Perhaps the area where OMSI has been able to grow the most as a result of NISE Net participation is its role in reaching public audiences.

I can't imagine that we would have gotten 10% of how far we have gotten with the the forums work, with the group meeting together and working things through on our own. I don't think we would have forums, and what we definitely would not have is be as educated about what we are doing.

OMSI's Science Pubs, the last of which drew an audience of 325 before they had to turn away an additional 80 people due to space restrictions, are a direct outgrowth of their Public Forums work in NISE Net. Furthermore, OMSI has worked harder to have a presence in the area of societal implications, where the social sciences interface with the STEM field, and has been awarded grant money from IMLS to continue its work.

OMSI's involvement with the NISE Net is a story of a relatively large museum that was well-respected, particularly in the areas of collaboration and exhibit development, that still had much to gain through it's involvement in a national network of museums. The museum was able to develop programs and products for nanotechnology, a subject area that had remained untapped and was difficult to address working in isolation. OMSI continues to serve as a bridge among small and large museums as a hub leader and exhibit developer. Furthermore, it will continue to advance its work in diversity and access, and societal implications of nanoscience and technology, while it explores other outreach opportunities such as after-school and community programs.

NISE Net

Interview Study with Scientists

May 2009

INVERNESS RESEARCH

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NISE Net
Interview Study with Scientists

Introduction

The Need

The National Science Foundation has invested significant funding for research and development in nanoscience and nanotechnology. Because this emerging interdisciplinary field of science offers so much potential but is often misunderstood, NSF is also deeply dedicated to increasing public awareness and understanding of nanoscience—what it is, how it works, and the potential societal and ethical implications of its development and use.

The NISE Network is intended to be a mechanism for national communication regarding nanoscience and education and engagement of the public. *The approach of NISE Net is to connect the scientific research community with Informal Science Education Institutions for the purpose of developing people, ideas, and tools that can address the challenge of communicating with the public on a large scale.*

NISE Net is thus meant to serve as a bridge—a kind of interface—between the science research community and the public. And as with any bridge, the connections on both sides must be carefully engineered. NISE Net is intending for informal science education institutions (ISEIs) to serve as this bridge largely because, NISE Net leaders argue, the ISEIs are capable of making connections with both the research community and the public, and translating between the two.

The Study Approach and Sample

In the Fall of 2008-2009, Inverness Research contacted NISE Net leaders to solicit names of scientists who were working with or had worked with the Network in some substantial way. Our purpose for the interviews was to determine the extent to which and the ways in which NISE Net has been able to create and support "win-win" relationships with scientists. We wanted to learn how the scientists became connected to NISE Net and, from their perspective, what benefits they experience as a result of their relationship with NISE Net, what contributions they feel NISE Net makes to their work and vice versa, and

their overall sense of NISE Net's effectiveness in communicating nanoscience to the public.[1]

Inverness Research (IR) conducted telephone interviews with 21 scientists. Each interview lasted between 30 and 60 minutes. The roles and positions of the scientists we interviewed ranged, and were distributed in the following way:

University professor / researcher	**6**
Science Center Outreach Director / Coordinator	**5**
Graduate Student	**3**
Professor / researcher AND outreach director / coordinator	**3**
Other	**2**
Researcher, non-university	**1**
Industry scientist	**1**

The scientists we interviewed also represented a range, in terms of levels of experience with, interest in, and commitment to nanoscience outreach.

Map of Scientist Interview Sites:

[1] See Appendix A for interview protocol for details.

Key Findings

The remaining sections of this document summarize our interview data and are organized according to the following categories:

A. Strong validation of the NISE Net theory of action and contributions

B. Mixed or neutral findings

C. Emerging issues and questions

Below each category are summary statements in bold text, followed by more detailed supporting data.

A. Strong Validation of the NISE Net Theory of Action and Contributions

In this section we highlight data that suggests NISE Net's strategies for connecting research scientists with ISE professionals and institutions seem to be successful.

1) Scientists are hearing about and getting involved in NISE Net from a variety of sources, but primarily through personal relationships and the professional associations (especially the Materials Research Society (MRS)).

From the beginning, NISE Net's strategies for connecting scientists both to Informal Science Eduation Institutions (ISEIs) and also more broadly to the NISE Network have relied on the local brokering and formation of relationships between museums and nearby researchers. The network worked with ISEIs individually to find local scientists with whom they could potentially develop a long-term relationship. Similarly, the Materials Research Society, as a partner in the Network, has evolved a strategy for matching MRS members who are interested in outreach with museums in their area.

The scientists we spoke with became connected to NISE Net in a range of ways, including through local prior relationships, MRS, and the short-lived professional development program for new scientists, called NEO:

Personal prior relationship	**9**
Through MRS	**5**
Contacted by a museum	**3**
Invited by NISE Net leadership	**2**
NEO	**2**

In short, NISE Net has created several different ways in which scientists and researchers get the opportunity to engage in the Network.

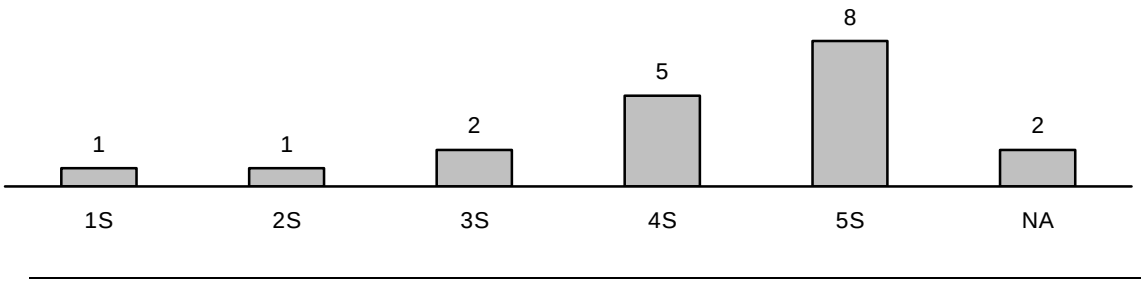
2) NISE Net provides a range of supports for scientists engaging in nanoscience education outreach activities.

On average, scientists rated the extent to which they feel supported by NISE Net in their educational outreach experiences a 4.1 of a total possible 5 on a likert scale.[2] It is noteworthy that eight scientists chose the highest possible ranking.

[2] The scientists were asked to rate their experiences with NISE along several dimensions as part of the interview. See Appendix A for the list of questions in the protocol.

The extent to which scientists feel they are supported by NISE Net in their educational outreach efforts.

Figure 1. The extent to which scientists feel they are supported by NISE Net in their educational outreach efforts.



Avg. rating: 4.1 *Ratings for this graph and those that follow are based on a 5 point scale where 1 = "not at all" and 5 = "to a very great extent." Bars represent the number of scientists who gave each rating.*

The majority of scientists we interviewed have engaged with and contributed to the NISE Net by providing general advising for NISE Net, by advising on content for NISE Net products and activities (including forums), or by serving as experts for public events (e.g., as speakers). Four scientists reported that they attended NEO, and have applied what they have learned in that program to their current outreach work. Many scientists told us they have participated in NanoDays events—either by serving as a speaker, or by using the NISE Net NanoDays kits in their own outreach work (both formal and informal outreach).

It appears that among the scientists we spoke with, NISE Net is succeeding in its attempts to encourage productive matches between scientists and ISEIs. These scientists, for the most part, have made solid connections, felt supported in their outreach work, and have engaged in a range of activities.

DIRECT ENGAGEMENT WITH THE PUBLIC

We were interested in hearing more about the kind of work scientists were doing with NISE Net, particularly in terms of working with the public. Fifteen of the 21 scientists we interviewed have interacted directly with the public as a result of their work with NISE Net. The large majority of scientists have given talks or presentations at NanoDays events or at a public Forum. Others have participated in more interactive activities, such as presenting at a teacher workshop, or interacting with parents at a NanoDays event while their children engaged in an activity.

For those scientists who interacted directly with the public, the experience was at times, in their words "terrifying." While a few of them had worked with the general public before, others were newcomers to this kind of activity and were grateful for any assistance or

coaching the ISEI staff gave them. Still, the experience was gratifying to all of the scientists we spoke with.

SAMPLE COMMENTS[3]

Yes, it is very different than any kind of public speaking I have ever done. The week before, I was told, 'you understand there is no laptop, no PowerPoint, you are just going to get up and talk?' That was pretty terrifying and I had never done that before. So with one of them, it was me and this women from a nanoscience watchdog group, which was a little intimidating too. Just getting up and speaking for 15 minutes about nanoscience was something that I had never had to do before. Also, I was interacting with public that I had not really interacted with before. The folks that come to these kinds of forums, in our area, tend to be kind of educated, a lot of retirees, and so, it wasn't a representative cross section of the population around here, but it was certainly a different group of people that I am used to talking to.

It actually has been a learning experience. The public has a huge range of understanding of nanoscience and science in general. [Doing this work with NISE Net is] feeding me because I want the public to become more informed for policy-making. The dangers of science and technology begin in the public's perceptions. I want them to feel comfortable as well. By talking with the public, it makes me want to do it more often. People are lost in science fiction. The fiction can take over their minds instead of reality. The questions they ask are really insightful.

3) Scientists who engage in NISE Net reap a range of benefits, both professional and personal.

We asked the scientists to talk specifically about the benefits they experienced as a result of their participation in NISE Net. As illustrated in the quotes above, the benefit scientists cited most often was the opportunity for them to learn how to better communicate their own scientific interests and research with public audiences. The benefit scientists cited nearly as often was being able to fulfill the broader impacts requirements of their NSF grants.

Scientists mentioned numerous other benefits as well, including but not limited to:

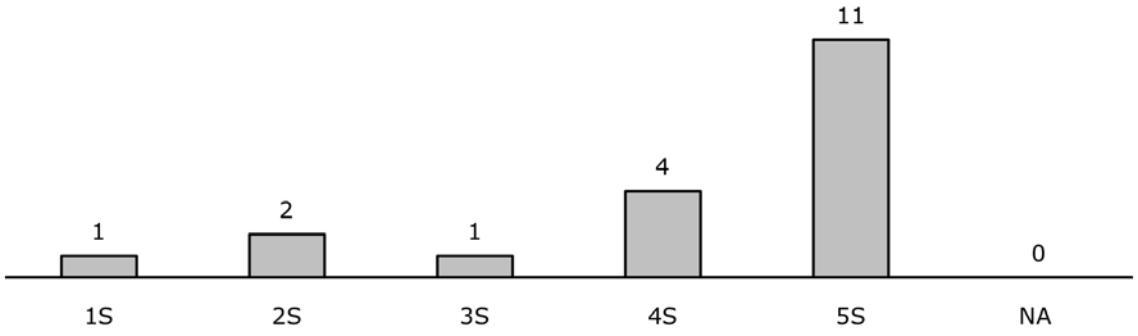
- Creating a better informed public
- Learning how to be a better communicator of science

[3] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker. See Appendix B for the complete set of comments.

- Being part of the development of a national infrastructure for raising public awareness of science
- Networking and relationships with other scientists
- Learning about science education and effective practices in museums
- Advancing professionally and having access to new opportunities
- Having new opportunities to engage in outreach (e.g., local library)
- Learning from the public-getting a chance to hear their questions, issues, and concerns regarding nanoscience

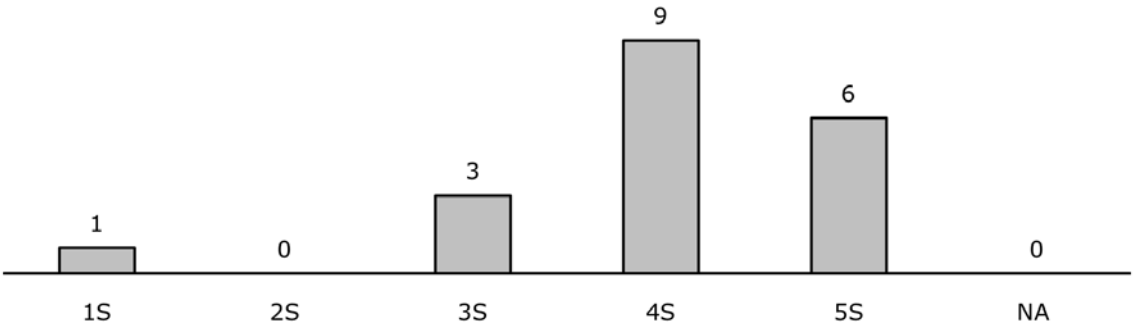
Several of the statements we asked scientists to rate, in terms of the extent to which they agreed, speak to the benefits above and present other potential benefits scientists might experience through participating in NISE Net. The diagrams below illustrate scientists' perspectives on the extent to which they experienced other benefits.

Figure 2. The extent to which scientists have developed a working relationship with an ISEI or other informal activity as a result of NISE Net.



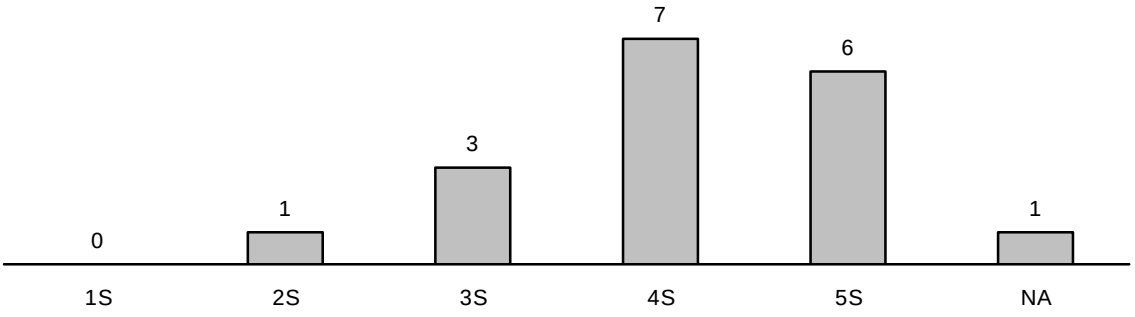
Avg. rating: 4.2 *A large majority of the scientists we interviewed (15 of 19) reported that they developed a working relationship with an ISEI or other informal activity to a great or very great extent.*

Figure 3. Extent to which scientists feel they can contribute more and more effectively to broader educational efforts in nanoscience education.



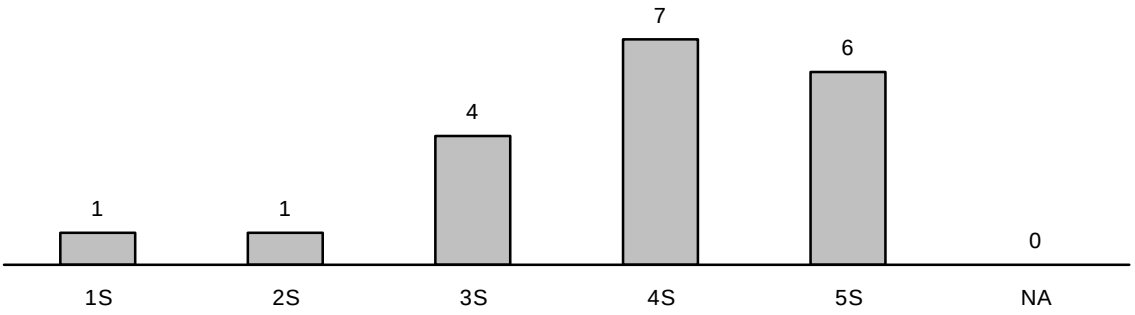
Avg. rating: 4.0 *Fifteen of nineteen said that they feel to a great or very great extent that they can contribute more and more effectively to efforts in nanoscience education.*

Figure 4. Extent to which scientists feel they have increased knowledge about doing educational outreach - how it works and how to get involved.



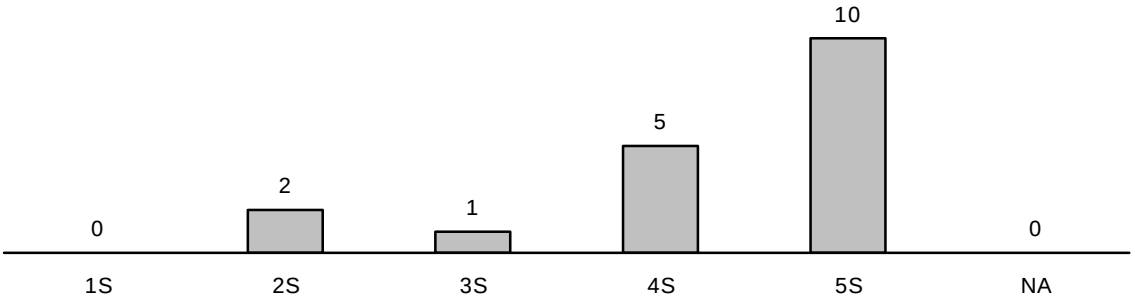
Avg. rating: 3.8 *13 of 17 reported that they now feel they have an increased knowledge about how to conduct and get involved in outreach to a great or very great extent.*

Figure 5. Extent to which scientists feel they have an increased interest in and motivation to engage in and make contributions to nanoscience outreach activities.



Avg. rating: 3.8 *13 of 19 reported that, to a great or very great extent, that they have an increased interest in and motivation to engage in and make contributions to outreach activities.*

Figure 6. Extent to which scientists feel they are gaining/have gained important relationships with others, in education and their own field.



Avg. rating: 4.1 *Nearly all of the scientists we interviewed agreed that they are gaining or have gained important relationships with others in either their own or the education field.*

Other comments scientists provided during our interviews also speak to the range of benefits they experienced through their participation in NISE Net. Underlined below are several such benefits.

NISE Net helps research scientists develop communication skills

Sample comments include:

I think it is a win-win. What I have noticed is that this type of collaboration allows universities—formal education—to get exposure to the public, and when I say public, I mean the public that would go to the museum and the public that won't go to the university lab to understand science… It is also good training, because as scientists, we are expected to be able to explain our science to other scientists, as well as the public, and quite often, many don't have the skills to do that. NISE Net helps foster the communication skills. On the other hand, museum workers or informal science educators gain from having firsthand knowledge from the folks who are actually working on this science.

I think number one, NISE Net is working towards having a better-informed public about science, which hopefully translates into people exciting their congressman or congresswoman about science funding. I think from the nitty-gritty point of view, any scientist or engineer can benefit from being a better communicator. That is something that we found with our relationship with the museum, is that these researchers who go through a communications workshop or go speak at the museum are much better at giving research talks at conferences too. There are a lot of transferable skills. In addition, engaging with the public is very motivating for graduate students and post-docs, and it helps them stay focused on why they are doing their research and how it benefits society.

Giving me a way of working on the skills necessary for communicating science to the general public has been very key. I wouldn't have probably developed [those skills] had it not been for NISE Net... Just understanding what the concerns are of the general public, what they know, and what they don't know. Knowing what you need to discuss and not necessarily watering down the science, but communicating in a manner that will not distance people from what is going on.

NISE Net helps connect research scientists and others in the ISE field

Sample comments include:

The other more broad role that NISE Net plays, not even specific to nanotechnology, is pulling together this huge network of scientists and also a huge network of museums, people to talk to and I think that is valuable in going forward. Now there is this infrastructure that has been developed, that is maybe outside of the nanoscale part of NISE Net, but that can be very valuable for any researcher.

The networking has been of huge value to me, now knowing personally, a lot of individuals of various positions in museums and universities and NSECs across the country. Having this bank of people to be able to call upon is very beneficial professionally.

I have run into a number of people I met at the NEO workshop, and I have continued relationships with a number of others.

The networking potential for me has been exceptionally good. I've made contacts at the University of Minnesota and in the business field that have spun off into other projects.

I've been able to get to know researchers more here at the university and now we've talked about things to do together. I've also met new colleagues through NISE Net. I've gotten to know new people, and other people better.

NISE Net helps research scientists fulfill the broader impacts requirements of NSF grants

Sample comments include:

I don't know how typical our situation is, but in our situation, it is a boon. When I sit down to write a grant, to write my NSF broader impact statement, I have pretty impressive things to write about. I have all of this interaction with the museums and this outreach stuff with the NISE Network is all over the place in those paragraphs that I write. It is sort of a symbiotic thing. I think for those who are willing to take advantage of it, there is a lot there to use. In the end, it is very specific to this NSF thing and beyond that, it really depends on how much the different universities support and give folks credit for this sort of thing.

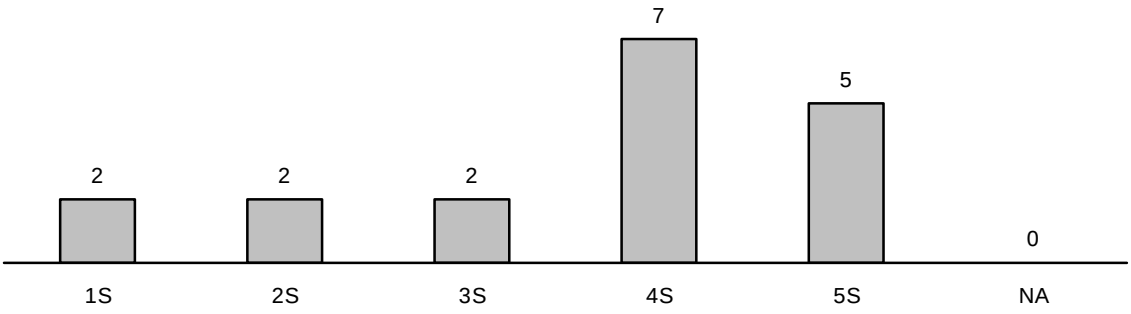
NISE Net helps research scientists get smarter about doing public outreach

Sample comments include:

I think that this has helped develop a latent interest that I have always had in public outreach, and helped me to mature in my understanding of what that means and how to go about it. I get to watch professionals whose job it is to bring science to the public and of course, that is something that I pay close attention to and it is something that I am interested in, in my own career.

Interestingly, nearly all of the scientist interviewees reported that their involvement in NISE Net has also helped them understand something new about nanoscience:

Figure 7. Extent to which scientists say that involvement in NISE Net helped them understand something new about nanoscience.



Avg. rating: 3.4

Other sample comments about scientists understanding something new about nanoscience:

There was a demonstration that we did on thermofluids and it was interesting to learn about it. Then then I came [here] to work. I was a physicist in chemical engineering at that time. When I came here, thermofluids was a big deal—it is a big deal to physicists, but I learned it in NEO before I got here.

I learned a lot of new stuff. I'm still learning!

I certainly learned some things about folks working on ethics and these advocacy groups. I actually shared a forum with somebody who was looking out for the horrible things that nanotechnology can do, and that was definitely an eye-opener and something that I definitely learned from.

There is so much activity in this field that it is hard to keep up. NISE Net helps to bring up some major things happening in the field of nanotechnology.

I have learned about a number of nanoscience experiments and have used them.

B. Mixed or Neutral Findings

In this section, we share findings that are neutral or mixed regarding scientists' involvement in NISE Net. These findings describe scientists' reasons for getting involved in NISE Net and include their reflections on the importance of scientists getting engaged in public outreach in general.

1) Scientists' reasons for getting involved in NISE Net vary, but primarily scientists are personally interested, professionally committed, or compelled by NSF broader impacts requirements.

The scientists we spoke with became involved for a variety of reasons. Most all of them have some reason to engage in outreach, either because it is mandated as a part of their research grants, or because they are interested in contributing to a better public understanding of science. The NEO participants were interested in an opportunity to expand their expertise in science communication, as were a few others. Some had prior relationships with their local museum, and getting involved in NISE Net was a way to strengthen that relationship. Several of them reported that they viewed NISE Net as a way to meet the NSF broader impacts requirement.

Sample comments:

> *I realized one thing that is very important that NSF cares a lot about is how you actually connect the research that is going on in an academic area with some kind of public concern, in a broader sense. If you tried to do that strictly from an academic position, it can be a bit difficult, because you will find that maybe 10% of the professors could actually stand on a soapbox and talk in a way that people would be interested in what they had to say. The other 90% don't really know how to do that. It is a different skill. NISE Net helps us with that.*

> *It's been great. I love working with the museum folks. It's been great. It's a really nice experience. In terms of an enriching experience, if someone is of that ilk, they gain by sharing their knowledge. The one thing it could end up doing, if you are really pragmatic about it, if you are a faculty, you have an education and outreach obligation. It could be a really instrumental way for researchers to check that box off. NISE Net should play that card even more by telling scientists, 'we can help you satisfy your outreach obligations'. That is the most concrete example. That's not trivial. It's a very nice experience, compared to working with scientists all the time. Extending into that community. I enjoy it.*

2) Nearly all of the scientists we spoke with agreed that scientists need to interact with the public on some level.

While they admitted that not all scientists are well-suited to do this work, they believe it is important for scientists to help the public understand their work and the implications of their work, especially as it relates to policy-making. And as stated above, **many scientists stated that NISE Net has helped improve their communication skills.**

Sample comments:

I think that NSF is trying to make all engineering university people get interested in K to 12 education, and I don't think that all faculty are suitable to do this job. I don't think they want to and I don't think they are capable, because that is not what they are trained to do. But I think that NISE Net should be there and serve as a fantastic resource, helping anybody who has the slightest interest.

I think it's really important but it depends on the scientist. It can't be mandatory. There are some scientists out there who want to but haven't had the opportunity, and there are some who wouldn't. But they need to be aware of the opportunities. The government is taking people's money and funding programs with it. People should know what is happening with their money.

Every time I've seen a scientist engaged with the public, they get a better understanding of their own research and its contact with society, and how their research actually impacts people and the environment. It also makes them better communicators to their peers. It is also important because the more the public knows, the better voters they are, and they are better critical thinkers. And that usually translates into more support for science.

My response to this question depends on the interests of the research scientists to communicate with the public. For scientists who work with a broader spectrum of people, including the public, I would say it is important to be involved in efforts like NISE Net, because it helps them think about communicating complex topics in a simpler way, so an educated public person can understand them. For a scientist who generally works in a lab and communicates mostly with their peers, it could be a disaster to have them engaged in efforts like NISE Net if they lack the communication skills to get their message across to a different audience. Also, some facilities have public information officers who bridge the gap between scientists and the public, and these types of people would be useful to engage in efforts like NISE Net.

I think it is important because just from a public policy perspective, you need that transparency, if you are going to be making decisions, whether it is at a regulatory level or what kind of product you are taking through to market, I think. The public has a right to know what is going on and a right to be informed.

To me, it is a moral imperative, if a scientist is going to recommend things. I just don't believe that you can disengage knowledge with what its impact is, and so I think scientists need to be at some level involved, or at least engaged in, what the potential impact is for the knowledge that they are producing.

[My experience with NISE Net has] reinforced the importance of being able to communicate science to the general public. I think that is the biggest key behind this, because otherwise, you get trapped in the mindset. You are in the lab and you are talking with scientists and you are working with scientists and you kind of forget how to communicate to the general public. I think it is important to get the public to understand what we are doing, because ultimately, it is their tax dollars that go to pay for what we get to do. What we are doing is going to have larger consequences, so I think it is very important to get as many people involved with it in the first place, even though not all researchers really care to be involved with that kind of activity. I think it is important that some of us do, because I think overall, it makes for a better scientific community, just to have that kind of initiative taking place.

C. Emerging Issues and Questions

We wanted to hear about any barriers the scientists were facing in their attempts to work with NISE Net, or in carrying out the work itself.

1) For the most part, scientists did not find any barriers other than constraints that were external to the relationship with NISE Net, such as finding time to participate in activities.

2) A significant minority raised a concern about the extent to which NISE Net has been able to successfully engage enough scientists, or the extent NISE Net knows enough about the universe of scientists might be interested or willing to participate in the network.

3) NEO participants lamented the demise of that program, and hoped that NISE Net would be willing to support some kind of ongoing participation, at least for the alumni of the workshops.

Sample comments:

I don't think a lot of scientists are aware of NISE Net. Most scientists are in professional organizations that may have their own outreach activities.

I think NISE Net is right at the point to make an impact. It needs more work. Now you have a bunch of different researchers, and even smaller museums, and who does the match making? Who does that? How does NISE Net overcome the fact that we are all really still in middle school, each at our own sides, too nervous to cross the gymnasium?!

Everyone has to do an NSF grant, everyone has to do broader impacts. If you are involved in this brokerage of activities, then you are covered. The language is covered for your grant and you can just check that box. But, I think very early on, NISE Net wanted to figure out if this was a centralized or decentralized effort because it is a network, and so it is hard to really know how scientists are getting involved case by case.

NISE Net could do a lot better job. I know people here and some researchers that I speak to that just don't know about it, and I think they could get involved and would want to get involved if it were more accessible or more known.

I would have to say some of the things that seem to be missing is that it is really hard to know where to touch it [NISE Net], where to open the door to get stuff done. You could be a new scientist who is very interested in being part of the NISE Net, and unless you do something local, or you are connected with an organization like MRS, which is broadcasting that it is part of this NISE Net, and someone who is unplugged in, you just don't know how to get plugged in. I think that is unfortunate. I want to help more, and maybe they don't know how to utilize me.

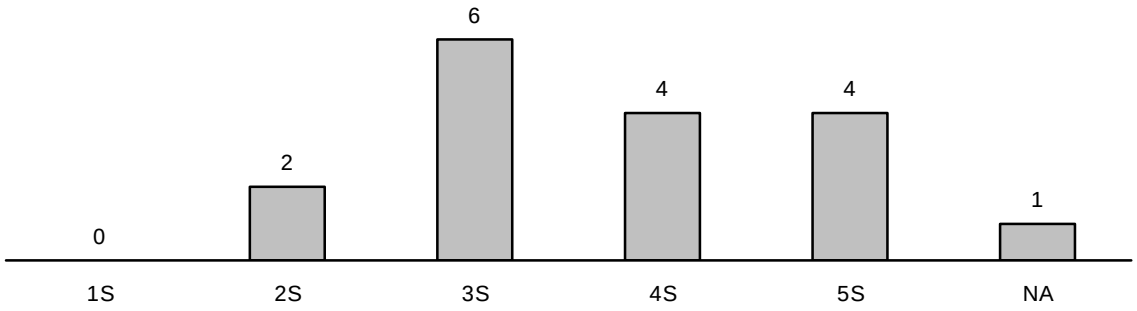
The NEO program is really great and it made all of these connections, but the ball kind of dropped after that, and there are a group of people out there that are willing to help and willing to participate, but kind of didn't know how, didn't know how the NISE Network really wanted to use them and so, I think there is a capacity to get a nice group of scientists together to be involved, but I am not sure if NISE Net has really figured out how they really want to utilize them. That is an area that I think could be improved.

I view NISE Net as a start of an organization that researchers can plug into, but they don't know how to do that. It is on their radar, but the interface isn't there. It's like the European plug vs. the US plug. Until a grant proposal is due, nobody wants to listen to all this, or until a scientist is rejected for funding [due to their not fulfilling broader impact requirements]. There have been lots of inroads, especially with MRS, lots of effort. We've gone up the curve, we are now at the asymptote, and it's hard to go the final five inches to get to the goal. There is still nitty-gritty one-to-one work to do.

I think the website could be a better place to help get people involved and being able to promote this to research scientists and university professor audiences with the areas that could be improved.

We also asked scientists to rate the extent to which they believed that NISE Net succeeds as a service organization for scientists seeking to engage in outreach in nanoscience education.

Figure 8. Extent to which scientists believe that NISE Net succeeds as a service organization for scientists seeking to engage in outreach activities



Avg. rating: 3.2 *Note that about half say they agree to a very or very great extent that NISE Net is succeeding in this role.*

Summary

Scientists' reasons for initially becoming involved in NISE Net vary, but primarily the reasons relate to the fact that the scientists are personally interested, professionally committed, or compelled by NSF broader impacts requirements. For this group, NISE Net provides several avenues and is a source of motivation for scientists being involved in outreach. Scientists feel strongly that they (and their colleagues) should be involved in efforts to increase public understanding of science.

Scientists are hearing about NISE Net from a variety of different sources, but mostly from personal relationships and the professional association Materials Research Society (MRS).

While barriers for engagement in NISE Net on the part of our sample are either non-existent or minimal, there was some concern that NISE Net is not known broadly as an opportunity for scientists to conduct outreach. Most of the relationships are forged through personal connection. Several scientists we spoke with felt NISE Net could do more to make itself known and easily accessible to scientists who may not work with MRS or already know someone involved in NISE Net. Finally, those scientists who participated in NEO found it extremely valuable, and lamented that it seemed to no longer be a priority for NISE Net.

Appendix A: Interview Protocol

NISE Net Scientist Study
Interview Protocol
Fall 2008

Introduction and purpose for the interview: Inverness research is serving as the external evaluators for the NISE Network and part of our work is to gather the insights, perspectives, and experiences of those engaged in the network in different ways. At this point in the work of NISE Net, we are interested in learning more about the nature of involvement and engagement scientists have with the network. This is also an interest of NSF.

BACKGROUND: RESEARCH AND OUTREACH

1. Tell us just a little about your research and relationship to nanoscience and technology. What is your institution, position, research foci? How would you best describe your position: grad student, postdoc, faculty, full professor, outreach director, etc. etc.

2. Have you had any involvement in the past with education outreach efforts? Education efforts particularly related to nano? Schools and formal education? Informal education? With local, regional or national informal science education institutions?

3. If so, which, when and what was the impetus for your getting involved?

ENGAGEMENT WITH NISE Net—THE NATURE OF THE WORK AND COLLABORATION

1. How did you first get involved with the work or efforts of NISE Net? Did you make the first contact, or did someone from an ISE contact you? Talk with us about how you got into the work. Who has been your contact person?

2. Why were you interested in becoming involved/why did you decide to become involved?

3. Tell me some specifics of the NISE Net work you have done or been involved with.

- Are the tasks or products already designed when you start the work, or are you involved in the design and development in any way? Please describe.

4. How do you characterize the kind of relationship you have with NISE Net—what has developed between you, your institution, and your ISE contact person and the ISE institution? (Collaboration, partnership, service, etc.)

- How much *give and take* is there in the actual interactions that happen?

5. What has the involvement in NISE Net been like for you? Has it been positive, negative, neutral?

6. About how much time do you spend on NISE Net work?

7. Is your institution very, somewhat, or not supportive of your involvement. Why or why not?

8. Have you heard of or been a part of the RISE Initiative? If you are, how has that helped your work? If not, what, if anything, do you know about it?

9. Have you had any direct engagement with the public as a function of this collaboration? If so, what have they been and how has that experience been for you?

10. What do you hope the public learns from interacting with you/the NISE Net program/exhibit? Do you have a sense yet of what they actually take away from the experience?

11. In the best case, the collaboration of scientists with informal science education will be a "win-win" arrangement. Both would benefit. To what extent is that happening in this case? How do you win? How does informal science win?

12. One way to evaluate NISE Net is to say that it should be a service project—helping scientists communicate their research and their field to broader audiences. How would you evaluate NISE Net as a service project? Do you think scientists know about and are able to use its "services"?

13. Are you aware of other scientist/ISE collaborations in NISE Net?

14. Do you have any complaints or misgivings about the NISE Net work? Any suggestions for how NISE Net might improve their work?

<u>BENEFITS/COSTS OF WORKING WITH NISE Net</u>

1. How does your work with NISE Net fit into your own work goals? The mission/goals for your institution?

2. What kinds of things have you learned or gained from the relationship/partnership/ collaboration? Have there been any benefits to you personally? Educational benefits? Political benefits? Unforeseen benefits? To your institution?

3. What have been the costs for the work? Financial, time, hassle, etc…

4. Have you encountered any barriers to working with NISE Net? If so, what are they and are they different from barriers you have encountered in other outreach experiences?"

5. Have you used the work to leverage any other work (grants/ other *outreach efforts* at your institution, new knowledge and practice, etc. Taking anything into their teaching/other outreach work? Are they getting more out of it—are you gaining in any way? Are they using what they've experienced, or learned, or produced?)

6. Here are two statements. Please let me know to what extent you agree with each: "NISE Net simply helped me do what I would have been doing anyway" And/Or: "I got involved in things I never would have been involved in, had it not been for NISE Net."

7. Will you continue to do this work? If so, why? If not, why not? Will your involvement stay about the same? Increase? Decrease? Will other scientists you know be likely to participate?

<u>SUMMARY JUDGMENTS ABOUT NISE</u>

1. How does the NISE Net work compare with other kinds of educational outreach you have done?

2. Has your involvement with NISE Net influenced your thinking about educational or public outreach? If so, how? Has it influenced the ways you go about doing educational outreach? Teaching? Other kinds of work?

3. On a scale from 1 to 5, with 1 being *Not at All Important* and 5 being *Extremely Important*, how important do you think it is for research scientists to be engaged in efforts like NISE Net? Why or why not?

4. What is your sense of the value in working with informal education avenues, as compared to formal (K-12) educational avenues?

I'm now going to ask you a series of summary questions that I would like you to rate and then explain your rating. Please rate these different aspects of NISE Net on a scale of 1 to 5, with 1 being not at all, and 5 being to a very great extent:

1. Extent to which you feel knowledgeable about NISE Network and its activities.

2. Extent to which you feel you have been supported in your educational outreach experiences in nanoscience.

3. Extent to which you have developed a working relationship with an ISE or other informal activities as a result of NISE Net.

4. Extent to which you feel you can contribute more and more effectively to broader educational efforts in nanoscience education.

5. Extent to which you feel you have increased knowledge about doing educational outreach - how it works and how to get involved.

6. Extent to which you feel you have an increased interest in and motivation to engage in and make contributions to nanoscience outreach activities.

7. Extent to which you feel there are significant barriers to engaging with NISE Net.

8. Extent to which you feel NISE Net succeeds as a service organization for scientists seeking to engage in outreach activities.

9. Extent to which you feel your involvement in NISE Net helped you understand something new about nanotechnology.

10. Extent to which you feel you are gaining/have gained important relationships with others, in education and your own field.

<u>OTHER</u>

Do you have any other comments or reflections about your collaboration/partnership/work with NISE Net?

Appendix B. Additional Quotes

Quotes: Why they got involved in NISE Net

I started with NEO, and then did work with SMM. I don't know how I would have gotten involved with this kind of stuff it I didn't get involved with NISE Net in the first place...even though I wanted to get involved with this kind of stuff, I don't know how I would have.

I had an initial connection with another university professor, then the museum staff person found out about the AFM that had been developed to do outreach with high school students, and so I contacted him initially about that. Since then, they have collaborated on other projects, including a laptop nanomanipulator program.

I believe at that time I saw something being advertised for NEO, and I don't know if it was in Science or something. Maybe in an email. I have always been interested in ancillary issues with regards to science policy or education, and at the time, I was looking for a job, and I certainly was looking to make a shift away from research and this seemed like an opportunity for me to learn about something that I wasn't trained directly to do. I was trained as a researcher, and as a scientist, but I thought that this was a good opportunity for me to learn about informal science education. My area of research really focuses on law, policy and emerging technologies. Collaborating here with folks at the University of Minnesota, we saw that the National Science Foundation had this RFP out there and we wanted to apply to it, and the first stage is finding out who else at the university is involved with NSF and especially who is involved with NSF dealing with nanotechnology and so really, that was the first piece of our homework was to find out who else is operating in this nanoscience world.

I work in a NI (Nanoscale Interdisciplinary Research Team); it is a very interdisciplinary team. So in that capacity is where I have really gotten a lot of the connections with the folks at the museum. As part of the NISE Net, myself and two others, the principal investigators, we have served on a nanoscience forum advisory board made up of scientists and policy and legal folks within the university and the local area. That has been really rewarding because we have been able to see the exhibits and have conversations with them about the development of their programs and how they are informing the public and how they are getting responses back from the public and things like that. Aside from that, a staff member at the museum is an advisory board member on our grant, and so he comes to the grant meetings that we have. He is really actively engaged with us as far as what they are doing at the museum and how that sort of integrates with what we are trying to do with issues of transparency and public awareness and education. Also this past semester, I co-taught a new course called Nanotechnology in Society.

I realized one thing that is very important that NSF cares a lot about, which is how you actually connect the research that is going on in an academic area with some kind of public concern, in a broader sense. What are the outcomes, what do ordinary people learn about what you are doing and with the goal of sort of connecting the public with some knowledge of what important issues are and what their effects could be, all an engaging and enjoyable way, not lecturing them. And when we created the NSEC, we did that, and if you tried to do that strictly from an academic position, it can be a bit difficult, because you will find that maybe 10% of the professors could actually stand on a soapbox and talk in a way that people would be interested in what they had to say. The other 90% don't really know how to do that. It is a different skill. NISE Net helps us with that.

A professor at the university was the link to getting me involved with the activities at the museum. I had read some of her research and had her give a presentation at our agency on her nanotechnology work, and she was already on an advisory panel at the museum under the NISE Net for some plays that they were going to have produced that were nanotechnology related. She had recommended me to the museum, to add me to that group. That is how I got involved.

Quotes: Ways they have engaged in NISE Net

I met once/week with [someone from my local museum] during one summer to help with exhibit development, I was also involved with Forums work the second year.

I am on the advisory board for forums. A museum staff person in NISE Net is very engaged with our work at our center. I have been involved in collaborations on grants, programs, courses, papers.

Our question was: How do you get the people at the museum to understand what is going on at the university? These are people who maybe had an undergraduate degree in chemistry or biology or physics or something like that, who are knowledgeable enough that they really do understand what a professor is telling them, even professors who aren't the most eloquent person in the world. As the director [of outreach at this research center], I would spend some time at the museum to try and understand how they worked, and then we would bring the museum people to [the university] to have them talk with people here. When we did that, we have a course that we run every 2 years that is a tutorial on nanoscience and the way that works, everybody that we give money to, the professors give a tutorial lecture about what they know, their expertise, to an audience that would be like undergraduate students who have no particular knowledge of that. They catch a pretty broad group and so the talks have to be really easily understandable. So what we have done is then bring the museum people in to actually listen to the lectures and when they do that, they get a very sort of pleasant way of getting educated about what the center is doing. They also find out that the professors who could be good candidates to hijack down to the museum so that they can give a public talk. They also find out issues that are good issues for the public.

I joined as part of an advisory committee to the NISE Network and to talk about how to do things, and how to get around business and what not.

I was just kind of plugged into was the advisory panel that they already had to. NISE Net had secured the services of a couple of playwrights to write some plays related to nanotechnology. Before those plays were produced, the advisory panel reviewed the plays and then made suggestions, particularly on things that were technically oriented, or suggestions to make them more useful.

I participated in a couple of things in NISE Net that I thought were really valuable. One was the NEO workshop. I went to that the very first time that workshop was offered. We took some of our graduate students there, and then the next year, one of our teachers who is in our summer teacher experience went and we have been able to bring back some of the elements of that workshop to our RET program which is the Research Experience for Teachers program and use those very effectively to teach inquiry and to help show them how to develop modules more effectively. The annual meeting was always very fun to make connections and we also had participated in NanoDays through the Museum of Science by sending speakers over and some of our researchers have done talks for the DVD that was put out, Talking Nano. I am also, through the MRS, I am now on a NISE Net subcommittee and we have talked a lot about how to engage researchers more effectively. The next natural step is to find a way to match-make between the researchers that we have on the MRS side and local museums.

I tell them all of the time that I think I am underutilized. And you know, I also think that we work from our comfort zone. First of all, it is a daunting thing to create this network, and so we outsource the different kinds of activities of things that we feel very uncomfortable with. The thing that is pushing people out of their comfort zone is probably the notion of nanotechnology to begin with. What I am asking them to do, is okay, you are already out of your comfort zone, lets also think of diverse ways to tap into populations we have never tapped before. I don't think they are quite ready to do that.

There is a program at MOS for REU students, and I also developed a video game on nanoscience that MOS might use on the floor in a kiosk. I have also attended the annual meeting, and been a forums speaker at MOS.

I have been doing quite a few workshops for 9th and 10th grade students and explaining to them what nanotechnology is in chemistry. These tend to be inner city kids. Last Saturday I was at the National

Association for Black Chemist and Chemical Engineers, and I gave an oral presentation there. Then, in the afternoon, I ran a workshop and there were students from schools who came in and I had brought some NanoDays kits from the [local museum] and that was part of my outreach doing those NanoDays kits. I have been using the kits, and the museum has been very generous. I am trying to copy the kits, but I can't find the liquid metals that were made. The museum is trying to get some pictures to put up on their walls for their new exhibits, and that has all kind of been strengthened through the NISE Network. I integrated quite a few of the things I learned in NEO into our summer outreach programs, specifically for a 3 week nanoscience chemistry academy that we created. We brought 80 at risk high school students onto the campus and they had a kind of hands-on chemistry class in the undergraduate chemistry lab and with faculty and high school teachers teaching them collaboratively. We used some of the activities on scale and on reactions and how size matters, that I learned out in California.

Mostly, I have been filling a role that the people at SMM have developed in the programs—doing symposia and educational seminars on the topic to include interactive and active portions.

In the first two years, I was heavily involved in NISE Net. I was part of the exhibits and programs group. In the last year, I haven't done any NISE Net travel, per se. I've interacted with NISE Net people at other events. No annual meetings. I've sort of excused myself for the last year. I have been on the MRS subcommittee, and I attend those meetings.

The initial involvement was finding out what was going on and information-gathering. Then Wendy Crone from UW Madison and I spent a couple of visits at NISE Net. Prototyping of exhibits and exhibit programs. I did that twice. July 2006 and 2007. I haven't done anything since then with that piece but I figure the exhibits are finished now. I've also been to two of the NISE Net annual meetings. Participating representing my institution and the MRS Committee.

I give advice on exhibits, Ask a Scientist. Getting involved with a NISE Net subcommittee did two things for me. It got me connected with the folks at Exploratorium, and from the individual perspective of a scientist professional, I was able to get involved in their lunchtime brown bag colloquia. I worked at Exploratorium on a couple of weekends. It gave me something that I was interested in doing but I didn't have a connection to do previously. I would like to see the NISE Net do more of that broadly. On a broader level, it gave me the opportunity to provide a network for scientists. Neither of those would have existed with the NISE Network.

The annual meeting has been about it. Beyond that, there has been no other contact.

At meetings, they will send us out on the floor. I've been to two big NISE Net meetings, in SF and at SMM. Part of the meeting, they would send everyone out on the floor. I would say I've been kind of on the edge of it. At both of these big meetings, they were showing prototypes and planning directions. The museum people are really doing most of the development. I would offer things like, this science is right and this science needs to be clarified. I've done some of that at the meetings. I've also had contacts and people have sent me written material to check over. They are trying to vet everything they will put in the public through a science person. The other thing is they have these NanoDays that happen once per year. I was part of the team that presented on Capitol Hill in April. We took our demonstrations and things and set up in the congressional office building and met the staffers.

My role has always been a role of presenter. I think my strengths lie in trying to convince people to pay attention to this problem. I am focusing my attention on improving the way we teach and disseminating the results and justifying our research. ALL of my involvement with NISE Net has been presenting. I have presented at Exploratorium and in Huntsville, Alabama. I have presented at Regional workshops. There are also cases where I have presented in science education research venues.

I went once to SMM to consult on exhibits. There was a strand meeting where they brought the new exhibits, the exhibit hardware. Those are the most concrete things. I am on the NISE Net Subcommitee for the MRS. I resigned from Public Outreach and stayed on NISE Net.

Quotes: Working with the public

I think what most scientists and engineers do is really aimed at the public good in a way that you can say what the good is going to be. You have some idea where you are going with this. It is not totally abstract. And in that case, I think it really pays to be connected with what the outcomes are or what the societal impact will be.

Yes. I would give a 15 minute keynote or whatever presentation, but then the groups would be broken into smaller groups, and they would have discussions about the topic and I would go around and just answer questions, help them out that way.

Yes, I have presented to nanoscience camp, also forums.

Yes, it is very different than any kind of public speaking I have ever done. The week before I was told, you understand there is no laptop, no PowerPoint, you are just going to get up and talk. That was pretty terrifying and I had never done that before. So with one of them, it was sort of me and then this women from a nanoscience watchdog group, which was a little intimidating too. Just getting up and speaking for 15 minutes about nanoscience was something that I had never had to do before. Also, I was interacting with public that I had not really interacted with before. The folks that come to these kinds of forums, in our area, tend to be kind of educated, a lot of retirees, and so, it wasn't a representative cross section of the population around here, but it was certainly a different group of people that I am used to talking to.

I had a blast. I have always enjoyed doing that and although the activities were really targeted at younger age groups and when we were both at CHOM and McWane, that was mostly what our target audience was and what I would fine was that generally the graduate students would actually work with that age group and a lot of times I would actually spend time talking to the parents and so, this is something that we very much enjoy doing and so, this is very much on the floor and this is very much and actually, I have probably taken about half a dozen, 8, maybe 10 graduate students to these various places and generally even ones without strong English skills really enjoyed doing it.

Yeah, I did mainly stage presentations and there was the forum events and I ran some teacher workshops actually and a little bit on NanoDays

It actually has been a learning experience. The public has a huge range of understanding of nanoscience and science in general. It's feeding me because I want the public to become more informed for policy-making. The dangers of science and technology begin in the public's perceptions. I want them to feel comfortable as well. By talking with the public, it makes me want to do it more often. People are lost in science fiction. I learned a long long time ago, where to draw the line. The fiction can take over their minds instead of reality. The questions they ask are really insightful.

There are three basic things I want the public to take away with anything I do. My three basic things are nanoscience is very very small, that smallness brings about new properties, and because we have new properties we can make new technologies. That's my main message. I will tailor that message for whatever I'm talking about—impact on society or whatever. It's different down there.

Yes definitely. One of the things we are reviewing is that we have a number of events that engage different target audiences: high school students, parents and children, the Sally Ride Science Festival, high school open

houses, the American Chemical Society, of which I am a member. This involves a number of different events, chemistry activities and nanoscience activities. Sometimes it's hard to be too technical.

I've had both direct and indirect engagement with the public. In the work I've done with NISE Net as a volunteer scientist, I've had direct. In my committee work, it's not direct. It's direct with MRS scientists.

I'm not one of the scientists developing anything specifically for the floor. I'm checking the information.

Yes, lectures.

NanoDays. It was great. We had no idea what we were going to get because it was the first one. It went really pretty well

Quotes: Benefits

I think number one, NISE Net is working towards having a better informed public about science, which hopefully translates into people exciting their congressman or congresswoman about science funding. I think from the nitty gritty point of view, any scientist or engineer can benefit from being a better communicator. And I think that is something that we found with our relationship with the Museum of Science, is that these researchers who go through a communications workshop or go speak at the Museum of Science are much better at giving research talks at conferences too. There are a lot of transferable skills. Engaging with the public is very motivating for graduate students and post-docs, and it helps them stay focused on why they are doing their research and its benefits society. The other more broad role that NISE Net plays, not even specific to nanotechnology, is pulling together this huge network of scientists and also a huge network of museums, and for anyone who wants to make contact with a science museum or a science center or a library that is hungry to collaborate, you have the data base. You have the people to talk to and I think that is valuable in going forward, that now there is this infrastructure that has been developed that is maybe even outside of the nanoscale part of NISE Net that can be very valuable for any researcher.

I don't know how typical our situation is, but in our situation, it is a boon. When I sit down to write a grant, to write my NSF broader impact statement, I have pretty impressive things to write about, right? I have all of this interaction with the museums and this outreach stuff with the NISE Network is all over the place in those paragraphs that I write. We grew together. We were doing this stuff already and NISE Net came to us. It is sort of a symbiotic thing. But I think for those that are willing to take advantage of it, there

is a lot there to use and in the end it is very specific to this NSF thing, and beyond that it really depends on how much the different universities support and give folks credit for this sort of thing.

I think that this has helped develop a latent interest that I have always had in public outreach and helped me to mature in my understanding of what that means and how to go about it. I get to watch professionals whose job it is to bring science to the public and of course, that is something that I pay close attention to and it is something that I am interested in, in my own career.

I think that is very important, but I think what I am gearing up is to really learn about where these holes are, because if NISE Net isn't going to tap this population, then I am trying to figure out how to do it. Maybe when I figure out what it is, maybe that will be part of the NISE Net, but I am just getting a sense of what people are doing, what is being done and what kind of needs to be done and really understanding why it is not being done, because it is a large problem. It is not just that we don't want to do it, it is a big problem and it is figuring out how to just chip at that tree? I am being educated, I guess I would say.

I do think that informal hands-on learning is so much more productive than a dry lecture. I learned a lot from the NEO workshop about kind of getting a hook, getting kids hooked and I feel like I personally learned a lot about how to teach more effectively. Actually I bring in all kinds of stuff whenever I go into lecture anymore, to try to get kids to see what the reality is, and what the applications are, instead of just a PowerPoint. ...I think that that discussion between informal and formal education is important and NISE Net has kind of opened that door for me.

Working with [scientists from our center] on how to present to general audiences was very beneficial. Even though there was an audience of 4, they appreciated the fact that the week or two beforehand, I was saying, hey, do you mind sending me your slides and lets work together. I would in some cases just go over to the university and sit down with them. They weren't used to presenting to non-scientific audiences. I am thinking of one scientist in particular who I developed a relationship with while I was there who really was grateful, and he said this will be great for me when I am writing proposals or I have to talk to my kids, being able to bring everything down to a level that the general public can understand is a valuable skill, no matter what you are doing.

The networking has been a huge value to me, now knowing personally a lot of individuals and various positions in museums and universities and NSECs across the country. Having this bank of people to be able to call upon is very beneficial professionally.

I look at the relationship with the museum as being symbiotic. Working with the staff and public are benefits.

We had an existing IPSE grant… Internships in Public Science Education. The museum partner there was someone we worked with before. So we used NISE Net to fulfill our partnership. NISE Net saved us.

As far as the personal thing, I think I really gained. I interacted more with the evaluators from the different institutions, and learning about how you get your head around looking at whether this is a successful effort. I learned from a science education standpoint. I also picked up some content on the nanoscale. I didn't know a lot about it. Another way I've gained is that I really enjoyed interacting and doing informal education. I worked in ISE while I was in graduate school. I value that experience, the concerns they have. Looking at it from an administrative standpoint, it is transferable to other disciplines.

I've gained a lot personally and professionally. Professionally, I've gained a huge amount. What we did with MRS was highly visible. So in terms of visibility within the MRS committee, I really benefited. I was elected to the board of MRS and I attribute part of that to the fact that I was on the NISE Net subcommittee. Then I was asked to join the Molecular Foundry just last December. Part of my credentials for that position was the educational outreach experience that I gained through NISE Net. So professionally, I have gained a lot. Personally, I have enjoyed working at the Exploratorium.

I would say I've gained nothing. I hate to sound negative. It's hard to gain. … Now that they are getting stuff up on the website, there will be of a benefit for us.

I'm doing more things than I would have. I've given several talks at the public library (not part of NISE Net), but I got asked because the library contacted the local science museum and they referred them to me. I've had more interactions with the people from various NISE Net museums.

Well, it's hard to say. Of course, there is the intellectual reward of seeing people react and the reward of having people approach you in the supermarket and thank you for what you've done. NSF insists more and more on outreach in their contract work. I have to describe how I fit my work into a broader context. How I contribute to human resources, helping in NISE Net allows that. I can tick off that box.

It's been great. I love working with the museum folks. It's been great. It's a really nice experience. I love working with the museum folks. In terms of an enriching experience… if someone is of that ilk, they gain by sharing their knowledge. It doesn't impact the research they do. The one thing it could end up doing, if you are really pragmatic about it, if you are a faculty, you have an education and outreach obligation. It could be a really instrumental way for researchers to check that box off. They should play that card even more. We can help you satisfy your outreach obligations. That is the most concrete. That's not trivial. It's really nice getting to know the museum folks. I've enjoyed that community. It's a very nice experience, compared to working with scientists all the time, extending into that community. I enjoy it.

Having [a NISE Net person] onboard and having him involved in our working group meetings and a part of the grant, it has been very helpful, because a lot of times if you get the scientists and the policy people and the lawyers at the table, you are missing that piece of the public in public engagement, and education and the role of that. So I think he has really helped out with that as have a lot of people that are working with him. Then of course having them be able to come into the classroom and give their perspective and that aspect of things has been really great for the students, because they want as broad as possible an understanding. What are the implications to society on this emerging technology? So, it is a rewarding relationship that we have had, they help us, we help them.

Participating in each other's events and keeping each other informed and all of that has been beneficial. I think educationally, in terms of gaining a perspective on the attitudes of the public is helpful to us. I have learned a lot about [the museum's] process, about how it is not just throwing information at the public, it is teaching them something and then asking them how they feel about a particular thing. Even just their process and their methodology as far as education is useful. It is not just giving people information, it is getting it from them as well. I have learned that.

What is important is to have both sides come at it, where each has an important input to it. That is, the scientists are always thinking about what the big questions are and what are they going to work on next and what is important to pursue? They are really very good at that. Typically, they really aren't that aware of how to latch onto the public's interest, and so the museum would care about that. That is a place where we can really get a lot out of the museums. It is really necessary to have a conversation between the two paths if you like, where the professors and the students find out. They really learn more about what do most people understand and what don't they understand, and how can we get them engaged and how can you make that whole process work? I think that is pretty interesting, but there is not a one way flow of information. It is more like holding hands, if you like, where people and information goes back and forth both directions. I think a lot of experimentation as to how you actually do this in a way that works for people who go to the museum is really worthwhile and something people should do.

NEO was more than I expected because I had never really done any type of formal training for informal science education and then issue of nanotechnology is fascinating. I have always been curious about it and my research was related and NEO taught me, not just about the issues with regards to nanotechnology, and not necessary, just the science issues, but how to teach it and how the public views it and then I learned about the different ways you can engage the public about it, with regards to forums or museum demonstration and just the different ways of making the public aware of it and so, it was just fascinating to know of a group of people, many which included scientists who were interested in that type of engagement with the pubic and so it wasn't just sociologists and it was clearly a number of scientists who were interested in sort of being a part of that…

I think it is a win-win. What I have noticed is that this type of collaboration allows universities, formal education, to get the type of exposure to the public. When I say public, I mean public that would go to the museum and the public that won't go to the university lab to understand science. It is good exposure for them, and people can consider science, young people especially who are looking into careers or looking into majors and so, on that end, it is good for them. It is also good training, because scientists are expected to be able to explain our science to other scientists as well as the public, and quite often, many don't have the skills to do that. So this helps foster the communication skills. On the other hand, museum workers or informal science educators gain from having firsthand knowledge from the folks who are actually working on this science. And for me, and here is a benefit that is unique and worth mentioning. My experience in NEO led me indirectly to the job that I have now and it showed me that my work can be valuable outside of the lab. And that is exactly what I am doing now and I think quite a few of my NEO cohorts have considered going into informal science education, or some other job that is relative to science, but not necessarily being a professor, it does that and it broadens the scope for many scientists.

Helping out with the forums was a good experience, just being able to talk about science with a general audience. I think that is a really important skill to have. That was key I think, just being able to do that and also being able to meet other scientists through the NEO network in particular, where they are doing kind of similar things that I am doing and are now in education, or we are trying to get into education. I think it was good to have that network established in the first place.

Quotes: Barriers

I haven't found any barriers at all.

The barriers are more just getting people aware that it exists and then how do you actually get scientists engaged in talking to NISE Net. Here I am talking from an administrative, and so I think these

NanoDays, that was a good way to get things rolling. I think some of the modules that are getting to be available, I think that will help a lot. It is a question of bootstrapping up the network for something that didn't used to catch at all, to something where people know about it. It is like starting a new company or something, to have a way to take some time to get everything rolling.

Not really, not that I have seen. People seem really eager to get scientists involved with it and so I think it has been a very good experience, so far.

The only barrier I encountered was to make an initial request to my supervisor for permission to assist the Science Museum of Minnesota on their NISE Net projects. I would have to go through this process for any external request for my time. The assistance I am providing the Science Museum is incorporated into my yearly work plan.

I would have to say some of the things that seem to be missing is that it is really hard to know, and since it is a network, you don't know where to touch it, and like where to open the door to get stuff done and so, you could be a new scientist who is very interested in being part of the NISE Net and unless you do something local, or you are connected with an organization like MRS which is broadcasting that is part of this NISE Net and someone who is unplugged in, just doesn't know how to get plugged in. I think that is unfortunate. And with a lot of new junior faculty, you know, who have a lot of energy and enthusiasm and still closer in age to people who might be interested, who are children, and there should be some pathway to get them involved. ...I have laid low and I have positioned myself like I want to help more and maybe they don't know how to utilize me and so it is what it is. I guess what is a barrier, getting information irregularly, like once a year, or twice a year or something like that. It should be a little bit more frequent.

I think programs like NEO are trying to incorporate the scientist more, but I have kept in touch with a few of the scientists too from that program and I know one thing that has come up is that the NEO program is really great and it made all of these connections, but the ball kind of dropped after that and there are a group of people out there that are willing to help and willing to participate, but kind of didn't know how, didn't know how the NISE Network really wanted to use them and so, I think there is a capacity to get a nice group of scientists together to be involved, but I am not sure if they have really figured out how they really want to utilize them and so, that is an area that I think could be improved.

No, I really wish I could bring the people to my lab but given the forum/symposia that's not really feasible. No barriers

I think there is the natural barrier that these are two different communities with two different languages and interaction styles. There are differences in how people communicate and interact. That can be a barrier sometimes.

No. The most valuable thing that has happened is that my institution, my director has allowed me to dedicate resources and time to participate in NISE Net related activities. Do something NISE Net related instead of something else.

No, I really think we all just get very busy.

I just fit it in when I can. I'm not going to say there is much in the way of costs.

Time is substantial. I put some of my budget into it for NanoDays. To put on NanoDays at Cornell, I took somewhere between $500 and $1,000 toward that. So we financially supported NanoDays at Cornell. It's just time and a little bit of money and planning.

Quotes: Why it is important for scientists to be involved in public engagement

I think it is important because just from a public policy perspective, you need that transparency, if you are going to be making decisions, whether it is at a regulatory level or what kind of product you are taking through to market, I think. The public has a right to know what is going on and a right to be informed.

To me, it is a moral imperative. If you are going to recommend things, I just don't believe that you can disengage knowledge with what its impact is, and so I think scientists need to be at some level involved, or at least engaged in, what the potential impact is for the knowledge that they are producing.

[My experience with NISE Net has] reinforced the importance of being able to communicate science to the general public. I think that is the biggest key behind this, because otherwise, you get trapped in the mindset. You are in the lab and you are talking with scientists and you are working with scientists and you kind of forget how to communicate to the general public. I think it is important to get them to understand what we are doing, because ultimately, it is their tax dollars that go to pay for what we get to do. What we are doing

is going to have larger consequences, so I think it is very important to get as many people involved with it in the first place, even though not all researchers really care to be involved with that kind of activity. I think it is important that some of us do, because I think overall, it makes for a better scientific community, just to have that kind of initiative taking place.

My response to this question depends on the interests of the research scientists to communicate with the public. For scientists who work with a broader spectrum of people, including the public, I would say it is important to be involved in efforts like NISE Net, because it helps them think about communicating complex topics in a simpler way so an educated public person can understand them. For someone who generally works in a lab and communicates mostly with their peers, it could be a disaster to have them engaged in efforts like NISE Net if they lack the communication skills to get their message across to a different audience. Also, some facilities have public information officers who bridge the gap between scientists and the public, and these types of people would be useful to engage in efforts like NISE Net.

Every time I've seen someone engaged with the public, they get a better understanding of their own research and its contact with society, and how their research actually impacts people and the environment. It also makes them better communicators to their peers. It is also important because the more the public knows, the better voters they are, and they are better critical thinkers. And that usually translates into more support for science.

The public needs to be educated on science. I think it is in the best interest of our country that more people know about what we are doing, not just for their sake, but for our sake. I think getting more scientists involved in speaking with the public helps the scientists, helps them think about how to communicate what they do and put it into a broader context. I think that is definitely a win-win. I think a lot of scientists don't look at it that way, they think of it as a chore. Let me put it this way, from a purely practical standpoint, and I think certainly in my institution, it is taken seriously, this is something that you should be doing. …The NISE Network is an easy avenue for folks to go out and do that, and they will become more skilled at interacting with the public. ... I am one of the people that really want to do this, and my university doesn't give a damn about it. But there is also another fraction of people, professors doing research who aren't going to do it, unless they get something out of it. And NSF and the universities need to be pressuring on that. Of course, it is a double-edged sword, you don't want people involved that really don't want you doing it, but I think the more incentives that you put in, institutional incentives, will bring those sort of folks on the border lands and a lot of those folks may find that they really love it.

I think we should be informing the general public about what we do. I think that is part of our job.

I think that NSF is trying to make all engineering university people get interested in K to 12 education, and I don't think that all faculty are suitable to do this job. I don't think they want to and I don't think they are capable, because that is not what they are trained to do. But I think that NISE Net should be there and serve as a fantastic resource helping anybody who has the slightest interest.

[At the NISE Net annual meeting] I actually sat in on one of the sessions about how to build these linkages and it was very strange, because I think I was one of the few scientists there and the rest were from the museum community, and I had to explain to them, the problem that you are going to have is that most scientists will not shut up if you get them talking about their research. We are passionate about it, and in fact the majority of scientists do feel that they are committed, and they do see [outreach] as a positive thing.

I think it is important. I think there is probably one place where it could be improved, because even when I went out to the NISE Net meeting, there weren't very many scientists there. There were a couple of people like me doing outreach specifically, and then there were graduate students with their posters from nano, but I know that the graduate students and I were kind of feeling like it was very heavily focused on museum stuff and thought that there wasn't quite enough focused on getting the faculty out there and involved.

I think it is really important because a lot of the educators are not as heavily involved in the science, and so you don't know all of the in's and out's and the updates on this and that, and it is hard to keep up with all of that in a widespread deal. It is nice to be able to have this bank of researchers who have this at the tip of their tongue, to be able to call upon them. Nanotechnology is changing so fast, and it is not like you are giving a presentation on solids, liquids and gases. It is the thing that really does need vetting. You need to keep up on the current research or what you are presenting is not going to be valid anymore.

I think it's really important but it depends on the scientist. It can't be mandatory. There are some out there who want to but haven't had the opportunity, and there are some who wouldn't. But they need to be aware of the opportunities. The government is taking people's money and funding programs with it. People should know what is happening with their money.

I hope that interacting with scientists gives them an impression that science is interesting and important and something they can personally engage with and contribute to. With adult and younger audiences, I want them to feel like they can connect. I think that's what Americans think—the only people who engage with science are scientists. Being a woman engineer, I think it's important for scientists to not all look the same.

There are several pretty serious societal issues that need to be addressed related to nano. People understanding and knowing the basics so they will be able to make some good decisions. My opinion about that is that I think NISE Net has made the first serious and substantial attempt at the informal level to address these issues. Not everything will come to fruition. I don't think anyone thought seriously about bringing nanoscience to the public. There are challenges and they've taken on a difficult task.

Like most scientists—or many scientists at least—I recognize the value of having a general public that understands and appreciates the role of science in society and can think about it using a rational approach, rather than having blind acceptance or fear. The only way to do that, in my mind, is to talk with people who aren't in universities and colleges. So I have a general appreciation for outreach.

I think it's critically important for two reasons. The public needs to see that not all scientists are weirdos, although there are some, believe me. If you are doing outreach in a field that is so cutting edge, it's good to have people who can say you have some of your facts wrong. It improves the public-scientist-engineer interactions.

You can't do science without some public acceptance of it. Society does get involved in the funding. If it's private funding, it's because they think it's in the market. If you put the term nanoscience on it, it's guaranteed to sell.

Scientists are onto the things that are going to determine the well-being of society in the future. We are nice and normal people. We are not un-understandable people in white coats. And not slick, untrustworthy people like politicians either. We want the public to know that we aim to uncover the beauty of science. Improve the quality of life.

I think it's important since pubic sways policy. There is the touchy-feely level, but the ultimate level is to keep public funding of research flowing. It's the fear thing. It's quelling the anxiety. That's important if you want to keep research funding alive. And if you want to interest kids in science. If you want to get kids to study science… those two things are equally important.

NISE Network

Reach and Impact Study

May 2009

INVERNESS RESEARCH

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NISE Network
Reach and Impact Study

Introduction

Early on, NISE Net set the goal for itself of "getting nano into 100 place"—that is, the network aimed to engage (at least) 100 institutions across the nation and support their implementation of nanoscience education programs for their public audiences. To accomplish this goal, NISE Net established a strategy for expanding the network to a national scale. It identified and supported regional "hubs" (formerly called "nodes") that would each be responsible for reaching out to and developing relationships with institutions in their geographical region. In addition, NISE sponsored workshops and meetings that helped the network hubs create relationships with informal science education institutions across the country.

To investigate the extent to which and the ways in which NISE Net is, in fact, succeeding in engaging the ISE and science research fields, in February 2009, Inverness Research invited 695 individuals listed in the NISE Net database to complete a short survey about the reach and impact of NISE Net[1]. The names were selected because the database indicated that at least one NISE Net leader or key partner had "collaborated with them" on some level. However, we did not include people who attended a regional workshop, since they were participating in a concurrent interview study we were conducting.[2] It is important to note, then, that the sample for this reach and impact study consists largely of individuals who comprise "the next layer out" from those people who have participated in the regional workshops.

The purpose of the survey was to determine the individual's nature and depth of involvement with NISE Net, and their anticipated future involvement; to gather their perceptions of 1) the extent to which NISE Net is contributing to their individual capacity to conduct nanoscience education for their audiences; 2) the contributions made to their institution's capacity to incorporate nanoscience into their current practices; 3) their current use of NISE Net resources or some other nanoscience education resources; and 4) the extent to which NISE Net has enabled them to develop collaborations within the ISE field and with scientists. The survey asked respondents to rate their level of agreement or

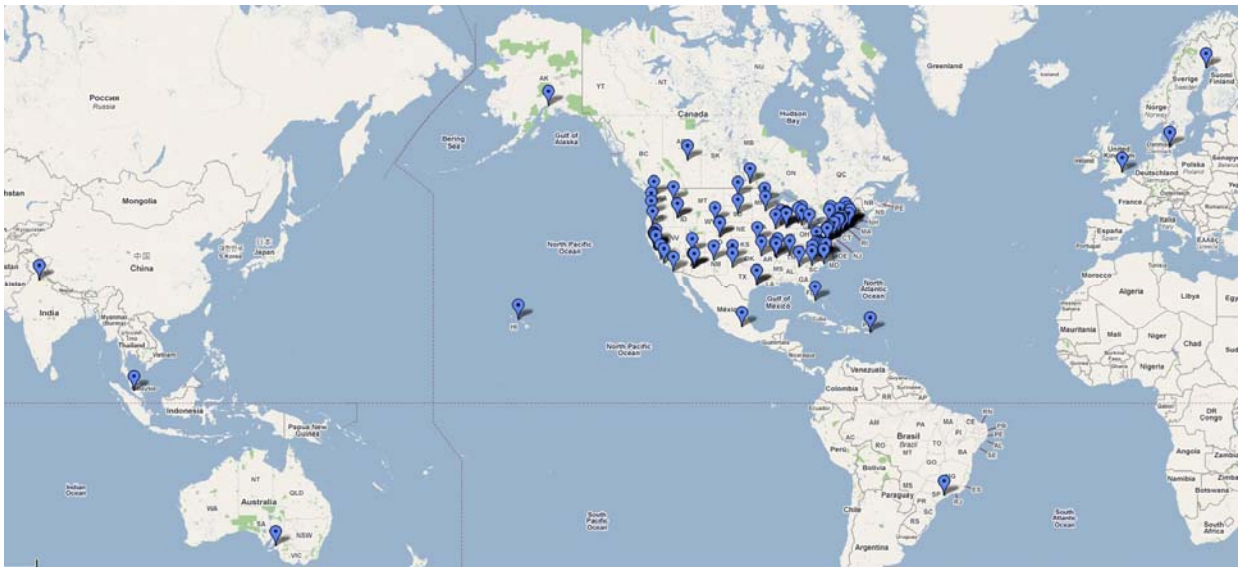
[1] We offered a $10 gift certificate for Amazon.com as an incentive.

[2] To determine whether or not the respondents were appreciably different from the non-respondents, we conducted a non-responders study. We feel confident that the respondents are representative. Please see Appendix B for a more detailed explanation of our non-responder study.

disagreement with a series of statements about NISE Net and offered a few spaces for respondents to qualify or explain their ratings.

In our analysis, we looked at the whole group of respondents as well as the subgroups of scientists as compared to the rest of the respondents. We also categorized and compiled answers to the 3 open-response questions (see Appendix A).

World Map of Reach & Impact Survey Sites:



Overview and Findings

The Sample

One hundred and seventy-five (175) individuals responded to the survey, for a return rate of 25%. In our experience, this is a typical response rate for surveys of this type. The results from this sample can not necessarily be extrapolated to make claims about the representative-ness of their answers to the rest of the population surveyed.

We did follow up with non-respondents and got some sense that they do not vary greatly from those who did respond. Seventy two (72) people, or 14% of the 520 people who did not respond to the initial survey, replied to our follow-up inquiries. A negative opinion of NISE Net was probably not the reason many people did not respond to the initial survey. Only one "non-responder" had a negative opinion of NISE Net. Instead, a mix of unfamiliarity or limited involvement with the NISE Net, along with confusion about the survey and busy schedules, probably cut the response rate.[3]

In our sample of responders scientists comprise 42% of our 175 respondents, and the "others" (58%) include program managers, science educators, etc. as detailed below. A majority of respondents are either from science museums or a university (71%). About a third are from science museums, a third from universities, and the rest from a range of other institutions. The majority of the scientists (86%) are university-affiliated, while the majority of others (62%) represent science museums.

The remaining sections of this document summarize data from the survey, organized by the following categories:[4]

A. Strong validation of the NISE Net theory of action and contributions

B. Mixed or neutral findings

C. Emerging issues and questions

[3] For more about the non-responders see the Appendix B at the end of this report.
[4] For more detail, please see the annotated workbook in Appendix C.

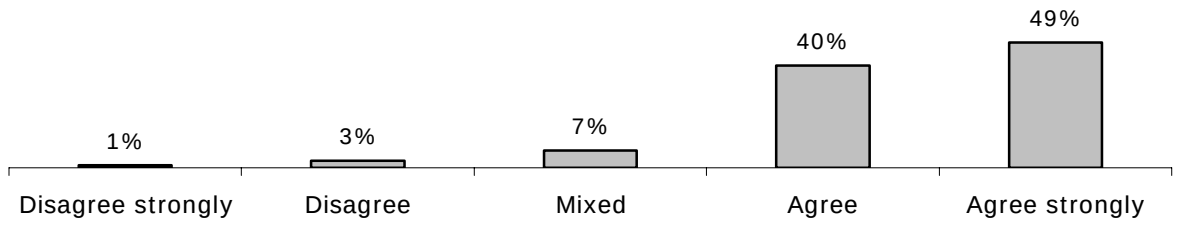
A. Strong validation of the NISE Net theory of action and contributions

In this section we highlight findings that validate the NISE Net strategy for reaching and impacting the broader ISE and science research fields, and illuminate areas in which NISE Net is making particularly strong contributions.

In general, NISE Net is contributing to individual and institutional capacity to engage in and offer nanoscience education. A majority of respondents believe that NISE Net is making a contribution to the field, and has contributed to an increased interest and commitment to nanoscience in their institutions. A majority are interested in continuing to work with NISE Net.

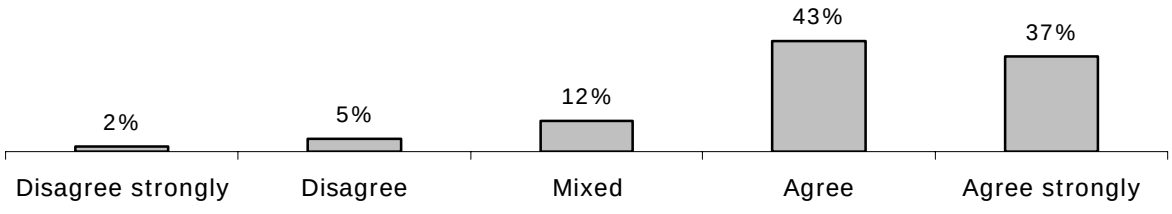
Nearly all respondents (89%) believe NISE Net is making an important contribution to nanoscience education for the field, believe NISE Net events are designed and implemented well, are positive about NISE Net's contribution to nanoscience education in the future, and are interested in continuing to work with NISE Net. A large majority (80%) say that NISE Net has contributed to their own capacity to assume increased responsibility for nanoscience education at their institution. 71% expect to contribute to NISE Net in the future.

Figure 1. "Based on my experience, I would say that NISE Net is making a significant contribution to the strength and quality of leadership for nanoscience education in the ISE community"



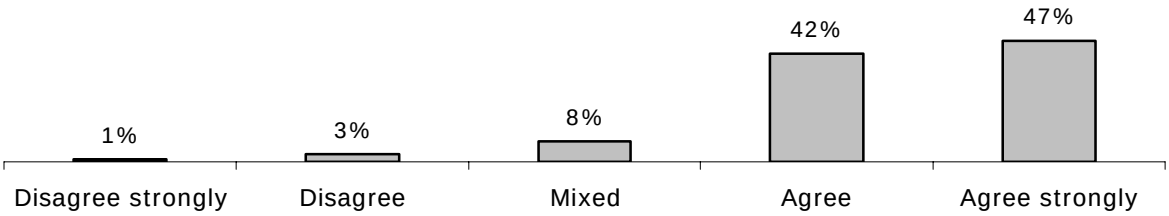
Percentages are based upon the respondents who responded; 12% checked NA/can't say.

Figure 2. "NISE Net has contributed to my own capacity to assume increased responsibility for nanoscience education in my institution"



Percentages are based upon the respondents who responded; 22% checked NA/can't say.

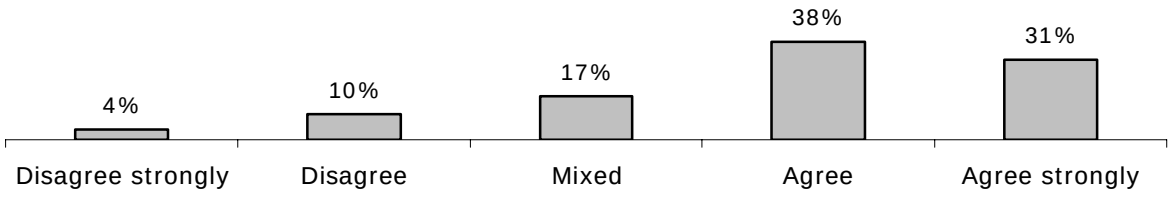
Figure 3. "I am interested in continuing to work with NISE Net"



Percentages are based upon the respondents who responded; 5% checked NA/can't say.

Three-fourths of respondents believe their institutions are interested in and committed to nanoscience, and are actually incorporating nanoscience into their programs and exhibits. Over 2/3 say their institution is now better able to incorporate nanoscience than it was three years ago.

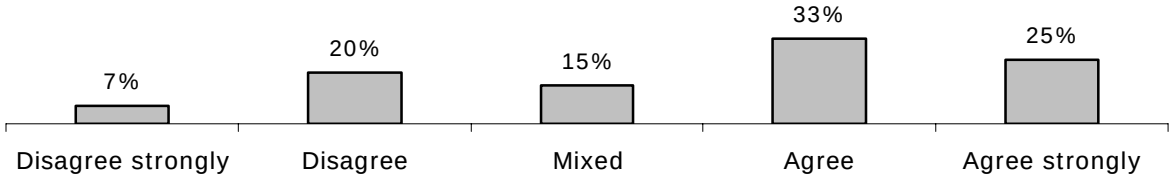
Figure 4. "Thanks to NISE Net, my institution is now better able to incorporate nanoscience than it was three years ago"



Percentages are based upon the respondents who responded; 24% checked NA/can't say.

Over one-half say their institution is more interested in nanoscience education now than it was three years ago.

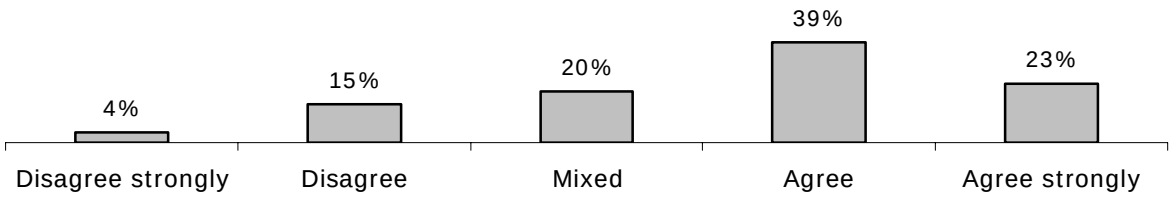
Figure 5. "Thanks to NISE Net, my institution is now more interested in incorporating nanoscience than it was three years ago"



Percentages are based upon the respondents who responded; 34% checked NA/can't say.

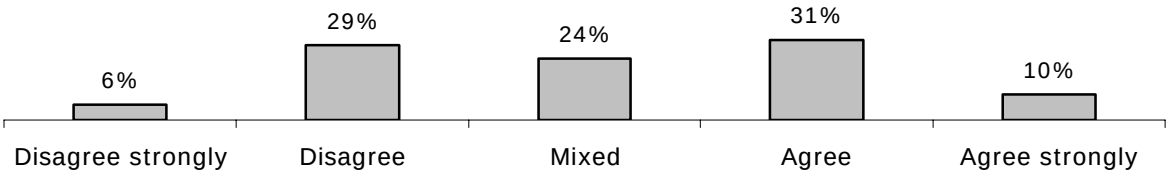
Nearly 2/3 say that NISE Net has facilitated their institutions' connections with other ISEs, and 41% say NISE Net has helped connect them to scientists/researchers.

Figure 6. "NISE Net has facilitated my institution's connections with informal science institutions"



Percentages are based upon the respondents who responded; 28% checked NA/can't say.

Figure 7. "NISE Net has facilitated my institution's connections with scientists/researchers"



Percentages are based upon the respondents who responded; 28% checked NA/can't say.

Scientists respond in ways that are both similar to and a little different from their ISE counterparts. Scientists see similar contributions to their own knowledge, skills and practice. The one area where the two groups differ is that a higher proportion of scientists (85%) than others (62%) say that they expect to continue to contribute to NISE Net in the future.

A higher percentage of scientists than others say that their institutions are committed to nanoscience education and to incorporating nanoscience into programs and exhibits (87% and 85% for the scientists, vs. 67% and 66% for all others). Conversely, a lower percentage of scientists than others say that their institutions are better able or more interested in engaging in nanoscience education than they were 3 years ago (56% and 37% respectively vs. 78% and 70%). (This is presumably due to the fact that research institutions were already committed to doing outreach). Over half of all scientist respondents say their institutions are committed to participating in NISE Net specifically.

Respondents reported that NISE Net resources are designed well (85% either agree or strongly agree). Many respondents commented in particular about the quality and usefulness of the NanoDays kits. Sample comments[5] below: [6]

We received our NanoDays kit in preparation for our first NanoDays celebration. The contents are amazing! We are a small non-profit organization and would not be able to afford to buy or produce materials of this quality on our own. I feel confident that it will be easy to train volunteers to facilitate our event because of the excellent information included with each activity. I am excited by the variety of ideas in the online 'Sandbox' and plan to try a few this year.

The presentation/packaging of the information is great and I really enjoy the "plug and play" aspect of the NANO kits. This would only be my second time implementing this program and I feel I have so much more to learn with the organization.

I really appreciate the materials we have received and the high-useful-information/low-fluff content of the workshops.

The NanoDays kit is phenomenal. I couldn't believe it when I opened the boxes. Everything is right there. You couldn't have made it easier to use! Thank you!

[5] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker.
[6] See Appendix A for additional comments.

The experiments and resources for NanoDays had HUGE impact on my program. We used those kits and experiments constantly throughout the year, every outreach proved an opportunity for "NanoDays!"

I feel that with the free NanoDays supplies and Program Packages that I have received sufficient support from the NISE Net to carry out this type of educational programming at my institution.

We LOVE participating in NanoDays and are grateful for the kits we got this year.

The NanoDays kit is great! Looking forward to our Museum participating in NanoDays this spring!

The box of materials is well done and complete. It gave a wide range of ideas to spring programs for and relate to our exhibitions and programs.

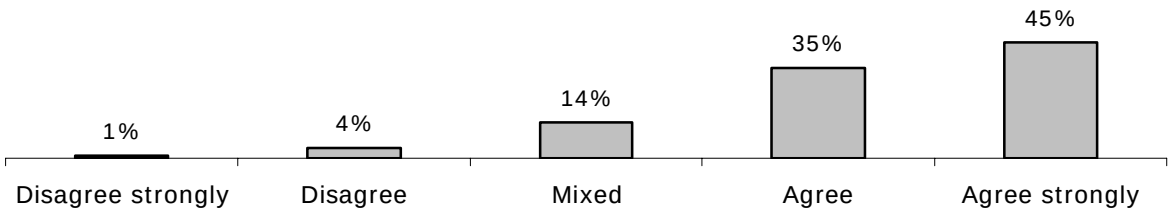
I was stunned by quality and quantity of the nanoscience kit. It is wonderful. We are putting it to great use.

I really think it's a model program. The NanoDays kits are put together very well!

NISE Net has played a strong role in developing professional relationships—although more could be achieved in this area, especially connecting scientists with ISE professionals.

Almost 2/3 of all respondents say they have interacted with informal educators through NISE Net, and just over 1/3 say they have interacted with scientists through NISE Net. 80% say that they feel better connected to others who are interested in nanoscience education.

Figure 8. "Thanks to NISE Net, I feel better connected to others who are interested in nanoscience-related education"



Percentages are based upon the respondents who responded; 17% checked NA/can't say.

B. Mixed or Neutral Findings

In this section, we share findings that are either mixed or neutral – findings that describe how respondents are likely to hear about NISE Net and its products and the nature and content of nanoscience activities they are doing in their institutions.

ISE professionals are more likely to hear about NISE Net and/or its products through conference sessions or workshops, and scientists through another NISE Net member.

Most of our sample heard about NISE Net in one of two ways: most respondents heard about NISE Net by 1) attending a conference or workshop, or 2) by word of mouth from another member of NISE Net. Fewer reported that they learned of NISE Net from another colleague (31%), or nisenet.org (27%). [NOTE: We learned in the open-ended comments that nisenet.org is an important source of information about the network. However, it does not yet appear to be a place where most people learn about NISE Net resources.]

Scientists are somewhat more likely to learn about NISE Net from word-of-mouth, and informal science educators and others are somewhat more likely to learn about NISE Net by attending a conference or workshop.

Among those respondents who are delivering nanoscience education, most provide classroom activities or cart demonstrations. Scientists engage more often in stage presentations and forums. Further, a large majority of NISE Net nanoscience programs, activities, exhibits and forums—from NISE Net or other resources – address the fundamentals of nanoscience. Finally, over 1/2 of the respondents (especially scientists) make changes to NISE Net materials and resources before delivering them.

At least 1/2 of the respondents have delivered some kind of nanoscience education to the public in the past three years (50% NISE Net, 55% non-NISE Net). About 1/3 have not. Of those who are planning to do nanoscience in the future, most appear to plan to use NISE Net materials.

Cart demonstrations and classroom activities are the most frequently used form of nanoscience education among this group, followed by stage presentations. Smaller numbers of institutions are doing theater programs and forums. At least 1/4 have done a stage presentation or program, either using NISE Net or non-NISE Net products. At least 1/2 have done a cart-based program of some kind.

As could be expected, scientists deliver more stage presentations and participate in forums more often than the other NISE Net participants, especially in non-NISE Net stage presentations and programs. On the other hand, they participate in cart demonstrations and programs much less often than others, especially in NISE Net-related contexts.

It appears that almost 8 in 10 nanoscience programs, activities, exhibits and forums—both for NISE Net and in other contexts—address fundamentals of nanoscience. Scientists' and others' institutions are presenting public programs on the fundamentals of nanoscience at almost equal levels. Scientists' institutions are more likely to present programs on materials, tools and applications; energy and environment; and society, policy, and economics. Other institutions are more likely to do public education that links nanoscience, art and nature.

C. Emerging Issues and Questions

Most of the more challenging issues and questions emerged from the open-ended comments. Below we highlight these areas and provide sample comments.

As noted above, the respondents believe that **more support could be provided by NISE Net to help ISEs make substantive and lasting connections to scientists and experts.** Some sample comments on this issue are below:

> *I also had hoped that there would be ongoing relationships extended from the research community to ISE's and to the public. After a promising start, the participation of the research community has dwindled to a vestigial state.*

> *I would like to concentrate on cultivating more relationships with researchers.*

> *The main issue is connecting scientists and educators (teachers). There is, in my opinion, a big disconnect between what's going on in the lab and in the classroom, both in terms of science and policy.*

> *For starters, NISE Net could actually ask scientists for things. There is a huge database of scientists that never get contacted, whose expertise isn't truly wanted or apparently necessary for NISE Net activities. I and many others that I know would love to participate with others in developing informal nanoscience educational products and work on projects in a substantial way within NISE Net... but there are no opportunities to do so—we are just asked to participate in NISE Net's self-promotion of itself and its poor products.*

There is more talent to tap outside the MRSECs and NSECs that seem to be the primary focus of connection to scientists (this opinion is the result of participation in the annual meeting in San Francisco).

I think we have been very shaky in building relationships with the research community, which I think is a major failing.

Offer local resources/contacts for collaborations in programming. Our biggest challenge is finding professionals who translate well in a public setting with a variety of age levels.

Involve more faculty members as a driver of the NISE Net message.

Seems to be a lack of continuity. NISE Net connected with graduate students at my university, but when those graduate students move on, I don't feel the connection to the University will persist.

Communication about the activities of NISE Net, what resources are available, and how to stay connected with others was a concern for some. Some sample comments, below:

NISE Net should establish a more constant newsletter.

Some kind of update on the front page or the emailed newsletter that highlights new nanoscience discoveries or research that apply to some of the programs and activities (like: new updates in carbon nanotubes!) or something. It's hard to keep up on all of the topics and the kids/public always want to know about the most recent stuff.

I would like more information sent to me about the programs, activities and workshops available. My experience has been that I have to actively search the information out myself which is more time consuming. The NISE Net workshop I did attend was introduced to me by an acquaintance at the museum where the program was being held not from NISE Net or their affiliates directly.

I think it might be helpful to "push out" summaries of what different groups across the country are doing for outreach activities just shortly after it happens. I would certainly be happy to be on an email list that just came out with just headlines and "click to see more" with a more detailed summary, maybe photos, etc.

Make it more obvious who does what activities, what kind of response activities have had in the past. Also making it clear which museums perform what function, in actuality not ideally. How have these museums or science centers integrated the goals of NISE Net effectively? How do they define effectively?

The comments regarding the NISE Net website (nisenet.org) were mostly negative. According to those surveyed, the website is critical but it is not sufficiently effective yet. While the majority of interviewees and survey respondents had noted positive changes in NISE Net as a project over time, the website does not appear to be keeping pace with the development of the project or with what people need. Sample comments below:

I can log in to the net, but some of the features are blocked for me. This prevented me from participating in forums and to see some of the activities.

NISE Net is seen in the community as a clique with fixed and stable audience and fairly unresponsive leadership. Increased openness and transparency would be most welcome, especially for materials on the Web, which are needlessly cumbersome to view and obtain.

It is very slow and difficult to navigate, and if this could be addressed I think I would use it more.

Make more resources available online, and encourage NISE Net members to be more active on the NISE Net website

Some of the items in the catalog are not clear as to how they are intended to be used. It seems that there is a lot of 'coming-soon' content, or maybe that was a while ago before resources began to be posted. I've been to the website a number of times, and for some things (NanoDays info) it was hard to navigate—I couldn't find a page again that I had found before, that sort of thing.

Providing information on the website for the those wanting to get involved would be valuable. Instead, the website serves mostly as a point of contact for general information. Also, it is unclear how images and visualizations are being incorporated into the educational curriculum.

Do not block features. Allow everyone to see exhibits details and other activities.

Provide more examples of tacit knowledge on the website to help educators more effectively integrate nanoscience into their curricula.

I had assumed, at the very least, that NISE Net would create a working public web site that was a useful guide to nano-related research and education. But there are 10 other websites I would go to for that kind of information before the NISE Net web site.

Since the website is the main portal to the members of the Network I haven't met personally through the programs team, I really wish the community section of the page was organized a little differently (or could be sorted by a drop down, possible options would be "children's musueums, program developers, exhibit developers, etc". These key words could be selected by NISE Net partners when completing their profile. Also, it would be great for the network to identify "content areas of high need" when it comes to programs, forums and exhibits, to better inform those of us looking to create new products about new (or even preexisting topics). By identifying these content areas, I think we can really diversify the catalog.

Make sure that all the content on the site is high quality. A rating system that lets users comment and rate programs and activities (like at Amazon or similar sites) would be helpful. Also, the site must be well-organized, especially as the content grows.

The catalog is, frankly, pathetic, with something like 20-30 activities and exhibits in there. I know some of the programs, and they are OK, but the exhibits are really not useable as described. I am actually shocked at how threadbare the catalog is. I had assumed that they would at least include interesting and creative activities and exhibitions.

The information on the web page is rather slow to be updated. It seems that there is nobody in charge of keeping it updated. More resources would be extremely useful.

The major barriers to involvement in NISE Net, other than issues cited above, centered around factors such as lack of public interest in nanoscience (and therefore nanoscience is a low priority for their educational institutions), and challenges related to funding. Sample comments below:

I remain skeptical of the value of nanoscience education in my institution so at this point I don't see NISE Net as a useful resource. It is an important topic relating to current science and technology, but is a very difficult subject for our visitors to grasp in a meaningful way and there are many other exciting and engaging and important topics for our museum's exhibits and programs that are more educationally productive.

There is some resistance to nanotechnology in my institution because the benefits aren't easy to see. That is, people aren't knocking down the doors to learn about the subject.

At this time, the topic is a bit out of the scope of our programming goals. It would be helpful to get an update... perhaps annually... on NISE Net and that way we can determine if its goals match those of our museum.

Nanoscience education is a low priority for our institution. Development of a quality traveling exhibition on nanoscience would be of interest to our institution.

We are a very small very nonprofit science center and do not have the funding to attend nanoscience instructional events. Wish we did.

With money tight, we're clamping down and focusing on how to meet core mission stuff. This is happening everywhere and it is not always easy to make a case for nanoscience education, despite the great work and energy that is the NISE Net.

Appendix A. Compilation of Comments - NISE Net R&I Study

This document is a collection of ALL comments made on the NISE Net Reach and Impact Survey that Inverness Research conducted in February of 2009. This document is divided into categories that are based on themes that emerged in participants' comments across questions:

- Resources and Materials Available Through NISE Net
    - *Positive comments on programs and activities*
    - *Need for more inquiry- or investigation-based activities*
    - *Need for improved access for diverse or varied audiences*
    - *Need for improved access for younger audiences/children's museums*
    - *More specific suggestions for improving resources*
    - *Need for more evaluation of resources*
- NanoDays Kits
- Networking and Connections Available Through NISE Net
    - *Positive comments regarding benefits*
    - *Need for improved access to experts, such as research scientists*
- Communication
    - *Variety of potential means (newsletters, email, etc)*
    - *Regional hubs*
    - *Meetings*
- Website (including the Catalog)
- Barriers to Involvement

- *Lack of interest on the part of the institution or public*
- *Lack of funding*

- Return on Investment
  - *Potential ways to leverage funding to grow additional resources*

- General Comments

Resources and Materials Available Through NISE Net

POSITIVE COMMENTS ON PROGRAMS AND ACTIVITIES

I think they are doing a wonderful job, and have not only been the reason that we are offering 2 nanotech events a year, but have given me the tools to do so. Once the network gets larger, there will be even more support and chances for me to offer new Nanotech programming.

I am very happy with the current resources, however, more regional hubs may assist increase impact.

The materials received are well done and useful for our planning.

Continue providing great activities and examples of how nanoscience is applied in every day life. Finding ways to take complex concepts and make them relatable to the regular person.

The cart and classroom programs are great. It provided me with a great demo (nano stained glass) that I hope to implement in this year's science festival. More of these types of programs would be great.

The resources from NISE Net have been fantastic! It is so wonderful to participate in an organization that provides so many materials that are of such excellent quality. Thank you!

From knowing absolutely nothing about nanoscience at the beginning of September, I am now our nano"expert". For my first workshop, I relied very heavily on NISE Net. I downloaded endless files for

activities. Probably most importantly, I contacted presenters from the regional workshop who gratiously provided me with explantions, references and additional files. As I prepare for my first NanoDays at the end of this month, I am awed by the depth of my newly acquired knowledge and my feeling of confidence to present in this field. Thanks to NISE Net.

I think that there is very little substance to the actual programs other than the NanoDays kits. The quality and quantity of public deliverables could have been created with a fraction of the money. It is a bit unfair to ask if we have delivered NISE Net programs, as many of the NISE Net programs were created through other projects and have been incorporated into NISE Net. I actually think this is deceptive. Just because an exhibition or program is in the NISE Net catalog, I don't think it is right to call it a NISE Net program.

NEED FOR MORE INQUIRY- OR INVESTIGATION-BASED ACTIVITIES

Need more activities that are INQUIRY-based. I'd be happy to attend another NEO workshop at the Exploratorium.

Every institution is different; in terms of cart demonstrations and activities, we prefer lengthy investigations where participants can really immerse themselves in the topic at hand. I would like to see more investigative style activities from NISE Net. That way, in conjunction with the faster demo's we receive, folks can really learn many aspects of nano.

NEED FOR IMPROVED ACCESS FOR DIVERSE OR VARIED AUDIENCES

We are a small museum in a rural area we are the only info getting out to the area and surrounding area for up to 100 miles. We are grateful for the help with the NanoDays kits and invites to work shops. You have done a great job if no one has told you recently.

Since my new institution is not a research university or museum, I am less sure how I fit into the network. Any activity that can be adapted to a formal education setting from the informal NISE Net materials would be helpful to me.

We would like to have an active participation, we would like to build a partnership, we are very interested in the translation of all materials into Spanish.

NEED FOR IMPROVED ACCESS FOR YOUNGER AUDIENCES/CHILDREN'S MUSEUMS

Since I work in a children's museum for ages 0-12, we are constantly trying to make difficult concepts more comprehensive for young children. NISE Net has been very specific in trying to work with educators from all kinds of institutions, and we only hope to continue this type of development.

Provide more simple and easy activities and demonstrations for younger children and elementary schools.

Continue to provide high quality that can be used to facilitate demonstrations and hands-on activities. We would particularly be more interested in materials that can be used with children.

Continue expanding resources for very young children (age 2-5).

Since this is our first experience with NISE Net and nanoscience I am hoping that we will be able to get support for our core audience which is at the elementary school level.

Need programs aimed at younger grade levels—information above average child visitor.

We deal with children ages 2-10. The materials provided are fantastic but had to be adjusted to TRY and make them more age appropriate for our audience.

More resources for very young audiences.

Continue to produce quality programming/exhibits but make sure it offers alternatives/variations for Children's Museums.

Tailor more educational materials and activities for young children so we can provide more nanoscience themed field trips to local school children.

Provide more simple and easy activities and demonstrations for younger children and elementary schools.

Provide opportunities to reach out to primary schools through program "kits" or sponsor local science fairs.

Support/materials for nanoscience at the elementary school level.

MORE SPECIFIC SUGGESTIONS FOR IMPROVING RESOURCES

Specific ties to Earth Science? Our exhibits are separated into themes, so organizing activities into themes tied to "macro" science might help me better integrate into my specific responsibility areas.

More tie-ins with climate change programming.

More info about current applications of nanoscience in everyday life.

Contract with the Lawrence Hall of Science to create a GEMS guide based upon nanoscience. We would buy and use that.

Really fun, interactive exhibits that are part of a sci/tech floor would help. In addition, I think a basic kiosk idea (similar to SMM's website) that links research at local universities to what a museum visitor can see at the museum would be great. I'm thinking of a template from which other museum/university partnerships can develop something that represents what is happening in regional higher education.

Provide an opportunity to promote supplementary non-NISE Net nanoscience programs to the network partners.

NEED FOR MORE EVALUATION OF RESOURCES

The most useful materials from the NISE Net have been the front-end research about public understanding of nanoscience and formative evaluation of exhibits and programs. That information has helped our institution make more informed decisions as we develop and deliver our own nao programs to the public.

Continue to collaboratively develop materials and programs, and to improve currently disseminated programs through learning goals and affective-goals oriented assessment. I think many of the NISE Net programs are good, but it is unclear whether they are improving public/student understanding of nanoscale issues. More thorough evaluation based on the goals of the program for the constituents would help improve materials.

We need to receive some of the assessment data. Since we do public perception work this material would be highly useful.

More information about research behind and related to exhibits, forums, activities in general. What kind of responses to people get? How do you know if that is a positive response? Why is it good to avoid certain topics when discussing nano. Where does NISE Net's agenda come from? How can it be altered?

By providing educational curriculum resources that come sorted by grade band and topic area, as well as having them put through an evaluation process as to their usability and effectiveness at producing student learning.

NanoDay Kits

We received our NanoDays kit in preparation for our first NanoDays celebration. The contents are amazing! We are a small non-profit organization and would not be able to afford to buy or produce materials of this quality on our own. I feel confident that it will be easy to train volunteers to facilitate our event because of the excellent information included with each activity. I am excited by the variety of ideas in the online 'Sandbox' and plan to try a few this year.

The presentation/packaging of the information is great and I really enjoy the "plug and play" aspect of the NANO kits. This would only be my second time implementing this program and I feel I have so much more to learn with the organization.

I really appreciate the materials we have received and the high-useful-information/low-fluff content of the workshops.

The NanoDays kit is phenomenal. I couldn't believe it when I opened the boxes. Everything is right there. You couldn't have made it easier to use! Thank you!

the experiments and resources for Nano Day had HUGE impact on my program. We used those kits and experiments constantly throughout the year, every outreach proved an opportunity for "NanoDays!"

I feel that with the free NanoDays supplies and Program Packages that I have received sufficient support from the NISE Net to carry out this type of educational programming at my institution.

We LOVE participating in NanoDays and are grateful for the kits we got this year.

The NanoDays kit is great! Looking forward to our Museum participating in NanoDays this spring!

Box of materials is well done and complete. It gave a wide range of ideas to spring programs for and relate to our exhibitions and programs.

I was stunned by quality and quantity of the nanoscience kit. It is wonderful. We are putting it to great use.

I really think it's a model program. The NanoDays kits are put together very well!

Networking and Connections Available Through NISE Net

Positive comments regarding benefits

I can't think of anything right now. I think that NISE Net is doing such a fantastic job and they really cover everything. Five stars!!!

Keep it coming. We need updates and additional support like those local nanoexperts you point us toward.

Need for improved access to experts, such as research scientists

I also had hoped that there would be ongoing relationships extended from the research community to ISE's and to the public. After a promising start, the participation of the research community has dwindled to a vestigial state.

I would like to concentrate on cultivating more relationships with researchers.

The main issue is connecting scientists and educators (teachers). There is, in my opinion, a big disconnect between what's going on in the lab and in the classroom, both in terms of science and policy.

For starters, NISE Net could actually ask scientists for things. There is a huge database of scientists that never get contacted, whose expertise isn't truly wanted or apparently necessary for NISE Net activities. I and many others that I know would love to participate with others in developing informal nanoscience educational products and work on projects in a substantial way within NISE Net... but there are no opportunities to do so—we are just asked to participate in NISE Net's self-promotion of itself and its poor products.

Find ways to include a larger share of researchers than those who are specifically funded by an NSF NSEC grant. Many other researchers would benefit from the education tools being developed by NISE Net members.

In my experience the NISE Net could connect much better with academics who are not members of SECs. My perception is that there is considerable interest within the community that is more "organic" than that driven by the need for outreach within MRSECs and NSECs.

There is more talent to tap outside the MRSECs and NSECs that seem to be the primary focus of connection to scientists (this opinion is the result of participation in the annual meeting in San Francisco).

I think we have been very shaky in building relationships with the research community, which I think is a major failing.

I'd love to have more DVDs of lectures by scientists and researchers in the field.

Our university partner recently spoke about her NISE Net work with us at the American Institute for Aeronautics and Astronautics. She was mobbed by fluid dynamics researchers wanting to know the secret to working effectively with non-formals in a productive way. She is still getting e-mails of interest 6 weeks later. NISE Net is making an impact.

Offer local resources/contacts for collaborations in programming. Our biggest challenge is finding professionals who translate well in a public setting with a variety of age levels.

Involve more faculty members as a driver of the NISE Net message.

Seems to be a lack of continuity. NISE Net connected with graduate students at my university, but when those graduate students move on, I don't feel the connection to the University will persist.

Communication

VARIETY OF POTENTIAL MEANS (NEWSLETTERS, EMAIL, ETC)

Ideas for activities; knowing about new exhibitions; connecting with people who do nanoscience education in aim to discuss ideas.

NISE Net should establish a more constant newsletter.

Perhaps a monthly or quarterly e-bulletin that highlighted current events/breakthroughs in nanoscience related to the kit materials. I think the current programs and kit materials are right on target and find these very valuable to our educational program. They have allowed us to develop a sound nanoscience education program, along with the help of local research scientists.

Some kind of update on the front page or the emailed newsletter that highlights new nanoscience discoveries or research that apply to some of the programs and activities (like: new updates in carbon nanotubes!) or something. It's hard to keep up on all of the topics and the kids/public always want to know about the most recent stuff.

I would like more information sent to me about the programs, activities and workshops available. My experience has been that I have to actively search the information out myself which is more time consuming. The NISE Net workshop I did attend was introduced to me by an acquaintance at the museum where the program was being held not from NISE Net or their affiliates directly.

I think it might be helpful to "push out" summaries of what different groups across the country are doing for outreach activities just shortly after it happens. I would certainly be happy to be on an email list that just came out with just headlines and "click to see more" with a more detailed summary, maybe photos, etc.

Make it more obvious who does what activities, what kind of response activities have had in the past. Also making it clear which museums perform what function, in actuality not ideally. How have these museums or science centers integrated the goals of NISE Net effectively? How do they define effectively?

REGIONAL HUBS

It has been hard to keep up with what has been happening. I don't get to the site often. I applied for starter sets in activities and exhibits but the offerings eventually went to south and east Texas and Oklahoma, I think. We are hundreds of miles from any of them. The new regional concept gets us at least in the participation arena.

I think it would be really beneficial to have more frequent regional meetings or at least coordinate a way for us to create local chapters so that it is easier to network with local NISE Net members.

More regional events, even on a smaller scale.

MEETINGS

I like the big meetings where we have presentations from forward looking nanoscientists and educators. I would like to have more program guides like the nano-days kit, good media and web resources would be useful as well.

NISE Net is doing well in supporting us, and I am interested in attending the next conference. I learned more at the 2007 conference than any other time, and am eager to share the new activities and connections I have made with the NISE Net members.

The meeting in San Fransisco seemed very disjointed. The different folks didn't seem to be on the same wavelength about what was happening or what resources were available or being developed. The general meeting felt rather useless for a graduate student who is doing research and outreach on the side.

Website nisenet.org (including the Catalog)

The information on the web page is rather slow to be updated. It seems that there is nobody in charge of keeping it updated. More resources would be extremely useful.

I can log in to the net, but some of the features are blocked for me. This prevented me from participating in forums and to see some of the activities.

NISE Net is seen in the community as a clique with fixed and stable audience and fairly unresponsive leadership. Increased openness and transparency would be most welcome, especially for materials on the Web, which are needlessly cumbersome to view and obtain.

It is very slow and difficult to navigate, and if this could be addressed I think I would use it more.

Make more resources available online, and encourage NISE Net members to be more active on the NISE Net website

I believe that the NISE Net is doing great work. A more intensive use of the Internet would be helpful.

More specific:

Better online distribution of educational materials that have ben generated by the NISE Network: programs, posters, imagery, books, graphics, etc. This portion of the website could be better organized and easier to navigate.

Some of the items in the catalog are not clear as to how they are intended to be used. It seems that there is a lot of 'coming-soon' content, or maybe that was a while ago before resources began to be posted. I've been to the website a number of times, and for some things (NanoDays info) it was hard to navigate—I couldn't find a page again that I had found before, that sort of thing.

Providing information on the website for the those wanting to get involved would be valuable. Instead, the website serves mostly as a point of contact for general information. Also, it is unclear how images and visualizations are being incorporated into the educational curriculum.

It would help to have a better organized website so resources and materials are easy to browse and access. It would also help to have the resources available posted in a more timely manner. A lot of time is spent tracking down indiduals for access to materials that should be posted on the site, but aren't.

Continuing to build a set of publicly available references, with good search and browse utilities, would be the best support I could imagine for people such as myself.

Set up a link of speakers that are available in specific geographical areas.

Do not block features. To allow everyone to see exhibits details and other activities.

Provide more examples of tacit knowledge on the website to help educators more effectively integrate nanoscience into their curricula.

I had assumed, at the very least, that NISE Net would create a working public web site that was a useful guide to nanoscience-related research and education. But there are 10 other websites I would go to for that kind of information before the NISE Net web site.

CATALOG

Since the website is the main portal to the members of the Network I haven't met personally through the programs team, I really wish the community section of the page was organized a little differently (or could be sorted by a drop down, possible options would be "children's musueums, program developers, exhibit developers, etc". These key words could be selected by NISE Net partners when completing their profile. Also, it would be great for the network to identify "content areas of high need" when it comes to programs, forums and exhibits, to better inform those of us looking to create new products about new (or even preexisting topics). By identifying these content areas, I think we can really diversify the catalog.

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Barriers to Involvement

LACK OF INTEREST ON THE PART OF THE INSTITUTION OR PUBLIC

We aren't interested in doing nanoscience exhibits and programs at our center, so there seems no need.

I remain skeptical of the value of nanoscience education in my institution so at this point I don't see NISE Net as a useful resource. It is an important topic relating to current science and technology, but is a very difficult subject for our visitors to grasp in a meaningful way and there are many other exciting and engaging and important topics for our museum's exhibits and programs that are more educationally productive.

There is some resistance to nanotechnology in my institution because the benefits aren't easy to see. That is, people aren't knocking down the doors to learn about the subject.

At this time, the topic is a bit out of the scope of our programming goals. It would be helpful to get an update... perhaps annually... on NISE Net and that way we can determine if its goals match those of our museum.

Nanoscience education is a low priority for our institution. Development of a quality traveling exhibition on nanoscience would be of interest to our institution.

LACK OF FUNDING

Really there just hasn't been time to branch out into this. With limited resource I have to focus my staff on our institutional goals, which currently do not significantly overlap into nanoscale technology. If that should change, I know I would certainly use the NISE Net resource.

We are a very small very nonprofit science center and do not have the funding to attend nanoscience instructional events. Wish we did.

With money tight, we're clamping down and focusing on how to meet core mission stuff. This is happening everywhere and it is not always easy to make a case for nanoscience education, despite the great work and energy that is the NISE Net.

I will certainly research how we can begin to benefit from NISE Net in the future. It is difficult for me to comment on how they can do it better since we have not really been utilizing them. That being said, however, for us, as with many non-profits, the reality is that cost is what typically determines where we can put our efforts at any particular time.

Since my new institution is not a research university or museum, I am less sure how I fit into the network. Any activity that can be adapted to a formal education setting from the informal NISE Net net materials would be helpful to me.

Return on Investment

With everything in place the network is now poised to roll out significant, useable programs and exhibits to interested institutions who now have similar knowledge levels, access to others who know more etc. It will be a poor return on investment if the project closes at this point.

The formation of the network is impressive and I hope that it will be funded to roll out at greater capacity what has been developed as there is learning for us all from what is being tested. The commitment to involving practicing scientists and engineers is commendable and has put together some great new links between formal learning establishments and science museum/science centers. The commitment to centers of all sizes and working with multi-age groups is admirable. The organizing centers' commitment, ingenuity and thoughtful programming of meetings has been excellent.

NISE Net provides a valuable service in educating the public on nanoscience and nanotechnology. I recommend continuing support.

It is an excellent initiative which needs to be strengthened

I am glad to have them as a resource and champion for ISE. I would like to see it continue to grow.

POTENTIAL WAYS TO LEVERAGE FUNDING TO GROW ADDITIONAL RESOURCES

Host professional development workshops.

Facilitate the funding and technical support of artists to work with scientists to develop new displays.

Provide resources to increase the number of staff at my institution who are capable of training volunteers on nanoscience programs.

Offer small collaborative or seed awards to folks outside (or maybe even inside) the network

Provide funding above and beyond materials foor the implementation of NISE Net demonstrations, exhibits, etc.

More support for large scale demonstration activities.

I would be interested in NISE Net materials or programs that better leverage the resources of LARGE and URBAN institutions—we have the capacity to reach large audiences, in addition to hands-on smaller scale interaction, and a network of large scale programming going on across the country could make great use of those possibilities!

By making a more significant commitment to supporting the development of dynamic displays and artworks designed to showcase the fundamentals of nanoscience to broad audiences by commissioning artists and scientists to collaborate and produce new works.

I would like to collaborate on outreach grant writing with others in the NISE Net network.

General Comments

Overall, I feel the NISE Net is a lot of very talented people spending an awful lot of money grappling with the problem of presenting a very mysterious topic to an audience undereducated in science and from a cost/benefit standpoint, really not cutting it. Ironically, NISE Net's approach to presenting the topic of nanoscience suffers from serious bloat. I feel that funding smaller individual grants of high merit would probably yield better results at a much smaller cost.

The process is slow and unwieldly, to me. It can't react quickly. At times, I think they R & D'd themselves to death. What they ended up with in exhibits, from what I remember, seems different from some of the early designs that were nice. There are two travelling exhibitions form which individual exhibit components could be taken. Would love to be able to access them. To the public, not much of a presence in a topic is a reality unless it is backed by an exhibit on the floor.

Being involved as a subawardee has been a fabulous experience. I have learned a lot about ISE and been exposed to so many different creative people. These experiences have really shaped me professionally.

NISE Net is an invaluable resource! I use it regularly and have recommended it to many colleagues.

It's a great initiative.

Very well put together, wish I had known about it in its inception, glad to be part of the community now.

Great resources and very worthwhile participating.

This is an important activity both for scientists to learn about outreach, and for the public to learn about nanotechnology impacts and issues.

NISE Net has really provided valuable opportunity for us to disseminate and engage guests on nanoscience. NISE Net is very organized and clear in terms of obtaining demo kits and it's convenient to find more information online. Thanks!

NISE Net represents one of the most successful collaborations ever to emerge on the scene of informal science education.

Being associated with NISE Net has helped our Museum reach a different audience that we would not have had the capacity to do on such a quick time line. This in turn has helped us in regards to our new mission.

Appendix B: Non-responder Study

NISE Net Reach and Impact Study

Findings from a small study of non-responders: As we do for most surveys of this kind, we assume that the 175 people who responded to the Reach and Impact survey (25% of those on our email list of 695 addresses) are among the most involved and positive individuals in the group surveyed. To find out whether the 520 "non-responders" (i.e., 695-175) were notably similar or different from the respondents, we conducted a small study.

Culling the email list to delete everyone from whom we were certain we had received a survey, we emailed a note to 648 email addresses asking recipients to answer two questions if they had not already responded to the survey: Why had they not responded to the survey (incorporating statements about favorability/un-favorability of opinion about NISE Net)? Had their institution had any experience with NISE Net? We provided response options that they could check. 72 people, or 14% of the 520 people who did not respond to the initial survey, replied. Another 15 email contacts elicited "out of office" and "no longer at the institution" responses.

The number and percentage of "non-responders" is not large, but their responses suggest that the non-responders are likely to be very generally similar to responders.

A negative opinion of NISE Net was probably not the reason many people did not respond to the initial survey. Only one "non-responder" had a negative opinion of NISE Net.

Instead, a mix of unfamiliarity or limited involvement with NISE Net, along with confusion about the survey and busy schedules, probably cut the response rate. 46% of the individuals who did not respond to the initial survey offered such reasons:

- 13% did not recall receiving the email link to the survey.
- 15% thought that they or someone else at their institution had completed the survey.
- 10% received the survey but knew little or nothing about NISE Net.
- 8% offered other reasons for not responding (e.g., not being able to accept the honorarium, thinking you had to be involved with NISE Net to respond, having participated in other NISE Net evaluation activities).

Over half (53%) of the "non-responders" had a positive opinion of NISE Net. This is congruent with two of our survey findings: 40-50% of respondents to the survey agreed strongly with a series of statements about NISE Net's contributions to their own capacity and practice, and 25-35% agreed strongly with statements about NISE Net's contributions to their institutions.

About two-thirds (69%) of the "non-responders" knew whether or not their institution had had some experience with NISE Net. Of this group, 76% said their institution had experience or involvement with NISE Net. Over half (53%) of the "non-responders" had a positive opinion of NISE Net. This is congruent with two of our survey findings: 40-50% of respondents to the survey agreed strongly with a series of statements about NISE Net's contributions to their own capacity and practice, and 25-35% agreed strongly with statements about NISE Net's contributions to their institutions.

Appendix C. NISE Net Reach and Impact Survey

Annotated Notebook of Results, including Sub-analysis of Scientists vs. Others

INVERNESS RESEARCH

MARCH 2009

175 individuals responded to the survey, for a return rate of 25%. In our experience, this is a typical response rate for surveys of this type. Scientists comprise 42% of our 175 respondents, and others 58% (program managers, science educators, etc. as detailed below).

1. **Response rate**

	All Responses			Scientists			All Others	
Invitations sent/good emails	695							
Surveys returned	175	25%		74	42%		101	58%

YOUR BACKGROUND

A large majority of respondents are either from science museums or a university (71% or 125 people). About a third are from science museums, a third from universities, and the rest from a range of other institutions. The great majority of the scientists (86%) are university-affiliated, while the majority of others (62% represent science museums.

2. **Primary professional affiliation**

	#	%		#	%		#	%
N	175			74			101	
Science museum	63	36%		0	0%		63	62%
Other museum (including children's)	16	9%		0	0%		16	16%
University	62	35%		62	84%		0	0%
Professional organization	6	3%		1	1%		5	5%
Scientific research organization	4	2%		4	5%		0	0%
Government & industry	6	3%		6	8%		0	0%
HS/CC/Library	5	3%		0	0%		5	5%
Other	13	7%		1	1%		12	12%

Consultant	Public education policy	
Evaluation	*Public television*	
Exhibition developer	Publications	
Law firm	*Science center*	
Magic Theatre	Science Learning Center	
Media	*self-employed science illustrator*	
Non profit education research organization		

Science educators, program managers, and scientists/researchers comprise just over half of the sample (54% or 95 people).

3. **Your primary professional role**	All Responses #	All Responses %	Scientists #	Scientists %	All Others #	All Others %
N	175		74		101	
Institutional director	17	10%	1	1%	16	16%
Program/project manager	32	18%	11	15%	21	21%
Administrative staff	6	3%	3	4%	3	3%
Media staff	1	1%	0	0%	1	1%
Exhibit staff	13	7%	0	0%	13	13%
Program staff	10	6%	2	3%	8	8%
Scientist/Researcher	28	16%	28	38%	0	0%
Outreach Director	13	7%	10	14%	3	3%
Science educator	35	20%	11	15%	24	24%
Public relations	3	2%	1	1%	2	2%
Other	17	10%	7	9%	10	10%

Consultant
policy staff
Graduate Student Volunteer
Professor (2)
Graphic Designer - Independent contractor
Professor Emeritus
Industrial laboratory manager
Science Coordinator (prog., exhibits, outreach)
Journalist
Science Department Chair
Librarian
science illustrator
Math & Pre-Engineering Teacher
Technical Advisor
Playwright
Vice President of Learning Experiences

YOUR PARTICIPATION IN NISE NET ACTIVITIES

A large majority of respondents have heard of NISE Net, are familiar with it, or are personally involved (97% or 171 people). Over 1/2 are personally involved in NISE Net.

A slightly greater percentage of the scientists who responded (64%) are personally involved with the Network compared to the other respondents (49%).

4. How well do you know the Nanoscale Informal Science Education Network (NISE Net)?

	#	%	#	%	#	%
N	175		74		101	
I have *not* heard of it	4	2%	3	4%	1	1%
I have heard of it	13	7%	3	4%	10	10%
I am familiar with NISE Net, but not personally involved	62	35%	21	28%	41	41%
I am personally involved in the Network	96	55%	47	64%	49	49%

By far the website reaches the largest percentage of this respondent group (72%). At least one-third have held Nanodays or participated in Nanodays. On average, people have had 3-4 contacts with NISE Net.

Scientists contributed to and advised on NISE Net programs/activities and participated in the NEO professional development program at a higher level than other NISE participants.

5. **Which of the following NISE Net activities have you engaged in?**								
	#	%		#	%		#	%
N	168			71			97	
Attended NISE Net regional workshop	46	27%		15	21%		31	32%
Attended NISE Net workshop at a national conference	43	26%		17	24%		26	27%
Attended NISE Annual Meeting in SF	49	29%		22	31%		27	28%
Attended a NISE Net Forum	19	11%		8	11%		11	11%
Participated in advising, contributing , delivering a NISE Net Forum	16	10%		9	13%		7	7%
Participated in delivering a NISE Net program or activity	40	24%		21	30%		19	20%
Contributed to/advised on a NISE Net program/activity	36	21%		21	30%		15	15%
Implemented a NISE Net exhibit	11	7%		5	7%		6	6%
Contributed to or advised on a NISE Net exhibit	19	11%		5	7%		14	14%
Held NanoDays at your institution	64	38%		31	44%		33	34%
Participated in NanoDays	62	37%		31	44%		31	32%
Planning NanoDays 2009	13	8%		2	3%		11	11%
Visited the nisenet.org website	121	72%		53	75%		68	70%
Contributed to the nisenet.org website	26	15%		10	14%		16	16%
Used the online NISE Net catalog	42	25%		15	21%		27	28%
Participated in the NEO prof. development program	12	7%		11	15%		1	1%
Advised on the development of the Network	15	9%		10	14%		5	5%
Other	11	7%		3	4%		8	8%

A part of the Arkansas Discovery Network that has a partnership with NISE

conducted NISE kit activities on our floor and participated in local nanoscience workshops using NISE materials

Downloaded a digital package that I intend to use for nanodays like activities

hosted NISE Net professionals at our nano related meetings; planned collaborative activities

Hosted two Fred Friendly Nanomedicine Forums.

I spoke with a NICE representative at the Materials Research Society Meeting held in Boston

Incorporated some of the Nanodays activities into other programs and demos

Published articles in The Informal Learning Review

Read about NanoDays in other museum newsletters and in ASTC Dimensions magazine

Reviewed NISE exhibits for in-house production

Sent a staff person to NISE Net regional workshop, submitted a letter of support for OMSI re: NISE Net exhibit

NISE NET'S CONTRIBUTIONS TO YOUR *OWN* CAPACITY & PRACTICE

In general, respondents believe that their participation in NISE Net has made substantial contributions to their individual capacity and practice. 8 or 9 in 10 are positive, and about half of them are very positive. 89% of respondents believe NISE Net is making an important contribution to nanoeducation for the field, believe NISE events are designed and implemented well, and are positive about NISE's contribution to nanoeducation in the future, and are interested in continuing to work with NISE. 71% expect to contribute to NISE Net in the future.

	All Responses								
6. Please rate the degree to which your own experience is consistent with the following statements. If you cannot respond to a statement, check Can't say/NA.	%Can't say/NA	N	Mean	Sigma	Disagree strongly	Disagree	Mixed	Agree	Agree strongly
Based on my experience, I would say that NISE Net is making a significant contribution to the strength and quality of leadership for nanoscience education in the ISE community.	12%	151	4.3	0.8	1%	3%	7%	40%	49%
I expect NISE Net to provide useful future supports and resources that will further efforts to do nano education at my institution.	15%	143	4.3	0.9	1%	4%	6%	41%	48%
I am interested in continuing to work with NISE Net.	5%	159	4.3	0.8	1%	3%	8%	42%	47%
Thanks to NISE Net, I feel better connected to others who are interested in nanoscience-related education.	17%	138	4.2	0.9	1%	4%	14%	35%	45%
NISE Net events (meetings, courses, and professional development workshops) are designed and implemented well.	34%	113	4.3	0.7	0%	1%	11%	50%	39%
NISE Net has contributed to my own capacity to assume increased responsibility for nanoscience education in my institution.	22%	130	4.1	1.0	2%	5%	12%	43%	37%
NISE Net resources are designed well.	14%	143	4.2	0.7	1%	1%	14%	50%	35%
I expect to contribute to NISE Net in the future.	14%	146	3.8	1.1	3%	10%	16%	42%	29%

7. **How could NISE Net better support your own efforts to do nanoscience education?**
See comments

The respondents are almost as positive about NISE Net's contributions to their institutions capacity to provide nano education. Three-fourths of respondents believe their institutions are interested in and committed to nano, and are actually incorporating nano into their programs and exhibits. Over two-thirds say their institution is now better able to incorporate nano than it was three years ago. Over 1/2 say their institution is more interested in nano now than it was three years ago. Nearly 2/3 say NISE has facilitated their institutions' connections with other ISEs, and 41% say NISE has helped connect them to scientists/researchers. Over half say their institutions are committed to participating in NISE Net specifically.

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE

8. **Please indicate the extent to which you agree or disagree with each of the following statements about NISE Net's contributions to your institution.**	All Responses								
	%Can't say/NA	N	Mean	Sigma	Disagree strongly	Disagree	Mixed	Agree	Agree strongly
My institution is interested in and committed to nanoscience education.	9%	157	4.0	1.0	3%	4%	18%	39%	36%
My institution is incorporating nanoscience in our programs and exhibits.	17%	141	4.0	1.0	3%	6%	17%	40%	35%
Thanks to NISE Net, my institution is now better able to incorporate nanoscience than it was three years ago.	24%	130	3.8	1.1	4%	10%	17%	38%	31%
Thanks to NISE Net, my institution is now more interested in incorporating nanoscience than it was three years ago.	26%	126	3.5	1.3	7%	20%	15%	33%	25%
NISE Net has facilitated my institution's connections with informal science institutions (other ISEs)	28%	122	3.6	1.1	4%	15%	20%	39%	23%
My institution is committed to participating in NISE Net specifically.	18%	136	3.5	1.0	4%	10%	31%	39%	15%
NISE Net has facilitated my institution's connections with scientists/researchers	28%	124	3.1	1.1	6%	29%	24%	31%	10%

NISE NET'S CONTRIBUTIONS TO YOUR *OWN* CAPACITY & PRACTICE

Scientists and others see similar contributions from their NISE Net participation to their individual capacity and practice. The one area where the two groups differ is that a higher proportion of scientists (85%) than others (62%) say that they expect to continue to contribute to NISE Net in the future.

		Scientists							All Others						
	6. Please rate the degree to which your own experience is consistent with the following statements. If you cannot respond to a statement, check Can't say/NA.	%Can't say/ NA	N	Mean	Sigma	Dis-agree or dis-agree strongly	Mixed	Agree or agree strongly	% Can't say/ NA	N	Mean	Sigma	Dis-agree or dis-agree strongly	Mixed	Agree or agree strongly
1	Based on my experience, I would say that NISE Net is making a significant contribution to the strength and quality of leadership for nanoscience education in the ISE community.	6%	66	4.3	0.8	3%	8%	89%	16%	85	4.3	0.8	5%	7%	88%
2	I expect NISE Net to provide useful future supports and resources that will further efforts to do nano education at my institution.	10%	61	4.3	0.9	5%	7%	89%	19%	82	4.3	0.9	6%	6%	88%
3	I am interested in continuing to work with NISE Net.	1%	68	4.4	0.6	1%	3%	96%	8%	91	4.2	0.9	5%	11%	84%
4	Thanks to NISE Net, I feel better connected to others who are interested in nanoscience-related education.	15%	58	4.1	1.0	9%	14%	78%	18%	80	4.3	0.9	4%	15%	81%
5	NISE Net events (meetings, courses, and professional development workshops) are designed and implemented well.	32%	47	4.3	0.8	2%	13%	85%	35%	66	4.3	0.6	0%	9%	91%
6	NISE Net has contributed to my own capacity to assume increased responsibility for nanoscience education in my institution.	21%	54	4.0	0.9	7%	13%	80%	23%	76	4.1	1.0	8%	12%	80%
7	NISE Net resources are designed well.	12%	60	4.2	0.8	2%	15%	83%	16%	83	4.2	0.7	1%	13%	86%
8	I expect to contribute to NISE Net in the future.	13%	60	4.2	0.8	3%	12%	85%	14%	86	3.6	1.1	20%	19%	62%

See comments

7. **How could NISE Net better support your own efforts to do nanoscience education?**

A higher percentage of scientists than others (about 9 in 10 vs. 6 or 7 in 10) say that their institutions are committed to nanoscience education and to incorporating nanoscience into programs and exhibits. Conversely, a lower percentage of scientists than others (about 4 or 5 in 10 vs. 7 or 8 in 10) say that their institutions are better able or more interested in incorporating nanoscience than they were 3 years ago.

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE

		Scientists							All Others						
	8. **Please indicate the extent to which you agree or disagree with each of the following statements about NISE Net's contributions to your institution.**	%Can't say/ NA	N	Mean	Sigma	Dis-agree or dis-agree strongly	Mixed	Agree or agree strongly	%Can't say/ NA	N	Mean	Sigma	Dis-agree or dis-agree strongly	Mixed	Agree or agree strongly
1	My institution is interested in and committed to nanoscience education.	3%	69	4.4	0.8	4%	9%	87%	13%	88	3.8	1.0	8%	25%	67%
2	My institution is incorporating nanoscience in our programs and exhibits.	13%	62	4.3	0.8	3%	11%	85%	20%	79	3.8	1.1	13%	22%	66%
3	Thanks to NISE Net, my institution is <u>now better able</u> to incorporate nanoscience than it was three years ago.	27%	52	3.5	1.0	19%	25%	56%	23%	78	4.0	1.1	10%	12%	78%
4	Thanks to NISE Net, my institution is now <u>more interested</u> in incorporating nanoscience than it was three years ago.	34%	46	3.0	1.2	43%	20%	37%	20%	80	3.8	1.2	18%	13%	70%
5	NISE Net has facilitated my institution's connections with informal science institutions (other ISEs)	23%	53	3.6	1.1	19%	23%	58%	31%	69	3.6	1.2	19%	17%	64%
6	My institution is committed to participating in NISE Net specifically.	16%	58	3.6	1.0	14%	34%	52%	19%	78	3.5	1.0	15%	28%	56%
7	NISE Net has facilitated my institution's connections with scientists/researchers	25%	53	3.0	1.0	43%	21%	36%	30%	71	3.2	1.2	30%	27%	44%

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE, continued

Almost 2/3 say they have interacted with informal educators through NISE Net, and just over one third say they have interacted with scientists through NISE Net.

All Responses

		Yes		No	
	N	#	%	#	%
9. Have you interacted with or worked with scientists through NISE Net?	172	60	35%	112	65%
10. Have you interacted with or worked with informal educators through NISE Net?	170	104	61%	66	39%

At least 1/2 of the respondents have delivered some kind of nano education to the public in the past three years (50% NISE, 55% non-NISE). About 1/3 have not. Of the few who are planning to do nano in the future, more appear to plan to use NISE materials.

11/16. Have you delivered any ... programs, activities, exhibits or Forums to the public in the past three years?

All Responses

	NISE Net		Non-NISE Net	
	#	%		#
N	172		170	
Yes	86	50%	94	55%
No (skip to question 16)	54	31%	61	36%
No, but planning to in the future	27	16%	7	4%
No, but someone else at my institution has	3	2%	6	4%
Not sure	2	1%	2	1%

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE, continued

Cart demonstrations and classroom activities are the most frequently used form of nano education among this group, followed by stage presentations. Smaller numbers of institutions are doing theater programs and forums. At least 1/4 have done a stage presentation or program, either using NISE or non-NISE products. At least 1/2 have done a cart-based program of some kind.

12/17. If you or someone else at your institution delivered any ... programs, activities, exhibits or Forums to the public in the past three years, what type of format did you present?

All Responses

	NISE Net		Non-NISE Net	
N	94		106	
Stage presentation or program	23	24%	28	26%
Cart demonstration or program	47	50%	36	34%
Theater program	6	6%	6	6%
Exhibit	22	23%	33	31%
Forum	13	14%	19	18%
Classroom activity	39	41%	59	56%
Not sure	5	5%	4	4%
Other	21	22%	25	24%

It appears that almost 8 in 10 nano programs, activities, exhibits and forums - both for NISE and in other contexts - address fundamentals of nanoscience. More often than NISE public education efforts, non-NISE programs, etc. include the topics of materials, tools, and applications (68% vs. 48%).

did they cover?

All Responses

	NISE Net		Non-NISE	
N	96		107	
Fundamentals of nanoscience	74	77%	84	79%
Art and nature	17	18%	27	25%
Biology and medicine	25	26%	50	47%
Energy and environment	26	27%	41	38%
Materials, tools, and applications	46	48%	73	68%
Society, policy, and economics	23	24%	40	37%
Not sure	11	11%	7	7%
Other	8	8%	8	7%

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE, continued

Most of our sample are hearing about NISE in one or two ways. Of those who answered this question, most heard about NISE Net products by attending a conference or workshop, or from another member of NISE Net. Fewer responded that they heard from another colleague (31%), or nisenet.org (27%). [NOTE: while the website is an important source of information about and point of contact with NISE Net, it is not yet a place where most people learn about NISE resources.]

14. How did you learn about the NISE Net programs, activities, exhibits or Forums you delivered?

	Responses	
N	105	
From nisenet.org	28	27%
From a member of NISE Net	44	42%
From another colleague	33	31%
By attending a conference or workshop	45	43%
Other	17	16%

Of those who have used NISE Net products, over half have made changes before delivering them to the public.

15. Did you make any changes or additions to the NISE Net programs, activities, exhibits or Forums before delivering them to the public?

	Responses	
N	105	
Yes	55	52%
No	29	28%
Not sure	21	20%

See comments

20. Is there anything else you would like to say about NISE Net?

See comments

NISE NET'S CONTRIBUTIONS TO YOUR *INSTITUTION'S* CAPACITY & PRACTICE, continued

A minority of scientists (41%) have interacted with other scientists through NISE Net. Slightly more scientists have with other scientists than have other participants. Also, scientists have interacted more than other NISE participants with informal educators (76% vs. 51%).

	Scientists					All Others				
		Yes		No			Yes		No	
	N	#	%	#	%	N	#	%	#	%
9. Have you interacted with or worked with scientists through NISE Net?	71	29	41%	42	59%	101	31	31%	70	69%
10. Have you interacted with or worked with informal educators through NISE Net?	71	54	76%	17	24%	99	50	51%	49	49%

A higher percentage of scientists than other respondents have delivered some form of nano education through NISE and elsewhere. The gap is largest for non-NISE public education, where 76% of the scientists have delivered non-NISE public education, compared to 41% of the other respondents.

11/16. Have you delivered any ... programs, activities, exhibits or Forums to the public in the past three years?

	Scientists				All Others			
	NISE Net		Non-NISE Net		NISE Net		Non-NISE Net	
	#	%		#	#	%		#
N	71		70		101		100	
Yes	43	61%	53	76%	43	43%	41	41%
No (skip to question 16)	20	28%	12	17%	34	34%	49	49%
No, but planning to in the future	4	6%	2	3%	23	23%	5	5%
No, but someone else at my institution has	2	3%	3	4%	1	1%	3	3%
Not sure	2	3%	0	0%	0	0%	2	2%

As could be expected, scientists deliver more stage presentations and participate in forums more often than the other NISE participants, especially in non-NISE stage presentations and programs. On the other hand, they participate in cart demonstrations and programs much less often than others, especially in NISE-related contexts.

12/17. If you or someone else at your institution delivered any ... programs, activities, exhibits or Forums to the public in the past three years, what type of format did you present?

	Scientists				All Others			
	NISE Net		**Non-NISE Net**		**NISE Net**		**Non-NISE Net**	
N	45		59		49		47	
Stage presentation or program	10	22%	20	34%	13	27%	8	17%
Cart demonstration or program	13	29%	16	27%	34	69%	20	43%
Theater program	1	2%	1	2%	5	10%	5	11%
Exhibit	11	24%	20	34%	11	22%	13	28%
Forum	9	20%	15	25%	4	8%	4	9%
Classroom activity	19	42%	37	63%	20	41%	22	47%
Not sure	2	4%	2	3%	3	6%	2	4%
Other	11	24%	15	25%	10	20%	10	21%

Scientists' and others' institutions are presenting public programs on the fundamentals of nanoscience at almost equal levels. Scientists' institutions are more likely to present programs on materials, tools and applications; energy and environment; and society, policy, and economics. Other institutions are more likely to do public education that links nano, art and nature.

13/18. If you or someone else at your institution delivered any ... programs, activities, exhibits or forums to the public in the past 3 years, what topics did they cover?

	Scientists				All Others			
	NISE Net		**Non-NISE**		**NISE Net**		**Non-NISE**	
N	47		60		49		47	
Fundamentals of nanoscience	34	72%	50	83%	40	82%	34	72%
Art and nature	6	13%	8	13%	11	22%	19	40%
Biology and medicine	10	21%	27	45%	15	31%	23	49%
Energy and environment	15	32%	27	45%	11	22%	14	30%
Materials, tools, and applications	24	51%	47	78%	22	45%	26	55%
Society, policy, and economics	17	36%	27	45%	6	12%	13	28%
Not sure	4	9%	3	5%	7	14%	4	9%
Other	6	13%	4	7%	2	4%	4	9%

Scientists are somewhat more likely to learn about NISE from a member of NISE Net, and others are somewhat more likely to learn about NISE by attending a conference or workshop.

14. How did you learn about the NISE Net programs, activities, exhibits or Forums you delivered?

	Scientists		All Others	
N	48		57	
From nisenet.org	13	27%	15	26%
From a member of NISE Net	24	50%	20	35%
From another colleague	14	29%	19	33%
By attending a conference or workshop	16	33%	29	51%
Other	10	21%	7	12%

Scientists may make changes to NISE Net resources before delivering them to the public more often than other participants, but the evidence is weak.

15. Did you make any changes or additions to the NISE Net programs, activities, exhibits or Forums before delivering them to the public?

	Scientists		All Others	
N	48		57	
Yes	28	58%	27	47%
No	14	29%	15	26%
Not sure	6	13%	15	26%

19. How could NISE Net better support your institution in cultivating or developing new and deeper relationships to nanoscience educatio

See comments

20. Is there anything else you would like to say about NISE Net?

See comments

NISE Network

Field Study

May 2009

INVERNESS RESEARCH

Table of Contents

NISE Network
Field Study

Introduction

Perhaps to an unprecedented degree, the NISE Net initiative is intended to help organize and involve the field of informal science education institutions (ISEIs) in a common endeavor. The goal of the NISE Net project is to help hundreds of ISEIs gain the capacity to provide nanoscience education for their public audiences. Our evaluation sought to find a way to study the penetration of NISE Net into the broader field of informal science education. In 2006, Inverness Research initiated a multi-year study, the "NISE Net Field Study," to gauge the extent and ways NISE Network would be able to reach into the ISE field, and to track changes in the interests and capacities of the field, with respect to nanoscience education, for the duration of the NISE Net project. Our approach was to recruit a diverse group of ISEIs before the start of the NISE Net initiative, and then track them over time to determine how, if at all, they interacted with the NISE Network.

Our first round of data gathering for the Field Study in 2006 served to provide baseline data at the beginning stage of the NISE Net work. We were interested in ISEIs' general knowledge of nanoscience and nanoscience education efforts; their interest in bringing nanoscience to their programming; ideas about what they would need to bring nanoscience education into the work of their institutions; and their familiarity and engagement with the NISE Network.

Map of Field Study Sites:

THE SAMPLE

In 2006, 17 informal science education institutions were identified and invited to serve as anonymous participants in the Field Study. The 17 sites, distributed across 16 states, were selected to represent a broad range of attributes[1]: annual operating budgets for exhibits and programs ranged from $20 thousand to $15 million, for example, and annual public attendance ranged from nine thousand to seven hundred thousand. Each ISEIs was paid a modest stipend for their participation, and a representative from each completed three surveys (in 2006, 2007, and 2009). Subsets of this initial group of 17 were also interviewed in 2006 and 2007.

Of these seventeen field study sites, 16 ISEIs participated in the study a year later, and 14 responded to the final survey in 2009. We acknowledge the number of participants in the study is small, and suggest findings from this study represent a window into the field, rather than the field at large.

[1] For additional information about the institutions and other data and findings from this study, please see the accompanying Excel workbook. Annual reports submitted in 2007 and 2008 detailed findings from the first two surveys.

The remaining sections of this document summarize data from the survey, organized by the following categories:

A. Strong validation of the NISE Net theory of action and contributions

B. Mixed or neutral findings

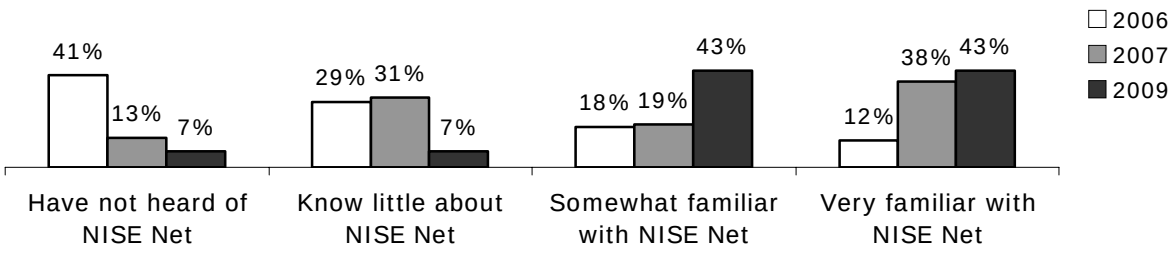
C. Emerging issues and questions

A. Strong validation of the NISE Net theory of action and contributions

In this section we highlight findings that validate NISE Net's strategy for increasing informal science education institution's awareness of and engagement with the NISE Net, and illuminate areas that imply NISE Net is making a difference for ISEIs interested in nanoscience education.

- **Over the course of the three years, the institutions' familiarity with the NISE Net grew significantly. Almost all of the institutions were familiar with NISE Net by 2009 compared with less than a third in 2006**. By 2009, only two of the fourteen sites had not heard of the NISE Net.

Figure 1. Familiarity with NISE Net

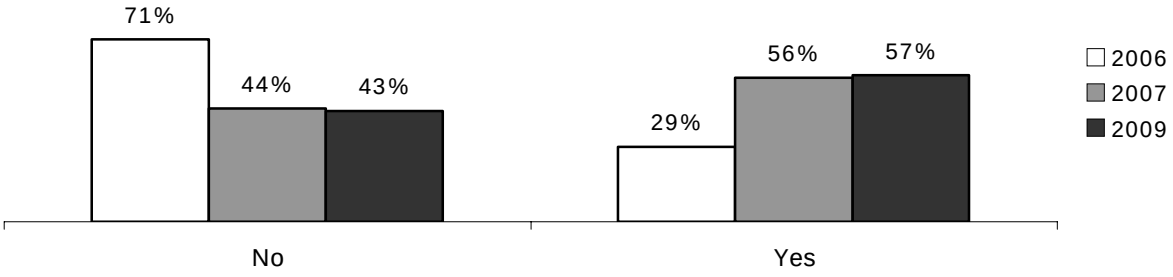


(17 institutions responded to this item in 2006, 16 in 2007, and 14 in 2009.)

- **Along with an increase in familiarity came an increase in interaction with the NISE Net; the field study sites weren't just hearing about NISE Net, they took advantage of opportunities to engage with the network as well**. Eight of the 14 institutions that responded in 2009 (57%) had had some interaction with NISE Net between fall 2006 and spring 2009. At the beginning, in 2006, only (24%) of the 17 responding institutions had had contact with NISE Net. Of those that have not had interaction to date, the majority indicated they are interested in being involved.

  Another intriguing surprise about the field study interactions occurred this winter as we were organizing and analyzing responses to two of our online surveys, the NISE Net Field Study and the NISE Net Reach and Impact Study. We discovered that there were eight Field Study sites that were also included in the respondents for the Reach and Impact survey. What is notable here is that the respondents to the Reach and Impact survey were names provided by the NISE Net as sites that had been engaged with the work of the network.

Figure 2. Interaction with NISE Net



(14 institutions responded in 2006, 16 in 2007, and 14 in 2009.)

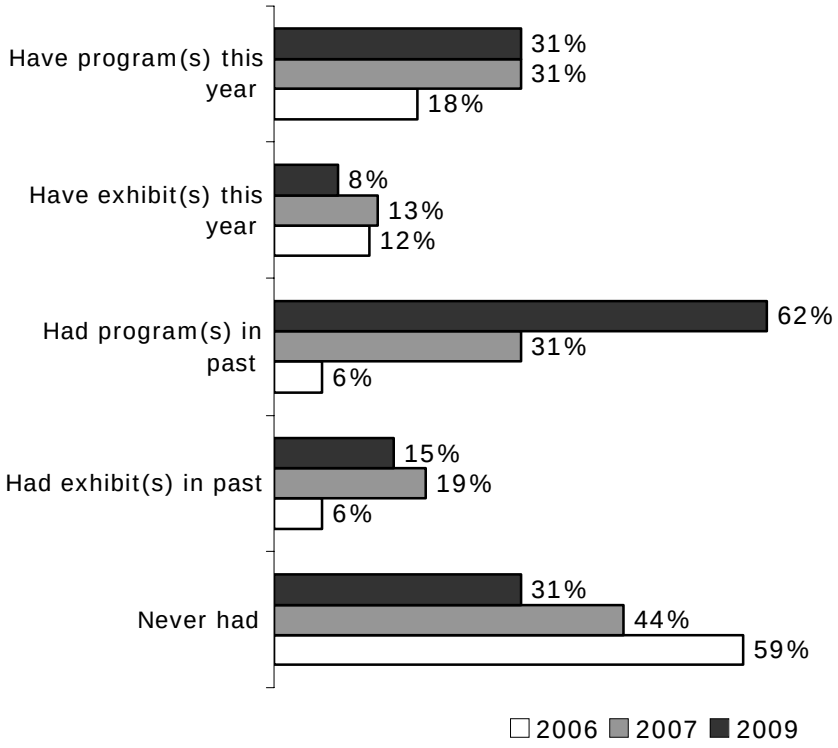
- Though we are unable to say that NISE Net is the single responsible factor, **over the three years of the Field Study, the percentage of ISEIs collaborating with other museums or research institutions to offer Nanoscience programs/exhibits more than once a year, more than doubled, growing from 41% to 86%**.

- **In terms of these ISEIs considering nanoscience to be consistent with their mission, we found a 24% decrease in reporting that Nanoscience was not consistent with their mission, and a decrease of 20% among those who reported that they lack the expertise to do nanoscience exhibits and**

programs. These findings are parallel to a growing familiarity and engagement with nanoscience education through the NISE Net.

- **Although the Field Study ISEIs' reported interest and capacity in providing "cutting edge science topics" has remained largely unchanged over the last three years, these same institutions reported incorporating cutting edge topics into their exhibits and programs more often in 2009 than in 2006**. Whereas about two-thirds of the institutions were incorporating cutting edge topics into exhibits in 2006 occasionally or often, by 2009, 100% of them were. **Additionally, there was a significant increase in the number of institutions that offered nanoscience exhibits and programs over the course of the three years**.

Figure 3. Institutions' past and current exhibits and programs related to nanoscale science and technology



(17 institutions responded in 2006, 16 in 2007 and 13 in 2009.)

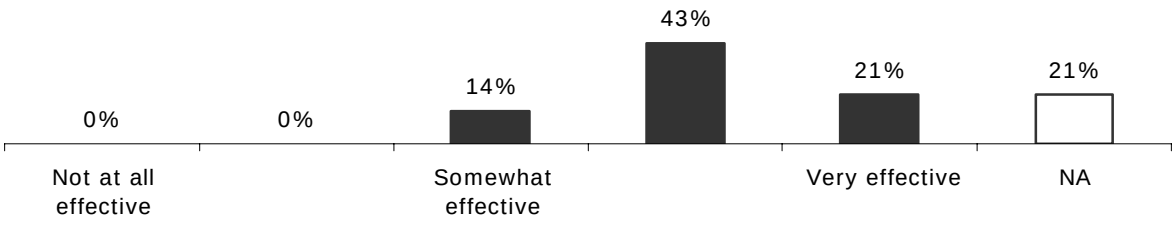
- **The barriers for ISEIs to offering nanoscience education are shifting, and some have been reduced over the three years**. There was a 25% decrease in the percentage of institutions reporting that they had not considered addressing nanoscale science and technology (from 53% in 2006 to 28% in 2009). And the

percentage of institutions that said that they lacked the expertise to mount nanoscience exhibits or programs fell from 41% to 21%.

- **Most field study respondents who have had contact with NISE Net have benefited professionally**. A majority said that their involvement in NISE Net helped them understand something new about nanotechnology (72% agree to a great or very great extent, and another 9% agree somewhat) and that they have gained important new relationships with others as a result of NISE Net (54% agree to a great or very great extent, and another 27% agree somewhat.

- In 2009 we asked the sites to rate NISE Net in terms of its effectiveness in attaining its goal to connect nanoscience research and the public. **Two-thirds of the sites judged NISE Net to be effective or very effective in this regard; the remaining indicated NISE Net was either somewhat effective or they couldn't say**.

Figure 4. 2009 Assessment of NISE Net in terms of connecting nanoscience research and the public



(14 institutions responded.)

B. Mixed or Neutral Findings

In this section, we share findings that are either mixed or neutral – findings that represented little or no change during the course of the three years.

- **We saw virtually no change in ISEIs level of interest in addressing nanoscience**. The overall interest remained quite high over the three years, with about 75% of ISEIs reporting great or considerable interest and the rest having some interest. **Similarly, as a group, the ISEIs' capacity to incorporate cutting edge topics remained constant, with half reporting very great or considerable capacity, and the other half reporting some or limited capacity**.

- **There has been little change in institutional interest in various specific topics related to nanoscale science and technology over three years**. Interest is highest in "Nano 101" and Environment and Energy, and lowest in security and military topics.

- **There was almost no change in either the roles that scientists play at the Field Study ISEIs or the types of affiliations ISEIs had with involved scientists over the course of our study**. Our average Field Study institution engages the set of scientists with whom it has relationships in four roles. The most frequent roles played by scientists did not shift, with nearly all institutions having scientists provide expertise for exhibit or program development (true for 93% of the institutions) and public programs (86%). Almost all of the Field Study sites have relationships with university and private sector scientists, and most have relationships with non-profit, unaffiliated, and government-affiliated scientists. Over the last three years, there was a slight increase in the percentage of ISEIs that had relationships with scientists from the private sector and non-profit realm.

C. Emerging Issues and Questions

In this section we present two findings that may raise questions or have implications for how NISE Net thinks about its work going forward. They fall into two categories, barriers and feasibility of particular kinds of supports and resources.

- **Not surprising, the most common barrier ISEIs face in hosting nanoscience exhibits and programs is budgetary issues and constraints (a barrier for 85% of the institutions). Having higher priorities for the institution and its school audiences is also a barrier for about 2/3 of the institutions**. A few institutions are seeing even less interest by audiences now than three years ago; in 2006, 18% of surveyed ISEIs said nanoscience would probably not be of interest to their audiences, and in 2009, the percentage rose to 36%.

- **About half of the ISEIs say that they would be likely to contract for a traveling exhibit about nanoscale science and technology if the size and fee were right**. Another quarter was not sure how much they would create in-house and how much they would augment with outside sources. The rest say that they would most likely create an exhibit entirely in-house or augment in-house resources with outside expertise and materials.

Summary Statement

What these field study sites tell us is that over the course of the last three years, the NISE Net has established a presence, made itself known, and engaged ISEIs who had little or no knowledge of NISE Net prior to our study. The reach of the NISE Net into the field is quite extensive, as many of our field study institutions became engaged with and supported by the initiative. But the study also tells us that the growth of nanoscience education is not instantaneous or linear. For many of these ISEIs, nanoscience education remains a challenging draw for their audiences, and many institutions still have questions about the centrality of nanoscience education to their mission. But it is clear that for those institutions that learn about nanoscience and that become interested in bringing nanoscience exhibits and programs to their audiences, the NISE Net offers resources and supports for doing so.

Appendix A. NISE Net Field Study Survey

Annotated Notebook of Results - 2006 - 2009

Inverness Research, Inc.

March 2009

CHARACTERISTICS OF THE FIELD STUDY INSTITUTIONS IN 2006*

Audience Demographics

Where is your institution located?	N	%
Urban area/city with urban characteristics	12	71%
Suburban area	1	6%
Rural area (pop. less than 5,000)	2	12%
Small city not part of a larger populated area	2	12%

Which of the following best describes the technology industry in the area that you serve?

Industry is mostly high tech	6	35%
Equal mix of high and low tech industry	9	53%
Industry is mostly low tech	2	12%
There is little industry of any kind	0	0%
Other	0	0%

What is the ethnicity of your institution's audience?

	Median	Range
% African American	7%	0 to 30%
% Asian	5%	0 to 30%
% Latino/Hispanic	10%	0 to 30%
% Native American	0%	0 to 5%
% Pacific Islander	0%	0 to 30%
% White	67%	20 to 97%
% Other/mixed/unknown	0%	0 to 6%

What is the age distribution of your audience?	N	%
% Younger children (0 – 5)	15%	5 to 35%
% Older children (6 – 11)	35%	15 to 60%
% Teens (12 – 19)	10%	0 to 30%
% Adults	40%	15 to 70%

About what percentage of your adult audience would you estimate holds a college degree?

Fewer than 25%	1	6%
25% - 50%	2	12%
51% - 75%	12	71%
Over 75%	2	12%

* *Three of the 17 institutions did not complete the study.*

Institutional Size and Capacity

Approximate size:	N	Mean	Median	Range
Annual operating budget for exhibits and programs:	16	$2,821,125	$1,357,500	$20K to $15M
Square footage of exhibit space:	17	39,941	25,000	1,500 to 132,000

17. If you host traveling exhibits, what is the approximate range of the size and cost of the traveling exhibits you host?

Range of size:	Range of cost:
exhibits built in house are generally smaller exhibits	500-10,000
10,000	500,000
1,500 to 6,000 Sq. Ft.	3,000 to $80,000
1500 - 3000	12000 - 18000
3,000 sq. feet	10,000 - 60,000
500-2,000 sq.ft.	free - $20,000
2500 square feet or so	unknown (haven't hosted one in two + years; probably v hosting any in the future)
2500 - 4000 s.f.	$1000 - $40,000
for example...Remains of a Rainbow (National geographic)	n/a
1000 - 13000	1,000,000
2500 -3000 sq ft	5,000-45,000
2500 sq ft.	25,000
2000-6000 sq.ft.	30,000-250,000
4,000 - 5,000	50,000 - 120,000

Approximate number of annual visitors	N	Mean	Median	Range
Children attending in school groups:	16	53,403	55,000	5K to 120K
General public (families, couples, etc.):	16	174,000	108,500	9K to 700K

Approximate number of employees and volunteers:

	N	None	1 to 4	5 to 10	11 to 20	21 to 50
Full time employees	17	0%	6%	24%	24%	29%
Part time employees	17	0%	12%	24%	29%	18%
Adult volunteers	17	6%	0%	18%	18%	12%
Minor volunteers	17	0%	12%	6%	35%	24%

Which of the following departments exist at your museum? *(check all that apply)*

N = 17	**N**	**%**
Education	14	82%
Programs	14	82%
Exhibits	13	76%
Fabrication/shop	12	71%
Research/evaluation	2	12%
Development (grant writing, fund-raising)	16	94%
Marketing	14	82%
Media	3	18%
Other	7	41%
Collections and research		
Finance		
Life Sciences		
OMNI large format theater		
Operations, Store		
Outreach, theaters		
Planetarium Production		

The major foci for the large majority of the institutions are Life Sciences (rated highly by 86% of the institutions) and Physical Sciences (85%). Other science areas that are important for at least half of the institutions are Space Sciences (71%), Earth Sciences (64%). and Environmental Science/Ecology (50%). Science areas that might be the most likely context for Nanotechnology -- Cutting edge science and technology and Issues of science, technology and society - are important foci for 43% of the institutions.

Over the three years of our study, about a third of the institutions have become more interested in Space Science and/or Earth Sciences. Other topics have shifted little if at all in terms of priority. Life and Physical science and to a lesser extent Engineering are of increasing interest to several institutions, while Technology has slipped slightly as a focus for these institutions.

3. Use the scale below to indicate the extent to which each of the following science areas is currently a priority and focus for your institution's efforts.

	2006 Survey			2007 Survey			2009 Survey		
	No or minor focus	Moderate focus	Major or top focus	No or minor focus	Moderate focus	Major or top focus	No or minor focus	Moderate focus	Major or top focus
Life sciences	6%	29%	65%	6%	6%	88%	7%	7%	86%
Physical sciences	12%	24%	65%	6%	13%	81%	8%	8%	85%
Space science	18%	47%	35%	19%	25%	56%	7%	21%	71%
Earth sciences	29%	35%	35%	13%	38%	50%	14%	21%	64%
Environmental science/Ecology	0%	44%	56%	0%	25%	75%	7%	43%	50%
Engineering	35%	35%	29%	43%	7%	50%	36%	21%	43%
Issues of science, technology and society	47%	18%	35%	31%	19%	50%	36%	21%	43%
Cutting edge science and technology	59%	12%	29%	31%	25%	44%	50%	7%	43%
Technology	35%	24%	41%	25%	25%	50%	29%	43%	29%
Social sciences	82%	12%	6%	56%	25%	19%	71%	21%	7%
Mathematics	76%	18%	6%	44%	38%	19%	71%	29%	0%
Other	50%	0%	50%	0%	0%	100%	0%	0%	100%

Percentages on this item and similar items are based on respondent ratings of 1+2, 3, and 4+5, using a 5-point scale where 1 = "no focus" and 5 = "top focus"

While there was generally little shift in the types of public programs offered by the FS sites over the three years, the percentage of institutions offering discussions and forums doubled from 29% to 57% and the percentage providing demonstrations rose from 71% to 100%. All of the FS sites offered school programs and camps for kids throughout the three year period.

5. What kinds of public programs does your institution offer?

	2006 Survey		2007 Survey		2009 Survey	
	N	**%**	**#**	**%**	**#**	**%**
N	**17**		**16**		**14**	
School programs	17	100%	16	100%	14	100%
Camps for kids	17	100%	16	100%	14	100%
Teacher programs	16	94%	14	88%	14	100%
Demonstrations	12	71%	15	94%	14	100%
Print publications	14	82%	15	94%	12	86%
Website supporting exhibits and programs	12	71%	11	69%	12	86%
Mobile van outreach programs	11	65%	12	75%	11	79%
Lectures	9	53%	11	69%	10	71%
Interactive kiosks	9	53%	12	75%	8	57%
Discussions/forums	5	29%	7	44%	8	57%
Other	6	35%	5	31%	6	43%
	Astronomy/planetarium		*Classes for adults (non teachers)*		*Family days*	
	Family oriented special events		*IMAX Theaters*		*girl and boy scout programming*	
	Girl Scout partnership		*Museum*		*informal cart activities*	
	IMAX, Laser shows, interactive carts		*Outreach programs without the van*		*scout programs*	
	Planetarium shows		*Traveling exhibits*		*Themed public special events Critterfest, Severe Weather Day*	
	School outreach programs (without a van)				*Weekend Programming - topics vary, hands-on activities usually included.*	

Over the three years, the percentage of institutions collaborating with other museums or institutions to offer programs/exhibits more than once a year doubled from 41% to 86%.

6. How often does your institution collaborate with other museums or institutions to offer programs/exhibits?

	2006 Survey		2007 Survey		2009 Survey	
	#	%	#	%	#	%
N	**17**		**16**		**14**	
Never	1	6%	0	0%	0	0%
Once every few years	6	35%	2	13%	2	14%
Once a year	3	18%	1	7%	0	0%
More than once a year	7	41%	12	80%	12	86%

Almost all of the FS sites have relationships with university and private sector scientists. Most have relationships with non-profit, unaffiliated and government-affiliated scientists. Over the last three years, there was a slight increase in the percentage of institutions with relationships with scientists from the private sector and non-profits.

8. With which of the following kinds of outside scientists does your institution have relationships?

	2006 Survey		2007 Survey		2009 Survey	
	N	**%**	**#**	**%**	**#**	**%**
N	**17**		**16**		**14**	
University	17	100%	16	100%	13	93%
Private sector	13	76%	13	81%	13	93%
Non-profit	9	53%	10	63%	11	79%
Unaffiliated, retired	10	59%	10	63%	9	64%
Government	8	47%	9	56%	7	50%
NA, our institution does not have any relationships with outside scientists	0	0%	0	0%	0	0%

There was almost no change in the roles that scientists play at the Field Study institutions over the course of our study. Our average Field Study institution engages the set of scientists with whom it has relationships in four roles. Over the course of the study the most frequent roles played by scientists have not shifted, with nearly all institutions having them provide expertise for exhibit or program development (true for 93% of the institutions) and public programs (86%).

9. If your institution has relationships with outside scientists, what roles do they play?

	2006 Survey		2007 Survey		2009 Survey	
	N	**%**	**#**	**%**	**#**	**%**
N	**17**		**16**		**14**	
Providing expertise for exhibit or program development	16	94%	16	100%	13	93%
Providing public programs (e.g., lectures, discussions)	14	82%	13	81%	12	86%
Serving as advisors or on our board	14	82%	14	88%	10	71%
Providing artifacts, materials or equipment	10	59%	11	69%	7	50%
Serving as volunteer docents	8	47%	11	69%	7	50%
Serving as mentors to teachers or students	6	35%	6	38%	5	36%
Other	2	12%	0	0%	0	0%

Over the course of the study, there was almost no shift in the Field Study institutions' overall interest in cutting edge topics in science and technology. The majority have very great interest (43%) or considerable interest (36%), and the rest have some interest (21%).

10. How would you rate your institution's overall interest in cutting edge topics in science and technology?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	#	%	#	%
N	16		16		14	
No interest	0	0%	0	0%	0	0%
Limited interest	1	6%	1	6%	0	0%
Some interest	3	19%	2	13%	3	21%
Considerable interest	5	31%	6	38%	5	36%
Very great interest	7	44%	7	44%	6	43%

Similarly, as a group the institutions do not report a shift over the three years in their capacity to incorporate cutting edge topics. Only one institution has very great capacity in this area. The majority report that they have some capacity (43%) or considerable capacity (29%), while the rest (21%) have a limited capacity.

11. How often does your institution incorporate cutting edge science and technology in exhibits and programs?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	#	%	#	%
N	17		16		14	
No capacity	0	0%	0	0%	0	0%
Limited capacity	4	24%	3	19%	3	21%
Some capacity	8	47%	7	44%	6	43%
Considerable capacity	3	18%	6	38%	4	29%
Very great capacity	2	12%	0	0%	1	7%

Although the Field Study institutions' interest and capacity in cutting edge topics has remained largely unchanged over the last three years, they do appear to be incorporating cutting edge topics into exhibits and programs more often in 2009 than in 2006. Whereas about two-thirds of the institutions were incorporating cutting edge topics into exhibits in 2006 occasionally or often, by 2009, all of them were.

12. How often does your institution incorporate cutting edge topics into exhibits and programs?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	#	%	#	%
N	17		16		14	
Never	0	0%	1	6%	0	0%
Rarely	6	35%	2	13%	0	0%
Occasionally	6	35%	9	56%	8	57%
Often	5	29%	4	25%	6	43%
Almost always	0	0%	0	0%	0	0%

Nanoscale Science and Technology

Just as there has been little if any change in the institutions' interest in cutting edge science topics, there has been no change in their overall interest in nanoscale science and technology. About a third have very great interest (14%) or considerable interest (21%). More (43%) have some interest. And a minority (21%) have limited interest.

14. How would you rate your institution's overall interest in nanoscale science and technology?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	N	%	N	%
	17		**16**		**14**	
No interest	0	0%	0	0%	0	0%
Limited interest	3	18%	5	31%	3	21%
Some interest	7	41%	4	25%	6	43%
Considerable interest	5	29%	4	25%	3	21%
Very great interest	2	12%	3	19%	2	14%

All but one of the institutions say that they have at least a limited capacity to offer exhibits and programs related to nanoscale science and technology. Over the three years, there has been very small shift in institutional capacity in this area, with about 4 in 10 having some capacity, 3 in 10 having considerable capacity, and the rest having less capacity.

15. How would you rate your institution's overall capacity to offer exhibits and programs related to nanoscale science and technology?

	2006 Survey		2007 Survey		2009 Survey	
	17		**16**		**14**	
No capacity	2	12%	2	13%	1	7%
Limited capacity	4	24%	4	25%	3	21%
Some capacity	6	35%	6	38%	6	43%
Considerable capacity	3	18%	3	19%	4	29%
Very great capacity	2	12%	1	6%	0	0%

The percentage of Field Study institutions that have never had exhibits or programs related to nanoscale science/technology was halved over the three years, from 59% that had never had exhibits or programs in 2006 to 31% in 2009. In 2006, a handful of institutions had had programs and/or exhibits. Over the three years, programs about nanoscience spread more rapidly than exhibits about nanoscience.

16. Does your institution currently have, or has your institution ever had, exhibits or programs related to nanoscale science/technology? (check all that apply)

	2006 Survey		2007 Survey		2009 Survey	
N	**17**		**16**		**13**	
We have never had exhibits or programs related to nanoscale science/technology	10	59%	7	44%	4	31%
We have had exhibit(s) in the past	1	6%	3	19%	2	15%
We have had program(s) in the past	1	6%	5	31%	8	62%
We have an exhibit this year	2	12%	2	13%	1	8%
We have a program this year	3	18%	5	31%	4	31%

The percentage of institutions having possible or definite plans for a nanoscale exhibit or program rose from 30% in 2006 to 50% in 2009. The rest are interested in having exhibits or programs, but have no plans.

18. Does your institution have future plans for exhibits or programs related to nanoscale science/technology?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	#	%	#	%
N	**17**		**16**		**14**	
We have no plans or interest	0	0%	0	0%	0	0%
We have some interest, but no plans	12	71%	6	38%	7	50%
We have possible plans	1	6%	5	31%	5	36%
We have definite plans	4	24%	5	31%	2	14%

Nearly all of the institutions that indicated that they have an interest in nanoscale science and technology say they would be likely to find several types of outside resources useful: information on what other museums and science centers are doing (86% say they would be likely or very likely to find this useful) and demonstrations that can be used as stand-alones or as part of an exhibit (85%). Many are also likely to be interested in most of the other resources we listed. They were very slightly less interested in outside resources in 2009 than in 2006 and 2007. The one resource in which their interest seems to have declined the most is "multimedia packages to download onto [the] institution's computers or public kiosks." In 2006, 67% of the institutions were likely to be interested in this resource, but by 2009, only 43% were likely to be interested.

19. If your institution has an interest in nanoscale science and technology, how likely is it that the following kinds of outside resources might be useful for exhibits/programs on this topic?

	2006 Survey					2007 Survey					2009 Survey				
	Very unlikely	Unlikely	Can't say	Likely	Very likely	Very unlikely	Unlikely	Can't say	Likely	Very likely	Very unlikely	Unlikely	Can't say	Likely	Very likely
Exhibits for rent	13%	19%	25%	31%	13%	13%	13%	19%	31%	25%	21%	7%	21%	43%	7%
Demonstrations that could be used as stand-alones or as part of an exhibit	6%	0%	0%	59%	35%	0%	7%	0%	40%	53%	7%	7%	0%	64%	21%
Materials on how to conduct public forums on science-related topics/issues	0%	13%	19%	44%	25%	13%	13%	0%	47%	27%	7%	21%	7%	50%	14%
Curriculum for use with teachers or students	6%	6%	6%	41%	41%	13%	6%	13%	25%	44%	7%	14%	7%	43%	29%
Multimedia packages to download onto your institution's computers or public kiosks	0%	27%	7%	47%	20%	13%	0%	19%	38%	31%	0%	36%	21%	36%	7%
Media and/or other links for your institution's website	0%	18%	12%	47%	24%	6%	6%	25%	38%	25%	7%	7%	21%	50%	14%
Information about what other museums and science centers that are active in nanoscale science and technology are doing	0%	12%	6%	53%	29%	6%	0%	0%	63%	31%	7%	7%	0%	57%	29%
Professional development for museum staff about nanoscience and nanoeducation	NA					6%	6%	6%	56%	25%	7%	14%	7%	50%	21%
Consultation services about how to incorporate nano into existing exhibits/programs						19%	0%	19%	31%	31%	7%	36%	14%	21%	21%
Participation in national nano science public education events						19%	6%	19%	31%	25%	7%	29%	21%	21%	21%
Support for connection with local nano science research facilities or scientists						0%	0%	31%	19%	50%	7%	14%	7%	50%	21%
Other kinds of programs and services	0%	0%	25%	50%	25%	0%	0%	50%	36%	14%	0%	0%	40%	30%	30%

Nanoscale Science and Technology

There has been little change in institutional interest in various topics related to nanoscale science and technology over three years. Interest is highest in "Nano 101" and Environment and Energy and lowest in security and military topics.

21. If your institution has an interest in nanoscale science and technology, which of the following nano topics would be of interest?

	2006 Survey	2007 Survey		2009 Survey	
		#	%	#	%
N		15		13	
"Nano 101" – The Basics of Nanoscale Science and Technology		13	87%	11	85%
Environment and Energy	Not asked	13	87%	12	92%
Medicine		12	80%	9	69%
Security		2	13%	3	23%
Military		2	13%	3	23%
Consumer products		7	47%	8	62%
Other		3	20%	1	8%

About half of the institutions say that they would be likely to contract for a traveling exhibit about nanoscale science and technology if the size and fee were right. Another quarter are not sure how much they would create inhouse and how much they woul

22. If your institution might be interested ..., what is the likelihood that it would create the exhibit in-house vs. contract for a traveling exhibit?

	2006 Survey		2007 Survey		2009 Survey	
	N	%	#	%	#	%
N	**16**		**15**		**13**	
It is likely that we would create an exhibit entirely in-house	0	0%	1	7%	2	15%
It is likely that we would create an exhibit by ourselves, but we would be interested in augmenting it with outside resources	6	38%	4	27%	1	8%
It is likely that we would contract for a traveling exhibit if the size and fee were right	7	44%	5	33%	7	54%
Can't say	3	19%	5	33%	3	23%

Not unexpectedly, the most common barrier to hosting nanoscale exhibits and programs is budgetary issues and constraints (a barrier for 85% of the institutions). Having higher priorities for the institution and its school audiences are also barriers for about 2/3 of the institutions. Some barriers have been reduced. Over the three years, there was a 25% decrease in the percentage of institutions reporting that they had not considered nanoscale science and technology (from 53% in 2006 to 28% in 2009). And the percentage of institutions that said that they lacked the expertise to mount nano exhibits or programs fell from 41% to 21%. On the other hand, some institutions are seeing less interest by audiences now than three years ago; In 2006 18% said nano would probably not be of interest to their audiences, and in 2009, the percentage rose to 36%.

24. To what extent is each of the following statements about possible barriers to hosting nanoscale exhibits or programs true for your institution?

	2006 Survey					2007 Survey					2009 Survey				
	Definitely not true	Mostly not true	Can't say	Mostly true	Definitely true	Definitely not true	Mostly not true	Can't say	Mostly true	Definitely true	Definitely not true	Mostly not true	Can't say	Mostly true	Definitely true
In general, the time and expertise required to create programs or exhibits about new topics is a barrier.	0%	53%	0%	35%	12%	13%	19%	0%	50%	19%	14%	43%	0%	43%	0%
Budget issues and constraints are a barrier.	0%	6%	6%	47%	41%	0%	6%	6%	25%	63%	8%	8%	0%	54%	31%
Nanoscale science and technology is not consistent with our mission.	53%	41%	0%	6%	0%	60%	20%	7%	13%	0%	36%	43%	7%	0%	14%
Nanoscale is consistent with our mission, but we have higher priorities.	0%	25%	0%	63%	13%	13%	44%	6%	19%	19%	0%	21%	7%	50%	21%
Nanoscale ... is consistent with our mission, just haven't considered it as a topic.	18%	24%	6%	35%	18%	44%	19%	6%	31%	0%	43%	29%	0%	21%	7%
We would not expect nanoscale science and technology to be a topic of high interest to our audiences.	24%	29%	29%	18%	0%	6%	25%	56%	13%	0%	14%	7%	43%	29%	7%
We lack the expertise to mount exhibits or programs related to nanoscale…	18%	24%	18%	35%	6%	19%	31%	13%	19%	19%	29%	29%	21%	14%	7%
We lack the staff expertise and/or leadership to bring this into our programming.	Not asked					19%	44%	13%	19%	6%	50%	36%	0%	14%	0%
Nanoscale science and technology seems to be difficult to convey or visualize for the general public.	0%	18%	35%	29%	18%	6%	6%	19%	44%	25%	0%	21%	21%	43%	14%
Nanoscale science and technology is not a priority for our school audiences.	6%	18%	6%	47%	24%	6%	13%	19%	38%	25%	7%	0%	29%	36%	29%
Nanoscale ... might be seen as controversial by our audiences.	12%	47%	35%	6%	0%	6%	50%	44%	0%	0%	21%	43%	29%	7%	0%
Other	0%	0%	0%	50%	50%	0%	0%	####	0%	0%	0%	0%	67%	33%	0%

Knowledge of NISE Network

In 2006, 30% of the Field Study institutions were familiar with NISE Net, and about the same percentage had heard of it. Forty-one percent had not heard of NISE Net. By 2009, 86% were familiar (43%) or very familiar (43%) with the network. Only 2 institutions, 14% knew little or nothing about NISE Net in 2009.

27. How much, if anything, do you know about the NISE Network?

	2006 Survey		2007 Survey		2009 Survey	
	#	%	#	%	#	
N	**17**		**16**		**14**	
I had never heard of NISE-Net before	7	41%	2	13%	1	7
I had heard of NISE-Net but know little about it	5	29%	5	31%	1	7
I am somewhat familiar with NISE-Net	3	18%	3	19%	6	43
I am very familiar with NISE-Net	2	12%	6	38%	6	43

28. What is your current understanding of the purpose and activities of NISE?

see comments

By 2007, about two-thirds of the institutions judged NISE Net to be effective or very effective in terms of its goal to connect nanoscience research and the public. The rest said it was somewhat effective (14%) or couldn't say (21%).

29. Overall, what is your assessment of the NISE Net in terms of its goal to connect nanoscience research and the public?

	2006 Survey		2007 Survey		2009 Survey	
	not asked		**not asked**		#	
N					**14**	
Not at all effective					0	0
2					0	0
Somewhat effective					2	14
4					6	43
Very effective					3	21
Can't say					3	21

30. In a sentence or two tell us why you gave it this rating:

see comments

32. [Have you had any interaction with the NISE Network?

	2006 Survey		2007 Survey		2009 Survey	
	#	%	#	%	#	%
N	**14**		**16**		**14**	
Yes	4	29%	9	56%	8	57%
No	10	71%	7	44%	6	43%

In 2007 and 2009, the question was"Since completing the first Inverness Research survey in Fall 2006, have you ....."

33. If yes, please describe ways you have been involved with the Network, or would like to be:

see comments

The majority of institutions that have had no interaction with NISE Net say that they are interested in being involved.

34. If not, are you interested in being involved?

	2006 Survey		2007 Survey		2009 Survey	
	not asked		#	%	#	%
N			**8**		**7**	
Yes			6	75%	5	71%
No			2	25%	2	29%

35. Whether you have heard of NISE-Net or not, we welcome any additional, final comments

see comments

Most field study respondents who have had contact with NISE Net have benefited professionally. A large majority say that their involvement in NISE helped them understand something new about nanotechnology (72% agree to a great or very great extent, and another 9% agree somewhat) and that they have gained important new relationships with others as a result of NISE Net (54% agree to a great or very great extent, and another 27% agree somewhat.

There was less consensus on specific aspects of NISE as a network. 86% say that NISE succeeds at least somewhat as a service organization for scientists who are seeking to engage in outreach activities (43% agree to a great or very great extent, and 43% agree somewhat). At the same time, 60% saw at least small barriers to engaging with NISE Net, though none thought that they were serious barriers.

Not quite half of the respondents say that they have developed a working relationship with an ISE institution or other informal activities (46% say this is true to at least some extent, including 23% who agree strongly).

31. Please rate the following statements about NISE from 1 to 5, using the scale below. When possible, add a short comment to explain your ratings (see comments):

	2006 Survey	2007 Survey	2009 Survey				
			Not at all	A little	Some-what	To a great extent	To a very great extent
Extent to which you feel your involvement in NISE helped you understand something new about nanotechnology.	NOT ASKED	NOT ASKED	9%	9%	9%	27%	45%
Extent to which you feel you are gaining/have gained important relationships with others, in education and your own field, as a result of NISE Net			9%	9%	27%	9%	45%
Extent to which you have developed a working relationship with an ISE institution or other informal activities as a result of NISE Net.			31%	23%	8%	15%	23%
Extent to which you feel NISE Net succeeds as a service organization for scientists seeking to engage in outreach activities.			0%	14%	43%	29%	14%
Extent to which you feel there are significant barriers to engaging with NISE Net.			40%	30%	30%	0%	0%