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NANOSCALE INFORMAL SCIENCE EDUCATION

NISE Net Museum & Community Partnerships Project

Evaluation Report

By Katie Todd, Zdanna King, Chris Cardiel, Smirla Ramos-Montañez, and Elizabeth Kunz Kollmann

February 2017

Acknowledgements

It is a pleasure to engage in evaluation with the support of several key collaborators and colleagues. We would like to thank staff from the Museum of Science, Boston; the Oregon Museum of Science and Industry; and the Science Museum of Minnesota for their work on the project, including Ryan Auster, Maria Barth, and Marta Beyer of the Museum of Science, Boston for their input and guidance with data analysis and the creation of this report. Allison Prasad from the Oregon Museum of Science and Industry was instrumental in supporting survey administration and recruitment. From the Science Museum of Minnesota, we would like to thank Maggie Ryan Sandford and Marjorie Bequette for their support in evaluation project planning and implementation, as well as Megan Goeke for her thoughtful participation in coding the open-ended comments and providing formatting support. Finally, we would like to thank members of the NISE Network for their feedback and support. Specifically, we would like to thank Larry Bell, Paul Martin, Brad Herring, Catherine McCarthy, Rae Ostman, and Kayla Berry from the Network Executive Group/Network Operational Group.

This report was based on work supported by the National Science Foundation under Grant No. DRL-0940143. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Foundation.

Elizabeth Kunz Kollmann
Museum of Science, Boston
Research & Evaluation Department
Science Park, Boston, MA 02114
ekollmann[at]mos[dot]org
617-589-0467

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Nanoscale Informal Science Education Network

Museum and Community Partnerships Evaluation Report

EXECUTIVE SUMMARY

This document is an executive summary of the *NISE Net Museum & Community Partnerships Project Evaluation Report* (Todd, King, Cardiel, Ramos-Montañez, & Kollmann, 2017). The sections below share some of the key points from the main findings in the report. Additional findings and information can be found in the full report.

Background of the NISE Network

The Nanoscale Informal Science Education Network (NISE Net, nisenet.org) is a national community of researchers and informal science educators dedicated to fostering public awareness, engagement, and understanding of nanoscale science, engineering, and technology (nano). NISE Net is one of the largest informal science education initiatives ever undertaken in the United States.

Background of the Museum & Community Partnerships Project

NISE Net received funding from the National Science Foundation for the Museum and Community Partnerships project, an initiative to build professionals' capacity to reach underserved audiences by fostering collaborations between museums and local community organizations. The Network distributed 100 *Explore Science—Zoom into Nano* outreach kits of professional resources and educational materials for partnerships (a museum paired with a local community organization) to use to reach underrepresented children, youth, or families. This document summarizes the summative evaluation findings from this project.

Evaluation Methods and Audiences

The data described in this report were gathered in three ways:

1. Pre- and post-surveys of participating professionals from museums and community organizations (*N*=254)
2. Activity surveys about kit materials collected from professionals who facilitated hands-on STEM activities (*N*=119)
3. Administrative records including project applications (*N*=100) and reports (*N*=84)

This executive summary and the associated report are structured to correspond to findings about the evaluation's two key target audiences:

1. **Professionals**: The staff and volunteers who participated in the project, consisting of those from:
   - *Museums*: NISE Net organizations including science centers, children's museums, universities, and more
   - *Community organizations*: Independent organizations or local branches of national youth-serving organizations
2. **Publics:** The children, youth, and families who were participants in project activities, many of whom were underserved by STEM institutions and/or underrepresented in the STEM fields.

Report citation: Todd, K., King, Z., Cardiel, C., Ramos-Montañez, S., & Kollmann, E.K. (2017). *NISE Net Museum & Community Partnerships Project: Evaluation Report*. Boston, MA: NISE Network.

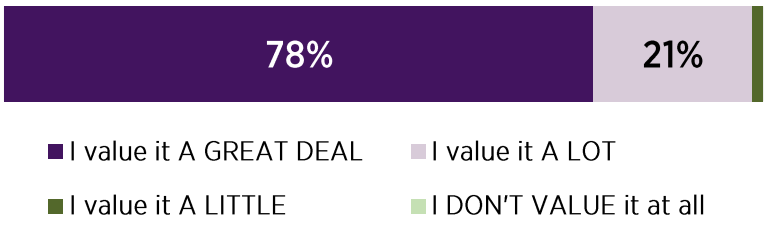
This report was based on work supported by the National Science Foundation under Grant No. DRL-0940143. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Foundation.

PROFESSIONAL IMPACTS FINDINGS

The Value of Partnership

Professionals **valued partnership** between museums and community organizations and reported being **more likely to engage in future collaboration**.

AFTER participating in *Explore Science—Zoom into Nano*, how much do you value fostering local partnerships betwen museums and community organizations? (*n*=72)



After the project,

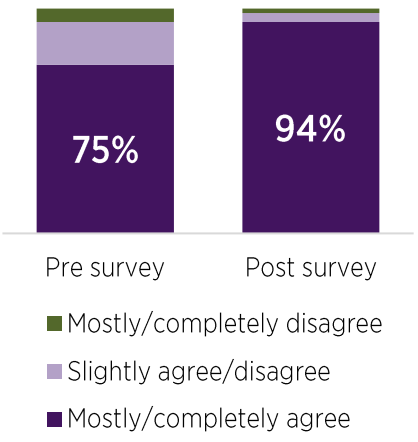
78%

of respondents (*n*=70) were **"MUCH MORE LIKELY" TO ENGAGE IN FUTURE COLLABORATION** with a museum and community organization.

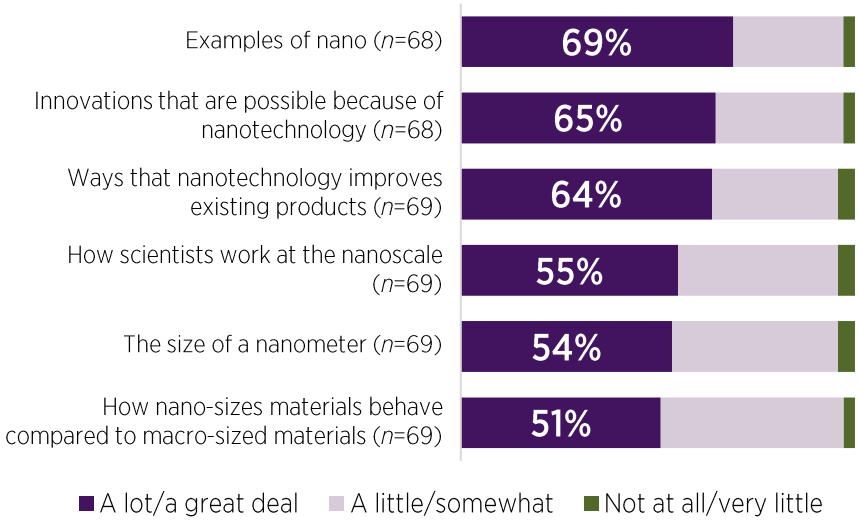
Learning about Nano Concepts

Professionals **gained confidence explaining nano** concepts and **attributed those gains to the project**.

I feel confident in my ability to explain examples of nano to another adult. (*n*=47)*



How much has *Explore Science—Zoom into Nano* affected your confidence in explaining to another adult...



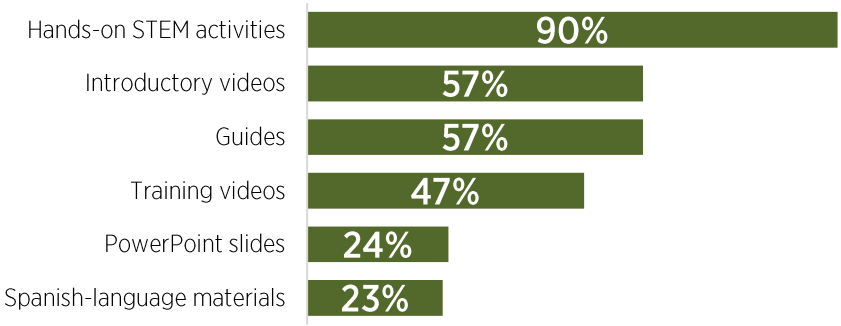
Note: See report to learn about other nano concepts.

PROFESSIONAL IMPACTS FINDINGS, CONTINUED

Usage of Project Materials

All **project resources were used**, especially the hands-on STEM activities, introductory videos, and guides. Many respondents—especially those from museums—had personally used kit materials in different ways **beyond project requirements**.

Which of the following *Explore Science—Zoom into Nano* materials have YOU PERSONALLY used as part of your *Explore Science—Zoom into Nano* partnership? (*n*=70)



67%

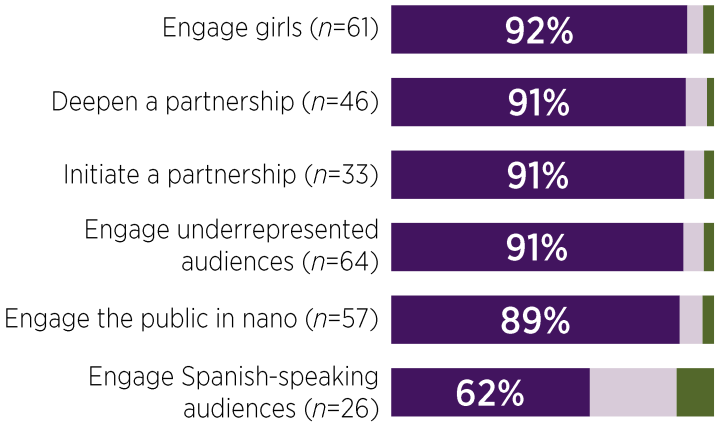
of respondents (*n*=64) had used kit materials to engage the public in content areas OTHER THAN NANO.

Note: This is what each individual respondent used, not what whole organizations used.

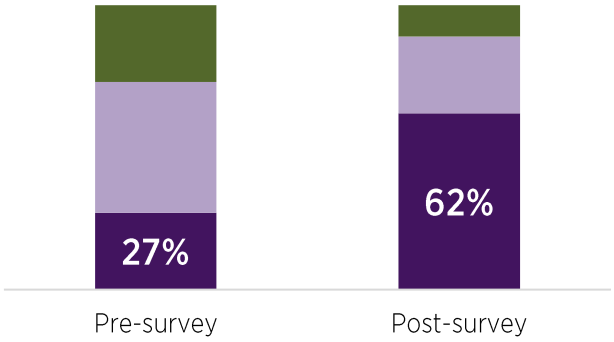
Confidence with Professional Practices

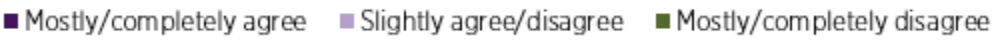
Professionals had **high levels of confidence** for implementing professional practices, and **confidence for engaging Spanish-speaking audiences grew**.

After participating in *Explore Science—Zoom into Nano*, I feel confident in my ability to...



[Before/after] participating in *Explore Science—Zoom into Nano*, I [felt/feel] confident in my ability to engage Spanish-speaking audiences. (*n*=26)*



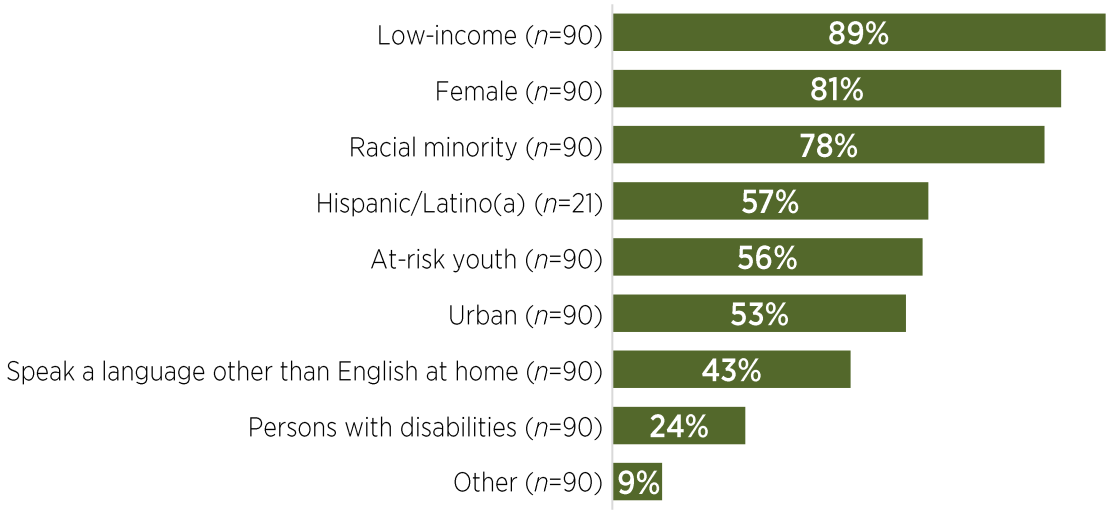


PUBLIC IMPACTS FINDINGS

Public Reach

Partners' self-reported estimates of underrepresented audiences indicated that the project activities most often reached participants who were **low-income, female, and people of color**.

Which of the following demographic categories apply to [the participants] in *Explore Science—Zoom into Nano* activities?



Education, Engagement, and Relevance of Hands-on STEM Activities

Facilitators felt the **activities were educational, engaging, and relevant** for the public, though there is an **opportunity to increase the activities' relevance**.

92%

of respondents (*n*=118) thought the activities were ENGAGING or VERY ENGAGING for the public.

85%

of respondents (*n*=117) thought participants LEARNED SOME or A LOT from the activities.

68%

of respondents (*n*=118) thought the activities were RELEVANT or VERY RELEVANT.

I. Introduction

1.1 Project overview

The Nanoscale Informal Science Education Network (hereafter referred to as "the Network" or "NISE Net") is "a national community of researchers and informal science educators dedicated to fostering public awareness, engagement, and understanding of nanoscale science, engineering, and technology (nano)" (NISE Network, 2011). The Network was created in 2005 as part of a five-year National Science Foundation (NSF) award (ESI-0532536), and was extended through a second five-year award in 2010 (DRL-0940143). Information about the evaluation of the two NSF grant periods can be found in the Review of NISE Network Evaluation Findings: Years 1-5 (Reich, Goss, Kollmann, Morgan, & Nelson, 2011) and the NISE Net Years 6-10 Evaluation Summary document (Bequette, Beyer, Kollmann, Svarovsky, & Wright, 2016).

As of 2016, the Network had included nearly 600 organizations and reached over 30 million people, making it one of the largest ever national informal science education (ISE) efforts (Svarovsky, Goss, & Kollmann, 2015). Figure 1 illustrates this reach.

Figure 1: NISE Net has a wide reach (map represents 2005-2015).

As the second round of NSF funding was coming to a close in 2015, the NISE Net leadership wished to continue its work and pursue projects beyond what had been possible during the two grant periods. In 2015, NSF provided supplemental funding that enabled the NISE Net team to help NISE Network partners:

1. Broaden the Network's reach by engaging audiences that the partner organizations were not currently serving and are traditionally underserved by

science, technology, engineering, and mathematics (STEM) institutions and underrepresented in STEM fields[1]
2. Create new or expanded collaborations between NISE Net partners and local community partners

The project was designed for existing, active NISE Network partners (such as children's museums, science museums, science centers, and university research center outreach programs) within the United States. This report details the evaluation of these efforts.

Before this project, the majority of the organizations in the Network were museums and universities that had collaborated to bring nano content to museum floors and to special events, mostly at museums and universities. With the supplemental funding from NSF, NISE Net initiated the Museum & Community Partnerships (MCP) project, which supported exploration through which existing NISE Net partners could collaborate with local community organizations that reached members of the public traditionally underrepresented in STEM and underserved by museums. In many cases, the MCP programming happened outside of the walls of museums and universities, instead bringing the new programming out into the community to meet new audiences where they were.

In order to reach these audiences and build professional capacity for working with underserved groups, the project created and distributed 100 physical *Explore Science—Zoom into Nano* kits that contained the materials and instructions to lead 17 hands-on activities with underserved children and families, as well as professional resources to support partnerships between museums and community organizations. These kits built on NISE Net's success with NanoDays, an annual series of events for which NISE Net provided partners with kits including hands-on activities and professional development materials. NanoDays kit recipients hosted public events for their local audiences using the provided materials. Prior evaluation shows that the NanoDays kit materials were adapted and utilized with diverse public audiences—including in programs with goals similar to MCP (Goss, et al., 2016). Thus, the project team saw NanoDays kits as a strong starting point for the MCP model. This assumption was tested at a meeting that included Network partners, representatives from national youth-serving organizations, and experts in reaching target audiences. NISE Net consulted with Network partners who were

[1] The project targeted "underserved and underrepresented audiences," which will be referred to "underrepresented" in this report. In collaboration with project leadership and working from several reports (NSF, 2008; NSF, 2015; US Census Bureau, 2015), evaluators defined "underrepresented" as persons who represent one or more of the following:

- Hispanic or Latino/a
- Racial minority
- Female
- Persons with disabilities
- Low-income
- Speak a language other than English at home
- Geographically underserved (rural, inner city)
- At-risk (experiencing multiple educational or health risk factors)
- Other underserved group, as defined locally

experienced in this type of work, as well as representatives of several national youth-serving organizations (such as Afterschool Alliance, 4-H, National Girls Collaborative Project, Boys & Girls Clubs of America, Girls Inc., and others) to adapt existing hands-on activities and training materials for these new partnerships and target audiences. These products were packaged into the *Explore Science—Zoom into Nano* kits for use in the context of partnerships between NISE Net organizations and community organizations with the goal of engaging underserved audiences in learning about nano.

Existing NISE Net partners were eligible to apply for the outreach kits in partnership with a local community organization of their choosing. The two organizations then collaborated to use the kit materials with members of the public in a fashion that best suited their organizations' and target public audience's needs. In some cases, this consisted of a one-time event. Other collaborators integrated the activities into ongoing out-of-school time curriculum or a combination of similar efforts. As part of their commitment for receiving the kit resources, Network partners were required to use their kits between February and October, 2016 and participate in the project evaluation. Programming occurred in the location of the local partners' choice, whether at the museum, community organization, or another venue (75% of activities took place at community organizations). For more information about how partners used their kits, see the text box below and the section on materials usage starting on page 30.

To summarize, the major differences between the MCP project and prior NISE Net efforts were the focus on reaching underserved and underrepresented audiences and the kind of organization with which the museums were asked to partner (community organizations). For many partners, this project was also implemented in a different location or setting (it could be in a museum, but it could also be many other places not regularly represented in previous NISE Net efforts). Additionally, the time scale of this project (and hence the evaluation) was shorter than the previous NISE Net initiatives: an 18-month funding period instead of 5 years. This contributed to the exploratory nature of the project and this evaluation, requiring rapid implementation by Network partners.

While this work built on NISE Net's prior successes, it was also seen as a new effort to explore different approaches to reaching underserved participants. NISE Net partners had increased capacity to lead nano education efforts with the public (Goss, et al., 2016), and this was an opportunity to apply that capacity in a different setting with a new audience. Reaching these new audiences is an important growth goal for the Network and continues to be an area that leadership is pursuing for the future. It allows the Network to support its partner organizations in interacting with community members who typically do not go to a museum, and as such it promotes expansion of the Network and furthers the mission of partner organizations. MCP has served as an opportunity to test and learn from ways that NISE Net can pursue this work.

The MCP project was one way that NISE Net extended its work at the end of its second five-year cycle of NSF funding. Another way the Network has changed since the conclusion of the second NSF award is through an extended content focus that now includes topics outside of nano (Earth and space, chemistry, synthetic biology, and other topics). Accordingly, the Network has renamed itself the National Informal STEM Education Network (still using the acronym "NISE Net").

How this work was different from previous NISE Net efforts

Some key differences between the MCP project and prior NISE Network include:

- *Collaborators:* In the past, NISE Net partners worked primarily with local scientists. This project promoted collaboration with community organizations.
- *Timeframe*: NanoDays events all occurred in a one-week period. This project gave sites the opportunity to use kits at any time in a 9-month window.
- *Target audience*: NanoDays kits were designed for a wide audience of museum attendees, whereas the MCP kit was designed for underrepresented audiences.
- *Number of activities*: There were twice as many hands-on STEM activities in the MCP kit as past NanoDays kits.
- *Event format*: While MCP kits could be used in a large public event similar to many NanoDays events, the kits were also designed for use in a group or out-of-school time classroom setting.

Terms

For the purposes of this report, evaluators have defined the following terms as described below.

Museums: NISE Net partners who received an MCP kit. In some cases, these organizations may have been universities or other types of organizations, but for the sake of simplicity they will be referred to as "museums" in this document.

Community organizations: An external partner for the NISE Net organization which received a kit, these sites worked with their NISE Net partners to implement MCP programming with the underserved or underrepresented that the community organization reaches. These organizations include local community groups, camps, afterschool programs, or libraries. Some are independent and some are affiliated with a national youth-serving group such as 4-H, Boys & Girls Clubs of America, Boy Scouts, or Girl Scouts).

Underrepresented audiences: The project targeted "underserved and underrepresented audiences," which will be shortened to "underrepresented" in this report. In collaboration with project leadership and working from several reports (NSF, 2008; NSF, 2015; US Census Bureau, 2015), evaluators defined "underrepresented" as persons who represent one or more of the following:

- Hispanic or Latino/a
- Racial minority
- Female
- Persons with disabilities
- Low-income
- Speak a language other than English at home
- Geographically underserved (rural, inner city)
- At-risk (experiencing multiple educational or health risk factors)
- Other underserved group, as defined locally

Professionals: The professionals who participated in the evaluation were adults who might have been as paid staff or volunteer, part-time or full-time. Within professionals, there were four subgroups:

- *Museum professional:* Someone affiliated with a museum. Mutually exclusive of community organization professionals.
- *Community organization professional*: Someone affiliated with a community organization. Mutually exclusive of museum professionals.
- *Facilitators*: People who led hands-on STEM activities with the public and completed an Activity Survey. They could be volunteers or staff at either museum or community partner locations with a range of experience (from minimal to advanced) in leading activities in informal settings.
- *Partners:* Professionals who responded to the pre- and/or post-survey. This includes both museum and community organization professionals. They may or may not have facilitated hands-on STEM activities.

A variety of local partnerships

Sites used the kit materials in many different ways. While there was no single "typical" partnership, this callout box describes several examples that demonstrate the diversity of partnership types.

A library event, led by a museum: A museum worked with a local library to host a 5-hour family event that reached 45 people. Museum staff led all the activities with the members of the public, who included inner city, female, ethnic minority, at-risk, and low-income populations.

A co-facilitated, ongoing afterschool curriculum: One museum partnered with a local 4-H club to offer a multi-session program, every other week during the semester. Museum staff and 4-H leaders co-taught each program, which served 40 children for a total of 15 contact hours. The public audience included rural, female, ethnic minority, and low-income children.

Activities led by a community organization: One museum collaborated with a local Boys & Girls Club, which took the lead in implementation. The Club kept possession of the kit and used it for the organization's STEM Science Night that reached nearly 600 Club Members in a six-hour event. Public participants included both rural and inner city youth, girls, ethnic minorities, low-income, and at-risk populations.

Youth-led, community-based activities: With the guidance of museum staff, youth at one partnership facilitated the activities for other, younger children at the community organization. The participating youth and children included low-income, female, ethnic minority, disabled/differently abled, and rural participants. A total of 200 children and youth participated, and 50 contact hours were offered.

Museum-led summer camp at a library: One museum led two summer camps at a local library, using the kit materials. Each camp met one hour each day for five days. A total of 60 children age 4 through 13 participated, including girls, ethnic minorities, low-income populations, and children who speak a language other than English.

A faith-based afterschool program: A NISE Net museum partnered with a local church's afterschool program to offer five, one-hour sessions for about 30 students. This expanded the partners' existing work together, which had previously used NanoDays kits in the afterschool program. Many of the children lived in the inner-city, were low-income, minorities, and many had disabilities.

A parenting program for offenders: One program used the kit as part of an existing parenting program for offenders. Museum staff taught the offenders how to facilitate the activities, and then the offenders led the activities with their children during visitation hours. Sixteen offenders participated in the programming and then used the activities with their eighteen children. All were African American.

1.2 Evaluation overview

The evaluation of the MCP project was conducted by the multi-institutional NISE Net evaluation team under the oversight of the Network's Committee of Visitors, a panel of experts that reviews evaluation work and provides guidance to promote rigor and objectivity. The evaluation team's overall approach for this project was influenced by the developmental evaluation perspective. Developmental evaluation enables a simultaneous process of understanding achievement of established learning outcomes while tracking emergent outcomes that may inform continued work (Patton, 2010). Due to the MCP project's exploratory nature and NISE Net's continued interest in working with underrepresented audiences beyond this supplemental grant, the evaluators designed the study to inform future work while also assessing the project in ways that aligned with past NISE Net summative evaluation studies (Goss, et al, 2016; Svarovsky, et al, 2013).

The findings of this report are organized into three sections: professional impact findings, public impact findings, and emergent findings. The first and second findings sections explore the extent to which the project met its goals for professionals and the public. In the third findings section, emergent outcomes provide descriptive information about what happened at local sites during the course of the project. In line with the developmental evaluation approach, this section identifies unplanned outcomes of this exploratory project.

Target Audiences

Following the structure of the logic model, there were two target audiences for this evaluation:

1. **Professional audiences**: Participating educators from the NISE Net partner and community organizations were the primary target audience for this evaluation. All participating staff and volunteers over the age of 18 were included in this group. It was especially important that evaluators gathered data from both the NISE Net audience and the community organization audience because the two professional audiences were expected to have different types of learning gains (for example, NISE Net professionals might learn about reaching new audiences and community organization professionals might learn about nano content) and/or definitions of success.

2. **Public audiences**: Public audiences included children, youth, and families from demographic groups underrepresented in STEM fields. NISE Net reaches the public indirectly, by building the professional capacity of partner organizations who then interact with the public. Following this structure, evaluators gathered data directly from professionals, but not from the public. Instead, evaluators asked professionals to report about the audiences they reached and how the project materials were received by the public. This was due to (a) the fact that many participants were minors who are unable to provide consent, (b) the geographic spread of project activities complicating public data collection, and (c) the desire to minimize the data collection burden on members of the public who had short interaction with project materials. Furthermore, professionals had prolonged exposure to MCP resources while some members of the public participated for

only several minutes. In conjunction with the limited scope and timeline of this project, these dynamics made direct public data collection unfeasible.

Evaluation questions

In order to better understand the MCP project's impact, the evaluation questions for this project were based on the professional and public goals for the project. For professionals, these goals drew from the Network's existing professional development objectives (see the Appendix), focusing on the short-term goals that are most appropriate for a project of this length. The goals have also been modified to focus specifically on reaching audiences that are underrepresented in STEM and the partnerships between NISE Net partners and local community organizations. MCP project goals for public audiences were based on existing Network objectives for educational products as expressed in the content map (Bequette et al., 2012) and learning framework (Ellenbogen et al., 2012). Evaluators also designed the evaluation questions to draw connections with past NISE Net evaluations (Goss, et. al, 2016; Svarovsky, et al, 2013).

Evaluation questions for professional audiences:

1. How, and to what extent, does participation in the Museum & Community Partnerships project impact the value professionals place on local collaborations among NISE Net partners and community organizations?
2. To what extent does participation in the Museum & Community Partnerships project impact professionals' awareness of key concepts in nanoscale science, engineering, and technology and its relationship with our lives, society, and environment?
3. How and to what extent does participation in the Museum & Community Partnerships project impact professionals' use of professional resources and educational products for creating partnerships and engaging diverse public audiences in nano?
4. To what extent does participation in the Museum & Community Partnerships project impact professionals' awareness of practices for effectively forming partnerships and engaging diverse public audiences in nano?

Evaluation questions for public audiences:

1. To what extent does the project reach its target audience of children, youth, and families from demographic groups that are underrepresented in STEM fields?
2. To what extent do the educational materials facilitate engagement and learning among public participants?

II. Methods

The team used three data sources to address the evaluation questions: (1) pre- and post-surveys of participating professionals; (2) an activity survey of educators who facilitated hands-on activities; and (3) administrative records collected through the project application form and final reporting. Each of these methods is described in more detail below and summarized in Table 1. All instruments are provided in the Appendix.

Table 1: Data collection methods.

	Pre- and post-surveys	Activity survey	Administrative records
Eligible respondents	• Adult staff and volunteers from museums and community organizations • Involved in the project in any way	• Adult staff and volunteers from museums and community organizations • Facilitated hands-on STEM activities	• A single person from each museum that received a kit
Recruitment	• Email invitation • Email and phone reminders	• Handout for partners and facilitators • Email reminders	• Official NISE Net communications • Email and phone reminders
Number of responses	• 143 pre-surveys • 111 post-surveys	• 119 surveys	• 100 applications • 84 reports
Types of questions	• How respondents were involved • What they learned, valued, and used • Views about project materials	• How kit materials were used • How educational, engaging, and relevant activities were	• Plans for kit use and collaboration • Reports about actual kit use and collaboration
Timeframe	• February 2016 (pre-) • October-November 2016 (post-)	• February-October 2016	• December 2015 (application) • November 2016 (report)

2.1 Pre- and post-survey

Evaluators collected data from participating professionals at the beginning and end of the project through online pre- and post-surveys. The pre-survey was administered in February 2016. Post-surveys were completed from October to November 2016. The surveys contained a mix of open- and closed-ended questions about how the professionals had been involved in the project, what they valued about the experience, what they had learned from participating, what project resources and practices they had used, and their views about the appropriateness of the project materials for reaching underrepresented

audiences. The surveys included branching and piping logic that allowed evaluators to ask targeted questions to sub-groups of respondents, including specific questions for museum respondents versus community organization respondents, and tailored questions based on the type of involvement with the project experienced by an individual respondent. These pre- and post-surveys were based on the NISE Net Annual Partner Survey (Goss, et. al, 2016), which was familiar to NISE Net participants. When appropriate, survey questions were the same as or similar to past NISE Net data collection tools.

Recruitment and sampling

All adult professionals who were involved in the project were eligible to complete the pre- and post-surveys. Initial contact information–including one main contact from each NISE Net partner organization and one main contact from each community organization—was collected from the kit application. When these main contacts completed their pre-surveys, they were asked to provide contact information for additional staff and volunteers at their organizations who were involved in project activities (whether in administrative, educational, or other roles). Using a snowball sample approach, these new contacts were then invited to take the survey. All main and snowball sample contacts from the pre-survey were invited to complete the post-survey, and a similar snowball sample approach was used to gather additional contact information from post-survey respondents.

Respondents

A total of 170 professionals provided data through the pre- and post-surveys. Of the 200 main contacts who received survey invitations, 57% (n=113) completed the pre-survey and 34% (n=68) completed the post-survey. Additionally, 31 of the 72 snowball sample invitees (43%) completed the survey. Sixty-five respondents (including main contacts and additional contacts) completed both the pre- and the post-surveys. Respondents included administrators, educators, and other roles within their organizations. Overall, 67% of the sample was NISE Net respondents and 33% were from community organizations. This disparity may be due to the fact that the NISE Net respondents were accustomed to completing the NISE Net Annual Partner Survey and other survey-based NISE Net reports. Some of the community organization respondents, on the other hand, indicated confusion about why they were included in the sample. Additional thoughts about the distribution of the sample can be found in the limitations section, beginning on page 77.

2.2 Activity survey

While the focus of the project was on providing resources and support for professionals, it was still important to the project team to understand the potential impacts of the *Explore Science—Zoom into Nano* activity kits on the public. The evaluation team reached out to adults who had facilitated *Explore Science—Zoom into Nano* activity kits with the public in order to capture their informed opinions and observations of ways in which their audiences may have learned from, been affected by, or connected to the activities and their facilitation. To do this, evaluators collected brief (less than 5 minute) online activity surveys on an ongoing basis throughout the project period. We asked that at least one adult facilitator complete the brief online survey after using hands-on STEM activities from the kit with the public. They were designed to be completed as part of the clean-up part of leading the activities, embedded within the experience in order to reduce respondent burden and ensure prompt data collection. Questions asked how educational,

relevant, and engaging the hands-on STEM activities were, as well as for some information about how the kit materials were used.

Recruitment and sampling

The evaluation team wanted to strategically reach out to kit recipients and their partners to maximize response rates while minimizing the number of times they were contacted. We used several methods to reach out to facilitators of the *Explore Science—Zoom into Nano* kits (see the Appendix for recruitment strategies used for this and each of the instruments). Kit recipients received two paper (and digital) handouts in the "Open Me First" box that came with their kits. The *Explore Science—Zoom into Nano* evaluation handout gave an overview of upcoming evaluation activities, including the activity survey, pre- and post-surveys, and required report. Another handout described the *Explore Science—Zoom into Nano* activity survey, provided a link, and requested that each day the activities were used, at least one adult facilitator would fill out the online survey on the same day that activities were led. The team also sent one reminder email to the kit recipients with a link to the activity survey and a digital handout that they could print and pass out to activity facilitators in order to recruit them to participate in the survey.

Respondents

Adult facilitators submitted 119 complete activity surveys, but one response was omitted because in that case the facilitator indicated that the activities had been used with other museum professionals and not the public (our target audience). We asked that one facilitator fill out the survey after each time the kit activities were used with the public. A little over half of the respondents (55%, n=88) completed the survey within two weeks of facilitating the activities on the floor with visitors. The remaining respondents responded to the survey between 3 and 13 weeks after administering the activities with the public.

Understanding the response rate for these surveys is challenging, given that we do not know how many times activities were facilitated by each of the partners, nor how consistently adult facilitators were recruited to fill out the surveys by our contacts. Thirty-nine organizations were represented, and about a quarter of these (9) were community organizations, while three quarters (30) were museums.

2.3 Administrative records

In addition to the targeted data collection described above, evaluators used existing project data gathered through the application for the physical kit and the final report that kit recipients completed. Both of these documents were completed by a single representative from the NISE Net partner organization that received the kit. Evaluators' use of these sources included gathering contact information and reviewing sites' responses about their usage of the kits, numbers and demographics of people reached, and numbers of professionals involved in the project.

Recruitment and sampling

Existing NISE Net partner organizations were eligible to apply for the kit if they partnered with a local community organization that reached an underrepresented audience. All kit applicants were expected to complete a final report describing their use of the materials. No incentives were provided directly for these documents, although applications provided

a chance to receive a kit and the report redirected to the incentivized post-survey when the report was complete. Kit recipients were informed that their failure to submit a final report could negatively impact their chances of receiving future NISE Net materials. Recruitment consisted of email invitations followed by email and phone reminders. When a respondent completed the application, she or he was immediately directed to the project's anonymous evaluation post-survey, described above.

Respondents

Kits were awarded using a competitive application process. This project was designed for existing active NISE Network informal science education institutions (such as children's museums, science museums, science centers, museums and university research center outreach programs) within the United States. Applications were selected based on a variety of criteria including: meeting eligibility guidelines, demonstrated strong alignment with the project purpose, compliance with the project terms, and representation of a diverse range of projects. Additional criteria included level of prior involvement in the Network, and the proposed project's ability to: 1) reach underrepresented audiences in their local community that they aren't currently reaching with nanoscale science, engineering, and technology and 2) collaborate with a new or existing community partner. Each of the 100 kit application selected for award were completed by one individual from an existing NISE Net partner organization. A total of 84 of these kit recipients completed the final reporting survey during the timeframe covered by the present report (additional reports were submitted after the deadline and were unable to be included in this analysis). It should be noted that the application process may have led to a biased sample; only those who valued this type of work were likely to apply. This has implications for some of the findings, as discussed in upcoming sections.

2.4 Data analysis

Quantitative data analysis included a mix of descriptive and inferential statistics. Descriptive statistics include counts, percentages, medians, and averages. Where appropriate, inferential tests were used to assess differences within the data (for example, differences between museums and community organizations or comparisons between pre- and post-survey data). Many of these tests are non-parametric, given the relatively small sample and subsample sizes and the fact that many of the data were not normally distributed. Statistically significant differences, those for which the statistical test results in a p-value below .05, are marked with an asterisk (*). The details of these inferential statistics are included in footnotes throughout the text. To promote consistency, the analysis plan for much of this data was based on work from previous NISE Network evaluation reports. Following the approach from the *NISE Network Professional Impacts Summative Evaluation* (Goss, et al., 2016), tests were conducted as outlined in Table 2:

Table 2: Statistical tests used for the types of data collected by this project.

Statistical Test	Type of Data
Chi-square ($\chi 2$) Test	Evaluator seeks to know the difference in proportion between two or more categories of frequency counts *Note: When conducting 2x2 $\chi 2$ tests, evaluators provide the Fischer's Exact p-value due to low expected cell counts in some cases.*
McNemar Test	Evaluator wishes to test differences between pre- and post-scores of a dichotomous variable (e.g., "Yes" or "No")
Mann-Whitney Test	Evaluator wants to assess differences between two continuous or ordinal, non-normal variables
Wilcoxon Signed Ranks Test	Evaluator wants to determine whether there are differences between two related samples of data that are ordinal (e.g., pre- and post- scores on a Likert scale of "Strongly Disagree" to "Strongly Agree")

For the sake of brevity, non-significant differences are not mentioned in the text. However, comparisons between museum and community organization respondents were made whenever the data allowed; when it is not mentioned, the reader can assume that there were no differences between these two groups' responses.

Qualitative data analysis included coding both inductively and deductively. Inductive coding involves reviewing the data and identifying the most frequent themes (Patton, 2002). In contrast, deductive coding approaches the data with an established set of criteria and looks for evidence of those criteria (Fereday & Muir-Cochrane, 2006). For example, deductive coding for this project included using NISE Net organizational categories of educational products. When using deductive approaches, evaluators first reviewed data with these criteria and then coded un-assigned comments inductively.

III. Professional Impact Findings

3.1 Valuing Collaboration between Museums and Community Organizations

This section shares data about the way this project impacted professional participants' views of partnerships between museums and community organizations. It addresses the first professional evaluation question:

> *How and to what extent does participation in the Museum & Community Partnerships project impact the value professionals place on local collaborations among NISE Net partners and community organizations?*

Partnerships between NISE Net partner organizations and universities have been an ongoing emphasis of the Network for many years. The MCP project sought to build on this capacity for local collaborations by deepening existing and initiating *new* partnerships between NISE Net partner organizations and local community organizations for the purpose of engaging underrepresented audiences in learning about nano. Evaluation of the partnership aspect focused on the short-term outcome of valuing partnership, due to the brief timeline of the MCP project.

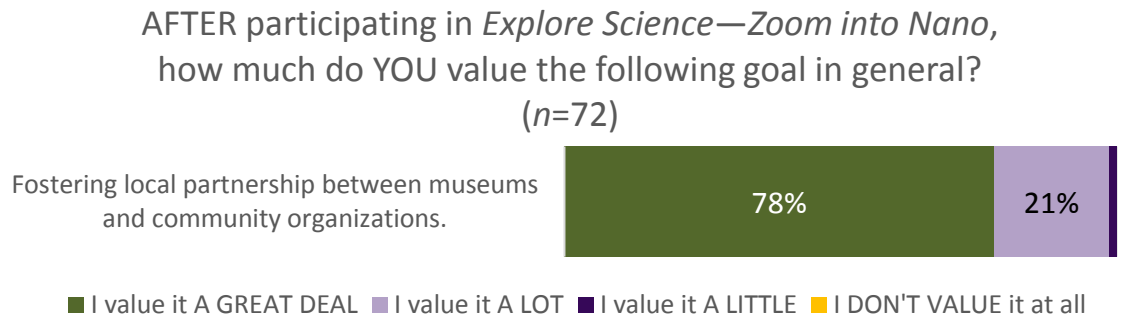
Two main findings emerged from the data in response to this evaluation question. The findings, which are explained on the following pages, include:

> 3.1.1 After participating in the project, professionals valued partnership between museums and community organizations and felt the project had enabled them to foster such partnerships.
>
> 3.1.2 Most professionals reported that the project increased their likelihood of participating in future collaborations between museums and community organizations.

3.1.1 After participating in the project, professionals valued partnership between museums and community organizations and felt the project had enabled them to foster such partnerships.

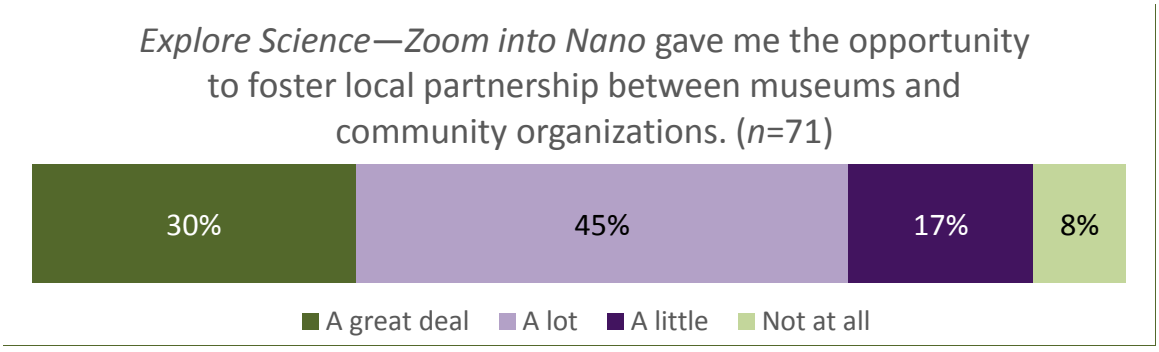
As shown in Figure 2, all post-survey respondents indicated that they valued partnership between museums and community organizations, with 99% valuing this type of partnership "a great deal" (78%) or "a lot" (21%). While there were no statistically significant changes between the pre- and post-survey data for this question, this may be due to the fact that pre-survey responses were also very high (98% valuing partnership "a lot" or "a great deal"), leaving little room for improvement. The reason for these high pre-survey responses is likely a self-selection factor, wherein only those organizations that already valued this type of work applied for the kit. To read more about how professionals benefitted from their participation, see the emergent outcomes section beginning on page 64.

Figure 2: Ratings of how much professionals value partnerships between museums and community organizations.



Not only did professionals value collaboration between museums and community organizations, but they felt the project had enabled them to pursue such collaboration. As shown in Figure 3, 75% of respondents indicated that the project had given them the opportunity to foster local partnership 'a great deal' (30%) or 'a lot' (45%).

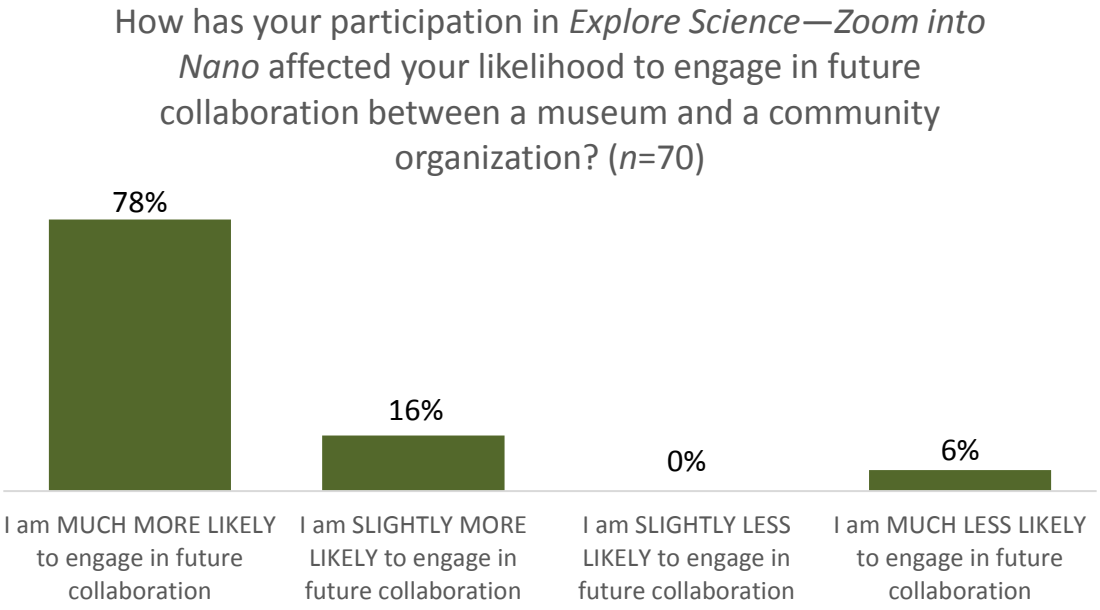
Figure 3: The extent to which professionals felt the project helped them foster local partnership.



3.1.2 Most professionals reported that the project increased their likelihood of participating in future collaborations between museums and community organizations.

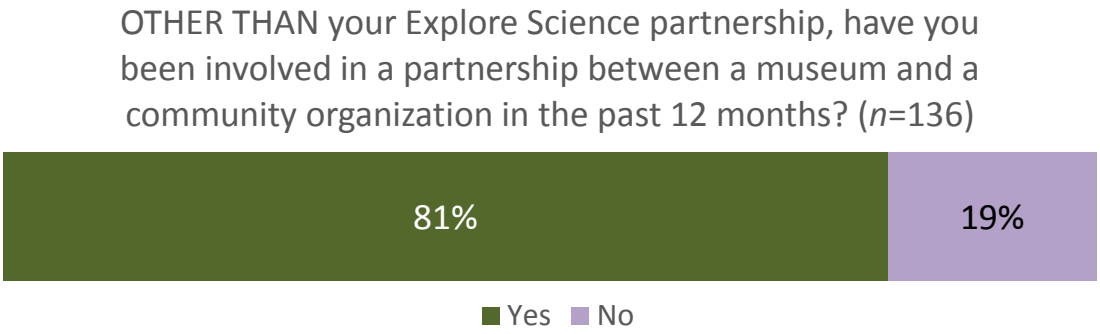
The post-survey asked respondents to indicate how much their participation in the project had changed their likelihood to participate in future similar partnerships. These data, shown in Figure 4, illustrate that 94% of respondents noted that they were 'much more likely' (78%) or 'slightly more likely' (16%) to engage in future collaborations between museums and community organizations because of their experiences in this project. This may be due to positive project experiences, or a developing confidence in the professional practices needed to carry out these partnerships (see page 39).

Figure 4: Professionals' likelihood of participating in future partnerships.



The interest in additional collaboration was also evidenced by the fact that 81% of post-survey respondents had been involved in a partnership between a museum and a community organization other than their *Explore Science—Zoom into Nano* partner during the previous year (see Figure 5). As NISE Net assesses the field's capacity and interest in future work that promotes collaboration between museums and community organizations, this combination of increased interest in future collaboration and high levels of collaboration outside of the MCP project is highly promising. There is opportunity for NISE Net resources for collaboration to be used in other partnerships, suggesting room for expanded and sustainable use. The extent to which other partnerships currently address STEM, nano, or underrepresented audiences is unclear.

Figure 5: Involvement in other partnerships between a museum and a community organization.



3.2 Learning about Nano Concepts

The evaluation of professional participants' learning about nano concepts focused on answering the following question:

> *To what extent does participation in the Museum & Community Partnerships project impact professionals' awareness of key concepts in nanoscale science, engineering, and technology and its relationship with our lives, society, and environment?*

In order to address this question, evaluators used an approach similar to what was done for the *NISE Network Professional Impacts Summative Evaluation Report* (Goss, et. al., 2016). This report builds off the four messages of the NISE Net Content Map (Bequette et al., 2012): (1) Nano is small and different, (2) Nano is studying and making tiny things, (3) Nano is new technologies, and (4) Nano is part of our society and our future. The MCP project emphasized the first three of the Content Map constructs, and thus the evaluation focuses on the first three, as well. Similar to the *NISE Network Professional Impacts Summative Evaluation Report* (Goss et al., 2016), the survey for this project asked about two sub-concepts of each themes. Table 3 shows the survey items that correspond to each Content Map area.

Table 3: Survey concepts as they relate to concepts of the NISE Net Content Map.

Content Map Concept	Sub-concepts For Survey Items
A. Nano is small and different.	1. The size of a nanometer 2. How nano-sized materials behave compared to macro-sized materials
B. Nano is studying and making tiny things.	3. How scientists work at the nanoscale 4. Examples of nano
C. Nano is new technologies.	5. Innovations that are possible because of nanotechnology 6. Ways that nanotechnology improves existing products

Note that NISE Net's forth Content Map concept was not emphasized in this project, and thus is not included in this evaluation.

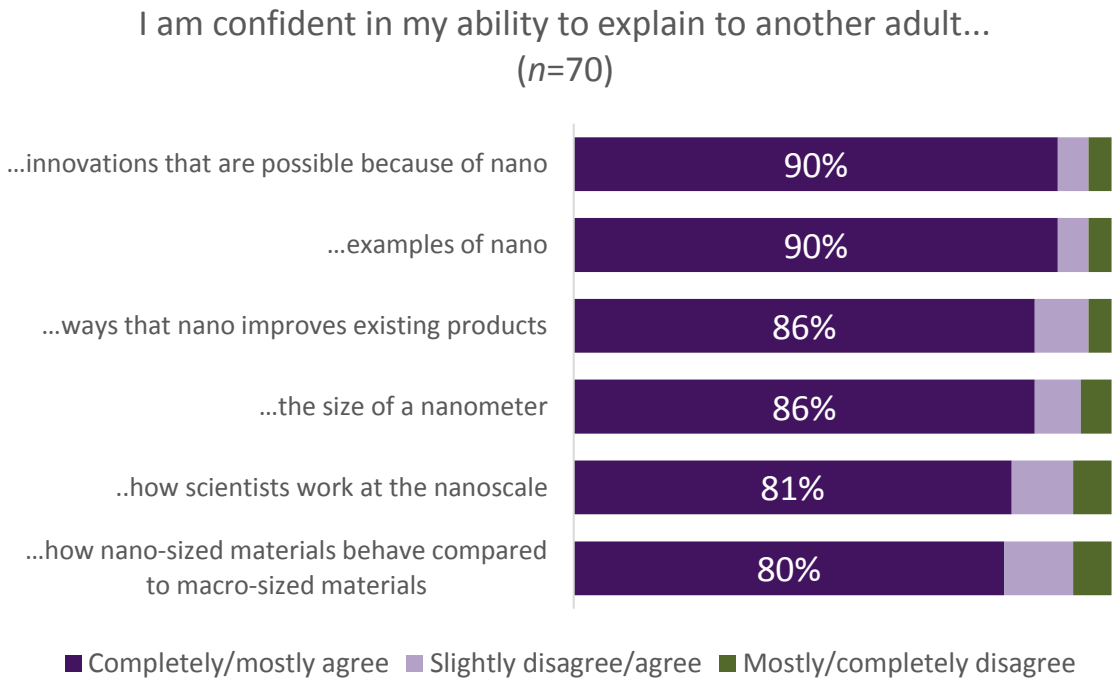
As the following sections describe, the key findings are:

> 3.2.1 By the end of the project, professionals—especially those from museums—had high levels of confidence in explaining nano concepts.
>
> 3.2.2 Professionals gained confidence in explaining nano concepts between pre- and post-surveys, and attributed those gains to their participation in the project.

3.2.1 By the end of the project, professionals—especially those from museums—had high levels of confidence in explaining nano concepts.

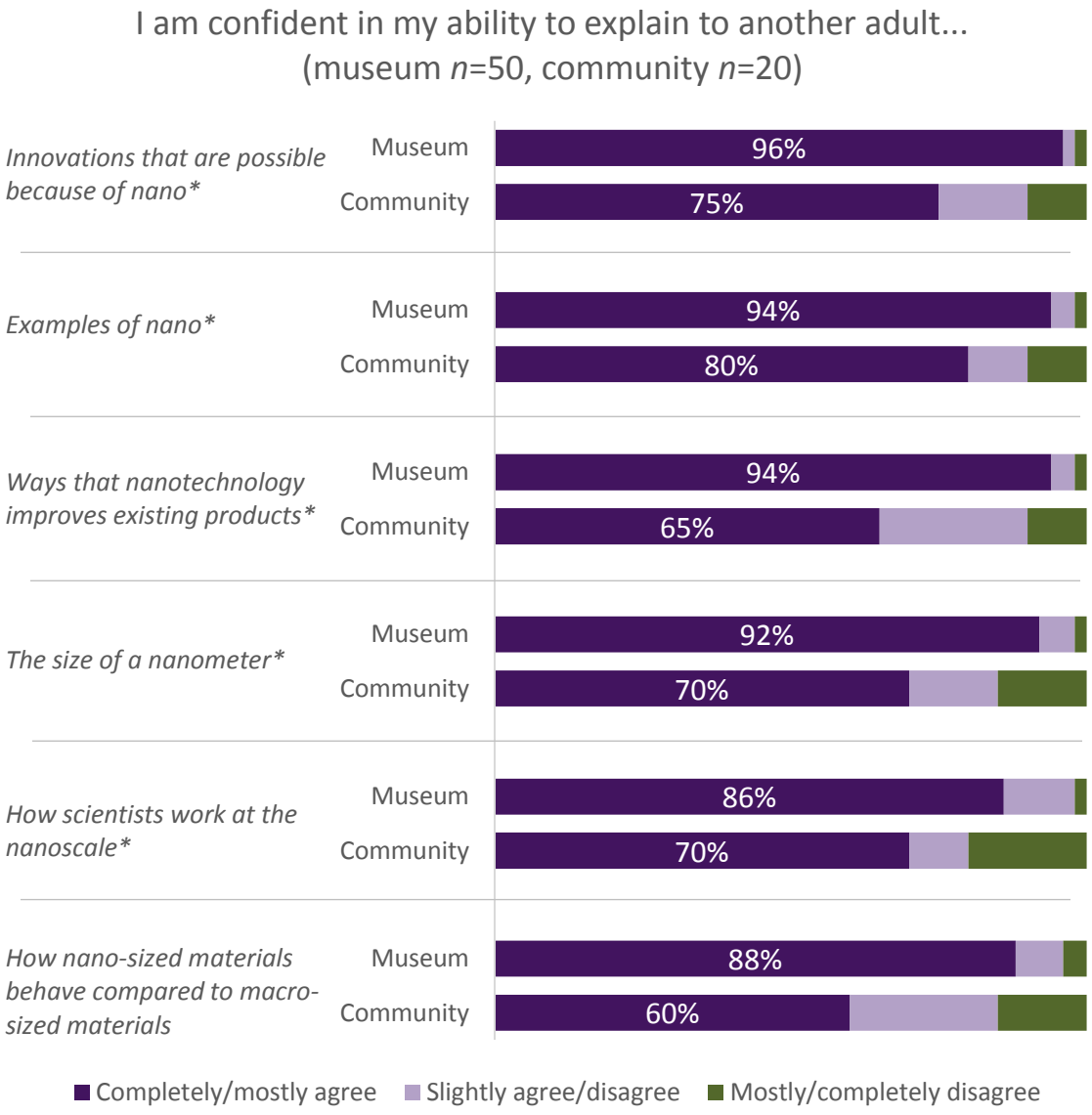
As shown in Figure 6, post-survey respondents had high rates of confidence in explaining nano concepts, with the percentage of respondents who 'completely' or 'mostly' agreed that they were confident ranging from 80% to 90% for each of the six questions.

Figure 6: Confidence in explaining nano concepts at the end of the project.



Museum respondents had significantly higher levels of confidence than community organization respondents on all six of the items (see Figure 7).[2] While these differences are statistically significant, it is important to notice that the sample size for the community organizations is small.

Figure 7: Comparison of museum and community organization respondents' confidence explaining nano concepts.[2]

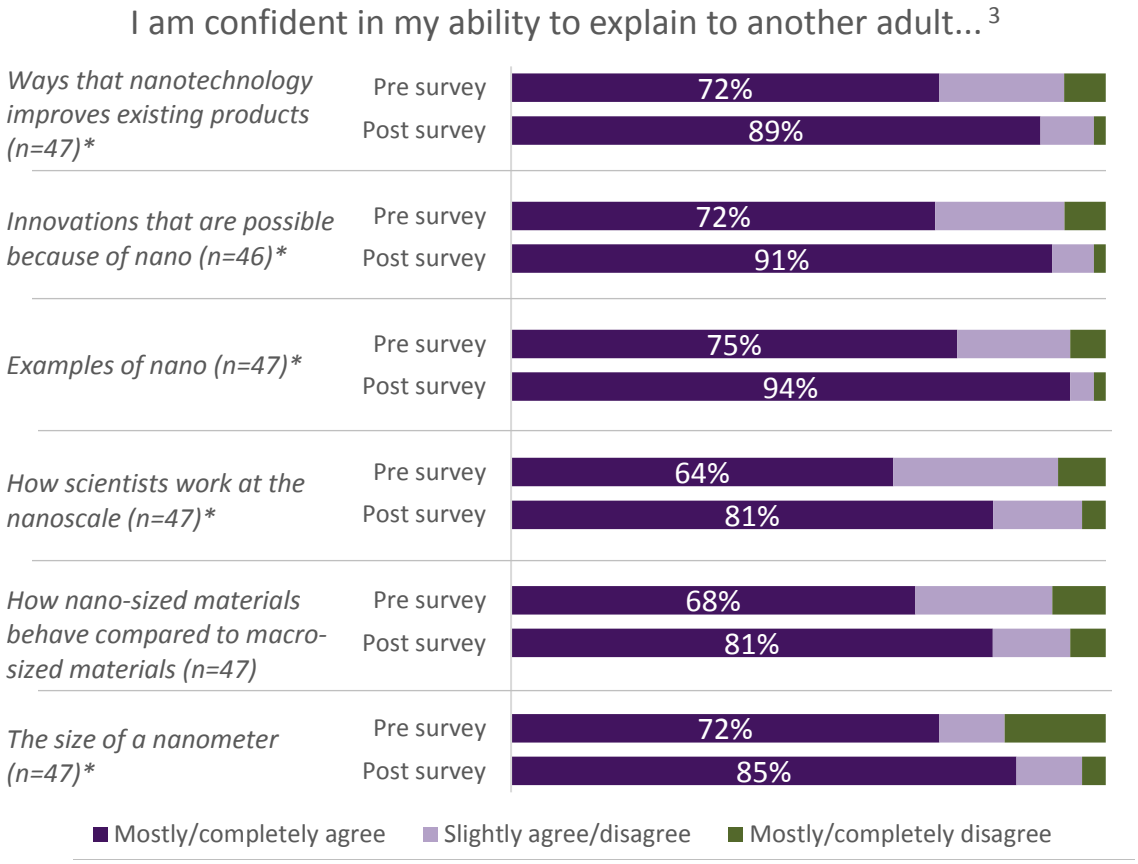


[2] *Innovations that are possible because of nano*: Mann Whitney U (*n*=70, U=348.5, *p*=0.026)
Examples of nano: Mann Whitney U (*n*=70, U=345.5, *p*=0.017)
Ways that nano improves existing products: Mann Whitney U (*n*=70, U=328.0, *p*=0.011)
The size of a nanometer: Mann Whitney U (*n*=70, U=306.0, *p*=0.004)

3.2.2 Professionals gained confidence in explaining nano concepts between pre- and post-surveys, and attributed those gains to their participation in the project.

In comparing pre-survey confidence explaining nano concepts to post-survey confidence, there were statistically significant gains for five out of the six nano concepts (see Figure 8).[3] Due to small sample sizes among respondents who completed these questions on both pre- and post-surveys, evaluators were unable to compare the extent of these gains between museum and community organization respondents. However, there is evidence that both museum and community organization professionals gained confidence.

Figure 8: Respondents' pre- and post-survey confidence explaining nano concepts.

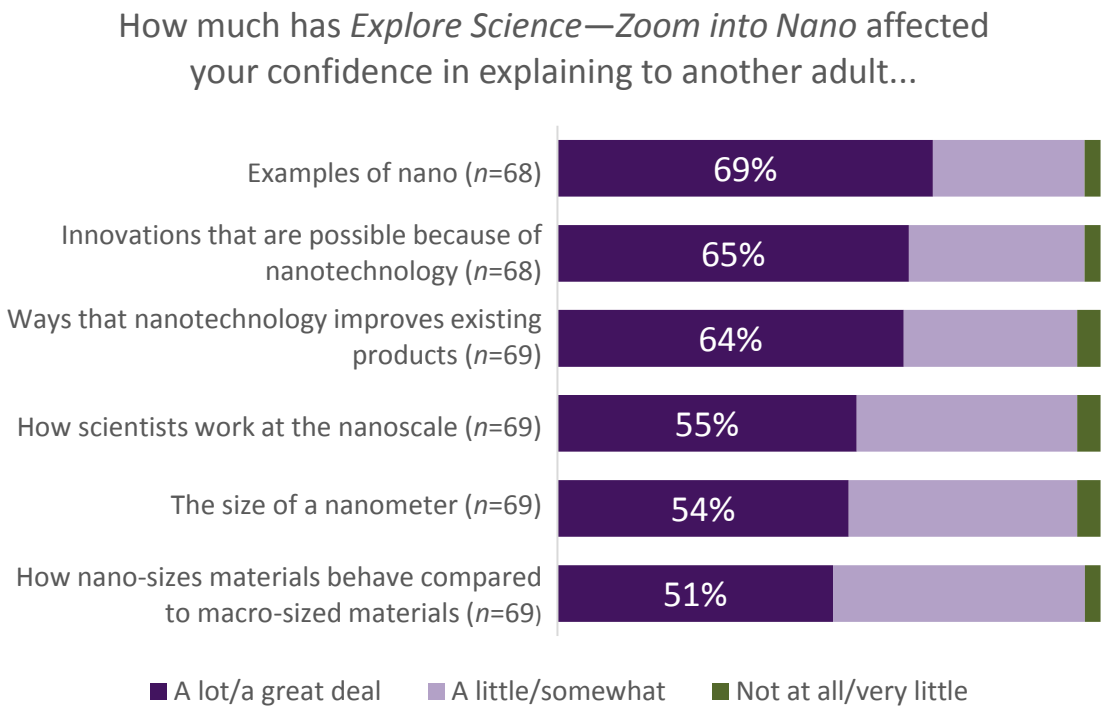


How scientists work at the nanoscale: Mann Whitney U (*n*=70, U=336.0, *p*=0.022)
How nano-sized materials behave compared to macro-sized materials: Mann Whitney U (*n*=70, U=354.0, *p*=0.040)

[3] *Innovations that are possible because of nano*: Wilcoxon Signed Ranks (*n*=46, Z=-2.653, *p*=0.008)
Examples of nano: Wilcoxon Signed Ranks (*n*=47, Z=-2.653, *p*=0.008)
Ways that nano improves existing products: Wilcoxon Signed Ranks (*n*=47, Z=-2.486, *p*=0.013)
The size of a nanometer: Wilcoxon Signed Ranks (*n*=47, Z=-2.443, *p*=0.015)
How scientists work at the nanoscale: Wilcoxon Signed Ranks (*n*=47, Z=-2.236, *p*=0.025)

In order to shed some light on the question of *how* the gains in confidence occurred, the post-survey asked respondents to indicate the extent to which the project had affected their confidence in explaining nano concepts to another adult. As shown in Figure 9, more than half of all respondents felt that the project had affected their confidence 'a lot' or 'a great deal' for each of the six nano concepts.

Figure 9: Ratings of how the project affected professionals' confidence.



These data are especially notable because the project had a relatively short timeframe. The implementation period was about nine months, but in many cases the local sites conducted their partnership in even less time; for some, the interaction with the public was a single day. Compared to past NISE Net evaluations which were sometimes looking at change over a period of up to several years, these data indicate that professionals feel even brief NISE Net projects can impact confidence with nano content. Alternatively, this data could be influenced by social desirability bias, wherein respondents indicated positive responses because they thought that was what the survey senders would have wanted.

3.3 Usage of Museum & Community Partnerships Products

The evaluation of professional participants' use of the materials created for the project aimed to address the following question:

> *How and to what extent does participation in the Museum & Community Partnerships project impact professionals' use of professional resources and educational products for creating partnerships and engaging diverse public audiences in nano?*

The project created planning resources for fostering partnership as well as a kit of materials for professional development and public engagement. Given that NISE Net hopes to pursue future work that fosters partnership between museums and community organizations, an understanding of what materials are most used may help the team make decisions about the types of products that will be produced.

The pre-survey asked about the usage of planning resources. While these materials were available online for anyone, they were designed for the museum partners initiating partnerships. Thus, the survey only asked the main applicants about these resources:

- Collaboration Tips handout
- Online Brown-Bag Workshop
- Video: Creating Successful Collaborations
- Sample email text for an invitation to collaborate
- Profiles of national youth-serving organizations

The post-survey asked both museum and community organization respondents about the professional and educational resources in the physical kit (and also online), including:

- Hands-on STEM activities
- Introductory videos
- Guides
- Training videos
- PowerPoint slides
- Spanish-language materials

The activity survey asked facilitators to report on how they used kit materials and reached potentially diverse public audiences, including:

- Specific activities led with participants
- Changes made to activities
- Where they facilitated activities

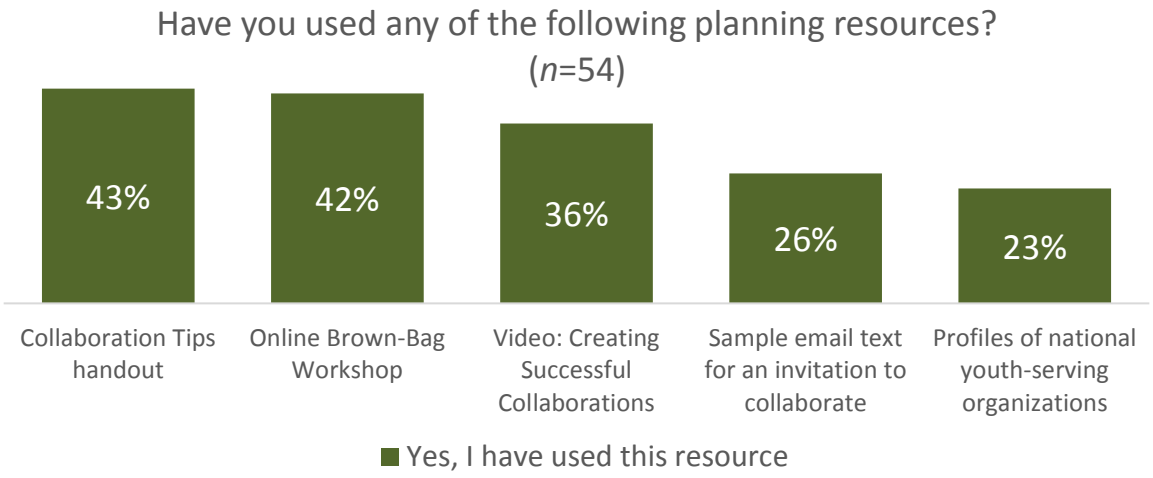
The findings for this section include:

> 3.3.1 All project resources were used, and the hands-on STEM activities, introductory videos, and guides were used especially widely.
>
> 3.3.2 Many professionals—especially those from museums—supplemented the kit with additional activities and used kit materials in different ways beyond the project requirements.

3.3.1 All project resources were used, and the hands-on STEM activities, introductory videos, and guides were used especially widely.

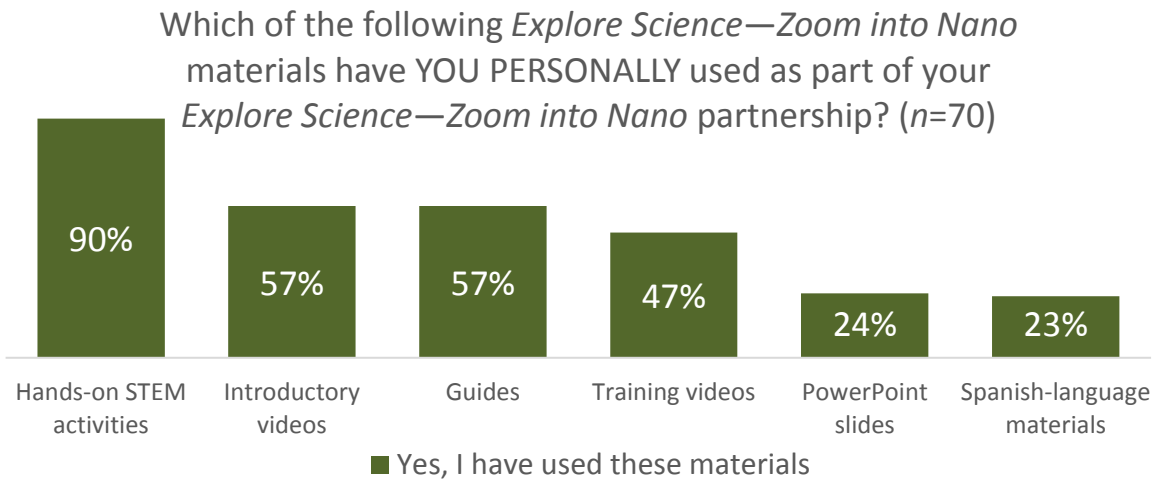
The pre-survey asked museum respondents whether they had used the planning resources that the project released prior to the shipment of the physical kits. Overall, 76% of respondents (*n*=54) had used at least one planning resource. As illustrated in Figure 10, each of the resources was used by between 23% and 43% of respondents. These numbers are high, given that the planning resources were all distributed digitally before the physical kits were shipped. These data suggest that sites were taking active steps to plan for their partnerships before the project even officially began. Note that this question asks about an individual's use of materials, not an organization's use. Because multiple people were involved from many organizations, the organizational rate of use was likely higher than the data shown below.

Figure 10: Individual respondents' usage of planning resources.



On the post-survey, all respondents were asked about their use of the materials within the kits. Overall, 96% of respondents (*n*=70) had used at least one of the resources. Figure 11 shows a summary of these responses. By far, the most commonly used materials were the hands-on STEM activities, (90%). More than half of the respondents had also used the introductory videos about the project as a whole which could be used for professional development or for showing the public (57%) and the written guides about engaging the public in nano, hosting and promoting events, and doing programs in out-of-school time (57%). The short training videos that instructed facilitators about how to lead each hands-on STEM activity were used by 47% of respondents, and the PowerPoint slides about STEM in out-of-school time were used by 24% of respondents. The Spanish-language materials were least frequently used, at 23%. Again, this question asked at the individual level, not whether anyone from the organization had used the materials.

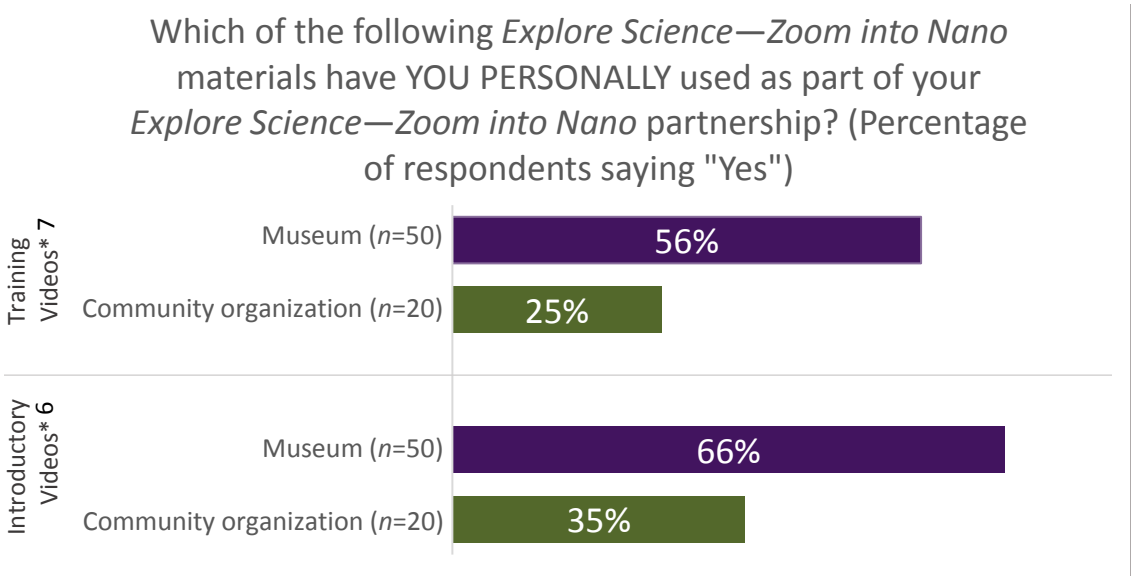
Figure 11: Individual respondents' usage of kit materials.



For most of the kit materials, museum and community organization respondents were equally likely to use the resources. However, both introductory[4] and training videos[5] were used more often by museums than by community organizations, as shown in Figure 12 (once again, it should be noted that the sample size was small for the community organizations). During the planning phases of the project, representatives from national youth-serving organizations indicated that some community organizations do not have access to equipment on which to play videos. However, the content was available in multiple ways such that those who might not have had the ability to play video, or who preferred different modes of transmission, could still have access to the material. For instance, facilitators could have prepared to lead an activity by *either* watching a training video about an activity *or* reading the printed facilitator guide. Similarly, the material in the introductory video (for professional development and/or sharing with the public) was also available in the printed guides and PowerPoint slides. Thus, it was not expected that every product would be used by every professional.

[4] $\chi 2$ (1, n=70) = 5.606, Fischer's Exact 2-tailed p=0.031
[5] $\chi 2$ (1, n=70) = 5.509, Fischer's Exact 2-tailed p=0.033

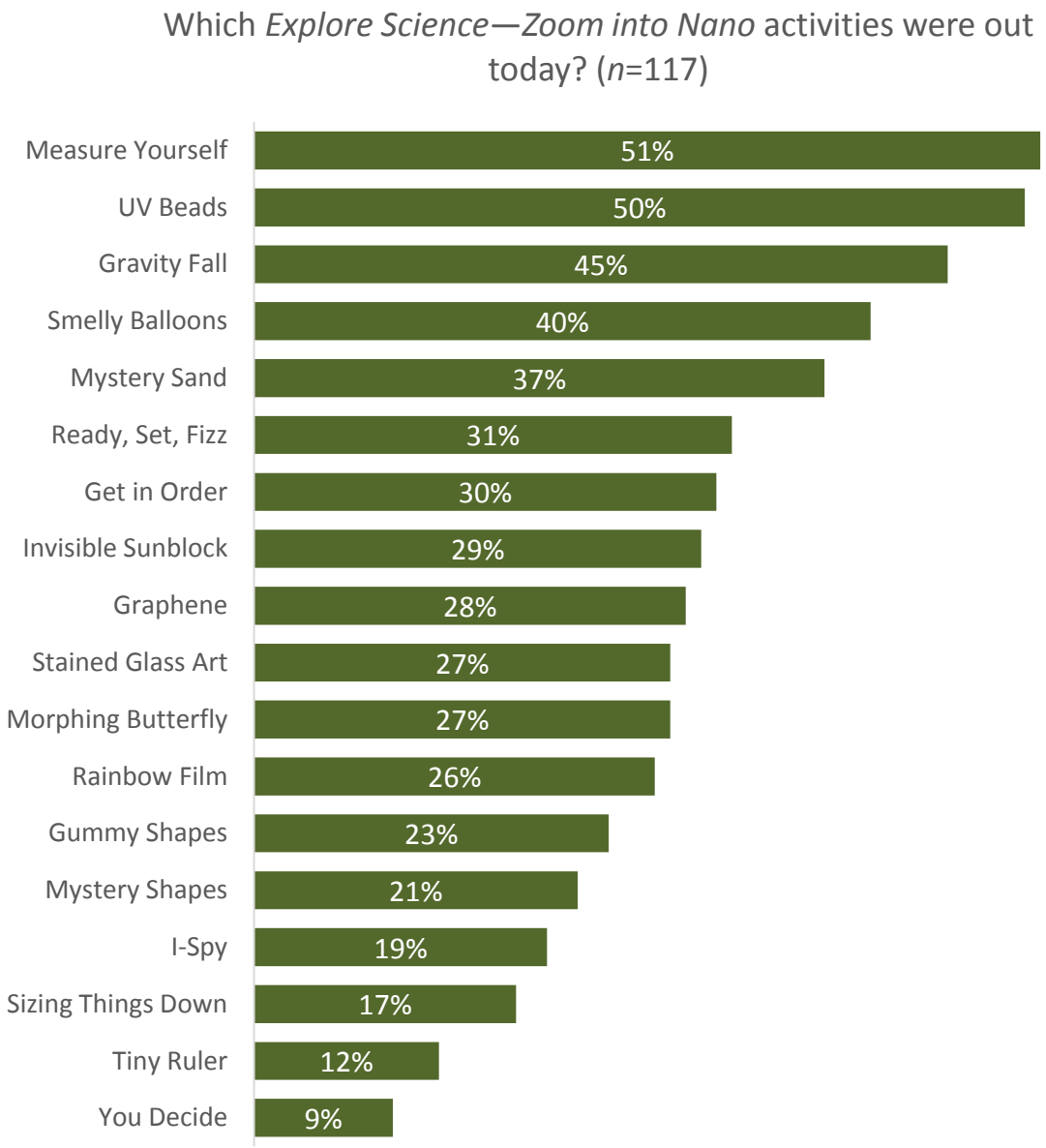
Figure 12: Museum and community organization respondents' usage of videos.



To further explore the use of the hands-on STEM activities, the most commonly used resource from the kit, evaluators asked facilitators which activities they used each time they responded to the activity survey. These facilitators were volunteers or staff who were leading activities at either museums or community organizations. Out of the eighteen activities, the five that were implemented most frequently were Measure Yourself (51%), UV Beads (50%), Gravity Fall (45%), Smelly Balloons (40%) and Mystery Sand (37%) (see Figure 13). You Decide was the activity used least frequently (by 9% of respondents). Unlike the other short, table-top activities in the kit, the discussion-based You Decide activity had a longer format for participation. It encouraged participants to consider the intersection of nano and society and was different from other activities, which were based on scientific content or phenomena. Some sites may have felt that You Decide did not fit as well with the other activities because of its different format. Alternatively, professionals may have felt they lacked sufficient training to lead this activity. Another possibility is that You Decide might have been seen as less appropriate for the audience than the other hands-on activities.

[6] $\chi 2$ (1, n=70) = 5.606, Fischer's Exact 2-tailed p=0.031
[7] $\chi 2$ (1, n=70) = 5.509, Fischer's Exact 2-tailed p=0.033

Figure 13: Usage of the hands-on STEM activities.



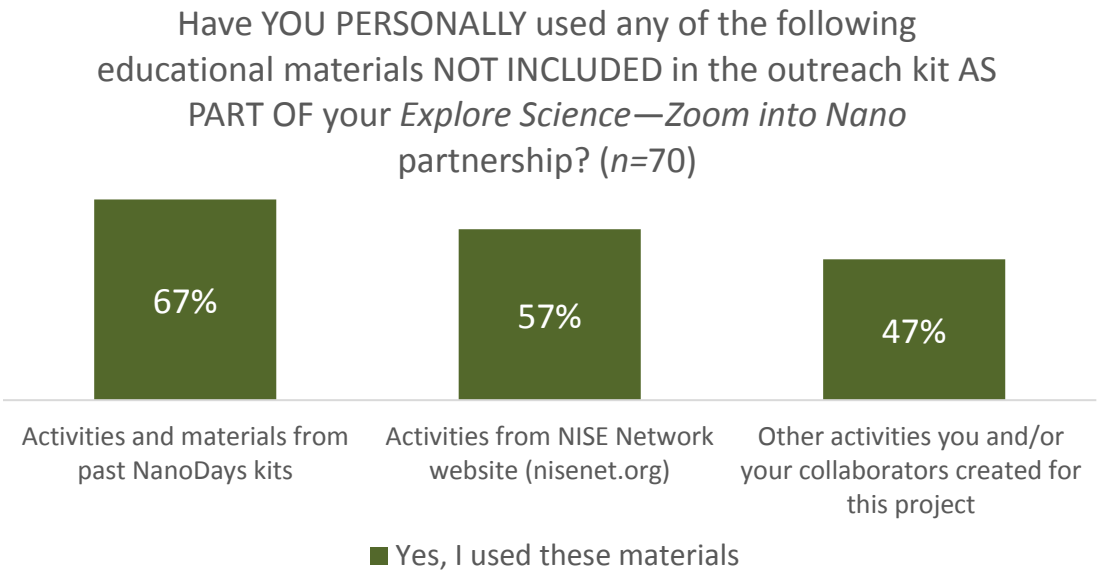
The activity survey also asked facilitators if there was anything else they would like to say about the activities. Two fifths (41%, *n*=58) took this opportunity to write about what they enjoyed about the activities. A little more than a quarter (28%) offered suggestions for improvement, including having more samples and activities in the kit, using different ways of shipping materials, or asking for ways to better explain tricky concepts like the powers of ten. One fifth (22%) shared challenges that they encountered, including that the activities may have felt too school-like for their youth or that the concepts felt too advanced for the young ages of their participants.

Post survey respondents who indicated that they had *not* used certain kit materials were asked to describe their reasons for not using the resources. Overall, 41% of respondents (*n*=126) indicated that the materials were not appropriate for their work (e.g., an administrator might not use the hands-on STEM activities), 29% said they were unaware the materials existed, 28% responded that they didn't have time to use the materials, and 2% noted that the materials were confusing.

3.3.2 Many professionals—especially those from museums—supplemented the kit with additional activities and used kit materials in different ways beyond the project requirements.

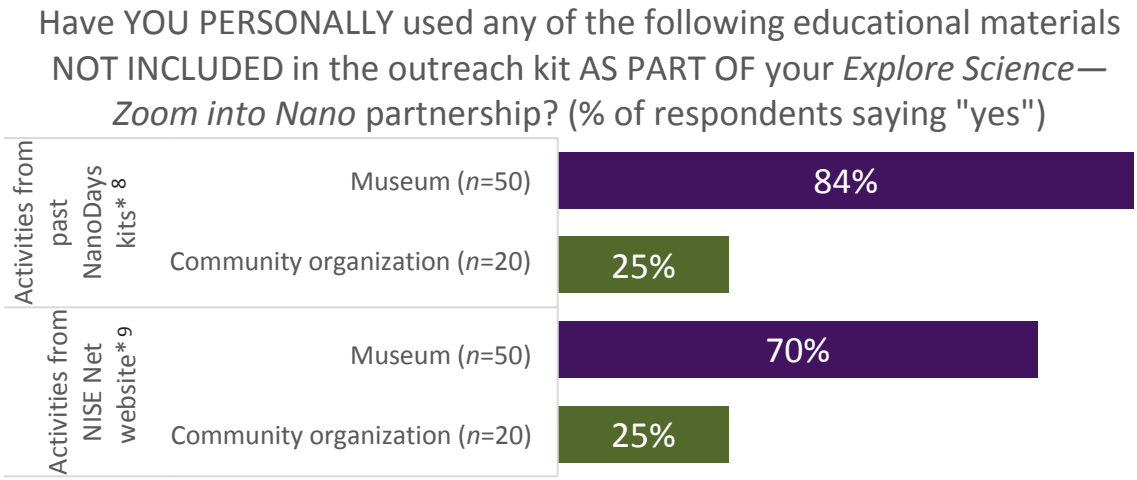
Many post-survey respondents indicated that they had integrated kit contents with materials from other sources. As shown in Figure 14, a total of 67% used activities from past NanoDays kits, 57% used materials from the NISE Net website, and 47% used activities that they or their partner had created for the project.

Figure 14: Use of materials not included in the kit.



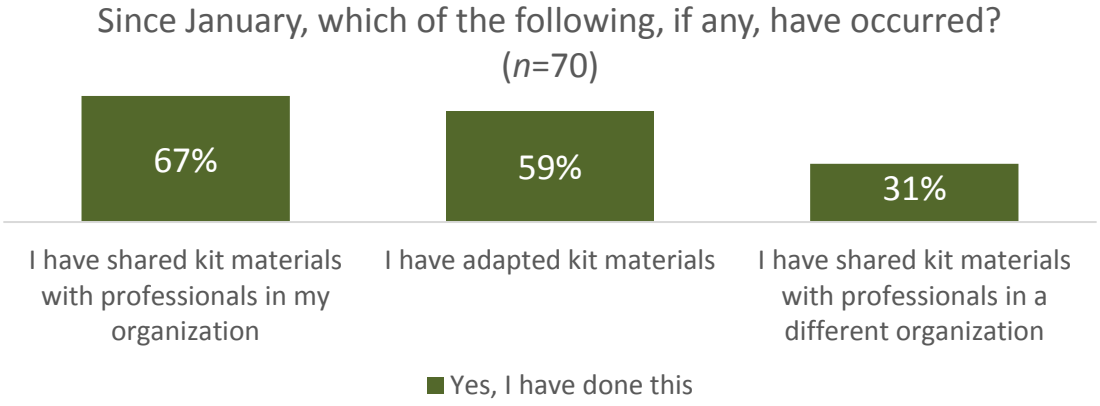
As shown in Figure 15, museum respondents were more likely than community organization respondents to use activities from past NanoDays kits[8] and activities from the NISE Net website.[9] This is likely due to the fact that community organizations had not received past NanoDays kits and were likely less familiar with the NISE Net website. However, the small sample size for the community organizations should be noted.

Figure 15: Museum and community organization usage of materials not in the kit.



In addition to using kit materials with other activities, professionals also shared and adapted kit materials beyond the proposed project requirements (see Figure 16).

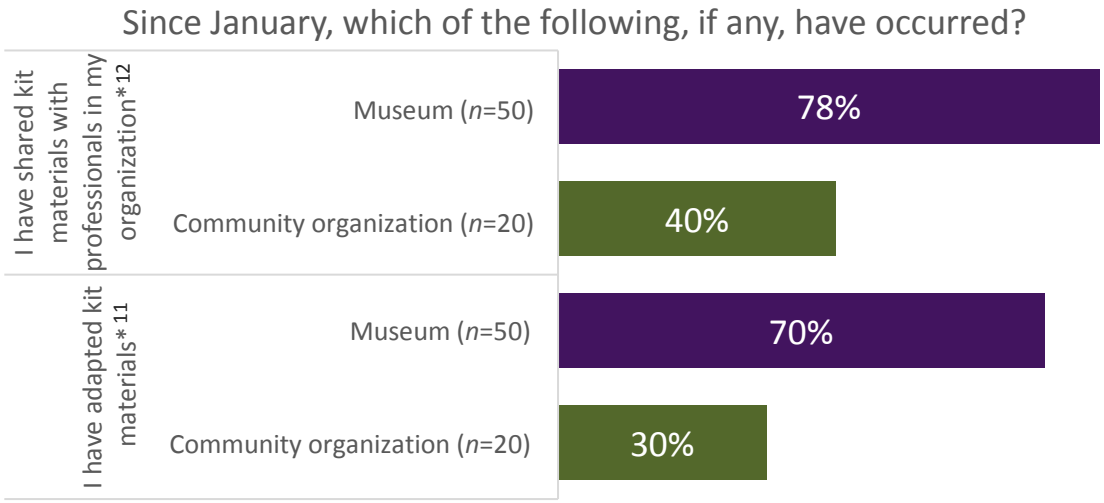
Figure 16: Additional uses of kit materials.[10]



[8] $\chi 2$ (1, n=70) = 22.541, Fischer's Exact 2-tailed p<0.001
[9] $\chi 2$ (1, n=70) = 11.813, Fischer's Exact 2-tailed p=0.001
[10] Note that January was the beginning of the project period.

As shown in Figure 17, museum respondents were more likely to adapt kit materials[11] and share materials with professionals in their organization.[12] NISE Net has promoted a culture of reuse and adaptation, so the community organizations' lower rates of adaptation may be due to the fact that these professionals had less direct interaction with the Network both prior to and during the MCP project. In terms of sharing materials, the kits were shipped to the museums, so it may be that the museums were in a better position to share the materials simply because the community organizations were not initially in possession of them. However, once again the differences between museum and community organization respondents should be considered with caution because of the small sample size of community organization professionals.

Figure 17: Adaptation and sharing of kit materials.

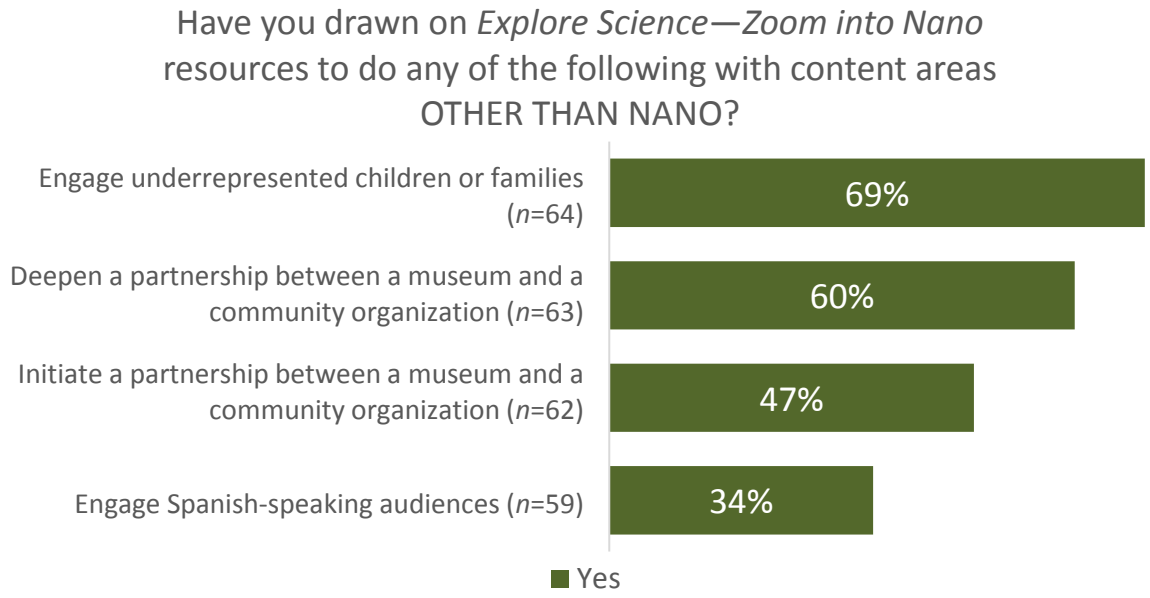


In addition to the post-survey data described above, the activity survey asked, "Did you make changes to any of today's 'Zoom into Nano' *Explore Science* activities?" followed by, "What changes did you make?" Two fifths of the respondents (40%, *n*=118) indicated that they had made changes. Of those who had, 62% (n=47) had modified or augmented the activities in some way, while 38% supplemented the experience with additional activities from previous NanoDays kits. Facilitators who made changes to the MCP activities offered specific ways that they had made the activities run more smoothly for them and their audiences. For example, one facilitator added the scent of coffee to the Smelly Balloons activity, saying that "the variety [was] helpful for engagement." Some facilitators went on to explain that they modified the activities in order to meet the needs of their participants, including changes made to suit younger children (8), help energize their participants (4), or better serve larger groups (3). One respondent had changed the Powers of Ten rules (from a previous NanoDays kit) to be more cooperative in nature so that everyone would be able to feel successful getting rid of their cards.

[11] $\chi 2$ (1, *n*=70) = 9.420, Fischer's Exact 2-tailed *p*=0.003
[12] $\chi 2$ (1, *n*=70) = 9.351, Fischer's Exact 2-tailed *p*=0.004

The contents of the kits focused on the content area of nano. However, NISE Net has traditionally encouraged professionals to expand their resources, skills, and knowledge beyond the bounds of the current activities. Thus, the post-survey asked whether professionals had used any of the project materials to engage in a range of practices for content other than nano (for more information about practices, see the next section). Figure 18 shows the data from this question. A total of 67% of respondents had used *Explore Science—Zoom into Nano* resources to do at least one of these practices for content other than nano.

Figure 18: Use of project materials with content other than nano.



3.4 Practices for Building Partnerships and Engaging Diverse Audiences

In addition to encouraging the use of project materials (see previous section), NISE Net promoted museum and community organization participants' engagement with a range of professional practices that can be applied beyond the specific context of nano. To evaluate the professionals' awareness of and participation in these practices, evaluators sought to answer the following evaluation question:

> *To what extent does participation in the Museum & Community Partnerships project impact professionals' awareness of practices for effectively forming partnerships and engaging diverse public audiences in nano?*

Working with the project team, evaluators developed a list of practices in which professionals involved in the project might engage, and that the project resources supported. The practices that the project aimed to foster included:

- Engaging underrepresented children and families
- Engaging girls
- Engaging the public in nano
- Engaging Spanish-speaking audiences
- Initiating a partnership between a museum and a community organization
- Deepening an existing partnership between a museum and a community organization

All professionals who were involved in the project had access to professional development resources for each of these practices through the materials that were available freely online as well as the physical materials that were part of the kit. However, it was not assumed that all professionals would engage in all of the practices. For instance, some organizations may not have been interacting with Spanish-speaking audiences, and thus that practice may not have been relevant to that particular partnership. Similarly, it was not expected that all professionals would increase their confidence for these practices, as many may have already had high confidence at the start of the project. The last two practices—initiating and deepening partnerships—were in many cases mutually exclusive. Kit recipients were only required to have a single partner, so most sites were either initiating a new partnership or deepening an existing partnership between a museum and a community organization.

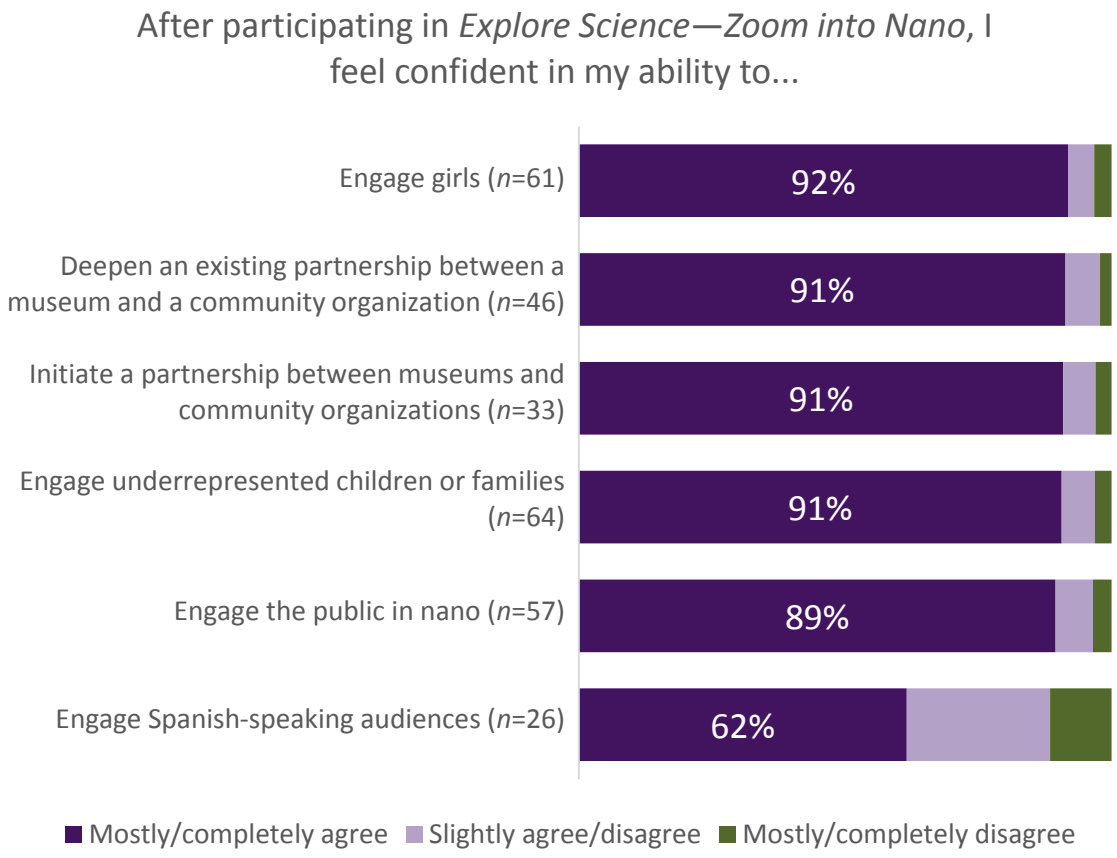
Findings for this section include:

> 3.4.1 By the end of the project, professionals had high levels of confidence in implementing the practices, and confidence for engaging Spanish-speaking audiences grew.
>
> 3.4.2 Not only were professionals confident in the practices, but many had done them, were aware of project resources about the practices, and used the project resources about these topics.

3.4.1 By the end of the project, professionals had high levels of confidence in implementing the practices, and confidence for engaging Spanish-speaking audiences grew.

Respondents were asked about their confidence engaging in the professional practices that were applicable for them. Note that this explains the different sample sizes for the different practices; so, for instance, engaging Spanish-speaking audiences has the smallest sample size because few professionals indicated that this practice was relevant for their work. Professionals also played different roles within their organizations, ranging from direct service to administration and many other responsibilities. Across all these professionals, levels of confidence were quite high, with 62%-92% of respondents 'completely' or 'mostly' agreeing that they were confident in the practices. Figure 19 displays this data for each practice.

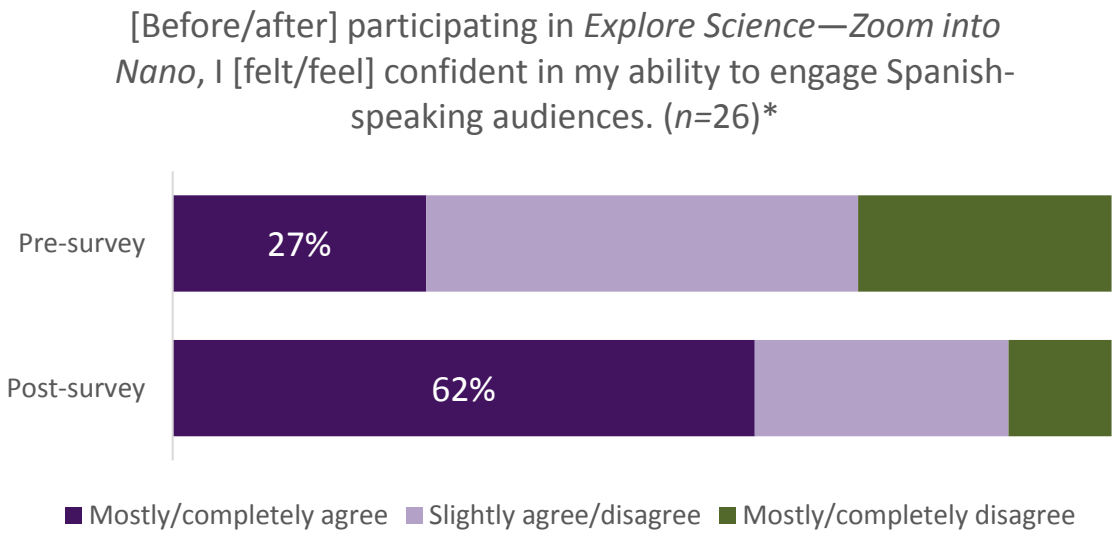
Figure 19: Confidence for implementing practices.



While engaging Spanish-speaking audiences stands out as the practice for which professionals had the least confidence, Figure 20 shows that, while the post-survey sample size was small, this was the only practice for which there was a statistically significant improvement between the pre- (33% mostly/completely agree) and post-

surveys (62% mostly/completely agree).[13] This could be a promising opportunity for future NISE Net efforts because fewer professionals were comfortable with and utilizing this practice, yet project participants showed gains in this area. There may be room for supporting more of this type of work among other professionals, although there may be a limited audience for this work, since engaging Spanish-speaking audiences was the practice that the fewest professionals found to be applicable to their jobs. Additionally, the fact that professionals were highly confident in other areas may open doors to exploring new practices for professionals. Future efforts may be able to focus on more specific or challenging audiences or techniques rather than the broad practices studied here, as it seems that many professionals already have confidence for these areas.

Figure 20: Pre- and post-survey confidence for engaging Spanish-speaking audiences.[13]



3.4.2 Not only were professionals confident in the practices, but many had done them, were aware of project resources about the practices, and used the project resources about these topics.

The post-survey asked respondents whether they had engaged in any of the project's practices. As illustrated in Figure 21, each practice was used by more than one-third of all respondents, ranging from engaging Spanish-speaking audiences (35%) to engaging underrepresented children or families (91%). The range of engagement is to be expected, as some of the practices were considered project requirements whereas others were applicable only to a subset of respondents.

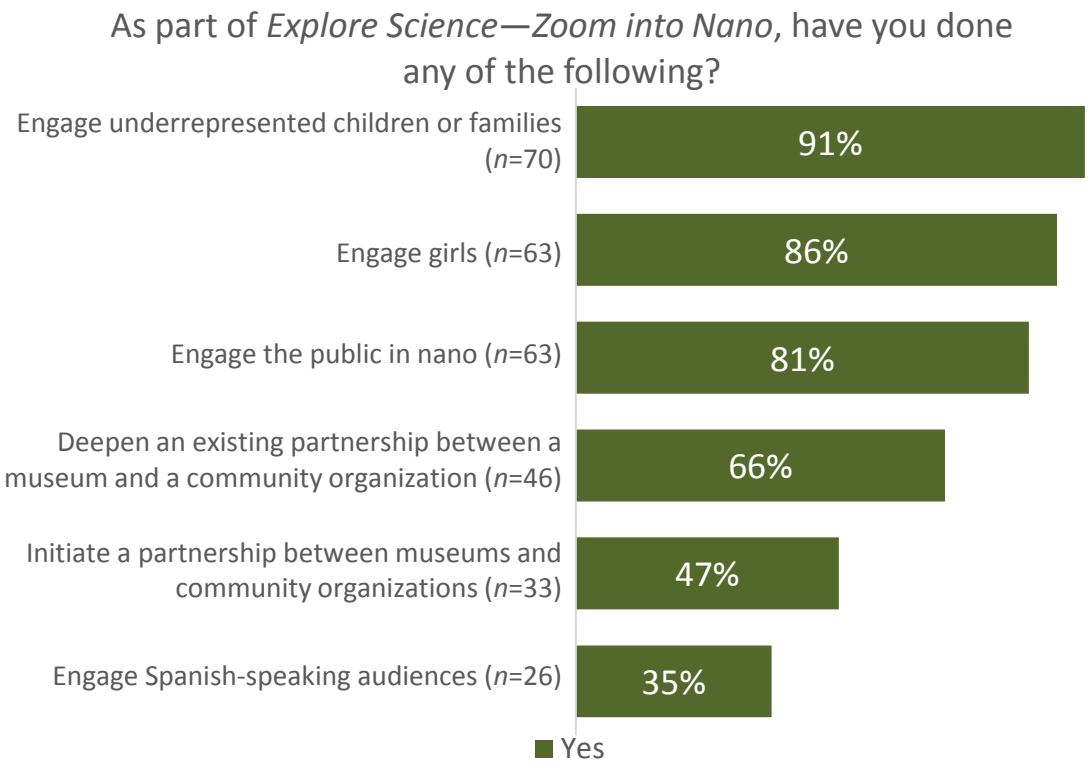
[13] Wilcoxon Signed Ranks Test (*n*=26, Z= -2.804, *p*=0.005)

The project required that kit recipients engage underrepresented audiences in nano, although it did not specify which specific audiences should be reached. Thus, it is unsurprising that engaging underrepresented children and families (91%) was the most common practice used as a part of the project, followed closely by engaging girls (86%)[14] and engaging the public in nano (81%). Engaging Spanish-speaking audiences was less common (35%). It is interesting that fewer professionals reported engaging the public in nano than engaging underrepresented children or families. This may mean that some professionals were doing non-nano activities that they considered to be within the scope of the project, that professionals did not recognize the project activities as being related to nano, or that the respondents doing nano activities did not consider the underrepresented children and families to be members of the public. Note that the survey question asked each professional to report what she or he had personally engaged in, so the fact that not all professionals reported engaging underrepresented children or families may be due to the fact that some respondents played a more administrative role that did not include direct interaction with the public.

Another requirement of kit receipt was partnership between a museum and a community organization. The survey looked at two sub-components of this partnership: initiating new partnerships (47%) and deepening existing partnerships (66%). Compared to many of the other practices, respondents were less likely to do each of these practices, but we would expect respondents to be split between the two, as the project required sites to *either* expand an existing partnership *or* start a new one. Of the 70 professionals who responded to one or both of these questions, 87% reported doing at least one of the two practices and 29% reported doing both. Again, this is individual-level data, so it is likely that more than 87% of *organizations* deepened or initiated a partnership, even though only 87% of the professionals involved in the project did these practices. These professionals may have been more involved in direct service or other project activities.

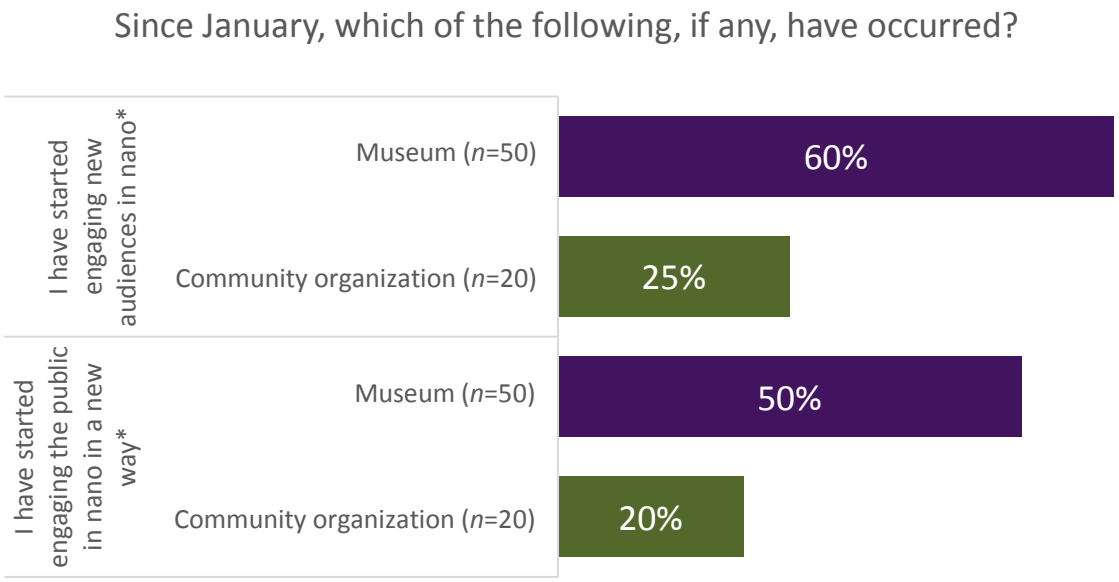
[14] For more information on the public audiences involved in this project, see the public reach section on page 48.

Figure 21: Engagement in project practices.



To further investigate the practices of engaging the public in nano and engaging underrepresented audiences, evaluators asked an additional question about whether professionals had begun engaging new audiences in nano or started engaging the public in nano in a new way since the beginning of the project. Overall, 50% of respondents reported engaging new audiences in nano and 41% reported engaging the public in nano in new ways. As shown in Figure 22, museum respondents were more likely to do both of these. The project was designed so that the products would be used to engage the existing populations served by the community organizations, so it makes sense that respondents from these organizations were less likely to report reaching a new audience. The fact that museum respondents were more likely to engage the public in nano in a new way may be due to museum professionals newly offering programming in contexts such as out-of-school time programs. Kits included classroom sets and activity books that had not been in previous NanoDays kits. The fact that few community organization respondents felt they had started engaging the public in nano in a new way may suggest that the project materials felt consistent with the types of programming they were already offering, making the integration of nano content feel natural. It may also be that the question's wording of "engaging the public in nano in a new way" could have been interpreted as implying that you could only engage in a "new way" if you had previously been engaging the public in nano in another way. The differences between museum and community organization respondents should be considered cautiously due to the small sample sizes among community organization professionals.

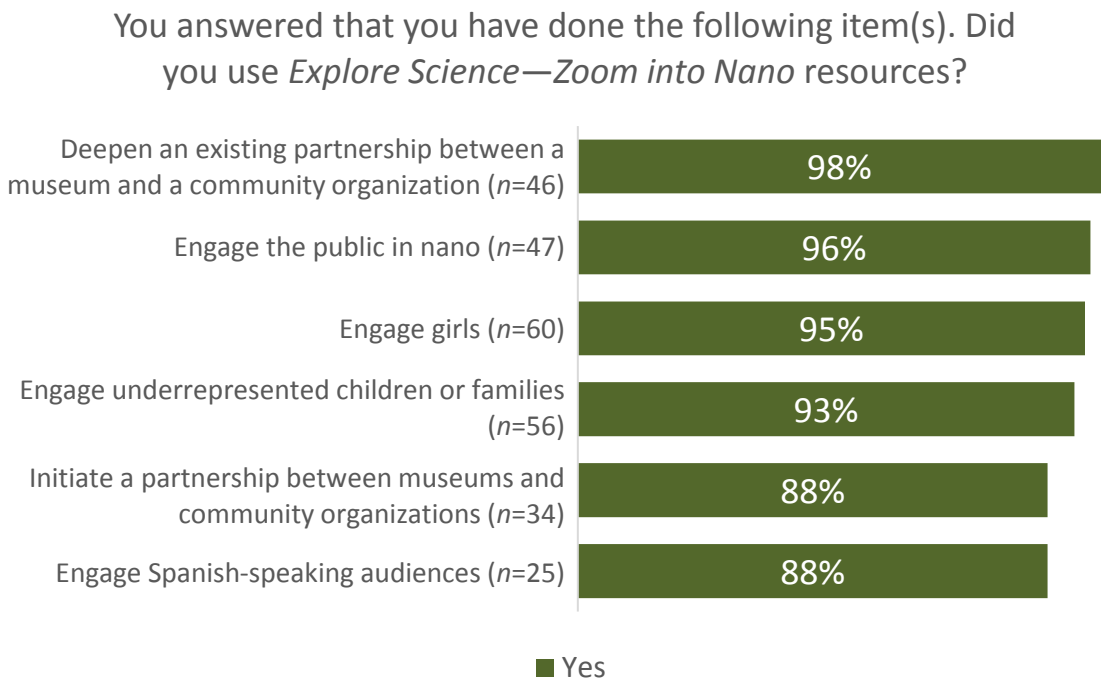
Figure 22: Museum and community organization engagement with practices. [15]



For each of the practices that respondents indicated they had done, the post-survey asked whether or not the professionals had used project materials when doing the practices. Overwhelmingly, the professionals reported that they had used the resources, with each resource being used at least 88% of the time, as shown in Figure 23. A total of 97% of respondents had used project resources to do at least one of the practices (n=69). Note that the sample sizes are small in some cases because they only include professionals who had done each of the practices.

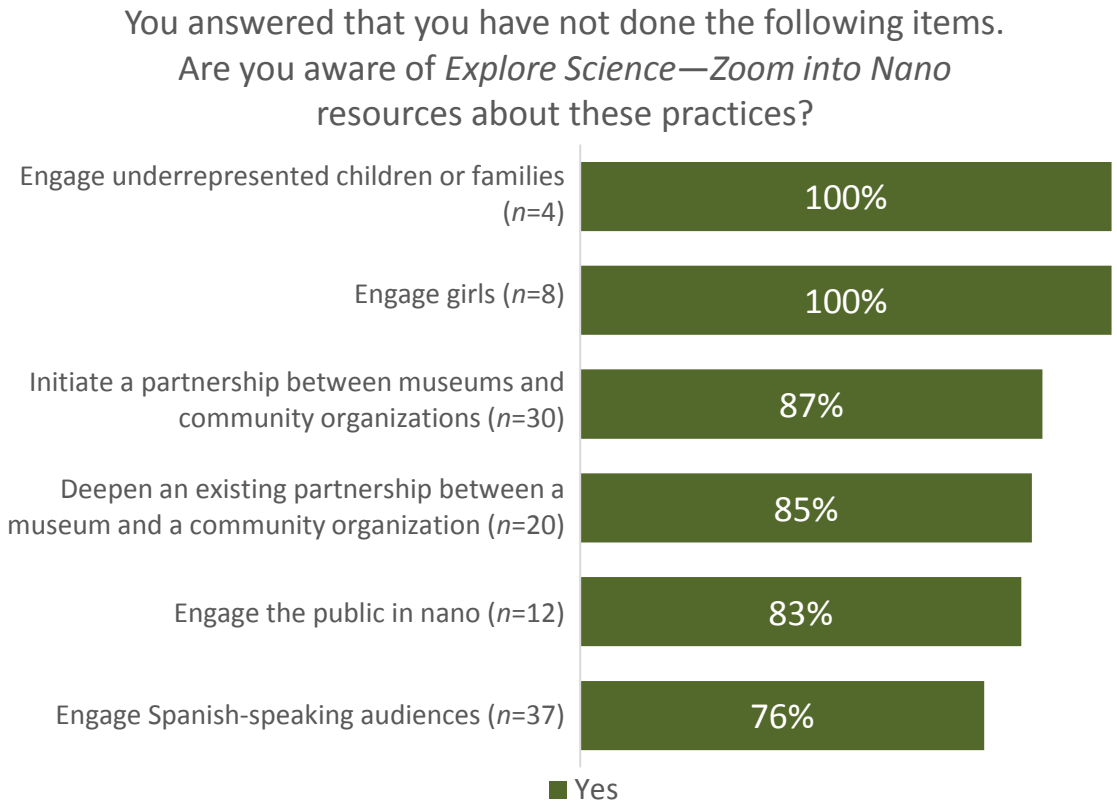
[15] *I have started engaging the public in nano in a new way*: $\chi 2$ (1, n=70) = 5.299, Fischer's Exact 2-tailed p=0.031
I have started engaging new audiences in nano: $\chi 2$ (1, n=70) = 7.000, Fischer's Exact 2-tailed p=0.016

Figure 23: Use of project materials when engaging in project practices.



For those practices that respondents indicated they had *not* done, the post-survey asked whether the professionals were aware that the project resources for these topics existed. The rates of doing the practices were quite high (see section 3.4.1), leaving very small sample sizes for these questions in some cases. However, the professionals who had not engaged in the practices reported high levels of knowledge about the materials, ranging from 76% of respondents who had not engaged Spanish-speaking audiences, to all of the professionals who had not engaged girls or underrepresented children or families. These data are displayed in Figure 24. The small sample sizes prevented evaluators from being able to confidently compare awareness between museum and community organization professionals.

Figure 24: Awareness of project resources for practices.



IV. Public Impact Findings

4.1 The Public Reach Estimates of the Museum & Community Partnerships *Explore Science—Zoom into Nano* Materials.

The evaluation of the public reach of the Museum & Community Partnerships kit materials drew on responses to professionals' post-surveys and kit reports to address the following question:

> *To what extent does the project reach its target audience of children, youth, and families from demographic groups that are underrepresented in STEM fields?*

Many community organizations and museums already track participation in their programming. Some do this through registration and head counts with self-reported enrollment data about demographics. Other organizations have close relationships with their local communities that allow them to get to know participants and recognize different ways in which participants self-identify. We wanted to draw on the partners' knowledge of their participants in order to understand the extent to which the *Explore Science—Zoom into Nano* activities were reaching underrepresented audiences.

The main finding for this section is:

> 4.1.1 Kits reached underrepresented audiences and were most likely to reach participants who were low-income, female, and people of color.

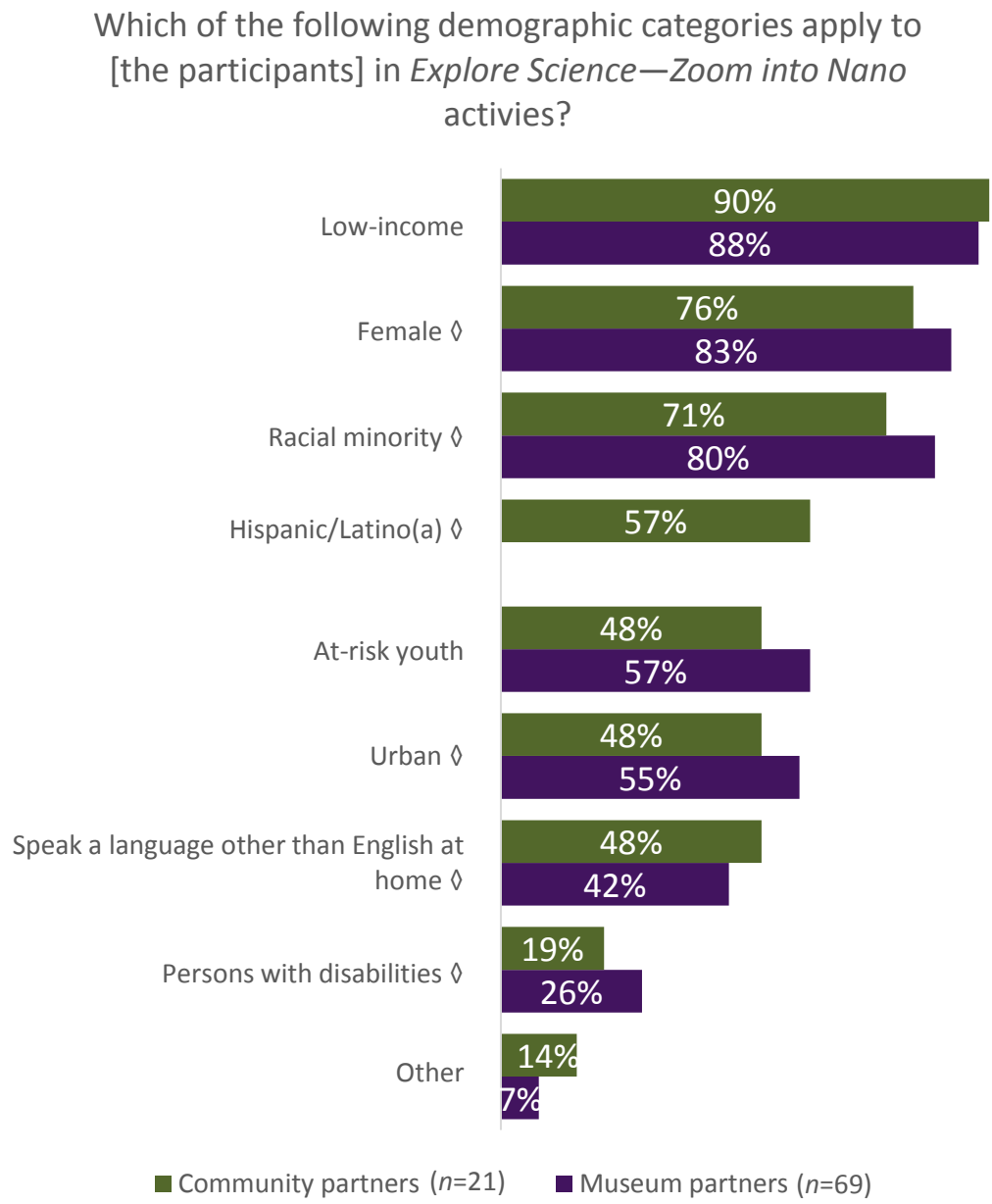
4.1.1 Kits reached underrepresented audiences and were most likely to reach participants who were low-income, female, and people of color.

We asked community partners, "which of the following demographic categories apply to the children, youth, and family members who participated in *Explore Science—Zoom into Nano* activities?", followed by each of the underrepresented categories mentioned in the introduction, including: a) Hispanic or Latinos/as, b) racial minorities, c) females (girls and women), d) persons with disabilities, e) low-income participants, f) participants who speak a language other than English at home, f) geographically underserved (rural, inner city) participants, g) at-risk youth, and h) other underserved groups, as defined locally. We asked museum partners a very similar question on the final report, which mirrored language from previous NISE Net instruments so that data could be used for other project-related analyses. The question for museum partners differed in a couple of key ways; they were asked to reflect about *youth* being reached (not families), were not asked specifically about reaching Hispanic/Latino(a) communities, and used slightly different language to refer to each of the categories. Both wordings are shared in Figure 25.

Museum and community partners agreed that they were most likely to reach low-income families (90% and 88%, respectively), women or girls (76%, 83%), and racial minorities (71%, 80%) (see Figure 25) with *Explore Science—Zoom into Nano* kit materials. While we might expect women or girls to engage in most public programming formats, it is possible that some organizations did not check this demographic because girls were not specifically targeted. It is also possible that some community organizations (such as the Boy Scouts of America, for example) may have held programming that was not attempting to reach women and girls.

One respondent did not identify any demographic categories as having participated in programming because they "don't keep those stats" and was hesitant to give these descriptions of their participants without measuring it more reliably. Respondents wrote that the other underserved audiences they reached included "international children," "Asian," "homeschooled," "faith-based," "children of the incarcerated," and "…our community is very diverse and all of these demographics attended."

Figure 25: Estimated demographics of public participants.



◊All categories above reflect language from the post survey with community partners; wording for these categories from the annual kit report from museum partners was different and included girls, ethnic minorities, no option for reporting on Hispanic/Latino(a) communities, inner city youth, non-native English speakers, and differently abled persons.

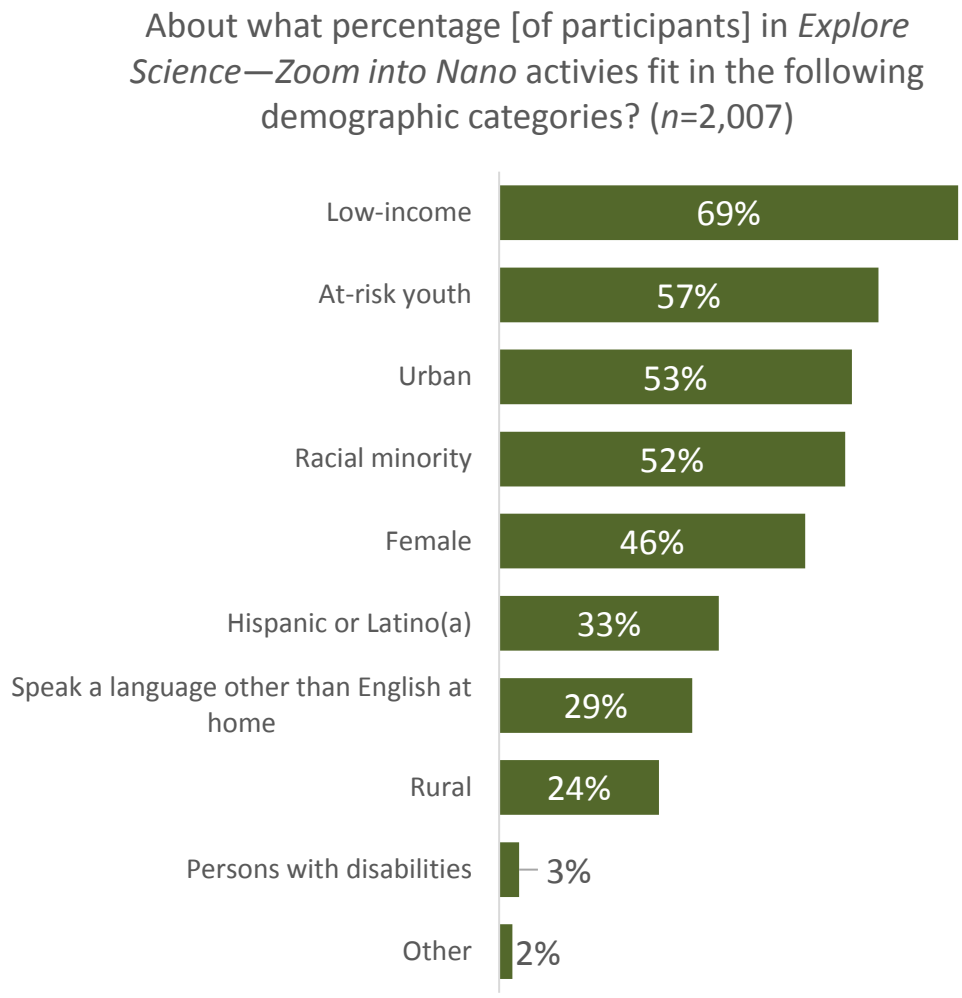
We also wanted to know about how many of the participants served were from each of the underrepresented audiences. Figure 25 above shows *which* audiences were served, but does *not* give us an idea of how many of the participants were from each of the categories,

In order to find out, we asked community partners to also estimate what percentage of their participants fell into each of the underrepresented groups.

We asked community partners, "About how many children, youth, and family members participated in this project as public participants?" We also asked, "About what percentage of the children, youth, and family members who participated in *Explore Science—Zoom into Nano* activities fit in the following demographics categories?" Seventeen community partners responded to both questions, and the combined, estimated number of people served was 2,007 participants. When asked to describe how they came up with these numbers, 90% indicated that they had directly counted participants.

Of the 2,007 participants reported by the small group of community partners, more than two-thirds were low-income (69%), 57% were at-risk youth, and about half were urban (53%) or a racial minority (52%) (see Figure 26). People with disabilities were almost unreached by the community partners for whom we have data and make up 3% of the participants. While the first estimate from Figure 25 gives us an idea of which communities were served overall, Figure 26 gives us a very general understanding of how many participants may have been present from each of those communities when *Explore Science—Zoom into Nano* activities were led. So, for example, we see that almost all (about 90%) of the programs reached low-income families (from Figure 25), but that low-income families only made up about 70% of the public who interacted with the activities (from Figure 26).

Figure 26: Estimated demographics of public participants by percentage.

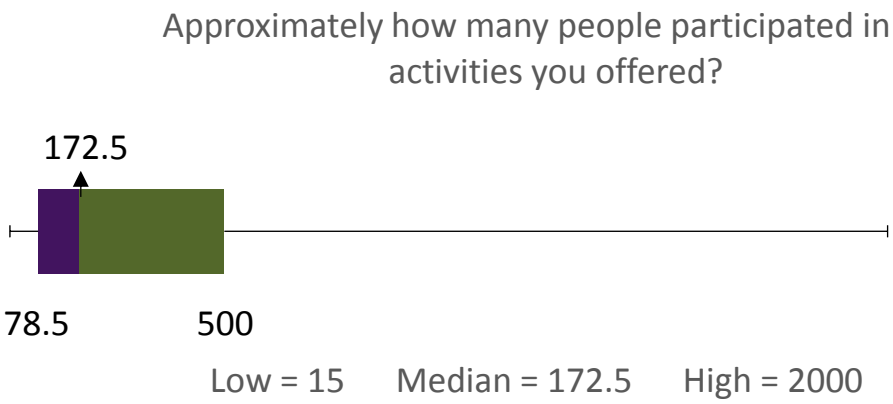


In order for the team to understand how many people may have been reached overall through the *Explore Science—Zoom into Nano* kits, we asked both museum and community partners to estimate how many people participated in their programming. We asked community partners, "About how many children, youth, and family members participated in this project as public participants? To the best of your ability, please provide the total number of people you reached." Most of these self-reported estimates were based on direct counts (90%) and ranged in size from 10 to 831, with a mean of 104 participants. When using estimates from the community partners, we felt it was acceptable to use the mean, because we have knowledge of how these estimates were generated and there were no obvious outliers. From these numbers, we can extrapolate that if each of the 100 community partner organizations had similar attendance, *at least* 10,000 members of the public would have been reached.

The final kit report also asked museum partners, "Approximately how many people participated in the activities you offered?" There were 68 responses that covered the

timespan between when kits were delivered to organizations and when our contacts completed the report (between February and October of 2016), but two were removed because the estimates were large outliers and may have been entered mistakenly. Unlike the community organization respondents, museum partners were not asked to describe how they gathered this data (to reduce burden on participants, we used data on the final report rather than adding survey questions). Responses ranged from 15 to 2000, with a mean of 365. A quarter of the estimates fell below 78.5, another 25% ranged from 78.5 to the median (172.5), another fourth of the responses ranged from 172.5 to 500 and the last 25% of responses ranged from 500 to 2000 (see Figure 27).

Figure 27: Distribution of estimates made by museum partners (*n*=66).



We used the total number of self-reported attendance from the 66 reporting institutions, plus an estimated attendance of about 170 for each of the non-reporting institutions to get an overall idea of how many people may have experienced MCP programming. We would offer the conservative estimate that the project reached between 10 and 30 thousand public participants between February and October, 2016.[16]

In the final kit report, museum partners were also asked if and how they planned to use their outreach kit materials in the future. All respondents (*n*=66) indicated that they were planning to use the kits in the coming year, and several talked about continuing to use the kit in ways that they had already begun (47%), such as integrating them into current on-going programming or upcoming events. Some went on to describe additional programming opportunities in which they were hoping to use the activities (24%), and another 26% offered ways they may continue to use the kits or specific dates when they would be used, but did not give a clear indication if kits activities would be used more, less, or about the same amount in the coming year. From these general data, it seems likely that the reach of the *Explore Science—Zoom into Nano* kit activities will continue to grow, but it is unclear what audiences it may reach in the coming year.

[16] The conservative estimate of 170 was used for each non-reporting institution because it was the median rounded down to the nearest ten, and medians are less responsive than means to large ranges in datasets (Rossner, 2006). As mentioned above, we did not ask museum partners how they came up with their estimates for public participants, so we have a lower level of confidence in their estimates.

4.2 The Public's Learning about and Engagement with Nano Concepts

The evaluation of the public's learning and engagement with the kit content relied on reflections from volunteers and staff who facilitated the activities (via the activity surveys), as well as museum and community partners' responses to the post surveys, to address the following question:

> *To what extent do the educational materials facilitate engagement and learning among public participants?*

It was important to the project team to create activities that were engaging, relevant, and educational for the public. To measure this, we asked museum and community partners, staff, and volunteers who facilitated the kits to rate the hands-on STEM activities on these three criteria (engagement, relevance, and education). Since some staff and volunteers responding to the activity survey may have been new to informal STEM settings and/or NISE Net, the evaluation team provided them with criteria to consider (detailed in the findings below) before giving each of the ratings. They were prompted to consider the criteria, make their rating, and then describe what led them to respond in that way, each time activities were used with the public. Museum and community partners who had personally facilitated the activities were asked to answer similar questions about their impressions of how the public reacted to the kit materials *overall* on the post survey. All of the respondents were able to draw on their immediate experiences with participants to respond to the activity survey, while museum and community partners may have been in a better position to understand the bigger picture of how kit materials were received by the public over the course of the project.

The evaluation team thought that there might be differences in the way facilitators responded to these questions, depending on if they were affiliated with a community organization or a museum. Respondents from community venues may have had more experience serving the target audiences of this project, and thus, may have had insights into how much participants were learning or finding engaging. They may also have had a different lens than museum and university counterparts for understanding how their audiences found relevance in informal science activities, that was more specific to the backgrounds, values, and lived experiences of their target audiences. Our sample for the activity survey, however, is mostly from museum-based facilitators (84%, n=118), and we saw very little difference in the way that community and museum-based facilitators responded to the activity surveys. Therefore, in the sections below, we compare results from our staff and volunteer facilitators with those from partners, because this is most useful for understanding how different stakeholders saw MCP programming impacting the public.

In this section, "facilitators" are the respondents to the activity survey, whose involvement with the project was activity facilitation, while "partners" are museum and community partner respondents to the post survey, who were more familiar with informal STEM settings, NISE Net, and the project as a whole, and who had experience facilitating activities as part of their overall NISE Net participation.

Findings for this section include:

4.2.1 The public was engaged in nano activities, though there is an opportunity to increase the activities' relevance to participants.

4.2.2 Almost all of the respondents thought that participants walked away learning something from the nano activities.

4.2.1 The public was engaged in nano activities, though there is an opportunity to increase the activities' relevance to participants.

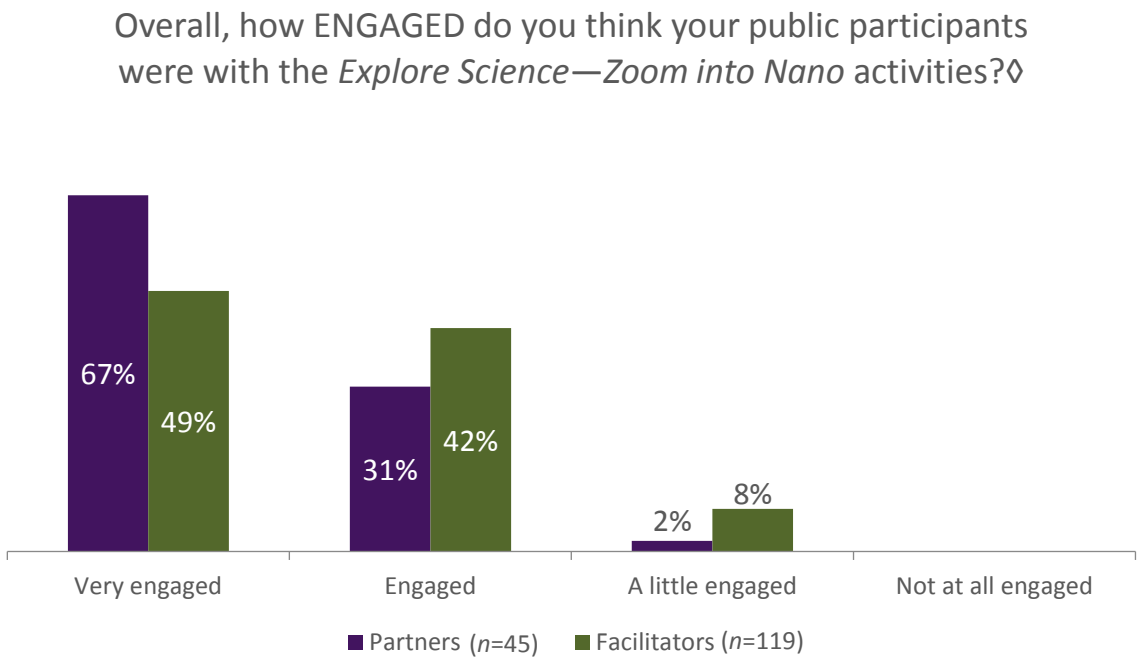
As stated above, we asked museum and community partners to reflect on how engaged public participants were overall, during the course of the project, on the post survey. We asked staff and volunteer facilitators to respond to a similar question about participant engagement on the activity survey, immediately after using the nano activities with the public.

More specifically, we asked partners on the post survey, "Overall, how engaged do you think your public participants were with the *Explore Science—Zoom into Nano* activities?" Since they were likely to be familiar with what might we might mean by being "engaged," we did not provide description about what engagement might include in order to avoid over-burdening them with text.

We asked staff and volunteer facilitators to reflect on how engaging they thought the *Explore Science—Zoom into Nano* activities were for participants and gave them three possible criteria to consider, including: a) how long participants used or discussed the activities, b) if participants appeared interested or excited while they used or discussed the activities, and c) if participants seemed interested in doing these activities again in the future.

Almost all of the facilitators (91%), as well as the museum and community partners (98%) indicated that the activities were engaging or very engaging for the public (see Figure 28). Partners, who may have had more experience with kit materials and the overall experiences of the public throughout the course of the project, gave higher ratings than the activity survey respondents. Over two-thirds of partners (69%) marked that public participants were very engaged by the materials, whereas about half (49%) of activity survey respondents gave this rating.

Figure 28: Ratings of activity engagement.



◊ This is how the question was phrased for partners on the post survey. In the activity survey, the question read, "Overall, how ENGAGING did you think today's '*Zoom into Nano' Explore Science* activities were for participants?'

When asked what they saw or heard that led to their engagement rating, facilitators and partners were most likely to share that public appeared interested (they looked excited or like they were having fun) (57% and 41%, respectively) and that they talked about the activity or asked related questions (44%, 50%) (see Table 4). Facilitators seemed more likely to bring up specific activities that attracted attention and talk about the length of time that participants spent at the activities, which is not surprising since they were reporting about their experiences with one event instead of reflecting about the bigger picture of participant engagement. Both facilitators and partners talked about the public wanting to return and do the activities again in the future or mentioned repeat visitation at a single event (13%, 25%). Partners were more likely to mention evidence of engagement that actually overlapped with the learning and relevance measures–about one in ten brought up relevance (13%) and several of the "other" comments from partners were about sharing evidence of learning from the activities. This may be because partners were considering participants' reactions to the kit in a more holistic way and were not given the clarifying criteria before giving each rating. Eleven facilitators gave examples of participants not being engaged with the activities; most often, they mentioned that their public had appeared to lose interest (4%).

Table 4: Examples of evidence for engagement from facilitators and partners.

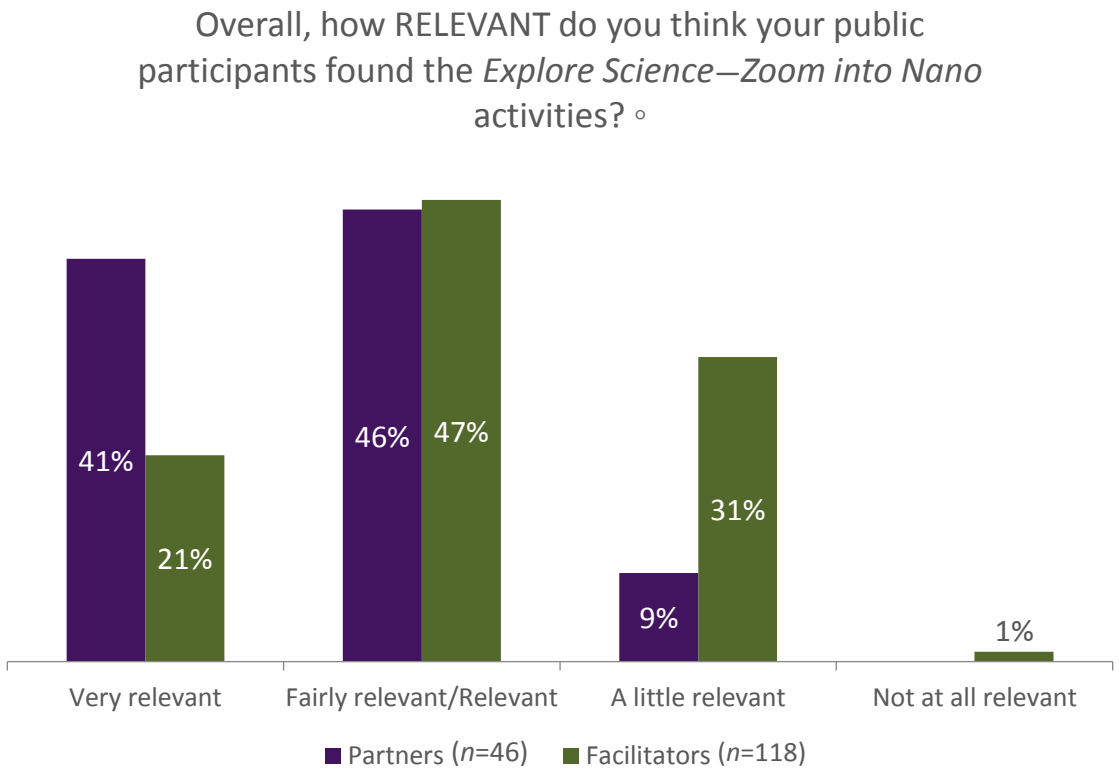
"What did you see or hear that lead to [your engagement rating]?"			
I saw/heard that the public…	**Facilitators (*n*=110)**	**Partners (*n*=32)**	**Example Quotations**
Appeared interested	57%	41%	"Kids were kept very busy and interacted in the activity."
Shared related comments or questions	44%	50%	"I heard lots of talk; lots of questions and kids explaining things to other kids."
Engaged with a specific activity	23%	0%	"Participants loved the UV Beads and Mystery Shapes!"
Had a long duration of engagement	18%	3%	"This is a K-1 afterschool program. Kids have a hard time staying on task. We did these two kits for an hour and all of the kids were engrossed in them."
Wanted to do an activity multiple times	13%	25%	"The kids couldn't wait to get to all the experiments and were really excited to do them over and over again."
Found the activity relevant	4%	13%	"The excitement of the students when they realized these materials are relevant to their lives and when they "got" the science."
Other	5%	19%	"The children were interested in doing the activities by themselves."

Another way of thinking about engagement is to consider how well the activities were connecting with something meaningful or relevant to the participants. We asked museum and community partners, "Overall, how relevant do you think your public participants found the *Explore Science—Zoom into Nano* activities?"

We also asked staff and volunteer facilitators from community organizations and museums to reflect on how relevant the activities were to the lives of their participants, and gave them three criteria to consider during their reflection, including: a) if participants talked about themselves in relation to the activities, b) if participants talked about their friends or communities while engaging in the activities, and c) if participants said things like, "This reminds me of…" or "I've seen this before."

Almost all of the partners (87%) indicated the activities were relevant or very relevant for participants, while a little over two thirds of the facilitators (68%) gave the same ratings (see Figure 29). Almost a third of the facilitators noted that the public found the activities to be only a little relevant.

Figure 29: Ratings of activities' relevance.



◦ This is how the question was phrased for partners on the post survey. In the activity survey, the question read, "Overall, how RELEVANT do you think today's 'Zoom into Nano' *Explore Science* activities were for participants?'

We asked facilitators and partners what they saw or heard that led to their relevance ratings. Almost all of the facilitators and about half of the partners shared how they thought the activities were relevant (88%, *n*=95; and 82%, *n*=22, respectively), and almost one fifth (17%, 18%) shared ways that activities were not relevant. The most frequently cited evidence for relevance given by both facilitators and partners was that participants were connecting the activities to something they had heard of or seen before (39%, 14%; see Table 5). Comments about participants finding personal connections or connections to daily life were coded as personally relevant (19%, 14%). Finally, connections to friends, family members and other people in the community came up a handful of times (8%, 5%), as well as participants' relating the activities to something they were doing at school (6%, but only mentioned by facilitators). The other categories for both facilitators and partners are so large because often, respondents did not provide evidence of how participants were finding relevance in the activities, and instead asserted that they were or offered evidence that they were engaged (looked interested) or that they had learned something as evidence of relevance.

Table 5: Examples of evidence for relevance and non-relevance from facilitators and partners.

"What did you see or hear that lead to [your relevance rating]?"			
I saw/heard that the public…	**Facilitators (*n*=95)**	**Partners (*n*=22)**	**Example Quotations**
Had seen or heard about it before	39%	14%	"Participants could see relationships between what they were observing and things in the world they were familiar with."
Found it personally relevant	19%	14%	"They were sharing stories [and] comments about how the activity related to their daily life in some way or made an observation that it was related."
Had difficulty finding relevance	17%	18%	"These participants found this activity too school-like and generally could not see how it related to them. Some of the vocal ones would rather have been doing other things."
Related it to friends, family, or community	8%	5%	"During You Decide, many participants were able to relate the technologies to their lives and needs. Two in particular had quite a discussion over whether a soldier would need high tech clothing or water filters more and their certainty was backed by experiences and family members in the military.∞"
Related it to school/ homeschool	6%	0%	"They did make connections between what they learned at school and what they were learning."
Other	29%	55%	"They all talked about the activities in a positive manner."

∞ Responses sometimes fell in more than one category, resulting in percentages that did not add up to 100%.

Several respondents articulated why they felt participants may *not* have found the activities relevant (n=20, representing 4 partner responses from the post survey and 16 facilitator responses from the activity survey). Some of their responses indicated that they felt some aspects of nano were difficult concepts, while others thought their participants were either too young or old for the activities to be relevant. Others thought that

facilitators were needed to help make these kinds of connections, implying that facilitators could have used more support or encouragement to do so.

Responses to "What did you see or hear that led to this answer?" that indicated participants did not find the activities to be relevant (n=20±).

± Responses from the activity survey are followed by "facilitator" in hard brackets, while responses from the post-survey are followed by "partner" in brackets.

Difficult to find relevance because nano is a difficult concept

- It seemed new to most and I did not get the feeling that it would stick in their minds long. [Partner]
- Hard for the kids to grasp how truly small nano is. [Facilitator]
- I did not hear them relate much to things they had not heard of or make many connections from the things they did hear of to Nano. Some of the scaling things they could relate to, but most small things they could not. [Facilitator]
- They had experience with balloons, not as much with UV Beads. Gummy shapes was a little advanced for explaining. [Facilitator]

Difficult to find relevance because of participant age

- I think the activities were relevant for kids under the age of 10. I had an older boy who was kind of bored by the activities. [Facilitator]
- Nanotechnology science tends to be a little outside our target age range which means our outreach public tends to be younger than recommended for nanotechnology activities. [Partner]
- Again, we had pretty young kiddos that weren't really making those connections other than some relating it to other things they've seen or done. [Facilitator]

Difficult to find relevance because facilitator needed more support to do so

- It was relevant, but I think more could have been brought to their attention that connects with their community. [Facilitator]
- (a) No.[The a) criteria was "if participants talked about themselves in relation to the activities".] (b) No. [The b) criteria was if participants talked about their friends or communities while engaging in the activities".] The kids weren't really encouraged to make specific connections to their lives, but maybe volunteers should be given more instruction. [Facilitator]
- Participants seemed to have trouble finding relevance with the stained glass and You Decide activities. With facilitators helping make connections they could make some for the activities. [Facilitator]

Other

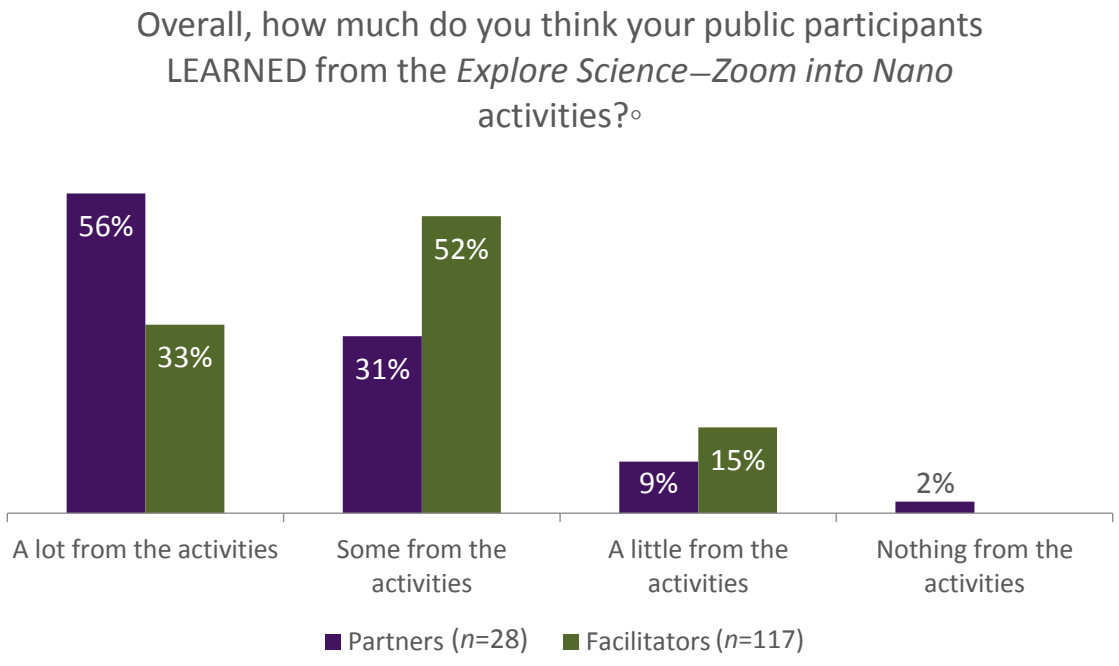
- Generally, it did not appear that the scientific concepts themselves were very applicable to the students' lives currently, but the hope is this will get students interested in nanoscience and science in general. [Facilitator]
- We know that they enjoyed and learned from the activities, but we aren't sure whether they would have any personal relevance to nano science. [Partner]
- Not a lot of self-driven exploration. [Facilitator]

- They recognized things in the cards and in the movie and talked about them. However, most of the really big and small things they had no experience with. [Facilitator]
- These participants found this activity too school-like and generally could not see how it related to them. Some of the vocal ones would rather have been doing other things. [Facilitator]
- Limited conversations regarding Nano but not uncommon for this population of students. They were absorbing all of the information, but were not able to relate. [Facilitator]
- They have seen stained glass before. [Facilitator]
- Kids wondered about the connections to their lives, but weren't certain how all of them applied to their situation. [Facilitator]
- I did not see the students make very many connections to previous knowledge. For most of our children, this is the first time doing something with any type of nanotechnology. [Facilitator]
- Sometimes the background science was missing for understanding the connection between nano and their lives, but overall, they were engaged and excited to learn something new. [Partner]

4.2.2 Almost all of the respondents thought that participants walked away learning something from the nano activities.

Finally, we asked museum and community partners, as well as staff and volunteer activity facilitators, to reflect on whether the activities led participants to learn anything. We asked facilitators to consider five criteria when giving their ratings, including if participants: a) seemed to have "ah-ha" moments, b) be aware of nano professions, c) asked questions of their own or showed investigating/exploring behaviors, d) tried something new in the activity to see what would happen, or e) talked about the effect nanotechnology might have on society. Almost all of the partners (87%) thought that the public learned a lot or some from the activities, while about two thirds of facilitators (68%) gave these ratings (see Figure 30). This may be due in part to partners' experiences in informal settings–partners may recognize learning in informal settings through conversations and observations, whereas some facilitators may be new to informal environments and assume that learning is only demonstrated through the explicit mastery of content knowledge, as assessed through a survey or a quiz. In fact, when asked to share what they saw or heard that led their ratings, a quarter of facilitators (26%, *n*=105) reflected that they heard participants talking about content or shared that they knew specific content. While this is an excellent indicator of learning, it may be that some facilitators are more likely to think of the absence of explicit talk related to content as evidence that participants are not learning. Partners thought that public participants learned more from the nano activities than did facilitators.

Figure 30: Ratings of activities' educational value.



◦ This is how the question was phrased for museum and community partners on the post survey. In the activity survey for people who led the activities, the question read, "Overall, how much do you think participants LEARNED from today's '*Zoom into Nano' Explore Science* activities?'

The most common source of evidence for learning was that participants were actively asking questions (31% of facilitators' responses, 29% of partners'), having visible 'ah-ha' moments (13% and 39%, respectively), or talking about the content (26% and 0%, respectively) (see Table 6). A handful of respondents shared that participants tried something new with their materials to see what would happen (13% and 4%, respectively). The other criteria were mentioned by between 14% and 3% of facilitators. Several comments were coded in the other category because they asserted that learning happened without providing an example, or because they shared what their specific approach was to leading the activities instead.

Table 6: Examples of evidence for learning from facilitators and partners.

"What did you see or hear that lead to [your learning rating]?"			
I saw/heard that the public…	**Facilitators (*n*=105)**	**Partners (*n*=28)**	**Example Quotations**
Asked questions	31%	29%	"Participants asked questions and appeared pleased to find out in-depth answers as to the "how" and "what" of the nano they were seeing."
Talked about content	26%	0%	"Many participants stated clearly that objects measured in nanometers are very small, but they can be so strong you can see and feel the force they produce."
Had an 'ah-ha' moment	13%	39%	"With the graphene kit there were several "ah-ha" moments. Also some of the participants were excited to try other drawings and patterns."
Tried something new to see what would happen	13%	4%	"They experimented with the beads and differing amounts of worm goo at Gummy Shapes to see the difference."
Other	40%	39%	"We tried to emphasize that nano means very small and that materials can change their behavior when they are that small."

V. Emergent Findings About Project Implementation

This findings section shares data from this developmental evaluation that illustrate the exploratory nature of this project. While the data and evaluation questions from the previous sections were planned at the start of the project, this section responds to questions that arose throughout the course of the project. In some cases, these data clarify questions to provide more data about the partners' implementation or to describe professionals' overall experiences, while in other cases the data are specifically designed to inform future efforts to promote collaboration between museums and community organizations.

Findings from this section include:

5.1.1 Overall, professionals reported that the most beneficial aspects of the project were the access to educational materials, developing their partnerships, reaching underrepresented audiences, and learning through professional development.

5.1.2 Both museum and community partners valued engaging underrepresented children and families around several aspects of STEM, and felt the project gave them the opportunity to do so.

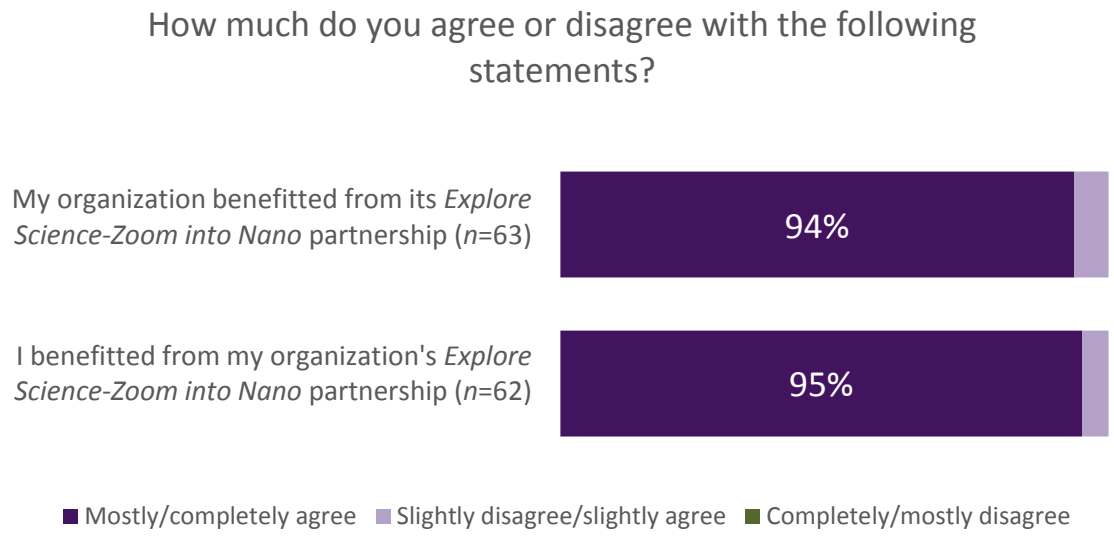
5.1.3 These projects were time intensive, and finding consistent staffing to manage project needs was a challenge.

5.1.4 Professionals are planning for future partnership between museums and community organizations, and feel funding and additional kits would support their future efforts to form partnerships between museums and community organizations.

5.1.1 Overall, professionals reported that the most beneficial aspects of the project were the access to educational materials, developing their partnerships, reaching underrepresented audiences, and learning through professional development.

As shown in Figure 31, professionals indicated that they benefitted from their participation in the partnership as individuals (95%), and that their organizations benefitted from the partnership (94%). Museum respondents (*n*=42, 100%) were more likely to 'mostly agree' or 'completely agree' that they had benefitted from their participation in the project than community organization respondents (*n*=20, 85%).[17] However, 100% of community organization respondents still indicated that they had benefitted to some extent.

Figure 31: Ratings of how beneficial the project was.



To better understand this data, an open-ended question asked about the top ways professionals benefitted from the project. Figure 32 shows a summary of this data. At least half of the respondents indicated that they had benefitted from receiving the educational materials in the kit (57%) and from the partnership they had developed (50%). Similar to the prior question, the list of options for this question was developed from inductive coding of a pre-survey open-response question. The data from that open-ended question are shown in the Appendix.

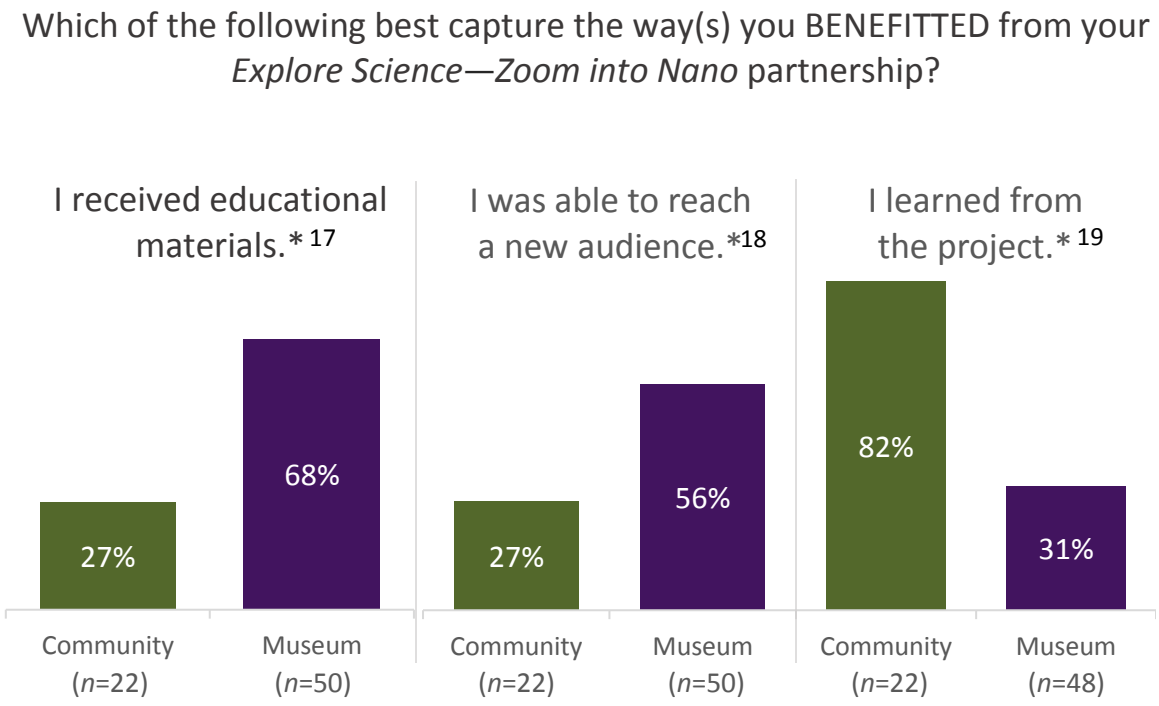
[17] $\chi 2$ (1, *n*=62) = 6.620, Fischer's Exact 2-tailed *p*=0.030

Figure 32: Ways professionals benefitted from the project.

There were three differences between museum professionals' responses to this question and the responses from community organization professionals. As shown in Figure 33, museum respondents were more likely to report that they had benefitted from receiving educational materials[18] and reaching a new audience,[19] while community organization respondents were more likely to indicate that they had learned from the project.[20]

[18] $\chi 2$ (1, n=72) = 10.263, Fischer's Exact 2-tailed p=0.002
[19] $\chi 2$ (1, n=72) = 5.559, Fischer's Exact 2-tailed p=0.039
[20] $\chi 2$ (1, n=70) = 15.481, Fischer's Exact 2-tailed p<0.001

Figure 33: Comparison of museum and community organization respondents' benefits from the project



The first difference can likely be explained because kits were shipped to the museums, and it was up to the museum to decide how to use and distribute those materials. As a result, this difference is likely due to access and should not be interpreted as saying the materials themselves were more beneficial to museums than community organizations. The second difference—that museums were more likely to benefit from reaching a new audience—is similarly understandable given the project's objective of reaching underrepresented audiences through partnerships with community organizations that already serve those audiences. The third difference—that professionals from community organizations were more likely to say learning was one of the greatest benefits of the project—is interesting. The question did not specify *what* was learned; future projects may wish to explore mutual professional learning between museums and community organizations to discover what types of learning they experience through this type of collaboration, and how that learning may be different between the organization types. This data should not be interpreted as saying that museums did not learn from the project. Rather, it was simply not reported as one of the most beneficial aspects of the project for museum professionals.

To further understand what was valuable about this type of work, evaluators asked an open-ended question on the post-survey for which respondents used their own words to describe what aspects of the *Explore Science—Zoom into Nano* project they had found most valuable. A summary of these responses is shown in Table 7, which lists the most common topics mentioned in these responses, the frequency with which those topics occurred, and an example quotation for each. These data show a similar pattern to the

close-ended question; the four top responses from that question (access to materials, developing a partnership, reaching underrepresented audiences, and professional learning) are four of the top five most frequent open-ended response types.

Table 7: Open-ended explanations of what was valuable about the project.

What aspects of the *Explore Science—Zoom into Nano* project, if any, did you find most valuable? (*n*=56)		
I valued…	**Percentage (Count)**	**Example quotation**
The hands-on activities	54% (30)	Museum respondent: "*It is extremely valuable for me to have a ready to go tabletop activity that can be used for outreach, camps, professional development, quick demos, etc. It all looks (and is) professional and attractive and comes with not only materials but signage and everything needed to explain it all.*"
Working with underrepresented audiences	29% (16)	Museum respondent: "*I think being able to reach children that don't normally have the opportunity to explore and experience science in such a hands-on fashion is great for all involved - the children, the community, myself, and even my students!*"
The professional development	29% (16)	Museum respondent: "*Having access to the provided teaching/training materials allowed me to deepen my understanding of the Science behind the activities.*"
Partnering with another organization	13% (7)	Museum respondent: "*Meeting new community members with similar goals and forming a new partnership.*"
Everything	4% (2)	Community organization respondent: "*All.*"
Other	2% (1)	Community organization respondent: "*Offering programs we do not have the expertise to provide, increasing the capacity to offer programs at different times of the day, the focus on the program being for families.*"

5.1.2 Both museum and community partners valued engaging underrepresented children and families around several aspects of STEM, and felt the project gave them the opportunity to do so.

We thought it necessary to explore whether both community and museum partners valued reaching underrepresented children and families around a variety of STEM-

related topics, since the missions of these organizations were not necessarily related to STEM-centered learning. We found that partners, regardless of affiliation, valued having an impact on participants in a variety of ways, including increasing their:

- Opportunities for real world STEM involvement
- Interest in STEM
- Confidence in STEM
- STEM knowledge and skills
- Problem solving skills
- Performance in STEM classes at school
- Likelihood of pursuing a STEM career

Over four fifths (82%-87%) of the partners from museums and community organizations valued the first five items "a great deal" (see Table 8). This may not be surprising, given that most organizations applying for *Explore Science—Zoom into Nano* kits may have been generally interested in increasing their participants' skills, confidence, excitement, involvement with, and knowledge about different content areas and they had an understanding from the application process that this was a STEM-focused kit. Two-thirds of the respondents, again regardless of museum or community organization affiliation, valued increasing performance in STEM classes at school through this project a great deal. This is worth noting, because informal educational settings where the outreach activities were implemented do not always aim to increase performance in formal educational settings. Finally, about half of the respondents valued increasing the likelihood of pursuing a STEM career a great deal. Again, this may actually reflect a relatively high rating, given that the nature of the programming where activities were implemented did not necessarily have a focus on developing youth's career pathways. There were no discernible changes in ratings from the pre and post surveys, indicating that partners came into the project with these values and did not experience any significant shifts throughout the course of their participation.

Many partners also reflected that their participation in *Explore Science—Zoom into Nano* gave them the opportunity to do these things with their participants (see Table 8). Over half of the partners offered that their participants had a lot or a great deal of opportunity for real world STEM involvement (72%), or increasing interest (68%), confidence (60%), or knowledge and skills (58%) in STEM.

Table 8: How much partners valued increasing different measures of underrepresented families' participation in STEM-related topics and how much opportunity they had to do these through the project.

How much do you value the following goals? Explore Science—Zoom into Nano gave me the opportunity to increase underrepresented children and families'…		
	Valued "a Great Deal" (*n*=136)	**Had "a Great Deal" or "A lot" of Opportunity to do this**
Opportunities for real world STEM involvement	87%	72% (*n*=69)
Interest in STEM	87%	68% (*n*=71)
Confidence in STEM	84%◦	60% (*n*=70)
STEM knowledge and skills	83%	58% (*n*=69)
Problem solving skills	82%	52% (*n*=67)
Performance in STEM classes in school	66%	31% (*n*=54)
Likelihood of pursuing a STEM career	51%	38% (*n*=64)

◦ *n*=135

One fifth of partners reported that underrepresented children or families exhibited awareness of STEM professions either a great deal or a lot (see Table 9). This is not surprising, given that many of the activities did not have explicit references to specific STEM professions. Twenty-eight percent of partners reported that participants demonstrated an understanding of the relationship between nano and society, which may be surprisingly high, since this is a relatively complex concept and not necessarily easy to facilitate in some settings. It should be noted that the activity survey data also suggested that the activity which was designed to address this, called You Decide, had a low reported rate of usage by facilitators; respondents to the activity survey used You Decide in 9% of their programming. Finally, partners reported that many more participants had ah-ha moments (46%) or engaged in STEM processes (43%) either a great deal or a lot. These experiences were expected to be prevalent and this suggests that the kits were on target for creating these opportunities for participants.

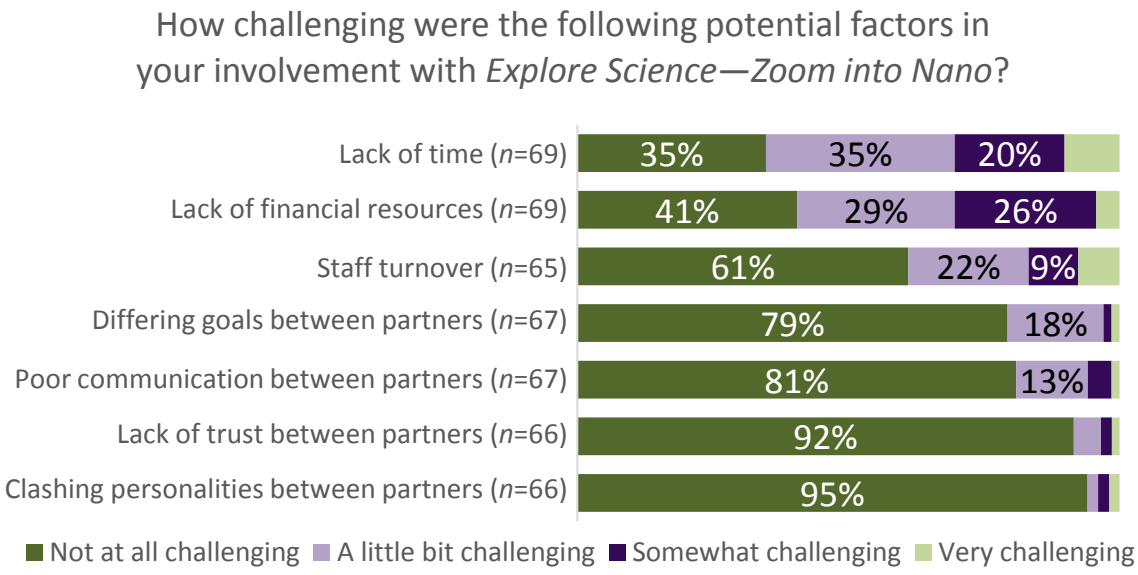
Table 9: Partners reported on their participants' opportunities to have different experiences through the activities.

During Explore Science—Zoom into Nano activities, underrepresented children or families…	
	… " a great deal" or "a lot".
Had ah-ha moments (*n*=68)	46%
Engaged in STEM processes (*n*=70)	43%
Demonstrated understanding of relationship between nano and society (*n*=60)	28%
Exhibited awareness of STEM professions (*n*=62)	18%

5.1.3 These projects were time intensive, and finding consistent staffing to manage project needs was a challenge.

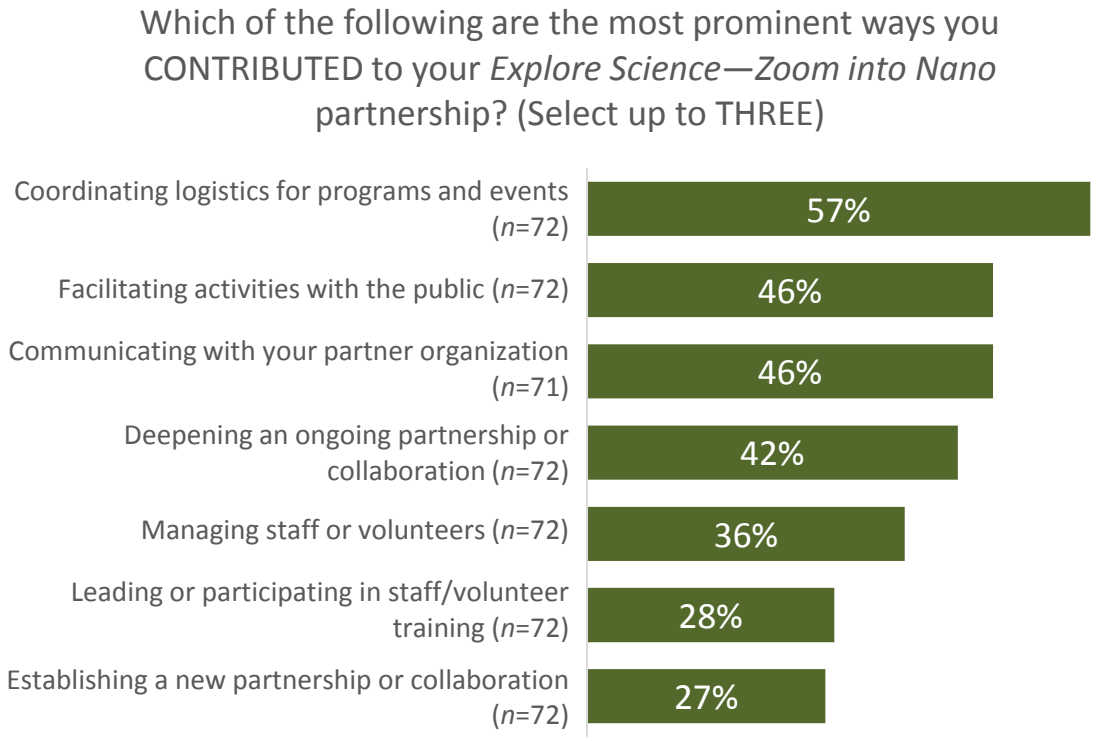
Because NISE Net is interested in future work that builds the Network's capacity to foster partnerships between museums and community organizations, it was important to understand not just the project's successes but also what challenges the sites faced. By understanding these challenges, NISE Net may be able to provide additional future resources that address the most pressing needs of the community. Figure 34 shows how challenging respondents perceived different aspects of the project.

Figure 34: Factors that were challenging during the project.



Two of the three most challenging aspects in the chart above have to do with staffing (lack of time and staff turnover), with lack of time being the most challenging. To further explore what types of tasks demanded time from professionals, evaluators asked respondents to select up to three close-ended options for the most prominent ways they supported the partnership. As shown in Figure 35, the most common contribution was coordinating logistics (57%), followed by facilitating activities with the public (46%) and communicating with the partner organization (46%). Museum respondents (*n*=50, 36%) were more likely than community organization respondents (*n*=22, 9%) to lead or participate in staff/volunteer training.[21] This finding ties into the use of NISE Net's professional development resources, as described in the section that begins on page 30.

Figure 35: Ways professionals contributed to their partnerships.[22]



[21] $\chi 2$ (1, *n*=72) = 5.514, Fischer's Exact 2-tailed *p*=0.023

[22] The list used for the close-ended question in the figure above was derived from inductive coding of an open-ended pre-survey question in which professionals were asked to describe in their own words the ways they anticipated that they would contribute to the project. These data are summarized in the Appendix.

5.1.4 Professionals feel funding and additional kits would support their future efforts to form partnerships between museums and community organizations.

On the final report, many kit recipients reported that they have plans to continue using project materials beyond the end of the reporting period. Knowing this, it is valuable to know what types of resources professionals feel would help them in their future efforts. In an open-ended question on the post-survey, respondents provided a range of suggested resources, with the most common being funding (36%), and additional kits (33%). Example quotations for each of these resources can be seen in Table 10. NISE Net has a history of providing both mini-grants and kits, so this finding suggests that the types of support the Network has provided in the past could continue to be valuable in the future.

Table 10: Resources that would help professionals engage underrepresented audiences in STEM.

What resources, if any, would help you or your organization engage underrepresented children, youth, and families in STEM? (*n*=45)		
The resource that would help my organization is…	**Percentage (Count)**	**Example quotation**
Funding	36% (16)	"A small budget to help offset travel costs and provide some food as a "lure."""
Additional kits	33% (15)	"Additional kits and new activities are always helpful."
Professional development	16% (7)	"Cultural competency training or the like would likely deepen our ability to engage audiences."
Outreach or marketing materials	9% (4)	"Develop marketing strategy/ outreach to engage public we don't reach via the usual formats"
Other	9% (4)	"More space to hold activities and programs."
Networking assistance	7% (3)	"Increased Peer Support within the larger science center community"
None	7% (3)	"Nothing further."

VI. Discussion

6.1 Overall messages from the findings

While the previous sections detailed findings by individual evaluation question, this section will step back to look at how the findings relate to one another across sections and what implications they might have on a broader scale. There are many connections to be drawn with these data, but we will explore the findings through three messages that transcend the individual sections:

6.1.1 Even though this project was shorter and smaller in scope than past NISE Net efforts, the data provide evidence of success in increasing partners' capacity to engage the public in ways that were engaging and educational for underserved audiences.

6.1.2 Professionals valued their participation in the project—especially the partnerships, access to educational materials and underserved audiences, and professional development—and have current and future plans to engage in similar work.

6.1.3 Opportunities for future work may arise from exploring differences between museums and community organizations—especially differences in learning styles, usage of products, benefits to the organizations, and approaches for finding relevance with public audiences.

6.1.1 Even though this project was shorter and smaller than past NISE Net efforts, the data provide evidence of success in increasing partners' capacity to engage the public in ways that were engaging and educational for underserved audiences.

This exploratory project was new territory for NISE Net, and there was a risk that at least some aspects would fail. The timeline was short, leaving evaluators wondering whether the project would produce quantitative changes between the pre- and post-surveys. Additionally, the budget of the project was smaller than the budget NISE Net had in the previous 10 years. This meant that the project team had to make difficult choices about what was most important, and many promising ideas were determined to be unfeasible given budget and timeline.

In spite of these challenges, the evaluation data demonstrate evidence of the project meeting goals and in some cases showing statistically significant changes between the pre- and post-surveys. As described in the value section,[23] professionals indicated that at the end of the project they were more likely to pursue future partnerships between museums and community organizations. Even though many respondents (especially museum respondents) had high confidence in explaining nano concepts at the start of the project, the learning section[24] details significant improvement in overall confidence, and professionals attribute that growth to their participation in the project. The product use section[25] and the practices section[26] describe how the project's materials and practices were used widely, although some were utilized more frequently than others. The public activities section[27] shares that the hands-on STEM activities were successful at creating educational, engaging, and relevant experiences for public audiences. Finally, but in no means least importantly, the public reach section[28] shows that the project succeeded in reaching a large number of public audiences who were from underrepresented populations.

All of this suggests that partnerships with community organizations are, as expected, a valuable way to reach audiences that are traditionally underserved by museums. NISE Net was not the first to pursue these types of partnerships, but the current study provides a systematic evaluation of 100 collaborations across the country and presents evidence of success at a large scale. This study can be seen as a type of replication, where a model of collaboration was proposed and the 100 sites all implemented it on their own terms. Despite notable diversity in implementation (the model allowed for everything from a single event to ongoing curriculum for a wide range of audiences), the data confirm hypotheses that these partnerships can successfully reach underrepresented audiences and can build professionals' capacity for this type of work.

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[23] See the section beginning on page 21.
[24] See the section beginning on page 25.
[25] See the section beginning on page 31.
[26] See the section beginning on page 40.
[27] See the section beginning on page 54.
[28] See the section beginning on page 48.

6.1.1 Professionals valued their participation in the project—especially the partnerships, access to educational materials and underserved audiences, and professional development—and have current and future plans to engage in similar work.

In addition to the project's success at a national and organizational level, a number of the findings make clear that individual professionals found the partnership between museums and community organizations to be beneficial, and that the interest in this type of partnership extends beyond the current project. For example, the emergent findings section[29] shared that 95% of respondents found the project personally beneficial, and they especially valued the hands-on activities, the partnership, the audiences they were able to serve, and the professional development that the project offered. The value section[30] built on this by sharing a more general finding that the professionals value not only this project but collaboration between museums and community organizations in general. This is supported by the fact that professionals have plans to pursue these partnerships in the future[31] and in many cases have already done so, either before or during the project.[32] On the pre-surveys, professionals already indicated that they valued this type of work to a high degree, a value that likely motivated them to apply for the kits.[33] This suggests that the project situated itself in an area that was—and continues to be—ripe for exploration due to its similarity to the work that is already being done and that professionals want to do in the future. Many professionals were already bought in to the idea that this work could be beneficial, and more than half had already begun to explore it, allowing this project to build off past experiences as well as introducing new professionals to this type of collaboration.[34]

6.1.3 Opportunities for future work may arise from exploring differences between museums and community organizations—especially differences in learning styles, usage of products, benefits to the organizations, and approaches for finding relevance with public audiences.

This report identifies a number of differences between museum and community organization professional respondents that may have implications for future work. For instance, community organization respondents were less likely than museum respondents to say they had been involved in staff training, but were more likely to report that learning from the project was one of the top ways they benefitted from the project.[35] Professional development has been a key component of NISE Net's work, so this finding merits thought. If the Network plans to continue working with community organizations, it would be valuable to explore the best modes of fostering learning for community

[29] See the section beginning on page 65.
[30] See the section beginning on page 21.
[31] See the sections beginning on pages 21 and 65.
[32] See the sections beginning on pages 21 and 40.
[33] See the section beginning on page 21.
[34] See the section beginning on page 40.
[35] See the section beginning on page 65.

organization professionals, as it may not be the same types of formal professional development that museums are used to.

Another difference between professionals was that museums had more use of, and benefitted more from, the kit materials.[36] These findings may be due to the fact that, as the main applicants for the kits, the museums may have been perceived as the kits' "owners." Perhaps connected to this finding, community organization respondents were less likely to report benefitting from the project. It should be noted that 85% of community organization respondents still 'mostly' or 'completely' agreed that they benefitted, but the difference between museums and community organizations deserves consideration. This project was intentionally set up with the museums as the mediators between NISE Net and the community organization partners. It seems that both museums and community organizations benefitted, but the benefit may not have been of equivalent scale.

One final difference was related to the public's experience. NISE Net has a strong track record of producing high-quality educational products for museum audiences. The data in this report showed that professionals viewed the kit activities as educational and engaging for underrepresented audiences, but that they were less relevant for the project's public audiences. Several respondents felt the activities were not appropriate for younger participants or struggled to be relevant because the concepts were too advanced. Others indicated that the facilitators may have needed more support to take advantage of local contexts and help elicit relevance for participants. MCP kit developers used input from national youth-serving organizations to assemble a kit for use with community organizations and underrepresented audiences, but given the timeframe of the project the kit team was only able to make slight packaging adjustments to existing activities rather than creating new activities. In the future, the team has expressed an interest in having additional involvement from professionals who reach underrepresented audiences and underrepresented members of the public themselves through a co-creation process. This type of process could be a valuable way of increasing the activities' relevance for underrepresented audiences.

6.2 Study limitations

While the evaluators worked hard to carry out as rigorous a study as possible, as is true of all evaluations there are a number of limitations which may have influenced the evaluation, as described below.

6.2.1 The criteria for inclusion in the project may have led to a biased sample.

All professionals who participated in this evaluation were part of an organization that voluntarily applied to be part of this project. This means that the organizations, and the professionals within them, likely already valued partnerships between museums and community organizations, and many had prior experience with this type of work.

[36] See the sections beginning on pages 31 and 65.

Additionally, all partnerships received a free kit of materials. This may have led to professionals feeling indebted, and could have contributed to them being more likely to report positive findings on the surveys. In many cases, the survey questions open themselves to social desirability bias; the "desired" responses are likely clear. Overall, this biased sample may have shifted findings in a positive direction.

6.2.2 In some cases, it was difficult to calculate an accurate response rate, leading to uncertainty about the representativeness of the sample.

A complete list of all professionals involved in the project was never available, so it was impossible to determine the response rate for the pre- and post-surveys in a way that was inclusive of all potential respondents. Instead, evaluators had access to the name of the main applicant from a museum and that applicant's main contact at her or his community organization partner. This generated a list of 200 people, but beyond that evaluators had to rely on names provided by those 200 people named on the application. If the main contact at a certain organization did not fill out a survey, evaluators would have no way of reaching out to other potential professionals from that organization.

For the activity survey, calculating response rate was even more challenging. The activity surveys could be filled out by as many professionals as facilitated activities. This challenge was similar to the pre- and post-surveys; we never knew exactly how many professionals facilitated activities, so we don't know what percentage of them completed the activity survey. The activity survey then had the added challenge that it could be filled out every day a facilitator led activities. Thus, a respondent at a site that led a 5-day camp with the activities could fill out the survey five times. Sites were not required to apprise NISE Net of their intended schedule, so we do not know how many total opportunities there were to complete the activity survey.

These challenges in calculating response rate lead to questions about how representative the data in this report are. While the data we received are meaningful in that they come from professionals who were involved in the project, we do not know whether they capture the diversity of perspectives that was present throughout the project, nor do we know whether the perspectives were proportional to the experiences of all professionals. This means that we might not have captured important views, and the frequencies at which we presented findings may not exactly match what the full eligible set of respondents would have reported.

6.2.3 Less data was received from community organization respondents than museum respondents.

As described above, we do not know exactly how many museum professionals and community organization professionals were involved in the project. However, we do know that only 33% of pre- and post-survey respondents (n=114) were from community organizations. This made it difficult in some cases to compare data between museum and community organization professionals. It also means that the data presented throughout the report may comparatively over-represent museum perspectives. This is especially notable because the community organization professionals are the ones who are newest in providing data for NISE Net evaluations. Many of these questions are similar to questions

on past NISE Net surveys, so the data in this report may be more similar to past reports than it would be if more community organization respondents were included. Evaluators posit that this familiarity actually contributed to the fact that more museum respondents completed the surveys; they were actively invested in the Network, identified as part of the Network, and were familiar with receiving NISE Net communications with requests to completing surveys and reports. In comparison, almost none of the local community organizations had ever been directly involved with the NISE Network before. Getting less data from the community organization respondents also led to small sample sizes in some cases when evaluators wanted to compare museum and community organization professionals. In some cases, this made statistical tests unfeasible, and in others the small sample sizes demand special caution when interpreting the results. Having additional data from this group would have made these findings more robust.

6.2.4 Response rates were inconsistent, and the team changed its approaches for recruitment and incentives.

As thanks for participation in the project and in appreciation of their time in responding to the survey, all main contacts received a $5.00 Amazon.com e-gift card with their pre- and post- survey invitation emails. These gift cards were theirs to keep regardless of whether a survey was submitted. During the pre-survey, all snowball sample respondents were entered into a drawing to win one of twenty $5.00 Amazon.com e-gift cards, while post-survey snowball sample respondents received a $5.00 Amazon.com e-gift card concurrent with their invitation email. To learn more about the incentive approach, see the Appendix.

As of January 3, 2017, a total of 491 Amazon.com gift cards have been distributed to survey invitees, of which 220 (45%) have been redeemed. The reasons for non-redemption have not been directly explored but may be related to the mis-categorization of gift card emails by automatic spam filters, confusion on the part of recipients regarding the "free" nature of these gift cards, and/or intentional delay in redemption by recipients until they are ready to make a purchase on Amazon.com. Whatever the reason, this low redemption percentage may well have implications for the response rate observed during the pre- and post-surveys. Past NISE Net evaluation efforts have included the use of physical gift cards as thank-you gifts for survey participation, and while administrative and logistical barriers rendered this impractical for the current study, it is possible that the incentive delivery method produced suboptimal results. To accommodate this, the evaluation team modified its approach to incentives prior to the post-survey and provided all post-survey participants (both main and non-main contacts) with an Amazon.com e-gift card in lieu of raffling off a set number of gift cards. While it is not possible to be certain of the effects of this decision, it is the team's hope that the resultant response rates were higher than they might otherwise have been; however, room for improvement clearly exists, and we encourage careful consideration of these dynamics when planning future data collection efforts.

6.2.5 The public impacts findings rely on secondary data about the public.

We relied on professionals' feedback to develop an understanding of how the kit materials were received by the public, so that the project could focus its resources on providing high

quality professional development and kit materials. This may have affected our data in several ways.

First, it is likely that many respondents had experience in informal education settings that may have made them skilled observers, able to interpret participant behavior. Most of these respondents have probably developed reasonable goals for participation in informal settings, understanding that learning and engagement can be indicated by a variety of factors (such as time spent at the activity, ways that materials are used, making personal connections to their experiences, et cetera). However, some facilitators may have had a different, potentially more content-oriented idea of learning and engagement (i.e., that learning is only demonstrated by actively quizzing participants and prompting them to respond with a pre-determined answer). Because we do not know the backgrounds of each facilitator, it is difficult to gauge their observational context.

Second, facilitators may be more critical of how public audiences engage with and learn from kit materials, since they may have experience leading several different kinds of activities in informal settings. Evaluations of informal programming often report high level ratings from participants—so much so that even a handful of less positive ratings from participants can indicate that the programming is less successful overall. However, facilitators develop relationships with the organizations for whom they volunteer or work, and may become more comfortable over time in giving more conservative ratings for engagement and learning.

Finally, what we may be missing by not hearing directly from participants are their personal stories of what was learned, what made the kits engaging or not, and how people were connecting the activities to their everyday lives. Professionals relied on their observations and interactions to come up with their reflections on the public's experience, but direct data collection with participants could have given the public an opportunity to share ideas or perspectives that they did not make explicit during their interactions with the kits. Also, by not surveying the public directly, we may have missed an opportunity to get more direct information on which audiences we were reaching through this project. While many of the community organizations' data were based on enrollment data and a close understanding of their participants, not giving participants an opportunity to self-select which specific audiences they identify with may have resulted in under-reporting the breadth of the reach of this project.

VII. Conclusions and Opportunities for Future Study

The data in this report demonstrate that professionals valued their participation in this project, and have interest in partnerships between museums and community organizations more broadly as well. Even though the project was relatively short in duration and included fewer partners than some past NISE Net efforts, there is notable evidence that this exploratory effort successfully raised partners' capacity to engage underserved audiences with nano content through local collaborative efforts. The data also offer some areas for future exploration arising from unexpected differences between museum and community organization professionals' learning styles and the benefits associated with patterns of material usage, as well as possible different approaches towards developing activities that are relevant for the public audiences served by these organizations.

In addition to programmatic possibilities for the future, the evaluators see several areas for future research or evaluation about this type of work. First, tracking partnerships over time would provide valuable information about the sustainability of this type of work. There is clearly interest in these partnerships, and many professionals indicate interest in future collaboration, but the data also identified a number of challenges to making this work possible. Longitudinal data collection, potentially including appreciative inquiry as a methodological framework to guide research or evaluation activities, could identify strategies that successful partnerships use to support the financial, staff, and other needs of an ongoing partnership. Perhaps just as valuable as successful strategies would be the identification of challenges that can be avoided. These strategies and pitfalls could then be shared with interested professionals who could use them in the future.

Another area for future research or evaluation work would be gathering additional qualitative data about the partnerships. Given the scope of this evaluation, interviews were not possible, but as in other NISE Net evaluations this type of data could lend richness and nuance to many of the numbers provided in this report. For instance, qualitative data would help us understand what and how community organization respondents learned from the project (these respondents were more likely than museum respondents to indicate that learning from the project was one of the top ways they benefitted, but the community organization professionals were less likely to be involved in staff training and were also underrepresented in the overall project dataset). Similar to the strategies described above, qualitative data would also help us understand the logistics of how sites made the collaboration work, and what types of facilitation and implementation strategies were most successful with different audiences in different settings, as well as what sites' individual needs are. Additionally, interviews would allow us to probe professionals so we could get a better picture of how many professionals were involved, what they did, and how often they offered activities—this would help us understand the overall representativeness of our sample.

We found the activity surveys to be a useful way of gathering secondary data about public participants, despite its drawbacks as described in the Limitations section. Maintaining a short survey experience, providing criteria for ratings questions, and collecting qualitative evidence about why ratings were given were crucial to our understanding of how the public were engaging with the nano activities. If we used this method again for future projects, we would want to strategize about how to shorten the lag time between when the

activities were used and when the survey was completed, as well as how to estimate a response rate for the surveys in order to gain an understanding of how representative they were of the facilitators' experiences.

Future research and evaluation could also gather data directly from members of the public. Again, the fast-paced and exploratory nature of the MCP project precluded this for the current study, but as described in the limitations section (see page 77), there are some drawbacks of having gathered second-hand data about the public through the professionals who serve them. Professionals may be able to interpret participant behavior in informal settings, but not being able to survey participants directly detracts from our ability to provide more reliable estimates about the breadth of the audiences reached by the project. It also makes it less likely that we will hear stories of impact or reflections from participants that are experienced quietly by the public and not shared explicitly with facilitators or partners. There may be interesting differences in how different audiences perceived and interacted with the materials that we could uncover through direct data collection with members of the public.

Overall, this project explored collaboration between museums and community organizations as a way to address an important need in the field: diversifying STEM education and participation to include members of the public who are underrepresented in STEM. NISE Net and its partner museums have done important work in developing valuable best-practices for informal STEM education, and this project has explored different ways of sharing those resources and knowledge with a related field that serves audiences which are often underserved by museums. The Network has already begun to plan for these next steps, including developing future project ideas to expand its work to reach underrepresented audiences through partnerships between museums and community organizations. The contents of this report can promote thought about these and other next steps in continuing to extend the reach of NISE Net, strengthen the capacity of informal STEM educators in different contexts, and bring high-quality STEM education to those who in many cases lack access to it.

VIII. References

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IX. Appendix

Appendix A: Pre-survey instrument

Introduction

Thank you for your willingness to complete this online survey! The purpose of this survey is to get feedback from professionals who are involved in the Museum & Community Partnerships project.

Please complete this survey by [Date].

How long will it take?

- The entire survey should take about 10 minutes to complete.
- The survey includes some questions about you and your expectations for the project.

Information about your participation:

- To take this survey, you must be 18 years of age or older.
- This survey is optional, and you can skip any questions or stop at any time.
- Your survey response will initially be linked to your e-mail address, but only trained research or evaluation staff will have access to this information.
- Your responses will remain confidential and disseminated only in non-identifiable and aggregate formats.
- The information you provide will be used to improve experiences for visitors who participate in the Museum & Community Partnerships project.

What's in it for you?
Upon completion of this survey, you will be entered into a raffle to win one of twenty $5 Amazon gift cards.

Thank you for your willingness to participate and your efforts to improve the Museum & Community Partnership project!

Please contact Katie Todd at ktodd@mos.org with any questions about the survey.

Terms

For the purposes of this survey, we will define the terms as indicated below.

Nano: Throughout the survey we will be using the abbreviation "nano" to represent "nanoscale science, engineering, and technology."

STEM: We will use the abbreviation "STEM" to signify the fields of Science, Technology, Engineering, and Mathematics.

Partnership: For this survey, we will define a "partnership" as a collaborative effort to work with others outside of your institution. This could include formal, ongoing activities and/or less formal, one-time events. *Explore Science* partnerships involve a museum and a community organization working together to use kit materials with public audiences.

Public: Throughout this survey, we will use the term "public" to stand for the children, youth, and families who participate in educational activities.

Underrepresented audience: For the purposes of this survey, we will use a broad understanding of an "underrepresented audience" based on several National Science Foundation documents about broadening participation and underrepresented minorities in STEM fields. We will consider an "underrepresented audience" to be children, youth, and families who represent one or more of the following:

- Racial or ethnic minority
- Girls
- Low socioeconomic status
- At-risk
- English as a Second Language
- Disabled or differently abled
- Geographically underserved (rural, inner city)
- Other underserved group, as defined locally

Community organization: This survey defines a "community organization" as an institution that provides youth-serving, community, or out-of-school time programs. Some of these organizations are local branches of a national network (e.g., Boys and Girls Clubs of America), whereas others are independent and based in local communities.

Museum: For this survey, we will refer to a "museum" as an informal learning institution such as a science center, science museum, children's museum, natural history museum, or a university doing outreach. This is the NISE Net partner who is the main recipient of the *Explore Science* kit.

Screening questions

1. ***Are you 18 years old or older?***
   - Yes
   - No [If no, terminate survey]

2. ***Are you affiliated with a museum or a community organization?***
   - Museum
   - Community organization
   - Other (please specify):

3. [All main contacts]: ***Are you the main contact for the Museum & Community Partnerships project at your organization?***
   - Yes
   - No

4. ***Do you plan to be involved in the Museum & Community Partnerships Explore Science program between now and September?*** This might include communicating virtually or attending in-person meetings with your partner, leading or participating in staff training, facilitating activities with the public, or other activities.
   - Yes
   - No [If no, terminate survey]

Value

5. ***Thinking beyond Explore Science, how much do you value the following goals in general?***

	I DON'T VALUE it at all	I value it A LITTLE	I value it A LOT	I value it a GREAT DEAL
Fostering a local partnership between a museum and a community organization.				
Engaging underrepresented children or families in STEM.				
Increasing underrepresented children or families' interest in STEM.				
Increasing underrepresented children or families' STEM knowledge and skills.				
Increasing underrepresented children or families' confidence in STEM.				
Improving underrepresented children's performance in STEM classes at school.				
Increasing the likelihood of underrepresented children pursuing a STEM career.				
Providing experiences for underrepresented children or families that foster the development of positive relationships.				
Offering underrepresented children or families meaningful opportunities for real-world STEM involvement.				
Increasing underrepresented children and families' problem-solving skills.				
Engaging underrepresented children or families in activities that have goals other than STEM education.				

6. [If respond 'a lot' or 'a great deal' to the last item]: ***When engaging underrepresented children or families, what goals outside of STEM education do you value?***

Partnerships

7. ***What, if anything, do you think you will <u>contribute</u> to your Explore Science partnership?*** This might include communicating virtually or attending in-person meetings with your partner, leading or participating in staff training, facilitating activities with the public, or other activities.

8. [All pre-surveys]: ***How, if at all, do you hope you will benefit from your Explore Science partnership?*** (Open response)

9. ***OTHER THAN your Explore Science partnership, have you been involved in a partnership between a museum and a community organization in the past 12 months?***
   - Yes
   - No

10. ***How concerned are you about the following potential challenges to your involvement with Explore Science?***

	Not at all Concerned	A Little Concerned	Somewhat Concerned	Very Concerned
Lack of time				
Lack of financial resources				
Poor communication between partners				
Differing goals between partners				
Lack of trust between partners				
Clashing personalities between partners				
Staff turnover				

Nano Content

Please rate the extent to which you agree or disagree with the following statements.

11. I feel confident in my ability to explain to another adult…

	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
The size of a nanometer.						
How nano-sized materials behave compared to macro-sized materials.						
How scientists work at the nanoscale.						
Examples of nano in nature.						
Innovations that are possible because of nanotechnology.						
Ways that nanotechnology improves existing products.						

Practices

12. I feel confident in my ability to…

	N/A	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
Engage underrepresented children or families.							
Engage the public in nano.							
Engage Spanish-speaking audiences							
Engage girls.							
Initiate a partnership between a museum and a community organization.							

Product Use

13. [Museum primary contacts]: ***Have you personally used any of the following planning resources as part of your Explore Science partnership?***

	Yes	No	Unsure
Profiles of national youth-serving organizations			
Collaboration Tips handout			
Sample email text for an invitation to collaborate			
Online Brown-Bag Workshop			
Video: Creating Successful Collaborations: Museum and Community Partnerships			

Closing Questions

14. ***Do you have any additional comments or questions you would like to share about Explore Science?***

New Contact Information

15. [If originally contacted as a main contact but indicated (s)he was not a main contact]: ***Do you know who the main contact for the Museum & Community Partnerships project at YOUR ORGANIZATION should be?***
    - Name:
    - Email:

16. [Main contacts]: ***Will any other professionals from YOUR ORGANIZATION be involved in the Museum & Community Partnerships project?***
    - Yes
    - No
    - Unsure

17. [If yes]: ***Please provide the names and email addresses of any other professionals from your organization who will be involved in the Museum & Community Partnership project.***

Name(s)	Email address(es)

18. [Main museum contacts]: ***Who should the main contact be for your COMMUNITY ORGANIZATION PARTNER?***
    - Organization:
    - Name:
    - Email:

Appendix B: Post-survey instrument

Introduction

Thank you for your willingness to complete this online survey! The purpose of this survey is to get feedback from professionals who are involved in the Museum & Community Partnerships *Explore Science—Zoom into Nano* project.

Please complete this survey by ***October 15***.

How long will it take?

- The entire survey should take about 20 minutes to complete.
- The survey includes some questions about you, and then some questions asking what you thought about the Museum & Community Partnerships project.

Information about your participation:

- To take this survey, you must be 18 years of age or older.
- This survey is optional, and you can skip any questions or stop at any time.
- Your survey responses will be anonymous.
- The information you provide will be used to understand the impacts of the Museum & Community Partnerships project.

What's in it for you?

- As thanks for your participation in this project, you should have received a $5 Amazon.com electronic gift card. This gift card is yours to keep regardless of your participation in the survey. However, we hope you complete the survey since your input is valuable in helping understand the impacts of the Museum & Community Partnerships project and improve future work

Thank you for your willingness to participate and your efforts to improve the Museum & Community Partnership project! Please contact Katie Todd at ktodd@mos.org with any questions about the survey.

Tooltips

This survey contains "tooltips". A tooltip is used to clarify certain words or expressions that you will find in the survey and you can use them by simply hovering your mouse over the hyperlinked text or clicking and the tooltip will appear. Try it now, hover **here.**

Definitions

For the purposes of this survey, we will define the following terms as indicated below.

- *Nano***:** Throughout the survey we will be using the abbreviation "nano" to represent "nanoscale science, engineering, and technology."
- *STEM***:** We will use the abbreviation "STEM" to signify the fields of Science, Technology, Engineering, and Mathematics.
- *Partnership***:** For this survey, we will define a "partnership" as a collaborative effort to work with others outside of your institution. This could include formal, ongoing activities and/or less formal, one-time events. *Explore Science—Zoom*

into Nano partnerships involve a museum and a community organization working together to use kit materials with public audiences.

- *Public*: Throughout this survey, we will use the term "public" to stand for the children, youth, and families and/or students who participate in educational activities.
- *Underrepresented audience*: For the purposes of this survey, we will use a broad understanding of an "underrepresented audience" based on several National Science Foundation documents about broadening participation and underrepresented minorities in STEM fields. Consider an "underrepresented audience" to be children, youth, and families who represent one or more of the following:
    - Hispanic or Latino/a
    - Racial minority
    - Female
    - Persons with disabilities
    - Low-income
    - Speak a language other than English at home
    - Geographically underserved (rural, inner city)
    - At-risk
    - Other under-served group, as defined locally
- *Museum*: For this survey, we will refer to a "museum" as the NISE Net partner who is the main recipient of the *Explore Science—Zoom into Nano* kit. This could be an informal learning institution such as a science center, science museum, children's museum, natural history museum, or a university doing outreach.
- *Community organization*: This survey defines a "community organization" as the organization that is partnering with the NISE Net kit recipient. This could be an institution that provides youth-serving, community, or out-of-school time programs. Some of these organizations are schools or local affiliates of a national network (e.g., Boys and Girls Clubs of America), whereas others are independent and based in local communities.
- *Relevance*: When thinking if the activities were relevant to the lives of participants, please consider if they talked about themselves or their communities in relation to the activities. Key phrases that visitors might say include, "This reminds me of…" or "I've seen this before…".
- *Engagement*: When thinking if the activities were engaging for participants, please consider about how long they used or talked about the activities, if they appeared interested or excited, or if they expressed interested in doing the activities again in the future.

Remember this information can also be found throughout the survey with the use of tooltips. To use the tooltips simply hover your mouse over the hyperlinked text or click and the tooltip will appear.

Screening

1. ***Are you 18 years old or older?****
   - Yes
   - No *[If no, terminate survey]*

2. ***Were YOU PERSONALLY involved in the Explore Science—Zoom into Nano program?*** This might include communicating virtually or attending in-person meetings with your partner organization, leading or participating in staff training, facilitating activities with the public, or other activities.
   - Yes
   - No *[If no, direct to closing questions]*

3. *[If yes to prior question]* ***Did YOU PERSONALLY facilitate Explore Science—Zoom into Nano activities with the public?***
   - Yes
   - No

Community demographics – ONLY for community organization main contacts

4. **Please briefly describe the overall impact the *Explore Science—Zoom into Nano* project has had on your organization.**

5. **About how many children, youth, and family members participated in this project as public participants?** *To the best of your ability, please provide the total number of people you reached. Please count each individual once, regardless of how many times he or she participated.*

6. **Please briefly explain how you estimated the number of participants.** *For example, do you keep daily attendance? Did you estimate based on your total enrollment or the capacity of your space?*

7. **Which of the following demographic categories apply to the children, youth, and family members who participated in Explore Science—Zoom into Nano activities?** (Please check all that apply) *See definitions at the bottom of this page*
   - Hispanic or Latino/a
   - Racial minority
   - Female
   - Persons with disabilities
   - Low-income
   - Speak a language other than English at home
   - Rural
   - Urban
   - At-risk youth
   - Other under-served audience(s) (please explain):

8. [Only for demographics selected above]: **About what percentage of the children, youth, and family members who participated in *Explore Science—Zoom into Nano* activities fit in the following demographic categories?** *If you have demographic data, please list this data below. Otherwise, make your best estimate or select 'I don't know.' Note that these factors are not mutually exclusive. The sum may add up to more than 100%.*

	Approximate percentage of participants (numerical text box)	I don't know (check box)
Hispanic or Latino/a	%	
Racial minority	%	
Female	%	
Persons with disabilities	%	
Low-income	%	
Speak a language other than English at home	%	
Rural	%	
Urban	%	
At-risk youth	%	
Other under-served audience (explain):	%	

9. [If provided demographic data]: **Please briefly explain how you came up with the demographic estimates in the table above.** *For example, do you have this data on the individual level? Did you estimate based on your total population?*

10. **Please provide the zip code where the programming took place:**

11. **Aside from this project, when would you guess MOST of the children, youth, and families who participated in this project last visited a museum?**

- Never
- Within the past three months
- 3-5 months ago

- 6 months to within the last year
- 1-2 years ago
- 2-5 years ago
- 5-10 years ago
- More than 10 years ago
- Not sure

Demographic terms – We recognize that demographic definitions vary across different communities and are often political and emotionally-charged. For the purposes of this survey, we have defined demographic factors as described below. These definitions are primarily based on the U.S. Census.

- *Hispanic or Latino/a***:** Persons of any race whose origin includes Spain or Spanish-speaking countries in Central or South America.
- *Racial minority***:** People whose racial identity includes a race other than White.
- *Female*: Persons who identifies her gender as female.
- *Persons with disabilities*: People who have a long-lasting physical, mental, or emotional condition.
- *Low-income*: Persons who are part of working families that earn less than twice the federal poverty line.
- *Speak a language other than English at home***:** Persons who speak a language other than English at home, either in addition to or in place of English.
- *Rural*: Any area not classified as urban by the U.S. Census Bureau.
- *Urban*: An area designated by the U.S. Census Bureau as being an urbanized area or urban cluster.
- *At-risk youth***:** Persons under the age of 18 who experience multiple risk factors that are correlated with academic and social success. Risk factors are defined locally but may include high crime in the community, poverty, pollution, drug use, truancy, single family households, etc.

Value

Please rate the extent to which you agree. Select "Not applicable to my job" if this opportunity is not relevant to your work.

12. Explore Science—Zoom into Nano gave me the opportunity to increase underrepresented children and families'…

	Not applicable to my job	Not at all	A Little	A Lot	A Great Deal
…interest in STEM					
…confidence in STEM.					
…STEM knowledge and skills.					
…performance in STEM classes at school.					
…likelihood of pursuing a STEM career.					

13. Explore Science—Zoom into Nano gave me the opportunity to…

	Not applicable to my job	Not at all	A Little	A Lot	A Great Deal
Foster local partnership between museums and community organizations.					
Engage underrepresented children, youth, and families in STEM.					
Increase underrepresented children and families' problem-solving skills.					
Offer underrepresented children or families meaningful opportunities for real-world STEM involvement.					

14. During Explore Science—Zoom into Nano activities, underrepresented children or families…

	I'm not sure	Never	A Little	A Lot	A Great Deal
Had "ah-ha" moments (excitement and discovery, etc.)					
Exhibited awareness of STEM professions.					
Engaged in STEM processes (investigation, experimentation, etc.).					
Demonstrated understanding of the relationship between nano and society (gave examples from their own lives; talked about risks, benefits, or implications).					

15. [ONLY for respondents who did NOT complete the pre-survey]: **BEFORE participating in Explore Science—Zoom into Nano, how much did you value the following goals in general?**

	I DIDN'T VALUE it at all	I valued it A LITTLE	I valued it A LOT	I valued it A GREAT DEAL
Fostering local partnership between museums and community organizations.				

Engaging underrepresented children, youth, and families in STEM.				

***16.* <u>AFTER</u> participating in *Explore Science—Zoom into Nano*, how much do <u>you</u> value the following goals in general?**

Increasing underrepresented children and families'...

	I DON'T VALUE it at all	I value it A LITTLE	I value it A LOT	I value it A GREAT DEAL
...interest in STEM				
...confidence in STEM.				
...STEM knowledge and skills.				
...performance in STEM classes at school.				
...likelihood of pursuing a STEM career.				

***17.* <u>AFTER</u> participating in Explore Science—Zoom into Nano, how much do <u>you</u> value the following goals in general?**

	I DON'T VALUE it at all	I value it A LITTLE	I value it A LOT	I value it A GREAT DEAL
Fostering local partnership between museums and community organizations.				
Engaging underrepresented children, youth, and families in STEM.				
Increasing underrepresented children and families' problem-solving skills.				
Offering underrepresented children or families meaningful opportunities for real-world STEM involvement.				

18. What are your other goals, if any, when engaging underrepresented children or families?

19. Thinking beyond Explore Science—Zoom into Nano, how much does <u>your organization</u> value the following opportunities in general?

Underrepresented children or families…

	Not applicable to my job	Not at all	A Little	A Lot	A Great Deal
… having "ah-ha" moments (excitement and discovery, etc.)					
… exhibiting awareness of STEM professions.					
… engaging in STEM processes (investigation, experimentation, etc.).					
…demonstrating understanding of the relationship between nano and society (gave examples from their own lives; talked about risks, benefits, or implications).					

Partnerships

20. How much do you agree or disagree with the following statements?

	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
Members of the public benefitted from my organization's *Explore Science* partnership.						
My organization benefitted from its *Explore Science* partnership.						
I benefitted from my organization's *Explore Science* partnership.						
I contributed to my organization's *Explore Science* partnership.						

21. [If slightly/mostly/completely agree with contribute statement above]: ***Which of the following are the most prominent ways you CONTRIBUTED to your Explore Science—Zoom into Nano partnership?*** *(Select up to THREE)* [Order randomized.]

- Leading or participating in staff/volunteer training
- Communicating with your partner organization (virtually or in-person)
- Facilitating activities with the public
- Coordinating logistics for Explore Science—Zoom into Nano programs and events (planning, scheduling, setup, etc.)
- Establishing a new partnership or collaboration
- Deepening ongoing partnership or collaboration
- Managing staff or volunteers
- I did not contribute
- Other (please explain):

22. [If slightly/mostly/completely agree with benefit statement above]: ***Which of the following best capture the way(s) you BENEFITTED from your Explore Science—Zoom into Nano partnership?*** *(Select up to THREE)*

- I developed professional skills
- I learned from the project
- I received educational materials
- I gained an understanding of the community's needs
- I developed a partnership with another organization
- I was able to reach a new audience
- I did not benefit
- Other (please explain):

23. What aspect(s) of the Explore Science—Zoom into Nano project, if any, did you find most valuable?

24. How has your participation in Explore Science—Zoom into Nano affected your likelihood to engage in future collaboration between a museum and a community organization?

- I am MUCH LESS LIKELY to engage in future collaboration between a museum and a community organization
- I am SLIGHTLY LESS LIKELY to engage in future collaboration between a museum and a community organization
- I am SLIGHTLY MORE LIKELY to engage in future collaboration between a museum and a community organization
- I am MUCH MORE LIKELY to engage in future collaboration between a museum and a community organization

25. How challenging were the following potential factors in your involvement with Explore Science—Zoom into Nano?

	Not sure	Not at all challenging	A Little bit challenging	Somewhat challenging	Very challenging
Lack of time					
Lack of financial resources					
Poor communication between partners					
Differing goals between partners					
Lack of trust between partners					
Clashing personalities between partners					
Staff turnover					
Other (please explain):					

26. What resources, if any, would help you or your organization engage underrepresented audiences in STEM?

Nano Content

27. I feel confident in my ability to explain to another adult…

	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
The size of a nanometer.						
How nano-sized materials behave compared to macro-sized materials.						
How scientists work at the nanoscale.						
Examples of nano in nature.						
Innovations that are possible because of nanotechnology.						
Ways that nanotechnology improves existing products.						

28. How much has Explore Science—Zoom into Nano affected your confidence in explaining to another adult…

	Not at all	Very Little	A Little	Somewhat	A Lot	A Great Deal
The size of a nanometer.						
How nano-sized materials behave compared to macro-sized materials.						
How scientists work at the nanoscale.						
Examples of nano in nature.						
Innovations that are possible because of nanotechnology.						
Ways that nanotechnology improves existing products.						

Practices

29. As a part of Explore Science—Zoom into Nano, have you done any of the following:

	Yes	No	Not applicable to my job
Engaged underrepresented children and families			
Engaged underrepresented children and families in nano			
Engaged Spanish-speaking audiences			
Engaged girls			
Initiated a partnership between a museum and a community organization			
Deepened an existing partnership between a museum and a community organization			

30. [ONLY for respondents who did NOT complete a pre-survey, table matches confidence question above]: ***<u>BEFORE</u> I PARTICIPATED IN EXPLORE SCIENCE—ZOOM INTO NANO, I felt confident in my ability to…***

	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
Engage underrepresented children and families						
Engage underrepresented children and families in nano						
Engage Spanish-speaking audiences						
Engage girls						
Initiate a partnership between a museum and a community organization						
Deepen an existing partnership between a museum and a community organization						

31. [If checked yes in question above]: ***AFTER PARTICIPATING IN EXPLORE SCIENCE—ZOOM INTO NANO, I feel confident in my ability to…***

	Completely Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Completely Agree
Engage underrepresented children and families						
Engage underrepresented children and families in nano						
Engage Spanish-speaking audiences						
Engage girls						
Initiate a partnership between a museum and a community organization						
Deepen an existing partnership between a museum and a community organization						

32. [If checked yes in question above]: ***You answered that you have done the following item(s). Did you use Explore Science—Zoom into Nano resources about this topic?***

	Yes	No
Engage underrepresented children and families		
Engage underrepresented children and families in nano		
Engage Spanish-speaking audiences		
Initiate a partnership between a museum and a community organization		
Deepen an existing partnership between a museum and a community organization		

33. [If checked no in question above]: ***You answered that you have not done the following item(s). Are you aware of Explore Science—Zoom into Nano resources about this topic?***

	Yes	No
Engage underrepresented children and families		
Engage underrepresented children and families in nano		
Engage Spanish-speaking audiences		
Initiate a partnership between a museum and a community organization		
Deepen an existing partnership between a museum and a community organization		

34. [All post-surveys, for practices respondent did]: ***Have you drawn on Explore Science—Zoom into Nano resources to do any of the following with content areas other than nano?***

	Yes	No	Not applicable to my job
Engage underrepresented children and families			
Engage Spanish-speaking audiences			
Initiate a partnership between a museum and a community organization			
Deepen a partnership between a museum and a community organization			

Product Use

35. Have YOU PERSONALLY used any of the following Explore Science—Zoom into Nano materials AS PART OF your Explore Science—Zoom into Nano partnership?

	Yes	No
Introductory videos (Nanotechnology: What's the Big Deal, Creating Successful Collaborations)		
Guides (Collaboration, Events, Out of School Programs, Promotion, Engaging the Public in Nano)		
PowerPoint slides (Intro to Nanotechnology, Science Outside of School, Activity Overview)		
Hands-on STEM activities		
Training videos for activities		
Spanish-language materials		

36. Have YOU PERSONALLY used any of the following educational materials NOT INCLUDED in the outreach kit AS PART OF your Explore Science—Zoom into Nano partnership?

	Yes	No
Activities and materials from past NanoDays kits		
Activities from the NISE Network website (nisenet.org)		
Other activities you and/or your collaborators created for this project		
Other (please explain):		

37.** [For materials that were not used; list populates from above]: **Why did you choose not to use the following materials?

	I did not know it existed	I thought it was confusing	I did not think it was appropriate for my work	I didn't have time	Other (please explain):
Introductory videos (Nanotechnology: What's the Big Deal, Creating Successful Collaborations)					
Guides (Collaboration, Events, Out of School Programs, Promotion, Engaging the Public in Nano)					
PowerPoint slides (Intro to Nanotechnology, Science Outside of School, Activity Overview)					
Hands-on STEM activities					
Training videos for activities					
Spanish-language materials					

38. Since January, which of the following, if any, have occurred? *Check all that apply.*

- I have shared *Explore Science—Zoom into Nano* educational materials with professionals in my own organization.
- I have shared *Explore Science—Zoom into Nano* educational materials with professionals in a different organization.
- I have adapted *Explore Science—Zoom into Nano* educational materials.
- I have started engaging new audiences in nano.
- I have started engaging the public in nano in a new way.
- None of these have occurred.
- Activity section—ONLY for those who facilitated hands-on activities

39. Overall, how ENGAGED do you think your public participants were with Explore Science—Zoom into Nano activities?

- I think our public participants were NOT AT ALL engaged
- I think our public participants were A LITTLE engaged
- I think our public participants were ENGAGED
- I think our public participants were VERY engaged
- I don't know

What did you see or hear that led to this answer?

40. Overall, how much do you think your public participants LEARNED from Explore Science—Zoom into Nano activities?

- I think our public participants learned NOTHING from *Explore Science—Zoom into Nano* activities.
- I think our public participants learned A LITTLE from *Explore Science—Zoom into Nano* activities
- I think our public participants learned SOME from *Explore Science—Zoom into Nano* activities
- I think our public participants learned A LOT from *Explore Science—Zoom into Nano* activities
- I don't know

What did you see or hear that led to this answer?

41. Overall, how RELEVANT do you think your public participants found Explore Science—Zoom into Nano activities?

- I think our public participants found *Explore Science—Zoom into Nano* activities to be NOT AT ALL relevant to their lives
- I think our public participants found *Explore Science—Zoom into Nano* activities to be A LITTLE relevant to their lives
- I think our public participants found *Explore Science—Zoom into Nano* activities to be FAIRLY relevant to their lives
- I think our public participants found *Explore Science—Zoom into Nano* activities to be VERY relevant to their lives
- I don't know

What did you see or hear that led to this answer?

Closing questions

42. Have any professionals or volunteers from YOUR ORGANIZATION been involved in the Explore Science—Zoom into Nano project?

- Yes
- No

43. [If yes]: ***Please provide the names and email addresses of any professionals or volunteers from YOUR ORGANIZATION who were involved in the Explore Science—Zoom into Nano project.***

Name(s)	Email address(es)

44. Do you have any additional comments or questions you would like to share about Explore Science—Zoom into Nano?

Appendix C: Activity survey instrument

Thank you for your willingness to complete this online survey! The purpose of this survey is to get feedback from people who facilitated "*Zoom into Nano" Explore Science* activities with the public.

Please complete this survey as soon as possible after facilitating *Explore Science* activities.

How long will it take?

- The entire survey should take about 5-10 minutes to complete.
- The survey includes some questions about how people interacted with the *Explore Science* activities, and then some questions asking what you thought about the activities.

Information about your participation:

- To take this survey, you must be 18 years of age or older.
- Your participation should not make you uncomfortable. This survey is optional, and you can skip any questions or stop at any time without any consequences.
- Your survey responses will be confidential and will not connect back to you.
- The information you provide will be used to improve experiences for visitors who participate in the Museum & Community Partnerships *Explore Science* project.
- As thanks for your participation, you will have the option of entering a raffle for the chance to win one of forty $5 Amazon gift cards at the end of the survey.
    - Each time you complete the survey and enter your email address, you earn a new "ticket" for a chance to win. There is no limit to the number of "tickets" you can earn, so please complete the survey after each event that includes "Zoom into Nano" *Explore Science* activities, so as increase your chances of winning! (Please note that each individual can win only the raffle once.)
    - Once again: Your survey answers will remain confidential. The email you provide will be kept separate from your answers, used only to inform you if you've won and deliver your electronic gift card to you.

Thank you for your willingness to participate and your efforts to improve The Museum & Community Partnerships project!

Please contact Zdanna King at zking@smm.org with any questions about the survey.

1. **Are you 18 years old or older?**
    - Yes
    - No [If no, terminate survey]

2. **What organization do you work/volunteer for?**

3. **When did you lead the activities?**

4. **At what organization did the *Explore Science* activities take place today?**

5. **Which "Zoom into Nano" *Explore Science* activities were out today?**
    - Measure Yourself
    - Get in Order
    - Sizing Things Down
    - Tiny Ruler
    - Gravity Fail
    - Smelly Balloons
    - Ready, Set, Fizz
    - UV Beads
    - Graphene
    - Mystery Shapes
    - Gummy Shapes
    - Picture Yourself as a Nanoscientist
    - Morphing Butterfly
    - Rainbow Film
    - Invisible Sunblock
    - I-Spy
    - Stained Glass Art
    - Mystery Sand
    - YouDecide!
    - What Would You Invent?

6. **About how long were the "Zoom into Nano" *Explore Science* activities out today?** (hours:minutes)

When assessing how ENGAGING today's "Zoom into Nano" Explore Science activities were for participants, please consider:

- *How long did participants use or discuss the activities?*
- *Did participants appear interested or excited while using or discussing the activities? How much so?*
- *Did participants seem interested in doing Explore Science activities again in the future?*

7. **Overall, how ENGAGING did you think today's "Zoom into Nano" *Explore Science* activities were for participants?**
    - NOT AT ALL engaging
    - A LITTLE engaging
    - ENGAGING
    - VERY engaging

    What did you see or hear that led to this answer?

When assessing whether the "Zoom into Nano" Explore Science Activities led participants to LEARN anything today, please consider:

- *Did participants exhibit any "Ah-Ha" moments while engaging with the activities?*
- *Did participants exhibit any awareness of nano professions?*
- *Did participants seem to be asking questions of their own (showing investigating/exploring behaviors)?*
- *Did participants ever try something new within the activity to "see what would happen" (experimenting)?*
- *Did participants talk about the effect nanotechnology might have on society in general?*

8. **Overall, how much do you think participants LEARNED from today's "Zoom into Nano" *Explore Science* activities?**
    - NOTHING
    - A LITTLE
    - SOME
    - A LOT

    What did you see or hear that led to this answer?

    When assessing whether or not "Zoom into Nano" Explore Science activities were RELEVANT to the lives of participants, please consider:
    - *Did participants talk about themselves in relation to the activities?*
    - *Did participants talk about their friends or communities while engaging with the activities?*
    - *Did participants say things like, "This reminds me of _____," "I've seen this before," etc.?*

9. **Overall, how RELEVANT do you think today's "Zoom into Nano" *Explore Science* activities were for participants?**
    - NOT AT ALL relevant
    - A LITTLE relevant
    - RELEVANT
    - VERY relevant

    What did you see or hear that led to this answer?

10. **Did you make changes to any of today's "Zoom into Nano" *Explore Science* activities?**
    - Yes
    - No

11. [If yes]: **What changes did you make? Why?**
12. **Is there anything else you'd like to say about today's *Explore Science* activities?**

Appendix D: Recruitment and incentive strategies

This appendix outlines the recruitment and incentive strategies for the three data collection methods employed in the course of this study. Where appropriate, each subsection below also outlines the differences in strategies between subsample groups (e.g., main and non-main contacts, museum and community organization contacts). Information regarding response rates is not included here, but can be found in the main body of this report.

A. Recruitment
   a) Pre-survey
      i) Main contact participants were recruited using registration contact information provided by *Explore Science* leadership. Recruitment consisted of a pre-invitation notification email, an initial invitation email, and two follow-up reminder emails. All emails included instructions on how to unsubscribe from future invitations if desired, and the invitation email and reminder emails each contained a link to the survey and information regarding the value of participation. Additionally, near the end of the two-week survey administration period, targeted reminder phone calls were made to main contacts from community organizations who had not yet submitted a pre-survey, as this group remained underrepresented in the responding sample.
      ii) Non-main contact participants were recruited through the use of a snowball sampling technique whereby main contacts provided names and email addresses of other personnel at their organizations who were planned to participate in the project. Recruitment consisted of an initial invitation email as well as two follow-up reminder emails, each containing a link to the survey, instructions on how to unsubscribe from future invitations if desired, and information regarding the value of participation.
   b) Post-survey
      i) Main contact participants were primarily recruited using registration contact information provided by *Explore Science* leadership, although this information was monitored and updated over the course of the project to ensure accuracy. Recruitment consisted of an initial invitation email as well as three follow-up reminder emails (one per week), each containing a link to the survey, instructions on how to unsubscribe from future reminders if desired, and information regarding the value of participation. Additionally, midway through the three-week survey administration period, targeted reminder phone calls were made to main contacts who had completed a pre-survey but had not yet submitted a post-survey.
      ii) Non-main contacts were invited to participate in the post-survey two weeks after main contacts. This delay was intended to accommodate the inclusion of

both existing non-main contacts who participated in the pre-survey and additional non-main contacts participants recruited through the use of a snowball sampling technique whereby main contacts provided names and email addresses of other personnel at their organizations who had participated in the project. Recruitment consisted of an initial invitation email as well as one follow-up reminder email; each contained a link to the survey and information regarding the value of participation, and the initial invitation email included instructions on how to unsubscribe from future reminders if desired.

c) Activity survey
   i) All organizations received an *Explore Science—Zoom into Nano* physical kit that included information regarding the activity survey purpose and process, with all activity facilitators (regardless of position within the organization or main/non-main contact status) encouraged to complete a survey after each event. Semi-targeted reminder emails were sent to organizational main contacts as appropriate on the basis of the originally estimated timeframes for activity delivery provided through the pre-survey.

B. Incentives
   a) Pre-survey
      i) All main contacts received a $5.00 Amazon.com e-gift card concurrent with their invitation to participate in the pre-survey. These gift cards were not contingent upon survey participation but were presented as preemptive thank-you gifts for main contacts' support of the project's evaluation activities.
      ii) Non-main contacts who completed the pre-survey were entered into a raffle to win one of twenty $5.00 Amazon.com e-gift cards. Raffle winners were notified and received their e-gift cards in March 2016, approximately one week after the pre-survey was closed.
   b) Post-survey
      i) In order to maximize response rate, rather than conduct a post-survey raffle for non-main contacts, all contacts (main and non-main alike) received a $5.00 Amazon.com e-gift card concurrent with their invitation to participate in the pre-survey; the timing of incentive delivery was staggered as additional non-main contact information was received through main contact survey responses. These gift cards were not contingent upon survey participation but were presented as preemptive thank-you gifts for contacts' support of the project's evaluation activities.
   c) Activity survey
      i) All activity survey respondents had the option of entering a raffle for one of forty $5 Amazon.com e-gift cards. The activity survey could be completed multiple times by the same organization and/or individual in the event that a

site hosted events featuring *Explore Science—Zoom into Nano* activities multiple times during the project period. With this in mind, participants could accrue multiple raffle "entries" (one per completed survey), but each participant was only eligible to win one e-gift card regardless of the number of entries they had accrued; in other words, multiple entries increased an individual's odds of winning but did not increase the number of prizes it was possible for that individual to win.

Appendix E: Additional data

The following open-ended pre-survey question was used to generate the close-ended list used in the multiple-choice post-survey question described in the main report.

How, if at all, do you hope you will BENEFIT from your *Explore Science* partnership? (*n*=127)		
Code	**Percentage (Count)**	**Example quotation**
I will benefit from partnering with another organization.	42% (53)	"As a jump start for a long-term relationship with our new community partner."
I will benefit from reaching a new or underserved audience.	24% (30)	"Strengthening community engagement with children and families who may not otherwise have had the opportunity to engage with the Museum."
I will benefit by learning from the project.	20% (26)	"Every year I learn more about Nano science, so I'm hoping to continue that trend."
I will benefit because the public will benefit.	18% (23)	"Getting kids interested in science."
I will benefit from the kit materials.	17% (22)	"Unique materials, concise and useful training materials and all inclusive kits."
I will benefit by developing professional skills.	15% (19)	"Great professional development experience."
I will benefit because my organization will benefit.	14% (18)	"Increasing stature of the Adventure Club through association with science programming."
I will benefit because it will be rewarding or fun.	3% (4)	"It will be fun and rewarding!"
Other	2% (2)	"To teach younger children to give back is so important and such a positive thing."

The following open-ended pre-survey question was used to generate the close-ended list used in the multiple-choice post-survey question described in the main report.

What, if anything, do you think you will CONTRIBUTE to your *Explore Science* partnership? (*n*=128)		
Code	**Percentage (Count)**	**Example quotation**
I will contribute by leading or participating in staff or volunteer training.	48% (62)	"We plan to do joint training for all volunteers, to introduce mentors who the students can identify with, and to provide quality professional teaching using inquiry based methods."
I will contribute by facilitating activities with the public.	44% (56)	"I will be facilitating activities with the public."
I will contribute by communicating with my partner.	43% (55)	"Communication with the museum and their staff."
I will contribute by coordinating logistics for programs and events.	29% (37)	"Facilitating scheduling of programs."
I will contribute by establishing or deepening a partnership.	20% (26)	"Reach out to other community partners to help get them engaged."
I will contribute by managing staff or volunteers.	9% (11)	"I will supervise our facilitators, answering questions and helping them understand appropriate ways to interact with children."
I will contribute by providing expertise or enthusiasm.	7% (9)	"I could contribute expertise in STEM curriculum and activities."
I will contribute by providing resources.	5% (7)	"Funding via tuition and grants."
Other	4% (5)	"Willingness to try ideas and help others."