Summative Evaluation:

Comparative Case Studies of Implementation at Five Sites

Conducted for
Pacific Science Center
Seattle, Washington

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Executive Summary

Portal to the Public (PoP) was a three-year project funded by the National Science Foundation (NSF) in 2007. It was one of several efforts to develop and test approaches to increase public awareness, understanding, and engagement with current science and technology. The developers described the project as follows:

> *Portal to the Public is a proven, scalable guiding framework for Informal Science Educators (ISE) to engage scientists and public audiences in face-to-face interactions that promote appreciation and understanding of current scientific research and its application (Pacific Science Center, 2010).*

The PoP approach had two important characteristics that set it apart from other efforts being developed and offered during this time: PoP (1) focused exclusively on face-to-face interactions between scientists[1] (SCI) and general public visitors (GPV); and (2) included professional development for the scientists interacting with the public.

The project began in July 2007 and included the development and testing of a guiding framework, materials, and approaches by three collaborating informal science education institutions. The three institutions that developed the approach contrast in size and are located in different geographic areas. Collaborating partner (CP) museums included the Pacific Science Center (PSC) in Seattle, Washington; Explora in Albuquerque, New Mexico; and North Museum of Science and Natural History in Lancaster, Pennsylvania. PSC is a large museum, Explora is a medium-sized museum, and North Museum is a small museum. The fourth collaborating partner was the Institute for Learning Innovation (ILI). ILI conducted a formative evaluation with the three collaborating partners during the initial development and testing of programming. Near the end of the project, ILI conducted a research study to determine the value of the PoP approach for scientist–visitor interactions at these three sites (Sickler, Foutz, Ong, Storksdieck, & Kisiel, 2011).

The collaborating museums decided against developing a single model for replication. Instead, they developed a guiding framework to support development of efforts that match the local context. In addition, the museums developed a *Portal to the Public Dissemination Manual* for other ISE institutions interested in implementing the approach. The manual included implementation areas that institutions need to consider in using the approach (i.e., Conceptual Planning, Partnership and Relationship Building, Professional Development for Scientists, and Public Programs). In addition, the collaborating partners developed a catalog of professional development activities that ISE institutions could use with scientists. At the project's midpoint, the PoP approach and drafts of the guiding framework and materials were disseminated to and tested at five user museums. The model and materials tested by the five user museums were drafts, not the final versions available at the end of project. Descriptions of the approach and materials cited in this report are the prototype versions upon which the five user-group museums

[1] The term "scientists" refers to science-based professionals, including research scientists, engineers, physicians, and others for whom science is a primary focus of their work. The term "science-based professionals" was used by the members of the PoP Team at the three collaborating institutions during the last two years of the project. The term "scientists" is used in this report because it is less awkward in narrative.

based their implementations. Materials used by the implementing museums included an initial draft of *Portal to the Public Dissemination Manual* (Pacific Science Center, 2009A) and the *Portal to the Public Professional Development Elements Catalog* (Pacific Science Center, 2009B). The implementation at the five institutions began at a Dissemination Workshop in Seattle in June 2009 and ended March 31, 2010.

The purpose of this summative evaluation was to evaluate the PoP dissemination strategy, guiding framework, materials, and approaches in supporting effective implementation of the program at five user museums. The Principal Investigator (PI) and Co-Principal Investigators (Co-PIs) requested this summative evaluation approach to avoid repeated requests for both research and evaluation responses from ISE and GPV participants at the three collaborating partner sites. The research study conducted by ILI in Year 3 of the project focused on the value of the PoP approach at those three sites (Sickler, Foutz, Ong, Storksdieck, & Kisiel, 2011). Providing findings about the applicability of the PoP approach beyond the three collaborating partner sites appeared a way to provide a greater understanding about usability of the guiding framework, materials, and approaches developed in the PoP project.

Findings in this report cover the range of adaptations among the five implementing institutions and identify factors that appeared to influence the effectiveness of implementation. The five implementing museums were:

- Museum of Life and Science (MLS) in Durham, North Carolina
- Adventure Science Center (ASC) in Nashville, Tennessee
- Discovery Center of Springfield (DCS) in Springfield, Missouri
- Discovery Center Museum (DCM) in Rockford, Illinois
- Explorit Science Center (ESC) in Davis, California

Using the number of full-time staff members and total attendance at each of these five museums and comparing them to percentiles at 119 institutions surveyed by the Association of Science-Technology Centers (Association of Science-Technology Centers, 2010), three of the five user-group institutions could be classified as small to very small (DCM, DCS, and ESC). The other two institutions, ASC and MLS, could be classified as medium to large.

Design and Methodology

Pacific Science Center contracted with Tisdal Consulting to conduct the summative evaluation. The study had three overarching questions:

- To what extent and in what ways were the PoP guiding framework, materials, and approaches implemented and adopted at the five sites?
- What factors affected implementation and adoption?
- To what extent and in what ways was the PoP approach effective in:
    - Building partnerships with scientists and science-based organizations?
    - Providing professional development to scientists?
    - Communicating current science to museum visitors?

The overall design of the summative evaluation was a comparative case study (Guba & Lincoln, 1989; Lincoln & Guba, 1985; Miles & Huberman, 1985; and Stake, 1995). Data were collected across five implementing sites.

Respondents to evaluation questions were members of the three target audiences of the PoP approach across the five implementation sites: informal science educators (*N* = 13), scientists (*N* = 38), and general public visiting groups (*N* = 16). Informal science educators were members of the PoP Teams at each location. The scientists and ISE staff members are population samples, but these populations were limited to the number of scientists and staff that the evaluation liaisons included in the study. General public visiting groups were purposively sampled (Miles & Huberman, 1985) at public programs attended by evaluators. Almost all general public visitors at all locations participated in programs in groups that included both adults and children. Respondents included 16 groups of general public visitors, with a total of 28 adults and 41 children.

Data collection began in August 2009 after final Institutional Review Board (IRB) approval and ended June 1, 2010. Methods included paper and online surveys, in-depth interviews, and naturalistic observations. Findings and conclusions were developed by identifying themes and patterns across cases through the constant comparative method (Lincoln & Guba, 1985, p. 339). The constant comparative method is discussed in the Methodology section of the report.

Summary of Findings

In this section, findings for the ISE audience are organized around the processes in the guiding framework (see graphic of guiding framework on page 5). One area in the guiding framework, Conceptual Planning, is included for the purpose of this study under a term describing a broader process, Preparation. This broader category includes decisions made at each institution related to selecting members of the local PoP Team. Findings related to these four implementation processes are followed by findings related to the two additional audiences: scientists and general public visitors. Findings about impact for scientists and general public visitors are organized around project-wide impact statements. Since all findings are based on qualitative data from multiple sources and multiple perspectives, terms such as most, many, several, some, and few are used to describe the breadth of impact rather than specific percentages or numbers that one would expect in a quantitative evaluation study.

Preparation

- Characteristics that appeared to make implementation less time-intensive and decision-making more streamlined include the following:
    - Previous experience in conducting professional development.
    - Previous experience organizing and offering public programs.
    - Higher levels of previous experience and ongoing relationships with scientists and science based-organizations.
- The Dissemination Workshop, the *Portal to the Public Dissemination Manual* (Pacific Science Center, 2009A), and the *Portal to the Public Professional Development Elements Catalog* (Pacific Science Center, 2009B), were perceived as highly useful in preparing ISE institutions for the implementations.
- Not all PoP Team members at each site attended the Dissemination Workshop. PoP Team members at each implementing site who had attended the Dissemination Workshop more clearly understood the overall purpose of the PoP approach and reported fewer challenges selecting and adapting professional development activities than those PoP Team members who did not attend the workshop.

- The *Conceptual Planning Worksheet* provided at the Dissemination Workshop offered a way for institutions to survey the landscape for implementation and to brainstorm possibilities for scientist recruitment, professional development, and public programs. Informal science educators at the five user museums cited this process as highly valuable. As the implementations unfolded, some strategies and tactics described in the plan did not always work as expected (e.g., phone calls and emails to local corporations did not produce scientists interested in participating in the program), and alternative methods had to be tried. Some initial strategies and tactics not working resulted in substantial differences between the planned and the actual implementations—that is, there were substantial differences between the *Conceptual Planning Worksheet*s submitted by some sites (i.e., DCM, ESC, and MLS) and the actual implementation carried out.
- The *Conceptual Planning Worksheet* lacked processes to help user museums anticipate and respond to challenges and obstacles encountered in implementation. Examples of challenges and obstacles included the adding of responsibilities to already heavy staff workloads, institutional politics, and economic conditions in the institution or the community. Planning that anticipated the need to overcome challenges could make implementations smoother and less time-intensive.

Partnership and Relationship Building

- Recruitment of scientists was a time-consuming process at all sites. This aspect of implementation was slower and took more time than most sites had anticipated, thus delaying the implementation of professional development and public programs from original timelines set forth in the *Conceptual Planning Worksheet*.
- Fairly similar tactics were used to recruit scientists at ASC, DCM, DCS, and ESC, with scientists being asked for similar commitments to both professional development and participation in new programs. These PoP Teams sent emails, made telephone calls, and developed flyers to send to science research organizations. These methods, while time-consuming, appeared productive in recruiting reasonable numbers at ASC, DCS, and ESC. The economic conditions in the community made these tactics less effective at DCM.
- The nature and extent of commitment asked of scientists varied among programs, ranging from 32 hours for medical students at DCM (required as part of the medical school curriculum) to an optional 1.75 hours at MLS. Closely tying the professional development to the opportunity to participate in a new public program appeared to make the value of the professional development experience more apparent to scientists. At MLS, professional development was added to an ongoing program, *NanoDays.* For MLS's scientists, some of whom had participated in *NanoDays* in previous years, professional development may have appeared an additional commitment of time for which they did not see a need. Therefore, some chose not to participate in the professional development (PD) workshop.
- For individual scientists across sites (N = 38), the most frequently cited motivation was the opportunity to *Communicate work and raise public awareness of science* (36.8%) and to *Encourage young people to enter science, technology, engineering, and math* (*STEM) fields* (21.1%).
- In contrast, the most frequently reported anticipated benefit by scientists in the program was to *Develop and improve communication skills* (65.8%).

Professional Development

- The implementing sites offered a range of PD experiences in terms of number of workshops and total time commitment for scientists.
    - Three sites (ASC, ESC, and MLS) offered one professional development workshop (ranging from 1.75 to 8.5 hours in length), with ongoing support at flexible time schedules for the scientists.
    - At DCS, four half-day workshops were offered once a month beginning in October 2009, leading to a series of small programs beginning in March. This timing appeared to cause some attrition (decreased scientist attendance) as the professional development continued.
    - At DCM, medical students committed to the program as part of their medical school curriculum with a total 36-hour commitment. Medical students attended two structured professional development workshops, observed afterschool programs, watched exhibit prototyping, staffed ongoing public programs, and worked with museum staff to develop their materials.
- Professional development at all sites was clearly shaped by the Dissemination Workshop, *Dissemination Manual*, and *Professional Development Elements Catalog* (Pacific Science Center, 2009). The catalog had 22 professional development activities (referred to as "elements" by the program developers). Across all 5 sites, 18 different PD elements were used in PD workshops for scientists. Four of the sites used the same 4 PD elements that the Dissemination Workshop prominently featured.

Public Programs

- Across the five sites, public program size ranged widely. Decisions were based on size of available space and institutional programming strategies. ASC offered a large-event program, with all scientists who had attended the professional development workshop presenting on the same day. DCM scheduled a smaller event in an exhibition gallery. DCS and ESC public programs featured individual or pairs of scientists. At MLS, scientists presented in a large annual event that was part of a national program.
- The five sites implemented a narrow range of public program formats. All five sites offered public programs with table-top materials-based activities. None of the implementations included lecture or other face-to-face formats sometimes used at science museums.
- Single-event public programs offered the advantage of staff members not having to spend additional time to contact and schedule individual scientists. One-time, single-event public programs also offered clear endpoints for scientists to finish developing their presentations and materials.

Adoption and Sustainability

- In general, after this initial implementation, all sites reported their intention to use the PoP approach to some extent and in some ways.
- Factors that appeared to support sustainability included the following:
    - The degree to which initial implementations had provided the development of expertise that continued with the same staff members (i.e., lack of staff turnover).
    - The extent to which the initial implementations supported community relationships that were widely perceived as valuable across the institutions.

   - The extent to which Professional Development Elements were perceived as applicable to a broad range of areas, including staff development and program formats other than materials-based table-top activities.
- Limited budget was cited as the primary obstacle to sustainability. This reported limitation centered on estimates of staff time to recruit scientists, provide professional development, and offer ongoing public programs. The budget for materials was not seen as an obstacle to sustainability.

Impacts

At the time of the dissemination, the three collaborating partners had not developed explicit impact statements and indicators for the project as a whole, which meant user-group museum PoP Team members did not have access to the project-wide impact statements when designing their programs. The draft guiding framework presented to the user museums showed examples of impact for each of the three project audiences. As part of the user museum's conceptual planning, each site developed impact statements for the three target audiences based on the site's own local needs and context. For the purpose of this report, data about impacts collected for the project were analyzed in relation to the selected project-wide impacts developed near the end of the project. This analysis allowed comparison across sites. Despite this advantage, this comparison is only somewhat reflective of each site's intentions. This decision is discussed further in the Limitations section of the report.

Scientists

- After observations at each of the five public programs, final in-depth interviews with scientists, and in-depth interviews with general public visitors at each of the five sites, evaluators reviewed observation notes and interview transcripts to identify characteristics associated with higher levels of engagement between scientists and general public visitors, as well as high levels of understanding by adults and children in general public visiting groups. Evaluators noted the following characteristics of high-level engagement:
   - Materials (e.g., table-top items, games, posters with questions) attracted visitors to walk up to scientists and touch materials, manipulate them, ask questions, or participate in a structured activity focused on science content.
   - Both adults and children were observed engaging directly (e.g., talking, listening, asking questions) with the scientists.
   - Both adults and children displayed focus, concentration, and enjoyment of content during their engagement.
   - Scientists adapted vocabulary, level of content, and tone based on age and interests of the visitors.
   - Scientists both talked and listened during the interactions, using facial expressions and comments to adapt and clarify during their engagements.
   - Scientists flexibly balanced length of engagement with level of crowding.
   - Scientists appeared comfortable and confident.

  Many of the materials and engagements evaluators saw included one or more of the characteristics above. Only a few included all of them. As a group, engagement between scientists and general public visitors and table-top materials at ASC and DCM reflected more of these characteristics than did those at other sites. This level of engagement appeared to be influenced by the extent and design of professional development experiences.

- Most activities and materials developed by scientists incorporated one or more of the ideas about effective learning in informal environments, as reflected in the Professional Development Elements and activities used in PD workshops[2].
- Among the respondents to the online survey (*N* = 11), all those responding (*N* = 9) reported they would participate in PoP-type programming in the future (2 did not respond to this item). All 11 respondents indicated they would recommend participation to a friend or colleague.
- Benefits of participation that scientists described during final in-depth interviews and in the online survey included the following:
    - Engaging with the public was fun, rewarding, and satisfying.
    - Concepts and skills they had learned could apply in other settings. For example, they could apply inquiry-based methods to university teaching or adapt the newly acquired communication skills when working with children and adults in their medical practice.
    - Engineers and scientists cited participation as an opportunity to communicate how their work benefited the public.

Impacts among General Public Visitors

- In-depth interviews assessed awareness of and enthusiasm for engaging with scientists.
    - When probed or asked directly, almost all respondents above age five responded that they were aware they had engaged with scientists or other types of scientists, such as engineers or architects.
    - Many visitors did express enthusiasm for interacting with people who were scientists and commented on learning about science careers about which they were previously unaware. Many children appeared to find it unsurprising to engage with "real" scientists in a science center.
- In-depth interviews assessed content learning. Children also were asked to draw pictures of their experience in the public programs. Holistic assessments were made by location, based on the varying numbers of interviews and observations that were possible on site visits.
    - Almost all adults and children remembered one or more science concepts from their engagements.
    - Depth and range of science concepts and ideas varied by age and location. This difference appeared to result from two factors: (1) scientists' exclusive focus on children at some sites; and (2) the level of vocabulary in conversations and the design of materials.
        - At ASC and DCM, both the adults and children the evaluator interviewed remembered more and had deeper understandings of science concepts. This finding appeared to be due to scientists' engagement with both adults and children and the appropriateness of materials and conversation for both groups.
        - At ESC and DCS, children had higher levels of understanding than did adults. These levels of understanding appeared to be due to the focus on children during engagement.
        - At MLS, adults recalled more science concepts than did children. The higher level of recollection appeared to be due to the vocabulary level and design of materials.

[2] Note that the PD workshop for scientists at each implementation site was different in content and length. Therefore, intended impacts (knowledge and skills implicit in the PD elements) for each site were also different.

Conclusions and Recommendations

The PoP guiding framework appeared adaptable and useful in a range of settings, and lessons were learned that can be applied to future implementations. Some of these findings can be applied only to sites deciding to implement materials-based programs—that is, they may not apply to lecture- or discussion-format public programs.

Preparation

- Selecting PoP Team members was an important factor in the implementation. Having team members with experience in professional development, public programs, and direct ownership for programs made implementation less time-intensive.
- A face-to-face implementation workshop experience appeared essential in preparing PoP Team members to implement the approach. The workshop provided an opportunity to clearly understand the guiding framework, recognize the benefits for scientists, and have time away from busy schedules to experience professional development activities and to plan.
- The conceptual planning process was a very strong element of the PoP approach. Representatives from all locations noted the importance and usefulness of this process, particularly in providing ways to adapt the approach to institutional and community contexts. Some sites, however, ran into unanticipated problems. Consideration should be given to adding a section on potential challenges and obstacles.
- The *Professional Development Elements Catalog* was an essential resource in preparing sites to implement the program. Using developed and tested activities saved staff time and provided a focus for sharing the program across institutions.

Partnership and Relationship Building

- The status of existing relationships between the institutions and scientists and organizations in which scientists work was an important factor in this set of implementations. Fully developing these relationships may take several program cycles.
- Additional focus on partnership and relationship building in the *Portal to the Public Dissemination Manual* and in workshop offerings also is recommended. Since this set of implementations began, Alpert (2010) has published a guide on this topic that may provide resources to further develop training for implementers of the PoP approach.

Professional Development

- The *Professional Development Elements Catalog* saved staff time, and informal science educators found it easy to adapt and implement. Scientists enjoyed participating in workshops featuring this element and cited numerous benefits from participating in these activities.
- For materials-based presentations, the importance of prototyping materials should be stressed so that scientists experience higher levels of success in their initial public programs.
- Some scientists were more skillful at engaging both children and adults and in accomplishing substantial learning in both these groups. Building knowledge and skills to engage with both adults and children needs to be stressed in revised materials and for future implementations.
- While there were advantages to all ranges and schedules of professional development offerings, first-time adopters of the PoP approach could productively try one full-day workshop scheduled close in time to the public event. This scheduling appeared to maximize attendance and provide a clear time frame for materials development.

Public Programs

- Both large-event and individual-presenter program formats were implemented and provided contexts for substantial visitor learning. Both larger and smaller institutions were able to make decisions well adapted to the size of their staffs, the organization of their buildings, and their audiences.
- Materials-based, face-to-face engagements appear to be fairly robust. Even presentations that may not be as well designed as others and are offered by scientists with less-developed communication skills can be somewhat effective in engaging with visitors.

Adoption and Sustainability

Factors that appeared to influence sustainability included the following:

- PoP Team members and administrators perceiving initial success at sites in recruiting scientists, conducting professional development, and implementing public programs.
- The amount of staff time to continue the program appearing reasonable in relation to the number of scientists participating in the program.
- PoP Team members perceiving a good match between the materials-based education approaches and those already being used in the institution.
- Low levels of staff turnover during and after the implementation so that skills and experience from the initial implementation could support continuing efforts.
- Arrival of the PoP approach in the institution being perceived as a vehicle to begin new programming and expand types or number of audiences.

Impacts

Informal Science Educators

In general, the experiences provided by the *Dissemination Manual* and *Professional Development Elements Catalog* prepared informal science educators to carry out locally adapted implementations. One area in the *Dissemination Manual*, Relationship Building, may need to be expanded. ISE at all sites reported recruiting scientists as one of the more challenging aspects of the implementation.

Scientists

Many scientists reported benefits from participation in PoP. These reports were from scientists with a wide range of previous experience in communicating science to the public. That means both experienced and inexperienced scientists reported benefits. Overall, most of the scientists participating in programs across all sites appeared to experience some increase in knowledge and skills. Their professional development experiences seemed to enable many of them to develop appropriate materials for informal learning and successfully engage with both children and adults. There were also several reports of scientists using PoP-developed skills and materials in other contexts (e.g., for other museum programs or for university teaching).

There is some indication that the recruitment processes and messages played a role in developing a "readiness to learn" among some scientists by making them aware the PD workshop could improve knowledge and skills in engaging with the public. Scientists who entered the program aware that participation could support improvement of their own knowledge and skills also appeared to experience greater impact. At the end of the program, these scientists (about two-thirds of the total number of scientists) exhibited greater knowledge about the differences between formal and informal contexts. That is, they used the vocabulary of the professional development experiences and were more likely to identify both strengths and weaknesses in their own behavior and to cite ways to improve their presentations.

Areas for Further Study and Final Reflections

Three important areas for further study were identified.

- Consideration needs to be given to the development and testing of the approach with other types of program formats beyond the materials-based approaches.
- Additional testing is needed so the PoP approach can be integrated into existing public programs, such as *Engineers Week* [3] or other special-events programming in which scientists have participated previously.
- Precise estimates of staff time for implementing different versions of the PoP approach would provide important information for planning and decision-making.

The PoP project as a whole has been a pioneering effort in implementing and testing a guiding framework, approaches, and set of materials designed to improve the experience of both scientists and the general public in face-to-face engagements. Each of these institutions shared the goal of providing common ground in which scientists and members of the general public could engage with one another. Informal science educators, scientists, and general public visitors who participated in this study were enthusiastic about the efforts and gained important knowledge, understanding, and skills.

[3] Some sites held *Engineering Day* (events) during *Engineers Week*. *Engineers Week* is the name of the national program sponsored by National Engineers Week Foundation (National Engineers Week Foundation, 2008). For consistency, *Engineers Week* is used throughout the report.

Acknowledgments

We want to acknowledge the contributions of several individuals and groups to this study.

The *Portal to the Public* Core Team included the following members at the three institutions that developed the guiding framework, materials, and approaches we studied. At the Pacific Science Center, we want to thank Lauren Russell, *Portal to the Public* project manager, who served as primary client for this evaluation study. We want to thank also Dennis Schatz, PI, who reviewed and commented on evaluation findings. Other Pacific Science Center core team members included Lauren Burman, Dana Vukajlovich, Meena Selvakumar, and Karen Hoffman. At Explora, core team members included Kristin Leigh as co-PI, Betsy Adamson, and Armelle Casau. At North Museum of Science and Natural History, core team members included Margie Marino as co-PI and Jim Ringlein. We want to thank also our colleagues at the Institute for Learning Innovation for sharing their experiences, findings, and instruments: Jessica Sickler as co-PI, Angie Ong, Susan Foutz, and Martin Storksdieck.

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Jeri Hasselbring, Adventure Science Center
Ann Marie Walker, Discovery Center Museum

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Finally, and most importantly, thank you to informal science educators, scientists and general public visitors who shared their perspectives. They enriched our understanding of learning in informal environments. In naturalistic inquiry, these respondents are our collaborators in the understanding and exploration of the questions of the study.

Introduction

Informal learning institutions play an important role in science learning for people of all ages. They provide learning experiences through interactive exhibits, face-to-face programs, large-format films, and websites. Such experiences are part of a complex infrastructure that contributes to the awareness and understanding of science for adults and children. Other influences include formal education, mass media, general Internet resources, and friends and family (Fenichel & Schweingruber, 2010, p. 2). Making current science and technology understandable and accessible to the public is an increasing focus for many science museums and centers. Lecture series with scientists and special events such as *Engineers Week* [4]have been longtime staples in bringing current science and technology to the public.

Yet the gaps in perspective, vocabulary, and experience between scientists (SCI) and general public visitors (GPV) have been apparent in these programs. Scientists have expressed concern about maintaining accuracy and authenticity in their communication. Members of the public are sometimes confused and confounded by both the methods and construction of knowledge in the scientific disciplines. The *Portal to the Public* (PoP) project, funded by the National Science Foundation (NSF) in 2007, is one of several efforts to develop and test approaches to increase public awareness, understanding, and engagement with current science and technology. The developers described the project as follows:

> *Portal to the Public is a proven, scalable guiding framework for Informal Science Educators (ISE) to engage scientists and public audiences in face-to-face interactions that promote appreciation and understanding of current scientific research and its application (Pacific Science Center, 2010).*

While distinctions can be made between public understanding of science and public engagement with science (McCallie, Bell, Lohwater, Falk, Lehr, Lewenstein, Needham, & Wiehe, 2009), the PoP project was just one of several national efforts that aimed to make connections between science and the general public during the time frame of the project. Examples of other efforts include the Nanoscale Informal Science Education Network[5] (NISE Net), originated in 2005 by the Museum of Science, Boston; the Exploratorium; and the Science Museum of Minnesota (Nanoscale Informal Science Education Network, 2010). Another example of an effort to connect scientists to the public was Science Café (Fenichel & Schweingruber, 2010, p. 8).

The PoP approach had two important characteristics that set it apart from these other efforts: PoP (1) focused exclusively on face-to-face interactions between scientists and members of the general public; and (2) included professional development for the scientists interacting with the public.

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[5] The Nanoscale Informal Science Network (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.

The project began in July 2007 and included the development and testing of a guiding framework, materials, and approaches by three collaborating informal science education institutions. The three institutions that developed the approach contrast in size and are located in different geographic areas. Collaborating partner (CP) museums included the Pacific Science Center (PSC) in Seattle, Washington; Explora in Albuquerque, New Mexico; and North Museum of Science and Natural History in Lancaster, Pennsylvania. PSC is a large museum, Explora is a medium-sized museum, and North Museum is a small museum. The fourth collaborating partner was the Institute for Learning Innovation (ILI). ILI conducted a formative evaluation with the three collaborating partners during the initial development and testing of programming. Near the end of the project, ILI conducted a research study to determine the value of a model for scientist–visitor interactions at these three sites (Sickler, Foutz, Ong, Storksdieck, & Kisiel, 2011).

The collaborating partner museums decided against developing a single model for replication. Instead, they developed a guiding framework to support development of efforts that match the local context. In addition, the museums developed a *Portal to the Public Dissemination Manual* for other ISE institutions interested in implementing the approach. The manual included implementation areas that institutions need to consider in using the approach (i.e., Conceptual Planning, Partnership and Relationship Building, Professional Development for Scientists, and Public Programs). In addition, the collaborating partners developed a catalog of professional development activities that ISE institutions could use with scientists.

At the project's midpoint, the PoP approach and drafts of the guiding framework and materials were disseminated to and tested at five user museums. The model and materials tested by the five user museums were drafts, not the final versions available at the end of project. Therefore, descriptions of the approach and materials cited in this report are the prototype versions upon which the five user-group museums based their implementations. Materials used by the implementing museums included an initial draft of *Portal to the Public Dissemination Manual* (Pacific Science Center, 2009A) and the *Portal to the Public Professional Development Elements Catalog* (Pacific Science Center, 2009B). The implementation at the five institutions began at a Dissemination Workshop in Seattle in June 2009 and ended March 31, 2010.

The purpose of this summative evaluation was to evaluate the PoP dissemination strategy, guiding framework, materials, and approaches in supporting effective implementation of the program at five user museums. Findings in this report cover the range of adaptations among the five implementing institutions and identify factors that appeared to influence the effectiveness of implementation. Topics in this study include building partnerships with scientists and science-based organizations, providing professional development to scientists, and engaging museum visitors in public programs with scientists. The extent to which the program appeared to be institutionalized and sustainable after the 10-month implementation period is discussed, along with a characterization of short-term impacts on the museums, informal science educators, scientists, and museum visitors.

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- To what extent and in what ways were the PoP guiding framework, materials, and approaches implemented and adopted at the five sites?
- What factors affected implementation and adoption?
- To what extent and in what ways was the PoP approach effective in

- Building partnerships with scientists and organizations?
- Providing professional development (PD) to scientists?
- Communicating current science to museum visitors?

The overall design of the summative evaluation was a comparative case study (Guba & Lincoln, 1989; Lincoln & Guba, 1985; Miles & Huberman, 1985; and Stake, 1995). Data collection began in August 2009 after final Institutional Review Board (IRB) approval and ended June 1, 2010. Preliminary findings were reported in September 2010. Data were collected across five implementing sites. Sites implementing PoP were geographically diverse.

- Museum of Life and Science (MLS) in Durham, North Carolina
- Adventure Science Center (ASC) in Nashville, Tennessee
- Discovery Center of Springfield (DCS) in Springfield, Missouri
- Discovery Center Museum (DCM) in Rockford, Illinois
- Explorit Science Center (ESC) in Davis, California

Using the number of full-time staff members and total attendance at each of these five museums and comparing them to percentiles at 119 institutions surveyed by the Association of Science-Technology Centers (Association of Science-Technology Centers, 2010), three of the five user-group institutions could be classified as small to very small (DCM, DCS, and ESC). The other two institutions, ASC and MLS, could be classified as medium to large.

During the time frame of this study, number of staff and attendance (indicators of size) at the implementing museums were as follows:

- ASC had about 40 full-time staff members and attendance was approximately 340,000 visits a year.
- DCM had approximately 8 to 10 full-time staff members and 50 part-time staff members, with total attendance about 120,000 visits per year.
- DCS had about 12 full-time and 15 part-time staff members, with an attendance of about 100,000 visits per year.
- ESC had 6 full-time staff members and about 17 part-time staff members, with an attendance of 65,502[6] visits and contacts per year.
- MLS had a full-time staff of about 70 employees and an attendance of about 400,000 visits per year (Museum of Life and Science, p. 4).

[6] This number includes visits to the public galleries and program contacts at various locations.

Background

Each of the five implementing institutions signed an agreement and received a $10,000 stipend to support implementation. They agreed to offer at least one professional development workshop and public program based on the PoP guiding framework, materials, and strategies. They agreed also to coordinate for this study the collection of contact information and data from scientists who participated in their implementations. Public programs were to be completed by March 31, 2010. PoP Team members at the user museums were to use feedback forms to report on the museums' professional development and public programs to the evaluation manager.

All five implementing institutions had at least one staff member who was a member of the PoP Advisory Team. This advisory team participated in developing the guiding framework at a meeting held in Seattle in February 2009. After this meeting, the collaborating partners refined the guiding framework and developed two important documents to guide the dissemination process: an initial draft of *Portal to the Public Dissemination Manual* (Pacific Science Center, 2009A) and *Portal to the Public Professional Development Elements Catalog* (Pacific Science Center, 2009B). The manual included a graphic display and presentation of the guiding framework. Figure 1 shows the guiding framework as presented at the Dissemination Workshop.

The manual described the major elements of the guiding framework, emphasizing that the impacts listed were examples, not prescriptive outcomes for the implementation. That meant each implementing site was expected to develop goals and impact statements during the conceptual planning process.

> *The tube contains four "rings," representing the four major elements of Portal to the Public efforts:*
>
> *Partners: This ring represents partnerships and relationships between informal science educators and science-based organizations and individuals.*
>
> *Professional development: This ring represents professional development experiences, strategies, approaches, and formats that informal science educators can facilitate to support scientists in interacting face-to-face with public audiences.*
>
> *Face-to-face public programs: This ring represents public program structures and approaches that bring scientists and public audiences together for face-to-face interactions.*
>
> *Impacts: This ring represents the impacts program designers wish to have on each audience—public audiences, scientists, and informal science educators. (Pacific Science Center, 2009A p. 9).*

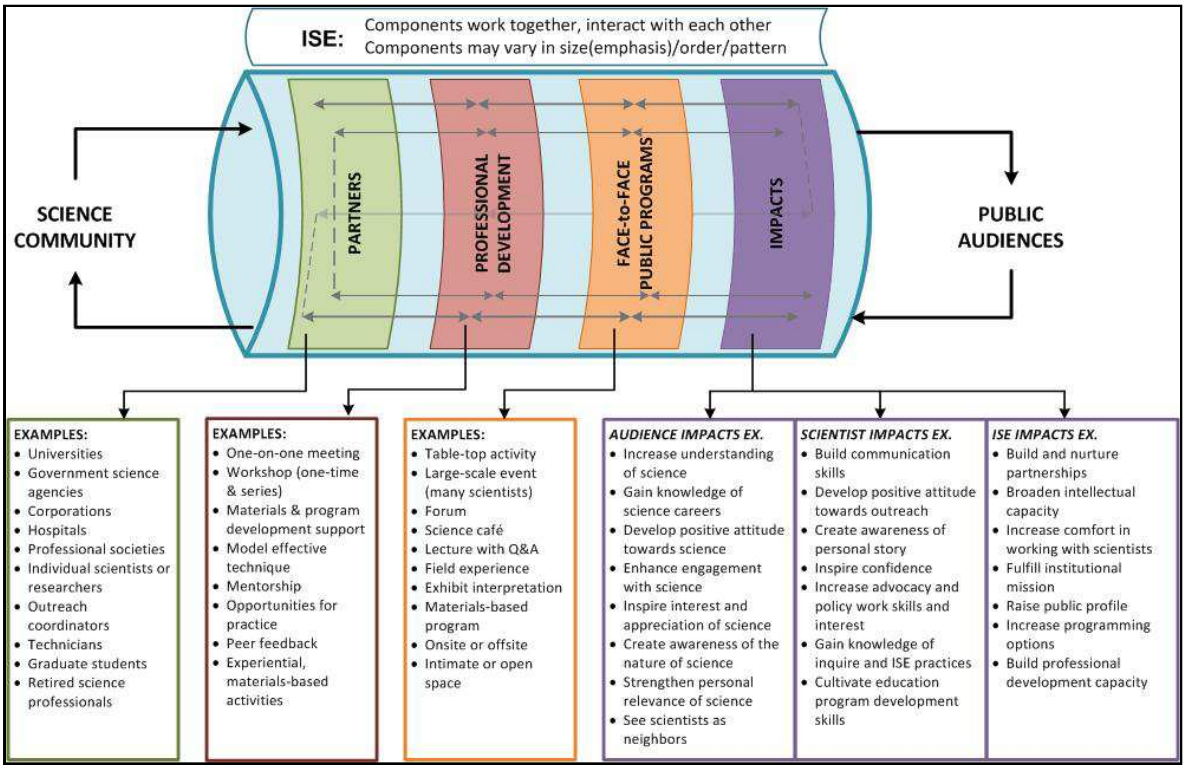

Figure 1. **Portal to the Public guiding framework (Pacific Science Center, 2009A, p. 8).**

The manual contained chapters introducing the program, followed by sections on conceptual planning, partnerships and relationship building, professional development, public programs, reflection, evaluation, and sustainability.

A four-day Dissemination Workshop was held in Seattle from June 16 through June 19, 2009, for two representatives from each of the five user museums. During the workshop, representatives from the three collaborating partner museums presented the guiding framework portraying the PoP approach at their institutions, shared Professional Development Elements they used, and showcased some of the public program activities developed by scientists at their sites. Appendix A includes the agenda for this workshop. As part of this workshop, the PoP project manager presented Dissemination Expectations and an invoicing schedule for stipends. Appendix B shows the handout summarizing these expectations.

While all areas were covered, more time was spent at the workshop on activities related to conceptual planning and professional development. Participants experienced several of the Professional Development Elements (the term used to describe the professional development activities developed by the collaborating partners). In addition, several scientists from PSC presented their public programs for the participants to experience. A panel of scientists from all three CP locations (including some on Skype) discussed what they had gained from participating in PoP.

Time also was allotted for representatives from each implementing institution to begin conceptual planning. Each site was assigned mentors from the three collaborating partner museums. Mentors met with user-museum representatives for some portion of the workshop and continued this process after the meeting. The planning was supported by the *Conceptual Planning Worksheet* designed to complement Chapter 2 (Conceptual Planning) in the manual. This process included two major areas: (1) self-inventory; and (2) program planning.

Questions related to self-inventory included the following:

1. What are our core values?
2. What are our strengths?
3. What are our internal resources?
4. What are our external resources?
5. Where do we want to go?

Questions related to program planning included the following:

1. What are the anticipated audience impacts of our programs?
    - Public audience impacts
    - Scientist impacts
    - Informal science educator impacts
2. What partnerships will we leverage or pursue with research organizations and/or scientists?
3. What general professional development program format will we use?
4. What general public program format will we use?
5. How will we evaluate our programs?
6. What considerations must we make regarding long-term sustainability?
7. What is our general program timeline?

In August 2009, workshop participants were surveyed about their experiences at the Dissemination Workshop. Broad findings included the following:

> *All the workshop learning experiences appeared to be highly valued by the respondents. Four areas stood out as particularly valuable for the participants: panel discussion with scientists, experiencing scientist public programs, experiencing professional development designed for scientists, and shared experiences from the Portal team. In addition, workshop participants seemed to find that materials and experiences had prepared them in each of the areas of activity covered by the Dissemination Manual. We found the highest ratings for preparation in Professional Development for Scientists and Conceptual Planning. Two other areas, Public Programs and Partnership and Relationship Building, appeared to be rated somewhat lower (Tisdal, 2009).*

After the workshop, representatives from the five implementing sites continued to work on their conceptual plans. As we noted, mentors were assigned from each of the collaborating partners to work with each of the five sites at the workshop. Workshop participants were encouraged to involve others in their institutions in the conceptual planning process. Conceptual plans were submitted to the PoP project manager, reviewed by mentors, and revised. This process was completed during August and September 2009.

Methodology and Methods

Design

Evaluators used a comparative case study design (Stake, 1995) to identify, describe, and assess the degree to which the PoP guiding framework, strategies, and approaches were implemented and to what extent they were effective in the five user museums. Figure 2 shows the design of the study in which data were collected to describe the process of implementation across time.

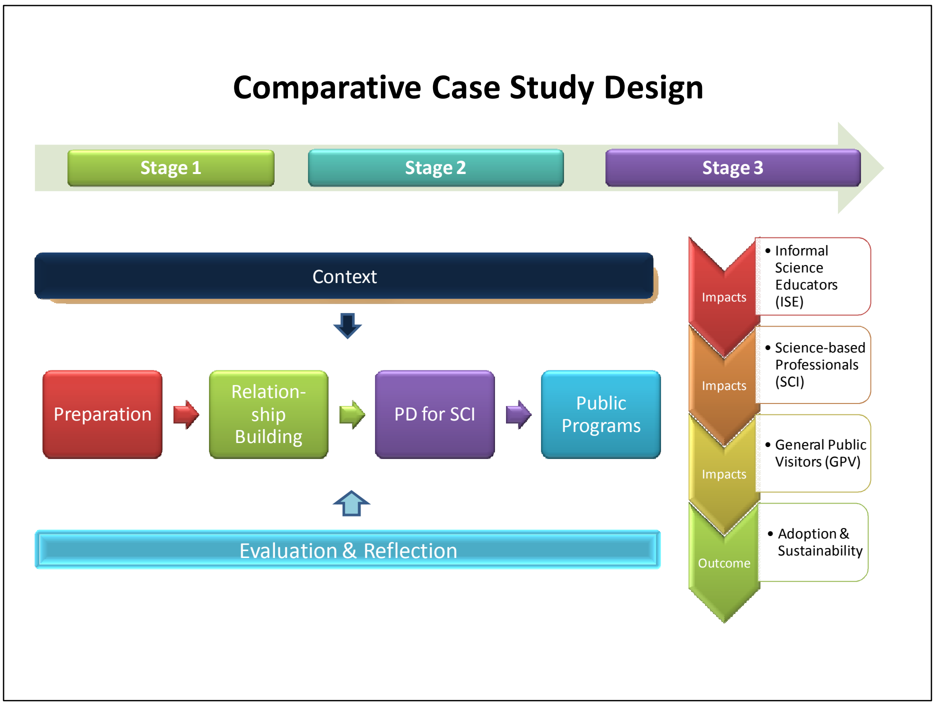

Figure 2. **Comparative case study design.**

Case study elements follow the PoP guiding framework, with the exception of conceptual planning. As data were collected and analyzed, evaluators realized that in addition to conceptual planning, institutions had made important decisions about which staff members would attend the Dissemination Workshop and what responsibilities they would have for implementing the program. The set of activities and decisions is presented under the topic Preparation. This study reports on impacts on two of the primary target audiences: informal science educators and scientists. Impacts on museum visitors, the secondary audience of the project, are considered as supporting evidence for outcomes and impacts in other areas and used to support findings for the cases and the scientists. They were not a primary focus of this study.

Methodology

Naturalistic inquiry (Lincoln & Guba, 1985) aims to provide a holistic understanding of a phenomenon by looking at it from several angles in a real-life setting. This type of inquiry uses a systematic approach for collecting and analyzing data in the context in which it occurs. In naturalistic inquiry, processes and activities are captured through a variety of sources from the multiple perspectives of various stakeholder groups and presented through in-depth descriptions. The impacts of the program were also captured through this process and connected to these processes and activities through the multiple perspectives of the people involved.

In naturalistic inquiry, data collection and analysis are ongoing and related processes. For this study, we analyzed data using a modified inductive constant comparison approach (Lincoln & Guba, 1985). Each set of data was compared with previous data sets to direct the focus of subsequent data collection. To do this comparison, specific instruments were developed for each of three stages of data collection. Stage One instruments were developed as data collection began. Stage Two and Stage Three instruments were developed to incorporate patterns and themes from the previous stages.

Methods

Both quantitative and qualitative data collection methods were used to develop a case study for each implementing site. Conversations about event tracking and instruments were held with ILI project staff members in January 2008 to coordinate joint development and sharing of instruments among the multiple studies in the PoP project. Instruments developed by ILI for front-end and formative evaluation were used with their permission as the basis for several instruments in this study.

Evaluators used similar methods for each site to allow for comparison of the implementation and its effectiveness across the cases. Methods included the following:

- Semi-structured surveys conducted online and onsite at each museum.
- In-depth interviews conducted on the telephone and onsite at each museum.
- Observations and interviews collected during three-day visits to each museum.
- Documents and program records (e.g., brochures, training materials, brochures for scientists, and marketing materials).

Appendix C shows a list of survey and in-depth interview instruments by stage of the study. Sampling for in-depth interviews was purposive (Miles & Huberman, 1985), which means that respondents were selected based on characteristics important to answering some questions of the study. Informal science educator in-depth interviews included members of the PoP Team at each location. Respondents for scientists' in-depth interviews were selected based on career stage and public program interactions that evaluators had observed. Online surveys were sent to populations of respondents.

Stage One data collection began in August 2009 after the Dissemination Workshop and after Institutional Review Board approval of protocol for the study. Using an online survey (*ISE Dissemination Workshop Survey*), evaluators assessed aspects of the Dissemination Workshops. Evaluators conducted in-depth telephone interviews (*ISE Stage One In-depth Interview*) with members of the PoP Teams at each location to understand the overall context of the implementation and to assess the status of individual and institutional experience, expertise, and prior relationships with science-based professionals before the project began. Background information was collected from informal science educators through the *ISE Participant Information Survey* and from scientists through the *Scientist*

Participant Information Form. Contact information was collected from members of both groups through separate forms. These were used in subsequent stages to contact individuals for telephone interviews and to request response to online surveys.

Stage Two data captured decisions and processes as the PoP approach was implemented at each institution. Project management documents (e.g., *Professional Development Feedback Forms* and *Public Program Feedback Forms*) were forwarded to evaluators by the PoP project manager. These forms supplied evidence about (a) the types and range of professional development experiences offered; and (b) the types and range of public events offered. This stage involved site visits to all five institutions. One evaluator collected data at DCM, DCS, DCM, and MLS. Two evaluators collected data at ASC. Site visits were conducted on the following dates:

- DCM in Rockford, IL – March 12 and 13, 2010
- DCS in Springfield, MO – March 19 and 20, 2010
- ASC in Nashville, TN – March 26 and 27, 2010
- MLS in Durham, NC – March 27, 2010
- ESC in Davis, CA – March 29 and 30, 2010

Onsite visit evaluators conducted observations of scientists and general public visitors in face-to-face interactions at public programs (*GPV Observation Interview Guide*). General public visitors were purposefully sampled to obtain a range of visiting groups in terms of size, numbers of children in the visiting group, and ages of children in the visiting group. Groups were intercepted during or prior to their participation and asked for their permission to be observed and to agree to a 10-minute interview. Both children and adults were observed and asked questions about their engagements with scientists. Children under 12 years old were asked to draw pictures about what they saw during their participation. Groups of respondents were given $10 gift certificates from museum stores as incentives.

On these site visits, evaluators also interviewed informal science educators about the connections between their professional development offerings and the types of public programs offered by their institutions (*ISE Stage Two Onsite Interview*). During site visits, project documents related to each implementation were collected.

Stage Three data were intended to be collected near the end of the implementation period to allow reflection on participation and to capture short-term impacts from scientists and informal science educators. An online survey was sent to all scientists for whom evaluators had received contact information. The survey was sent to a total of 38 respondents, including ASC (*N* = 15), DCM (*N* = 2), DCS (*N* = 11), and ESC (*N* = 6). This total included all scientists who attended professional development workshops for which evaluation liaisons had collected contact information. At MLS, evaluators received contact information from individuals (*N* = 4) who had presented at the MLS public program but only three of whom had attended a professional development workshop. The response rate among the group to whom this survey was sent via email (*N* = 38) was quite low, with only nine responses (23.7%). Evaluators targeted two in-depth interviews per site.

To explore any changes in the levels of partnership between science research organizations (SRO) and implementing sites, evaluators had developed an online survey (*SRO Online Survey*) and an in-depth interview (*SRO Stage Three In-depth Interview*). These respondents were intended to provide additional perspectives about the impact of participation on scientists. No location, however, provided this information, and no data were collected from any SRO respondents.

Table 1 shows numbers by method and site across study phases. Data were collected from informal science educators and scientists early, during, and late in the implementation. Observation of general public visitors included engagements with scientists and was followed by in-depth interviews. These respondents were purposively selected. In addition to the data in this table, 28 program records (feedback forms) and 21 program documents were included in the analysis.

This report cites program documents and in-depth interviews to show the data. Appendix D includes a list of program documents. Appendix E presents a listing of ISE and SCI interviews. Appendix F lists GPV interviews and demographics. The names of documents and in-depth interviews are included in the narrative. These references also provide an audit trail for the study. An audit trail is a standard practice for qualitative research to allow the reader to review the sources of information upon which findings and conclusions were based.

Table 1. Data Sources

Respondent group	Totals	ASC	DCM	DCS	ESC	MLS
Informal science educators (ISE)	*N = 13*					
# ISE participant info survey	*13*	2	3	3	3	2
# ISE stage 1 interviews	*12*	2	3	3	3	1
# ISE stage 2 & 3 interviews	*17*	3	4	4	4	2
Science-based professionals (SCI)	*N= 38*					
# SCI participant info survey	*38*	15	2	11	6	4
# SCI stage 3 interviews	*9*	3	2	1	1	2
# SCI stage 3 online survey	*11*	5	1	2	1	2
General public visitors (GPV)	*N = 69*					
# Observations/interviews	*21*	5	3	6	4	3
# Drawings	*32*	6	5	9	8	4
Total respondents	*N = 120*					

Data Analysis

Quantitative data were analyzed using descriptive statistics. Qualitative data were coded using the constant comparative method to identify patterns and themes. The constant comparative method is a method for analyzing data in order to inductively develop findings (categories and their relationships) from qualitative data. This method was developed by Glaser and Strauss (1967) as part of their research process called grounded theory. In this process, a phenomenon or object of interest is identified. In this study, the phenomena were the implementation of the PoP guiding framework and materials at five user museums.

The next step is to identify the structural process of the system. For this study, the structural process comprised four phases of program implementation: preparation, relationship building, offering professional development for scientists, and offering public programs for general public visitors. Data were analyzed in three phases to identify similarities and differences across sites and changes between initial plans and actual implementations and perceptions. In addition, data were collected and analyzed across time to identify changes in perception and understanding among informal science educators and scientists.

Ideally, using this method, decisions are made about what questions should be answered and what data should be collected based on previous analysis and the relevance of understanding emerging categories. For example, scientists who decided not to attend optional professional development could have been interviewed. This approach was not practical, however, given the IRB review procedures, fees, and time frame in which implementation decisions were made. Some implementation decisions (for example, the scheduling of public program offerings) were not made until quite late in the implementation process (10 days to two weeks prior to the offering of the programming). This lateness in scheduling public programs meant that case comparisons were not done sequentially and questions were not explored based on previous data.

Findings were developed by triangulating information (Lincoln & Guba, 1985, p. 339) among data sources (in-depth interviews, surveys, project documents, and observations) and from multiple perspectives (informal science educators, scientists, and general public visitors). Consistent methods were used across cases. This method is one way of assuring rigor in qualitative inquiry. Final conclusions were reached by triangulating both quantitative and qualitative findings and comparing these across museums by case (Lincoln & Guba, 1985, p. 339).

Management of the Evaluation

The study was led at Tisdal Consulting by Carey Tisdal, who designed the protocol and adapted and designed instruments. The evaluation team included a professional-level associate Barbara Addelson, who conducted some in-depth telephone interviews and collected data on some site visits. Data collection at each location was coordinated by an evaluation liaison who was a member of the PoP Team at the site. After training at the Dissemination Workshop, these individuals were responsible for explaining the purpose of the project to informal science educators and scientists at their site, obtaining signed consent forms, and distributing and returning participant information surveys from informal science educators and scientists. In addition, they provided review of email requests for the online survey. The evaluation manager met monthly with these liaisons.

Limitations

First, the dissemination effort was added during the project funding process. At this point, the five implementing sites were added to an evaluation design. The original summative evaluation included the sites of the three collaborating partner museums. In February 2009, at the initiative of the PI and co-PIs, the focus of the summative evaluation study was shifted to a test of concept at the implementing sites and excluded the collaborating sites. This focus prevented multiple data-collection efforts from the same respondents by ILI, in conducting formative evaluation and research studies, and by Tisdal Consulting, contracted to conduct the summative evaluation. This decision provided some clear benefits to prevent testing the patience of a fairly small number of respondents with multiple requests to provide information at the collaborating partner locations. Yet the decision blurred the lines between the research and evaluation components of the inquiry for the project.

This study is a field test of the PoP approach. Field tests are generally considered formative rather than summative evaluation studies. Yet, taken together, the research and evaluation studies provided an assessment of project accomplishments across all eight sites and avoided duplication in data collection efforts.

Implementations at the five user sites began at the PoP project's midpoint before the final versions of the guiding framework, manual, *Professional Development Elements Catalog,* and research documentation about approaches were published by the collaborating partners. Therefore, while this study provides a "test of concept," it is not a test of the mature version of the implementation manual developed by the collaborating partners to disseminate PoP. This study focuses on prototype versions of the approach and materials provided to the implementing sites at the Dissemination Workshop in June 2009. These include the *Portal to the Public Dissemination Manual* (Pacific Science Center, 2009A) and the *Portal to the Public Professional Development Elements Catalog* (Pacific Science Center, 2009B). These prototype versions of those materials are cited and included in the References section of this Summative Evaluation, not in the final versions of these documents.

Third, the comparative case study design is appropriate to the questions of this study, yet the nature of the implementations meant sample sizes at each of the implementing sites were small. In addition, each site had some unique characteristics. In research design terms, this uniqueness means the treatment (e.g., the experience of scientists and museum visitors) that influenced the impacts was not consistent. While there are some strong patterns across sites, readers need to remember there were different levels and types of professional development for scientists at each site and varying intended outcomes and experiences for museum visitors. Keeping this idea clearly in mind adds detail to the presentations of the findings in this study.

Finally, naturalistic methods are intended to be flexible and adaptable over time to meet the needs of emerging questions and local context. This intent was challenging, given the IRB requirements and fees that were not included in the original evaluation budget. Efforts were made to protect this feature of the methodology by submitting site-visit protocols and instruments nearer in time to site visits (with accompanying fees). The observational methods and in-depth interviews could have been more fully developed for the variation among sites.

Characteristics of Respondents

Respondents to surveys and interviews—the focus of observations in this study—were members of the three target audiences of the PoP approach: (1) informal science educators; (2) scientists; and (3) general public visitors. Informal science educators were members of the PoP Teams at each location. Scientists were participants in professional development and public programs at those locations. Both these groups were population samples. General public visitors were groups of visitors who were purposively sampled (Miles & Huberman, 1985) by evaluators.

Both informal science educators and scientists were asked to respond to participant information surveys. The characteristics reported in this section are from that source; other information appears later in the report. Across all locations, 13 informal science educators responded to the information survey. Evaluators did not receive information from one male PoP Team member at ESC and one female PoP Team member at ASC. Across all locations, 38 scientists completed the *Scientist Participant Information Survey.* Only 9 scientists responded to the online survey, with a fairly low response rate of 23.7%. Evaluators conducted a total of 9 in-depth interviews with a purposively selected sample of scientists.

The gender of informal science educators by location is shown in Table 2. Of the total number (*N* = 13), 8 of the respondents were female and 5 were male.

Table 2. Gender of Informal **Science** ***Educators by Location***

Location	ASC	DCM	DCS	ESC	MLS	All
Male	1	0	0	2	2	5
Female	1	3	3	1	0	8
Total	*2*	*3*	*3*	*3*	*2*	*13*

Table 3 shows the career stage reported by informal science educators by location. In general, sites appeared to select more experienced staff members to implement the PoP approach. There were, however, some early-career-stage ISE respondents at DCS and ESC.

Table 3. Career Stage of Informal **Science** ***Educators by Location***

Career Stage	ASC	DCM	DCS	ESC	MLS	All
Early career with less than 3 years' experience	0	0	1	0	0	1
Established position with at least 3–6 years' experience	0	0	0	1	1	2
Established position with more than 6 years' experience	2	3	2	2	1	10
Total	*2*	*3*	*3*	*3*	*2*	*13*

Table 4 shows gender of scientists by location. At all sites, both genders were represented fairly evenly among the scientists who responded to the information survey.

Table 4. Gender of Scientists by Location

Gender	ASC	DCM	DCS	ESC	MLS	All
Male	8	1	7	2	2	20
Female	7	1	4	4	2	18
Total	*15*	*2*	*11*	*6*	*4*	*38*

Table 5 shows the career stage reported by scientists by location. At all sites, more respondents reported earlier career stages. This reporting may reflect recruitment strategies and efforts at the locations as well as some generational differences in the respondents. In open-ended comments and on other items, several of the respondents at earlier stages of their careers reported involvement with outreach efforts as undergraduates, part-time work in other science museums, and encouragement by their professors or the PIs to participate.

Table 5. ***Career Stage by Location***

Career stage	ASC	DCM	DCS	ESC	MLS	ALL
Grad school	1	2	4	2	0	9
Post-doc/entry	5	0	2	3	2	12
Established (3–6 years)	3	0	2	1	1	7
Established (6+ years)	5	0	2	0	0	7
Retired	0	0	1	0	1	2
No response	1	0	0	0	0	0
Total	*15*	*2*	*11*	*6*	*4*	*38*

Table 6 shows museum visitor respondents who were observed and interviewed as groups at public programs. Because only parents or legal guardians could provide consent for minor children to be interviewed, all interview data were restricted to children accompanied by a parent or guardian. In one group at DCM, a mother who was interviewed also had brought her two nieces to the museum. These older children were not interviewed.

Among visitor groups (*N* = 21), there were 28 adults who were observed to be between 25 and 45 years old. Five were male and 23 were female. Among the children in the groups, the average age was 7.4 years old, with a range from 2 to 14. The median age was 7 years old. Among the total number of 41 children, 21 were male and 20 were female. A complete table of demographics for individual interviews by location is included in Appendix F.

Table 6. General Public Visitors at All Locations

LOC	ASC	DCM	DCS	ESC	MLS	Total
Number of groups	5	3	6	4	3	21
Adults	6	3	10	6	3	28
Children	9	7	13	8	4	41
Total respondents	*15*	*10*	*23*	*14*	*7*	*69*

Case Studies

Each of the five museums made decisions about how it would implement the PoP approach. These decisions, and the contextual factors that influenced them, are presented in this section as part of the five case studies. This presentation is followed by a comparison of the cases, discussion of impacts, and findings on sustainability.

The five case studies present descriptions of the implementations at the five user museums. Case study elements follow the major processes of the PoP guiding framework, with the addition of Background and Context. The Conceptual Planning Phase of the framework was expanded to a broader concept of Preparation.

- **Background and Context** includes information about the community (e.g., size, economy, and location), the institution (e.g., mission, attendance, and staffing), and internal factors influencing the implementation.
- **Preparation** focuses on the five user museums' connections to the broader PoP grant (e.g., membership on the advisory team), decisions made about staffing the program, staff experience and perceptions of the Dissemination Workshop, and conceptual planning.
- **Partnership and Relationship Building** describes the strategies and tactics used by the PoP Team at their institutions to involve scientists in the implementation.
- **Professional Development** includes descriptions of the scientist professional development strategy used and documentation of the workshops and activities. Perceptions from informal science educators and scientists about what worked well and what did not are also included.
- **Public Programs** describes the strategies used to offer programs to the public and perceptions from informal science educators and scientists about what worked well and what did not.

The case studies are followed by a comparison among the sites, including a discussion of what factors appeared to affect the effectiveness of different adaptations of the PoP approach. Discussions of impacts are included for scientists and general public visitors. Informal science educator impacts are integrated into case studies.

Adventure Science Center

Figure 3. **Adventure Science Center logo and photographs of activities and materials at public program.**

The use of the PoP framework, strategies, and materials at Adventure Science Center (ASC) clearly was the most extensive compared to other sites in terms of both the number of scientists involved in professional development and public programs and the number of visitors who engaged with scientists. Recruiting was supported by community economic climate, strong existing relationships, and explicit recruiting strategy and goals. Selecting experienced science educators at ASC with direct responsibility for programming appeared to positively affect the extent and range of this implementation. They made decisions about the length and timing of the workshop, selection of Professional Development Elements, and setting dates for public programs early in the process. This approach allowed scientists to have a very clear idea about the scope of their commitment. Figure 3 shows photos of the public program at ASC.

Background and Context

ASC is located in Nashville, the capital city of Tennessee. This city of 635,000 is located in north central Tennessee and is the home of 17 colleges and universities. ASC had ongoing relationships with several universities prior to the PoP program, including Tennessee State University, a historically Black institution; Belmont University; and Vanderbilt University, with its extensive research activities and medical school. Nashville is a center for the healthcare, entertainment, and banking industries *(World News Digest* database, *Encyclopedia*, 2010C).

ASC has about 40 full-time staff members, with about 15 staff members in its education department. Attendance is approximately 340,000 visits a year. A $21 million expansion opened recently, including a new wing and planetarium (Adventure Science Center, 2011A). In 2010, ASC adopted an updated mission statement, shown in Figure 4. This mission statement shows a shift from focusing primarily on children to developing an audience of people across all life stages.

Adventure Science Center ignites curiosity and inspires the lifelong discovery of science.
(Adventure Science Center 2011B)

Figure 4. **ASC mission statement.**

Participating in PoP is one of a number of ASC's efforts to become connected to the community, build connections with other community organizations, and become a place in the community for "serious" science. Evaluators also learned that the city of Nashville, with an economy more focused on services than manufacturing, had not been as strongly impacted by the global economic downturn as had some other sites. On the other hand, this urban area is part of a region with high levels of rural poverty that preceded the economic crisis of 2008.

The urban schools were noted as in particular need of support in science education. Responding to these needs, ASC has programs focused on providing support for science, technology, engineering, and math (STEM) in K–12 formal education both in the urban area and in the middle Tennessee region. During the time period of the PoP implementation, ASC was launching an initiative to expand its community and school outreach efforts to 15 additional counties *(ISE-1-1_ASC_4849_082609)*.

Preparation

The formal PoP Team at ASC included three experienced professionals with long terms of service at ASC: the Education Team Leader, Community Outreach Educator, and Director of Education. Their primary roles and Dissemination Workshop participation are shown in Figure 5.

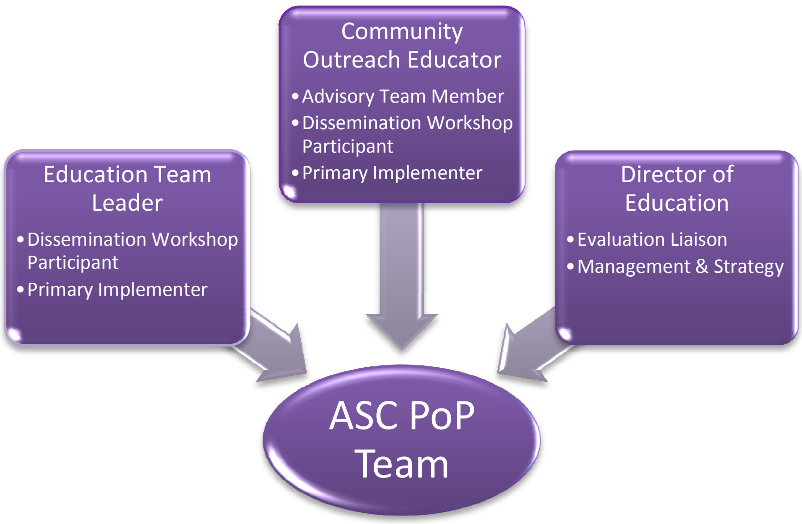

Figure 5. **PoP Team at ASC.**

The primary recruitment and program planning responsibilities were carried out by the Education Team Leader, who had been at ASC for 18 years, and the Community Outreach Educator, who had worked at ASC for more than 20 years. They had prior experience in providing professional development for staff, scientists, and teachers. Both primary implementers attended the Dissemination Workshop. They also had long-term relationships with many scientists who had participated in previous programs. The Director of Education served as the evaluation liaison and supervised the program, coordinating it with other ASC offerings and community connections.

Comparing ASC's *Conceptual Planning Worksheet* as finalized in September 2009 with the actual program shows that, in Stage One in-depth interviews, the ASC team recognized their existing relationships with scientists as an advantage in implementing the program.

> *We have ongoing relationships with many area government agencies, universities, and research and science-based businesses, clubs and individuals. In our initial recruitment effort, we will contact these organizations and individuals to recruit research scientists and graduate students for Scientists on Site (POP_CPW_ASC_2009).*

Of all the locations, ASC had the closest correlation between the early program plans and actual implementation. The *Conceptual Planning Worksheet* shows an early decision to provide six to eight hours of training and to focus on one large event. Among the primary implementers, ASC also had higher levels of ISE experience in presenting public programs with scientists. While other factors were at play, these high levels of existing relationships and previous experience appear to support the scope and quality of this implementation.

Partnership and Relationship Building

Evaluators learned in interviews that the primary PoP implementers set themselves a goal of recruiting five scientists each. They exceeded their goal.

> *We contacted nearly all of the 23 groups identified in our Conceptual Plan. We recruited all 15 scientists from 12 of those organizations (ASC PP Feedback Form_032710).*

The two team members had a specific strategy of building on their own existing connections.

> *When [starting] our solicitation, we split up our groups [into] different groups of people that we [individual ISE staff members] are connected with. For example, mine was my professional women that have helped me with my TWISTER program; my connections with Vanderbilt University and the people I've worked with there; and the connections with TSU, Tennessee State University (ISE_2-1_ASC_6254_032610).*

An email was sent to individual scientists and to organizational contacts.

Important factors supporting their recruitment efforts appeared to be previous levels of working with scientists in specific ASC programs and the overall level of outreach at ASC. The Education Team Leader had worked with the TWISTER program. She explained:

TWISTER is a one-day . . . hands-on conference for young women in high school. And about 125 young women come here, and I have 20 to 30 women that are in STEM careers. They come and they volunteer to present a one-hour session to the girls that talk about their career. . . . So I have this eight years of women that have come to the science center and presented programs as a volunteer (ISE_2-1_ASC_6254_032610).

The Community Outreach Educator pointed out that working with people previously, as well as the high level of science outreach in the community, supported successful recruiting.

Our advantage is that we have some people that we worked with in the past–and this whole project appealed to them. They've already shown that they're interested in outreach kinds of things. . . . [In addition] there's a lot of outreach going on in Nashville for science (ISE_2-1_ASC_4849_032610).

In addition to knowing the manager at the Vanderbilt Center for Science Outreach, the Education Team Leader also had existing connections with the American Chemical Society's local sections and Belmont University. The Community Outreach Educator had led a youth program whose alumni included research scientists. Two of these former youth volunteers, now physicians, participated as scientists in the implementation.

We invited them to join us, and it's exciting to see youth volunteers who are now coming back as research scientists (ISE_2-1_ASC_4849_032610).

In summary, at ASC there were existing relationships of very specific types. These were with individuals and groups who had participated in outreach programs and other types of programming that were part of the core offerings of ASC. These existing relationships supported recruitment of PoP participants.

Profile of ASC Scientists

Number of Repsondents = 15

Gender
- Female = 7
- Male = 8

Career stage
- Grad school = 1
- Post-doc/entry = 5
- Established (3–6) years' experience
- Established (6+) years' experience
- No response = 1

Highest level of education
- Undergrad = 3
- Masters = 5
- Doctorate = 7

Previous relationship
- Yes = 11
- No = 4

Area of work (multiple options)
- Life science = 3
- Physical science = 1
- Research = 6
- Applied science = 4
- Engineering = 3
- Architecture = 2
- Medicine = 2
- Other = 1

Figure 6. Profile of ASC* scientists *(N= 15).

Figure 6 shows a profile[7] of the 15 ASC scientists. These data were collected via the *Scientist Participant Information Survey* at the ASC Professional Development Workshop. Note that 11 of the 15 participants reported a previous relationship with the science center. The profile shows a balance of gender and a fairly wide range of career stages, with a higher concentration of more experienced professionals than at any of the other implementation locations. The profile also reflects a wide range of research scientists (i.e., life and physical science) and others working in applied areas such as engineering, architecture, and weather forecasting (the latter represented by "Other" in the profile).

[7] Due to small sample size across all groups at all locations, descriptive statistics are generally presented as counts. These are helpful in understanding the size of each implementation.

Professional Development

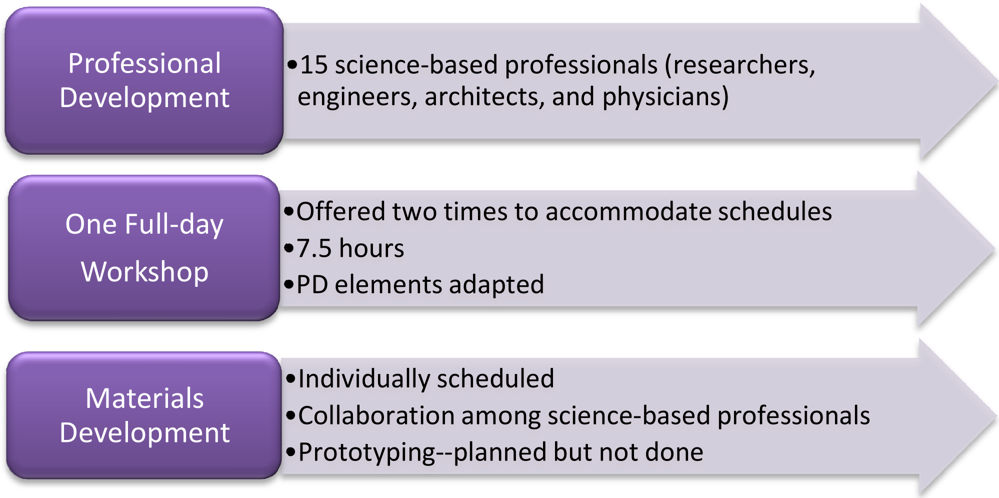

***Figure 7.* Professional development workshop.**

The PoP Team at ASC decided to offer one full-day workshop on two different days to accommodate participants' different schedules and then follow up with individual support for scientists as they developed materials for their presentation. Figure 7 provides an overview of professional development at ASC. The workshop was offered on Saturday, December 12, and Monday, December 14, 2009, with 15 scientists attending. One PoP Team member explained their strategy:

> *We knew that everyone had a very busy schedule. We knew that we did, too. And so we essentially took what had been two or even three training sessions, and we asked people to spend the whole day with us. . . . And we tried to find ways to blend some of the activities together so that we could do one activity, but through that one activity we could highlight a couple of points (ISE_2-1_ASC_4849_032610).*

The feedback form for the workshop describes the goals this way:

> *Our goal was to help our participants develop ideas and skills to begin the process of creating a floor/table activity about their topic. We wanted to build a sense of team that was working toward a common goal (ASC_professional development_ ISE Feedback 1212-1409).*

The workshop agenda included adaptations of several of the activities featured in the PoP *Professional Development Elements Catalog*. These activities were adapted to fit the time frame and sequence of the activities to reach specific goals. Note that this goal was very task-focused and included the development of mutual support among participants. At the end of the workshop, the workshop leaders used an evaluation form to collect feedback. Some changes were made between the Saturday and Monday workshop sessions.

We did shift a few things on the second day of training based on some feedback from the first. But that was primarily giving people a little more of the big picture of what they were getting into (ISE_2-1_ASC_4849_032610).

In addition to the activities, the workshop also included a review of the overall timeline. This timeline included one-on-one opportunities to work with ASC staff members and to engage in prototype activities after the workshop. It also provided a specific date for the culminating event, thus avoiding the need for additional scheduling with multiple participants and providing a clear target and endpoint. Figure 8 shows the explicit timeline provided for scientists at ASC.

Scientist on Site Timeline	
December 12 and 14	Professional development workshop for participants Adventure Science Center, 8:30 to 4 p.m.
December to January	ASC staff partner with scientists to begin planning Scientists develop prototype Scientists test and evaluate *Option:* Present prototype to ASC staff, guests, or youth volunteers
January to March	Practice, present, and evaluate on floor with public visitors
March 27	Culminating event at ASC, title yet to be determined
March to Summer	Continue program, recruiting new scientists, plan new workshop

***Figure 8.* Timeline for preparation for *Scientist on Site* event.**

Even though this group of scientists had some of the highest levels of experience in informal learning environments, one PoP Team member reported on a feedback form:

I assumed that they [the scientists] had already had some of these experiences but was surprised to learn that the terminology and activities were new to the scientists, even the professors. I watched them progress from broad topics to basic ideas, and this was exciting to see. I could tell that they understood the importance of hooks and open-ended questions (ASC_PD_ISE_Feedback_122109).

As intended, the group of scientists developed and exhibited a sense of teamwork. In one instance, two individuals provided ideas that helped each other.

An architect who was planning a solar project . . . was trying to figure out how to build a house that would stand up with the crowds that we were anticipating. She came to work on her project *on the same day that the other person was working on houses for a project on epidemiology and decided to use the same technique for building her houses. When the epidemiologist ran into a problem because she wanted the houses to look nice and didn't know how to do the outside covering to make it look right, the architect shared her plan for how to make them look right. So, they really did problem solving for each other (ISE_2-1_ASC_4849_032610).*

In another instance, a mentoring-type relationship developed between two participants. Finally, one participant made a banner everyone could sign to celebrate the day of the public event.

There's a banner related to his work place, and he came up with another banner that he's going to get people to sign. But one of the things he wants to do is to use that to get each participant to sign it also. So I think . . . they see themselves as a community (ISE_2-1_ASC_4849_032610).

While plans for collaboration among the teams worked, the open-ended offer to allow prototyping was not accepted.

We had intended to have people to work on their projects and for us to schedule times for them to come in, present them to us and our visitors, and for us to debrief with them. People have been so busy that it's been really hard for them to have the time. Several people tried to set up times to do that, and then they had conflicts (ISE_2-1_ASC_4849_032610).

Evaluators received responses from 8 of the 15 scientists at the end of the implementation period (i.e., after the public event). The online survey had five responses and evaluators conducted three in-depth interviews. Scientists identified several strengths in the professional development workshop and follow-up meetings. Several respondents reported that an important element of the workshop was getting a clear understanding of the characteristics of the audience who generally attended the science center, particularly the number of young children under five or six years old who are part of typical visiting groups.

Saturday training day at the science center, involving everything from role-playing to just general information given out on . . . how we were going to deal with the public. What types of things would be effective in relating to our age group and the demographic that was going to be there, primarily the younger kids, of course. I think they did a really good job preparing us for this particular venue (SCI_3-2_ASC_6253_051910).

It would have been very easy for me to have not planned on that young a group, and that would have been a big mistake. And so I think that preparation at the science center in advance, focusing on that younger age group was . . . really important. And it turned out, in retrospect, was a good decision (SCI_3-2_ASC_6253_051910).

Another respondent, who had participated in science outreach as an undergraduate and now as a graduate student, reported the following:

> *I've done a lot of teaching and done a lot of science outreach. I've never really had any structured education or mentoring. And how to really bring the idea of inquiry into an educational activity. So I found that really helpful . . . to see . . . various science center staff members do it. But actually get to slowly . . . go through and lead a semi-structured inquiry activity (SCI_3-2_ASC_6884_052510).*

Finally, the level of support in developing ideas and providing materials was noted by both interview and survey respondents:

> *[PoP Team members] both helped me brainstorm how to create my project. I ended up using cardboard boxes and folders to create [miniature] houses [to simulate a neighborhood setting]. . . . So that was helpful getting that interaction. . . . They gave a ton of different ideas and examples that they had that I could use and that was the one I went with (SCI_3-2_ASC_8782_051910).*

On the online survey and in in-depth interviews at the end of the program, scientists also made some recommendations for changes and improvements. The two most frequently cited changes were recruiting more scientists to participate (two respondents) and more time or additional sessions for brainstorming with the PoP Team or other scientists (two respondents). On the *Professional Development Feedback* form for the workshop, the PoP Team reported that adjustments were made to provide more time for participants to exchange ideas and develop concepts.

In addition, three respondents noted that Saturdays for workshops and events were difficult times for some people. This ongoing tension about time was reflected in an in-depth interview:

> *A lot of people [scientists] have kids and so weekends are really difficult. . . . In an ideal world a second session to network about the projects would have been helpful to some (SCI_3-2_ASC_8782_051910).*

Public Program

ASC held one large-format event from 11 a.m. to 3 p.m. on Saturday, March 27, 2010. The event, titled *Got* Science*?*, had two components involving 25 table-top activities located in galleries on both floors of the building. One component, *Scientists on Site,* included 15 presentations by scientists who had participated in the PoP professional development workshop. These were located on the first and second floors. In addition there were 10 *NanoDays* activities hosted by student volunteers from Vanderbilt University and Tennessee State University. Two evaluators attended this event, observed engagements, and interviewed visitor groups. Figure 9 provides an overview of this large-format event.

ASC Public Program
Got Science?
"Scientists on Site"

- Saturday, March 27, 2010
- 11 a.m. to 3 p.m. (4 hours)
- Materials-based/table-top activities
- Large event: 15 PoP science-based professionals & 10 hosted *NanoDays* activities
- Offered once
- Location: 1st and 2nd floor galleries matched to topics
- Attendance reported: 506 (ages 13 and over) and 379 (ages 3 to 12)

Figure 9. **ASC public program.**

In in-depth interviews, members of the ASC PoP Team explained their rationale for combining the two components of the program.

> *The reason why we combine nanotechnology with [Scientists on Site] was because we already have this resource that [NanoDays presenters] were part of. . . . [NISE Net] provides us with these kits, and so well why not throw them in with this event because it just gives a lot of hands-on activities for the kids to do, too, as part of it. And it all relates to scientists. And some of these volunteers that are coming are research scientists that are coming to share their nano research with the kids (ISE_2-1_ASC_6254_032610).*

The large-format event had considerable marketing support. ASC reported that the event was attended by 506 adults (ages 13 and over[8]) and 379 children (ages 3 to 12).

> *[Our marketing director has] been working hard for two weeks now helping to get ready for this event. . . . We're making things to give away. There are buttons. She's creating the program. She was doing the in-house marketing website. Marketing to press releases, all those things, all the things a marketing person does to get the word out. . . . It is but we're not really marketing it as NanoDays. We have nanotechnology as part of our* sciences *that is being touched on today. The focus is on . . .* Got Science*? And so our Scientist on Site [is] one component of that and then our volunteers manning nanotechnology tables [is another] (ISE_2-1_ASC_6254_032610).*

While PoP Team members noted they were short-staffed during the day, evaluators observed a well-organized and smoothly running large event with particularly high levels of attendance on a spring day with good weather. While none of the visitors were from school groups, evaluators talked with several homeschool families who used the event as a field trip as part of their curriculum. Most of the homeschool families with whom we spoke said they were members of ASC and had received an email about the event.

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[8] Age categories are those used by ASC in reporting attendance.

A program listing all the activities and their locations was given to visitors at a table near the lobby as they entered. They also received a long strip-shaped game card titled *Eye Spy,* which they could use to collect ink stamps at each station. This game card allowed them to track what they had visited and what they had not. The program also listed the locations of the 15 programs, the name of the presenter, and his or her area of expertise.[9]

First Floor, Space Chase

1. Would you like to solve the health mystery? (epidemiologist)
2. Would you like to hear the sun play a song? (electrical engineer)
3. How can you reduce your water footprint? (architect)
4. How can we predict the weather? (meteorologist)
5. What happens to your body in space? (orthopedic surgeon)
6. How would you exercise in space? (cardiologist)
7. How can you make electricity from the wind? (mechanical engineer)
8. Which bead do you live on? (astrobiologist)
9. How can you let more sun into your home? (architect)

Second Floor, Space Chase

10. Would you like to build a bloodsucking bug? (medical entomologist)
11. Would you fly a kite in a thunderstorm? (environmental engineer)
12. Can you help me untangle these nerves? (neuroscientist)
13. What determines when a baby is born? (statistical geneticist)
14. What's the best way to move freight? (engineer)
15. How can you make a faster car? (engineer)

At each presentation location, tables were available for activities. In addition, the PoP Team provided signs, such as that shown in Figure 10, which clearly identified the scientists, area of expertise, and the name of the presentation. This signage, along with the event program and *Eye Spy* game, helped visitors find and remember multiple presentation experiences.

[9] Names are not listed because scientists were promised anonymity when possible.

Figure 10. **Signage at ASC for PoP presentations.**

The PoP Team, scientists, and general public visitors reported positive overall perceptions of the event. Only two comments on the online survey recommended changes in the event. One noted that shorter public events would be better, and the other asked for better lighting at presentation tables. In addition, another presenter, recognizing the value of the *Eye Spy* game in helping visitors identify and find all the presentations, suggested changing the game.

> *And what was happening is many of the kids would run up to the exhibit and say, "Where's the letters, where's the letters?" [To] make this process better each child would need to turn in one salient point about each exhibit so that they would at least have to engage in some conversation with the exhibitor (SCI_3-2_ASC_6253_051910).*

Summary of ASC Case

ASC application of PoP strategies, materials, and approaches clearly was the most complete of any of the locations. A community with a large number of prospective university, association, and business partners clearly supported the implementation, as did a fairly good economic climate. A large number of scientists were recruited and participated in both professional development and public programs. This recruitment appears to have been influenced by ongoing relationships with members of the PoP Team. Remarkably, all those who attended the professional development workshop presented at the large event.

The large-event format was well-suited to the institutional experience. The event was well-attended, with indications of effective marketing and with thought to methods that allowed visitors to find and navigate the multiple presentations throughout the building. Signage and programs clearly supported visitors' learning. Science topics were connected to exhibition galleries. Influential factors in this case appear to be the selection of experienced educators to implement the program. They made well-considered decisions about the amount of time scientists could and would commit. The size of the group of scientists allowed the development of a sense of collaboration and camaraderie.

Discovery Center Museum

Figure 11. **DCM logo and photographs of activities and materials at public program.**

Of all the applications of the PoP strategies, materials, and approaches, the Discovery Center Museum (DCM) case appeared to provide the deepest experience for scientists and to result in a long-term relationship with a local medical school. Official PoP participants were two medical students fulfilling a 36-hour commitment as part of their curriculum. These are the only two "non-voluntary" scientists in the study. The case illustrates the effect of economic conditions on relationship building, as well as the value of sharing the PoP approach among staff members to raise awareness about the efforts. This case also includes reports from other initiatives at DCM to apply PoP approaches in less time-intensive ways to less effect. These efforts are instructive to others considering applying PoP approaches. Figure 11 shows photographs from the DCM public program.

Background and Context

DCM is located in Rockford, Illinois, a city of about 150,000 in a farming area. The city has a history as a manufacturing center *(World News Digest* database, *Encyclopedia*, 2010D), but many employers have left the area since the 1980s. The city is located about 100 miles northwest of Chicago, and DCM serves northern Illinois and parts of southern Wisconsin and Iowa. About 25% of visitation comes from the northern Chicago suburbs (*ISE-1-4_DCM_9068_100209*). During the time frame of the PoP implementation, total attendance was about 120,000 visits per year, including 100,000 visits from general public visitors and about 20,000 among organized groups. The museum had approximately 8 to 10 full-time staff members and 50 part-time staff members. Many part-timers were college students.

In interviews, staff members offered the opinion that the Rockford community probably perceived the DCM as a children's museum. One respondent called it a "children's science museum" and another termed DCM as a "children's/science museum hybrid." One explained:

> *And our community image might be a bit different than our internal image; we find a lot of people in our community refer to us as the children's museum. And even though we don't have children in our title, that is a big part of our audience (ISE-1-4_DCM_3045_092309).*

Create opportunities for joyful learning and discovery through hands-on experiences in science and art.

Figure 12. **Discovery Center Museum mission statement.**

Figure 12 displays the DCM mission statement. The museum has an extensive set of educational programs. Outreach efforts include involvement in a national effort, the *21st Century* afterschool program. The museum was the lead agency for this program in five public schools. Educational programming also is extensive, including preschool classes and classes for a large homeschool community. Classes and opportunities are offered from preschool through high school. Another staff member explained that extensive museum programming was a response to community economic conditions.

> *You have to understand that in our community, 17 percent of our community has graduated from college, and that's all . . . 95 percent of our kids in our afterschool programs are on free or reduced lunch. We have a tremendous underserved population. . . . [Rockford] was very much blue collar and industry has moved out of the country or at least out of the state. . . . I mean this was huge, tremendous manufacturing [center] (ISE-1-4_DCM_5852_093009).*

The museum itself was financially stable and growing. The Executive Director had served since 1985, and the center had just completed a successful joint capital campaign with the natural history museum next door. During the implementation of PoP, construction was underway to add space for classrooms, exhibitions, and office space to accommodate growth. While the expansion was perceived as a positive in terms of both community service and support, it also provided challenges during the implementation period.

> *Certain parts of the museum will have to be closed off at different times between now and next summer. [So we are] trying to . . . minimize any negative effects that has on our visitor experience and keeping people informed (ISE-1-4_DCM_9068_100209).*

Vacancies in staff positions among this relatively small staff were another factor affecting the implementation. The complement of 10 full-time staff members was down to 8, with vacancies in positions reporting to educational programming and outreach.

Preparation

PoP Team

The three core members of the PoP Team at DCM were the Executive Director, the Marketing Manager, and the Director of Education and Programs. Figure 13 shows the PoP Team at DCM. The Marketing Manager and Director of Education and Programs were selected to attend the Dissemination Workshop in Seattle from June 16 to June 19, 2009. In general, these two staff members primarily were responsible for the implementation. The Marketing Manager, who had been at DCM for six years in a three-quarters time position, took the lead on recruitment, building relationships, and marketing programs. The Director of Education and Programs, who had been at DCM for 10 years, took the lead in professional development and public programs.

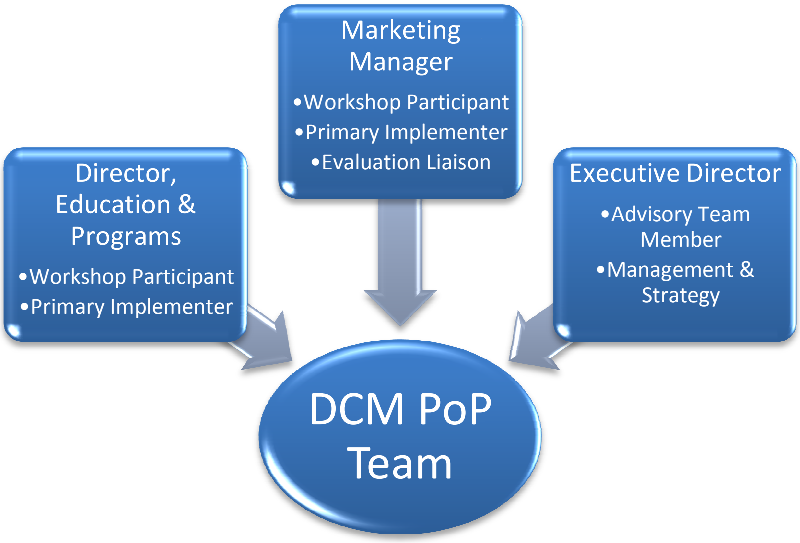

Figure 13. **DCM PoP Team.**

DCM was the only PoP user-group museum to include a member from marketing on its PoP Team and to send a marketer to the Dissemination Workshop. The Marketing Manager had been involved in developing community partnerships as part of a capital campaign. One perceived benefit of the PoP program was building relationships that could support future development efforts. The Marketing Manager brought her experience from the capital campaign to the project.

> *I'm also . . . involved in community partnerships. . . I see myself more as perhaps being the liaison between the scientists and our education staff [and] our exhibit staff here. Trying to find those scientists, maybe some initial meetings with them to get them on board and see the importance of [PoP] (ISE-1-4_DCM_9068_100209).*

The Director of Education and Programs was an experienced informal science educator who had worked in several science centers and museums for more than 25 years. She had extensive experience in training staff. She had managed events such as *Engineers Week, NanoDays*, and events for African-American scientists. Training for scientists had not been part of these efforts. She explained she was not originally slated to participate in the PoP program.

> *I was not the one who originally was going to do the POP training, but we lost that person to grad school (ISE_2-1_DCM_5856_031210).*

The Marketing Manager also had additional job responsibilities during the implementation.

> *We're in midst of expanding and . . . I've got to go through everything in all the marketing files and decide whether to keep it or not, and how to store it. Move our offices, think about the grand opening, and start to develop plans for that (ISE_2-1_DCM_9068_031210).*

Not surprisingly, given overall staff size, staff vacancies, and being in the midst of a major expansion, the amount of staff time required to plan and implement the program was a major concern throughout the implementation.

Conceptual Planning

Both DCM representatives found the Dissemination Workshop quite valuable. The Director of Education and Programs reported her perceptions of the benefits of the workshop and also its limitations.

> *Oh, for me personally, it got me fired up again. Like yeah, we could do this, this is going to be fabulous. Wow, this is great. . . . [The most valuable thing was] for me to actually see the scientists and talk to them and realize that . . . they want to do this more (ISE-1-4_DCM_5852_093009).*

The Director of Education and Programs would have liked more information from the collaborating partner museums about making decisions on budgeting and the selection of appropriate programs in which to implement the approach. She noted also that little planning time was available when they returned to work.

> *What I really would have loved to have is an extra day there. Because [the marketing manager] and I are going to have to take the day here and get offsite and actually sit down and do this, and that's really hard to carve that time out (ISE-1-4_DCM_5852_093009).*

Both DCM staff who went to the Dissemination Workshop said they found the conceptual planning process useful, particularly the process of putting it into writing. The plan was presented at a DCM staff meeting to build internal awareness and support. A quick overview of the DCM *Conceptual Planning Worksheet (POP_CPW_DCM_2009*) shows that the early ideas came from brainstorming that later was more narrowly focused. The plan cited pursuing partnerships with 11 local industries, 8 local research institutions, and several other clubs and projects. Ideas for public programs included materials-based table-top activities at several larger-themed events and smaller interactive events.

Partnership and Relationship Building

During the September 2009 interviews, evaluators learned about numerous efforts to recruit scientists to participate in PoP-related programming. All three mentioned *Engineers Week* as a program that looked like a good target for the implementation of the PoP programming. The Marketing Manager explained that *Engineers Week* looked promising because, over time, the engineers had begun using more and more hands-on materials and demonstrations. In addition to *Engineers Week*, the Executive Director noted that board membership provided relationships to the science and engineering community.

> *We have people on our board who work at various companies that are scientific in nature. Sometimes we have asked people to serve on advisory committees if we're trying to develop a new exhibit that might have something to do with what they do (ISE-1-4_DCM_3045_092309).*

DCM had also been involved with other projects presenting science careers and current science to the community. In one project, they trained local engineers to go out to schools. This project focused on how a scientific/engineering team might solve a problem. Additionally, DCM had a long history of retired engineers designing and building exhibits. They also noted relationships with the local medical school.

We have the University of Illinois School of Medicine here. And we get those students coming here to help us with dissection, for like shark dissection or eyeball dissection or whatever we're doing (ISE-1-4_DCM_5852_093009).

But as recruiting began, respondents from DCM found many of their efforts were not paying off. Contacts through a board member to a large food science company, which had appeared promising, were not followed through by the company. A marketing manager at a large manufacturing firm did not return phone calls. One respondent explained:

And then we went about trying to find our scientists. Now that proved to be a bit more difficult than we anticipated. . . . We have one of the highest unemployment [levels] in the nation. The highest in Illinois. And we're just really hurting here. And so lots of people have lost their jobs and as a result the people who were fortunate enough to still have their jobs are now doing the jobs of multiple people. . . . It was like you're lucky to have your job but you're unlucky to have your job because now . . . .your department has been cut in half and you're doing more jobs (ISE_2-1_DCM_9068_031210).

Respondents told us that when they talked directly with engineers who had participated previously in *Engineers Week* events, the situation became clearer.

These engineers that I was talking to were just so busy to even give up some time on a Saturday—one Saturday was a sacrifice. . . . The story that I would hear via email or phone calls [was] of people saying I can't do it this year, I'm just too busy. Or I would like to do something bigger and better, but I've just been assigned this additional project and I just can't do it. . . . Many of these people were already committed to our organization. So imagine somebody who's not committed yet (ISE_2-1_DCM_9068_031210).

One effort was productive, the result of sharing PoP experiences and information among the DCM staff: The DCM PoP Team offered a professional development workshop using PoP materials to staff members and presented information about the program at a staff meeting. The associate director of the museum, who had attended both these events, recognized a good match between PoP and the needs of the local medical school. The medical school was beginning a program requiring second-year medical students to participate in 36 hours of community service.

One of our board members is the dean of the College of Medicine. . . . We first talked to him and said, do you even think this would . . . work? . . . He then suggested a particular liaison at the college who oversees the activities of the medical students (ISE_2-1_DCM_9068_031210).

Two medical students chose DCM as their community service option. While PoP materials and approaches were used in other areas, this was, as one respondent characterized it, the "official" number of PoP participants recruited at this site.

Now the two med students are the official PoP people. We've done unofficial stuff, too—working with the extension office. Working with one guy who is a shark diver who has . . . blossomed into is a whole series of programs called Second Saturday Science *(ISE_2-1_DCM_5856B_031210).*

Figure 14 shows information collected via the *Scientist Participant Information Survey* at the first DCM workshop. One of the second-year medical students selected DCM as his community service option because he enjoyed working with young people and had previously done some work with the Chicago Children's Museum. The other second-year medical student had similar experience. She had worked at the Lawrence Hall of Science in Berkeley and had tutored high school students.

Profile of DCM Scientists

Number = 2

Gender
- Female = 1
- Male = 1

Career stage
- Grad school = 2

Level of education completed
- Masters = 2

Previous relationship
- Yes = 0
- No = 2

Area of work (multiple options)
- Life science = 2

Figure 14. **Profile of DCM scientists *(N =* 2*).***

Unlike PoP scientists at other sites, both these respondents participated in PoP as part of their educational requirements. These participants had a greater investment of time than any of the other scientists in the study. Yet these two medical students framed their experience at DCM in terms of the community service requirement rather than the requirements of DCM.

Professional Development

While the second-year medical students were the official PoP participants, the Director of Education and Programs also used PoP approaches with some other scientists. In the DCM conceptual plan, one public program option was an ongoing gallery-based program called *Second Saturday Science,* during which scientists would engage with general public visitors. This program began in September 2010. On two program feedback forms, the PoP Team member reported on her efforts to work by telephone with *Second Saturday Science* presenters to make sure they used hands-on, open-ended experiences with visitors. The first phone call took place in late September with one presenter and in November with the other. Her reflections on these conversations show how difficult it is to assess knowledge and skill levels based on information about previous experience alone.

> *During the first experience, we spoke too much in generalities instead of specifically finding out what the activities would be. Perhaps I was afraid of being too pushy or assertive. This was, after all, an experienced teacher who had done this presentation before at other locations. I was reassured by our conversation that this University professor's hands-on presentation the following weekend would be an open-ended experience suitable for multiple ages and ability levels. It was not. The second month with a different scientist, I was up front and specific about what was expected: hands on, multi-level, engaging. This did happen, but I don't think it was because of our conversation. Rather, this was already an engaging presenter with dynamite materials (a shark diver!) who knew how to work with a multi-age audience (the 40-foot blow-up shark helped, too) (DCM_PD ISE Feedback 092509).*

Based on these experiences, the Director of Education and Programs concluded:

> *The one-on-one activity development requires more time than a phone conversation and will be much more valuable when aligned with a series of other PDs [Professional Development Elements] which introduce or reinforce the nature of informal* science *(DCM_PD ISE Feedback 092509).*

A professional development workshop was offered to staff members. Part of the rationale for this decision appeared to be developing and prototyping the workshop activities and making staff members aware of the PoP program. But making this work count in multiple directions also seemed to play a role. With up to 50 part-time staff members and with frequent turnover among the many college students in these positions, the hiring and training of part-time staff is a continual and time-consuming endeavor. The Director of Education and Programs explained:

> *I want to get my floor staff or my educators to understand this is how you do informal science. It is so different from even the afterschool setting. And it's so different from camp-ins. [This is] the "walking up" public. . . . How do I get them to be interested in what I'm doing. . . . It's just a whole different animal (ISE_2-1_DCM_5856B_031210).*

The first staff workshop was held on November 5, 2009, with floor staff members, and the second on November 12, 2009, with camp-in staff members.

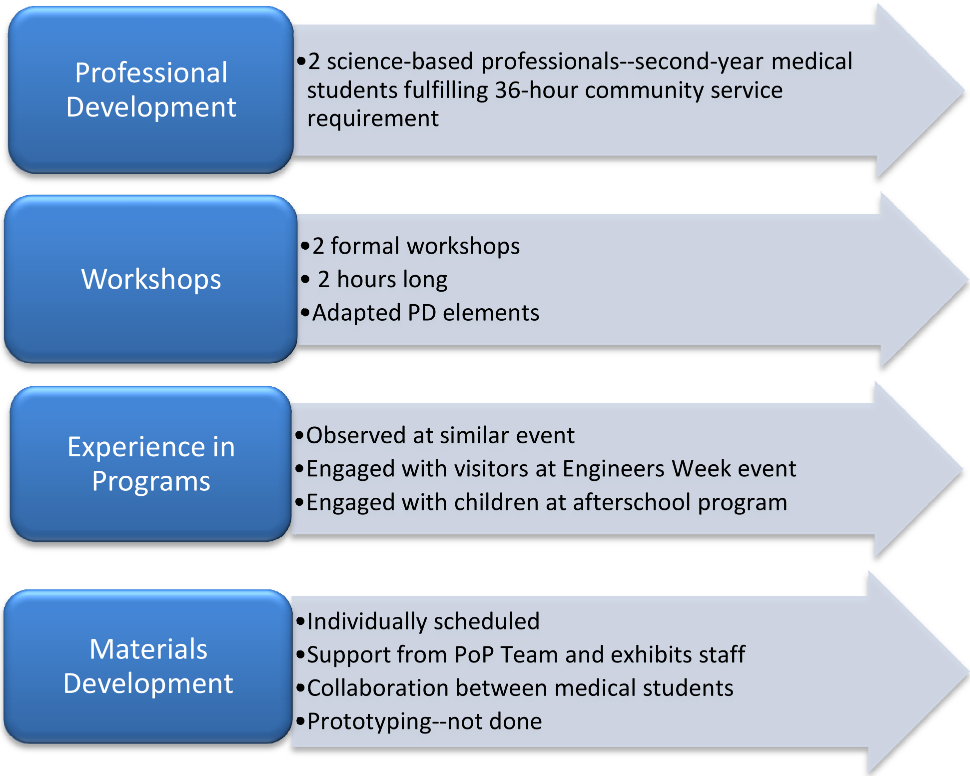

Figure 15. **DCM professional development.**

Figure 15 summarizes the professional development of the two official PoP scientists at DCM. The first training session for them was held on February 2, 2010 (*DCM_PD ISE Feedback 020210*). Their professional development included two workshop-type sessions and several other experiences, such as visiting an afterschool program, assisting at *Engineers Week*, and observing exhibit prototyping. In the workshops, activities from the *Professional Development Elements Catalog* were used, including *Making Meaning, Sharing a Common Vision, Hooks, Brainstorming,* and *Concept Mapping*. The director explained:

> *We also literally gave them time away from their studies without other distractions to enable them to sketch out what it is they wanted to present. . . . I was surprised at how quickly they knew what aspects they wanted to present, and their enthusiasm for sharing (DCM_PD ISE Feedback 021910).*

The next professional development session involved meeting with program and exhibits staff to discuss their topics and how to create open-ended visitor experiences. Thinking began about "…the nuts and bolts of fabricating props, itemizing materials needed, and ordering supplies" (*DCM_PD ISE Feedback 022310*).

The medical students also received support from the exhibit department in constructing exhibits as well as from teen volunteers who painted some items. The museum also produced signs and labels for the activities.

They gave us resources. . . . They had a machine shop [with] engineers that worked in the machine shop. And we could give those ideas and they'd. . . make props for us (SCI_3-2_DCM_7777_061110).

Through observation and working on the museum floor at events, the medical students refined their understanding of how to work with visitors.

We went to a couple of [Second Science Saturday] *events where we walked around and acted like a fly on the wall. Just observed what went on at these types of events . . . what we could expect. What kind of traffic that we could expect on the day that we had our event (SCI_3-2_DCM_7777_061110).*

[We worked] at a station with . . . Toy Connects. *. . . And [visitors would] come and we'd help them build it. . . . It gave us an opportunity to . . . approach children and talk to them (SCI_3-2_DCM_7777_061110).*

They also tested their ideas with teen interns at the museums.

Something that I thought of that kids would be bored with, they loved. And there was something that we thought that kids maybe would just . . . eat up and be really interested in . . . they just shrugged it off. So it really helped us to fine-tune . . . what our project was going to be about (SCI_3-2_DCM_7777_061110).

It's clear that the time commitment for this level of professional development was challenging, despite the fact that this was a medical school requirement. Both respondents discussed the time commitment. On the online survey one pointed out, "I had a hard time finding time in my own schedule for the development end." The other noted:

Being busy with school— this wasn't something that we had . . . endless amounts of time to do. We were still going through classes and—and tests . . . just as we normally did. And so . . . we were doing this . . . on the side. . . . On average we put in about six hours a week. So it wasn't any enormous amount of time . . . at any one time. But over the course of the few months [it mounted up] (SCI_3-2_DCM_7777_061110).

A program strength cited by the scientists was the attitude and expertise of the staff members with whom they worked.

I think that was very helpful having someone who works at the level of educating children and doing this on a regular basis working with us. Because otherwise, I don't think . . . we could have quite come up with the same ideas about how to express something (SCI_3-2_DCM_6581_052610).

One of the medical students reflected on the difference between communicating information and the process of designing a presentation.

Working at the [Lawrence Hall of Science], basically, all of the curriculum was developed ahead of time. And so this was really the first time that I started from scratch and said, okay, what are important things or the interesting things about medicine that I think would appeal to a child? So it was starting from the very beginning of developing what I wanted to do that I hadn't done before. And I think that was really valuable just to think in terms of what's going to make it interesting, what's going to make it fun, what's really going to stick, what's going to resonate with a kid (SCI_3-2_DCM_6581_052610).

Public Program

DCM Public Program

Second Saturday Science

"Junior MD"

- March 13, 2010
- 1 to 4 p.m. (3 hours)
- Materials-based/table-top activities
- Medium-sized event: 4 science-based professionals
- Part of ongoing series
- Locations: Body Shop gallery
- Attendance reported: Adults = 179 and Children = 215

***Figure 16.* DCM public program summary.**

The *Second Scientist Saturday* program developed by medical students (the official PoP participants) was presented Saturday, March 13, 2010, from 1 to 4 p.m. in the Body Shop gallery at DCM. Figure 16 includes a summary of this program. Public relations materials described the program as follows:

> ***Junior MD***
> *What do doctors look for when they make you say "Ahh" or look in your ears? Find out as you get the inside scoop on diagnosing diseases. Look through microscopes, test for germs, and listen through a stethoscope, and use real medical equipment. Med students from the U of I School of Medicine are on hand to teach you what doctors really do! (POP_DCM_second sat sciencePR_ 031310).*

The marketing and public relations efforts for the event included press releases, articles in the member newsletter, and notices posted on the web calendar.

The Body Shop exhibition gallery is on the second floor of DCM. Activities were grouped into two areas and anchored by three large exhibits produced for the program: a throat with pus, an infected ear, and a cast. One area (two long tables) included activities developed by the female PoP participant. These focused on different types of germs and the process of diagnosing diseases. A hand-washing station, hosted by a DCM staff member, was located nearby. Also nearby, located on one long table, were activities related to diagnosing broken bones and other aspects of making a physical diagnosis. The male medical student was not able to be present for the program. The female PoP participant and three other medical school students (two females and one male) engaged with the public. All wore their white lab coats over casual clothing.

One evaluator observed the medical students as they engaged with members of the general public during this program. The area was very crowded with groups of adults and children. Children's ages ranged from babies to about 11 or 12 years old. During the general observation, the evaluator saw many groups using most of the activities, with stay times that ranged from about five minutes to nearly an hour.

Summary of DCM Case
DCM use of the PoP framework, strategies, and materials shows the influence of economic conditions and business response to them in a community. The DCM case also reflects the challenges of implementing a new program during a period with staff vacancies and the opening of a major renovation. Clearly, the PoP Team would have liked to have larger numbers of scientists participating in the program. Yet this implementation may have resulted in an important ongoing relationship with another community institution.

Discovery Center of Springfield

Figure 17. **DCS logo and photos of public programs.**

Discovery Center of Springfield (DCS), building on strong community involvement and previous relationships, recruited 11 scientists who participated in professional development. They offered the most extensive set of formal workshops, beginning in October 2009 and concluding in February 2010 with a prototyping session. On the other hand, this format appeared to have experienced some attrition, with some scientists not attending all workshops and a few dropping out. The application of the PoP approach at this location was very focused on a specific gallery area and addressed a longtime goal at the institution—that is, having local scientists share their research onsite with visitors. In earlier efforts toward this goal, research laboratory facilities had been added to a gallery area of the museum. Yet prior to the program, only one scientist had conducted his research at the museum. Figure 17 shows photos of the DCS public program.

Background and Context
DCS is located in a city of about 150,000 in southwestern Missouri. The city of Springfield experienced rapid growth during the last half of the 20th century and is a regional center for healthcare, manufacturing, and transportation. It is also located close to several popular tourist areas in the Ozark

Mountain region. Area colleges and universities include Baptist Bible College, Central Bible College, Drury University, Evangel University, Missouri State University, and a campus of the Ozark Technical Community College *(World News Digest* database, *Encyclopedia*, 2010E). Figure 18 shows the DCS mission statement.

Discovery Center of Springfield is an interactive, hands-on museum committed to inspiring people of all ages with a life-long love of learning and an appreciation of the world and our place in it.
(Discovery Center of Springfield, 2010A)

Figure 18. **DCS mission statement.**

DCS has about 12 full-time and 15 part-time staff members and regularly serves a 35-county area with an attendance of about 100,000 visitors per year. Schools are an important audience, but family and adult audiences are growing.

> *And I would say 60 percent [school] field trips, 38 percent families, and 2 percent adults. . . . And we're definitely seeing more young adult audience. We're seeing people here for dates. We're seeing college couples here. We're seeing college kids. It's not a lot, but certainly more than ever in the past. (ISE-1-4_DCS_7667_093009).*

DCS incorporated in 1991 and expanded the downtown facility in 2006, becoming the first Leadership in Energy and Environmental Design (LEED) Gold-certified building in southwest Missouri (Discovery Center of Springfield, 2010B). This certification is one example of efforts to provide innovative programs and exhibits for visitors. The CEO and other staff members noted an awareness of the relationship between innovation and staff workloads.

Like most areas of the country, the Springfield area was somewhat affected by the economic downturn during the time frame of the implementation. On the other hand, the Springfield community leaders were engaged in active economic development. One such effort is the Jordan Valley Innovation Center. The CEO of the DCS is on the board of this research and development incubator.

> *This project, under the umbrella of Missouri State University, also had corporate partners. Scientists there conduct research related to nanotechnology, material sciences, and biotechnology (ISE_2-1_DCS_0004_031910).*

DCS staff members also mentioned that the institution maintained an awareness of the religious and political context of the community. In the past, some public requests had been made to remove an exhibit portraying a geologic time frame. The concept of evolution has been handled carefully. In addition, during the time frame of the study, an amendment to the Missouri State Constitution restricting stem cell research was on the ballot statewide (*ISE-1-4_DCS_7667_093009*). It is within this context that DCS aimed to be a community site where citizens can find trustworthy science information. To the CEO and staff, that had long meant having scientists at the center.

We're . . . trying to be a credible resource. . . . Not just a place to come and play for little children. . . . We're definitely a science center, not a children's museum. . . . . If we're a science center, then we need to have scientists here, and this is a way that we can afford to do it (ISE_2-1_DCS_5060_031910).

Preparation

Figure 19 shows the PoP Team members at DCS. With four members, DCS had the largest PoP Team among the five sites. The CEO served on the PoP Advisory Team and maintained an active interest in both recruitment and programming. Two staff members attended the Dissemination Workshop in June 2009. One individual was a part-time employee whose job had been created with an eye to her role in coordinating the PoP program. With the job title of Life Science Assistant, she worked 30 to 35 hours per week, with an estimated 10 hours per week for PoP and additional responsibilities in the Health Science Galleries. The other primary implementer was the Health and Life Sciences Coordinator. During the implementation, her responsibilities changed as she was promoted to Director of Visitor Experience[10]. In her previous work in the health sciences area, she had developed relationships with scientists in the community. While the relationships and expertise of this experienced professional appeared essential to the project, her new position and the implementation of PoP exerted considerable pressure on her time and priorities. To support the project as the less-experienced professional gained confidence in her role, the Education Director served as a mentor for the Life Science Assistant, looking over professional development presentations and making recommendations. She also served as the evaluation liaison and provided back-up for logistical support in scheduling and providing food for workshops. In her supervisory role, she reviewed conceptual plans for recruitment and public programs and played a role in making decisions.

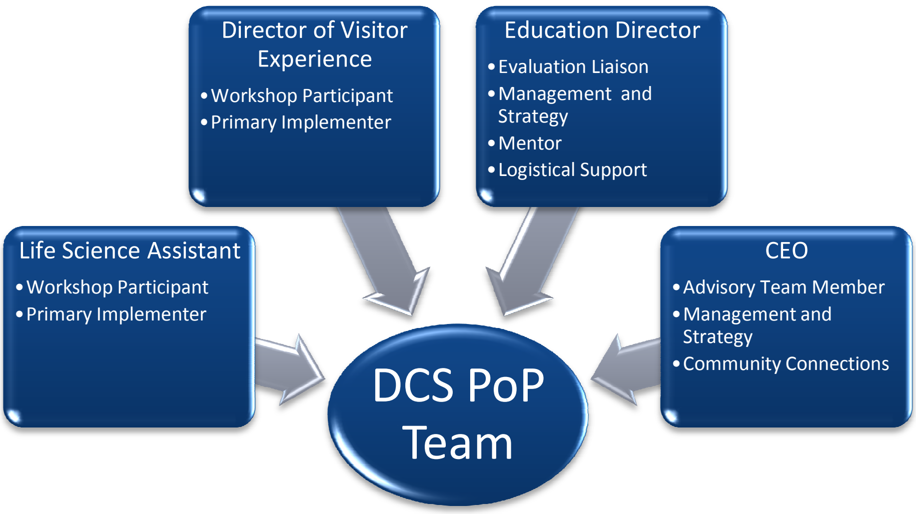

Figure 19. **DCS PoP Team.**

From the beginning, DCS planning focused on two areas: (1) making better use of the Resident Scientist Lab; and (2) making the center a place the public perceived as a credible and trustworthy science

[10] Past this point in the report, this individual is referred to as the Director of Visitor Experience.

resource. This Resident Scientist Lab was added during the 2006 renovation. One respondent explained the goals for the space:

> *To provide a venue for scientists to directly communicate with the general public about their work. . . . Another goal was [for scientists to do] their research, collecting their data, at our site, in our lab, in front of the public. . . . by seeing scientists actually doing their work we would . . . spur kids to . . . take an interest in a science career, and their accompanying adults be less intimidated by science (ISE-1-4_DCS_7667_093009).*

Early in the implementation, the *Conceptual Planning Worksheet* cited several opportunities for incorporating PoP into special events.

> *DCS has a variety of public program formats that lend themselves to PoP. We plan to provide tabletop space for the Meet a Scientist nook near the Resident Scientist Lab, as well as add PoP scientists to the public demonstration (Brain Bytes) schedule. Future opportunities to include PoP scientists include Special Event Days (e.g., DNA Day or Earth Day) and presenters at our quarterly Science Cafes. We are also considering adding "Meet a Scientist Saturday" to our event calendar on a regular basis (POP_CPW_DCS_2009).*

The initial plan also included a very clear strategy of focusing recruiting efforts on university research scientists.

> *We felt the best approach for gathering scientists to participate in PoP would be to focus our efforts on science researchers in the academic setting, many of which have already shown a great interest for being involved with DCS as either science resources during program development, participants in public special events, or researchers in the Resident Scientist program (POP_CPW_DCS_2009).*

Partnership and Relationship Building

The PoP Team at DCS had set a goal of recruiting five scientists. In her previous role as the Health and Life Sciences Coordinator, the Director of Visitor Experience had developed some long-term relationships with universities and scientists.

> *We've had a long-term relationship with Missouri State University, faculty and staff members [from the] the get-go with Discovery Center. . . . And those faculty members have since become deans and then been able to connect us with some of the vice president-level people (ISE-1-4_DCS_7667_093009).*

She explained that the relationship with Drury University was not as active as that with Missouri State University, but faculty from Drury had served as consultants. The third group targeted was the Jordan Valley Innovation Center, where the DCS CEO served on the board. This group was currently sponsoring Science Cafés. In addition, retired scientists volunteered their time on the floor at DCS and some had presented in programs.

> *We have had scientists and engineers do career exploration presentations. So a couple of years ago I put together—a huge summer camp for girls only on engineering. And each day there was*

an engineer, a female engineer from a different area of engineering that came and talked to the girls for 30 minutes about how she got into engineering and what her job looks like (ISE-1-4_DCS_7667_093009).

The overall recruiting strategy built on these relationships. One staff member reported 10 responses from the 15 emails that were sent. The PoP Team held a one-hour open house in September 2009 to explain the program. The Director of Visitor Experience further described the efforts.

So it was an electronic invitation email, and then followed up with that same letter and a little flyer, hard copies mailed to them. I drew together from the original group of scientists that were interested in the resident scientist lab. Or those that had helped in some type of program with me through health and life science in the past. . . .I first made contact with a large portion of this group in 2003 for the 50th anniversary of DNA, the Watson–Crick paper. . . . [At the initial open house] we had representatives from one, two, three, four labs. But one lab sent two reps, two graduate students that are working on different projects in the same lab. So essentially the introductory meeting yielded five activities (ISE-1-4_DCS_7667_093009).

While no scientists from Jordan Valley Innovation Center participated, all the PoP Team members were pleased and satisfied with their recruiting efforts.

I think it was phenomenal because we were hoping we would get five people to commit. Because when you look at what we asked people to do, those four Saturdays and they were full days. . . . I think the fact that we doubled what we were hoping to accomplish is just amazing. So it far exceeded, I think, all of our expectations (ISE_2-1_DCS_0004_031910).

Figure 20 shows the characteristics of the 11 scientists who participated in at least one of the professional development workshops. This group encompasses a wide range in terms of gender, education, and career stage. The lower levels of education reflect the undergraduates and graduate students who accompanied faculty members to the workshops. Not surprisingly, given the recruitment strategy, 6 identified their areas of work as life science and 5 reported doing research. In addition, 5 of the 11 respondents reported having a previous relationship with DCS.

Profile of DCS Scientists

Number of respondents = 11

Gender

- Female = 4
- Male = 7

Career stage

- Grad school = 4
- Post-doc/entry = 2
- Established (3-6) years' experience = 2
- Established (6+) years' experience = 2
- Retired = 1

Level of education completed

- High school = 2
- Undergrad = 2
- Masters = 3
- Doctorate = 4

Previous relationship

- Yes = 5
- No = 6

Area of work (multiple options)

- Life science = 6
- Physical science = 1
- Research = 5
- Applied science = 2

Figure 20. **Profile of DCS scientists.**

Professional Development

Figure 21 provides an overview of professional development at DCS. The PoP Team at DCS used the largest number of Professional Development Elements of any of the sites and, with the February workshop, was the only site at which scientists prototyped their activities prior to the official public program.

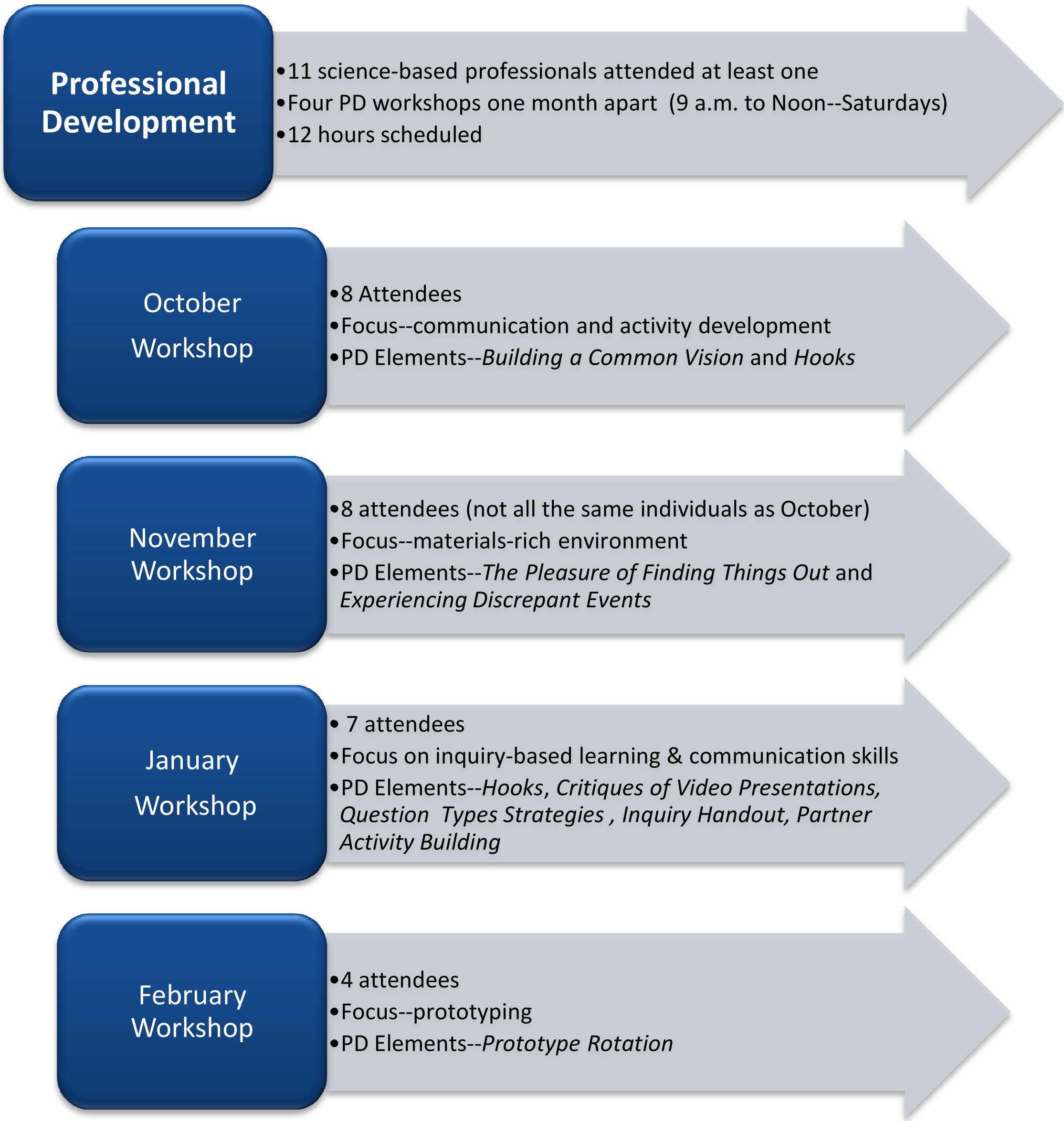

Figure 21. **DCS professional development.**

The PoP Team evaluated each workshop and made adjustments based on this feedback.

> *At the end of each workshop we had a very brief three-question [survey]. . . . The most concerning comment because we got it . . . was something to the effect of, I don't understand why I have to come for nine more hours of professional development. Yeah, and we were like, whoa. Uh-oh. We need to change this perception. Something's not clicking for some people. And that was because . . . the first one was really boring, it was paperwork and—and an introduction thing. And it was boring. . . . [Changes were made] and the next one was very fun (ISE_2-1_DCS_7667_031910).*

Prototyping appeared to be a valuable experience for those who participated.

> *Three out of six [science-based professionals] tested their presentations. And it was very beneficial for them. The ones that attended that prototyping session experienced exactly what we hoped they would. The multi-age audience and shifting gears from talking with a retired couple to figuring out how to talk about DNA to a three-year-old. They also were exhausted. They could not believe how tired they were after presenting their concept again and again and again and again and again and again in that one hour (ISE_2-1_DCS_7667_031910).*

Among all the locations, DCS had the highest number of hours of scheduled professional development workshops. In addition, the workshops were spread over the longest period of time. Some scientists dropped out. Even among those who completed the program and planned to present in the public program, not all attended each session.

> *We did have a couple drop out of the program. So for sure we have six projects, and some of those projects are team projects, so we have 9 or 10 scientists total (ISE_2-1_DCS_7667_031910).*

Evaluators asked PoP Team members if they would offer this number of workshops again.

> *We would . . . do four workshops; I think it was a minimum number. I was almost like we need more. Because we did not give them [enough] time to work on their project during our workshops . . . . But we did give them 30 to 45 minutes of activity planning time at each workshop. (ISE_2-1_DCS_7667_031910).*

There were only two responses to the online survey and one in-depth interview (with a different respondent). The responses were consistent, however, with other information and appear useful. On the online survey, respondents—both forensic scientists—included an experienced professional and her graduate student. They estimated they had spent about 35 hours participating in the PoP program as a whole—a far higher estimate than for those at other locations. On the online survey, respondents commented on this element as a challenging aspect of the program, and several noted finding time to attend the workshop was challenging.

On the online survey they described the activity their group had designed and tested:

> *Participants cracked open cells, released DNA and used it to match items to their owners (as is done in the forensic realm) (POP_SCI-3-1_Online Survey).*

One of these online survey respondents found the experience of dealing with the public at the prototyping session most valuable.

> *Nothing can really prepare you for dealing with the public—other than dealing with the public (POP_SCI-3-1_Online Survey).*

The other cited the value of the professional development.

I thought I knew how to teach, but the staff gave me many new and productive ideas (POP_SCI-3-1_Online Survey).

The scientist who was interviewed reported that the professional development raised his consciousness about the challenges of communicating with visitors.

I think probably the most important thing is [that the workshop] raised my awareness of what many of the problems are. And ways you have to try and assess what the knowledge is of the person you're talking to, as well as how to not talk in scientific-ese if you will. Try to communicate in rather clear language, but accurate, and know exactly what you're doing so they would understand it. So I think the training was . . . quite useful and maybe surprising in some respects for what it showed you (SCI_3-2_DCS_9730_051910).

Public Program

One staff member noted that preparing for the workshop series and initiating a new program had required a great deal of time and preparation. The initial plan was to launch *Scientist Saturday* and then begin implementing PoP as part of Science Cafés (ISE_2-1_DCS_8184_031910). In practice, only one public program was offered during the implementation period that ended March 31, 2010.

One PoP Team member explained the rationale underlying the *Scientist Saturday* program.

The idea that emerged . . . to pick a day that would be busiest, [have] the most traffic flow through here, which is Saturdays. . . . And so we decided to market a launch of this program, this Scientist Saturday*. And then have everyone that's participating, all of our scientists on a rotation schedule, that way they don't have to be here all the time, but maybe once a month. At least through the end of the summer to be here at the Discovery Center on Saturdays. . . . (ISE_2-1_DCS_8184_031910).*

She explained also that the marketing director played a large part in the launch of this new program by developing signage, press releases, and advertising. The Spring 2010 DCS newsletter *Imagine* (Discovery Center of Springfield, 2010C) featured the launch of the program with an article and listing of the names of the eight scientists, their positions, institutions, and names of their presentations. Five of these scientists were from Missouri State University, representing the molecular and biomedical sciences areas. One was a professor of biology at Drury University, one was a retired geophysicist from the U.S. Geological Survey (and museum volunteer), and one was a forensic scientist from the local crime lab.

In interviews, one PoP Team member was concerned about the event location, noting that it was not in an area with high traffic. The public program feedback indicated considerable attention had been given to providing signage for this event and that a more permanent presentation space was under construction (*DCS_PP_ISE_Feedback Form 032010*).

DCS
Public Program
Scientist Saturday

- March 20, 2010
- Noon to 4 p.m. (2-hour shifts)
- Materials-based/table-top activities
- Small event: 2 science-based professionals
- Number of offerings--once during implementation; ongoing
- Locations--exhibit gallery "nook"
- Attendance Reported--196 (age 16+ from 10 a.m. to 5 p.m.) and 234 (ages 3-15 from 10 a.m.-5p.m.)
- Evaluator estimates of visitors engaging with scientist--Adults = 20 and Children = 50

Figure 22. **DCS public program.**

Figure 22 provides an overview of the public programs at DCS. The *Scientist Saturday* public program on March 20, 2010, was the first in this series of new programs, and two scientists presented in the nook near the Resident Scientist Lab.

One evaluator observed two programs at this event, *Magnetic Properties of Gemstones* and *Green Fluorescent Protein and Glowing Worms*. The gemstone presenter sat at the table and engaged with visitors. About 25 feet away in the Chromosome Gallery areas, the other presenter used an exhibit he had helped develop. The evaluator observed fairly constant traffic flow, with a few gaps, through the area and estimated each presenter spoke to five or six groups.

Summary of DCS Case

In addition to the success in recruiting by building on existing relationships and the extensive set of workshop offerings, DCS also had a staffing strategy of note. As with other locations, workload issues were of concern. DCS's solution was to add a part-time staff member to grow into this project. To support this process, DCS had four team members rather than the two or three at other sites. The extent of time DCS asked scientists to commit to workshops mirrored that among the collaborating institutions that developed the program. In this case, there was attrition over time.

Explorit Science Center

Figure 23. **ESC logo and public program photos.**

In terms of yearly attendance, Explorit Science Center (ESC) was the smallest of the locations to use the PoP framework, strategies, and materials. It was the only site at which a primary implementer of the program did not attend the Dissemination Workshop. This observation provides some insight into the importance of that experience, particularly in using the Professional Development Elements. In addition, ESC had fewer scientists and science-based organizations that had participated in public programs than at some other locations. The story of ESC's recruiting efforts is instructive. While this location had some financial stresses during the implementation period, it implemented a small-format program and offered three public programs as part of a new series called *Meet the Scientists*. Figure 23 shows photographs from an ESC public program.

Background and Context

ESC is a small institution located in Davis, California, in the Sacramento Valley, a thriving agricultural region in the central valley of California. Davis has a population of about 60,000 but is located just 15 miles from Sacramento, the California capital and center of a metropolitan area of about 2.5 million. In the early 2000s, this was one of the fastest growing metropolitan areas in the United States. The University of California–Davis, a land-grant university, is a central element of the community and is noted for schools of agriculture, veterinary medicine, winemaking, and genetics research *(World News Digest* database, *Encyclopedia*, 2010A).

During the implementation period, ESC had 6 full-time staff members and about 17 part-time staff members. In 2009, attendance totaled 65,502 contacts, which included 19,507 contacts with general public visitors onsite, 6,832 school visitors onsite, and 39,163 in offsite programs. Thus, school and youth programs play a primary role in the educational offerings of ESC, with general public visitors (i.e., casual visitors, including families and adults) providing only about 30.0% of the attendance (*ISE_2-1_ESC_9180_032910*). Onsite general public visitors generally comprised family groups with children under age 12.

Figure 24 shows the institutional mission. Supporting this mission was an education philosophy focusing on everyday materials and connections with science in people's lives.

We engage people in science experiences that touch all our lives.

Figure 24. **ESC mission statement.**

Programs and exhibits were offered at the two ESC locations. One site, the ESC Nature Center, housed a majority of science center offices and classroom space where workshops were conducted. The other site, about a mile away, included galleries for general public visitation. This public site featured interactive exhibits and lab spaces. At the ESC public site, exhibit areas and meeting rooms were located on two floors, along with a limited number of staff offices. Because storage is limited at the public site, program materials stored at the Nature Center have to be transported to the other building for use.

Prior to the PoP implementation, scientists' involvement with the center had been limited to a few volunteers working with visitors at the public facility and a public lecture series. These *Cutting Edge Lectures* (CELS) focused on adults and teens and were held offsite in the Davis Branch of the Yolo County Library and the Davis Musical Theatre Company's building. Four to eight lectures per year were offered. ESC had offered professional development for teachers, and professional development for staff was offered through regular staff meetings (*ISE-1-4_ESC_4241_091609*).

During the implementation, ESC experienced some financial challenges requiring reduction of hours at the public facility (from being open six days to three days per week) as well as the layoff of staff members. These reductions appeared to influence decisions to keep the PoP professional development and public programs efforts within appropriate boundaries for staff time. In addition, the public location of ESC had small gallery spaces. Program size needed to match the size and traffic flow of these space requirements.

Preparation

Figure 25 shows the three members of the PoP Team at ESC. The Program Director and Executive Director attended the PoP Dissemination Workshop in June 2009 in Seattle. The Program Director and an educator, who reported to her, were primary program implementers. This educator served as the primary point person for the program. He coordinated recruiting, planned the professional development workshop, and scheduled public programs in conjunction with the Program Director. ESC was the only location at which one of the primary implementers did not attend the Dissemination Workshop. This exception makes the experiences and perspectives of this respondent particularly important because it emphasizes the contributions of the Dissemination Workshop to implementation.

The Program Director explained that all her staff had specific programs for which they were responsible, and this one had been assigned to this educator. She explained the roles in the implementation, noting the adaptation to individual schedules of scientists:

> *For the most part [the Educator] was involved in doing the majority of the recruiting unless [the Executive Director] or I had an individual connection with somebody. We would draft . . . recruitment letters, [check] scheduling [to see] when they might be able to come for a workshop of a program (ISE_2-1_ESC_9180_032910).*

Both the Educator and the Program Director taught the professional development workshop. The Educator clearly had substantial responsibility for the PoP implementation. Yet in in-depth interviews, the Program Director shared extensive files of letters, agendas, to-do lists for professional development and public programs, and copies of handouts and marketing materials that indicated she had both carefully monitored the entire implementation and worked in close partnership in the development and offering of programs.

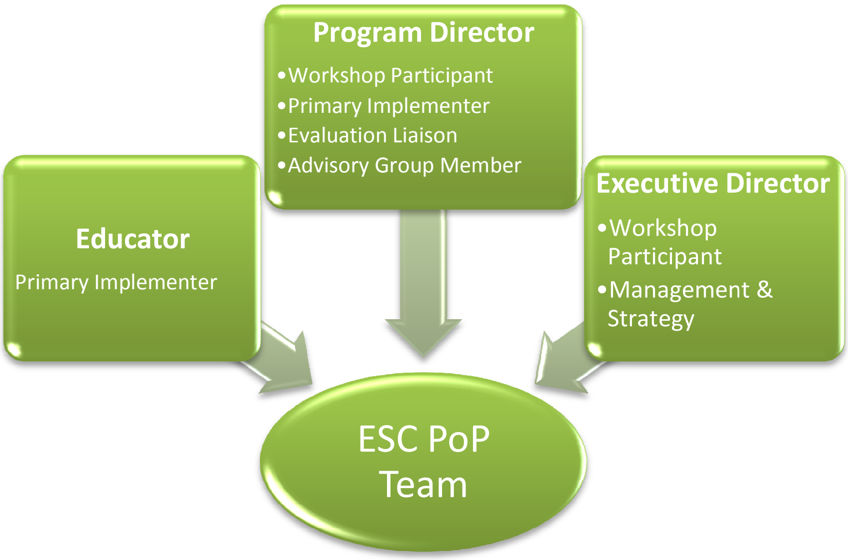

Figure 25. **ESC PoP Team.**

The Program Director had served at ESC for five years, beginning as an educator, moving into a position coordinating family programs, and then serving for the last two-and-a-half years in her current position. In this role, she supervised both program and exhibit staff members.

The Educator, whose other responsibilities included teaching field trips that visited ESC and traveling to schools, noted he was planning to attend law school and would be leaving ESC in August 2010. At UC Davis he had worked at the Teaching Resource Center and had developed a curriculum for university instructors on teaching.

> *Mainly because I come from a university teaching background, I used to teach graduate students at UC Davis how to teach (ISE_2-1_ESC_0227A_032910).*

Conceptual Planning

The conceptual plan was developed by the Program Director and the Executive Director, with much of the work done at the Dissemination Workshop (*ISE_2-1_ESC_9180_032910*). The *Conceptual Planning Worksheet* (*POP_CPW_ESC_2009*) shows a wide range of options considered. Several options were listed, with decisions being made about what appeared to work best as the process unfolded. The Program Director commented:

There were maybe some areas where we were. . . really ambitious, we wanted to start big and then we ended up going small (ISE_2-1_ESC_9180_032910).

The conceptual plan envisioned recruiting from Davis's business and industry sector as well as UC Davis. Four professional development workshops with follow-up materials development were envisioned, along with the incorporation of scientists into public venues (as was done) and into summer camps (undertaken after the end of the implementation period). All sites except ASC had similar gaps between envisioned and actual implementations.

Partnership and Relationship Building

As we noted previously, unlike some locations that began the implementation with ongoing relationships and existing mailing lists of scientists from previous programming, partnerships and relationship building appeared to begin at a much earlier stage at ESC. The PoP Team began by developing an awareness of PoP among staff and board members. Professional Development Elements and an overview of the program were presented at both staff and board meetings. Staff members completed some of the activities presented in the workshops.

We did something very similar with the board of directors. [The Program Director] and I went in and gave a brief talk about what is [PoP], using the mystery boxes again to try and get them to understand . . . what it's all about and what's going on and how it works (ISE_2-1_ESC_0227A_032910).

This strategy included staff members and board members identifying scientists who might be good prospects and then contacting the prospects by phone. The Executive Director made several of these phone calls.

Within the staff and board, we started with any personal connections that anyone had to any scientist, like a family friend or any business that their family worked, or anything like that. And from those we contacted those people either by phone . . . because it's easier to explain the program [over the phone]. . . . Also—we had an email template that we sent out that had this flyer plus background information on the program. And then we let people know if you're interested, we'll send you a letter of invitation (ISE_2-1_ESC_9180_032910).

The flyer and phone calls stressed the opportunity to be part of an NSF-funded nationwide program. The Program Director explained:

Are you a scientist interested in coming to a free workshop and then giving a program and being part of this nationwide program (ISE_2-1_ESC_9180_032910)?

In addition, the Executive Director and the Program Director presented at local organizations.

We asked for guests spots at meetings where we thought scientists might be at the meetings. So we went to Rotary Clubs. I went to the Cal Environmental Protection Agency and did a presentation there (ISE_2-1_ESC_9180_032910).

The Educator explored using his connections at the Teaching Resource Center at UC Davis. He visited the campus, leaving business cards and talking with staff members. He found this was not a productive strategy. This respondent reflected that, looking back over the *Conceptual Planning Worksheet*, some opportunities may have been missed in contacting local businesses (*ISE_2-1_ESC_0227A_032910).*

The Program Director noted also that the PoP Team at ESC selected a professional development workshop date based on the schedules of scientists. It was not possible, however, to find a date that worked for all. Additionally, she explained that keeping the number within ESC's capacity also was important.

> *We didn't want to have 100 people interested and then . . . we're not going to be able to sign you up until June (ISE_2-1_ESC_9180_032910).*

In summary, ESC identified a total of 16 individuals and sent invitations and flyers. Ten responded they were interested in participating in the program. Only 6 of these 10 interested individuals were able to attend the professional development workshop at the time it was offered. The other 4 were kept on a waiting list for future workshops. Of the 6 who attended the professional development workshop, 3 had presented by the end of the implementation period.

At the time of the site visit, the scientists who had not presented were not answering emails or phone calls. The status of their interest in scheduling a public program was uncertain. Ultimately, all three of the scientists who presented public programs during the implementation originally had called ESC inquiring about volunteer opportunities. Two had worked as volunteers with general public visitors prior to PoP, and one called during the implementation and was guided to the program.

The partnership and relationship building also revealed opportunities for relationships that could be developed for the future.

> *Another group that we're trying to find a date for, it's a nursing group at UC Davis Medical Center. And then [a group] at UC Davis . . . . One person is at the med center. But if we could get them all together on one workshop and one program, that would be great (ISE_2-1_ESC_9180_032910).*

Profile of ESC Scientists

Number = 6

Gender

- Female = 4
- Male = 2

Career stage

- Grad school = 2
- Post-doc/entry = 3
- Established (3-6 years' experience) = 1

Level of education completed

- Undergrad = 1
- Masters = 1
- Doctorate = 4

Previous relationship

- Yes = 2
- No = 4

Area of work (multiple options)

- Life science = 3
- Physical science = 1
- Research = 4
- Applied science = 1
- Engineering = 1

Figure 26. **Profile of ESC scientists *(N* = 6*).***

Figure 26 shows a profile of the six scientists who participated in the ESC professional development workshop. As noted previously, all were associated with UC Davis. In addition, most were at early career stages but with a fairly high number (four of six) having doctoral degrees.

Professional Development

At ESC a one-day, 4.0-hour professional development workshop was offered to six scientists on December 19, 2009. The educator explained the rationale for selecting this format rather than the multisession format used at some other locations.

> *In part it [was for] budgetary reasons, what was it that Explorit could put out for [PoP] and do? . . . [In addition,] if I were to come to them and say we've got a four-day workshop to attend to, they'll say no, I don't have time to do that. Whereas a one-day, morning–afternoon session, we could get them to do (ISE_2-1_ESC_0227A_032910).*

The Educator, who had not attended the Dissemination Workshop, had primary responsibility for developing the agenda and selecting Professional Development Elements for the professional development workshop offered at ESC. He explained he had some challenges in this process because, unlike primary implementers who had attended the workshop, he did not feel free to adapt them. Developing transitions was a problem for him.

> *I was given specific instructions . . . to use them with pretty much zero modification to the lesson plan. . . . The units themselves are very isolated, which is fine. And again, as I mentioned earlier, that's a good and a bad thing because they're very easy to follow. The problem is if you were to take them all and not actually talk about the transitions, just do activity, activity, activity, there's going to be a disconnect . . . [between] what's going on and what exactly we're supposed to be getting out of this (ISE_2-1_ESC_0227A_032910).*

The Educator also cited the need to see how the Professional Development Elements worked in action, another experience featured at the Dissemination Workshop.

> *So I took a lot of the stuff home with me and played around there to get that perspective . . . is this coming across okay, because he's an educator at UC Davis as well. So we're both coming from very similar backgrounds. And that was how I was able to fine-tune which activities we were ultimately ending up using. In part because while I had never seen these in action, and that was indeed a problem because you can only get so much from reading a lesson plan. . . . (ISE_2-1_ESC_0227A_032910).*

Apparently, the Program Director wanted to try out the Professional Development Elements provided in the catalog. Unlike the Educator, she experienced these activities herself.

> *We selected all from the manual just to see how the framework fit with us . . . a lot of the ones we picked were ones that [the Executive Director] and I did at the mid-course dissemination, because we were familiar with them and it was easier to . . . It was easier to have a starting place because time is an issue for us (ISE_2-1_ESC_9180_032910).*

The Educator said one reason he would like to see continued use of the Professional Development Elements at ESC was so staff members could experience them before working in this program.

> *You're not just reading a lesson plan and thinking, all right, now what do I do? So that's—hopefully I would like to see the workshops continue, if this is indeed something we can do (ISE_2-1_ESC_0227A_032910).*

The Program Director noted:

> *So we didn't settle on the final format until we knew we had six scientists . . . that will work for a small group work . . . split up the sessions, have lunch type of thing. . . . And I think [the educator], once he saw we have two plant scientists and one materials scientist . . . he looked and thought, well, which activities would give enough variety between the different disciplines and so he selected the activities for the workshop (ISE_2-1_ESC_9180_032910).*

Figure 27 shows a summary of the professional development workshop at ESC. The program was scheduled from 10 a.m. to 2 p.m. at ESC's Nature Center. The workshop opened with *The Pleasure of Finding Things Out*, followed by a welcome and introductions with a brief discussion. The two workshop facilitators led *Questioning Strategies* just before lunch. After lunch, they facilitated *Question Types and Sequences*, *Building a Common Vision*, and *Concept Mapping*. The workshop ended at 2 p.m. with an invitation to go to the public site of ESC, tour the space, and observe visitors. Several participants had visited the site previously and others chose not to go that day.

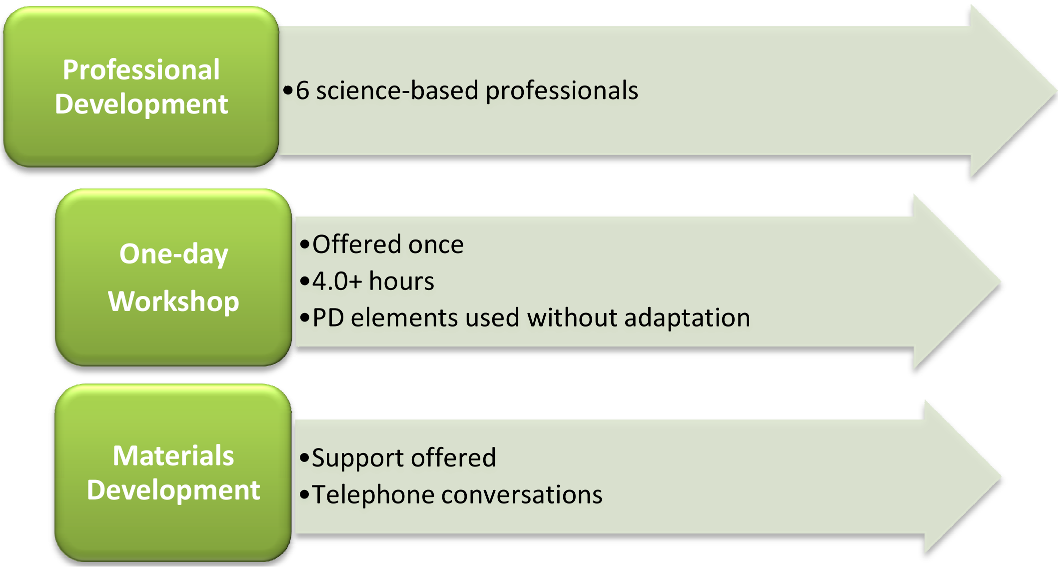

Figure 27. **ESC professional development.**

Upon reflection, the workshop facilitators noted the schedule for the workshop worked well, but more focus on and support for materials development would have been optimal.

> *We wanted to build more time for the concept mapping by trimming some of the time off of some of the other activities. But it seemed that the layout worked really well . . . just the one day, have some lunch, have time at the museum (ISE_2-1_ESC_9180_032910).*

The Educator noted also that he wished a more structured scheduled had been set up to support materials development.

> *We wish we had also spent more time on [materials development] or set up specific dates instead . . . doing it over the phone (ISE_2-1_ESC_9180_032910).*

The other workshop facilitator agreed.

> *I think the one-day workshop was good. [But, we should have called to see if they needed] . . . one-on-one testing of their activity or advice about their activity. Instead of waiting until they*

called us or waiting until a few days before the program saying . . . how is it going (ISE_2-1_ESC_9180_032910).

One presenter did come to ESC to review materials and incorporated some materials NISE Net provided.

She came in and just met with us to look at the NanoDays activity. And while she was here, we asked her how her activity was going . . . it seemed like she's pretty ready to go (ISE_2-1_ESC_9180_032910).

Evaluators had limited response from scientists at this site. Of the six workshop attendees, only one replied to the online survey, even after two additional requests. The same participant was the only one willing to be interviewed by phone. Both workshop facilitators, however, said they received good feedback, and attendees appeared to enjoy the program. The one scientist we interviewed indicated he had found the workshop useful.

So I think the workshop really helped out in preparing us for what to expect when we actually did the POP program presentation (SCI_3-2_ESC_4179_052610).

Public Program

ESC was the first implementation site to complete professional development and begin offering public programs. These were small-format events featuring one or two scientists. Figure 28 summarizes the public programs offered at ESC. Two of the programs were held on Saturdays and one on a weekday. The first two programs were held on the second floor of ESC in meeting rooms. The third program was held in the Discovery Room, just to the left of the ESC public entrance. One evaluator observed the program on March 30, 2010.

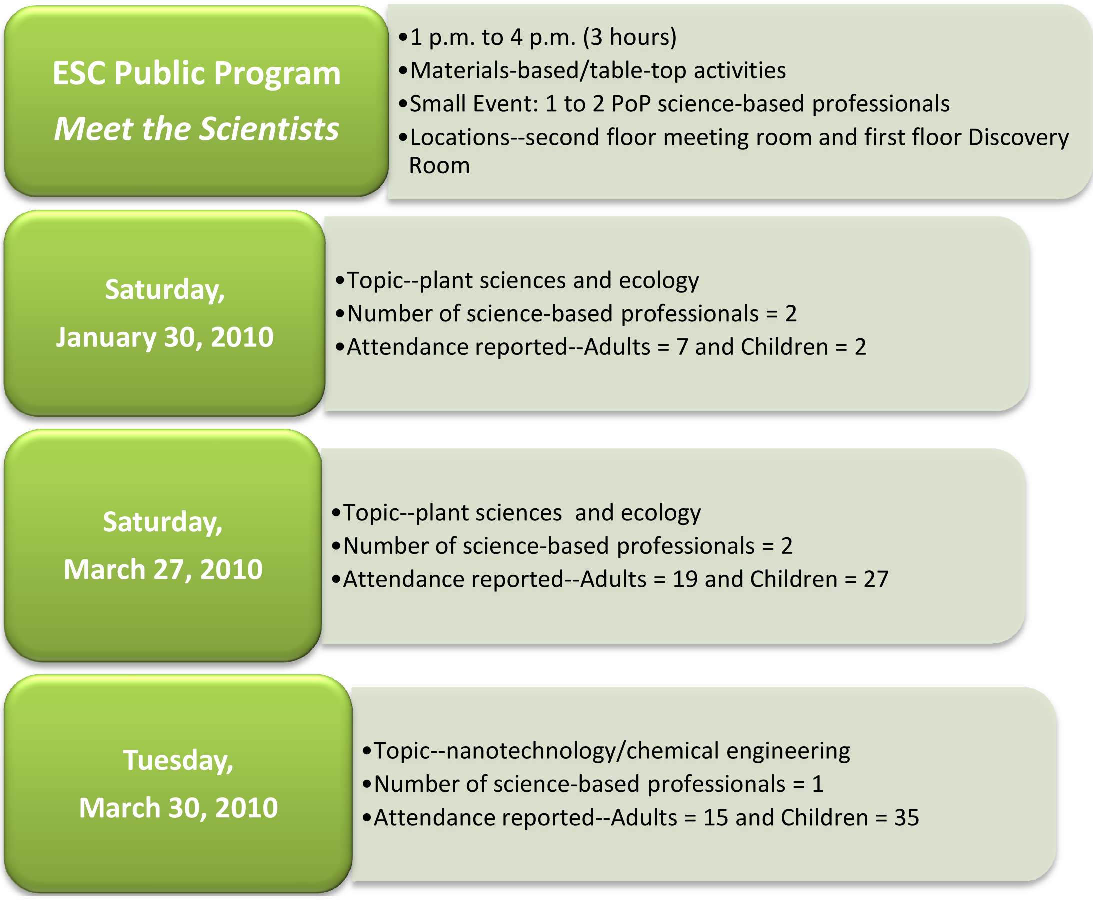

Figure 28. **ESC public programs.**

The January 30 and March 27 programs were done by the same scientists, a husband-and-wife team who were post-doctoral research scientists at UC Davis. The male specialized in plant science, doing molecular biology, biochemistry, and genetics. The female member of the team was an ecologist studying soil microbiology *(SCI_3-2_ESC_4179_052610)*. This team developed two different activities, one for each of the public programs. The male—the only scientist from this location who responded to the online survey and the only one willing to be interviewed—described what they did:

> *I prepared two activities/presentations for Explorit. The first was titled "What are you eating?" and the second was titled "What are plants good for?" Both activities consisted of demonstrations, questions, and hands-on activities for kids/parents that related to the titles listed. Both exhibits strongly reflected my scientific interests and were designed, additionally, to demonstrate the ways in which science could be applied/related to answering these questions (POP_SCI_Online Survey).*

The presenter on March 30 was from the UC Davis Department of Chemical Engineering and Materials Science. This program combined with a *NanoDays* event and featured hands-on activities provided by NISE Net. The presenter sat at a table in the middle of the Discovery Room with a computer PowerPoint presentation she had developed as part of her university teaching. She also used an analog to a scanning probe microscope provided from among the NISE Net activities nearby. Other NISE Net activities were available around the room.

Based on responses from the PoP Team on the feedback form, it is probable that the materials scientist, while friendly and personable, may not have been quite as skillful as the other presenters. As we will discuss in the Impacts section, she did not invite participation and sometimes did not appear aware of the knowledge level of some of the general public visitors. One of the presenters at a previous program pointed out that working with visitors as a volunteer at ESC had provided an advantage for him and his presentation partner.

> *Three of the six scientists who did the workshop have done their program, so 50 percent is pretty good. . . . It's just hard to schedule with people. When you send out a letter and they think, oh I'm interested. We don't have the time to follow up and say, oh remember that letter we sent you? Are you interested? Come in tomorrow and . . . let's set this up. I think if we had had a full-time staff person dedicated to it, they could have spent more time following up with people (ISE_2-1_ESC_9180_032910).*

The Educator pointed out he had learned he needed to be proactive in scheduling public programs:

> *But just be much more proactive . . . spell it out very, very specifically. . . . I tend to say all right, we're going to get this going, we'll do it on this date, but the time can be a little fluid, we'll play with it a little bit depending upon what we've got. . . . [In the future] we're going to say, here are six days, pick one of these (SCI_3-2_ESC_4179_052610).*

Both were pleased, however, with the number of scientists who had presented workshops by the end of the implementation.

> *Six people that came for the workshop, 50 percent did a program. That's pretty good when . . . to be truthful, you're really relying a lot on altruism to get the scientist willing to do this (SCI_3-2_ESC_4179_052610).*

The Program Director also judged that selecting the scale of the implementation had been wise. She noted the weekday presentation as a plus:

> *We don't have the resources to coordinate [a] large scale . . . program. We always do programs on Saturdays, [but today] is nice because there's something on Tuesdays . . . for people to enjoy (ISE_2-1_ESC_9180_032910).*

At the end of the third program, the PoP Team noted some of the same challenges for the presenter, as did the evaluator. They used this information to inform how they would adjust future workshops.

> *[The educator] and I both felt that more time could have been spent in the workshop discussing (a) accessing prior knowledge, (b) question types and sequences, and (c) working with different ages. We also felt it would be better to have the program take place closer to the workshop. (The workshop was in December and the program was originally scheduled for January but was*

postponed.) Additionally, we think for the next series that we would "require" at least one one-on-one meeting and one prototype day (ESC_PP3_Feedback Form 033010).

In a telephone interview with a scientist, he noted how valuable he found this experience:

We really enjoyed the experience overall and we talked to [PoP Team members at ESC] about possibly doing another one. And so we've actually done a follow-up. And I think that's probably your biggest indicator of how much we enjoyed it, the fact that we were willing and excited about doing a second kind of presentation (SCI_3-2_ESC_4179_052610).

Summary of ESC Case

The number of scientists recruited at ESC appeared quite high, compared with the levels of previous relationships with which they started. Some of the public contact they exerted in this time period may bear fruit in the future. As with some other locations, ESC experienced challenges with staffing and workloads during the implementation. Offering three public programs was an accomplishment, and ESC learned important lessons about offering the workshop closer to the event time to keep the momentum from training to application of new knowledge and skills. Scheduling for individual and two-person public programs required additional staff time compared to single-event formats at some other sites. In hindsight, the PoP Team at this location could have been more proactive in communications and offering direct support for materials development. The small-format programs fit the public space, and experimenting with locations proved fruitful.

Museum of Life and Science

***Figure 28.* MLS logo and public program photos.**

Of all the PoP sites testing the PoP framework, strategies, and materials, the implementation at Museum of Life and Science (MLS) provides the biggest contrast. While the other locations developed and implemented new programs that included professional development for scientists, MLS integrated professional development into two existing grant-based programs: *NanoDays* and discussion-based *Genome Diner*. This contrasting use of the PoP approach and the reasons for these decisions allow for a clearer understanding of the range applicability of the PoP approach as presented in the Dissemination Workshop in June 2009.

As at other sites, MLS staff members also participated in professional development featuring PoP Professional Development Elements. The PoP Team decided to integrate PoP into existing public understanding-of-science offerings to make efficient use of staff time. MLS, the largest institution among the locations in this study, also had the most well-established set of programs in which scientists engaged with visitors. Both these factors appear to have influenced decisions about the implementation at this location. Figure 28 shows photographs of the *NanoDays* public event.

Background and Context

MLS is located in Durham, North Carolina, a city with a population of about 220,000 (U.S. Census Bureau, 2009). Durham is part of the Research Triangle region of North Carolina with a population 1,677,000 (Research Triangle Regional Partnership, 2011). The region features an important concentration of higher education, medicine, and research-focused universities and businesses. Duke University, with which the museum has strong ties, is about five miles from MLS and the University of North Carolina–Chapel Hill is about 14. *(World News Digest* database, *Encyclopedia*, 2010B).

The mission statement of this institution is shown in Figure 29. In 2009, MLS had an attendance of more than 400,000 (Museum of Life and Science, p. 4) and employed a full-time staff of about 70.

> *Our mission is to create a place of lifelong learning where people, from young child to senior citizen, embrace science as a way of knowing about themselves, their community, and their world.*

Figure 29. **MLS mission statement.**

MLS had an extensive set of existing programs involving scientists engaging with general public visitors. Most of the existing relationships were with Duke University faculty, post-docs, and graduate students. MLS was the southeastern regional hub leader for the NSF-funded NISE Net. It reported 1,500 visitor contacts through this program in 2009. In addition, MLS developed and implemented *Genome Diner: A strategy for community-researcher engagement in genome sciences,* a project that National Institutes of Health (NIH) funded (Museum of Life and Science, 2010, p. 7). MLS also offered *Periodic Tables*, a *Science Café* program for adults. In addition, MLS held themed events similar to those in other locations, such as *Engineers Week*.

Preparation

The PoP project at MLS had two team members: one was Vice President for Innovation and Learning, the other was Manager of Public Engagement with Science (PES). The Vice President participated as a member of the PoP Advisory Team. The Manager of PES, who had primary responsibility for PoP implementation and served as evaluation liaison, had an educational background in biology and formerly worked as a marine biologist. He was a key staff member on the *Genome Diner* program and worked with other staff in coordinating *Periodic Tables*, a *Science Café* program offered in a local restaurant. Half his job responsibilities included oversight of the care of the museum’s animal collection. During the PoP implementation, he met with the Vice President to consult and to coordinate project decisions. Figure 30 shows the PoP Team at MLS.

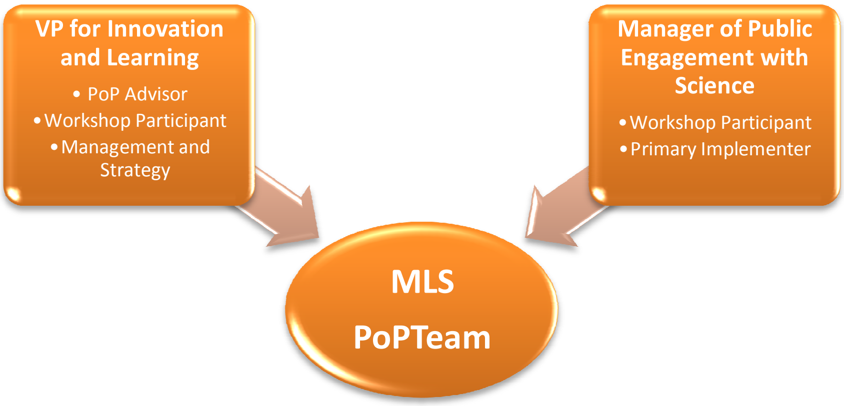

Figure 30. **MLS PoP Team.**

Both MLS PoP Team members cited positive aspects about the Dissemination Workshop in June 2009. One noted:

> *The most important thing that it did was that it gave us a very rich set of professional development options . . . we didn't have to reinvent that wheel. So now when we think about adapting PD [professional development] for researchers we have to think about what we might use to get a given program together (ISE_3-1_MLS_2267_051410).*

In an interview shortly after the Dissemination Workshop, the Manager of PES expressed enthusiasm for the PoP program but pointed out that some additional information was needed about the staffing levels to produce the efforts presented in the examples from PSC, Explora, and North. He noted that in large institutions such as his, ownership and responsibility for programs spread across different organization units and staff members:

> *The initial recruitment of scientists to participate in the program is not trivial. . . . We're probably going to do some initial original programming that we thought we'd have more control over it. When I say "we" I mean . . . the Innovation group. But we already do quite a few large themed events. . . . We definitely don't feel like we can currently implement the program across the board for our programming due to our size . . . in many cases a staff member [not on the Innovations group] has a sense of ownership about the program (ISE-1-4_MLS_4270_081409).*

He commented also about the time commitment for scientists presented in some examples by the collaborating partner museums:

> *We're still concerned about whether we can get researchers to make the time commitments to us that they would need to do Portal type training. It's certainly something that I was very skeptical of, but hearing the success that the folks at the Pacific Science Center have had with getting time commitments for training was very inspirational to me and definitely caused me to*

change my attitude. I'm at least more optimistic now that we'll be able to do this (ISE-1-4_MLS_4270_081409).

When the *Conceptual Planning Worksheet* was submitted, the PoP Team at MLS envisioned implementing PoP into two program areas: a discussion program (*Genome Diner*) and a new program connected with the opening of a major paleontology exhibition. The MLS workshop included the following descriptions of these plans:

In our existing Genome Diner program, researchers . . . meet with 7th grade students and their parents in a school cafeteria while sharing an evening meal. The researchers and other participants follow a discussion program that focuses on the societal and ethical implications of genetic research and is facilitated by staff from the museum. Both researchers and facilitators will have participated in the workshop described above.

Our spring 2010 program will generate face to face interactions between visitors and researchers from the fields of geology and paleontology at our newly opened dinosaur exhibit. Visitors will have the opportunity to dig for fossils alongside a paleontologist and examine minerals with a geologist. Researchers will be able to showcase their own research in an environment rich with concrete examples of the principles they study (POP_CPW_MLS_2009).

Integration into Existing Partnerships and Programs

In the final implementation, some aspects of the PoP approach were used in two existing offerings, *Genome Diner* and *NanoDays*. *NanoDays* was the program for which the evaluation liaison collected contact information and *Scientist Information Participant Survey* feedback as well as providing *Professional Development Feedback* and *Public Program Feedback* forms to the project manager. (Sites were requested to coordinate this type of data collection for one professional development offering and one public program.) *NanoDays* also was the focus of evaluator observations during site visits. Most of the additional findings in subsequent sections focus on *NanoDays*. *Genome Diner,* however, was the only discussion-based-format public offering at any site where PoP materials were used.

In interviews and in an additional memo (*MLS_PortalNarrative_051410*), evaluators learned more about the application of PoP in *Genome Diner*. One member of the PoP Team had direct program responsibility for *Genome Diner*, which looked like a good possibility for using PoP Professional Development Elements and materials. The *Genome Diner* professional development workshop involved researchers from Duke University's Institute for Genome Sciences and Policy. The workshop used program elements from PoP.

All researchers (26 faculty and post-docs) were required to attend a two-hour workshop that included the professional development components "Questioning Strategies" and "Scientists find their Stories" (MLS_PortalNarrative_051410).

The Manager of PES explained:

So what Portal did for Genome Diner is fairly radically changed the training for the researchers that went into that program (ISE_3-1_MLS_4270_051410).

The implementation of PoP approaches shifted the professional development for this program in some important ways. No PoP data were collected from scientists because another evaluation study was already in place for this program. (NIH funded *Genome Diner.*) Collecting data for the PoP summative evaluation from these scientists would have consumed most of the workshop time and could have annoyed the scientists. His observations indicated these program elements were effective for this existing program.

> *I actually think [the Professional Development Elements] work well for what we wanted to do . . . they're not really about designing effective materials-based experiences. . . . They're really more about exploration and ideas and ways of learning (ISE_3-1_MLS_4270_051410).*

He explained that *Genome Diner* aimed to encourage people of many ages to investigate questions in their own lives and specifically to consider decisions related to advances in genetics research.

> *One of the things we were trying to emphasize was this is not a program where a scientist comes and gives a talk. Or a scientist comes and even leads a discussion. We very much wanted the scientists to be a part of the conversation (ISE_3-1_MLS_4270_051410).*

In the first year, preparation had focused on case study examples of how to handle situations, such as instances when a parent and child disagree on a subject. By reflecting on the experience with the first-year training in *Genome Diner* and the PoP Dissemination Workshop, the *Genome Diner* program staff changed the program preparation.

> *We decided . . . to focus on some basic communication issues. . . . How do you discover new ideas? We wanted the researchers to think a lot more about the discovery process. Particularly in how it might happen . . . from a 40-year-old or a 35-year-old parent, or in some cases even a grandparent was present, down to these . . . 13 to 16-year-old students. And we found that the [PoP Professional Development Elements] really gave the scientists more confidence and ultimately they had a higher satisfaction in their experience that second year than the original training that we designed which was really focused more on dealing with problems that might arise (ISE_3-1_MLS_4270_051410).*

The other MLS program into which the PoP approach was integrated was *NanoDays.* This professional development was offered to 19 research scientists. Presenters for the *NanoDays* events at several institutions were invited to attend.

> *[Another] area of integration of Portal principles took place during our preparation for NanoDays activities around the Research Triangle area of North Carolina. . . . Some workshop participants also took advantage of one-on-one consultations regarding their activities. Other NanoDays participants declined to attend the workshop but consulted with Museum of Life and Science staff via email, phone, and personal meetings. Workshop participants attended NanoDays events at museums and learning centers in the area (MLS_PortalNarrative_051410).*

Presenters from three of the four activities presented at the MLS *NanoDays* event attended the workshop. *Scientist Participant Information Survey*s were collected from one respondent representing each of the four groups that participated at the public program.

The *Professional Development Feedback Form* for the *NanoDays* workshop showed some concern about how the materials had been received. Most of the responses to Professional Development Elements were positive. Similar to the experience at DCM with previous *Engineers Week* presenters, the Manager of PES found that some individuals who had already engaged with the public in previous informal learning events were less receptive to professional development experiences.

> *Researchers with previous event experience seemed less open to receiving new information. Their attitude seemed to be "we've done it, we know what we're doing." The PD [Professional Development Elements] were seen as "extra" stuff they didn't need to do (MLS PD ISE Feedback Form_030810).*

We conducted in-depth interviews with one scientist who had attended the workshop and one who had not. Both were very positive about having the opportunity to participate and to engage with visitors at the *NanoDays* event. One respondent, a post-doc from Duke, noted he would have liked an opportunity to try out his materials prior to the actual event and appreciated the help in obtaining resources. The scientist in the other interview explained that, based on previous outreach experience with middle-school students and restrictions of time, she decided not to attend the training session and saw little need for additional professional development.

Summary of MLS Case

This implementation provides two important areas of note. First, it speaks to the examples of public programs in the Dissemination Workshop. These examples, while useful, may have reflected levels of staffing that may not be available for some sites interested in adopting the PoP approach. The implementation also raises some questions of scale. Implementing PoP approaches at such large institutions as MLS had some specific challenges where existing programs were not directly managed by those on the PoP Team. At the end of the implementation, the Manager of PES noted he found the Dissemination Workshop valuable and clear. His concerns were about the fit between the PoP strategies and framework and his institution.

> *I think they did an excellent job of laying out . . . logistic expectations, timelines, I thought all those materials were very, very clear and concise and easily referenced for me later. So I think the biggest questions I left with weren't about the program itself, but [about] how we would institute them in our institution. . . . I don't mean that in a negative sense, I just mean that in the sense that it's a big challenge for some of our programming to implement this (ISE-1-4_MLS_4270_081409).*

Comparison of Cases

A comparison of cases highlights some of the factors that appeared to influence the nature and scope of the implementations at the five implementing sites. All five of the institutions conducted professional development and held at least one public program featuring face-to-face engagements between visitors and scientists. Each implementation had unique features. There were also striking commonalities. These similarities and differences are discussed in this section in terms of*:*

- Background and Context
- Preparation
- Partnership and Relationship Building
- Professional Development
- Public Programs.

Background and Context

Some important aspects of context were shared by all five sites. All institutions had one institutional PoP Team member who also served as a member of the project-wide PoP Advisory Committee. In addition, all five sites had signed an agreement to complete the implementation and all received a $10,000 stipend and travel expenses to meetings. Compared to institutions without these relationships or stipends, these formal relationships and the stipend may have supported a greater investment of resources and increased the institution's persistence in overcoming obstacles.

Sites were affected differentially by the types of science-based organizations in their community. Both ASC and MLS were located close to more than one large, nationally known research university, with fairly high levels of both academic and business scientific research in their communities. ESC's close connection to UC Davis influenced recruitment and the nature of both ESC's program and audience. DCS's involvement with community workforce development and a range of higher education institutions also seemed to affect the implementation. DCM, with a local economy transitioning from heavy manufacturing, appeared to have the biggest challenge in finding partners and recruiting scientists.

An aim shared among all sites was the motivation to increase the scientific credibility of their institutions in their communities by including scientists among their program offerings. This motivation seemed closely connected to their missions, some of which recently had been updated to emphasize attracting and serving adult visitors. DCM and DCS expressed explicit concerns about members of their communities seeing their institutions as places for children, not for adults. All saw PoP as one means to change the community view of their organizations from places where children learn to places where people of all ages learn.

Staff size played a role also. In smaller institutions, implementation required, proportionally, a larger overall percentage of staff time than at larger institutions. At MLS, a larger institution, program ownership within a large and complex organization also appeared to influence decisions. Staff size and staffing issues were themes that ran throughout the implementations.

Preparation

One factor that appeared to affect implementation was selection of staff members who would attend the Dissemination Workshop and serve on the implementation team. Implementing sites made some contrasting decisions about which staff they sent to the workshop. ASC sent two experienced educators who later shared some responsibilities and split others. The Director of Education supervised the process and was involved in program decisions. DCM sent two experienced professionals, one educator and one marketer. Responsibilities were divided between these two, whom the Executive Director supervised. At ESC, an educator and the Executive Director attended the Dissemination Workshop. Another educator who was extensively involved did not attend. In interviews, this respondent explained his difficulties in understanding the intent and nature of PoP from the materials alone. At DCS, one experienced and one less-experienced educator attended the meeting. At this site, they learned that efficiently implementing the program required some degree of experience in professional development and program logistics. Both PoP Team members at MLS, the Vice President for Innovation and Learning and the Manager of Public Engagement with Science, attended the implementation workshop. The Manager of Public Engagement with Science had primary responsibility for implementation.

At the Dissemination Workshop, participants had time to work on conceptual plans. Data collected from interviews and site visits showed patterns across the sites of informal science educators juggling multiple priorities. ISE were forced to focus on program delivery, with planning a much lower priority. Some of this urgency resulted from the need to cover multiple positions stemming from frequent turnover among staff positions—not an uncommon issue in science museums. Informal science educators cited the time to plan offsite, removed from urgent priorities, as an essential and welcome part of the project.

The *Conceptual Planning Worksheet* appeared to provide a way for institutions to survey the landscape for implementation and brainstorm possibilities for recruitment, professional development, and public programs. We did not find a one-to-one match between initial conceptual plans and the implemented programs. This is not a negative finding. Instead, it reflects the evolving nature of program implementation. But it appears that where institutions had less prior experience in areas such as relationship building and offering public programs with scientists, the number of options listed was broader, providing a range of options to try as the implementation unfolded. Trying options that did not work took additional staff time.

Issues such as staff workloads—the biggest challenge at all locations—were not frankly addressed. In in-depth interviews, evaluators sometimes found informal science educators appearing to take the "blame" for problems they encountered that clearly were outside their own control. DCM's challenges with the recruiting and the economics of their community are examples of this type of challenge. No representatives from this site attended a second meeting of the user-group museums in April 2010, and a reluctance to share problems appeared at least partly responsible for that decision. At MLS, challenges with ownership of programs by other areas of the institution—thereby limiting the options for use of the PoP approach—seemed to be another area for which the primary implementer appeared to hold himself accountable. Those challenges, however, were not directly his responsibility. The positive, inspiration tone set at the Dissemination Workshops sent institutional PoP Team members back to their sites with filled with great enthusiasm. Yet it also left some institutions' PoP Team members unprepared for obstacles and open to taking blame for factors beyond their control.

Partnership and Relationship Building

Recruiting Methods

Implementation sites began with varying levels of partnerships and prior relationships with scientists. ASC and MLS, located in areas with higher concentrations of research universities, had the most numerous and long-term relationships. DCS and ESC had some relationships but used PoP to focus on their further development. Prior to the implementation, DCM relationships with scientists were limited to *Engineers Week* types of events and development and fundraising activities. Fairly similar methods were used across ASC, DCM, DCS, and ESC to recruit scientists to participate in PoP professional development and public programs. These levels of relationship are reflected in Figure 31, which shows the number of scientists at each site who had worked with the science center prior to the PoP implementation.

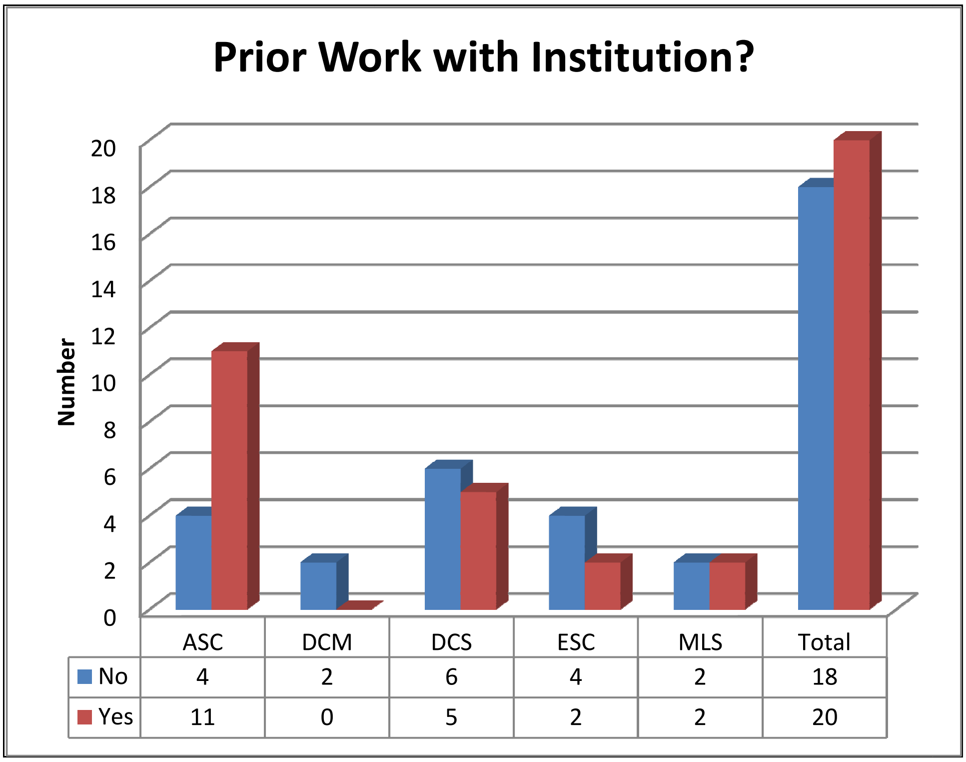

Figure 31. **Numbers of scientists by location who had previously worked with institutions (*N* = 38).**

In interviews with informal science educators, evaluators heard that fairly similar tactics had been used to recruit scientists at ASC, DCM, DCS, and ESC. These PoP Teams sent emails, made telephone calls, and developed flyers to send to science-research organizations or to post on websites. Yet the number of scientists these efforts yielded varied. The PoP Team at ASC clearly had the strongest set of personal connections between members of the implementation team and individual scientists and outreach coordinators. Like ASC, DCS used previous connections of one of their primary implementers, along with emails, flyers, and community connections. ESC invested some time in recruiting through a teaching resource center at UC Davis, but more successful efforts resulted from community connections, flyers, and telephone calls. DCM had the biggest challenge in recruiting. Despite some previous development of relationships and indications of interest, its successful tactic hinged on using a board member and the awareness of an administrator in making the connection.

At ASC, DCM, DCS, and ESC, new programs were developed in association with PoP implementation. One central recruitment and implementation feature at these sites was asking prospective scientist participants to commit to attending professional development workshops to prepare for participation in a specific new public program.

MLS used a different strategy for the *NanoDays* public program. Scientists presenting at MLS (and several other regional *NanoDays* locations) were invited to a professional development workshop. Attendance was optional, and not all those presenting at MLS *NanoDays* attended the workshop. Materials development assistance also was optional, and not all those attending the workshop participated in this activity. One reason for this difference in strategy at MLS was that this site already had several public understanding of science programs, featuring scientists engaging with the public. Scientists had previously participated in public programs and some had already developed materials for these programs. Similar to the *Engineers Week* participants at DCM who had done presentations before and saw no need for assistance, some of the MLS participants did not appear open to the professional development activities or to accept offers for assistance in materials development. This resistance highlights a challenge that can occur when implementing the PoP approach in an existing program. Figure 32 summarizes the nature and levels of commitment across locations.

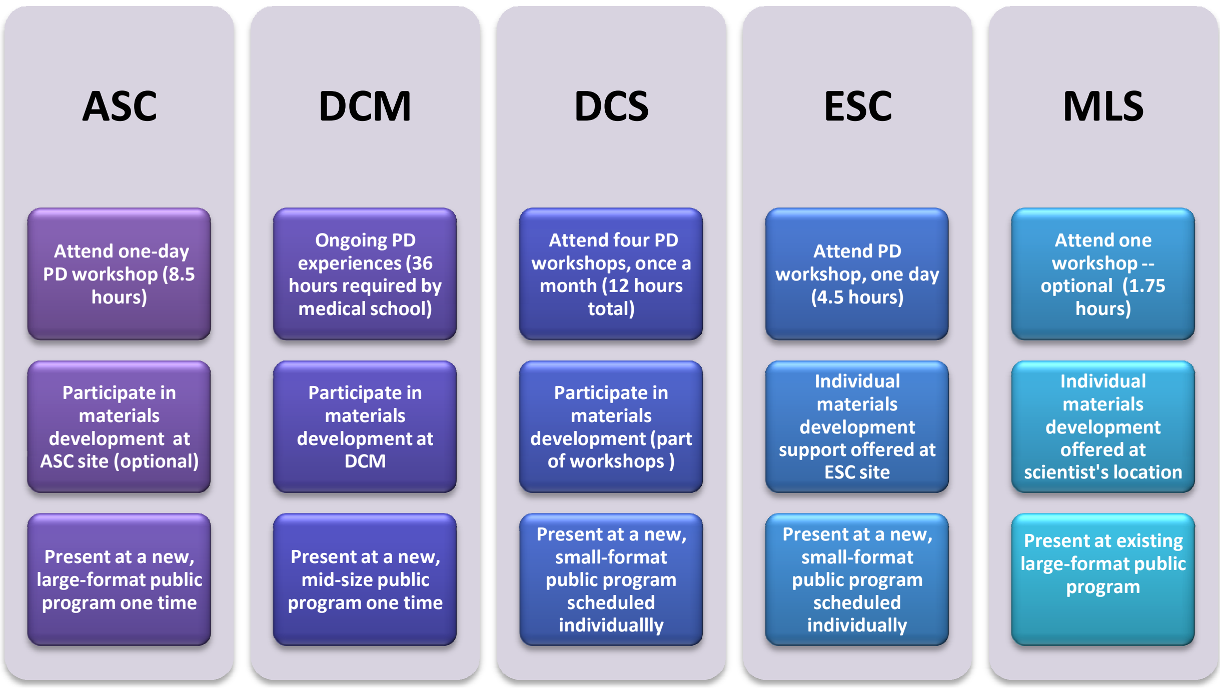

Figure 32. **Nature and extent of commitment by scientists by location.**

Perceived Motivations and Benefits of Participation by Scientists
At the beginning of their PD workshop at each site (Stage One of the study), scientists were asked to complete a *Scientist Participant Information Form.* Two open-ended questions were posed to elicit their reasons and expectations for participating in the PoP program (professional development and public programs). In one question, defined as a *motivation* item, we asked scientists, “Why did you decide to participate in this experience?” In another, defined as a *perceived benefits* item, we asked, “What benefits do you expect to take away from this experience?”

Responses were coded into up to two categories. The same codes were used for both questions. Percentages shown in Figure 33 are the percentages of individual respondents making this type of response. These percentages reflect all scientists at all sites. The substantial difference between motivation and benefits among all groups early in their participation in the PoP activities may be useful in developing recruitment messages and approaches.

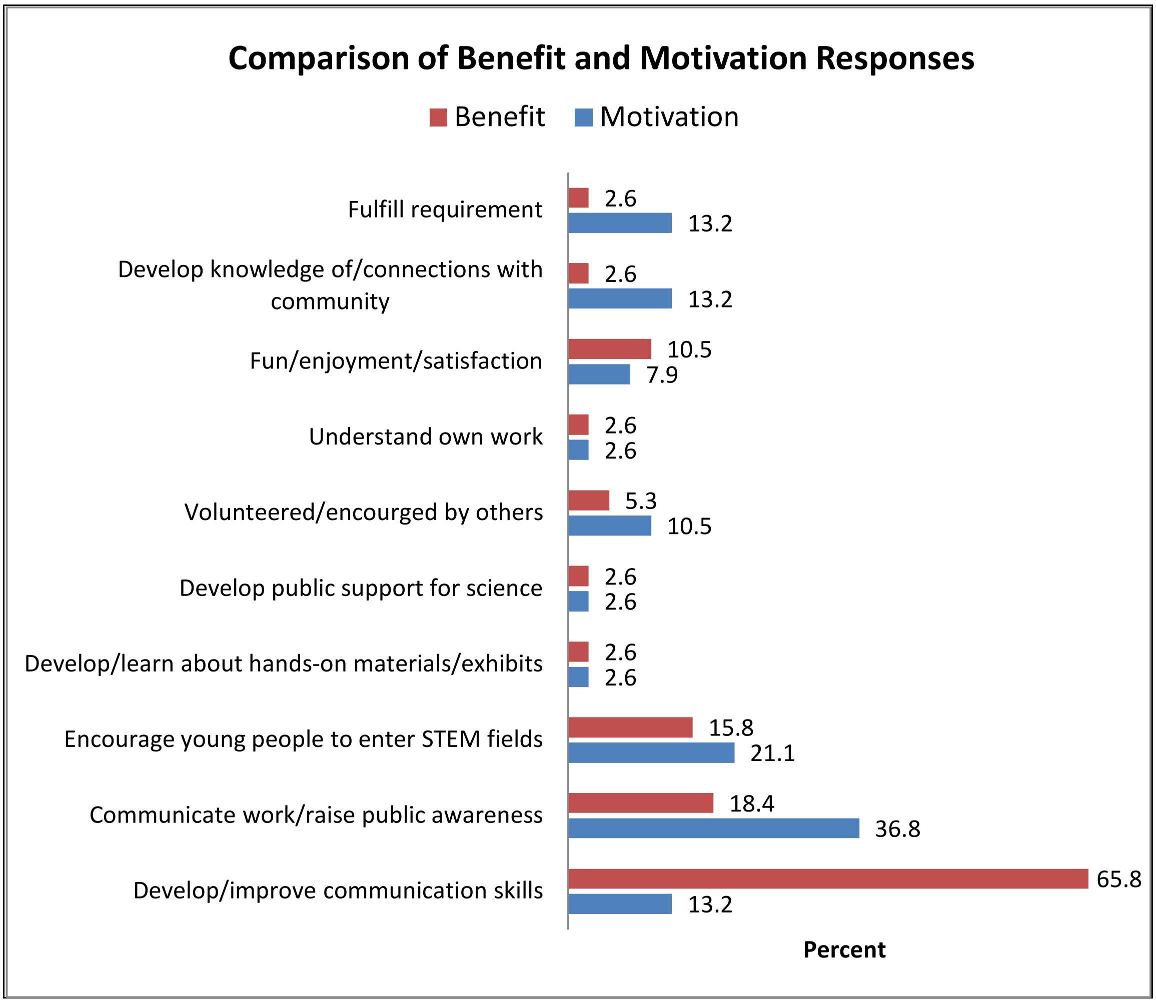

Figure 33. **Comparison of scientists’ motivations and perceived benefits (*N* = 38).**

As shown in Figure 33, for individual scientists across sites ($N = 38$), the most frequently cited motivation was the opportunity to *Communicate work and raise public awareness of* science (36.8%) and *Encourage young people to enter STEM fields* (21.1%). But 65.8% of all scientists reported that the benefit they perceived was *Develop and improve communication skills*. Yet it should be pointed out that the 15 scientists from ASC comprised about 40% of all the scientists. The development and improvement of communications skills was a benefit frequently noted by ASC scientists in data collected immediately after recruitment.

Professional Development

Range of Professional Development Experiences

The implementing sites offered a range of experiences in terms of number of workshops and total time commitment for professional development. Three offered one workshop, with ongoing support at flexible time schedules for the scientists. At DCS, materials development time was part of the scheduled workshop series. DCM and DCS offered the most extensive professional development experiences. At DCM, where the medical students committed time as part of their curriculum, participants attended two structured professional development workshops, observed afterschool programs, watched exhibit prototyping, and "worked" another event. At DCS, four half-day workshops were offered, once a month beginning in October prior to March program offerings. There appeared, however, to be some attrition with this timing—namely, lack of attendance as the professional development continued. At ESC, scientists could choose between two different times to attend the one-day workshop. This option was offered to accommodate busy scientists' schedules. Public program participation was scheduled for each individual presenter at DCS and ESC. This scheduling was time-consuming, and some scientists did not return calls or emails from ISE about scheduling their public presentations. Figure 34 shows the range of professional development offerings.

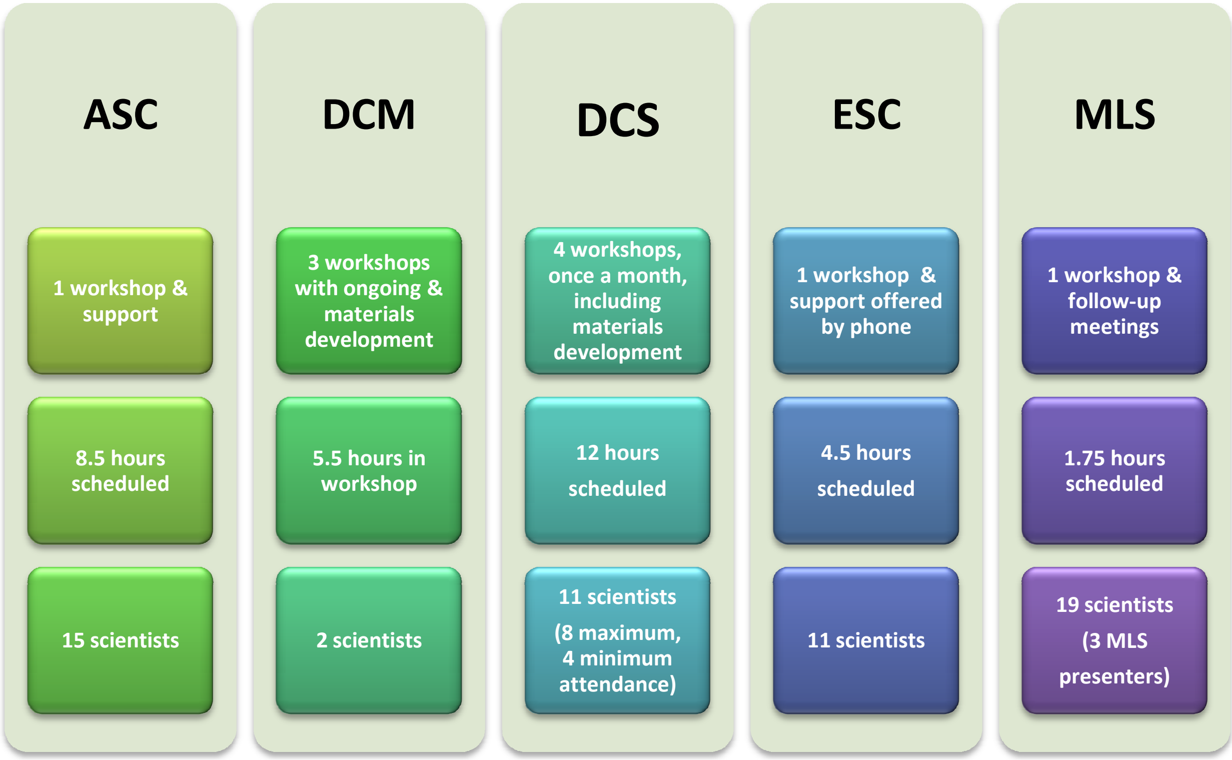

Figure 34. **Range of professional development experiences.**[11]

Content of Professional Development

Professional development at all sites was clearly shaped by the Dissemination Workshop and the *Professional Development Elements Catalog* (Pacific Science Center, 2009). Figure 35 shows the Professional Development Elements listed on user museums' workshop agendas and those provided on the *Professional Development Feedback* forms. Activity prototyping only occurred at DCS (with four of the scientist participants). This activity was planned at some other locations but ultimately did not take place. After the experience, both ISE and scientists pointed out that prototyping materials should be a part of all professional development workshops and experiences for materials-based table-top public programs.

[11] At MLS, a professional development workshop was offered to 19 scientists. These 19 scientists were recruited from those presenting at several *NanoDays* public programs offered at institutions in North Carolina. Attendance was a voluntary part of participating in the *NanoDays* public program at all sites. Only 3 of those attending the workshop presented at the MLS *NanoDays* public program. At MLS, approximately 11 scientists (including faculty and graduate students assisting faculty) presented at the MLS public program—which means most of the scientists at the MLS public program had not attended the PD workshop.

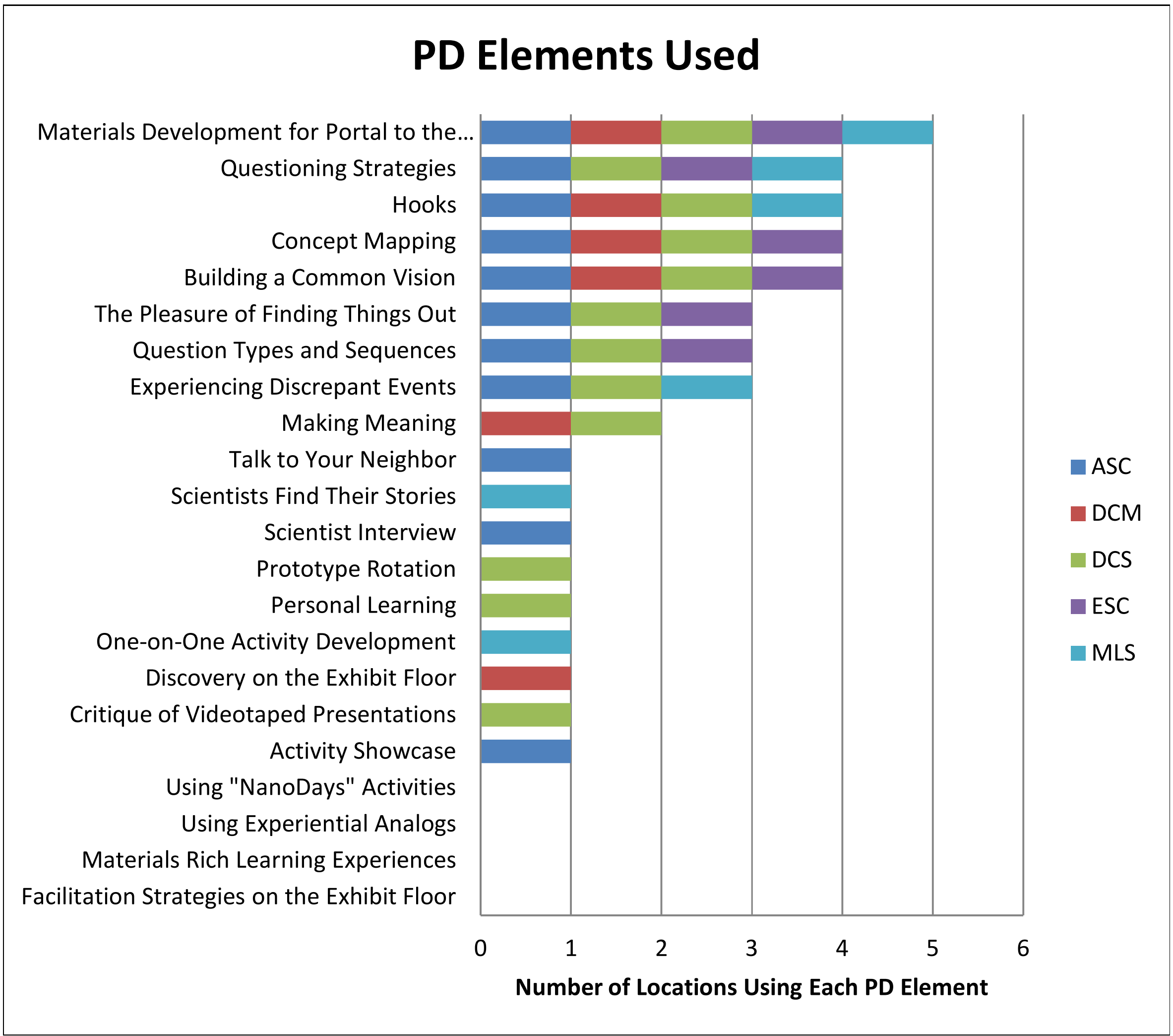

Figure 35. **Professional Development Elements used across locations.**

At two sites, we found the development of a collaborative spirit among scientists. At both ASC and DCM, informal science educators and scientists reported participants helping one another solve problems and sharing one another's ideas. Scientists reported these collaborations as a positive aspect of their experience.

Offering Professional Development to Staff Members

All sites offered a version of the professional development designed for scientists to members of their staff. In general, there appeared to be a similar rationale for this practice across sites. First, it raised the awareness of PoP among other members of the staff. Second, it allowed PoP Team members to prototype activities at their own sites and to practice presentation skills. Third, informal science educators found this set of materials highly useful, not only for scientists but also for staff members engaging directly with visitors.

Public Programs

Across the five sites, there was a wide range of program size but a narrow range of format. All five sites offered programs with table-top materials-based activities. The integration of PoP Professional Development Elements into the discussion-based *Genome Diner* at MLS was the exception. Figure 36 shows the range of program types across locations.

ASC	DCM	DCS	ESC	MLS
•New program •Large event •One time •Format: table-top activities near exhibits on similar topics	•New program •Small event •Part of series •Once in series •Format: table-top activities in exhibit gallery on topic	•New program •Individual scientists •Part of series •Format: table-top activities in gallery area	•New program •Small events •Part of series •Format: table-top actvities in meeting and special purpose rooms	•Existing programs •Large events •Yearly •Formats: table-top activities & discussion

***Figure 36*. Comparison of public programs across sites.**

The date of the large event at ASC was set and included in the timeline at the time of professional development at ASC. This scheduling provided a clear target and timeline for participation, and staff at ASC did not have to schedule scientists individually to present at the museum. This arrangement was true also with the medical students at DCM. Even with the advanced scheduling, however, one medical student could not participate in the public programs. At DCS and ESC, the PoP Teams selected individual and small-format programs as appropriate undertakings for their program space and staff-support capacity. At both these sites, though, museum staff noted some challenges in scheduling scientists. In general, providing a clear beginning and end stage for materials development and program participation appeared to be strength of the ASC implementation.

Adoption and Sustainability

At the end of the implementation, prospects for sustainability differed among the locations. In general, after this initial implementation, all sites reported the intention to use the PoP approach to some extent and in some ways. Some informal science educators saw additional opportunities to apply the approach. Finances and budgets were concerns at all sites.

Among members of the PoP Team at ASC, the two primary implementers noted that the approach fit well into their strategic plan with multiple program options. One explained:

> *I think if we wanted to continue doing something on the order of [PoP], we would just do it because we already know how to do it. And it's not like it's a ramp up starting, training, learning curve, we already know how to do this. It fits in our plan. . . . We can plug it into science cafés. We're involved in a girl's afterschool program that's mentoring middle school girls to consider*

careers in STEM. [We] want women to go into these classrooms and talk to them. . . . So it plugs in, in a lot of ways (ISE_2-ISE_2-1_ASC_1948_032610).

Both the primary implementers, as well as the other members of their team, noted program support was an ongoing challenge. One implementer explained:

*We had a fairly easy time of raising 35 million dollars in seven years to build shiny new things . . . and people love a shiny, new thing. . . . People love capital [investments]. It's supporting the programs that become the challenge (ISE_2-1_ASC_1948_032610)***.**

At DCM, where PoP Professional Development Elements fit into her role of training staff, a PoP Team member noted:

This program is so worthwhile to me that we will sustain it whether I've got the funding or not. Whether I have the time or not, we'll come up with a way to do this (ISE_2-1_DCM_5856A_031210).

After the implementation, DCM learned that the medical school wanted to continue the relationship during the coming year. Yet in other interviews, members of the PoP Team at DCM expressed concerns about the amount of staff time invested in only two scientist program participants.

At DCS, the program appeared likely to continue. Financial concerns were mentioned but so were funding possibilities.

I think there are several science-oriented companies that once we get this year under our belt and we are then able to go to them with a proposal. . . . I think we have some potential sponsors (ISE_2-1_DCS_0004_031910).

I think it's very sustainable because . . . we made the initial investment and the financial support from the grant helped us make some of the initial investment in the materials that we needed to do the workshops. . . . Supporting the scientists in purchasing the materials for their presentations will be something that we'll just need to build into the budget (ISE_2-1_DCS_0004_031910).

There's all kinds of people that I'd like to see a part of this. Not just from the university world, more business. . . . I would love to . . . have our local business journal do a feature on it. I think that would be really terrific in helping to recruit new [group of scientists] (ISE_2-1_DCS_5060_031910).

The ESC team planned to continue with the current program immediately after the formal PoP implementation time period. These plans involved incorporating scientists who had attended professional development workshops into summer camps scheduled for later in 2010. Views about long-term viability of PoP type efforts at ESC differed among team members. ESC was facing some financial challenges. In response, the institutional PoP team members had discussed charging for the professional development workshop.

[We could continue] if we had more money to dedicate someone to do it. But other than that I'm not sure how we could. . . . [If scientists paid for the workshop,] then it would be a sustainable program. [We talked] about the likelihood of somebody paying for the workshop. I mean they get the value that's in the workshop, but then we're asking them to deliver a program for free. [Perhaps,] eventually we could apply for somebody to sponsor this program. At the moment though, it's not in our budget (ISE_2-1_ESC_9180_032910).

At MLS during final interviews, the two PoP Team members shared their perspectives on PoP at their location. One said:

The most important thing that it did was that it gave us a very rich set of professional development options . . . we didn't have to reinvent that wheel. . . . We have a go to place when we start to think about what might we use to get a given program together (ISE_3-1_MLS_2267_051410).

He noted also:

But we're probably not going to do . . . a typical PoP professional development program for somebody . . . we're not going to ask them to put in an hour or two hours for a 15- to 20-minute dialogue-based program. But we use the thought processes that come along with the work we did in PoP when we're talking to researchers about getting up in front of our audience (ISE_3-1_MLS_2267_051410).

The primary implementer, however, saw some different challenges in implementing professional development into some existing programs.

To me there was a really big problem in trying to get [PoP] training into the NanoDays program because it was not something . . . I own in an institutional sense. . . . And it's the ownership issue and the timing issue is really important. With the Genome Diner *folks . . . we asked them to commit to something [and] it was a condition of entry. Whereas these* [NanoDays] *folks, we were trying to convince them, 'Well, you already think you're prepared to do this. We'd like to help you do it better.' And that was frankly a tough sell for some of them (ISE_3-1_MLS_4270_051410).*

Impacts on Scientists and Public Visitors

This section includes discussion of impacts on (1) scientists and (2) general public visitors. Impacts of the implementations on informal science educators are implicit in the case studies. The set of impacts and indicators in Appendix G was developed in April 2010 by the PoP project manager, researchers from ILI, and the summative evaluator to include the full range of indicators for all eight sites. The set of indicators reflects the project as a whole. It includes some impacts and indicators for the implementations of PoP at the three lead institutions and in the research study.[12]

The specific set of impacts in Appendix G was not available at the time of the Dissemination Workshop, which used examples of impacts rather than a prescriptive set. Therefore, no interpretation should be made about the extent to which implementing sites attempted to accomplish the set of impacts included as a whole in Appendix G. Rather, they are useful in comparing across sites and assessing the overall implementation effort. In the *Conceptual Planning Worksheet*s from the five sites, example impacts were listed. The set of impacts discussed in this section is a selected set relevant to these implementations that may be useful to the PoP project as it goes forward. While this analysis was not part of the original process-focused evaluation design, its inclusion here supports cross-site comparisons in this implementation, allows reporting to the funder, and provides a bridge to compare findings to the research study by ILI at the three collaborating partner sites.

In addition, design of this study focuses primarily at the institutional level. Evidence about individual impacts on informal science educators and scientists is based on relatively small numbers of individuals participating at each site. Observations, engagements, and in-depth interviews with visitors at public programs provide evidence about the level of impact on both scientists and general public visitor target audiences. These findings should be considered suggestive rather than definitive, and more study of audience impacts will be needed as the PoP project continues.

Impacts among Scientists

This discussion of impact among scientists is drawn from several data sources. We observed 23 of the 38 scientists on site visits as they engaged with general public visitors during public programs. We conducted in-depth interviews with 11 scientists, who included at least one earlier and one later career-stage scientist at each location. In order to obtain a big picture view of the entire group, we used an online survey sent after the scientists' public program experience; only 9 scientists, however, responded to the online survey. This low response rate limits the strength of some findings. In addition, both scientist respondents to the online survey and those agreeing to in-depth interviews may have been biased toward scientists who were more deeply affected by and supportive of the PoP programs at their locations. Therefore, our discussion of the range of impacts may be more reflective of scientists who were more enthusiastic about the program.

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[12] The numbered impact areas identified in this section are provided to enhance readability. The numbers do not correspond to the numbered impacts in Appendix G.

Scientist Impact One: Scientists' Understanding of Learning in Informal Environments

Most activities and materials developed by scientists appeared to reflect one or more principles of effective informal learning, as reflected in the Professional Development Elements used in professional development workshops. During program observations, we looked for the extent to which activities (materials and communication) addressed all ages, illustrated a key scientific content or idea, prompted longer engagements, and allowed for visitor participation. Many of the materials evaluators saw reflected one or more of these principles. A few had some characteristics that made them less appropriate for informal learning settings.

As a group, activities and materials at ASC and DCM reflected the most completely developed experience for informal learning. At other locations, there were also materials that were clearly well-suited for informal learning environments. Statements in this section about how intriguing or memorable activities were will be supported in the following section, which includes data from general public visitors.

At ASC, there were 15 presentations and table-top experiences. Clear titles and signage supported the clarity and focus of all these experiences. One example of materials and activities with characteristics well-suited for informal learning environments was an interactive game called *Would you like to solve the health mystery?,* developed by an epidemiologist who explained:

> *I prepared an interactive game to identify the source of a disease outbreak. I used this activity to teach the participants about basic epidemiological techniques and provide hand hygiene education (POP_SCI-3-1_Online Survey).*

Visitors observed frequencies of disease among homes and businesses in a community, and the presenter recorded these observations on a whiteboard. As the game progressed, participants were able to see that the epidemic began in a daycare center where children were not washing their hands. This activity called for observation, analysis, and even the use of math to reach a conclusion. Children could make a connection to their daily lives. Adults generally observed rather than participated, but several adults approached the epidemiologist with questions after the game.

Another example of a particularly well-developed set of activities focused on attracting visitor engagement through an intriguing phenomenon. One electrical engineer developed an activity titled *Would you like to hear the sun play a song?* He built a small house that had several electrical devices powered by an actual solar panel on the roof. Using the vocabulary from the professional development workshop, he explained:

> *And my hook was "Would you like to hear the sun play a song?" And one of the appliances inside the house that was running was a small CD player, along with a little amplifier and some speakers that were playing "Here Comes the Sun." That was all powered by this solar panel that was on the roof of the house. I also had lights and a . . . small fan unit that was like a heating and air unit on this model home (SCI_3-2_ASC_6253_051910).*

In addition to using these intriguing phenomena to attract visitors, the electrical engineer also provided activities and handouts with more information about solar power. Children were clearly intrigued and definitely connected to the concept. Several adults were observed in long conversations with the electrical engineer, discussing applications of solar power they were considering.

Another set of activities and materials, *Would you like to build a bloodsucking bug?*, illustrated adaptation to an environment and the transmission of disease from insects to humans. This activity was offered by a medical entomologist.

> *The goal was to educate children and their parents about a tree hole-inhabiting insect in our area that is capable of transmitting a parasitic disease to humans. To this end I asked children to build a model of what they thought a blood-sucking bug would look like using clay models and tacky adhesive. I also showed children photos of six animals and had them put a star on the ones they thought might live in tree holes or cavities (POP_SCI-3-1_Online Survey).*

Children primarily participated in the activity, but adults observed and had questions about the likelihood of disease transmission in places they visited.

Another activity that was particularly memorable for both children and adults used a simulated analogy and models to prompt questions. Both adults and children participated in an activity called *Can you help me untangle these nerves?*

> *To represent my research as a neuroscientist, I described and demonstrated principles of how neuroscientists map connections between brain parts. As visitors approached, I asked them to help me untangle a heaping pile of tubing. Right as they would reach to physically untangle it, I would interject and tell them that there was a catch: they had to untangle the tubes without moving them. That surprised a lot of kids and made them very receptive to my neuroscience solution: to "untangle" nerves in the brain, we inject nerve fibers (like tubes) with colored substances that allow us to trace the path of the "tangle"—thereby untangling the nerves without touching them. . . . To further illustrate this concept, I developed a 3-D brain model where the visitor could trace the nerve pathways by pulling a colored string through them (POP_SCI-3-1_Online Survey).*

Other presentations at ASC exhibited similar characteristics. Some showed considerable effort to make complex topics accessible. Yet some scientists opted to break down complex ideas into different activities. As experienced exhibit developers know, it is often difficult to lead visitors of any age through multiple, sequential steps in inquiry. There are other activities, and other visitors distract their attention.

At a presentation on statistical genetics, there were two activities spread out over two eight-foot tables. Children attracted by the photos of animals and stuffed animals approached the table-top stations. They frequently used the table-top activities alone, while the scientists had conversations with adult females about premature birth. The experience appealed to children, yet many did not engage with the scientist. In in-depth interviews, adult females found this experience memorable, but that did not appear to be the case among children.

In contrast, at DCM the activities functioned as a whole, with two primary focus areas reflecting the work of each of the two medical students. Many visitors used many of the activities in sequence, following the conceptual sequence in the design. One area focused on medical diagnosis and the other on broken bones, both familiar topics to adults and children. Each area had multiple materials and intended activities that included displays, photos, and models of a sore throat and infected ear. A six-foot-high case surrounded the area. These activities were staffed by one of the medical students formally involved in the PoP implementation and four other medical students who had volunteered for the day. All the activities supported touching, observation, and prompted conversation. The medical diagnosis area focused on ear and throat inflections, with a microscope available to view the bacteria involved. The activities also included the opportunity to use medical instruments, such as a stethoscope to listen to the heart and an otoscope that children and adults used to look into each other's ears. One involved a medical test.

> *The goal was to give an idea of what does a doctor do when they're diagnosing you with a sore throat . . . what are they looking for? So I had a large model mouth that we had spread shaving cream over to represent like a goopy . . . pus at the back of the throat that you see when you have an infection. And we had kids come up with Q-tips and take a little sample and put it on the card. And then they'd put drops of different indicators on it that was a mock-up of what a rapid strep test might be. And they were testing to see do we have strep throat? Is it streptococcal? Or is it a viral infection of the throat? So that was one station. . . . Some of the kids came back time and time again just to take a sample and see if the color changed of the test they were doing (SCI_3-2_DCM_6581_052610).*

The other area focused on diagnosis of broken bones and featured a complete skeleton and numerous bones.

> *We had one other table set up that was looking at fractures. So we had models—this was something that [the museum staff] helped make up for us—models of what different fractures would look like. So . . . a twisting fracture versus a hitting fracture versus . . . a compound fracture where it sticks out of the bone. This is also where we had the giant cast that the kids could sign their names on. . . . And we had an X-ray box and some X-rays so the kids could look at different kinds of fractures, too (SCI_3-2_DCM_6581_052610).*

The materials appeared well-suited to both children and adults, with adults engaging with their children. Several scientists (classmates of the two medical students) demonstrated the use of specific medical devices (e.g., microscope, stethoscope, and otoscope). The demonstration appeared to elicit questions from both adults and children.

The materials-based format appeared to provide a robust basis for engagement, even when some aspects of the activities were less well-suited for all members of the audience. At ESC, for example, evaluators observed one scientist focusing her attention primarily on children. She appeared approachable, and many children talked with her as she prompted them to look through an electron microscope. Yet the presentation also included a PowerPoint with specialized vocabulary she had developed for her graduate-level classes. So while this presentation may have had some elements (e.g., the PowerPoint) not entirely appropriate for children, it had several other elements that worked for children in the informal learning environment.

At DCS, an evaluator saw two sets of activities and materials. One featured an experienced presenter who had tested his presentation, and the other featured a younger scientist trying out his presentation for the first time. The experienced presenter's activity was called *Focus on Research.* It involved the magnetic properties of gemstones. The other presenter's activity related to researching green florescent protein in glow worms. Both sets of activities and materials showed considerable thought in illustrating scientific concepts and making them accessible to people of all ages.

The gemstones activity provided more opportunities for direct experience, with intriguing phenomena that prompted visitor inquiry.

> *The message I tried to give is that all material substances react to a magnet. Most things are repelled, but a few things—a few materials are actually attracted to a magnet. And one can do a very, very sensitive test to show this since the materials that are repelled are very weakly repelled. . . . I just cut off the top of a polyfoam coffee cup—it makes a very small raft. And so I float a topaz and an aquamarine, two light-blue colored stones. . . . If you bring one of these very strong rare magnets up to it, you can show that the topaz is repelled and the aquamarine is attracted. So it's a very simple way to demonstrate that some materials are repelled and others are attracted (SCI_3-2_DCS_9730_051910).*

This presenter allowed visitors to test the magnets and then led them to some additional items, including journals in which his work on the magnetic properties of gemstones had been published. This simple connection to publications led to further discussion of his work in several cases. While children were generally prompted to use the activity first, both adults and children participated. In two cases evaluators observed, fathers who had detached themselves from their family groups rejoined to participate and ask questions.

Materials for *Green Florescent Protein and the Glowing Worms* also showed considerable thought about the presentation of concepts. A large-scale model demonstrating how florescent protein is inserted into DNA to produce glowing worms is featured in several children's pictures later this section. To complete his explanation, however, this presenter had relied on illustrations and photographs in an exhibit located about 30 feet away from the designated presentation area, requiring groups to move across the gallery. Children handled the model and used the exhibit at the presenter's prompting. Adults stood back and were not invited to participate. The model was clearly intriguing and the exhibit use extended the engagement, but the presentation and materials elicited little two-way conversation and few questions.

At MLS, evaluators observed four sets of activities and materials. Two sets of materials offered intriguing phenomena. One focused on the risk of using nano materials in aquatic toxicology. It featured fish embryos. This presentation showed that considerable thought had been given to making the concepts accessible.

> *We [introduced] them to what aquatic toxicology is . . . [and how we use it to] try to understand things that might potentially be at risk in the environment or to human health. . . . We brought fish embryos . . . [to] show them that we can actually [look] at the structure of the heart. . . . We talked about how some of those time points are very sensitive. We tried to link that to children growing up. . . . Things out in the environment can cause a problem. So we tried to focus [on the] tools that we [use]. . . . We had microscopes set up [for] both video screens so they didn't have to actually be able to use a microscope to be able to see things (SCI_3-2_MLS_5773_061010).*

Another set of materials and activities featured heat-sensitive nano particles. The color change was attractive, especially to children, but the phenomena were not embedded in questions or inquiry. Some other sets of materials at MLS were less well-suited to informal learning environments, including a poster from a professional conference that may not have fit the wide range of understanding and age levels of the visitors. The evaluator noted that several scientists relied heavily on specialized scientific vocabulary, even when speaking with children. Few responses from children's in-depth interviews reflected deep understanding of the phenomena or the information provided in conversations with scientists.

In summary, we observed and documented a range of activities and materials developed by scientists. Many had several characteristics that made them appropriate for this setting. A few were less well-suited, with scientists using materials or vocabulary appropriate for college and graduate students. Scientists using high-level vocabulary and poster presentations from professional conferences were among those who had chosen not to attend the professional development workshop.

Scientist Impact Two: Scientists' Communication Skills and Support of Visitor Inquiry and Engagement
Despite a few last-minute changes, most of the scientists in in-depth interviews conducted after the conclusion of their participation said that the professional development workshop they attended prepared them to participate. One scientist from ESC commented:

> *I think the workshop really helped . . . in preparing us for what to expect when we actually did the POP program presentation (SCI_3-2_ESC_4179_052610).*

At ASC, one respondent recalled how the workshop helped her to make quick adaptations based on visitor understanding. She explained that she and a partner had built shapes with magnets:

> *That activity provided a really good example and a good way to think through how do you, on the fly essentially, adjust your plan [or] procedures for doing something to be responsive to what people were actually appearing to understand (SCI_3-2_ASC_6884_052510).*

Based on an analysis of the agenda for professional development workshops, we found that all five sites offered opportunities to develop communication skills. At three sites (ASC, DCS, and ESC), inquiry skills were included as part of the training for scientists.

We found more frequent mention of scientists applying communication strategies to other settings at ASC and DCM. Both medical students at DCM made connections between communicating in the museum and in work with patients in medicine.

> *And I think that was really one neat thing about working there is [that] a kid would come to us, and describe things in a certain way. And then all of a sudden the grandparents or the aunts and uncle would come up and you would have to describe the same thing, but of course you're not going to talk to them like you just spoke to the kid. . . . That's exactly how it is in the working in the medical profession. Not only are you going to have to describe what's going on to the patient, but if that patient just happens to be younger, you're going to have to describe what's going on to that mom or dad (SCI_3-2_DCM_7777_061110).*

There were benefits for me in terms of learning how to develop something at the level for children and how to explain and communicate with someone who is not in my field. And that's something that I'm going to work on, on a day-to-day basis as a physician. None of your patients are experts in the field (SCI_3-2_DCM_6581_052610).

A respondent at ASC recalled how she used the materials developed for the PoP public program in another ASC program for high-school-age girls interested in science and technology. Another scientist at ASC adapted the materials she developed at ASC and used them in a university class. A PoP Team member at ASC had heard about this experience:

Her professor . . . asked her to help him to teach a class on risk management to these Vanderbilt students. So she took the stuff that she developed for [ASC] and she took it into that classroom and she made it more advanced for these Vanderbilt students, and very hands-on. . . . And her professor [asked] would you let me have some of this stuff? I'd like to do this again. I'd like to share this with other classes. And she said the students loved it (ISE_2-1_ASC_6254_032610).

Scientist Impact Three: Scientists' Reflective Practice and Modifications of Activities

Responses focusing on reflections and modifications generally were related to differences in understanding between adults and children—and the realization that informal science institution audiences include both adults and children. One respondent at ASC had focused on children in preparation. After the public program experience, she understood that some adults may have more in-depth questions.

I didn't have as much prepared for [adults] because I hadn't anticipated that level of discussions. So that would have been something to change (SCI_3-2_ASC_8782_051910).

Other scientists noted they had developed a deeper understanding of the need to adjust communication among different groups.

Some of [the adults] asked some fairly technical questions, [and for children] it wasn't at the same level. So it was interesting . . . differentiating between the two groups (SCI_3-2_MLS_0177_051810).

I usually only talk about science with people who are college age or older . . . I need to work on my ability to present what I do to the general public at large. And that includes children and adults who are not scientists (SCI_3-2_ESC_4179_052610).

Others recognized they needed to improve their skills in assessing knowledge of children.

I was a little bit surprised that some of the kids . . . didn't know what an atom. . . . I'm really not up as to what grade levels they introduce various aspects of science. So that was probably the hardest thing—how to gauge at what level I should talk to the kids (SCI_3-2_DCS_9730_051910).

Scientist Impact Four: Positive Attitudes toward Outreach and Public Engagement Activities
Based on the initial survey, most of the scientists entered the project with fairly positive attitudes toward public engagement activities. At the end of the program, we found intention by the scientists to continue and expand their activities in presenting their work to the general public. At ESC, a scientist who had presented two public programs noted:

> *I think that the bottom line is that the fact that we did it a second time and if given the opportunity would do another presentation, I think that speaks loudly about how much we really enjoyed the overall program itself. (SCI_3-2_ESC_4179_052610).*

One DCM participant explained how he had connected with other medical school students to the museum:

> *Through my experience with the Discovery Center, I've gotten the pediatric interest group involved in doing service with the Discovery Center. . . . We enjoy doing community service projects . . . and I think that they're going to start doing a lot more activities on a regular basis (P53: SCI_3-2_DCM_7777_061110).*

The other medical student explained that she had recommended volunteering in afterschool programs to her medical school classmates:

> *The Discovery Center has a lot of opportunities . . . for this program to expand because they work with the afterschool programs. I think that doing this on a continuing basis, as opposed to just a one-time thing, would also be a really valuable experience (SCI_3-2_DCM_6581_052610).*

Scientist Impact Five: Interest in Participating in Professional Development and Public Programs at Informal Science Institutions
Among the respondents to the online survey (N = 11), 9 indicated they would participate in PoP-type programming in the future (2 did not respond to this item). The only comments recommended recruiting more scientists to participate. All 11 respondents indicated they would recommend participation to a friend or colleague.

Benefits that scientist respondents described ranged from personal enjoyment to helping the public understand science. Online survey responses were similar in range and frequency to these comments from in-depth interviews.

> *I enjoy engaging the public and teaching them about my area of expertise. . . . Having the questions about hand washing and outbreak investigations and about what I do, that was very rewarding (SCI_3-2_ASC_8782_051910).*

Others noted that the professional development included the development of skills they could apply in their university-level teaching.

> *Well, I think one of the major benefits [was] instruction and experience leading an inquiry based activity. It's one of those things that as an educator in science I hear a lot about. . . . . We really should be doing more inquiry-based activities in our science classroom. . . . But [up to this point*

in my career I hadn't] identified a resource to get experience in doing that. And really finding a way to incorporate into the classroom. So I think that is a huge benefit (SCI_3-2_ASC_6884_052510).

Both medical students believed the experience would improve their clinical practice.

And looking at it from a very selfish standpoint, whether I helped any kids or not, I learned a ton and I got a ton out of it. And I think it's going to greatly improve the way I practice medicine (SCI_3-2_DCM_7777_061110).

Several of the scientists cited, as a personal benefit, the opportunity to explain to the general public why science is important.

It's always valuable and . . . a reality check to talk to the general public about what you do. And I think it helps you . . . condense down the science that you do into something that's more [understandable]. We think in terms of publications, but the public isn't all that impressed with publications. They want to know why your work is important (SCI_3-2_MLS_5773_061010).

Scientists involved in medical research and practice stressed the importance of understanding science so individuals can make decisions about their own lives.

As a human geneticist I see [science literacy] being particularly important [in] academic medicine. There's continuing conversations about sequencing technology, having the ability to sequence an entire person's genome and use that whole resource of information to inform medical decisions. . . . And without a way to understand science and a way to be interested enough to want to understand it, the public's really not going to be able to be as empowered and engaged in making informed decisions (SCI_3-2_ASC_6884_052510).

Others saw the benefits of participation in helping the public understand broader issues.

I think exposing children and the public to nature, and not only for its own sake [but] how it's useful for humans in a more selfish sense. So we can use nature to help protect ourselves and understand what might be a risk for us. And helping people understand that we're part of this big system that we're trying to understand (SCI_3-2_MLS_5773_061010).

Impacts among General Public Visitors

Impact among general public visitors was assessed through observations of engagements with scientists at public programs, followed by in-depth interviews with parents and children. Children were asked to draw something they remembered from the program. Parents were the most likely to identify the presenters as scientists and to value this aspect of the program. Children appeared to accept scientists in a more matter-of-fact way than did adults. Parents cited the value of programs for their children. Also, we observed adults sometimes becoming involved in lengthy conversations that explored their own interests.

Children's drawings were focused more highly on content than on personal engagement with scientists. Where comparisons among multiple activities at the site were possible (ASC and DCM), some activities and approaches were more memorable than others. Not surprisingly, presentations featuring rapid delivery of information with little eliciting of conversation from visitors were less memorable (and less frequently the topic of drawings) than those that encouraged visitor questions and provided for activity.

The following sections present examples of data collected relative to two specific impacts areas:
(1) Awareness of Current Science Research, Applications, and Scientists in the Community; and
(2) Awareness of and Connections to Scientists.

General Public Visitor Impact One: Awareness of Current Science Research, Applications, and Scientists in the Community

With the exception of children under five years old, almost all respondents we interviewed found something memorable that related directly to the scientific content of the presentations we observed. Surprisingly, this was the case even for face-to-face engagements where scientists' skill level and the design of the materials may have featured fewer informal learning characteristics than others. It appeared that the materials-based format provided a robust context for learning across a variety of skill levels.

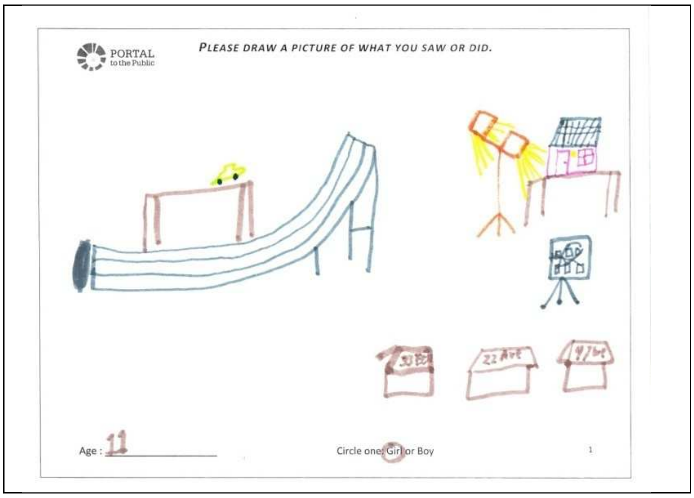
Taken as a whole, there were patterns across sites related to differences among adults and children. All visitors we observed were members of groups of adults with children. Yet there were substantial differences across sites. In in-depth interviews at ASC and DCM, both adults and children shared something memorable they had seen or scientific content they had learned. At DCS and ESC, children easily shared things they had learned, but adults were less likely to do so. At MLS, adults who were interviewed made direct connections to science more frequently than did children. Children at MLS were enthusiastic about their experience but made few connections to applications and their daily lives.

Adult connections to content at ASC seemed particularly high. Presentations featuring practical applications of science appeared particularly memorable, and adults made connections to their own lives and behavior.

> *How we can do things, save more water, that was interesting when the lady talked about saving our water. And we talked about the attachment on the toilet you could put on the toilet. And just the wind turbines . . . and the solar panels, how we're going to be able to conserve more energy. . . . I didn't even know about the toilet, but evidently Europe does, and most of the United States evidently doesn't know or they'd probably get an adaptor (GPV_2-1_ASC2_032710)***.***

In a similar vein, one of the longest individual engagements observed was between a scientist and an adult female visitor at ASC. This presenter took the time to answer questions and discuss her interests. The area was not crowded at the time, which probably influenced the length of the engagement. In her interview, she described why she was so interested in solar energy. Her husband was considering the construction of a building, and during her engagement at ASC she made a connection between the information and this situation in her life.

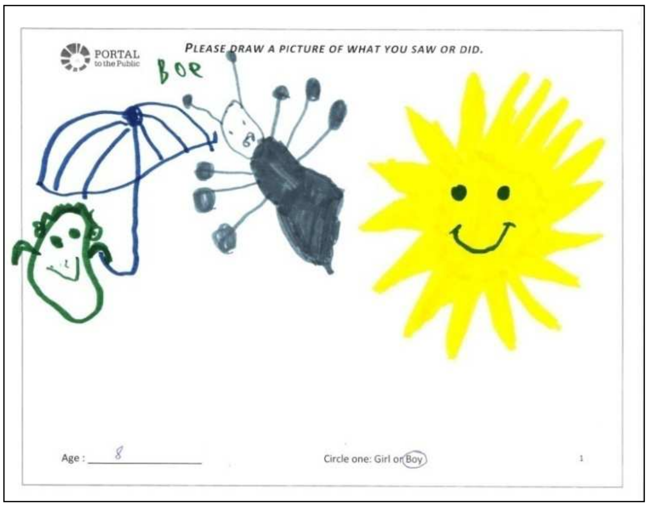
Children's understanding differed by age level, with children at ASC, DCM, DCS, and ESC having higher levels of memory of specific science concepts than at MLS. The three ASC drawings included here show the various levels of understanding developed by children of different ages in the same group. Figure 37 shows a drawing by an 11-year-old girl who portrayed three memorable presentations. Her explanation shows an understanding of the scientific processes underlying two of these activities.



I really liked how the sun could sing also and how it could take the energy. I knew about it, but I didn't know a lot. And another thing was I really like the cars. . . . We raced some cars so it was fun to watch other cars being raced. And he teaching us how where the weight, I didn't know if it mattered where the weight was, as long as the weight was on it. It goes faster if it's in the back and when it. . . . That really surprised me, I didn't know that. (GPV_2-1_ASC3B_032710).

Figure 37. **ASC, girl, age 11.**

Her younger brother, whose drawing is shown in Figure 38, also drew the solar energy presentation. But the topics he chose to explain were illustrating the activities *How can you reduce your water footprint?* and *Would you like to build a bloodsucking bug?* His explanations included comments that indicate a connection between the content of the research and the practical applications based on that research:



It's a water drop with an umbrella. And that one was for . . . how to keep water and not waste it for money and stuff. [By not] putting sprinklers in your garden or keep the water running when you were brushing your teeth, stuff like that. . . . I liked the bugs [activity] where [scientists] would go out and trap them and then they'd learn about them. And they take them back and have these machines identify them on how they kept getting people sick and stuff (GPV_2-1_ASC3C_032710).

Figure 38. **ASC, boy, age 8.**

The youngest child in this group, a boy aged six, remembered the solar energy exhibit, but items in his drawings such as the clocks were simply things he felt like drawing. Figure 39 shows his drawing. Based on other interview comments, his primary focus was the opportunity to accompany older siblings on a family outing.

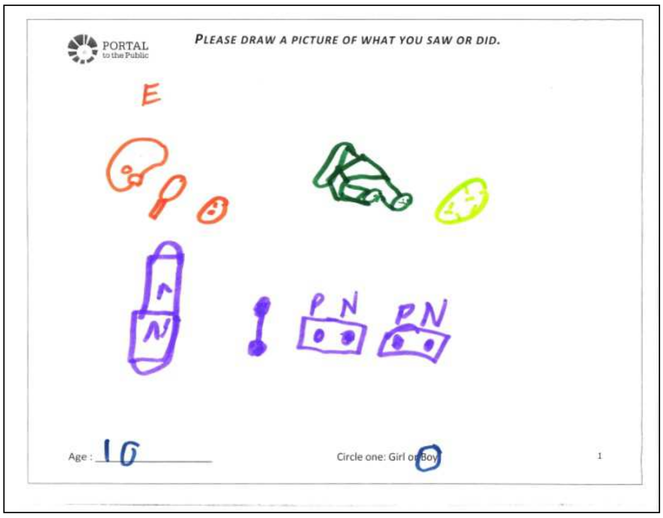
I drew a sun. A truck with ice cream on it. And I drew this weird thing that has scribble scrabble. I just like clocks (GPV_2-1_ASC3D_032710).

Figure 39. **ASC, boy, age 6.**

While many of the engagements observed at DCM were child-focused, some of the adults also had highly meaningful learning experiences. One mother we observed with her four-year-old daughter asked the medical students multiple questions and used almost all the medical equipment. The idea that she was seeing what a doctor saw when examining her daughter was interesting and emotionally affecting.

> *I was able to get a chance to see what it is that the doctor sees when she looks at [my daughter's] ears. . . . Listening to her heart, that was awesome, too. . . . I think that's probably the first time I ever listened to her heart beat like that (GPV_2-1_DCM1_031310)***.**

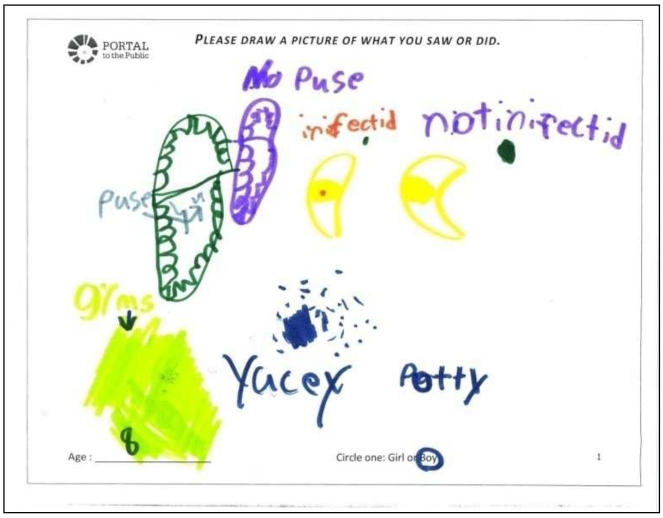
At DCM, the range of activities appeared to allow even younger children to learn some specific points. Yet, as at other locations, older children had more pointed observations and deeper understanding. The three drawings from DCM also came from the same group of siblings. Figure 40 shows a drawing by an 10-year-old boy who made the connections between the appearances of infected and uninfected ears. He understood also the purpose of the simulated tests.



Well, this was when we opened the ear. . . . And we used the thing and magnified it. Like a certain ear looked waxy, and certain ears looked infected. When we sweep the stuff from the guy's mouth and then we put it on the card. And then we put one thing on it to see if it was positive or negative. . . . I didn't know when they test your throat . . . if it's a certain color it means you have a negative or positive results about some sickness (GPV_2-1_DCM1B_031310).

Figure 40. **DCM, boy, age 10.**

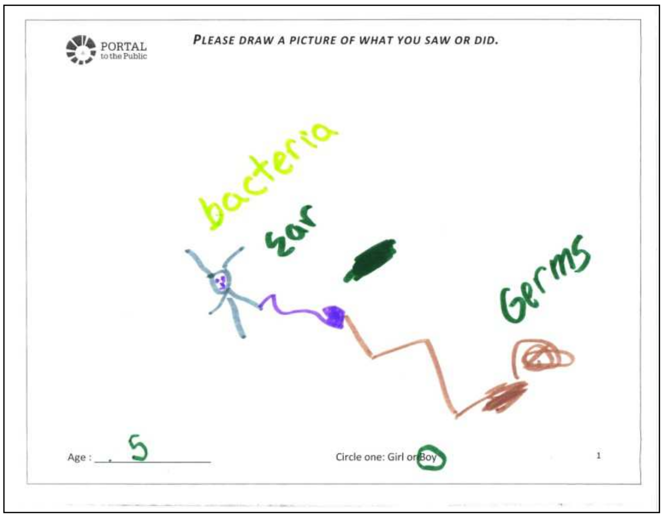
His eight-year-old brother, whose drawing is shown in Figure 41, focused more on physical symptoms. He also made a clear distinction between the appearance of an inflected and an uninfected ear.



This is a pus—pus in the mouth. And this is an infected ear and this is not an infected—this is yucky part of the ear. The stuff that's on the right is all yucky. And this is a germ on your hand (GPV_2-1_DCM1D_031310).

Figure 41. **DCM, boy, age 8.**

Their youngest brother grasped a simpler but important concept—there are both good and bad germs. His drawing is shown in Figure 42.



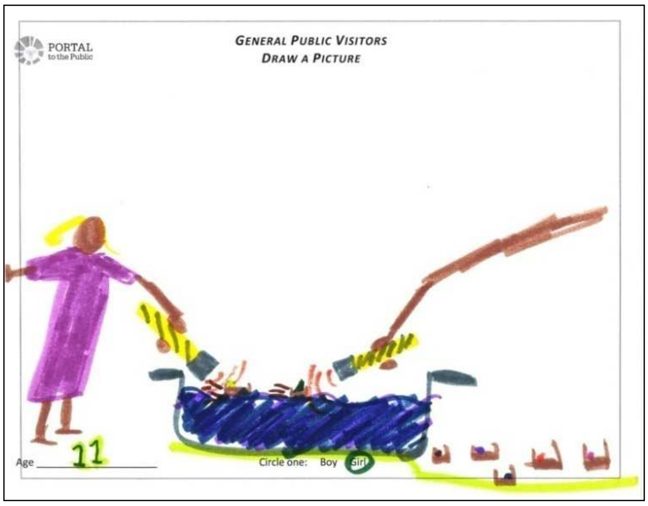
Germs and good germs. But this is a bad germ. The bad germ is taking over the good germ [labels written by the mother] (*GPV_2-1_DCM1BB_031310*).

***Figure 42*. DCM, boy, age 5.**

At DCS we observed two activities. One focused on the magnetic properties of gemstones. The other showed research focusing on how green florescent protein could be spliced into the genes of worms to create glowing worms. The gemstones presenter engaged with both children and adults, but the other presenter engaged primarily with children. Most of the adults in both groups we interviewed at DCS deflected questions about their own learning and repeated them to their children. We interpreted this tendency as a perception among adults that the activities (and perhaps the entire museum experience) were primarily for the benefit of their children. Only one adult, a middle-school teacher, commented on her own learning.

> *I was shocked at how they didn't all have the same magnetic pull (GPV_2-1_DCS1_032010).*

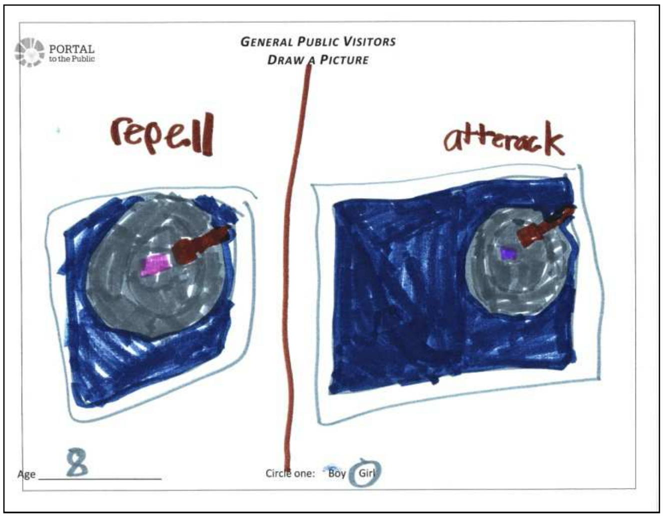
Drawings showed children engaging with the gemstone research understood that the magnets repelled and attracted the gemstones. This was clearly a fascinating activity. The Figure 43 drawing by a girl, age 11, showed understanding of the underlying process being demonstrated.



He had a bucket of water and then he had cut off the bottoms of Styrofoam cups. And then he put certain stones in them—gem stones. And then he put the magnet by them to see if they were attracted or repelled (GPV_2-1_DCS2C_032010).

Figure 43. **DCS, girl, age 11.**

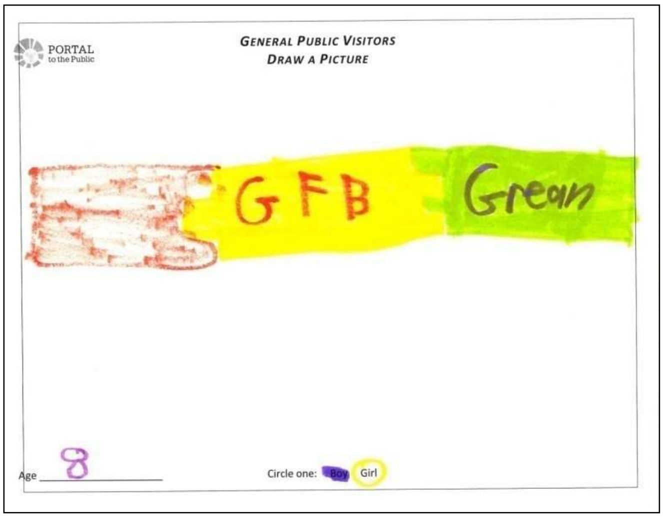
Her younger sister, whose drawing is shown in Figure 44, said that the terms *repel* and *attract* were new to her, even though she was familiar with magnets. This vocabulary and these concepts were her new learning from the engagement. She connected these new concepts to previous knowledge of magnets.



I did when it was repelling and attracting. Light blue . . . was pushing itself away from it, that magnet. [The other one] was attracting and it was purple and it was bringing itself towards the magnet (GPV_2-1_DCS2B_032010).

Figure 44. **DCS, girl, age 8.**

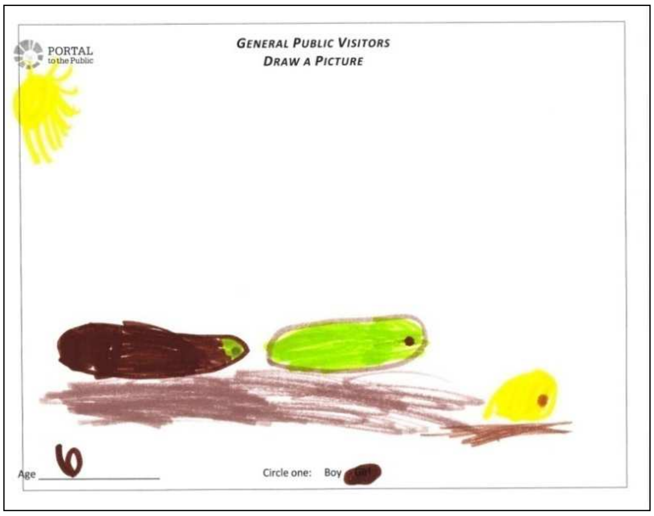
The groups we observed engaging with the scientist who conducted genetic research on green florescent protein all had younger children. The presenter focused on the children in the groups, with adults sometimes standing in other areas of the gallery. Similar to the other groups, adults appeared to deflect questions about their own learning and responded by commenting on their children's learning. Worms were familiar to all the children, and the idea of glowing worms was intriguing to them. Figure 45 shows the drawing by an eight-year-old girl who depicted a tube the presenter had designed to illustrate gene splicing. She understood that something was removed from one animal and placed into another.



The glow stuff [was] in the squid . . . they get out and they put into the worms (GPV_2-1_DCS6_032010).

Figure 45. **DCS, girl, age 8.**

Her younger sister, age six, drew different colors of worms. Her drawing is shown in Figure 46. She made a distinction between the worms that glowed and those that did not.



I made two worms, one is brown and with the green face on it. And green with a brown eye. . . . One glowed (GPV_2-1_DCS5_032010).

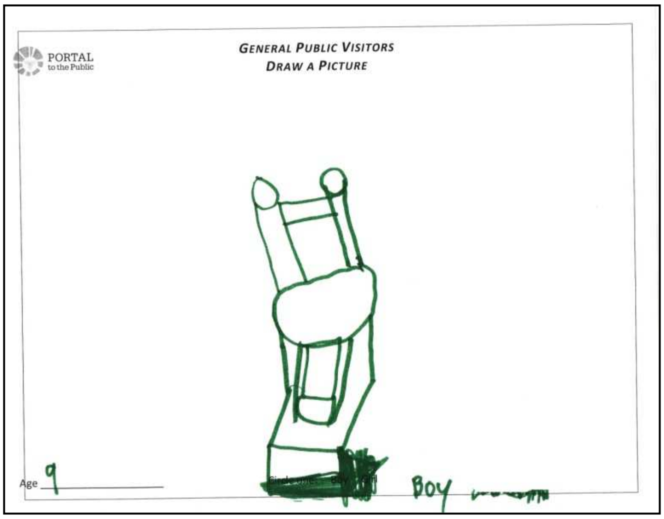
Figure 46. **DCM, girl, age 6.**

At ESC, the scientist we observed presented her research involving a topic at the nano level, the improvement of LED lights by changing the patterns with atoms in materials. The presenter appeared to focus more on children than on adults, although adults did interact with their children. In interviews, we found that a few adults had picked up some new information. This information appeared, however, to be fairly factual.

That soon the LED lights would be replacing the traffic signals (GPV_2-1_ESC1_033010).

I didn't know anything about nanos, and I didn't know that the three colors combined made white. Like the red, yellow—or green and blue (GPV_2-1_ESC1_033010).

One of the clearest explanations of the research came from a nine-year-old boy. His drawing is shown in Figure 47.



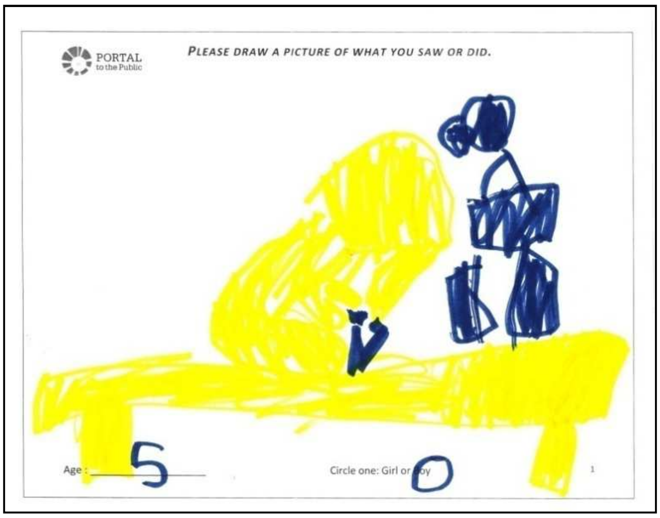
I'm trying to draw the microscope. . . . [The scientist] was trying to figure out how to get rid of the errors in the atoms . . . in the pattern of the atoms. . . . She said if she could fix that . . . she could make [LED light] last longer and be brighter (GPV_2-1_ESC4C_033010).

***Figure 47*. ESC, boy, age 9.**

Many of the children we interviewed at this location were very young, under five or six years old. In addition to understanding that *nano* meant *very small*, vocabulary appeared to be the primary type of learning from the engagements with the presenter. Figures 48 and 49 show drawings by twin sisters, age five. Both recalled looking through the microscope and seeing "atoms." For young children, recalling the experiencing of looking through a microscope is an age-appropriate type of learning. One understood the presentation had something to do with magnetism. Her twin made a connection to another very small thing with which she was familiar: bugs.

Well, I drew some atoms because I saw some. I think they're inside magnets (GPV_2-1_ESC1B_033010).

Figure 48. **ESC, girl, age 5.**



I drew atoms. And I think atoms are actually bugs (GPV_2-1_ESC1C_033010).

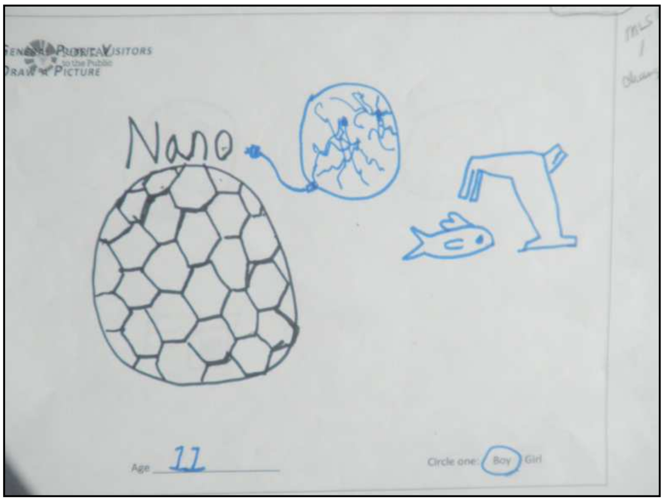
Figure 49. **ESC, girl, age 5.**

In in-depth interviews at MLS, adults, more than children, appeared to connect to practical applications of the research and to learn new things. Presentations featuring products and environmental impacts were particularly memorable.

> *I saw that they were studying the effects of the nano part on the environment. And how it affects the different products that we may use every day. . . . I guess it's a safety factor as well (GPV_2-1_MLS1_032710).*

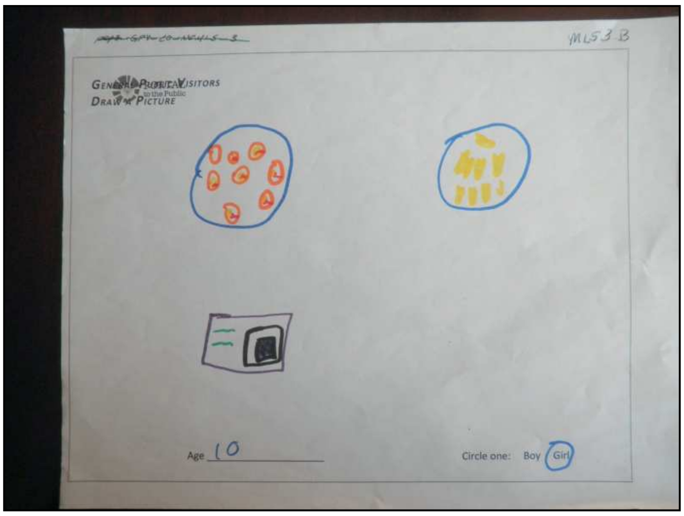
I would just say information about how it's used in everyday items. And what is it, the titanium dioxide that's in milk and—that's another thing that's in our food. Oh, and the toothpaste (GPV_2-1_MLS1_032).

All the children observed and interviewed could recall some element of their experience. Fish embryos were particularly memorable; they were featured in all the drawings. At this site, we found that children found things fun and interesting but did not make numerous connections to the topic of nanotechnology as a whole. Figures 50, 51, and 52 show drawings from this site.



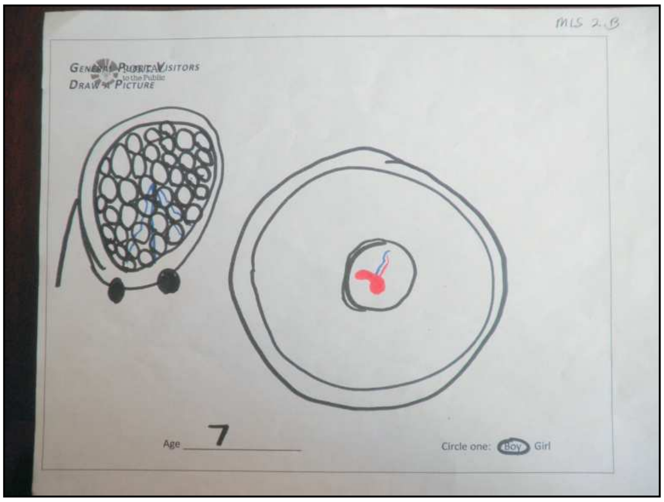
Well, I actually in the fish section . . . that there are some eggs and they're really, really tiny and you can see the hearts in them if you look closely at the eggs. I thought that was really cool (GPV_2-1C_MLS1C_032710).

Figure 50. **MLS, boy, age 11.**



You can see . . . some the small fishes moving around. And you can see the hearts in the fish (GPV_2-1_MLS3B_032710).

Figure 51. **MLS, girl, age 10.**



The fish eggs. It was something interesting that I remembered (GPV_2-1_MLS2B_032710).

Figure 52. **MLS, boy, age 7.**

General Public Visitor Impact Two: Awareness of and Connections to Scientists
Some of the project-wide intended impacts focused on visitors being aware that they were engaging with scientists. In Stage One in-depth interviews, ISE at four of the five sites specifically mentioned the importance of developing institutional credibility with the public by having scientists involved in their programming. In analysis of in-depth interviews, we identified some patterns of difference across locations related to these intended impacts. When probed or asked directly, almost all respondents older than age five responded they were aware they had engaged with scientists or other types of scientists, such as engineers or architects. When asked if the person to whom they had talked was a scientist, typical responses included the following:

> *He was a scientist. He discovers stuff and he does experiments on things (GPV_2-1_DCS6_032010).*
>
> *She studies atoms and stuff in stuff. She's a scientist (GPV_2-1_ESC4_033010).*

As with the respondents at MLS *NanoDays*, adults and children indicated their focus was on science, not scientists. Typical comments included the following:

> *Well, we talked about science a lot. I mean they didn't really talk about themselves. . . . I think that that's very interesting, some of the things they were telling me, because we don't get to go into that much detail in science sometimes (GPV_2-1_MLS3_032710).*
>
> *Honestly, I didn't really get a whole of information about them (GPV_2-1_MLS3_032710).*

In three interviews at ASC, respondents did display enthusiasm or deeper connections to the idea they were engaging with scientists. These interviews stood out because the connection was so much more pronounced than those in other interviews. In one interview, both a mother and her homeschooled son valued the interaction with scientists and cited this interaction as a memorable part of their experience.

The 12-year-old clearly was interested in science and had looked forward to coming to ASC for the event.

> *That's what the science museum has been so great about . . . you can get this from these engineers and these experts in the fields. The up-to-date things that are going on (GPV_2-1_ASC2_032710).*

> *It was cool because I actually got to interact with them. Instead of just like maybe talking to them for maybe like two minutes (GPV_2-1_ASC2_032710).*

A neonatal intensive care physician attending the ASC program with her two sons was fascinated with two physicians' presentations.

> *The first person [we talked with] was an astrobiologist, and he's working on how to adapt bacteria to work on Mars. And it was really, really cool about what kinds of bacteria he develops and plants and so it was really neat. I didn't know that was going on. And then the two scientists who were at the astronaut booth ended up being, which I didn't know, colleagues of mine. The cardiologist and the orthopedic surgeon who were there and . . . their outlook on it was really cool. I had no idea that . . . doctors applied to be astronauts (GPV_2-1_ASC1_032710).*

Another female respondent was fascinated by the concept of a medical entomologist.

> *I just thought that was interesting that they would mix medicine with studying bugs. . . . We went to bug presentation where [my children were] fascinated with bugs, and identifying bugs, and finding new bugs, that's all they do. But to mix medicine with it . . . I'm a nurse, I just thought that was neat. I didn't realize there was such a field. (GPV_2-1_ASC3_032710).*

In summary, respondents appeared aware they were engaging with scientists at most of these public programs. With the exception of a few pronounced instances, however, the enthusiasm and learning focused primarily on science content rather than personal connections with or satisfaction from engaging with scientists.

Conclusions and Recommendations

In general, the POP approach appeared adaptable and useful across a range of settings. Yet there are some important lessons that can be applied by the collaborating partner PoP Team in revising the approach. Other lessons may be useful to informal science education institutions in making decisions about implementing the approach.

Preparation of Informal Science Educators to Support Implementation

The preparation process was highly influential in the nature and range of implementations. It is a strong feature of this overall approach. Some lessons were learned about the selection of members for institutional PoP Teams.

- The characteristics of staff members that institutions selected for the local PoP Team were an important factor in the implementation. Sites selecting team members with experience in professional development, public programs, and direct ownership for programs made some implementations smoother and reduced staff time in implementing the program.
- A face-to-face workshop experience appeared essential in preparing PoP Team members to implement the approach. The workshops provided an opportunity to clearly understand the guiding framework, recognize the benefits for scientists, and have time away from busy schedules to plan and to experience professional development activities.
- The conceptual planning process was a very strong element of the PoP approach. Representatives from all locations noted the importance and usefulness of this process, particularly in providing ways to adapt the approach to their institutional and community contexts. Some sites did, however, run into unanticipated problems. Consideration should be given to adding a section on potential challenges and obstacles.
- The catalog of Professional Development Elements was the most highly valued and influential aspect of the preparation process. Having experienced these activities as learners made using the elements less time-consuming for ISE who had attended the workshop.

Building Partnerships with Scientists and Organizations

The PoP approach supported the development of ongoing partnerships with scientists, but in different ways and to different extents. This element of the PoP approach may need the most attention as the project goes forward.

- The status of existing relationships was an important factor in this set of implementations. Developing these relationships may take several program cycles. This element of the model could be strengthened by additional focus on managing expectations among implementers just beginning to develop these relationships.
- Additional focus on partnership and relationship building in the *Portal to the Public Dissemination Manual* and in workshop offerings is also recommended. Since this set of implementations began, Alpert (2010) has published a guide on this topic that may provide resources to further develop training for implementers of the PoP approach.

Professional Development

The professional development aspect of the PoP approach was highly valued and appears to be one of the strongest aspects of the approach. Informal science educators valued and used the guiding framework, strategies, and materials in planning the professional development experiences.

- The highest level of enthusiasm focused on Professional Development Elements in the *Professional Development Elements Catalog*. This collection of activities saved staff time, as informal science educators found the elements easy to adapt and implement. Scientists enjoyed participating in workshops featuring these activities and cited numerous benefits from their participation.
- For sites selecting materials-based presentations as the format for their public programs, the importance of prototyping materials should be stressed. This prototyping would support scientist perceptions of success in their first public program efforts.
- Presenters at some locations were more skillful at engaging both children and adults and accomplishing substantial learning in both these groups. Including Professional Development Elements that build skills for both audiences is recommended for any implementation where both these groups are part of the institution's audience.
- While there were advantages to all ranges and schedules of professional development offerings, first-time adopters of the PoP approach could productively try one full-day workshop scheduled close in time to the public event. This scheduling appeared to maximize attendance and provide a clear time frame for materials development.

Public Programs

The materials-based, table-top public program format was a flexible option for both large- and small-size public programs. The material-based activities appeared to support communication engagement with general public visitors even when the communication of the scientists or design of the materials could have been improved. The materials-based format featured in all five of these implementations appeared an effective method of supporting face-to-face engagement between scientists and general public visitors.

Some consideration needs to be given to the development and testing of the approach with other types of program formats. The materials-based models and examples in the Dissemination Workshop appeared to influence many sites to select that format. Yet many of the Professional Development Elements appear applicable to discussion-based formats—and even lectures and demonstrations. Given the overall strength of the approach, it would be unfortunate if PoP were not to continue to grow in breadth as well as depth.

Some additional testing and consideration are needed so the PoP approach can be integrated into existing public programs, such as *Engineers Week* or other special events programming in which scientists have previously participated. This is a choice that institutions with well-developed public understanding of science programs featuring scientists may find appealing. This study raised questions about how the recruitment messages affected the readiness of scientists for professional development.

Adoption and Sustainability

Factors that appeared to influence sustainability included the following:

- PoP Team members and administrators at sites perceiving initial success in recruiting scientists, conducting professional development, and implementing public programs.
- The amount of staff time to continue the program appearing reasonable in relation to the number of scientists participating in the program.
- PoP Team members perceiving a good match between the materials-based education approaches and those already being used in the institution.
- Low levels of staff turnover during and after the implementation so that skills and experience from the initial implementation could support continuing efforts.
- Arrival of the PoP approach in the institution being perceived as a vehicle to begin new programming and expand types or number of audiences.

While informal science educators from all institutions indicated some degree of intention to continue the program, factors supporting sustainability appeared strongest at ASC, which had a well-attended event that met the expectations of both informal science educators and scientists.

Sustainability is somewhat likely at DCM, which had a similarly well-attended public event where an ongoing relationship with the local medical school was forged. Yet at DCM, the number of participants recruited was disappointing to the informal science educators, and the amount of staff time devoted to this implementation may not be sustainable for future implementations. Sustainability appeared promising at DCS, where programming was well-integrated into its mission and at a level commensurate with a fairly small staff.

Stability of staffing also appeared to be an important factor. At ESC and MLS, important members of the institutional PoP Teams left after the end of the project. Staff changes meant there would be a learning curve for future implementations. On the other hand, the integration into ESC's ongoing program operation and commitment to the program may make this adjustment possible.

Sustainability of the PoP approach as a whole may be less likely at MLS. Compared to other sites, MLS already was more highly involved at the institutional level with other public engagement with science programs, so the perceived need for the program may not have been as high. The MLS *NanoDays* public program was well-attended, and additional efforts to adapt professional development to that ongoing program may be commenced. Ongoing use of PoP Professional Development Elements in a range of public programs also may be undertaken.

Finally, implementing sites would benefit from more precise estimates of staff time for implementing and offering ongoing programs. In this study, we found the implementations were generally more staff-intensive than anticipated, but we did not measure this factor precisely. More precise estimates of staff time for implementing the PoP approach would provide important information for planning and decision-making and would support long-term sustainability.

Impacts

In general, the experiences provided by the *Dissemination Workshop Manual* and *Professional Development Elements Catalog* prepared informal science educators to carry out locally adapted implementations. Informal science educators appeared well-prepared for relationship building, successfully using many of the methods in the *Dissemination Manual*. Yet relationship building was the most challenging phase of the implementation process. Most informal science educators reflected a higher level of confidence in their preparation to offer professional development for scientists than to recruit scientists for the program. Most also had high levels of intention to continue PoP-type programming and professional development.

The openness to professional development and improvement of communication skills seemed to hinge on whether the scientists identified PoP as an opportunity to improve their own skills. Surveys indicate that some scientists entered the program with this awareness, while others developed the awareness during professional development experiences. A few scientists did not perceive this benefit and appear to have been impacted least by professional development. The relationship between (1) an awareness of the need for skill improvement; and (2) the overall impact of an experience involving professional development appears reasonable. Further study is needed, however, to confirm or deny what can only be presented as a tentative conclusion based on the data collected in this evaluation.

Areas for Further Study and Final Reflections

Three important areas for further study were identified.

- Consideration needs to be given to the development and testing of the approach with other types of program formats beyond the materials-based approaches.
- Additional testing is needed so the PoP approach can be integrated into existing public programs, such as *Engineers Week or* other special-events programming in which scientists have participated previously.
- Precise estimates of staff time for implementing different versions of the PoP approach would provide important information for planning and decision-making.

The PoP project as a whole has been a pioneering effort in implementing and testing a guiding framework, approaches, and set of materials designed to improve the experience of both scientists and general public visitors in face-to-face engagements. Each of these five implementations had unique features that affected the nature and extent of their implementation. Yet, in general, the PoP approach worked in guiding implementations across institutions encompassing a wide range of sizes and in communities with very different characteristics. PoP appeared to work least well in developing scientists' knowledge and skills when PoP professional development workshops were added to existing public programs. Each of these institutions shared the goal of providing common ground where scientists and members of the general public could engage with one another. Many informal science educators, scientists, and general public visitors were enthusiastic about the programs and activities that were part of the implementations and gained important knowledge, understanding, and skills.

References

Adventure Science Center. (2011A). History. Retrieved January 4, 2011, from http://www.adventuresci.com/default.aspx?section=aboutus&title=history&page=4.

Adventure Science Center. (2011B). Why support us? Retrieved January 4, 2011, from http://www.adventuresci.com/default.aspx?section=contact&title=why%20support%20us?&page=102 .

Alpert, C. L. (2010). Small steps, big impact: An online guide for museum leaders developing partnerships with university-based research centers. Boston: Museum of Science, Boston. Retrieved January 11, 2011, from http://risepartnerguide.org.

Association of Science-Technology Centers. (2010). 2010 ASTC statistics analysis package [electronic report]. Washington, DC: Association of Science-Technology Centers.

Discovery Center of Springfield. (2010A). About Us. Retrieved November 11, 2010, from http://www.discoverycenter.org/AboutUs/AboutUs.htm .

Discovery Center of Springfield. (2010B). History. Retrieved November 11, 2010, from http://www.discoverycenter.org/AboutUs/History.htm.

Discovery Center of Springfield. (2010C). Scientists Saturday starting 03.20.10. Imagine Newsletter.

Discovery Center of Springfield, Springfield, Missouri. (11, 1), p 1.

Glaser, B. G. & Strauss, A. L. (1967). The discovery of grounded theory: strategies for qualitative research. New York: Aldine De Gruyter.

Fenichel, M., & Schweingruber, H. A. (2010). Surrounded by science: Learning science in Informal environments. Board of Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: the National Academies Press.

Guba, E. G., & Lincoln, Y. S. (1989). Fourth generation evaluation. London: Sage Publications.

Lincoln, Y. S. & Guba, E. G. (1985). Naturalistic inquiry. Beverly Hills, CA: Sage Publications.

McCallie, E., Bell, L., Lohwater, T., Falk, J. H., Lehr, J. L., Lewenstein, B. V., Needham, C., and Wiehe, B. (2009). Many experts, many audiences: Public engagement with science and informal science education. A CAISE Inquiry Group Report. Washington, D.C.: Center for Advancement of Informal Science Education (CAISE). Retrieved November 11, 2010, from http://caise.insci.org/uploads/docs/public_engagement_with_science.pdf.

Miles, M. & Huberman, A. (1994). Qualitative data analysis. Thousand Oaks, CA: Sage Publications.

Museum of Life and Science. (2010). The year in review: A report of achievements in FY 2009. Retrieved from http://www.ncmls.org/files/Annual%20Review_09_WEB.pdf.

Museum of Life and Science. About the Museum of Life and Science. (n.d.). Retrieved November 11, 2010, from http://www.ncmls.org/about-us.

National Engineers Week Foundation. (2008). Welcome. Retrieved September 3, 2011, from http://www.eweek.org/Home.aspx.

Pacific Science Center. (2006). Portal to the Public Project. Seattle, WA: Pacific Science Center. Unpublished proposal submitted to the National Science Foundation cited from disk copy.

Pacific Science Center. (2009A). Portal to the Public Dissemination Manual, V.3. Seattle, WA: Pacific Science Center. Unpublished document shared with the author.

Pacific Science Center. (2009B). Portal to the Public Professional Development Catalog. Seattle, WA: Pacific Science Center. Unpublished document shared with the author.

Pacific Science Center. (2009C). Portal to the Public professional development supplemental materials. Seattle, WA: Pacific Science Center. Unpublished digital documents shared with the author.

Pacific Science Center. (2010). PoP Slides. Unpublished PowerPoint slides shared with the author, p. 1.

Research Triangle Regional Partnership. (2011). Population. Retrieved February 9, 2011, from http://www.researchtriangle.org/pages.php?page1=52&page2=71&page3=73&page4=&page_id=64.

Schatz, Dennis. (2006). Responses to Portal to the Public proposal (0639021). Unpublished document shared with the author, dated November 28, 2006. Seattle, WA: Pacific Science Center.

Sickler, J., Foutz, S., Ong, A., Storksdieck, M., & Kisiel, J. (2011). Portal to the Public guiding framework: Determining the value of a model for scientist-visitor interactions. Technical report. Institute for Learning Innovation: Edgewater, MD.

Springfield, Missouri. (n.d.). Encyclopedia. Retrieved November 11, 2010, from World News Digest database, http://www.2facts.com/article/xsp169900a?DBType=WND

Stake, R.E. (1995). The art of case study research. Thousand Oaks, CA: Sage.

The Nanoscale Informal Science Education Network. (2010). Welcome to the NISE Net. Retrieved November 10, 2010, from http://www.nisenet.org/about.

Tisdal, C.E. (2009). Portal to the Public Dissemination Workshop survey summary. Seattle, WA: Pacific Science Center. Unpublished report.

U.S. Census Bureau. (2009). American Fact Finder, 2005–2009 American Community Survey. Retrieved February 9, 2011, from http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=ChangeGeoContext&geo_id=16000US3719000&_geoContext=&_street=&_county=durham&_cityTown=durham&_state=04000US37&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&pctxt=fph&pgsl=010&_submenuId=factsheet_1&ds_name=ACS_2009_5YR_SAFF&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry.

World News Digest database, Encyclopedia. (2010A). Davis. Retrieved November 11, 2010, from http://www.2facts.com/article/xda016000a .

World News Digest database, Encyclopedia. (2010B). Durham. Retrieved November 11, 2010, from http://www.2facts.com/article/xdu101000a?DBType=WND .

World News Digest database, Encyclopedia. (2010C). Nashville, Tennessee. Retrieved November 11, 2010, from http://www.2facts.com/article/xna009600a?DBType=WND.

World News Digest database, Encyclopedia. (2010D). Rockford, Illinois. Retrieved November 11, 2010, from http://www.2facts.com/article/xro060500a.

World News Digest database, Encyclopedia. (2010E). Springfield, Missouri. Retrieved November 11, 2010, from http://www.2facts.com/article/xsp169900a?DBType=WND.

Appendix A: Portal to the Public Dissemination Workshop Agenda

AGENDA DETAIL[13]

Workshop Goals:

- Clearly present the Portal to the Public guiding framework and a range of associated strategies and approaches.
- Provide useful tools for the conceptual planning process and ample team reflection time.
- Empower participants to have reflective mindsets, willingness to try new approaches and confidence to engage in the project.
- Use time effectively and efficiently to provide fun, authentic interactive professional development experiences.
- Develop a team-oriented, friendly and supportive atmosphere.
- Ensure participants understand project expectations and available resources.

Notes:

- Each MCD team will be assigned one or two PoP mentors. These mentors will sit with them during conceptual planning work sessions and advise as appropriate. Mentors will take special care to "get to know" their assigned team/institution before the workshop.
- During the first conceptual planning session, each team will be given a blank PoP Guiding Framework poster and *Conceptual Planning Worksheet*. Throughout the reflection sessions, teams will be working on filling out their poster and worksheet (adding drawings, post-its, text, etc.).

Tuesday, June 16th

3:30p	PoP Collaboration meets at PSC in the Board Room • Workshop agenda review • Last minute prep
6:30p ish	Group dinner

Wednesday, June 17th

8:30a	Breakfast at PSC
9:00a	Welcome • Welcome and brief introductions of participants • Overview of workshop goals, agenda, manual
10:00a	3 MCD team presentations

[13] Font size on this document was changed to shorten. Names of individuals facilitating segments of the workshop have been removed from the agenda.

- Each of the MCD museums will be asked to prepare a 5 minute presentation about who they are and what they hope to get out of their participation with Portal to the Public. Each institution will be asked to bring one object that represents their institutions character or mission. Power points are not necessary. Teams will be told they have only 5 minutes for the presentation, but the agenda will allow for up to 10 minutes each.

10:30a Break

10:45a Introduction to the Portal to the Public Guiding Framework

- Overview of the PoP framework and how to use it, with slideshow pictures
- Presentations from Explora, North and PSC on what each guiding framework would look like. Use large scale framework poster. 15 minutes each.

12:00p Lunch

12:45p Conceptual planning &team reflection time

- Brief overview to the general conceptual planning process and expectations for the workshop (mentor assignments, blank poster, worksheet). (Lauren R.?)
- Introduction to thinking about: self-inventory, partner selection and defining impacts
- Team reflection time

2:30p Break (embed break into team reflection time)

2:45p 3 MCD team presentations

3:15p Introduction to Portal to the Public professional development

- Provide rational for PD, explanation of content objectives
- Introduce PoP PD materials (catalogue, example structures, CD materials)

3:45p Experience PD: The Pleasure of Finding Out – Mystery Boxes

4:45p Wrap-up, mini evaluation, logistics

6:30p? Dinner

Thursday, June 18th

8:30a Breakfast

9:00a Speed PD

- Teams will rotate through 5 stations (15 minutes each) to become familiar with the basic idea behind all PD elements. There will be 1 North station, 2 Explora stations and 2 PSC stations. Plan to explain the basic concept of each element and show materials or pictures so that participants get a sense of how they work.

10:30a Public Programs format overview

- Some kind of brief overview of different public program formats available. Direct participants to public program manual chapter. We will not spend much time on the details of planning and executing these programs because we know everyone has experience running programs.

10:45a	Break
11:00a	Experience PoP Scientist public programs • Programs will be set up in Ackerley Gallery.
12:00p	Lunch (scientists will join)
1:00p	Panel Discussion with Scientists • 5-7 PSC PoP scientists will be joined by 1 or 2 from North and Explora via videoconference. • We will ask a few general questions: what were your motivations for participating in Portal programs? What did you learn from these experiences? [Need to create list]. These questions will each be answered by 2-3 scientists. Then there will be open questions.
2:00p	Large group reflection • Discussion of reflections, challenges and solutions
2:30p	Break
2:45p	Conceptual Planning & team reflection time • Focus on: relationship building and program design (partners, impacts, PD, programs) – brief intro by (?) • Team reflection time
4:15p	Experience PD: Building a Common Vision
5:00p	Wrap-up, mini evaluation, logistics
7:00p?	Group dinner out at Queen City Grill

Friday, June 19th

8:30a	Breakfast
9:00a	Experience PD: Making Meaning
9:30a	Conceptual planning & team reflection time • Team reflection time • Finish poster, prepare presentation
11:00a	Break (take within conceptual planning time)
11:15a	3 MCD team presentations • 20 minutes each (including Q&A and feedback) • Audience is given a worksheet to comment on advice, ideas, critique that will be given to team (to capture feedback that there wasn't time to discuss as a group)
12:15p	Lunch

1:00p	2 MCD team presentations
1:45p	Experience PD: Question Types and Sequences
2:30p	Break
2:45p	Mid Course Dissemination Nuts & Bolts • Review evaluation processes, expectations and instruments • Overview of MCD program expectations and next steps
4:00p	Large group reflection & sharing • Roundtable sharing of key things they “got” out of the workshop, challenges they anticipate.
4:45p	Graduation and thank you! • Presentation of “certificates” and some kind of meaningful PoP prop/toy?
5:00p	Wrap-up, logistics • Note: workshop evaluation will be sent out on Survey Monkey after they return home.

Dinner on your own!

Appendix B: Dissemination Expectations

PORTAL to the Public

Dissemination Expectations[14]

Note: Please direct any questions regarding these expectations and procedures to Lauren Russell, lauren_russell@pacsci.org or 206-443-2910.

Schedule of payments and deliverables:

	Amount	Deliverable	Target Date
First Payment	$2,000.00	Two staff attend and participate in Training Workshop held at Pacific Science Center • After workshop completion (June 19th), submit an invoice to PSC.	June 2009
Second Payment	$3,000.00	Submission and approval of Conceptual Plan • Complete *Conceptual Planning Worksheet,* found in the CD of supplementary resources. • Once this worksheet has been approved by Lauren Russell and your mentor team, submit an invoice to PSC.	August 2009
Third Payment	$3,000.00	Execution of required activities and programs • Deliver at least one professional development experience for scientists. • Submit completed *Professional Development ISE Feedback Form* (found in CD of supplementary resources) and associated documentation to Lauren Russell. • Host at least one public program that features face-to-face interactions between scientists who have participated in professional development and public audiences. • Submit completed *Public Program ISE Feedback Form* (found in CD of supplementary resources) and associated documentation to Lauren Russell. • Participate in evaluation activities and assist Tisdal Consulting as necessary.	March 2010
Final Payment	$2,000.00	Completion of evaluation activities and submission of brief Final Report	April 2010
TOTAL	$10,000.00		

[14] Formatting and font size of this document changed to shorten.

Feedback Forms and Program documentation:
Program documentation and ISE feedback forms will help us understand how the Portal guiding framework was implemented at your site. These materials will also be shared with our external evaluator, Tisdal Consulting. Note that you are required to execute at least one professional development experience and one public program. If you host more than this, please submit feedback forms and documentation for the additional events.

Along with your *ISE Professional Development Feedback Form*, please include the following program documentation, as applicable:

- Scientist recruiting materials
- Workshop agendas
- Photographs

Along with your *ISE Public Program Feedback Form*, please include the following program documentation, as applicable:

- Event programs
- Marketing materials
- Photographs

Invoicing procedures:
After the specified deliverables have been completed please send invoices to:
Pacific Science Center
Accounts Payable
Attn: Lauren Russell
200 2nd Ave N
Seattle, WA 98109

On the invoice, please reference:

- Your contract number (found on the top of your contract)
- Portal to the Public Dissemination

Recognition:
Please recognize the National Science Foundation by including their logo and the Portal to the Public logo on any marketing or printed materials you develop as part of your Portal to the Public effort. You will find NSF and Portal logos on the CD of supplementary materials. NSF logos can also be downloaded from http://www.nsf.gov/policies/logos.jsp. Please include the following text on any published written materials: Portal to the Public is a project supported by National Science Foundation under Grant No. DRL-0639021. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Appendix C: List of Instruments by Stage

Table C. Instruments by Stage

Stage	Instrument Name	File Name
Stage One	ISE Dissemination Workshop Survey	POP3_ISE-1-1 Dis Wksp Survey V.3
Stage One	ISE Written Consent Form	POP3_ISE-1-2A Written Consent V.3
Stage One	ISE Contact Information Form	POP3_ISE-1-2B Contact Info V.1
Stage One	ISE Participant Information Survey	POP3_ISE-1-3 Participant Info Survey V.2
Stage One	ISE Stage One In-depth Interview	POP3_ISE-1-4 In-Depth Interview V.2
Stage One	SRO Contact Information	POP3_SRO 1-1 Contact Info V.2
Stage One	SRO Online Survey	POP3_SRO-1-2 Online Survey V.3
Stage One	Scientist Written Consent Form	*POP3_SCI-1-1A Written Consent V.4
Stage One	Scientist Contact Information Form	POP3_SCI-1-1B Contact Info V.3
Stage One	Scientist Participant Information Form	POP3_SCI-1-1 Participant Info Survey V.3
Stage Two	ISE Stage Two Onsite Interview	POP3_ISE-2-1 Onsite Interview V.1
Stage Two	Focused Observation of Scientist & Visitor; In-depth Interviews with Visitors	POP3_GPV-2-1 OI Data Set V.1
Stage Three	ISE Stage Three In-depth Interview	POP3_ISE-3-1 In-Depth Interview V.1
Stage Three	SRO Stage Three In-depth Interview	POP3_SRO-3-1 In-Depth Interview V.1
Stage Three	Scientists Portal Experience Survey	POP3_SCI-3-1 Online Survey V.1
Stage Three	Scientists Portal Experience In-depth Interview	POP3_SCI-3-2 In-depth Interview V.1

Appendix D: Program Documents Included in Analysis

Table D. Program Document Descriptions and Name with Date

Description	Document Name with Date
Adventure Science Center Conceptual Planning Worksheet	POP_CPW_ASC_2009
Discovery Center Museum Conceptual Planning Worksheet	POP_CPW_DCM_2009
Discovery Center of Springfield Conceptual Planning Worksheet	POP_CPW_DCS_2009
Explorit Science Center CPW	POP_CPW_ESC_2009
Museum of Life and Science CPW	POP_CPW_MLS_2009
Adventure Science Center Professional Development ISE Feedback Form	ASC_PD ISE Feedback 12121409r
Discovery Center Museum Professional Development ISE Feedback Form	DCM_PD ISE Feedback 020210
Discovery Center Museum Professional Development ISE Feedback Form	DCM_PD ISE Feedback 021910
Discovery Center Museum Professional Development ISE Feedback Form	DCM_PD ISE Feedback 022310
Discovery Center Museum Professional Development ISE Feedback Form	DCM_PD ISE Feedback 092509
Discovery Center Museum Professional Development ISE Feedback Form	DCM_PD Staff ISE Feedback 110509
Discovery Center of Springfield Professional Development Feedback Form	DCS_PD ISE Feedback Form 1_101009
Discovery Center of Springfield Professional Development Feedback Form	DCS_PD ISE Feedback Form 2 090709
Discovery Center of Springfield Professional Development Feedback Form	DCS_PD ISE Feedback Form 4
Discovery Center of Springfield Professional Development Feedback Form	DCS PD ISE Feedback Form 3 012310
Discovery Center of Springfield Professional Development Feedback Form	DCS_PD_Feedback Form 4 021310
Museum of Life and Science Professional Development ISE Feedback Form	MLS_PD ISE Feedback Form_030810
Adventure Science Center Public Program Feedback Form	ASC_PP Feedback Form_032710
Discovery Center Museum Staff Professional Development Feedback Form	DCM_PD Staff ISE Feedback 111109
Discovery Center Museum Public Program Feedback Form	DCM_PP_Feeback Form 031310
Discovery Center Museum Public Program Feedback Form	DCM_PP_Feeback Form 101009
Discovery Center Museum Public Program Feedback Form	DCM_PP_Feedback Form 111409
Discovery Center of Springfield Public Program Feedback Form	DCS_PP_ISE_Feedback Form 032010
Explorit Science Center Public Program Feedback Form	ESC_PP1_Feedback Form 013010
Explorit Science Center Public Program Feedback Form	ESC_PP3_Feedback Form 033010
Explorit Science Center Professional Development Feedback Form	ESC_PD1 Feedback Form 121909
Museum of Life and Science Public Program Feedback Form	MLS_PP_Feedback Form 032710

Appendix E: ISE and SCI In-depth Interviews

Table E. In-Depth Interview List for ISE and SCI by Stage

Stage	Instrument Name	Transcript Name
Stage One	ISE Stage One In-depth Interview	ISE_1-1_ASC_4849_082609
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCM_3045_092309
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCM_5852_093009
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCM_9068_100209
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCS_5060_093009
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCS_7667_093009
Stage One	ISE Stage One In-depth Interview	ISE_1-4_DCS_8184_092109b
Stage One	ISE Stage One In-depth Interview	ISE_1-4_ESC_4241_091609
Stage One	ISE Stage One In-depth Interview	ISE_1-4_MLS_4270_081409
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ASC_1948_032610
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ASC_4849_032610
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ASC_6254_032610
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCM_5856AB_031210
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCM_9068_031210
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCS_0004_031910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCS_5060_031910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCS_7667_031910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_DCS_8184_031910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ESC_0227AB_032910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ESC_4241_032910
Stage Two	ISE Stage Two Onsite Interview	ISE_2-1_ESC_9180_032910
Stage Three	ISE Stage Three In-depth Interview	ISE_3-1_MLS_2267_051410
Stage Three	ISE Stage Three In-depth Interview	ISE_3-1_MLS_4270_051410
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_6253_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_6884_052510
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_8782_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCM_6581_052610
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCM_7777_061110
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCS_9730_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ESC_4179_052610
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_MLS_0177_051810
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_MLS_5773_060110
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_6253_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_6884_052510
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ASC_8782_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCM_6581_052610
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCM_7777_061110
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_DCS_9730_051910
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_ESC_4179_052610
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_MLS_0177_051810
Stage Three	Scientists Portal Experience In-depth Interview	SCI_3-2_MLS_5773_061010

Appendix F: General Public Visitor Observation/Interview Demographics

Table F. GPV Demographics by Data Set

Interview case number	Location	Group size	Number of adults	Number of children	A_AGE	B_AGE	C_AGE	D_AGE	E_AGE	A_SEX	B_SEX	C_SEX	D_SEX	E_SEX
GPV_2-1_ASC1_032710	ASC	4	2	2	30	20	6	3		2	2	1	1	
GPV_2-1_ASC11_032710	ASC	2	1	1	30	14				1	1			
GPV_2-1_ASC12_032710	ASC	3	1	2	30	10	5			2	2	2		
GPV_2-1_ASC2_032710	ASC	2	1	1	30	13				2	1			
GPV_2-1_ASC3_032710	ASC	4	1	3	40	11	8	6		2	2	1	2	
GPV_2-1_DCM1_031310	DCM	4	1	3	30	10	4	8		2	1	1	1	
GPV_2-1_DCM2_031310	DCM	4	1	3	30	5	10	8		2	1	1	1	
GPV_2-1_DCM3_031310	DCM	2	1	1	30	4				2	2			
GPV_2-1_DCS1_032010	DCS	2	1	1	30	9				2	2			
GPV_2-1_DCS2_032010	DCS	4	2	2	30	8	12	40		2	2	2	1	
GPV_2-1_DCS3_032010	DCS	5	2	3	30	30	12	10	5	2	1	2	2	1
GPV_2-1_DCS4_032010	DCS	3	1	2	30	4	7			2	2	1		
GPV_2-1_DCS5_032010	DCS	5	2	3	20	20	6	4	2	2	2	2	2	2
GPV_2-1_DCS6_032010	DCS	4	2	2	30	30	8	6		2	2	2	1	
GPV_2-1_ESC1_033010	ESC	5	2	3	30	6	30	6	3	2	1	2	1	1
GPV_2-1_ESC2_033010	ESC	3	1	2	30	5	5			2	1	1		
GPV_2-1_ESC3_033010	ESC	2	1	1	30	7				2	2			
GPV_2-1_ESC4_033010	ESC	4	2	2	30	30	9	6		1	2	1	2	
GPV_2-1_MLS1_032710	MLS	2	1	1	30	10				2	2			
GPV_2-1_MLS2_032710	MLS	2	1	1	30	7				1	1			
GPV_2-1_MLS3_032710	MLS	3	1	2	30	11	8			2	1	2		
Totals	*Totals*	*69*	*28*	*41*										

Appendix G: Portal to the Public Project-wide Impacts and Indicators

Public Audience Impacts

1. Public audiences will demonstrate new awareness of current science research, applications and scientists working in their community.
1.1. Visitors who attend public programs will describe at least one new topic of science or research discovered or learned from the program.
1.2. Visitors who attend public programs will be aware that they have interacted with working scientists from their community.
2. Public audiences will demonstrate their interest in current science research, applications and scientists working in their community.
2.1. Visitors who attend programs will report interest in learning more about the topic or more opportunities to interact with scientists.
2.2. Visitors will describe new questions about science, research, and applications that were inspired by the program.
2.3. Visitor comments during interactions with scientists will include expressions of interest and engagement in the content.
3. Public audiences will experience personal engagement with science and scientists through face-to-face interaction with scientists.
3.1. Visitors will report high satisfaction with experience of interacting with the scientist(s).
3.2. Visitors will report high satisfaction with the degree of personal connection and group involvement with the scientist(s).
3.3. Interactions between scientists and visitors during programs will include two-way communication, questioning, and use of analogies to draw personal connections.
3.4. Visitors will report personal connections with scientists among the most important characteristics of the program.
4. Public audiences will develop new perspectives and appreciation about current science research, applications and scientists working in their community.
4.1. Visitors will indicate higher importance that program inspired new appreciation and experiences of current science, relative to other program aspects.
4.2. Visitors will report new insights from the program that demonstrate shift in perspective about content, research, or applications.

Scientists Impacts

5. Scientists will increase their understanding of how people learn science in informal learning environments.
5.1. Scientists will develop activities and programs that embody principles of learning in informal environments.
5.2. Scientists will be able to articulate qualities of effective informal learning experiences.
6. Scientists will build communication skills that support museum visitors' inquiry and engagement.
6.1. Scientists will indicate that their feeling of preparedness for public communication increased due to participation in PoP.
6.2. Scientists will indicate higher feeling of preparedness for public communication than do non-participant colleagues.

6.3. Scientists will enact specific communication skills that foster inquiry and engagement during training and programs.

6.4. Scientists will apply strategies learned in PoP to other communication settings.

7. Scientists will develop skills in reflective practice that contribute to their self-awareness and development as communicators.

7.1. Scientists will actively reflect upon their skills following interaction with visitors, describing needs and strategies for improvement.

7.2. Scientists will modify and improve activities and communication strategies based upon outcomes of reflection.

8. Scientists will demonstrate increased positive attitudes toward outreach and public engagement activities.

8.1. Scientists will rate value of public outreach higher and a greater number of areas than non-participating colleagues.

8.2. Scientists will indicate a desire to do more and new forms of public outreach following participation.

8.3. Scientists will indicate a higher degree of personal benefit or reward from outreach than non-participating colleagues.

8.4. Scientists will describe or identify specific personal and professional benefits from participating in outreach.

9. Scientists will demonstrate interest in participating in professional development and public programming at informal science education institutions.

9.1. Scientists will indicate a desire to continue future participation in Portal to the Public, Portal to the Public-like programs, and other informal science education outreach.

9.2. Participants will describe the personal benefits of professional development and informal science education public programming.

Informal Science Education Staff Impacts

10. Informal science educators will increase knowledge of the effective ways to develop relationships with local scientists and science organizations.

10.1. Informal science educators will provide examples of plans and communications to develop relationships with scientists.

10.2. Informal science educators will reflect on level of knowledge about developing relationships with scientists.

11. Informal science educators will develop confidence to collaborate with scientists and science organizations.

11.1. Informal science educators will report increased confidence to collaborate with scientists and science organizations.

11.2. Scientists will provide examples of expertise of and support from informal science educators during the preparation of public programs.

11.3. Scientists will report support from Informal science educators during the preparation for public programs.

11.4. Informal science educators will report the intention to continue collaboration with scientists and science organizations after the end of implementation.

12. Informal science educators will develop skills to facilitate professional development for scientists.

12.1. Informal science educators will report increased level of skills in delivering professional development to scientists after implementing the program.
12.2. Informal science educators will develop agendas and plans and execute professional development for scientists.
13. Informal science educators will develop skills to design and execute current science-themed public programs that feature scientists.
13.1. Informal science educators will provide examples of plans (guiding framework) and program materials and reflect on their development.
13.2. Informal science educators will report increase levels of skill in developing science-themed public programs that feature scientists.
14. Informal science educators will build their understanding of current science research, applications and scientists working in their community.
14.1. Informal science educators will describe working with scientists to develop learning activities and strategies to communicate science concepts.
14.2. Informal science educators will report increase levels of understanding of current science.
15. Informal science education institutions will show an ongoing interest in providing current science-themed programs.
15.1. Informal science educators will describe plans for continuation of professional development and public programming after implementation.