Traveling Exhibits At Museums of Science (TEAMS)

A Summative Evaluation Report

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Table of Contents

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INTRODUCTION

Background on the Collaborative

The TEAMS Collaborative consists of a group of seven museums that received National Science Foundation funding to build four traveling exhibitions which would rotate amongst the group, then be made available, through the Association of Science-Technology Centers (ASTC) to small science museums across the country. This group of seven museums included four which had been funded, as a group, by a previous NSF award: [1]

- Catawba Science Center in Hickory, North Carolina
- Discovery Center Museum in Rockford, Illinois
- Montshire Museum of Science in Norwich, Vermont
- Sciencenter in Ithaca, New York

For this current grant, three new partner institutions were recruited to work closely with three of the original museums; these include: The Health Adventure in Asheville, North Carolina which partnered with Catawba; Rochester Museum and Science Center which partnered with the Sciencenter; and the Family Museum of Arts and Science in Bettendorf, Iowa which partnered with the Discovery Center Museum. Montshire Museum created an exhibition without a formal partner, as well as serving as the administrative and financial coordinator of TEAMS.

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[1] Ann Arbor Hands-On Museum in Ann Arbor, Michigan, was also a member of the first TEAMS collaborative.

The seven museums produced the following exhibitions and related educational programs:

> - *Body Carnival: The Science and Fun of Being You!* (The Health Adventure and Catawba);
> - *Hear, Here: Listening With Eyes and Ears* (Montshire Museum of Science)
> - *Cool Moves! The Artistry of Motion* (Sciencenter and Rochester)
> - *Team Up! Explore Science and Sports* (Discovery Center and Family Museum)

The exhibitions have finished their tours through the Collaborative museums, and are currently being rented, through ASTC, to other small museums.

In early 2002, the TEAMS Collaborative applied for and received a supplemental NSF grant to conduct further research about and dissemination of knowledge about the collaborative project, as well as to bolster its professional development efforts.

Background on the Evaluation

Inverness Research Associates has been contracted by the TEAMS Collaborative to conduct formative and summative evaluations of their exhibitions and of the Collaborative.[2] In spring 2002, we conducted formative evaluations of each of the TEAMS Collaborative's four exhibitions. The evaluation process included staff from both partnering museums, as well as disability advisors and other interested community members. Our formative evaluations incorporated feedback from interviews with and observations of visitors, as well as our own reviews; detailed findings were posted on the Collaborative's internal website. In addition, throughout the length of the grant, we participated in planning meetings, workshops, on-line "chats," listserv conversations and reviewed project web sites.

During the final year of the grant, Inverness also conducted four summative evaluations, studying the exhibitions in the context of their first traveling venue within the Collaborative. During these site visits, we focused our efforts on gaining insight into the nature of the visitors' experiences with the exhibits, and the extent to which visitors had rich, open-ended, and significant experiences with the exhibits and the phenomena presented. We also surveyed the TEAMS members and interviewed an expert on traveling exhibitions to gain further insight into the overall quality of the exhibitions.

In addition to our work on the exhibits, we conducted interviews with TEAMS staff about the collaborative process: its strengths and issues, its personal and professional benefits, and the ways in which the Collaborative is contributing to the member museums and to the field.

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[2] Inverness Research also served at the evaluators on the first TEAMS award; see http://www.montshire.org/teams/teams1/evaluation/final_c.html for our report.

The Theory of Action: Why a Collaborative?

Before we begin discussing the findings about this particular collaboration, we think it is important to frame that discussion by first examining the theory of action behind the collaborative. That is, we want to examine why these museums decided to collaborate, and why they were funded.

Several propositions underlie the TEAMS Collaborative's theory of action. First of all, small museums often lack the capacity for developing good exhibits on their own. If several small museums can work together, then, it is theorized, they can share collective resources such as materials, time, consulting with experts on particular themes of interest (e.g., family learning, or accessibility), as well as time with evaluators. And by networking, each museum that builds an exhibit can use the others as peer reviewers and network meetings become a place to get feedback on their ideas and designs. In short, using their collective resources, they can build better exhibitions as a group than they could alone.

Related to this is another theory behind the collaborative, and that is that small museums have different exhibit needs than large museums. If a group of small museums can come together to create traveling exhibitions designed specifically for small museums, then they will serve themselves and other small museums better than if they relied on large museums to do the job.

The field of science museums is highly skewed – there are a few large museums and many small ones. And the small museums typically do not have the resources to employ large numbers of staff members. Consequently, there are few specialists on the staffs of small museums; everyone must do a little of everything. Therefore, there is both a need and an opportunity to develop the exhibit-building capacity of small museums, and such a capacity-building effort must be tailored to the realities of small museums. A collaborative, therefore, is not only seen as a good way to build better exhibits, but also is seen as a good way to engage in a collective capacity-building endeavor.

Relatedly, staff at small museums tend to be isolated. The exhibit designer in a one-person shop is not likely to have colleagues close by with which he or she can share ideas, or get critiques or even assistance from. A collaboration provides access to other exhibit developers, educators, etc., and allows previously isolated staff to develop professional relationships where they gain more knowledge and access to resources than they could on their own.

Also, as a fact, it is quite difficult for an individual small museum to obtain National Science Foundation funding to develop a traveling exhibition, in part because of the limited audience to be served as well as the small numbers of staff and limited museum

capacity. Collaboratives make NSF funding a possibility – and even a good investment – as NSF is able to reach museums and audiences, particularly those in rural regions and small cities, that it has not previously served.

We include here a diagram that we hope helps the reader visualize the theory of action for the TEAMS Collaborative as we see it:

TEAMS II – THEORY OF ACTION
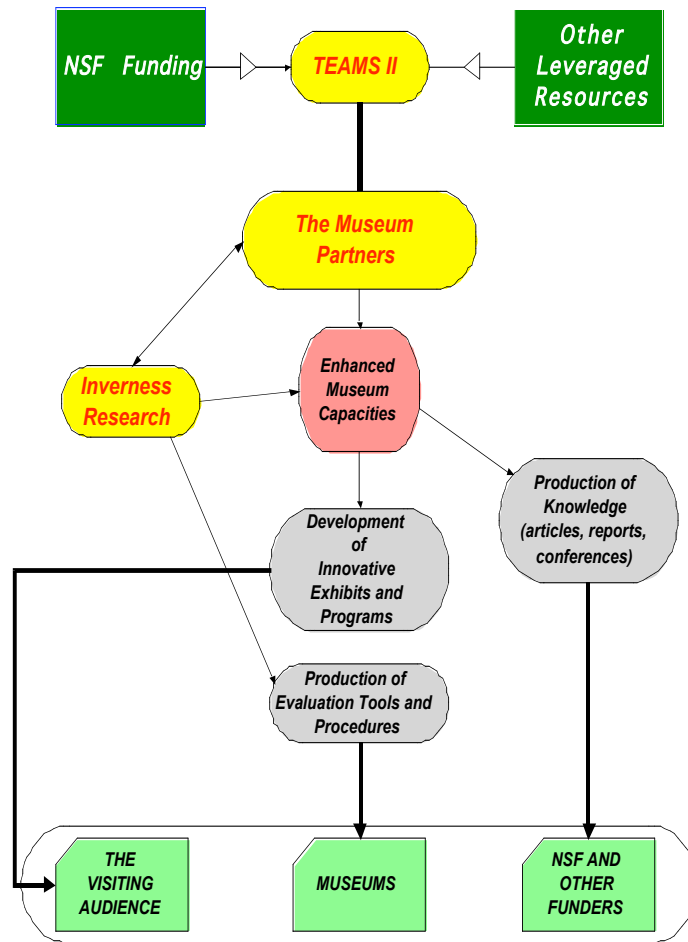
This Report

It is with these propositions in mind that we discuss the lessons learned from this second award of NSF funding for the TEAMS Collaborative. How successful were these seven museums in building good exhibits as well as enhancing the capacity at their institutions through the collaborative work? What were the mechanisms they used to do this, and what did they learn from implementing those mechanisms? In what ways were the new "partner" museums an improvement on the original collaborative? How did these partnerships work out? What were the costs and benefits to collaborating as partners and as a network? To what extent were the museums able to produce high-quality exhibitions and programs that were engaging to visitors? These are some of the questions we will address in this report.

We have divided our findings into two broad domains: 1) findings about the design and quality of exhibitions and the overall visitor experience, and 2) findings about the Collaborative and partnerships. In our Summary and Final Thoughts section we revisit briefly the theory of action.

DEVELOPING HIGH-QUALITY EXHIBITIONS AND PROGRAMS

The seven partner museums have developed four interactive, hands-on exhibitions with which visitors can explore fundamental scientific phenomena. The exhibitions include

> *Body Carnival* (Catawba Science Center and The Health Adventure): An exploration of the physics of the human body, including pressure, leverage, and balance, and how some of these concepts relate to health.
> *Cool Moves* (Sciencenter and Rochester Museum of Science): Visitors can explore in a very open-ended fashion various kinds of motion as they are expressed in aesthetic and surprising phenomena such as wind in water and through windsocks, vibration and how it affects water and makes waves, and video-based images of animal motion that visitors can investigate at various speeds.
> *Hear Here* (Montshire Museum of Science): An exploration of the physics of sound in particular as it relates to how humans hear and interpret their aural environment.
> *Team Up* (Discovery Center Museum and Family Museum of Arts and Science): By using exhibits that are focused on sports and the physics of sporting equipment, visitors can experiment with force and velocity, friction, center of gravity, trajectory, and other phenomena.[3]

Evaluation methodology

Inverness Research Associates provided both formative and summative evaluation to the Collaborative.

> *For us, Inverness has been a learning resource, that collaboratively we could bring your researchers here to help us understand how we can ask questions of what we do and how we are disciplined in answering those questions. One measure of the value is after TEAMS I the Montshire staff had a conversation about whether we should do TEAMS II and one of their responses was, yes, we would be interested in being involved in TEAMS II, if Inverness were to be involved. They saw that as an important resource coming in to help us build capacity and understanding, and that is a key part of the experience. For us, by far the biggest area of growth is being in a situation where imposed upon us was this kind of discipline about prototyping and involving visitors in designing our exhibits. It changed the culture of this institution. The collaborative created the matrix in which this thoughtful development process would happen. We didn't know how to do evaluation like this and couldn't have afforded it ourselves in a way that would have been useful. It now permeates everything we do.   --TEAMS Director*

Formative

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[3] A list of individual components for each exhibition, as well as some exhibit photographs, can be found through links on the TEAMS website: http://www.montshire.org/teams/

Twice during the development of the exhibitions (in fall of 2001 and spring of 2002), Inverness Research staff visited the museums to critique prototypes, observe and interview visitors interacting with the prototypes, and to check in with staff about their overall progress. We conducted naturalistic observations of visitors using the prototypes, as well as guided interviews around the prototypes. We invited staff to work with us as we worked with visitors. At the end of each formative site visit, we provided staff with verbal feedback about our findings that detailed the strengths and issues around each prototype, and any recommendations we had about the further development of the exhibits. We also made recommendations as to specific exhibits we thought that, based on our work with visitors, needed to be discarded. In addition, shortly following our visit, we posted our findings on the project's internal website.

Summative

In two- or three-day site visits to TEAMS museums between August and December 2003, Inverness Research conducted summative evaluations on each of the four exhibitions. With one exception, we conducted these studies while the exhibitions were at their first traveling venue within the Collaborative. In this way we could evaluate how the exhibitions were being used in a traveling venue, and also provide critical feedback to home institutions on any remedial work that needed to be conducted before the exhibits rotated on through the Collaborative, and then to museums outside the group.

To gather summative data, we conducted naturalistic (un-interrupted) observations of visitors, timing studies ("trackings"), exit interviews, and "mediated" (in-depth, concept-specific) interviews at key components.

In our timing studies, we tracked visitors during the entire length of their visit to each of the exhibitions.[4] It is important to note that most of our evaluation work was focused on formative and front-end planning. That is, our major role was to help make the exhibits and the Collaborative better; our summative work allowed for a brief "reality check" on the exhibits as they were used in another setting. As the scope of this evaluation was limited, we were unable to collect a large number of trackings at each exhibition. However, we feel the data do help illuminate some general trends about visitor behavior in the exhibitions. It is also important to note that in the case of every exhibition, we observed visitors whom we had tracked returning a second, and sometimes third, time to explore the exhibitions further. These additional visits were most often not tracked, as we were choosing visitors randomly. Thus, the original

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[4] The variation in the number of trackings across exhibition is due to a number of factors, primarily the numbers and flow of visitors during the time we were at the museums, and the extent to which we felt we needed to spend time investigating the visitor experience through other methodologies (such as in-depth interviewing with disability advisors).

average usage times are, in some cases, lower than what we know happens with many visitors.

In addition, we developed a survey for all TEAMS Collaborative members to complete that asked for ratings on the quality of each of the four exhibitions in particular domains, as well as the overall quality and value of the four exhibitions as a whole. A summary of the survey data is available in the appendix of this report. We also interviewed a staff member of the Association of Science-Technology Centers (ASTC) who has seen many of the traveling exhibitions available to the field; we wanted to learn about her perspectives on the quality of the TEAMS exhibitions.

We have organized our findings about the quality of the exhibitions in the following way. The first section looks at the visitors' experiences with the exhibitions as a whole. The second section looks at the qualities of key individual exhibits and presents findings on the ways in which these individual exhibits were either "rich" or "at-risk" along several key dimensions. In discussing our findings, we will be drawing on our observations of and interviews with visitors, the staff surveys, our interview with the ASTC exhibitions staff person, and our own critique of the exhibitions.

The Nature and Quality of Visitors' Experiences in the Exhibitions as a Whole

   The amount of time visitors spent in the exhibitions

The table below indicates the number of trackings for each exhibition; the average, shortest and longest times <u>in the exhibition</u>; and average time <u>at individual exhibits</u> for each of the four exhibitions. In each case, the numbers of males and females tracked were roughly equal.

Exhibition	Number of trackings	Average time using the exhibition (mins:secs)	Shortest time using the exhibition (mins:secs)	Longest time using the exhibition (mins:secs)	Average time at individual exhibits (mins:secs)
Body Carnival	11	0:04:23	0:00:02	0:09:51	0:00:48
Cool Moves	25	0:11:10	0:01:04	0:28:32	0:01:02
Hear Here	19	0:09:20	0:01:11	0:39:45	0:01:26
Team Up	15	0:10:33	0:02:49	0:22:54	0:01:24

In the appendix of this report, we have attached a full tracking data summary for each of the four exhibitions.

The tracking data indicate the range of experiences these four exhibitions offered to visitors. In general, the visitors we observed did become engaged by the phenomenon and/or the content. In each of the exhibitions, we observed visitors finding at least one, and usually more than one, exhibit that held their attention for significant amounts of time. Also, each of the exhibitions contained at least some inquiry-based components

that allowed visitors to explore many of their own questions about a particular phenomenon.

> For example, from *Body Carnival*, visitors appeared to us to have satisfying experiences; they did not leave frustrated or confused. We observed visitors having many experiential encounters with phenomena related to the body, such as blood flow and balance. Visitors commented to us about the attractiveness of the exhibition.
>
> In *Cool Moves*, we observed visitors engage with a variety of multi-sided, fairly open-ended and experiential exhibits. We observed visitors representing a wide age range find components that intrigued them. For example, the toddlers were more engaged by Windy Wonders and the Dancing Wall, while the older children and adults were drawn to the tornadoes and Theramin.
>
> *Hear, Here* provided visitors with a quiet and reflective experience perhaps due to the nature of the topic and the fact that it had several computer-based exhibits. We observed visitors exploring ideas about pitch, volume, vibration and the range of ways we experience sound in our environments.
>
> The initial attraction of *Team Up*, because of the sports theme, is to "come and play!" We observed visitors having many experiential encounters with phenomena – such as gravity, force and velocity – related to various sports. The exhibition included a range of types of exhibits and experiences, from role-playing to matching games, to experiential challenges, to mental challenges.

In terms of comparisons with the exhibitions from the first TEAMS award, the average number of trackings conducted were similar (i.e., 13 to 30 for the first round, 11 to 25 for the second round). Average time spent in the exhibition for the first set of TEAMS exhibitions ranged from eight and a half minutes to just over 12 minutes. For round two, average time spent in the exhibitions ranged from four and a half minutes to just over 10 minutes.

In the table below, we show a comparison of time spent by visitors in other similar-sized exhibitions. These exhibits were selected from an extensive visitor tracking and timing study conducted by Beverly Serrell;[5] we included here exhibitions that were between 1000 and 1800 square feet.

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[5] Serrell, Beverly. 1998. *Paying Attention: Visitors and Museum Exhibitions*. Washington, D.C.: American Association of Museums.

INSTITUTION: EXHIBITION TITLE	SQ FT	N TRACKED	AVG TIME (MIN)
SHEDD AQUARIUM: *OTTERS & OIL*	1000	45	4
BERGEN COUNTY ZOO: *WETLAND AVIARY*	1496	101	3
MUSEUM OF SCIENCE & INDUSTRY: *PRENATAL DEVELOPMENT*	1000	49	6
EXPLORATORIUM: *QUESTION OF SIZE*	1000	22	4
MINNESOTA HISTORICAL SOCIETY: *HISTORY BY SEAT OF YOUR PANTS*	1450	47	3
ROSWELL MUSEUM & ART CENTER: *P.G.A. GALLERY*	1345	40	3
SAN FRANCISCO MOMA: *GALLERY 5*	1040	76	3

Although the Serrell study tracked a larger number of visitors than we did, and although we acknowledge that there are many other factors that influence how long visitors spend in exhibitions, still it seems important to note that the "hold time" for the TEAMS exhibitions was longer than in these seven other exhibits of comparable size.

The TEAMS Collaborative members we interviewed who had hosted at least half of the exhibitions thought they were better than average. Overall, 79% of those responding to our survey rated the overall quality of the exhibitions as high to very high quality, while 66% rated the overall value of the four exhibitions as offering good to very good value. And the outside expert noted:

> *I would stop short at excellent and say these are very good. And very good is pretty good for small museum exhibits.*

As one exhibit developer noted:

> *The exhibits are equal or a little better in terms of quality to other traveling exhibitions we have had and much better than some we have had. I would say they are equal to the upper echelon of traveling exhibits we have hosted. They are a step up from the first round of TEAMS. It shows that we learned a lot in the first round and I think expanding the partnership contributes a lot to bringing up the quality…*

And one director noted:

> *These were not the best exhibitions we've ever had here, but they were way better than average.*

The Nature and Quality of Individual Exhibits: Rich vs. At-risk Exhibits

In June 2003, TEAMS staff met at the Montshire Museum in Vermont to begin early discussions that would lead to the NSF proposal for TEAMS 3. During that meeting, the group dissected their own thinking -- with the facilitation of Inverness Research -- as to what they believed were successful and unsuccessful experiences for visitors. The discussion was framed around the analogy of "rich" and "at-risk" classrooms.[6] We supposed that such a list could also be generated for exhibits, and for the visitor experience. The list generated for rich exhibits included such things as:

- accurate scientific content,
- robustness and durability,
- media that fits the message,
- invitation: immediate attraction and appeal,
- easy navigation and universal access,
- experiential access (opportunities for engagement for all age levels at a variety of different levels),
- multiple routes to success, and
- a rich socio-cultural context.

In contrast, the characteristics of at-risk exhibits included such things as:

- science content that is missing or that people cannot understand,
- being worn out or broken,
- safety issues,
- incorrect media for the phenomenon,
- lack of invitation – where visitors can't figure out what to do,
- unclear navigation or an exhibit that is 100% linear,
- too complex,
- no opportunity for inquiry,
- being lectured to, being talked down to, and
- a design that does not promote social interaction or causes conflict between goals and activities.

It is clear that not all of the exhibits in the exhibitions were of uniform quality. We have organized our findings around key criteria from the above lists, including science content, universal accessibility, invitation, robustness, and the extent to which there was adequate payoff for the visitors' investment. To what extent were the TEAMS members successful in creating rich exhibits? Were there examples of at-risk exhibits as well?

Rich and At-risk Exhibits: Science Content

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[6] In our studies of classroom practices, we have seen that there are conditions and criteria seen in successful classrooms (such as an educated and interested teacher, motivated students, adequate or plentiful resources, etc.) while other criteria are likely to lead to less than successful learning experiences for students (poor teaching, dilapidated or non-existing resources, behavioral problems amongst students, etc.).

In each of the exhibitions, we know that visitors were leaving their visit with at least a basic understanding of or interaction with the scientific concepts inherent to the exhibitions. Below we share a few exit comments about what visitors thought the exhibitions were about.

From *Team Up:*

> *Gravity – like the balancing thing relies on friction.*
> *Trajectory, balance, spin and grip… any sport is physics.*
> *About how kids play, movement, center of gravity, gravity and balance.*

From *Body Carnival*:

> *Your body, bones, strength, flexibility.*
> *Shows you how your body works; and how you're supposed to take care of it.*
> *About the inside of your body, what it's like inside; how you get exercise.*

From *Cool Moves*:

> *You play with wind and electricity and waves.*
> *I saw things move.*
> *It had something to do with forces.*
> *It's about an appreciation for the wonder of our world.*

From *Hear, Here*:

> *It's about communications, listening.*
> *It's about different pitches, sounds.*
> *Hearing is important; be happy that you can hear.*
> *Sound isn't just hearing – we can also see and feel sound.*

However, it is important to note that for all of the exhibitions, we think there were areas where the content could have been made either more readily accessible to visitors, or where opportunities for visitors to delve more deeply into the scientific concepts behind the exhibition would have enhanced the visitors' experiences. We wondered in some cases if visitors were able to go beyond the experiential aspects of experimenting with the phenomena to consciously connect with the science principles as well.

> For example, at *Body Carnival*, at the Dizzy Tunnel, visitors understood in a basic way that they feel like they are moving when they are not; however, they were not able to articulate the relationship between vision and balance.

> In *Cool Moves*, visitors we interviewed were able to articulate that the exhibition was about motion and movement, but were unable to talk about the deeper connections between the exhibits; instead, they tended to list the phenomena they experienced, like wind, electricity and waves.

In *Hear, Here*, we did not see much evidence that visitors were really understanding the differences and relationships between frequency, volume, and pitch.

At *Team Up*, many of the visitors we interviewed were unable to describe more than that the exhibition was about sports and motion or moving.

When we surveyed the TEAMS staff about the four exhibitions, many commented on the need for all of the exhibitions to provide additional ways for visitors to explore the science content, such as providing more content on the floor for those visitors who want it, but not necessarily at each component. The average rating across all of the exhibitions in the area of science content was 3.8 (where 1 = inadequate, inappropriate or inaccurate content, and 5 = very adequate, appropriate or accurate content; n=17 for *Team Up*, *Body Carnival* and *Cool Moves*; n=21 for *Hear, Here*).

Rich and At-risk Exhibits: Universal Accessibility

I don't expect to be able to do everything. If I can use the majority of the exhibits I'm happy.

–Disability advisor in wheelchair

As we wrote earlier in this report, making accessible exhibits was a major goal and unifying theme of this project. Each of the four institutions took a very different approach to addressing issues of accessibility. For example, the *Team Up* exhibition focused on making the exhibitions accessible for autistic children, an area where they have much expertise in terms of local advisors. *Hear, Here* focused on making individual exhibits accessible within a larger theme of learning about sound and hearing connected to the idea of accessibility. *Body Carnival* focused on Braille and included an audio tour, while *Cool Moves* tried to address overall issues of accessibility to people with disabilities, while doing some additional research on audio description. Each of the museums worked diligently to address the issue in the exhibitions, and – at least to some extent – included local advisors from their own communities to help them develop exhibits along these lines.

The highest ratings on the TEAMS staff survey, across all four exhibitions, came in making the exhibitions accessible to visitors in wheelchairs (average of 3.9); the lowest rating came in the area of making exhibits accessible to visitors with vision disabilities (average rating of 2.9). The outside expert we interviewed about the TEAMS exhibitions noted that the exhibitions seemed to be designed on the principle of taking a finished product and making it more accessible after the fact, rather than designing for accessibility being an integral and earlier part of the design process.

In our work with visitors and local advisory committees, we found that making exhibits "accessible" means doing so both physically and conceptually. For example, in the *Team Up* exhibition, we were surprised by how physically accessible some of the

activities were to people who couldn't see – for example, several blind advisors really persisted with Bounce Pass (using their hearing), and they used the Balance Beam. Other exhibits were completely inaccessible to them conceptually – such as Twin Spin (they could do the activity – i.e., spin the two wooden figures – but had no way to experience the differences in momentum between the two) and Set Shot (no way to experience trajectory).

We also learned that in some cases, the educational background and life experiences of a visitor had more of an influence on their understanding of a phenomenon than the nature or extent of their disability. For example, an advisor who has been blind from birth has extensive experience with studying and playing around with radio; we found that the content of the sound exhibits was much more accessible to him than to some "normal" visitors who had access to the content through all their senses. We heard about the importance of taking into consideration the personal experience of the visitor as a person as opposed to a person who, for example, can't see. At the *Team Up* exhibits, one woman said she would have been more comfortable using Bounce Pass except she doesn't have experience with basketball. (However, the same woman felt she could at least try the Bounce Pass activity if she had access to information, in Braille or by audio, about what to do.)

As part of our summative study, we invited local disability advisors to review and critique the exhibitions with us. In general, the exhibitions received positive reviews. However, in each exhibition, there were one or two areas that were not as carefully addressed as others. For example, while *Body Carnival* provided Braille and audio tours for sight-impaired visitors, there were a few components that were not wheelchair accessible. In contrast, *Cool Moves* was successful in providing good access for those in wheelchairs, but was not highly successful in providing experiences for blind visitors. A father of a girl who is blind, who served as a *Cool Moves* disability advisor, suggested that people with disabilities be on the development committees (not just in on the prototyping process) – "when this happens, you can tell the difference [with the final product]."

We want to note that, because of this effort to make these exhibits "accessible," the exhibits were consequently made better for all visitors. They raised appreciation and awareness on the part of people without disabilities, and were likely to be more accessible to a range of "normal" visitors. For example, by creating signage text that is inviting and readable by someone with a significant vision impairment, that sign is also likely to be more readable for much older, and younger (new reader) visitors as well.

Overall, we found that the range of experiences is generally broad enough so that there is "something for everyone;" even if some exhibits aren't accessible, several advisors said they "can learn by watching." In addition, from our observations and our work with accessibility advisors, we learned that designing universally accessibly exhibitions

is a difficult task. There is such a wide range of disabilities, perhaps no exhibition can ever be designed in such a way that it is equally accessible to all.

Rich and At-risk Exhibits: Robustness

Each of the exhibitions contained "at-risk" components that were simply not robust enough. Several of the exhibitions contained exhibits that were frequently broken down.

> For *Team Up*, one of the biggest issues was that an exhibit that had favored heavily in the marketing campaign was on the floor but broken during our summative visit.

> In *Body Carnival*, the Pressure Vessel cuff had multiple problems: Sometimes it did not read users' pressure, and what the visitor *was* able to see was often confusing, and sometimes even alarming (the cuff consistently reported a researcher's blood pressure as 200 when in reality it is 120). The user often did not get both systolic and diastolic reading.

In addition to the fact that several components were frequently broken down, museum staff responding to our survey noted that several of the exhibitions were not in good condition by their final slot on their scheduled rotation. The outside expert we interviewed said that signs need to be made more durably and new equipment should be used. She noted that if the TEAMS Collaborative want to build exhibitions that will truly stand the test of time:

> *They need to think about what is the best way to do this rather than the cheapest or most expedient way.*

Rich and At-risk Exhibits: Invitation

For each of the four exhibitions, there were components that were used by most visitors, and tended to be used for longer amounts of time or used for shorter amounts of time but used again and again by the same visitor. These exhibits tended to be ones that were more child-friendly, or that had elements that were unique or enlightening, or that were more open-ended and provided more options to visitors.

> For example, from *Team Up*, the How Fast Was That Pitch?, Bounce Pass, and Sweet Spot exhibits were all popular. These provided visitors with the ability to do "cool," familiar, and/or appropriately challenging activities.

> With *Hear, Here*, the Make a Movie soundtrack, Cricket in Kitchen, and sign language exhibits provided unique and enlightening exhibits that were fun and that caused visitors to contemplate a range of aspects about sound and hearing.

> In *Cool Moves*, Windy Wonders allowed visitors to investigate and play with many different types of air motion, and Three Wheeled Raceway engaged visitors in playful exploration of a range of wheel shapes and related motion.

> In *Body Carnival*, the most used exhibits were Hang Time (a chin-up bar with a timer), Dizzy Tunnel, and Feel Music. The last two are large, experiential, and simple to use.

In contrast, there were components that were not used much primarily because visitors did not see them or did not find them inviting enough to invest in.

> In *Cool Moves*, some of the least used exhibits were the pendulum exhibits. These exhibits did not seem to be inviting to visitors and when visitors did use them, generally they still did not understand chaotic motion.   (This is consistent with our formative evaluation, where we found that visitors struggled to comprehend this abstract phenomenon.)

> With *Hear Here*, one of the least used exhibits was High Pitch, Low Pitch; this had to do partly with its position in the exhibition, and partly, we think, with the activity not being viewed as much fun to do by visitors. This activity had a single outcome, and some visitors thought it was too easy.

Rich and At-risk Exhibits: No Payoff for Investment

Other exhibits were considered "at-risk" either because visitors could not figure out how to navigate them, or because the "payoff" in terms of experience and/or understanding simply was not enough for visitors to invest in them.

For example, in *Body Carnival*, the Calculation Station exhibit involved visitors using small calculators in a multi-step process; visitors appeared uninterested in the complicated process they needed to go through just to measure their heart rate, so didn't invest in it or abandoned it. This is an example of a complicated exhibit with low payoff for visitors.

Summary

Thus, as much as the TEAMS staff has learned along the way, there is progress yet to be made in creating more exhibits that are rich, and fewer that are at-risk. As one exhibit designer noted:

> *We all have dark corners in our exhibitions where there are safety issues, accessibility problems that with just a little more thought could have been solved, durability issues, incorrect or absent explanations, and exhibits that appear to have gone into the exhibition because someone couldn't bear to leave them out.*

The Quality of Accompanying Education Materials

Each of the exhibitions included education materials for enriching the exhibitions, through family and school group activities. Most of the programming was designed to allow families and school groups to explore the content and phenomena of the exhibition in additional ways, through facilitated interactions on the floor or in classrooms with museum education staff. The programs also provide visitors with an opportunity to explore science content not directly embedded in the exhibits, but rather content that related to, deepened, and/or complemented that content. Additionally, materials and programs provide school teachers with additional activities they can do with their students in their classrooms to further explore the content of the exhibitions.

According to the TEAMS website, the educational materials for each TEAMS exhibition are organized into two main categories:

"**Public Programs**, which include activities, experiments, and demonstrations for use by the host museum; and **Teachers' Materials**, for use before or after the museum visit. These educational materials are available both in PDF format at the website and in a notebook that accompanies the exhibit along with any specialized materials necessary for each activity.

Public Program Materials

Public Program Materials are available for host museums to involve community audiences in the opening and experiences of each exhibition. The following are included:

> ~Fifteen to twenty short activities (5-20 minutes in length), to supplement and complement the exhibition. These activities are planned as independent presentations but can be combined with school programs or community events held at the museum or another venue. They are designed to be led by museum staff or volunteers and include recommended ages, list of required materials, directions, and suggestions for further investigations.

> ~Summary sheet of the activities cross-referenced by age, time, and scientific concept.

> ~Ideas for other activities, such as possible connections with local groups, that might be incorporated in a community event.

Teachers' Materials

Teachers' Materials include a variety of resources to use prior to or following a field trip to the museum. Included are the following:

> ~Summary of the exhibition components.
> ~Correlation of the exhibition to the "Benchmarks for Science Literacy," as put forth by the American Association for the Advancement of Science.
> ~Glossary of terms used in the exhibition.
> ~Related websites and books.
> ~Pre- and post-visit activities for grades K-2, 3-5, or 6-8."

It is important to note several factors about the context of program development, prior to discussing the overall quality of the education materials and programs. First of all, the programming components were not as high a priority for the work of the Collaborative. They received less funding, staff received less opportunities, especially in the early part of the grant, to receive professional development, and this aspect of the Collaborative similarly received less attention from the evaluation. In addition, there was staff turnover at each of the participating museums between rounds one and two of the TEAMS funding; thus, the education staff who participated in this round of funding were new to their museums and new to the Collaborative. In addition, often when we were conducting our summative site visits, the related programming was not being offered at that time.

Staff responding to our survey who felt they could judge this aspect of the Collaborative's work rated the overall quality of the materials and programs across all

four exhibitions with an average rating of 3.6 (with '1' being *not at all supportive of the visitor experience* and '5' being *greatly supportive of the visitor experience*; n = 8 for *Team Up*, 9 for *Body Carnival*, 10 for *Cool Moves*, and 13 for *Hear, Here*).

The outside expert we interviewed noted that the education materials accompanying the exhibitions were very good. She said,

> *This was one of the best aspects of the exhibitions. They paid attention to detail, and it shows.*

FINDINGS ABOUT THE COLLABORATIVE AND PARTNERSHIPS

The Collaborative

This section of the report lays out our findings about the Collaborative as a whole, and the partnerships within it. We discuss the overall capacity-building efforts of the Collaborative, paying particular attention to the emphasis the Collaborative placed on universal accessibility; then we will examine the benefits and costs of participating in the Collaborative. Finally, we will discuss the 2-museum partnerships within the Collaborative – how they were created, how they evolved over time, and the benefits and costs of participating in the partnerships.

Mechanisms for Community Building, Learning, and Building Capacity

The collaborative structure is a mechanism that does two things. The first is what we call a "direct service" in building exhibitions and developing programs. These are <u>material things</u> that the museums share with one another, and with the larger field. At the same time, the collaborative helps to <u>build the capacity</u> of the field of small museums to continue to do better work. The TEAMS Collaborative has balanced the two aspects quite nicely. The professional development and capacity-building efforts have been in the service of creating better exhibitions and programs, and the efforts to create better exhibitions and programs have led to greater capacity within these institutions, and also within the larger field of small museums.

The TEAMS Collaborative used several different strategies for providing professional learning opportunities for participating museum staff. These mechanisms allowed staff to interact around the challenges of exhibit and program development and included:

> - Charrettes: One each for exhibits and programs/education staff. These charrettes were discussions facilitated by Inverness Research that involved staff carefully talking through specific ideas for their exhibitions and programs, and getting critiques and feedback from the other members of the Collaborative. The charrettes also provided the opportunity for the group to reflect broadly together on what they were doing – and about the quality and qualities of – as well as the philosophies behind – their work.

> - Meetings at ASTC for TEAMS/participation in ASTC meetings: Annually, the TEAMS members met for a day during the ASTC conference. In addition to giving them a day together to work on TEAMS, this helped facilitate museum staff's participation in the larger conference when they might not have attended otherwise. Moreover, several of the TEAMS staff members made presentations at ASTC and other conferences that related to or had emerged from their work on the TEAMS grants.

- Working with partner museums: This involved regular meetings where staff exchanged ideas, shared resources, and critiqued each other's work.

- Listserv and website: Both of these were set up to facilitate regular and ongoing communication among all members of the Collaborative, and within sub-groups of the Collaborative (such as exhibits, programs, directors, and public relations staff).

- Inverness site visits: Twice during the development of the exhibitions, Inverness Research staff visited the museums to critique prototypes, observe and interview visitors interacting with the prototypes, and to check in with staff about their overall progress. We invited staff to work with us as we worked with visitors around their prototypes. At the end of each formative site visit, we provided staff with verbal feedback about our findings; in addition, we posted our findings on the project's internal website.

- Travel grants: Staff could apply for these grants that would enable them to travel to other TEAMS museums to learn about different facets of their work. This allowed staff to visit a wider set of museums within the Collaborative. Six staff applied for and received grants. The specific foci for the visits ranged from deeper investigations into exhibit accessibility (i.e., further development of audio tours), to learning about different ways of managing Collaborative tasks, to sharing specific ideas about program development.

- Staff essays: Staff were invited and paid to reflect on an aspect of their experience and some of the lessons learned from their involvement in the Collaborative. They chose their own topics, which ranged from the experience of exhibits and education staff working closely together to develop exhibit ideas, to specific details about the communication mechanisms the Collaborative used and how those were set up. These essays, lightly edited by Inverness Research, are attached to this report.

- Shared research and focus: All seven museums focused on the theme of designing accessible exhibits, including attending a workshop on accessibility. We discuss this important facet of the Collaborative's work in the next section.

- Shared access to and work with evaluation team: TEAMS staff participated intensively in the evaluation process, and acquired shared experience, language, and tools in exhibit and program evaluation.

Shared focus and research

One of the key elements of the capacity-building effort has been fostered by establishing a shared focus across all seven museums. This focus comes in the form of a theme that the Collaborative pursued collectively and tried to learn more about and incorporate into their individual work. In the first TEAMS project, the shared focus was on family learning and, to some extent, prototyping and formative evaluation. With the second award, the focus was on creating exhibits that are accessible to visitors with a range of disabilities.

All members of the Collaborative participated in an ASTC-sponsored accessibility workshop at Montshire Museum of Science in January 2001. In addition, they all worked with local advisory committees comprised of people with disabilities who helped evaluate ideas and prototypes. The notion of building accessible exhibitions played out quite differently at each museum – for example, two of the exhibitions included audio tours and one of those museums developed their entire exhibition around hearing and sound. However, staff at all museums learned a great deal by focusing on this issue.

A shared focus, it can be argued, contributes to better exhibits but also to greater capacity building. In the current project, accessibility was a unifying theme for the work of the Collaborative – staff members could study it collectively as well as individually through their efforts to execute the principles and ideas as they developed their exhibitions. To a great extent, the group took this effort seriously, and spent a lot of time developing tools and sharing ideas about accessibility, and then incorporating what they learned into the design of their exhibitions and programs. For example, the North Carolina partnership spent quite a bit of effort on developing an audio tour device, and included corresponding Braille identification numbers to each exhibit. And the New York team researched audio-description, which they included in their video-based exhibit on animal motion.

For most of the museums' staff, paying attention to this issue changed the way they thought about not only this exhibition, but all of the work that they do. Thus, attention to this theme allowed for significant institutional development as well. As one director said:

> *[Having the theme of accessibility] is the number one key benefit for our museum from participating in the Collaborative.*

As another staff member said:

> *The accessibility workshop gave us good exposure to a process and we have implemented goals in one-, three- and five-year plans to apply those lessons to old and new exhibits – to look at more than just wheelchair accessibility…*

One thing that perhaps would have assisted in creating even more capacity-building around this issue would have been additional mechanisms -- both during and near the end of the project -- to come together and share what individuals had learned about their work on the accessibility theme. As it was, each individual museum learned a great deal, but there was a missed opportunity for greater, collaborative-wide sharing of their individual approaches, their rationales for taking those approaches, their strategies for working with different groups in their local communities, and the lessons they learned that they will work to incorporate into other projects.

Benefits of participating in the Collaborative

For most of the Collaborative members, the overall benefits of participating in the TEAMS Collaborative have, in their eyes, far outweighed the costs.   In particular, the opportunities the Collaborative provided for personal and professional growth, and the participation by a variety of staff members, have helped the participating institutions develop and grow.

The museums in this collaborative participated in vertically integrated teams –the director, program people, exhibit developers and marketing staff were all involved. Within each of these institutions this teamwork resulted in connections and learning within individual institutions that might not have happened otherwise. In most cases, the Collaborative has been an occasion for team- and institution-building. This was viewed by most people we interviewed as one key benefit of the Collaborative.

> *My number one benefit was staff development…. Huge staff development. [Evaluation] increased our capacity to make interactives and to listen to our visitors.*   –Director

In most of these museums, the Collaborative was a significant part of the overall work staff were engaged in. The structure of the Collaborative, combined with the size and scale of these institutions, resulted in directors being quite involved in the Collaborative process. This allowed for more institutional engagement and impact than we might have seen in larger museums.   That is, the capacity-building efforts of the Collaborative seemed to have quite a significant influence on each of the individual museums.

Directors we interviewed reported benefits of the overall Collaborative to themselves and their staff to include:

-personal and professional growth in the form of exposure to new philosophies of exhibit topic development, staff development, community relationships and fund raising;

-logistical support and sharing of the work of administering the grant: financial management, scheduling and logistics of exhibition tour; development of public relation materials, managing timelines, etc.;

-access to inexpensive, small-sized exhibitions for their museums;

-cost-sharing, and imprimatur of having a national grant to raise other funds; and

-staff with background in different fields (e.g., some from museums, others from K-12 formal education) contributing greatly to each others' knowledge and sophistication about their work.

Another benefit of the Collaborative came in the form of the experimenting with various ways to communicate and keep in contact with one another. While not every mechanism for communication was viewed as key or successful by all the members of the Collaborative, the willingness of the group to experiment with different ways to communicate was essential. Perhaps the most used, and most successful, of these mechanisms was the listserv. This was used quite regularly by almost all members of the Collaborative and proved to be a good resource for the ongoing sharing of ideas and logistical details. As one staff member explained:

> *[Through the listserv] we can develop the PR template – a descriptive paragraph about TEAMS, and what is in the press kit – the listserv is a huge step.*

The internal web sites were used to a great extent by some museums and less so by others. While it was a good mechanism for easily sharing descriptions and photos of prototypes, and a good common place to post evaluation findings, it did require quite a bit of work to post materials. Also, not many staff people responded to or commented on the material that was posted. As one exhibits staff member said:

> *I did our web site and I didn't feel like anybody ever went there, even in our own collaborative…the listservs were more dynamic. The web sites were reports that had to be done… it wasn't dynamic like I expected it to be…*

The on-line chats were an interesting experiment – while they were easy to set up and use, some people were not comfortable with this way of communicating; the chats were simply not viewed to be as effective as conference calls.

Perhaps most importantly, Collaborative members benefited a great deal from the numerous opportunities they had to learn about how different museums approach their work. The capacity of individuals within the institutions grew significantly as individual staff members gained key skills in building exhibits and developing education programs, felt less isolation in their work, and learned much more about prototyping and evaluation. The accessibility and evaluation components enabled staff members to interact with outside consultants that helped expand their thinking and changed the way they view their processes at their own museums. As one staff member said about the formative evaluation process:

This has been a really positive experience for me and I think it certainly helps me here in my home institution– that I have this great foundation to base things on. If I suggest prototyping something or a particular design approach, I have a reference a great deal of the time. I don't know if any of the exhibits people have a formal education in exhibit development so it gives us all a common ground to work from…. For a museum our size, it is unusual for people to be exposed to exhibit development and evaluation to that extent… I can't imagine how many ASTC workshops you would have to sit through to get that level of expertise.

The charrettes, in particular, were mentioned as being invaluable to the exhibit development process of the Collaborative members. As one exhibit staff member noted:

I thought the prototype workshop at Montshire was fantastic and I thought that really gave us a leg up in the development of the prototypes. It was a good creative atmosphere because it enabled the individual partners to work together and bounce ideas off the other partners and see their approach to things. And, it is one thing to sit in a meeting and hear descriptions, but to bang a prototype together and be able to play with it and see it out on the floor was really valuable. Because Inverness people were there that was a good intro to how to evaluate the prototypes and get something out, come back, and make adjustments… it was invaluable.

The travel grants were also viewed as valuable professional development by the staff members who participated. Staff members traveled to other museums with a project or question in mind, but often what happened was that staff exchanged ideas on a whole range of subjects. In addition, most staff returned to their home institutions and shared with the rest of the staff what they had learned, so the "learning" went beyond the staff doing the traveling. As one staff person reported in their post-travel interview with us:

I had a lot of great experiences going and seeing staff interact, and seeing staff and volunteers interact, getting photos and activity ideas. Half was Cool Moves-based and the other half was checking out the museum… I was glad to bring back a lot of photos and show everyone ideas for exhibits.

Staff members we interviewed also reported the benefits the established relationships bring when the traveling exhibits are on the floor of their museum:

What makes it nice here is that I have a rapport with the creators of the exhibit so I can send an e-mail or pick up the phone and we work it out together – so there's less of a calling-and-complaining situation.

Issues and Challenges

In this section of the report, we will examine some of the issues raised through interviews with staff and through staff survey data.   Each of these issues needs careful attention as the Collaborative proceeds into their third round of funding.

Clarification and coordination of administrative assignments

We think it would be helpful for the group to clarify and solidify the work the directors will do as part of their larger administrative assignments.   Several of the new directors, in particular, were unclear as to what they were to be doing when they were placed "in charge" of an aspect of the Collaborative, such as accessibility or public relations. Were they to shepherd the work of the Collaborative on this issue? Were they to ensure that everyone addressed the accessibility issue or took care of their public relations duties? Or were they to guide the overall vision for this aspect of the Collaborative's work? Or were they to collect the lessons learned and share them with the field?

Priority of and role for education and programs staff

Additionally, it would be helpful in future efforts to better clarify the overall priority of education materials and programming, as well as the professional development mechanisms for education staff. It seems to us that programming can be symbiotic with good exhibits; they can reinforce each other. The institutional values around this issue among Collaborative members are wide-ranging. How much programming is needed? What role do programs play in bringing visitors in and generating revenues? How will the programming get developed and what mechanisms could the Collaborative put in place to facilitate this work? All of these questions warrant further discussion. The programs charrette that happened as a result of the supplemental grant was viewed as an important step by the education staff who participated, as were the travel grants by those education staff who took advantage of them. However, these important opportunities were offered quite late in the grant.

Values around nature of exhibitions

The Collaborative could also get better at clarifying the values of the group around the nature and quality of the exhibitions. What is the spectrum here in terms of the amount and depth of science content to be offered? To what extent should inquiry experiences be a key part of the exhibitions? What is the overall importance of having a highly marketable exhibition topic? The survey data and our interviews indicated that there is still some discomfort about the range of philosophies and quality of the exhibitions.

Roles and responsibilities within partnerships

A further domain for clarification is around the roles and responsibilities within the partnerships, and the Collaborative's mechanisms for dealing with issues within the partnerships as they arise. How will tasks within the partnerships be divided up? What oversight will the larger Collaborative provide when tensions and issues within the partnerships create conflict? We discuss this more thoroughly in the next section of the report.

The Partnerships

The theory

One of the goals of TEAMS was to extend the benefits of the project out from the original five small museums to reach a larger group. They did this by experimenting with the development of regional partnerships. In these partnerships each museum from the first TEAMS grant, with more experience in exhibit development, serves as a "mentor" to a new TEAMS member museum. The idea was that the three new museums brought into the Collaborative could learn from the more experienced ones, while contributing their own strengths and capacity to the regional partnership.

How partnerships were chosen and structured

Each of the three museums in the original collaborative chose a local partner, with input from the larger collaborative. Proximity was a primary criterion for choosing partners – museums wanted them located within a few hours' drive so that staff could easily meet and work together. Also, directors agreed that both museums in the partnerships needed to be small- to medium-sized museums, and that they needed to have at least somewhat comparable philosophies about hands-on science education.

How the partnerships worked: benefits and costs

As in all collaborations and partnerships, there are benefits and costs to institutions that choose to work with another toward a common goal. Staff in originating and partner museums quickly realized that the "new" museums had a lot of their own ideas about exhibit and program development, and had unique capacities and perspectives to bring to the Collaborative. Therefore, although the "charter" TEAMS museums provided guidance and training in some areas, the structure in most cases moved from the proposed mentor/apprentice approach to that of a more equal partnership model.

Partnerships brought a range of strengths to the Collaborative. These included:

> - partnership and mentoring as the two museums worked together to build
> exhibits;
> -redundancy and back-up in staff when turnover occurred in partner museums;
> -a great reduction in isolation; and
> -positive peer pressure to produce high-quality products.

We have conducted interviews with staff about the Collaborative, and – although there have been issues that have arisen – for the most part TEAMS staff report that the benefits of the partnerships outweigh the costs. Overall, the structure of the partnership seemed to be a good one, especially benefiting exhibit development and program staff. In contrast to the first TEAMS Collaborative, the majority of the work of the "collaboration" happened at the regional partnership level, rather than with the larger collaborative group.   The quotes below from exhibits and education staff illustrate this point:

> *There's another level [of collaboration] now, because of the partnership. I would go there first before to the rest of the Collaborative… I'm spending so much time on my own partnership. The partnership requires a lot higher level of communication. We are really in development with another place…*
>
> *I think bringing in the additional partners added greatly to the pool of expertise and diversity of knowledge and experience among the exhibits group.*
>
> *We get to do things creatively. To have someone else to lean on – [the mentee's] organizational skills are much more honed than mine.*
>
> *They (the partner museum) have a huge number of visitors and a bigger museum so it is a great place to test exhibits. And we prototype and they had never done that before.*

As with any kind of collaboration, there were difficulties that emerged from the partner arrangements. For most partners, it was difficult at first to determine how tasks would be divided up and how much structure the partnerships should have. Some of the partnerships were still struggling with these issues near the end of the funding period. It was also difficult for new museums to join a new partnership as well as a larger collaborative – the partners needed shepherding in both and sometimes that did not happen. Perhaps most importantly, museums discovered quickly any differences in their partner's philosophies as they started the work of co-developing an exhibition. It takes a long time to develop the trust and understanding of one another to work effectively together; in this case, they had to jump immediately to the task at hand. Another factor that made the partnerships difficult from the start was that the charter museums had already selected topics for the exhibitions; partner museums had to accept the topic without having had input. The following quotes from directors from collaborating museums illustrate some of the difficulties that arose with the partner institutions:

I would structure it differently between the two museums and have more of a rigid breakdown of responsibilities and deadlines.

I think in our particular instance there wasn't a clear delineation of who was to be spokesman, leader, coordinator, or organizer of the partnership…

We struggled a lot with differences in philosophies and everyone has their own way of working and internal way of juggling decision-making. When you get two different groups together, it gets complicated.

In spite of these difficulties, as we stated above, Collaborative members for the most part felt the benefits gained were worth these costs, and in some cases the partner museums continue to work together on other projects in addition to TEAMS.

SUMMARYAND FINAL THOUGHTS

The TEAMS Collaborative was ambitious in its efforts in this second round of funding, and was successful along a number of fronts. The TEAMS Collaborative was funded to simultaneously develop a set of traveling exhibitions that would meet the needs of small museums while at the same time developing the capacity of the staff working in the participating museums. Our evaluation shows that the NSF investment in TEAMS did, in fact, provide for both of these outcomes to occur.   Four good-quality exhibitions and related education programs were produced that are well-suited to help meet the needs of small museums. The exhibitions are sized to fit small spaces, have compelling themes (the human body, force and motion, the science of sports, and hearing), and engage visitors through a variety of experiences.   They help expand the repertoire of available exhibitions for small museums to rent.

Quality control amongst the group, along with outside evaluation assistance, helped to identify problems and eliminate most exhibit "failures." The collaborative provided a greatly supportive structure — a development scheme, timetable, and process (including charrettes where members shared and critiqued exhibit ideas; and formative evaluation visits by Inverness Research Associates) — that each museum followed. Because all museums participated in the structured process, we saw improvements in the exhibits and programs at each stage of development. This did not mean that all exhibits were of uniform quality, but it did ensure a more thoughtful, solid and uniform exhibit development process. In this way, the collaborative structure and processes did add real value to the final products. There is little doubt that these exhibits were better than if they had been done by individual institutions working in isolation.

Also, the addition of the "partner" museums allowed each museum to work closely with another museum in its region. This created many opportunities for shared learning on not only exhibition and education program development and evaluation, but also on museum operations and management.

The emphasis on community provided opportunities for staff to share their ideas in a charrette, to travel to other museums and reflect on their experiences in writing, and provided many different avenues for staff to communicate their ideas with one another. The community created in the Collaborative also provided a shared set of expectations and commitment, and increased the connection to and investment in this project.

The emphasis of the Collaborative on formative evaluation created a role for Inverness Research that provided ongoing feedback and critique of their work. The facilitative role of Inverness Research also provided structure, opportunities, and benchmarks for the collective development process. The research aspect of the work of Inverness Research helped everyone see that their work involved not only the creation of exhibits but also the creation of knowledge that could help the field.
Thus, NSF's investment in the TEAMS Collaborative appears to us to be a sound one. The TEAMS project represented a major grant for each of these small institutions, and

thus, it received a significant amount of attention from the museum directors as well as education, exhibit and marketing staff. The imprimatur of the NSF funds allowed museums to leverage those dollars productively, raising local funds and gaining local support for their institutions because of their participation in this project.

In addition, we think the fact that NSF invested in two rounds of TEAMS allowed for a kind of longitudinal developmental work that is all too rare. The re-investment in basically the same group of museums supported a cumulative building of capacity, over approximately ten years and across a range of domains, which would probably not have occurred to such an extent without the continuing work of the same museums. They all were simply better the second time around.   Now the TEAMS Collaborative is poised to take the assets created in TEAMS 1 and 2 and put them to work in TEAMS 3.

We believe this collaborative is a good example of measured and thoughtful longitudinal investment by the NSF, an approach that builds upon and puts to work the return of its previous investment. This investment is exemplary in that it does provide funding for cumulative development that stretches over ten years. And it suggests that NSF may well want to examine ways to foster other such collaboratives involving small institutions.   In the meantime, TEAMS continues to build on what it has already accomplished. We look forward to working with the TEAMS 3 group as they continue finding ways to contribute to the small museum community as well as the broader field of exhibit developers and informal science education researchers.

APPENDICES

Appendix A:
Summary of TEAMS Staff Survey Data

Appendix B:
Summary of Tracking Data

APPENDIX A

SUMMARY OF TEAMS STAFF SURVEY DATA

In the summer of 2004, we developed a survey for all TEAMS Collaborative members to complete that asked for ratings on the quality of each of the four exhibitions in particular domains, as well as the overall quality and value of the four exhibitions as a whole. Tables summarizing the survey data are presented in this appendix.

Overall Summary Ratings across All Four Exhibitions

	Average	% 4's/5's	% 1's/2's
Overall rating in terms of quality	3.75	79%	0
Overall rating in terms of value	3.25	66%	0

N=24

Science Content

Body Carnival (n=17)	Average	% 4's/5's	%1's/2's
Amount of science content	4.18	88%	0
Accuracy of science content (n=15)	4.40	76%	0
Age-appropriateness of science content	4.35	88%	5%
Clarity of big ideas/themes	4.12	70%	0
Transfer of important scientific principles/ concepts (n=16)	3.44	35%	0
Cool Moves (n=17)			
Amount of science content	3.76	58%	5%
Accuracy of science content (n=15)	4.33	88%	0
Age-appropriateness of science content	3.88	58%	0
Clarity of big ideas/themes	3.53	35%	0
Transfer of important scientific principles/ concepts (n=16)	3.38	52%	5%
Hear, Here (n=21)			
Amount of science content	4.14	76%	4%
Accuracy of science content (n=20)	4.30	90%	0
Age-appropriateness of science content	3.10	28%	23%
Clarity of big ideas/themes	3.90	61%	0
Transfer of important scientific principles/ concepts	3.59	61%	4%
Team Up (n=17)			
Amount of science content	3.29	47%	17%
Accuracy of science content (n=15)	3.53	70%	11%
Age-appropriateness of science content	4.35	88%	0
Clarity of big ideas/themes	4.06	76%	0
Transfer of important scientific principles/ concepts (n=16)	2.75	17%	29%

1 = inadequate, inappropriate, inaccurate, not at all; 3 = somewhat; 5 = very adequate, appropriate, accurate, to a great extent

Visitor Experience

Body Carnival (n=17)	Average	% 4's/5's	%1's/2's
Provides fun and engaging experiences	4.41	88%	5%
Promotes inquiry	2.94	11%	17%
Accessible to visitors with wide range of learning styles	3.76	70%	0
Conducive to family learning	4.06	82%	5%
Provides a balance of activities	4.12	82%	0
Cool Moves (n=17)			
Provides fun and engaging experiences	3.65	58%	0
Promotes inquiry	3.82	70%	0
Accessible to visitors with wide range of learning styles	4.00	76%	0
Conducive to family learning	3.94	76%	0
Provides a balance of activities	3.53	52%	11%
Hear, Here (n=21)			
Provides fun and engaging experiences	3.10	23%	19%
Promotes inquiry	3.43	47%	14%
Accessible to visitors with wide range of learning styles	3.29	33%	19%
Conducive to family learning	3.76	57%	4%
Provides a balance of activities	2.67	14%	42%
Team Up (n=17)			
Provides fun and engaging experiences	4.47	94%	0
Promotes inquiry	3.00	17%	17%
Accessible to visitors with wide range of learning styles	3.65	58%	0
Conducive to family learning	3.88	76%	0
Provides a balance of activities	3.18	41%	23%

1 = not at all; 3 = somewhat; 5 = to a great extent

Education Materials

Body Carnival	Average	% 4's/5's	% 1's/2's
Materials support and enhance the overall visitor experience (n=9)	4.33	47%	0
Programs support and enhance the overall visitor experience (n=9)	3.89	35%	0
Cool Moves			
Materials support and enhance the overall visitor experience (n=10)	3.80	47%	5%
Programs support and enhance the overall visitor experience (n=10)	3.70	47%	5%
Hear, Here			
Materials support and enhance the overall visitor experience (n=13)	3.23	38%	19%
Programs support and enhance the overall visitor experience (n=12)	3.50	38%	9%
Team Up			
Materials support and enhance the overall visitor experience (n=8)	3.13	17%	11%
Programs support and enhance the overall visitor experience (n=8)	3.50	23%	0

1 = not at all; 3 = somewhat; 5 = to a great extent

Accessibility

Body Carnival (n=17)	Average	% 4's/5's	% 1's/2's
Accessible to visitors with vision disability (n=16)	3.50	47%	17%
Accessible to visitors with hearing disability (n=16)	3.81	58%	0
Accessible to visitors with impaired mobility (n=16)	3.25	23%	0
Accessible to visitors in wheelchairs	3.82	70%	0
Cool Moves (n=17)			
Accessible to visitors with vision disability	2.71	17%	29%
Accessible to visitors with hearing disability	3.82	76%	0
Accessible to visitors with impaired mobility	3.24	29%	5%
Accessible to visitors in wheelchairs	4.06	88%	0
Hear, Here (n=21)			
Accessible to visitors with vision disability	3.43	66%	4%
Accessible to visitors with hearing disability	3.48	57%	19%
Accessible to visitors with impaired mobility	3.33	57%	9%
Accessible to visitors in wheelchairs	4.38	100%	0
Team Up (n=17)			
Accessible to visitors with vision disability	2.35	5%	52%
Accessible to visitors with hearing disability	3.59	52%	0
Accessible to visitors with impaired mobility	2.65	5%	23%
Accessible to visitors in wheelchairs	3.47	47%	0

1 = not at all; 3 = somewhat; 5 = to a great extent

Physical Qualities

Body Carnival (n=17)	Average	% 4's/5's	%1's/2's
Extent to which exhibition is durable	3.35	58%	5%
Extent to which exhibition is safe	3.88	64%	5%
Extent to which exhibition is easy to set up and maintain (n=10)	3.00	17%	17%
Cool Moves (n=17)			
Extent to which exhibition is durable (n=16)	3.63	76%	0
Extent to which exhibition is safe	4.41	94%	0
Extent to which exhibition is easy to set up and maintain (n=11)	3.64	52%	0
Hear, Here (n=21)			
Extent to which exhibition is durable	3.81	71%	9%
Extent to which exhibition is safe	4.67	94%	0
Extent to which exhibition is easy to set up and maintain	3.05	52%	0
Team Up (n=17)			
Extent to which exhibition is durable	2.76	29%	23%
Extent to which exhibition is safe	3.94	70%	0
Extent to which exhibition is easy to set up and maintain	2.29	17%	23%

1 = not at all; 3 = somewhat; 5 = to a great extent

Summary

Body Carnival (n=17)	Average	% 4's/5's	%1's/2's
Extent to which exhibition worked well in your museum setting	4.41	94%	0
Extent to which this is a marketable exhibition (n=16)	4.38	82%	0
Summary rating in terms of quality	3.82	70%	0
Summary rating in terms of value (n=16)	4.06	64%	0
Cool Moves (n=17)			
Extent to which exhibition worked well in your museum setting	3.53	41%	0
Extent to which this is a marketable exhibition	3.71	52%	0
Summary rating in terms of quality	3.82	64%	0
Summary rating in terms of value (n=15)	3.73	70%	0
Hear, Here (n=19)			
Extent to which exhibition worked well in your museum setting	3.29	38%	9%
Extent to which this is a marketable exhibition	3.14	38%	23%
Summary rating in terms of quality	3.62	52%	4%
Summary rating in terms of value (n=19)	3.21	424%	23%
Team Up (n=17)			
Extent to which exhibition worked well in your museum setting	4.47	94%	0
Extent to which this is a marketable exhibition	4.53	94%	0
Summary rating in terms of quality	3.59	58%	5%
Summary rating in terms of value (n=16)	3.47	52%	5%

1 = not at all; 3 = somewhat; 5 = to a great extent

APPENDIX B

SUMMARY OF TRACKING DATA

Exhibition	Number of Trackings	Average Time Using the Exhibition	Shortest Time Using the Exhibition	Longest Time Using the Exhibition	Average Time at Exhibits
Body Carnival	**11**	0:04:23	0:00:02	0:09:51	0:00:48
Females Tracked	4				
Males Tracked	7				
Cool Moves	**25**	0:11:10	0:01:04	0:28:32	0:01:02
Females Tracked	10				
Males Tracked	15				
Hear Here	**19**	0:09:20	0:01:11	0:39:45	0:01:26
Females Tracked	11				
Males Tracked	8				
Team Up	**15**	0:10:33	0:02:49	0:22:54	0:01:24
Females Tracked	6				
Males Tracked	9				

Dwell Times and Uses		Exhibit	Time	Number of Uses	% Used
Body Carnival	Longest Average Dwell	Hang Time	0:01:03	11	100%
	Shortest Average Dwell	Dizzy Tunnel	0:00:19	8	73%
Cool Moves	Longest Average Dwell	Animals in Motion	0:02:05	7	28%
	Shortest Average Dwell	Crazy Pendulums	0:00:21	7	28%
Hear Here	Longest Average Dwell	Make a Movie Soundtrack	0:02:59	10	53%
	Shortest Average Dwell	What's That Sound	0:00:45	8	42%
Team Up	Longest Average Dwell	Fast Ball	0:02:08	17	113%
	Shortest Average Dwell	Horse	0:00:40	5	33%

Body Carnival

Exhibit	Average Time@ Exhibit	# of Uses	% of Trackings Who Used	Shortest Time at Exhibit	Longest Time at Exhibit
Entrance	0:00:19	1	9%	0:00:19	0:00:19
Balancing Act	0:00:26	4	36%	0:00:05	0:00:41
Walk the Plank	0:01:43	5	45%	0:00:44	0:04:01
Dizzy Tunnel	0:00:19	8	73%	0:00:02	0:00:47
Goofy Goggles	0:00:49	1	9%	0:00:49	0:00:49
Wacky Wall	0:00:30	4	36%	0:00:05	0:01:35
Get a Grip	0:00:29	5	45%	0:00:04	0:01:13
House of Color	0:00:23	2	18%	0:00:06	0:00:39
Pressure Vessel	0:01:04	4	36%	0:00:33	0:02:20
Go With the Flow	0:02:17	1	9%	0:02:17	0:02:17
Tunnel of Blood	0:00:51	4	36%	0:00:07	0:02:07
Calculation Station H20	0:00:00	0	0%		
Calculation Station Heart Rate	0:00:37	1	9%	0:00:02	0:00:02
Calculation Station Yardstick	0:00:42	2	18%	0:00:06	0:00:48
Clown Figures	0:01:28	1	9%	0:01:28	0:01:28
Feel Music	0:00:42	7	64%	0:00:06	0:01:53
Hang Time	0:01:03	11	100%	0:00:02	0:03:08
Think Fast	0:00:00	0	0%		
Sit and Reach	0:00:42	3	27%	0:00:18	0:00:59
Wacky Mirror-R	0:00:32	1	9%	0:00:32	0:00:32
Wacky Mirror-L	0:00:58	1	9%	0:00:58	0:00:58

Body Carnival (continued)

Three Most Used Exhibits	# Uses	Three Least Used Exhibits	# Uses	Exhibits Not Used
Hang Time	11	Entrance	1	Calculation Station H20
Dizzy Tunnel	8	Calculation Station Heart Rate	1	Think Fast
Feel Music	7	Wacky Mirror-R	1	

Three Longest Used Exhibits (excludes long dwell time, low use anomalies)	Average Use	Shortest Used Exhibits	Average Use
Walk the Plank	0:01:43	Dizzy Tunnel	0:00:19
Pressure Vessel	0:01:04	Balancing Act	0:00:26
Hang Time	0:01:03	Get a Grip	0:00:29

Cool Moves

Exhibit	Average Time@ Exhibit	# of Uses	% of Trackings who Used	Shortest time at exhibit	Longest time at exhibit
Turbulent Orbs	0:00:36	18	72%	0:00:05	0:01:24
Dancing Wall	0:00:41	27	108%	0:00:05	0:04:05
Three-wheeled Raceway	0:01:28	28	112%	0:00:10	0:07:16
Giant Pendulum	0:01:30	17	68%	0:00:05	0:06:35
Crazy Pendulums	0:00:21	7	28%	0:00:07	0:00:34
Tornado	0:01:20	16	64%	0:00:20	0:03:41
Wind Over Water	0:01:26	18	72%	0:00:26	0:04;53
Animals in Motion	0:02:05	7	28%	0:00:22	0:05:45
Swinging Art	0:01:17	16	64%	0:00:05	0:03:08
Ripple Tank	0:00:42	17	68%	0:00:08	0:01:50
Sound Strings	0:00:44	18	72%	0:00:03	0:02:04
Video	0:00:32	5	20%	0:00:08	0:00:59
Windy Wonders	0:01:46	28	112%	0:00:02	0:06:51
Air Instrument	0:00:56	12	48%	0:00:19	0:03:55

Three Most Used Exhibits	# Uses	Least Used Exhibits	# Uses	Exhibits Not Used
Three-wheeled Raceway	28	Video	5	
Windy Wonders	28	Animals in Motion	7	
Dancing Wall	27	Crazy Pendulums	7	

Three Longest Used Exhibits (excludes long dwell time, low use anomalies)	Average Use	Shortest Used Exhibits	Average Use
Animals in Motion	0:02:05	Crazy Pendulums	0:00:21
Windy Wonders	0:01:46	Video	0:00:32
Giant Pendulum	0:01:30	Dancing Wall	0:00:41

Hear Here

	Average Time@ Exhibit	# of Uses	% of Trackings Who Used	Shortest time at exhibit	Longest time at exhibit
Loud and Louder	0:02:03	1	5%	0:02:03	0:02:03
High Pitch, Low Pitch	0:01:24	2	11%	0:01:21	0:01:26
Vibration Station	0:01:16	17	89%	0:00:02	0:03:21
Seeing Your Voice	0:01:00	11	58%	0:00:12	0:02:45
Voice Music	0:00:45	8	42%	0:00:08	0:04:56
Make a Movie Soundtrack	0:02:59	10	53%	0:00:11	0:08:31
Cricket in the Kitchen	0:01:58	19	100%	0:00:01	0:06:58
What's That Sound	0:00:45	8	42%	0:00:09	0:02:34
Sign Language	0:01:17	15	79%	0:00:05	0:04:40
Long Distance Listening	0:01:15	17	89%	0:00:04	0:10:57
Hear Today, Gone Tomorrow	0:01:28	2	11%	0:00:06	0:02:51
Hear to Stay	0:01:48	2	11%	0:01:20	0:02:16
Missing Pitches	0:01:21	7	37%	0:00:10	0:03:08

Most Used Exhibits	# Uses	Least Used Exhibits	# Uses	Exhibits Not Used
Cricket in the Kitchen	19	Loud and Louder	1	
Vibration Station	17	High Pitch, Low Pitch	2	
Long Distance Listening	17	Hear Today, Gone Tomorrow	2	

Three Longest Used Exhibits (excludes long dwell time, low use anomalies)	Average Use	Shortest Used Exhibits	Average Use
Make a Movie Soundtrack	0:02:59	What's That Sound	0:00:45
Cricket in the Kitchen	0:01:58	Voice Music	0:00:45
Sign Language	0:01:17	Seeing Your Voice	0:01:00

Team Up

	Average Time@ Exhibit	# of Uses	% of Trackings Who Used	Shortest time at exhibit	Longest time at exhibit
Entry		0	0%		
Fast Ball	0:02:08	17	113%	0:00:09	0:06:12
Bounce Pass	0:02:03	13	87%	0:00:25	0:04:22
Ricochet Racquet			0%		
Locker Room	0:01:07	3	20%	0:00:42	0:01:28
Sweet Spot	0:01:08	13	87%	0:00:16	0:04:36
Name that Ball	0:02:03	8	53%	0:00:33	0:03:47
Set Shot	0:01:34	12	80%	0:00:22	0:04:08
Inside Scoop	0:04:45	5	33%	0:00:05	0:01:12
Balance Table	0:01:34	11	73%	0:00:10	0:03:20
Horse	0:00:40	5	33%	0:00:05	0:01:20
Balance Beam	0:00:53	7	47%	0:00:06	0:01:43
Get in the Game			0%		
Sole of the Game	0:00:53	11	73%	0:00:01	0:02:23
Twin Spin	0:00:44	10	67%	0:00:09	0:01:19

Three Most Used Exhibits	# Uses	Three Least Used Exhibits	# Uses	Exhibits Not Used
Fast Ball	17	Locker Room	3	Entry
Bounce Pass	13	Inside Scoop	5	Ricochet Racquet
Sweet Spot	13	Horse	5	Get in the Game

Three Longest Used Exhibits	Average Use	Three Shortest Used Exhibits	Average Use
Fast Ball	0:02:08	Horse	0:00:40
Bounce Pass	0:02:03	Twin Spin	0:00:44
Name that Ball	0:02:03	Sole of the Game	0:00:53