This narrative supports the final report for the TEAMS Small Museum Exhibit Collaborative grant which began October 1, 2004. This was the third of three sequential grants provided by NSF and thus this report, in a sense, also represents a culminating report for a twelve year effort. For this reason, in addition to a detailed report on the most recent 4 years, the latter section of this narrative reflects on the full twelve year experience. Inverness Research, the project evaluators, were also asked to reflect on the larger twelve year experience in addition to their final evaluation report and the resulting "Lessons Learned" document is attached.

TEAMS 2004 – 2008

The project was initiated with a September 2004 coordinating meeting attended by all of the TEAMS directors, two representatives of Inverness Research Associates, and three of the project national advisors. In October a planning charrette was hosted at Montshire Museum in Vermont to explore the integration of the research component with exhibit design. In addition to TEAMS directors and the Inverness Research group, exhibit and program staff from all seven TEAMS museums participated along with the project researchers, Dr. Maureen Callanan and Dr. Kevin Dunbar, and the National Advisory Committee. Based on this two-day discussion, the work plan was developed in greater detail and the working relationship between researchers and practitioners was examined. The rich collaborative conversation among researchers, practitioners, and evaluators led to a deeper understanding of the role and limits of research to inform exhibits. Staff development about the process of research and its implications for exhibits was identified as a valuable goal for the project.

Following a national search coordinated by Dr. Dunbar, in November 2004 Dartmouth College appointed Dr. Leslie Atkins for the project's post-doctoral position under Dr. Dunbar. During the next 18 months weekly research coordination meetings were held at Montshire with Dunbar, Atkins, and four members of Montshire's exhibit and programming staff. A sequenced iterative process, described later in this report, was developed for this research phase.

Inverness Research Associates participated with the research process design via conference calls to inform their role, later in the project, of leading discussions on what generic design tools might evolve from the research findings.

During this time period, designers at TEAMS museums were initiating their design process with development of preliminary prototypes to be integrated into the research process. Based on preliminary research findings, a survey of exhibit characteristics in relation to visitor conversations was developed and each of the seven museums collected data.

In June, 2005 staff from all TEAMS museums along with national advisors, evaluators, and the researchers convened at Montshire Museum. A workshop on video techniques as a tool for prototyping exhibits and for assessing learning was led by Dr. Atkins, Dr. Dunbar, and advisory committee member, Dr. Allen. The group then discussed ideas for tools that could use conversations as a means of informing exhibit designs. Each museum group agreed to investigate a different approach. Some implemented their own version of the full video analysis while others tried simpler approaches like using a checklist to gather data about conversation patterns. In another technique, the design team was asked to, in a formal process, imagine what conversations they would like to hear at their exhibit and then to compare actual visitor conversations to the ideal during prototyping. During this meeting, the Inverness representatives initiated conversations about the larger meaning of the research and focused the TEAMS work on the creation of design tools for the field.

In October 2005, the entire TEAMS group (three to four representatives from each of the seven museums) met for a full day of planning and coordination. The work groups on exhibits, programs, and marketing were facilitated by TEAMS directors Trautmann, Bennett, and Goudy. Ideas were refined and coordinating guidelines and schedules developed and adopted.

Intensive prototyping has been a hallmark of the exhibit design training TEAMS developed for its constituent museums and generous time in the exhibit process was afforded to this element. Inverness Research Associates supported this effort with two prototyping site visits at each of the four exhibition development

sites. One of these occurred at an early prototyping stage to guide early selection of the most promising modules. One of the most difficult processes for an exhibit designer is to understand when it is appropriate to abandon an early, appealing exhibit idea that simply is not resonating with the public during early prototyping. TEAMS worked hard on the staff development process with regard to effective use of prototyping and the Inverness summative report confirms that notable progress was made over the twelve year TEAMS cycle. The second prototyping round facilitated by Inverness, during summer 2006, focused on robustness and effectiveness of advanced prototypes.

In 2006 the Education and PR/marketing teams coordinated development of their materials for the exhibitions. Initial programming ideas underwent a prototyping process to refine the ideas prior to completion of the exhibitions. The PR/marketing group focused on refining the final exhibition titles to maximize marketability. TEAMS task groups also completed work on logistics for exhibition shipping, and travel schedules.

The research activities also continued during 2006. The video-taping process generated data through an iterative process. Following protocols developed by Dr. Sue Allen and colleagues at the Exploratorium and Dr. Maureen Callanan at University of California, Santa Cruz (both project advisors) visitors to select exhibitions were recorded on videotape with microphones placed to capture their conversations. The process, designed to create a close relationship between researchers and design practitioners, was approximately as follows: 1) Two days of taping completed; 2) researchers review the tapes and use a quick-coding process to gather initial findings; 3) researchers prepare highlight DVD of clips from the tapes and distribute copies to the entire research and design team for review; 4) entire team meets to review DVD together and discuss meaning; 5) based on the data, group decides on further modification to exhibit; 6) modifications are completed and next round of taping begins. The cycle time was about twelve – fourteen days for this process.

After completing the data-gathering phase, the researchers concentrated on detailed coding (as opposed to the quick-coding during the initial iterative process) of the accumulated video data. The analysis of the information, discussion of meaning, and drafting of papers continued through the end of 2006.

Investigating the importance of designing an exhibit to help "frame" the visitor's conversation and learning became an important research theme. In one example, relatively minor modifications to create framing in an exhibit resulted in dramatic improvements in the quality of visitor conversation about the phenomena. It also appears from further investigation that the value and approach to framing for any exhibit likely must take into account the specific exhibit theme and the pre-existing frames that visitors may bring. For example, our approach to framing was highly beneficial when turbulence was the subject but for a similar exhibit about heat, the same techniques appear to diminish the quality of learning conversations. We also noted that in some instances, exhibits that are more structured and less open-ended may generate better learning conversations than more open-ended exhibits. This data appears to reinforce earlier work by Dr. Sue Allen suggesting that perhaps exhibits can be too open-ended.

The research team worked closely with the TEAMS leaders and with Inverness Research to explore how the research findings and the experience of the research-practitioner process (the iterative process described above) could be translated into generic tools to help others in the museum exhibition field improve exhibit design. In April, 2006 five representatives from the TEAMS museums, the research team, and two representatives from Inverness Research Associates met at Montshire Museum to analyze the experience to date and consider how to use the larger TEAMS group to further investigate the application of the research process to improve exhibit design. A strategy was developed for visits by Dr. Atkins to all of the sites as part of Inverness prototype evaluation team. During these visits she was able to more deeply engage and support the local TEAMS staff groups in their own experiments in gathering visitor conversation data as part of their prototyping processes.

Informative and valuable as the research proved to be in the broader aspect of expanding knowledge of exhibit design and impact on learning, two of the proposed outcomes proved elusive. The video techniques worked best in relatively late stages of design when primary issues of functionality and navigation were solved. For this round of TEAMS exhibits, the established exhibit schedule didn't allow sufficient time to optimize use of the research techniques to the final exhibits. In addition, the

translation of research findings into generalizable tools proved more difficult than expected. Some techniques including having designers imagine and articulate, prior to initiating the design, the conversations they would like to hear at their exhibit were embraced by several of the design teams. In addition, extracting key elements observed in the videos to a simpler and cheaper observational tool using a PDA device (Palm Pilot) appears to have merit. This approach was developed late in the project and was not sufficiently evaluated to offer conclusive results.

The process of close collaboration between researchers and practitioners was seen by our national advisors as a unique and important contribution. The TEAMS experience with this process was presented for discussion by the field at the 2005 Bay Area Institute and the 2006 ASTC annual conference.

During 2007, the major activity focused on 1) final design and prototyping of the four exhibitions; 2) fabrication and public display of the four exhibitions at their home museum sites 3) remedial assessment by Inverness Research Associates 4) remedial modifications to exhibits as necessary, and 5) completion of all programming and marketing packages for the exhibits.

In October 2007, the entire TEAMS group (three to four representatives from each of the seven museums) met for a full day of planning and coordination for the final project activities. The work groups on exhibits, programs, and marketing were facilitated by TEAMS directors Trautmann and Bennett. Inverness Research Associates (IRA) helped facilitate and inform the discussions.

Inverness Research participated in the meeting and led discussions with TEAMS staff to further consider the generalizable learning created by the TEAMS process, and how it may support description of new ”tools” to aid exhibition design. The information from this forum informed the “Lessons Learned” report enclosed as part of this final report.

The advanced prototyping period tested near-final elements of the exhibitions at the home museums with museum visitors, a process supported by visits to each museum by associates from Inverness Research. This process supported final decisions about

exhibit design and label content. The four exhibitions were then fabricated and installed at the home museums.

The four exhibitions completed by TEAMS were:

1) *Science at Play: How Toys Work*, by Montshire Museum of Science (Norwich, VT) explores the physical principles and mechanical mechanisms that make toys work.

2) *Tell Me About It*!, developed by the Discovery Center Museum (Rockford, IL) and Family Museum of Arts & Science (Bettendorf, IA) is a playful exhibition that lets visitors experience many different forms of communication while highlighting the central role that science has played in their evolution and development.

3) *Spin* – developed by the Catawba Science Center (Hickory, NC) and The Health Adventure (Asheville, NC) uses the intrinsic fascination with things that roll, spin, or rotate to explore the science of spinning motion.

4) *From Here to There* – developed by the Sciencenter (Ithaca, NY) and Rochester Museum & Science Center (Rochester, NY) is a playful interactive exhibition illustrating that while many types of transportation may seem complex, they use simple principles of science to move people and things.

The eight completed TEAMS exhibitions (two copies of four titles) circulated among the seven TEAMS museums from late 2007 through 2008. During that time a request for proposals was distributed to organizations interested in contracting with the TEAMS museums for national circulation of the exhibitions. TEAMS directors, excepting Dr. Trautmann who had a conflict of interest and was isolated from the process, reviewed the two proposals received and selected Sciencenter's Traveling Exhibition Service as offering the better terms. Current contracts with Sciencenter provide for a two year travel schedule for three of the four TEAMS exhibitions. If the exhibits are successful, as previous TEAMS exhibits have been, it is anticipated that the tour contracts will be extended for additional years.

Once the exhibitions were open to the public, Inverness researchers visited each site for several days of remedial evaluation. This provided rich opportunity for the design staff to work with Inverness to observe whether the exhibits were working as intended and to make changes where appropriate and feasible. Inverness researchers met with host museum staff to report their findings at the conclusion of each visit and followed-up with edited copies of their field notes to guide remedial modifications. They also gathered data for use in the final summative report.

One of the lessons learned from previous TEAMS exhibit development cycles relates to labels. In the previous TEAMS exhibits, labels and exhibits underwent final prototyping together and were fabricated together for final display. The high level of label modification indicated by the remedial evaluation demonstrated that labels that worked well in the late-stage prototype environment are often inadequate when applied to the final product. To address this problem, TEAMS modified its protocol. Attractive but temporary labels of inexpensive materials were created for use during the first several months of public exhibition. Once the label text received additional testing in the final exhibit environment, the durable final labels were installed. Although most visitors did not notice that the initial labels were temporary, they were informed of the process and seemed to appreciate the diligence and care that the process indicated and welcomed the opportunity to provide comments on the label content.

During the initial exhibition period of approximately six months at the home museums, exhibit staff closely monitored the exhibits for any components that required excessive maintenance. The goal was to re-design and eliminate any such problem areas before the exhibit is shipped to other venues. TEAMS experience is that no matter the level of design diligence to create a low maintenance exhibit, some unexpected failures nearly always occur and the TEAMS process is intended to resolve these before the exhibit leaves the home museum.

Education and PR/marketing teams coordinated final production of their support materials for the exhibitions during 2007. Initial programming ideas were prototyped the previous year and this process informed final materials development. The TEAMS

website was expanded to focus specifically on the four new TEAMS exhibits and to provided access to the support materials for programs and marketing. It offered color exhibit logos, marketing photographs, and sample press releases and media public service announcements for use by future venues to market the exhibit. For program staff at future venues, the site also contained, in downloadable PDF format, activities relating to the science content of the exhibits, along with cross-references to national educational standards, and other materials to support supplementary educational use of the exhibit by museum visitors and school classes.

The two-year research component supporting Dr. Atkins post-doctoral work for TEAMS had ended by 2007 and Dr. Atkins took a position at the University of California, Chico. She remained available to TEAMS for information and support and participated with Goudy in two conferences reporting on the TEAMS research.

During this past four years, the TEAMS website has also been maintained with both a public section and an internal working section. The internal section provided a workspace for TEAMS staff to share ideas, to comment on the work of their colleagues, to share design drafts, and in other ways to facilitate communication among the participants. The public site provided general information about TEAMS of interest to others in the field as well as posting the educational and marketing materials for TEAMS exhibits. As of the close of the project at the end of 2008, the site was reduced in form to function primarily as a public site for general information on TEAMS. In early 2009, the exhibit support materials will be removed from the TEAMS site and supported on the Sciencenter exhibition rental site.

TEAMS: Reflections on twelve years: 1996 - 2008

This final report for the funding cycle ending in 2008 is an appropriate moment for reflection over the longer project period. TEAMS created significant benefits in four major areas:

1) production of exhibits for national distribution.
2) exploring the nature of a successful collaboration and sharing the results with the field.
3) building capacity among member museums.
4) research in conversations as indicators of learning at exhibits.

If measured only by its exhibition agenda, TEAMS results would be impressive.

- A total of 21 exhibitions (13 unique titles) featuring interactive science explorations, with companion marketing and educational materials were produced for small, generally under-served venues.
- Over 12 million visitors (including projections for the remainder of the TEAMS 3 tour) benefitted from these exhibitions.
- TEAMS exhibits have proven to be robust and popular: two of the exhibitions completed in 1998 are still circulating and most others are exceeding their projected tour lives.
- Over one third of the national inventory of interactive science exhibitions available for rental to small science center venues are TEAMS projects.

TEAMS has however accomplished much more than production of exhibits. It has carefully documented, analyzed and shared its own process of collaboration. Publication of *TEAMing Up*, a monograph (available for download at www.informalscience.org) examining the nature of TEAMS' collaboration provides a detailed written report on the inner workings of the collaborative, analyzing its successes as well as difficult challenges. Interest in the subject of collaboration, particularly among small science centers, led to numerous conference presentations and articles by TEAMS directors. These included:

- 1999 ASTC annual conference. “TEAMS – An Experiment in Small Museum Collaboration”, David Goudy.
- 2003, "Collaborating for Leveraged Success in Exhibitions", ASTC Dimensions - May/June, Kate Bennett and Debra Jacobson.
- 2004 New England Museum Association annual conference. “TEAMS, a model for small exhibit collaboration”, David Goudy.
- 2006 Illinois Conference for Parks and Recreation. “Dimensions of Successful Collaborations”, Sarah Wolf.
- 2007 annual conference of the Association of Children’s Museums. Panel discussion on collaboration, Sarah Wolf.
- 2008 Midwest Museums/Mountain Plains Museums annual conference. “Collaborative Approaches to Family Learning in Museums”, Tracey Keuhl.

In addition, TEAMS has responded to requests from numerous informal science education organizations to advise them in creation of their own collaborative partnerships. A few examples include the New England based “Environmental Exhibit Collaborative”, the STEPS project of Space Science Institute, Twin Cities Public Television Dragonfly TV science museum series, and “Outreach to Space”, a ten museum collaborative.

TEAMS was also designed to increase the science exhibition capacity of the member museums. Comments from several participating directors illustrate the significant impact this project had on their museums. Additional examples and analysis are found in the “Lessons Learned” document.

> When we joined the collaborative, even though we were larger than the other TEAMS members my staff had little experience in creating hands-on exhibits and was even more limited in creating science oriented experiences. We had big plans for recreating our institution and focusing on science and technology. We needed to train staff and develop processes to be able to create the exhibit and program experiences our community needed. We needed to become proficient at prototyping and designing interactive science

exhibits.

Learning came in small but important doses. With the help of clear communication within the collaborative about the importance and level of work that was expected, we learned much from our successes and our failures. By the end of the first year, we could see our capacity improving. Later on, I observed changes in the way we approached problems at several levels of the institution. Our visitors became more involved in helping us create our exhibits and we noticed that our internal conversations became more robust. We often used our newly gained knowledge of prototyping and observation of experiences to better complete other projects on our work plan. Staff created relations with professionals at other organizations, in a way that helped them realize their growing contributions to the community and the field. We learned to listen for differing ways to accomplish work.

In the six years of the project, we have created more than 45 interactive exhibits in addition to those we created with the collaborative, vastly improving the visitor experience. We have been honored to participate in this collaborative, for the community we serve is the beneficiary of the partnership.

Kate Bennett, Director
Rochester Museum

Beginning with the proposal development phase, the TEAMS Collaborative spanned 13 years. Watching the growth of capacity among the participating museums during that period has been astounding. The Sciencenter had never participated in a major collaborative, had never had NSF funding, and had never developed a traveling exhibition. We had barely heard of “formative evaluation” and had no experience with it.

The TEAMS Collaborative opened the door to many exhibit development opportunities and provided opportunities for us to learn about evaluation, universal design, and designing exhibits for maximum educational impact. We learned about marketing and touring exhibitions, the opportunities, advantages, and caveats of collaborative work, and the

strength of educational programming when it is designed early on to couple with exhibitions. The professional capacity of our staff grew dramatically through the interactions with other museum staff, the training workshops that TEAMS organized, and the conferences we attended.

Charles Trautmann, Director
Sciencenter

For the Family Museum and its staff members, TEAMS did several things in helping to build institutional capacity. It enabled us to be involved in an NSF project ... our first ever. That alone offered opportunities for learning about what it takes to develop a competitive program for this type of funding. Second, the project linked us intimately with six other great museums from which we learned about different approaches to the same problem, similarities in operational and philosophical approaches to exhibit and program design, and I truly believe established a set of professional relationships that will last for years among the seven museums. TEAMS enabled us to delve deeper and enhance our staff understanding in several areas critical to successful exhibits that fully serve our community – topics including universal design, family learning, and encouraging conversation among museum visitors. We took away valuable lessons on how to create new programs and exhibits that incorporate these elements. We also learned how to use these approaches to retool existing programs and services.

As the result of TEAMS, I ask more critical questions now of not only our own in-house creations, but of those we might rent, questions that probe more deeply into a potential exhibit and what type of conversation starter or family learning opportunities it might bring to our audience.

Tracey Kuehl, Director
Family Museum of Art & Science

Our staff has benefited greatly from the TEAMS project.

Learning the techniques of prototyping and evaluating come to mind immediately. Learning to work with partners and the value of visiting other museums behind the scenes has allowed us to grow as an institution. The finished exhibits that we created as well as the exhibits from our partners have added to the visitor experience at our museum.

The special emphasis and training that we gained in designing exhibits with universal access, and stimulating conversation among families are lessons that we use everyday. Our staff continue to communicate with their partners and we use our TEAMS colleagues as our benchmarks for many subjects, not just exhibits and programs, but personnel issues, fundraising ideas, etc.

I was able to use lessons learned from TEAMS in many ways. I have become a better grant writer, I have helped establish another collaboration, and I have gained professional training as has my staff.

Sarah Wolf, Director
Discovery Center Museum

Although research was a small component in the overall twelve year TEAMS effort, the TEAMS approach to closely link the research process to the practice of exhibit design gained substantial interest in the field. The number of requests for conference presentations on this subject are indicative of this interest. The collective impact of published papers, conference presentations and informal discussions and interactions among the TEAMS research team and the research advisors represents an important contribution by TEAMS to the field, furthering our understanding of how visitors learn in museum settings.

The significant funding provided by NSF reflected a faith and confidence in the ability of our group of small museums to make important contributions to the field. Reflecting on the four primary TEAMS goals set out in the proposals to NSF and summarized at the beginning of this section, TEAMS is proud of the success achieved. We are deeply appreciative of the partnership with NSF that has made this possible.