Universally Designed Museum Programming
White Paper

Written by
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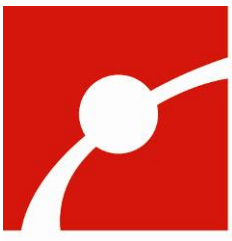
August, 2012
Report # 2012-7
Funded by Institute for Museum and Library Services
Project # *LG-45-11-0049-11*



Museum of Science ®

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Acknowledgements

This project is made possible by a grant from the U.S. Institute of Museum and Library Services *LG-45-11-0049-11.*

Special thanks to:

- Our team of professionals including advisors and Museum of Science educators. Without your efforts and participation, this process would not have been possible.
- Our Museum of Science visitors for providing your feedback about programs in their ever-evolving state. Thank you for continuing to participate in our evaluations.
- Maria Cabrera and Nora Nagle for helping recruit visitors with and without disabilities for our focus groups.
- Joe Rivers and Matt Griffin for finding the assistive technologies necessary to make our project inclusive.
- Sunewan Chunhasuwan for assisting with focus group data collection.

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EXECUTIVE SUMMARY

The *Universally Designed Museum Programming* project was envisioned as a way to create public programs that are more inclusive of people with disabilities. We used the concepts of universal design and Universal Design for Learning as well as our prior experiences with these topics in exhibition design and nanotechnology programming as a foundation for our work. Through this process we have learned not only the possibilities for developing public programs, but also methods for facilitating inclusive professional projects.

Through this paper, we describe our process of developing universally designed museum programming by building a community of interest and conducting a design charrette. Because we collected evaluation data from both the professionals involved in the project as well as museum visitors with and without disabilities, we can offer the story of our project from our perspective as well as the perspectives of others. It is our hope that this information will allow others to implement their own design charrettes and further develop inclusive programming in other settings.

Through this project, we gained insight into the following areas:

- Building a community of interest
    - When bringing together individuals with a range of backgrounds, we learned the importance of providing opportunities for mutual learning.
- Facilitating a charrette in an inclusive way
    - When facilitating a multi-faceted project, we learned that it was possible to allow everyone with and without disabilities to participate together by using available assistive technologies.
- Using universal design guidelines to develop programs
    - When developing inclusive programs, we learned the value in utilizing universal design guidelines in conjunction with gathering perspectives from people with disabilities.
- Measuring the effectiveness of our process
    - When modifying programs to become more inclusive, we learned that it was possible to make quick, rapid changes that not only impact people with disabilities, but also improve the programs for people without disabilities.

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INTRODUCTION

This project began with the desire to make museum programming more inclusive of all visitors, including those with a wide range of abilities and disabilities. While there are many avenues for approaching access and inclusion, we decided to embrace the concepts of universal design (UD) and Universal Design for Learning (UDL). This framework was not new to the Museum of Science in that it has been used in exhibition design for many years. In addition, a small group of Museum of Science staff members were part of a project which incorporated UD and UDL into the design of museum programming on the topic of nanotechnology. However, this project emerged as a method through which to expand the integration of UD into multiple museum programs across multiple program topics. Would it be possible to expand upon universal design guidelines developed for museum programs on nanotechnology so that they could be used for other content topics? Could programs be made more inclusive if a team drew on the perspectives of multiple professionals with a wide range of professional and personal experience in science education, disability rights, inclusion, and access? It was these questions, and others, that interested us.

We set out to develop more universally designed programming and test our assumption that developing a community of interest and conducting a design charrette[1] was a useful avenue for doing so. In this paper, we will describe the process undertaken by the *Universally Designed Museum Programming* team and some of the lessons learned. It is our hope that this information will allow others to develop more inclusive programming.

Specifically, we will address the following:

- This project intended to bring together multiple individuals with diverse perspectives in order to form a community of interest. How can a diverse team be led to develop a shared understanding of a topic? We will share our process of creating a common understanding in a group with varying knowledge bases.
- This project is based on building a team of reflective practitioners and advisors with a range of abilities and disabilities. How can this be done in a way that allows all individuals to participate together? We will share our process of facilitating an accessible design charrette.
- This project used existing universal design guidelines that were developed for a project on nanotechnology. How useful were these guidelines for educators engaging the public in a wide range of topics? We will share our process of using these guidelines and our attempts to expand upon them.
- This project sought to create inclusive museum programming through the process of building a community of interest and conducting a design charrette. How did this process impact the programs being developed? We will share our findings from evaluation conducted with visitors with and without disabilities which highlights the impact of our modifications.

[1] A design charrette is an intensive effort to develop a new or innovative design that takes place over a short period of time and involves people of diverse backgrounds and areas of expertise (Design Charrettes).

OUR FRAMEWORK

The *Universally Designed Museum Programming* project was envisioned as a way to create public programs that are more inclusive of people with disabilities. Universal Design (UD), which is focused on creating environments that are inclusive of all people, including those with disabilities, has been used to create a large number of science museum exhibitions (Bell, 2000; Department of Evaluation and Research in Learning, 2007; Reich, 2000). This design philosophy, however, has not been applied frequently to the design and development of museum programs. More often, museum programming targets specific groups of people with disabilities and less frequently incorporates universal design elements into programs that are designed to engage all visitors, including those with disabilities (Reich, Price, Rubin, & Steiner, 2010). This method of programming excludes visitors with disabilities from fully participating in the range of programs a museum offers. This also prevents people with disabilities and their families and friends from sharing the full range of social learning that museum programming allows.

But what is universal design and what makes it a useful construct for developing museum programming? We will provide a brief background on the concept of universal design and how we leveraged our previous UD experience for exhibition design to develop a process specifically for programs.

Universal Design defined:

"the design of products and environments to be usable by all people,
to the greatest extent possible,
without the need for adaptation or specialized design"
Center for Universal Design, 2002

WHAT IS UNIVERSAL DESIGN?

Universal design is not just a theoretical framework. Rather, it is an approach that has been applied and demonstrated to be successful in a variety of contexts, including media, public transportation, public spaces, workplaces, cars, homes, and classrooms, among others (Preiser & Ostroff, 2001).

Universal design is commonly defined as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design, 2002). Universal design is not about creating a "one-size-fits-all" solution. Rather, it is about acknowledging and designing for human variation in a way that does not stigmatize based on physical, cognitive, and sensory characteristics (Story, Mueller, & Mace, 1998). The variation considered in the design may include considerations related to the use of assistive devices. For example, universal design does not mean the elimination of the need for wheelchairs. Rather, it means that the design needs to reflect the fact that some people navigate environments with wheeled devices (which would include wheelchairs as well as strollers).

At its core, universal design is about embracing flexibility and providing users with options. Through the years, a number of principles of universal design have been created, including those used for architecture and product development (Story et al., 1998) and learning (Rose & Meyer, 2002). In a museum environment where individuals learn through their interactions with a designed environment, both sets of principles apply. The universal design principles for architecture and products include the following: equitable use, flexibility in use, perceptible information, simple and intuitive operation, size and shape for approach and use, tolerance for error, and low physical effort (Connell et al., 1997). Similarly, the concept of Universal Design for Learning (UDL) does not imply one optimal solution that serves all learners but instead encourages the development of flexible, customizable designs that allow for multiple representations of information, multiple methods of action and expression, and multiple means of engagement (Rose & Meyer, 2002).

WHY DID WE USE UNIVERSAL DESIGN?

Our *Universally Designed Museum Programming* team decided to use universal design as a foundation of our project in order to build upon our prior work in exhibition design. In addition, we wanted to expand upon an earlier program development process conducted on behalf of the Nanoscale Informal Science Education Network (NISE Net). We felt that through this project we could capitalize on our expertise in UD for exhibitions and our experience developing universal design guidelines for programs with the NISE Net to be able to examine and improve upon the ideas of this framework and process.

For the past 25 years, the Museum of Science, Boston has been integrating universal design principles into exhibition design (Davidson, Heald, & Hein, 1991; Lindgren-Streicher & Goss, 2011; Reich, 2000). This exhibit development process relies on both universal design and Universal Design for Learning approaches as well as using the Smithsonian Guidelines for Accessible Exhibition Design (Smithsonian Institution, 2000). Our work over the years has led to our understanding that more inclusive exhibitions are developed not only by adhering to these guidelines, but also by including people with disabilities in the development process. With that in mind, all Museum of Science exhibit evaluations are conducted with visitors with disabilities.

In 2007, embracing the two-pronged approach of universal design guidelines and including people with disabilities in exhibit design, we embarked on a project which would apply our exhibition experience to museum programming. On behalf of the NISE Net, museum professionals representing six science museums across the nation and four experts from the field of universal design, who have disabilities, participated in a design charrette which culminated in the development of the *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008).

The *Universal Design Guidelines for Public Programs in Science Museums* are intended to be a work in progress and change over time as more programs are developed and tested. Our goal in implementing the *Universally Designed Museum Programming* project was to expand upon these existing guidelines and see if they could apply to topics beyond nanotechnology.

OUR STORY

The *Universally Designed Museum Programming* (UDMP) project team sought to form a community of interest centered on the framework of universal design and conduct a design charrette in order to create public programs that are inclusive of people with disabilities. In describing the story of our project, we hope to offer details that would assist others in replicating this process. Therefore we will not only provide our methods, we will also reflect upon our methods and share what we have learned. Because we collected evaluation data from both the professionals involved as well as museum visitors with and without disabilities, we can offer the story of our project from our perspective as well as from the perspectives of others.

It is our hope that this information will allow others to implement their own design charrettes and further develop inclusive programming in other settings. Specifically, we hope to provide our lessons learned about the following areas:

- Building a community of interest
- Facilitating a charrette in an inclusive way
- Using universal design guidelines to develop programs
- Measuring the effectiveness of our process

BUILDING A COMMUNITY OF INTEREST

We formed a team of professionals with a wide range of experiences and expertise hoping to develop a common, shared understanding of effective methods for creating more inclusive programs. In bringing together diverse perspectives, we learned the importance of providing multiple avenues for engagement in order to allow opportunities for mutual learning.

Our project team consisted of fourteen members who were selected in an effort to form a community of interest. As outlined by Fischer (2001), a community of interest brings together different communities of practice who share an interest in a common problem. In this case, we brought together Museum of Science educators who work to present content about the fields of science, technology, engineering, and math (STEM) and advisors from the fields of disability access, universal design, and Universal Design for Learning (UD/UDL). The "common problem" we were interested in investigating was how to create museum programming inclusive of people with disabilities.

In an effort to foster this community, we engaged in collaborative journal writing and discussed articles and research papers relevant to the field of universal design. Museum educators kept a journal about their experiences implementing programs on the floor and the full team (educators and advisors) met periodically to discuss these journal entries and the other shared reading materials.[2] This reading and journaling occurred over a four month period preceding the design charrette. Communication relied on e-mail, face-to-face meetings, conference calls, and postal mail. This segment of the project concluded when we convened in-person for a four-day design

[2] See Appendix A for more information and examples of the journal entries. See Appendix B for a list of the articles read by our group.

charrette to rapidly assess and modify selected presentations to reflect principles of universal design[3]. To gain a feel for how this process worked for the educators and advisors, the evaluation team members, which include three of the four authors of this paper, surveyed the educators and advisors about the process when it was over, and asked the entire group to reflect on the process during a large group discussion.

The key lesson we learned about our process for building a reflective team is that individuals valued different aspects of the project. For example, the journaling process seems to have been more helpful for our advisors in that it increased their understanding of what happens in a real-world museum context. Conversely, the initial background reading was more frequently mentioned by educators as something they found particularly useful because the reading provided new theories, methods, and practices to use.

During the group discussion about the process of journaling at the end of the charrette, educators and advisors both appeared appreciative of the journal process. For example, one educator said, "I hadn't taken the time to reflect on programming in a while. This [journal writing] gave me the opportunity to think about what I was doing and why." Another educator added, "[I] found it was a great excuse to start thinking about that stuff. It's really easy to get stuck in the rut of doing your show the same way." An advisor said, "It's a wonderful example of how people learn from one another."

However, advisors seemed to benefit more from reading the journal entries than did educators from writing a journal. In a follow-up email survey, one educator commented that the journaling,

> *"was a more verbose and less efficient approach to do what I believe presenters naturally do – continually monitor and integrate feedback … Exchanging journal entries with a colleague did expose some commonality of challenges and offered opportunity for exchange of solutions/suggestions, but I believe group meetings in person periodically would be both more efficient and expand the exchange."*

This was juxtaposed by the viewpoint of an advisor who stated,

> *"I truly enjoyed reading the staff journal entries. Not only the parts pertaining to education, but controlling the crowd on busy days and altering the program depending on the audience. I also liked reading about the various presenters' growing awareness of integrating UD concepts into their presentations."*

A similar situation occurred when advisors and educators discussed the impact of the background reading. While two educators mentioned the reading as one aspect that positively impacted their project experience, two advisors disagreed. In the follow-up email survey, two educators mentioned reading the *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008) saying, "the NISE Net reading for UD in presentations articulating a multiplicity of sensory approaches, opportunities for engagement, and physical and social accessibility is a helpful framework for identifying specific ways to make presentations

[3] See Appendix C for an overview of the charrette agenda.

more accessible/inclusive." Another educator found that this reading provided context for our project saying,

> *"I remember hearing about this back in 2007, but hadn't seen any of the results. It was good to see the paper that was published on what happened then… It was helpful to think about the needs of museum audiences as being physical, cognitive, and social."*

However, a project advisor commented in the follow-up email survey that "the preliminary readings and conference call discussions were too much." Another advisor stated, "Personally, I found the readings fairly redundant. For people who might be less familiar with UD concepts there were good examples to illustrate their usefulness in education."

These project aspects were intended to provide educators and advisors with a shared understanding of programming in a museum context (through journaling) and a shared understanding of the principles of universal design (through the background reading). However, as educators came into the project with a greater understanding of the concerns for programming in a museum context and advisors had more professional expertise with the principles of universal design, these aspects also came to represent areas in which information that was intended to provide mutual learning actually ended up being communicated in a somewhat unidirectional manner. Although there is evidence that both educators and advisors benefitted from journaling and background reading, there are also educators and advisors who identified these benefits as intended for someone else.

Lessons learned about building a community of interest

Efforts to develop a shared understanding can be difficult as individuals with varying expertise will find value in varying content. When trying to get everyone on the same page, consider highlighting the importance of developing a shared understanding. The fact that individuals in our team found value in contrasting elements suggests that incorporating content on a wide range of issues is important to keep the full team interested and engaged.

FACILITATING A CHARRETTE IN AN INCLUSIVE WAY

Our project was designed to create more inclusive experiences for museum visitors. However, the process of building our reflective team over a four month period and hosting our four-day design charrette also allowed us to learn how we could make more inclusive experiences for professionals.

Our pre-charrette discussions about the background of universal design, communities of interest, and museum programming took place through teleconferences, and the majority of communication between group members over this four month period occurred over email or phone. However, our initial plans were to use Facebook to communicate in the weeks leading up to the charrette. Everyone, including educators and advisors, were eager and interested in this opportunity to hone their social networking skills. However, Facebook proved to be inaccessible for some members. Specifically, one advisor was unable to successfully interface her screen reader with the site, which would have limited her ability to work with the group. Therefore, our team made the decision to forego Facebook in lieu of more inclusive methods. We decided to communicate over the phone so that everyone, including advisors who were unable to travel, could contribute to discussions. We had four calls leading up to the charrette and used Communication Access Realtime Translation (CART) interpretation to communicate with one advisor who is Deaf.

Another opportunity to learn how to facilitate more inclusively arose as we sought to provide a way for an offsite advisor to participate in the design charrette. Due to health reasons, one advisor who is Deaf was unable to contribute to the charrette in person. However, by working with the Museum of Science Audio Visual Department, we were able to establish a system allowing for those onsite and offsite to participate together. During the large and small group discussions, the offsite advisor used a combination of iChat and American Sign Language (ASL) interpretation to participate. A large TV monitor and camera was placed in the meeting room so the advisor could see the room and be seen by people participating on-site. ASL interpretation was provided through another camera and appeared as a picture-in-picture format. When it came time to watch the presentations in the exhibit halls, videos were taken of the programs and uploaded to a private YouTube link directly after the presentation so that the off-site advisor could participate. ASL interpretation was recorded during each program and combined with the program video so that the final videos also included picture-in-picture viewing capabilities. At first, we were uncertain how well the picture-in-picture video would work because ASL is a visual language and therefore any video freezing would lead to inaccessible content for the offsite advisor. After testing the video quality prior to the charrette, this process was successful and we would encourage others to engage offsite advisors who are Deaf in a similar manner.

Another onsite advisor who is hard of hearing used an assistive listening device throughout the design charrette. In multiple scenarios, including large group discussions, small group discussions, and presentations in the exhibit halls, sound was amplified from a microphone directly to a headset worn by the advisor. We passed around a microphone in the large group discussions and used a tabletop microphone for smaller groups. During the presentations within the exhibit halls, the presenter wore a wireless microphone. This process proved to be beneficial for the advisor.

When choosing the types of technology to use in order for all of us to access the program presentations and discussions, decisions were often made based on compatibility with the Museum's in-house technology. For example, we did not use one piece of technology rented for the charrette due to its incompatibility with the conference room's audio visual ports. Also, some types of technology required more audio visual staff members for longer of periods of time than other options. After considering the amount of staff time required for some of the technology

along with the compatibility of newer technologies with the Museum's infrastructure, we decided to use the assistive technologies mentioned.

As described above, we sought to increase the accessibility of this project for all participants during the pre-charrette discussions and during the charrette. We intentionally chose to conduct pre-charrette discussions over the phone and email instead of through inaccessible social networking sites. During the charrette, onsite assistive technology included assistive listening devices. Additionally, we were able to communicate to an offsite advisor using ASL interpretation, picture-in-picture videos, and online video chat. We learned that these inclusive measures were vital in facilitating full participation for all project members. One advisor commented on this aspect in her follow-up email response saying, "It was very impressive that I could participate 'virtually' with the benefit of technology. It goes to show how much the MOS values its advisors!"

Lessons learned about facilitating a charrette in an inclusive way

Including people with a wide range of abilities and disabilities in a multi-faceted project is possible and efforts taken to include all participants can be particularly valued. We learned that changing our initial plans made everyone feel included and allowed all participants to learn from one another together. Even if some of the technologies mentioned are beyond your current capabilities, there is a wide range of assistive technologies available today that you can consider. Being flexible and thinking through multiple options allowed us to model our inclusive process at the professional level.

USING UNIVERSAL DESIGN GUIDELINES TO DEVELOP PROGRAMS

Our project used existing universal design guidelines developed on behalf of the Nanoscale Informal Science Education Network (NISE Net) to guide changes to our programs. It was our goal to see if these guidelines could be used with programs on topics other than nanotechnology and, if not, to determine how to expand the guidelines to make them more comprehensive. Through this process, we learned that these guidelines are useful for programs on various topics and the concepts included are extensive and well-stated.

The *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008) identifies three core concepts of universal design important to the development and implementation of inclusive programs including:

- Repeat and reinforce the main ideas and concepts;
- Make sure that multiple entry points and multiple ways of engagement are available; and
- Provide physical and sensory access to all aspects of the program.

At the beginning of our project, we chose four programs as the focus of the charrette including:

- The **"Porcupine Live Animal Presentation"** which is a stage presentation that explores the adaptation, behaviors, and ecology of the porcupine, as well as their living environments.
- The **"Charles River Water Interpretation Cart"** which is a drop-in activity that explores the water of the Charles River using microscopes and large-scale images.
- The **"Theater of Electricity Lightning! Show"** which features indoor bolts produced by the world's largest air-insulated Van de Graaff generator and shares explorations of lightning, electric charge, and storm safety.
- **"Mind Games"** which is a stage presentation that invites volunteers from the audience to participate in demonstrations that reveal how the brain can misinterpret visual and other sensory experiences.

These programs were the ones that we attempted to make more inclusive. During the pre-charrette teleconferences and journaling, educators were exposed to principles within the NISE Net UD Guidelines, and group discussions often led to brainstorming potential aspects of the programs that could be improved. Later, on the first day of the charrette after watching the unaltered programs, we offered additional comments about ways the program was or was not inclusive and suggestions about ways to improve the inclusiveness of the program. For example, while one advisor might praise a program presenter for a slow and understandable pace of speech, another might comment that the presenter could improve their verbal description and provide suggestions.

Across the four programs, our group generated a list of 85 strengths and weaknesses of the programs. We collected all of these comments and suggestions and coded them into the three universal design concepts. Table 1 provides several examples of comments made about the four programs and how these comments were categorized into the three universal design concepts.

TABLE 1. Examples of Program Comment Categorizations.

Universal Design Concept	Strength	Weakness
Repeat and reinforce the main ideas and concepts	"I liked the fact that you described what was going to happen, did it, and then brought them back to what they should be looking for."	"There were so many words that were new or that I might not have been familiar with, wish there was a word cloud somewhere."
Make multiple entry points and multiple ways of engagement available.	"Appreciated the multiple layers - actual water; monitor; microscope; tactile models - all different ways to interact."	"Kids with processing disorders need information more slowly or repeated. Repeat in different words so that other kids will get it too."
Provide physical and sensory access to all aspects of the program	"I like how you involved the volunteer in the audio description."	"Position made it hard to get an overview of everything that is happening. Couldn't see what was happening on monitor and the shapes."

It was our goal to see if new categories emerged. If we were able to identify ways the programs could be more inclusive that were different than the three concepts of universal design presented in the NISE Net guidelines, we would be able to augment the original guidelines. However, all comments, both positive and negative, could be categorized as aligning with the three concepts of universal design for programs. This illustrates the strength of the existing framework set forth in the *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008). Because we uncovered no new areas of inclusion, we think any future program development which seeks to be more inclusive could benefit from applying these guidelines.

Our team of educators had read the UD guidelines, discussed them as a group, and made some changes to their programs. Even with these changes, there was still room for further improvement on the programs, which could be addressed during the charrette. It is our general conclusion that this will always happen. Although guidelines are an important step and our team found them useful in modifying programs, guidelines alone will never be comprehensive enough to be used in isolation. The process we used which included using the guidelines and seeking the advice of people with disabilities allowed us to incorporate multiple perspectives and make our programs more inclusive than we would be able to do with the guidelines alone.

Lessons learned about using universal design guidelines to develop programs

The *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008) is a useful and effective tool for creating programs that are more inclusive. We learned that the three concepts of UD offered in this document are broad and encompass multiple aspects of inclusive program design. We would encourage others to use these existing guidelines in conjunction with a process of gathering the perspectives of people with disabilities. Because our process allowed us to incorporate feedback from visitors and advisors with personal and professional expertise in the fields of disability and access, we were able to make more inclusive programs than if we had solely relied on the guidelines.

MEASURING THE EFFECTIVENESS OF OUR PROCESS

Our project sought to create inclusive museum programming by building a community of interest and applying universal design guidelines. Through the design charrette, we identified potential ways in which four programs could be changed to make them more inclusive. Each program was changed and evaluated at the end of the week with people with and without disabilities. Through this process, we learned not only that changes could be made quickly, but that those changes can positively impact people with and without disabilities.

On days two and three of the charrette, we brainstormed ways to change the programs and made those program modifications. During the brainstorming, a total of 120 changes were suggested

across the four programs, and each educator selected between three and five modifications to include in their program. A list of the final changes made to the four programs is in Table 2. Of these final sixteen changes, nine were modifications of an existing programmatic element (such as adjusting the lighting around a camera), while the other seven changes required the development of a new element (such as developing a new tactile model of a porcupine quill).

TABLE 2. Modifications to Programs.

Program Name	Changes Made to Programs During the Charrette	Modification to Existing Element	Development of New Element
Porcupine Live Animal Presentation	1. Construct a 3D quill model with pinecone overlap pattern		X
	2. Increase lighting around the projection camera to improve brightness and/ or contrast	X	
	3. Add an audio example of Porcupine sounds		X
Charles River Water Interpretation	1. Create flash cards with new or difficult terms		X
	2. Position the cart differently to allow easier visual and physical access to all of the elements	X	
	3. Develop instructions or visuals to make the microscopes more user friendly		X
	4. Create a way to show the movement of organisms		X
	5. Re-emboss the braille on cards as the current version is too large	X	
Theater of Electricity Lightning! Show	1. Focus the presentation by thinking about essential content – 2-3 main messages	X	
	2. Add audio descriptions of the theater at the start of the presentation – birdcage size, composition, weight, etc.	X	
	3. Display difficult vocabulary visually on screen		X
	4. Involve those with disabilities as volunteers	X	
Mind Games	1. Supplement the auditory illusion with a physical representation of the tone – up and down	X	
	2. Provide audio description of the stage and props	X	
	3. Develop an additional illusion that is not visual to engage other senses – auditory, tactile, taste, etc.		X
	4. Include audio description of the results of audience voting	X	
Total		**9**	**7**

The newly modified programs were presented to the public and our team on the fourth and final day of the charrette. We conducted focus groups with visitors with and without disabilities in order to gather visitor feedback on the programs.[4] After watching the programs, visitors were asked to identify aspects of the programs that led to or detracted from greater inclusion. Focus group participants mentioned how several of the changes made during the charrette led to a more inclusive program. These comments highlight the impact of small, rapid changes made in collaboration with people with disabilities. Visitors' feedback also shows how changes made to assist one type of learner can likewise benefit other learners. For example, a change made to assist a person who is blind also helped a person with a cognitive disability. In addition, some changes made to assist people with disabilities benefitted people without disabilities.

Some changes made to programs specifically addressed visitors with a particular disability. For example, due to the great number of visual illusions included in the original "Mind Games" presentation, one change made to the presentation was to add a new, nonvisual illusion. Therefore, on day four of the charrette, "Mind Games" included a new illusion based on physically sensing heat and cold. During the focus groups which followed this presentation, two participants who are blind commented specifically on this show saying the following:

> *"I appreciated that it was a hodgepodge of stuff. The visual stuff was lost on me. I liked that there was different kinds so everybody got something." (FG4, Blind)*

> *"I thought it was well done and I don't see any way it could be more inclusive from my perspective, really, that particular demonstration." (FG3, Blind)*

In addition, the added audio description of the "Theater of Electricity Lightning! Show" was acknowledged and appreciated by a focus group participant who is blind.

> *"I thought he did a good job in general explaining the room and explaining the Van de Graaff generators… That was helpful for me." (FG3, Blind)*

Moving the "Charles River Water Interpretation Cart" to a new area in the exhibit gallery could benefit a variety of disabilities. One focus group participant commented on how he appreciated the atmosphere, suggesting that the cart was in a more comfortable setting.

> *"I like the atmosphere, there's no rush for you to go through it quick. It pace[s] yourself to your way of learning. You can ask her a question, look at something real and then also walk around and think about it." (FG2, Cognitive)*

While some changes were made to programs to specifically address visitors with a particular disability, focus group data also describe instances in which changes made to programs positively impacted an even broader audience including those with and without disabilities. For example, one change made to the "Porcupine Live Animal Presentation" was to increase the lighting around the projection camera to improve brightness. During this show, a camera is positioned at the dark-colored porcupine and projected to a projection screen above the presenter. It was thought that this projection would be difficult for various visitors to see, especially those

[4] See Appendix D for further information on our method for conducting focus groups.

with low vision. Focus group participants with and without disabilities mentioned how changes to the screen and brighter lighting contributed to the inclusiveness of the program.

> *"The whole zooming camera thing was pretty helpful." (FG2, No disability)*

> *"It was that dark at first and I couldn't see anything either and then she changed the lighting." (FG2, Cognitive)*

> *"I found the screen useful because it was hard to see from the back." (FG1, No Disability)*

Another change made that had a broader impact took place in the "Theater of Electricity Lightning! Show." When the educator focused the content to two or three main messages, visitors commented on the accessibility of the language used and that it was helpful to have the content explained and demonstrated simultaneously.

> *"He got the science without being too technical and he was inclusive; he didn't use any jargon." (FG3, Blind)*

> *"…it was really accessible language-wise" (FG3, Deaf)*

> *"I liked how he explained what he was doing as he did it." (FG4, Physical)*

All in all, this process developed more inclusive programs. The existing guidelines provided the team with a solid foundation which was strengthened by the input of people with disabilities. In evaluating these programs, the changes made during the charrette were identified as the exact elements which led to a more inclusive program. These changes assisted visitors with and without disabilities. We learned that making a program modification to address one learner can actually have broader impacts that help multiple kinds of learners.

Lessons learned about measuring the effectiveness of our process

Programmatic changes can be made quickly and effectively with the aid of universal design guidelines and the incorporation of feedback from people with disabilities. Making changes for one type of learner can benefit multiple learners. We learned that some of the changes we made to programs not only helped people with disabilities, these changes also helped people without disabilities.

CONCLUSION

In the end, our *Universally Designed Museum Programming* team was able to create museum programming that is more inclusive of all visitors, including those with a wide range of abilities and disabilities. Our lessons learned are described throughout this paper to provide others interested in developing inclusive programming with a starting point.

We began this project with the assumption that building a community of interest and conducting a design charrette based on the approach of universal design would positively impact the inclusiveness of programs. Not only have we learned methods for developing more inclusive programs, we have also learned methods for facilitating professional projects in an inclusive way. We would encourage other individuals interested in developing more inclusive programming to utilize the existing guidelines posed by the NISE Network in *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008). When implementing these guidelines, we further recommend including the feedback of people with disabilities as a part of the process.

Some of the important lessons learned include the following:

- When building a community of interest, it is important to include content about various project aspects in order to develop a shared understanding between individuals. By the end of the project, our advisors and educators found value in the elements we provided which introduced a new perspective. While advisors were more interested in the "real-world" implementation of museum programming, educators found value in learning new theories, methods, and practices which they could put into action. This resulted in a project which provided everyone with new understandings.
- When facilitating a project, it is important to include everyone in all aspects of that project. Our team was made up of individuals with a range of abilities and disabilities, and it was important to us to allow everyone to participate together. We learned that changing our initial plans and thinking through multiple options of assistive technology provided an inclusive project experience for everyone. Being inclusive at the professional level became just as important as producing more inclusive programming for our public audience.
- When creating programs that are more inclusive, it is important to use universal design guidelines such as those found in the *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008). We learned that utilizing the NISE Net guidelines was helpful for programs on a range of topics and made even stronger when combined with the input of people with disabilities.
- When modifying programs to become more inclusive of one audience, it is important to realize that these changes can also positively impact other audiences as well. We learned that some of the changes we made to programs helped not only people with disabilities, but that these changes also helped people without disabilities.

REFERENCES

Bell, L. (2000). Assuring intellectual access: Lessons from Boston's Museum of Science. *ASTC Dimensions*, 3-5.

Center for Universal Design. (2002). *Definition of universal design*. Retrieved November, 2002, from http://www.design.ncsu.edu/cud

Connell, B.R., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., & Vanderheiden, G. (1997). *The principles of universal design.* Retrieved August 22, 2012, from North Carolina State University, The Center for Universal Design Web site: http://www.ncsu.edu/project/design-projects/udi/center-for-universal-design/the-principles-of-universal-design/

Davidson, B., Heald, C. L., & Hein, G. (1991). Increased exhibit accessibility through multisensory interaction. *Curator, 34*(4), 273-290.

Department of Evaluation and Research in Learning. (2007). *Remedial Evaluation: Wild Music*. St. Paul, MN: Science Museum of Minnesota.

Design Charrettes. (n.d.). Retrieved August 22, 2012, from http://www.peopleandparticipation.net/display/Methods/Design+Charrettes.

Fischer, G. (2001). *Communities of Interest: Learning through the Interaction of Multiple Knowledge Systems*. Paper presented at the 24th Annual Information Systems Research Seminar In Scandinavia (IRIS'24), Ulvik, Norway.

Lindgren-Streicher, A., & Goss, J. (2011). Universal Design and Exhibits. *NEMA News, 31*, 12-13.

NISE Network. (2008). *Universal design guidelines for public programs in science museums*. Boston, MA: NISE Network, from http://www.nisenet.org/catalog/tools_guides/universal_design_guidelines_programs

Preiser, W.F.E. & Ostroff, E. (Eds.) (2001). *Universal Design Handbook*. New York: McGraw-Hill.

Reich, C., Price, J., Rubin, E., & Steiner, M. (2010). *Inclusion, disabilities and informal science learning. A CAISE inquiry group report.* Washington, DC: Center for the Advancement of Informal Science Education (CAISE).

Reich, C. A. (2000). The power of universal design: building an accessible exhibition. *Dimensions*, 5-6.

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: Association for Supervision and Curriculum Development.

Smithsonian Institution (2000). Smithsonian Guidelines for Accessible Exhibition Design. Retrieved August 22, 2012, from http://accessible.si.edu/pdf/Smithsonian%20Guidelines%20for%20accessible%20design.pdf

Story, M. F., Mueller, J. L., & Mace, R. L. (1998). *The universal design file: Designing for people of all ages and abilities*. Raleigh, NC: The Center for Universal Design.

APPENDIX A: FURTHER INFORMATION ABOUT COLLABORATIVE JOURNAL WRITING

In the four months leading up to the charrette, educators on our team maintained journal entries of observations and reflections on the details of delivering museum programming. Educators were given pocket-sized journals and instructed to note the program type, date, and general audience makeup. They were instructed to pay particular attention to program elements and features which seemed to work well or were challenging, and to reflect on why they believed the program worked or did not work well. They were also instructed to note interactions with visitors with apparent disabilities.

Each journaling educator was paired with a "journal buddy" with whom journal entries were exchanged for peer feedback. Sometimes the entries elicited a number of rounds of comments and responses between journaling pairs. All entries and comments were collected and reviewed weekly by a project facilitator.

Journal entries and responses were collated before the charrette and each journal pairing was reviewed by an advisor partner. Advisors were instructed to give written feedback in the form of general comments, questions, and suggestions for more inclusive program delivery. The entries, with feedback from the advisors, were both discussed during pre-charrette teleconferences and used to shape the content of the design charrette.

The following is an example of a journal exchange between two educators about effectively informing visitors with children that the sounds during the "Theater of Electricity Lightning! Show" would be very loud:

Educator 1:

> [Worked] Not Well? child crying after big Tesla
> Do differently? I do not think there is anything more we can do to warn visitors. Did have to wait as child and parent left. Not sure if it was too long a pause, but it seemed okay.

Educator 2:

> I'm always amazed by the number of parents who ignore our warnings that small children will not enjoy the loud noises. This is a discussion for the bigger Theater of Electricity presenter group, but I was thinking something like 1) a graphic slide that displays levels of sound in the TOE compared to everyday sounds. We could say something like "if THIS sounds bugs your child, chances are our sounds will too." Also 2) monitors outside the theater showing our show so that parents can retreat outside the doors with a crying child, sit on a bench and still see the show.

Educator 1:

> I like this idea of a slide, but it makes no difference if paths are blocked and parents choose to sit in the middle of the space. I actually play the walk in music fairly loudly on the belief that if you think the music is too loud, you're not going to like the show very much… As for a monitor outside, maybe. It could also display showtimes when there is not a show, but it all takes money and time, something that we don't seem to ever have

for such a project. There is also the CCP balcony, which is quieter, but you actually have to further into the space to get to it.

Educator 2:

I'm hoping as part of our project we can list things we'd like to do, prioritize, and list things that will need further buy-in and funding by MOS, when cash is available.

APPENDIX B: LIST OF ARTICLES READ BEFORE THE CHARRETTE

The following is a list of articles and documents reviewed by our team during teleconferences prior to the charrette. These were intended to provide background on various relevant topics including developing communities of interest, disability and access, and the incorporation of universal design principles into the development and delivery of museum programs.

- The grant proposal for our project

- An article defining a community of interest:

  Fischer, G. (2001). *Communities of Interest: Learning through the Interaction of Multiple Knowledge Systems*. Paper presented at the 24th Annual Information Systems Research Seminar In Scandinavia (IRIS'24), Ulvik, Norway.

- The universal design guidelines for programs crafted prior to this project:

  NISE Network (2008). *Universal design guidelines for public programs in science museums*. Boston, MA: NISE Network.

- An excerpt of a CAISE report about inclusion in museums:

  Reich, C., Price, J., Rubin, E., & Steiner, M. (2010). *Inclusion, disabilities and informal science learning. A CAISE inquiry group report.* Washington, DC: Center for the Advancement of Informal Science Education (CAISE).

APPENDIX C: CHARRETTE AGENDA OVERVIEW

Each day of the four-day charrette is described below. In brief, day 1 focused on program implementation, days 2 and 3 were spent modifying the programs, and day 4 consisted of implementing the modified programs.

Day 1: Day 1 consisted of live presentations of the four programs at 10am, 11am, 12pm, and 1pm. While the educators were setting up for their programs, advisors were briefed in the classroom. All advisors and educators were given an observation form to fill out while watching each program. The audience for these presentations was the general public, the advisors, and the three non-presenting educators. The project team originally planned to discuss each program immediately following its presentation. However, after rushing the discussion following the first presentation, the team realized there would not be time to debrief in between programs. Feedback for the next three programs was given after the final program at the end of the first day. Comments given during the feedback sessions were collected by evaluators and shared with the group the following day.

Day 2: Day 2 began with a presentation of the history of universal design within the Museum of Science. This was followed by discussions intended to identify the changes that should be made to each program. The "Porcupine Live Animal Presentation" and the "Charles River Water Interpretation Cart" were the focus of day 2. The project team, advisors, and educators split into two brainstorming groups. Using the compiled comments and suggestions from the previous day, one group discussed possible improvements for the Live Animal Presentation and the other discussed changes for the Charles River Water Interpretation. Each suggested improvement was written on a post-it and stuck up onto the wall. At the end of the discussion, each person voted for five changes that they thought could be implemented in a short period of time and would improve the inclusiveness of the program. At the end of this process, the educators explained to the group how they wanted to implement the three to five ideas that emerged from brainstorming sessions. As changes were being made to the programs throughout the afternoon, advisors were available on site or via cell phone. The Collections Department at the Museum informed the team about the collections that could be made available for improving the programs. Educators also learned about other in-house resources, such as the Swell Form Printer and Braille Embosser.

Day 3: Day 3 was similar to Day 2 in format. The day's content differed, however, as the morning's discussion consisted of advisor feedback on journal entries and the programs being discussed and modified were the "Theater of Electricity Lightning! Show" and "Mind Games".

Day 4: Day 4 consisted of presentations of the four modified programs. These were presented to the general public, advisors, educators, as well as focus group participants recruited to give feedback on the programs. The fourth day and charrette ended with a project debrief in which educators and advisors offered feedback on the newly modified programs. Their reflections included aspects that went well, challenges, and some ways universal design had been incorporated.

APPENDIX D: FURTHER INFORMATION ABOUT FOCUS GROUP METHODS

We embedded evaluation in all aspects of our project in order to gather feedback from both professional and public audiences. This work was completed by our team members from the Museum of Science Research and Evaluation department. To understand a visitor's perspective on our newly modified programs, we invited visitors with and without disabilities to watch the modified programs and participate in a focus group.

Four focus groups comprised of 6-7 people each were conducted on the fourth day of the charrette. Although quantitative surveys enable more exact comparisons, this data collection method is inaccessible for many individuals with disabilities (including visitors who are blind, visitors who are dyslexic, and visitors whose first language is not English, such as those who are Deaf). Focus groups provided a rich description of aspects visitors found to be inclusive or not inclusive and gathered data in an inclusive way. American Sign Language (ASL) interpreters were available during focus groups. Visitors with and without disabilities, recruited through local and regional accessibility-related listservs, were invited to the Museum of Science to provide feedback on the accessibility of four public programs. During focus group registration, individuals were divided into two sessions (morning and afternoon) in order to have representation from people with a range of disabilities including physical, visual, auditory, and cognitive disabilities in each group. In each 2-2.5 hour session, participants watched two programs and participated in a focus group moderated by a member of the Research and Evaluation Department. Two focus groups were held per session to allow for more effective facilitation. Table D1 provides a summary of the types of disabilities represented at each session and focus group. Twenty-six visitors with and without disabilities were asked questions related to their interest in the program, their learning through the program, and how inclusive they felt the program was.

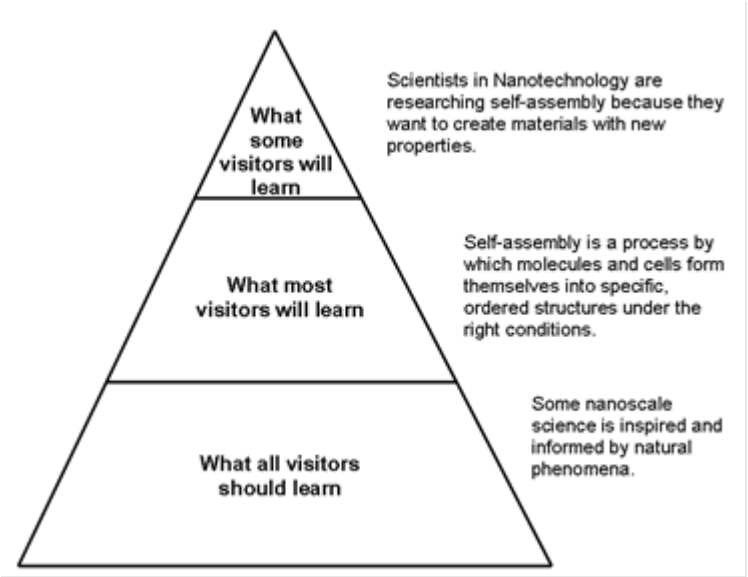
TABLE D1. Description of Focus Group Participant Disabilities.

	Auditory	*Cognitive*	*Physical*	*Visual*	*No Disability*	*Total*
Morning Session						
Focus group 1 (FG1)	0	0	1	2	4	7
Focus group 2 (FG2)	1	1	3	0	1	6
Afternoon Session						
Focus group 3 (FG3)	3	1	0	1	2	7
Focus group 4 (FG4)	0	1	2	1	2	6
Total	**4**	**3**	**6**	**4**	**9**	26

Note. Morning session participants viewed the "Porcupine Live Animal Presentation" and the "Charles River Water Interpretation Cart". Afternoon session participants viewed the "Theater of Electricity Lightning! Show" and "Mind Games".

APPENDIX E: PROGRAM PLANNING PYRAMIDS DEVELOPED THROUGH THE PROJECT

After reading and discussing the *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008), educators decided to create planning pyramids for the educational goals of their programs. These pyramids were created pre-charrette, before any modifications were made to the programs, and were used to assure that all visitors with and without disabilities would leave the program having learned something. The following is an example of a planning pyramid for educational goals:



Note. Reprinted with permission from *Universal Design Guidelines for Public Programs in Science Museums* (NISE Network, 2008)

Below are descriptions of the planning pyramids outlined after the pre-charrette discussions:

"Porcupine Live Animal Presentation" Planning Pyramid

What some visitors will learn

- How some of the adaptations function (ie. how the quills claws work)

What most visitors will learn

- The behaviors and characteristics are adaptations that are key for survival in the forest environment

What all visitors will learn

- Through observation we can learn about the porcupine's behaviors and characteristics

"Theater of Electricity Lightning! Show" Planning Pyramid

What some visitors will learn

- Electricity is a catch-all & thus ambiguous and potentially confusing term that can mean electric charge, electric force, voltage (the energy each charge has), or current (the number of charges moving by each second).
- Electric charge, as well as electric and magnetic forces, are in everything, are invisible, and interact.
- Although we can't see or electric charge or electric forces, we can see the heat, light, and sound produced by them.
- A car provides protection from a lightning flash because it is an enclosing conductor and lightning changes rapidly. In particular, charge changing its motion rapidly produces changing magnetic forces that prevent the charge from penetrating any deeper than the outermost skin of the metal.

What most visitors will learn

- Electricity can mean many things and therefore is a potentially confusing word
- Electric charge, electric and magnetic forces are in everything, invisible, interact
- Although we can't see electric charge or forces, we can experience the heat, light and sound they make
- A car provides protection from a lightning flash because it surrounds you with a good conductor, because lightning changes quickly, and because electricity and magnetism interact.

What all visitors will learn

- Electricity can mean many things
- Electricity is invisible but in everything
- We don't see electricity, but do sense the heat, light, and sound it makes
- A car protects you from a lightning flash, and it has nothing to do with the tires!

"Charles River Water Interpretation Cart" Planning Pyramid

What some visitors will learn

- How to figure out the size of micro-organisms.

What most visitors will learn

- You can identify micro-organisms by observing details and comparing them to the provided images; some organisms are bigger than others.

What all visitors will learn

- There is a diversity of life at the microscopic level.

"Mind Games" Planning Pyramid

What some visitors will learn

- In science we use observation to understand the world, but we should understand the limits of our senses to view the world accurately
- There is variation among people; not everyone will see the same thing

What most visitors will learn

- In science we do experiments to test our ideas
- Illusions can show is how both our senses and brains can be confused

What all visitors will learn

- We use our senses to observe the world, but those senses can be confused.