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Universal Design Guidelines

for NISE Network Exhibits

Produced by the NISE Network

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The NISE Network exhibits partners are committed to making their exhibits as accessible as possible for museum visitors with a broad range of abilities and disabilities. This document lays out some basic concepts and guidelines to begin a discussion among the partners about the best way to achieve the universal design of exhibits.

What is universal design?

Universal design, as opposed to accessible design or assistive technology, will be the guiding framework for this project. According to the Center for Universal Design, universal design is 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.[1]

Universal design strives to create experiences that are accessible to users along a broad spectrum of ability—from able to disabled—to engage in a given task. A central tenet of universal design is that the location of a person on this spectrum is a result of both individual needs and the design of the environment. Universal design focuses on the users at the "less able" end of the spectrum, and tries to determine ways these individuals can become more "able" to complete a given task. It is assumed that if their needs are met, access will increase for everyone in between. As stated by David Rose and Anne Meyer:

> Traditional views of disability…suggest that a person either does or does not belong to the category "disabled." New understanding…shows that abilities in many domains fall along a very large number of continua. Further, the importance of a particular strength or weakness depends upon what is being asked of the learner. That is why, for example, a youngster with perfect pitch who has difficulty recognizing letters is seen as disabled, but a child who is tone deaf but can read words easily is not.[2]

Universal design reflects a push towards creating environments that promote inclusion, as opposed to "separate but equal" accommodations for persons with disabilities. Blamires[3] considers inclusion to be an essential element in the universal design of learning environments. He defines inclusion in three different categories: physical, social and cognitive, and considers inclusion to be a function of both access to and engagement in a learning experience.

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

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

3 Blamires, M. 1999. Universal design for learning: Re-establishing differentiation as part of the inclusion agenda? Support for Learning, 14(4), 158-163.

How to Achieve Universal Design

> "Universal Design" is about inclusion. In museums, it goes beyond accessibility, to educational concept. It defines an approach that uses multisensory, multimodal experiences as an educational tool—the means of communicating an exhibit's main point. "Multisensory and multimodal" implies choice—something for everyone. It implies that visitors with widely ranging ages, abilities, levels of interest and sophistication, learning styles and cultural identities can access the exhibit's main messages and have fun doing it.[4]

To achieve universal design, exhibit and program designers and developers need to consider ways to create experiences that are inclusive of the broadest possible audience from the very beginning of the development process. From the time the exhibit or program concept is first conceived to the moment the final product is installed or delivered, all of the development team members should consider the following three key questions:

- **Is the experience physically inclusive of people with a range of abilities?** (i.e., Is the space comfortable, approachable, reachable, and perceptible for a broad range of users?)

- **Is the experience cognitively inclusive of people with a range of abilities?** (i.e., Is the interpretive information delivered through multiple modalities—text, audio, and images—so that all visitors can receive it? Are there educational activities that engage multiple senses—touch, smell, sight, and hearing—so that all visitors can engage in interactive learning experiences?)

- **Is the experience socially inclusive of people with a range of abilities?** (i.e., Can people with a range of abilities participate together in the activity? Can each person participate independently without relying on the help and assistance of others? Can all visitors find themselves represented in the pictures and images of people in the gallery?)

To answer these questions, designers and developers need to not only think about the needs of different audiences (including visitors who are wheelchairs users, visitors with limited upper body strength, visitors who are deaf/hard of hearing, visitors who are blind or have low vision, and visitors with learning and/or cognitive disabilities), but must also seek feedback from the broadest range of learners themselves.

While creating exhibits that reflect universal design may seem like a daunting task, the good news is that you don't need to start at the very beginning. There are a number of proven guidelines and design solutions that you can turn to for help.

4 Quote attributed to Betty Davidson, Ph.D., http://www.mos.org/exhibitdevelopment/access/index.html.

Resources and Methods

This section outlines a number of guidelines for creating accessible exhibits. It will be obvious as you read these that some of them will sometimes be outside our control, as they will be affected by the venues in which our exhibits will ultimately be installed. However, we will continue to make every effort to meet these guidelines, so that no unnecessary limits on accessibility are introduced by our products. We can also discuss ways to improve accessibility and accessibility awareness in the museums in which our exhibits ultimately reside.

Achieving physical inclusion

The exhibits partners should follow the Smithsonian Guidelines for Accessible Exhibition Design (GUIDELINES) when designing the physical accessibility of our exhibits.[5] More specifically, this means that we will:

- develop any exhibit or program furnishings to meet or exceed GUIDELINES specifications;
- make our exhibits navigable for wheelchair users, cane users, and/or persons who are blind as specified in the GUIDELINES;
- provide welcoming "comfort" features such as adequate seating (stools and/or benches) and lighting levels as described in the GUIDELINES; and
- produce signage that follows guidelines with respect to font size, style, line length, contrast, and placement. We will use fonts that provide minimal difficulty to people with dyslexia[6] and people with low vision.

In addition to the GUIDELINES developed by the Smithsonian Institution, there are other universal design techniques that we will follow:

- Wherever possible, we will mount specimens and artifacts so that they are **touchable**. Where this is not possible, we will mount touchable models of artifacts and specimens contained in protective cases.
- We will produce **media in an accessible form** as required by law under Section 508. This includes captions on all audio and video.[7]

5 Smithsonian Institution Press, Washington, DC 1996. Available online at http://www.si.edu/opa/accessibility/exdesign/start.htm.

6 http://www.dyslexic.com/articlecontent.asp?CAT=Accessibility&slug=67&title=Typefaces%20for%20Dyslexia.

7 http://main.wgbh.org/wgbh/pages/mag/services/captioning/faq/sugg-styles-conv-faq.html.

- **Tactile versions[8] of illustrations and graphs** can bring appearances alive and make relationships clear. We'll use (simplified) tactile illustrations and graphs in our components and explore the feasibility of their use in our programs.

- Touch-screen displays and mouse pointing devices are not accessible for many users. The Museum of Science has developed an interface that uses **physical buttons with distinguishable tactile shapes** for navigation of electronic programming[9]. We will look at this and other options, and agree upon a set of interface guidelines that maximize accessibility.

- **Tactile sound transducers** can be used to translate very low bass sound frequencies into physical movement of chair seats and platforms, thus making sound-based experiences accessible to those who cannot hear. We will explore the use of tactile transducers to enhance visitors' experience of our exhibits, and then set guidelines for their use in our exhibit and program packages.

- **Vibrating touch pads** are devices that reproduce the lower frequencies of sound as tactile vibrations that can be sensed through visitors' hands. These pads are effective at transmitting frequencies lower than 800 Hz. This corresponds to the lower frequencies of the human speaking voice. NISE Network partners will explore the use of vibrating touch pads for components and programs that involve significant sounds at lower frequencies, and adopt them where they enhance accessibility.

Tactile whale models
In this exhibit from *Wild Music*, developed by the Science Museum of Minnesota, visitors can explore whale species with multiple senses. Easy-to-locate buttons activate the songs of different species of whales.

Touching songs
At this *Wild Music* exhibit visitors can select a tactile diagram (sonogram) of a bird, mammal, or insect song and insert it into a slot to activate an audio recording. As the recording plays, visitors follow the sound with their fingertips.

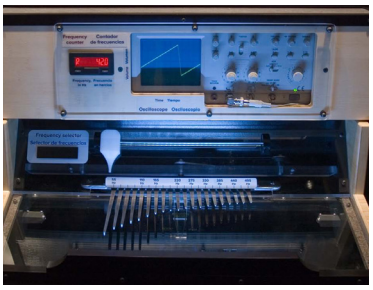
8 http://tsbvi.edu/Education/tactile-graphics.htm

9 http://www.archimuse.com/mw2006/papers/reich/reich.html (see Appendix)

Achieving cognitive inclusion

To create exhibits that are cognitively inclusive, NISE Network partners will consider how visitors with different learning styles, as well as sensory and learning abilities, will interact with and engage in the various exhibits we create.[10] We will try to meet the following standards, unless our evaluations show the effectiveness of other, equally accessible, design standards:

- Exhibits should incorporate **multi-sensory elements** into each experience. If a multi-sensory option is not feasible, we'll try to create complementary experiences, with each one engaging a different sense in order to achieve the same learning objective across a range of experiences.



Spectrum analyzer—a multi-sensory experience
This exhibit lets visitors both see and feel that sounds may be composed of several different frequencies. Sounds electrically fed into a sound transducer vibrate a bar with touchable metal strips of varying length. Strips of the proper length resonate to specific frequencies in the sound. Visitors not only see these vibrations, but feel them directly with their fingers.

- **Audio descriptions** (delivered through a handset, speaker or headphone) should provide verbal descriptions of visual elements in a display. We will provide audio descriptions for major visual components and for all components that require that the visitor be oriented before engaging interactively. Buttons/switches activating the audio descriptions should be consistently placed so that they are easily found by persons who are blind or have low vision.
- We will provide in situ **Braille labels** for all cranks, knobs, switches, and loose parts, and **Braille translations** for components without audio description. The Braille will communicate each component title, topic sentence, and focus headline.
- We will design our exhibits for **bilingual use** and/or presentation. Here's how we think this will work: One language will be English. The text in English will be placed to the left on graphic panels and slant surfaces. The second language will be placed on removable boards to the right of the English text. The use of removable boards permits the second language to be changed as needed for specific exhibition venues.[11]
- Because Spanish is by far the second-most popular language in the U.S., we will produce a set of **Spanish language panels** for each component and program.

10 http://www.mos.org/exhibitdevelopment/access/index.html

11 While it is true that non-English speakers are not disabled, it is also true that designing exhibits that only feature English can prevent non-English speakers from fully participating in the learning experience. Therefore, an English-focused design is not accessible to the broadest possible audience. We're trying to create a solution that can respond to local museums' needs for various second-language interpretation, depending on the makeup of the local communities.

In addition, captions for electronic media and audio descriptions will be provided in Spanish as well as in English.

- We will use **images to support and replicate information** that is communicated through text and audio. These images should both provide an indication of how to use the exhibit, as well as the scientific content being communicated.

Achieving social inclusion

Achieving social inclusion calls for the creation of learning experiences where each person in a social group can learn independently without substantial assistance. Given that museum visitors are known to learn through their social interactions with others, the importance of social inclusion is even more important in museums than in some other learning environments. To meet this criteria, we will try to create experiences that meet the following standards:

- Exhibits should be designed so that they are **welcoming and inclusive** to the broadest possible audience, and not be "separate but equal" learning experiences that segregate certain types of learners from other types. If it is not possible to create an exhibit or program that reflects universal design, and accessibility can only be achieved through the development of assistive technology (which is to be used only by the individual with a disability), every effort should be made to ensure that this technology does not socially isolate the person with a disability from their learning group.

- When applicable, images in the gallery should include persons with disabilities and accurately reflect disability culture.

Exhibition Accessibility Review

Once we have had a chance to talk through all of these guidelines and agree upon a set of standards that we want to follow, accessibility will become one of the factors that we consider whenever we evaluate an exhibit or program. Kirsten Ellenbogen and Amy Grack Nelson will work with all of the partners to incorporate accessibility reviews into our ongoing prototyping process. This will probably entail a three-stage review including:

- a checklist that partners will use to evaluate each exhibit and program locally;

- a more involved review by Kirsten and Amy when prototypes are brought to exhibits workshops; and

- periodic reviews of sets of exhibit and program prototypes by invited multi-abled audiences, probably in conjunction with workshops.

Appendix

This Appendix includes some resources of interest to exhibit and program developers as they think about accessibility. We will continue to build a set of resources to help us refine our standards and determine how to implement them intelligently.

Universally designed computer interface (developed by MOS)

The universally designed computer interface consists of five large push-buttons, each with a distinctive shape. At the left, a single rectangular button toggles audio narration on and off. At the bottom center, a large square button selects content (the "enter" function). Arrow keys on each side of the enter button sort though choices on the screen. A rectangular button on the top restarts the media program at the beginning. These controls are accessible for persons with limited dexterity and mobility (who can simply use a closed fist to operate them), as well as persons who are blind for whom existing interfaces (such as touchscreens and trackballs) are largely inaccessible.

Universally designed computer interface

Previous research has shown that providing accessible controls is only the first step toward creating accessible computer interactives. Other features, such as the use of images, audio and text, and the provision of explicit and clear directions, also play a key role in the development of computer interactives that are accessible to the broadest possible audience. The table below provides more details on the design features that have been found to be effective at creating computer interactives that are accessible to the broadest possible audience.[1]

1 http://www.archimuse.com/mw2006/papers/reich/reich.html

Reich, C. A. 2005. Universal design of interactives for museum exhibitions. Unpublished master's thesis, Lesley University, Cambridge, MA.

Reich, C. A., and Rayle, R. 2004, December 7-12. Creating interactive learning experiences for all. Paper presented at Designing for the 21st Century III: An International Conference on Universal Design, Rio de Janeiro.

Table 1:

Computer Interactive Design Features That Promote Universal Design

Feature	Audience members who benefit
Screen text that is read aloud and makes sense when heard and not viewed	• Visitors who are blind or have low vision • Visitors who are learning to read • Visitors with cognitive or learning disabilities • Visitors whose first language is not English
Open captions for videos and non-text-based audio	• Visitors who are deaf and hard of hearing • Older adults
Audio descriptions for videos, images, and other visually based information	• Visitors who are blind and have low vision • Visitors who have cognitive or learning disabilities affecting image reading
Text with large print, a clear typeface, capital and lowercase letters and ample space between lettering and text lines	• Visitors with low vision (including older adults) • Visitors who are dyslexic • Visitors at extreme heights (low and high) who may be subjected to glare
Alternatives to color-coded cues	• Visitors with low vision (including older adults and persons who are color-blind)
High-contrast images and text	• Visitors with low vision • Older adults
Minimized use of flickering and quick-moving images	• Visitors who are subject to seizures
Images that offer a visual indication of what to do, how to proceed and the activity's content	• Visitors learning to read • Visitors with learning disabilities • Visitors who do not speak English (including American Sign Language users)
A short description of activity's goal presented through images, audio and text	• Visitors who have ADD • Inexperienced computer users

Use of the clearest, simplest text that is free of jargon	• Visitors learning to read • Visitors with cognitive or learning disabilities • Visitors whose first language is not English (including those who use ASL)
Clear, simple directions that provide a literal and precise indication of what to do and the exact order for doing it	• Visitors who are blind or have low vision • Visitors with learning disabilities • Infrequent computer users
A clear, consistent and repetitive layout for presenting information	• Visitors with cognitive disabilities • Visitors who are blind or have low vision (and rely on their auditory memory) • Older adults • Infrequent computer users
A limited number of choices presented at one time (5-7)	• Visitors who are blind or have low vision (and rely on auditory working memory) • Visitors with cognitive or learning disabilities (including ADD)
Minimized screen scrolling	• Visitors with low vision • Visitors who have learning disabilities
A tactile interface, such as buttons, for navigating choices and making selections	• Visitors who are blind or have low vision • Visitors with limited upper body mobility • Visitors concerned with issues of reliability
Control over the pace of interaction, including when a computer "times out"	• Visitors who are deaf • Visitors who have low vision • Visitors with limited mobility • Visitors who are dyslexic
Clear mapping between the buttons and screen images	• All sighted visitors, especially visual learners
Stools	• Visitors with lower back pain • Visitors with low vision • Young children • Older adults
Monitors placed in an upright position close to the edge of the table	• Visitors who use wheelchairs • Visitors with low vision

Buttons placed on a slanted surface near the edge of the table	• Visitors with limited upper body mobility
Buttons that are clearly labeled with both a tactile and visual indication of their use	• Visitors who are blind or have low vision • Inexperienced computer users
Minimized background noise, when possible	• Visitors who are hard of hearing • Visitors who rely on audio to receive information such as visitors who are blind, have low vision or are dyslexic
A clear, consistent and repetitive layout for presenting information	• Visitors with cognitive disabilities • Visitors who are blind or have low vision (and rely on their auditory memory) • Older adults • Infrequent computer users