Museum Visitor Studies, Evaluation & Audience Research

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Remedial Evaluation of the *Science on a Sphere®* exhibition

Prepared for the
Boonshoft Museum of Discovery
Dayton, OH

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INTRODUCTION

This report presents the findings from a remedial evaluation of the *Science on a Sphere®* exhibition conducted by Randi Korn & Associates, Inc. (RK&A) for the Boonshoft Museum of Discovery (BMD) in Dayton, Ohio. *Science on a Sphere®* is a room-sized global display system that uses computers and video projectors to display planetary data onto a sphere or giant animated globe. BMD's exhibition also includes three interactive exhibits designed to allow visitors to more fully explore the causes and effects of climate change by controlling the data sets projected on the sphere. The National Oceanic and Atmospheric Administration (NOAA) developed *Science on a Sphere®* and BMD is one of many institutions to purchase a *Science on a Sphere®* installation. RK&A conducted this evaluation to identify aspects of BMD's *Science on a Sphere®* exhibition that require remediation. Data for this study were collected in January 2010.

Specifically, the remedial evaluation explores:

- Visitors' overall experiences with the exhibition, including interactive exhibit experiences;
- Specific exhibit-related behaviors, including time spent and group interactions;
- Visitors' understanding of the connections between the sphere and interactive exhibit experiences; and,
- Visitors' understanding of key exhibit messages, including:
  - the environment can be studied in systematic ways and informed assessments can be drawn from it; and,
  - local activities can affect the global environment.

METHODOLOGY

RK&A used two data collection strategies to assess visitors' experiences in the *Science on a Sphere®* exhibition and with interactive exhibits: observations and interviews.

OVERALL EXHIBITION

OBSERVATIONS

RK&A conducted naturalistic observations of visiting families to explore visitors' response to the overall *Science on a Sphere®* exhibition. RK&A unobtrusively observed walk-in visitors as they interacted with exhibit components and noted select behaviors (see Appendix A for the data collection instrument).

Naturalistic observations provide an objective account of visitors' responses to exhibit experiences—rather than visitors' recollections. They provide detailed information about how visitors use and respond to exhibit components. They also suggest the range of visitor responses.

INTERVIEWS

Open-ended interviews produce data rich in information because interviewees are encouraged and motivated to describe their experiences, express their opinions and feelings, and share with the interviewer the meaning they constructed during a visit. RK&A interviewed walk-in visitors. Adults (18 years and older) visiting in family groups were eligible to participate in an interview.

To recruit walk-in interviewees, RK&A intercepted eligible visitors as they exited the *Science on a Sphere*® exhibition, following a continuous random sampling method. In accordance with this method, the interviewer stationed herself at the exhibition's exit, selected the first eligible visitor to exit the exhibition, and asked him or her to participate in an interview. Willing visitors were asked several open-ended questions about their exhibit experience. After each interview was complete, the interviewer returned to the exit to await the next eligible visitor.

The interview guide was intentionally open-ended to allow interviewees to discuss what they felt was meaningful (see Appendix A for the interview guide). Interviews were audio-recorded with participants' permission and transcribed to facilitate analysis.

INTERACTIVE EXHIBITS

Owing to low visitation levels, RK&A conducted cued observations and interviews to understand visitors' experiences with each interactive exhibit. For cued observations and interviews, RK&A approached visitors and invited them to participate in the study. RK&A observed families—children (17 and younger) and their adult caregivers (18 years and older)—one group at a time using two interactive exhibits—Frozen Connections and Global Connections.[1] Each visitor group used the exhibit while the evaluator noted their behaviors.

When visitors finished using the exhibit, the evaluator interviewed visitors about their experiences. The interview guides were intentionally open-ended to allow interviewees to discuss what they felt was meaningful (see Appendix B for the data collection instruments). Interviews were audio-recorded with participants' permission and transcribed to facilitate analysis.

DATA ANALYSIS AND REPORTING METHOD

Observations and interviews produced qualitative data, meaning that results are descriptive. In analyzing qualitative data, the evaluator studies the data for meaningful patterns and trends, and, as patterns and trends emerge, groups similar responses. Quotations in this report illustrate interviewees' thoughts and ideas as fully as possible and give the reader the flavor of visitors' experiences.

The data are presented in narrative. Interviewees' verbatim quotations (edited for clarity) are included and the interviewer's questions appear in parentheses. Visitors' genders and ages are included in brackets following quotations; within quotations, an asterisk (*) signifies the start of a different speaker's comments. Trends in the data are presented from most- to least-frequently occurring.

SECTIONS OF THE REPORT:

1. Principal Findings: Overall Exhibition
2. Principal Findings: Interactive Exhibits
3. Recommendations

[1] Three interactive exhibits were designed to accompany the *Science on a Sphere*® exhibition; however, only two exhibits—Frozen Connections and Global Connections—were operational at the time of the evaluation. Further, Global Connections was not fully operational—the LED map that accompanied the exhibit was not installed at the time of the evaluation.

PRINCIPAL FINDINGS: OVERALL EXHIBITION

INTRODUCTION

Data exploring visitors' experience in the overall *Science on a Sphere*® exhibition were collected in January 2010 at BMD. The overall exhibition includes the sphere, a flat-screen television describing current and upcoming data sets, and three interactive exhibits that explored the causes and effects of climate change in more depth.[2] Unobtrusive observations and exit interviews captured visitors' collective experiences with these components.

OBSERVATIONS

RK&A unobtrusively observed 47 visitor groups comprised of 156 visitors as they interacted with the *Science on a Sphere*® exhibition. Most visitor groups had at least one child; a few were adult-only groups. RK&A observed visitors in the morning and afternoon on three consecutive days of a holiday weekend and during different levels of crowding—low, moderate, and high.

VISITORS' USE OF EXHIBIT COMPONENTS

RK&A noted whether visitors interacted with exhibit components and visitors' approximate dwell time in the exhibit. Key findings are presented here.

- Visitors' time spent in the exhibit varied widely—about one-third spent less than five minutes in the exhibition (many of these visitors had children five years and younger), about one-third spent five to 10 minutes, and one-third spent 10 minutes or more. Visitors' dwell time in the exhibit ranged from 30 seconds to 30 minutes.
- Nearly all visitors engaged with the sphere while in the exhibit; about one-half watched part of or one full data set, one-quarter watched two data sets, and one-quarter watched three or more data sets.
- About one-half of visitors looked at the introductory flat screen panel displaying and describing current and upcoming data sets; the remaining visitors did not look at it, however this did not seem to affect their dwell time or level of engagement.
- A few children noticed the interactive exhibits but did not engage with them other than pushing a button and returning to the sphere; a couple visitor groups fully engaged with the interactive exhibits.
- Regardless of dwell time, most visitors were engaged with exhibit components during their entire experience; there was little exhibit misuse and non-exhibit related conversation.
- A few younger children ran around the sphere or climbed on benches while in the exhibit; a few adults talked on their phones or carried on non-exhibit related conversations.

[2] Three interactive exhibits were designed to accompany the *Science on a Sphere*® exhibition; however, only two exhibits—Frozen Connections and Global Connections—were operational at the time of the evaluation. Further, Global Connections was not fully operational—the LED map that accompanied the exhibit was not installed at the time of the evaluation.

VISITORS' LEVEL OF ENGAGEMENT

RK&A noted the ways in which visitors interacted with exhibit components, including visitors' exhibit-related conversations. Key findings are presented here.

- Visitors' level of engagement varied:
  - About one-half of visitors sat down and quietly watched the sphere; these visitors occasionally answered questions or pointed things out for their children (e.g., One adult said, "Look, it's the big red spot" during *Largest,* and a child asked, "What is that, daddy?" to which he answered "smoke stacks.")
  - About one-third of visitors engaged briefly with the sphere, walking around it once without stopping or following their child until they exited the space. Many of these visitors had younger children and made comments such as, "He's not going to stay still; come on buddy, let's go."
  - Several visitors walked around the sphere in addition to watching data sets. Usually, this happened when data sets without audio were playing (e.g., *The Dead Zone*) or with *Earth - The Blue Marble*. Adult visitors pointed out geographic features (e.g., One adult said, "See the clouds forming? That's what it looked like on Christmas day." Another said, "Do you see the United States? It's on the other side [of the sphere]; come on, let's go see the United States.") or read the sphere text out loud.
  - A few visitors sat through the whole cycle of films and continuously engaged in exhibit-related conversation. For example, one group of adults and children ages 4 to 5 years carried on a conversation about the solar system and Jupiter specifically (e.g., One adult said, "Is Jupiter the next closest planet [to Earth]?" and another adult responded by using a mnemonic device; a child said, "I wish I could go into heaven" and the adult said, "You mean space").

IN-DEPTH INTERVIEWS

RK&A conducted 10 exit interviews with visitor groups comprised of 14 adults and 15 children, ranging in age from 1 to 12 years, with a median of 9. Most visitor groups had visited the Museum at least once before.

OVERALL EXPERIENCE

MOST ENGAGING ASPECTS

When asked what was most engaging about the overall exhibition, most interviewees said something about the visual aspects of the sphere. They said that the sphere was beautiful, that the colors and audio presentation engaged them and their children, and that the unique presentation of data on a globe made Earth come to life (see the first quotation below). About one-half of interviewees also said they were engaged by new information that they learned (see the second quotation), and a couple said the exhibition piqued their curiosity and inspired them to learn more (see the third quotation).

> (What was most engaging about the exhibit?) I think the size and the color. I think it just makes it [the Earth] very life like. (And, for your daughter, what do you feel was most engaging?) The same thing. She thought it [the Earth] grew bigger because it [the film] used more of the [sphere], so I think she really enjoyed seeing it [the exhibition]. [It] made [the Earth] real. [male, 50]

(What did you find most interesting or engaging about this exhibit?) The graphics were fantastic; the visual was quite interesting. [We] learned lots of new stuff about Jupiter that I had no idea [about]. (Like what?) [About] the weather patterns. I did not know a lot about it [Jupiter], so it was quite fascinating the way they presented the information. (Is there any particular thing that stands out that you learned that was new?) Just the number of moons and the weather patterns. He [my son] was very interested in the fact that it changed all the time. [female, 36]

(Can you tell me what was most interesting or engaging about this exhibit?) We learned about the diatoms. I did not realize they even existed. So, now I am going to go home and look them up on the Internet. [female, 52]

LEAST ENGAGING ASPECTS

When asked what was least engaging about the exhibition, the majority of interviewees named a particular presentation (e.g., *Energy Planet* and *Return to the Moon*), explaining that the sound or graphics were not as appealing or realistic, the information did not lend itself to being on the sphere, or the information was not as interesting for them or their children (see the two quotations below). A few said that nothing was least interesting; they said they enjoyed all the presentations they experienced.

(What was least engaging about this exhibit?) I think that possibly the least engaging might be the choice of selections; like the energy one [*Energy Planet*] was not necessarily perfect for this particular presentation. The ones where you have Jupiter and the moon and stuff like that, where you can see things visually and it actually works on the sphere, those make sense. But the thing about the energy, not so much. (In terms of the actual shape of the sphere?) Yes; projecting on a sphere did not add anything to the information. [male, 40]

(What was least engaging?) I thought [*Frozen*] where you see a lot of pictures of ice and the swirling aspect of it, but it [the presentation] could have [had] more definitive graphics. (Do you have an example of what you mean?) Yes; instead [of] that constant picture of the ice melting, showing more actual glaciers melting, maybe more pictures of stuff that occurs nowadays because, in Alaska, they have glaciers that go into the ocean. I do not have that much experience with it, but something like that. [male, 36]

THOUGHTS ABOUT THE EXHIBITION FOR CHILDREN

When asked their thoughts about the exhibition for engaging their children, interviewees' responses were evenly divided. About one-half (usually those with older children) said the exhibition was engaging visually and in terms of content. They said their children are learning earth science in school, like the subject of space, and/or asked questions related to the data set showing (see the first quotation below). Another one-half (usually those with younger children) said their children were visually engaged by the sphere (e.g., Children commented, "Ooh, pretty!" or "What is it?"); however, they said the content was too advanced or there was not anything interactive for their kids other than looking at the sphere (see the second quotation).

(How old is she?) Seven. (For her age, what are your thoughts about this exhibit?) It just gives her a chance to see something that [relates to] science. . . . She loves space. She was telling me which one of Jupiter's moons were her favorites, in order. [male, 50]

(How old are they?) Three and five. (What are your thoughts about this exhibit for kids their age?) It is pretty good. It is a little over their heads for right now, but it's engaging enough for them to sit [through]. They [have] asked questions the entire time we have been here [at the Museum]—"What's that?" "What are they talking about?" (What kinds of questions were they asking in this exhibition?) Just like, "What did he say?" [and] "What are they talking about?" Part of it was he just was not quite listening to what [the film] said so I [had] to repeat [it] and then, some of it, I had to simplify a little for them. [female, 36]

USE OF SUPPLEMENTAL EXHIBITS

When asked whether they noticed or engaged with the interactive exhibits, most interviewees said they did not notice it or noticed it, but thought it was a "staff-only" area used to control the sphere. One group engaged with the interactive exhibits—the adult described being more engaged with the interactive exhibits compared to the children (see the quotation below).

(What, if anything, did you do back there?) They [my kids] looked at the magnifying glass, they read some of the little boards [the flip panels] they have up there. But, after that, they were pretty much done with it. (Okay. What did you do back there?) I read what some of the buttons did and I pushed a couple of the buttons to get some of the little movies to come up. That's pretty much it. (Did you realize that the buttons caused something to happen?) Eventually, I figured it out. (How did you figure it out?) I actually read where it said, 'When you push this selection, it appears on the screen to your left.' (And, were you interested in waiting to see what you had selected or did you move on after you pressed the buttons?) I was interested; however, the 9-year-olds wanted to do something else. [male, 40]

When asked whether they noticed or used the flat panel television announcing what was showing next on the sphere, the majority of interviewees said they used it to see what was playing or what was on the sphere (see the quotation below). A few noticed it but could not read what it said or did not realize what it was for.

(Did you notice the television on the wall?) Oh, yeah. That gave me an idea of how long you had. So I was able to [see] how long that video was. When we came in, there was a minute left of whatever they were watching so I knew something new would start. [male, 42]

VISITORS' UNDERSTANDING OF SPHERE CONTENT

When asked to talk about what they viewed on the sphere, all interviewees could accurately recall what was showing (i.e., no interviewees expressed confusion about what was showing on the sphere). However, the extent to which interviewees recalled content varied. About one-half generally recalled what was showing on the sphere by naming the title or subject of the presentation (e.g., *X-ray Sun*, "the one about Jupiter," etc.); these interviewees did not elaborate about the content, other than to say it was interesting or visually appealing (see the first quotation below). Another approximate one-half recalled specific ideas that they heard or saw, most of which was new information they had learned (see the second quotation).

(Can you talk about what was showing on the sphere when you guys were in here?) Gosh, which one was it? [I think it was about] arctic water; I do not remember the name of it because we came in the middle of it. (Anything else that you remember?) There was an energy video [and a] phytoplankton video. There was the dead zone. There was some really cool stuff. [male, 42]

[We learned that] about 75 percent of the earth's water is [located] within two massive ice caps, one in Greenland and the other in Antarctica. [We saw] the graphic of the rapid decline of the Earth's ice and then, how just a little bit of change in sea level can affect the planet. I know that if all the ice melts, the [sea] level rises and it [will] flood. *[We also learned about] permafrost and methane gas being released and [it] makes things more potent [with] carbon dioxide and the greenhouse effect. [male, 36; female 39]

EXHIBIT MESSAGES

When asked what they thought the exhibition was trying to show or tell visitors, about one-half of interviewees gave general responses, saying the exhibition was trying to teach visitors different things about Earth or the Universe (see the first quotation below). Another almost one-half of interviewees said the exhibition was trying to teach visitors about being "green" and that we need to conserve energy (see the second quotation). A couple said the exhibition was a way to teach non-scientists or kids about science (see the third quotation). Not surprisingly, the exhibit messages gleaned by interviewees usually corresponded to the films or data sets they viewed while in the exhibition.

(Overall, what do you feel like this exhibition is trying to show or tell visitors?) [I think it is trying to] teach people about the Universe, and I think that is good. (What was the take away that you had for this exhibit?) *[I] wonder, maybe, that there is much more to know than you know already. So, if you start to learn about [one thing], whole big categories of interesting things will open up [and you can] explore those. (And what made you think that was the big idea?) *I learned a lot more about Jupiter than I knew and some I did not know. [female, 36; male, 9]

(What did you feel the exhibition is trying to tell people?) Well, I think it's trying to show you that we use up so much energy and other countries do not. You know, [the] "green" earth type thing. (And, when you say "green" earth type thing, what do you mean by that?) Well, just the way that we use, consume energy compared to other countries and where our energy comes from. (And, what made you feel like the exhibit was showing you that?) Well, I think it all stems back to the "green" related things. Trying to emphasize that we do use a lot of energy and we need to cut back. [male, 68]

(Overall, what do you feel like this exhibition is trying to show or tell visitors?) [I think the exhibition is] just trying to introduce them [visitors] to science. I think it is perfect for children. [male, 50]

PRINCIPAL FINDINGS: INTERACTIVE EXHIBITS

INTRODUCTION

Three interactive exhibits were designed to accompany the *Science on a Sphere*® exhibition—Frozen Connections, Global Connections, and Climate Connections. This evaluation did not explore visitors' experiences with Climate Connections, as it was not operational at the time of the evaluation. Further, Global Connections was only partially operational. RK&A conducted cued observations and interviews with family groups who used Frozen and Global Connections exhibits. Since participants' experiences with both exhibits were similar, findings from observations and interviews are presented together; however, where applicable, findings relevant to individual exhibits are highlighted.

DESCRIPTION OF VISITOR GROUPS

RK&A conducted cued observations and interviews with 10 visitor groups comprised of 12 adults and 21 children, ranging in age from 2 to 14 years, with a median age of 7. Equal numbers of male and female children were part of the observations and interviews. The majority of visitor groups had visited the Museum at least once previously.

DESCRIPTION OF INTERACTIVE EXHIBITS

The Frozen Connections exhibit includes text and graphics that explore the effects of climate change on sea ice concentration and phytoplankton. The exhibit also has a magnifying glass that visitors can use to explore diatoms in sea ice and four buttons that visitors can push to see related content projected on the sphere (e.g., the NASA-produced movie, *Frozen*) (see Appendix C for the exhibit's graphic panel).

The Global Connections exhibit includes two graphic panels that explore the effects of local actions on the Gulf of Mexico. On the first panel, visitors are asked to read about five environmentally-related problems faced by five different Ohio residents (e.g., a farmer is choosing whether to grow organically or to continue using pesticides) and help them make a decision by choosing one of two pictures on a flip panel (e.g., one picture shows the decision to grow organically and the other shows the decision to continue using pesticides). Once visitors make their choice, they match the border color of their picture with a corresponding button of the same color on the second panel; pushing the button lights up how their choice affects the Gulf of Mexico on a LED map (e.g., choosing to grow crops organically results in a clean Gulf).[3] The exhibit also includes four separate buttons that visitors can push to see related content projected on the sphere (e.g., *Sea Level Rise*) (see Appendix D for the exhibit's graphic panels).

OPERATIONAL FUNCTION

- All participants—children and adults—easily used the magnifying glass at Frozen Connections to view the pictures of phytoplankton underneath; most children also used the magnifying glass

[3] The LED map was not installed at the time of the evaluation; instead, RK&A used mock-up paper flip panels showing visitors what the result of their decision would be for the Gulf of Mexico (see Appendix F).

to look at their hands or fingers up close. Likewise, all participants easily flipped the pictures at Global Connections.

- Although the evaluator explained to participants that the two Global Connections panels were connected and part of the same exhibit, all adult and child participants struggled to figure out *how* the two panels were connected. Many did not make the connection between the border color of the picture they chose and the corresponding colored button.[4]
- All participants—children and adults—struggled to use the supplementary buttons at each exhibit to view something additional on the sphere. Younger children tended to haphazardly push the buttons; however, most adults and older children immediately looked at the sphere after pushing the buttons and repeatedly pushed the same button or another button when they did not notice a change, eventually giving up.
- A few adults noticed the instructions about how to operate the buttons added by the evaluator (see Appendix E) and looked up at the flat panel television to see when their selection would play. However, these adults explained later that they expected to see their selection reflected on the list of upcoming data sets, but were confused or frustrated when this was not the case (this occurred because another group or their own children had already activated the lock-out mechanism by pushing multiple buttons at the exhibit) (see the quotation below).

> (Did you all push any of the buttons that were on the orange box and did you know what those were for?) Not really. This [button is] not working. (They are not working?) It just seems like when you push them, what happens? You [have to] look over there [at the television screen] and [it doesn't] seem like [anything happened]—I was looking to see what changed. And that's when I pushed the buttons, [thinking] like, 'What does it do?' It didn't do what I thought—something should have [happened] over there on that [television] screen and it didn't change. (Okay, so you were expecting it to change something?) I thought if I pushed [button] A [that] it would reflect what I was reading on here, you know? (Did you expect it to immediately play on the sphere or were you expecting it to scroll up there?) I expected it to scroll [up on the television]. (So how did you know to look up there?) Because it [the instructions] said "look to your left." (Was it clear to you when your selection would play?) It says in order of how it was pushed it would [play]. (But did you see your selection up there?) No. As soon as I pushed it, it didn't change. I didn't wait to see what was going on. [female, 49]

- Most adult participants said they struggled to concentrate, read text, and see graphics owing to the low light levels and audio playing on the sphere. Specifically, once the evaluator explained the relevance of the border color around the flip panel pictures at Global Connections, most said they could not determine the color given the low light levels. A few also said that the flat panel television was difficult to read from behind the exhibits.

VISITORS' LEVEL OF ENGAGEMENT

- Most children were engaged with the magnifying glass and many said it was their favorite part of both exhibits because they could look at their hands or fingers up close. Many parents also

[4] To be fair, the second part of Global Connections was not installed at the time of the evaluation and the evaluator used mock-up flip panels to test the main exhibit concept—that local actions can affect the global environment (see Appendix F). Because the mock-up was not meant to accurately portray how the LED map would operate, visitors may have struggled to make an easy transition between the two parts of the exhibit.

reiterated that this was their children's favorite part of both exhibits because it was interactive (see the quotation below).

> (What was most engaging about [Frozen Connections]?) The magnifying glass. (And why was that most engaging?) Something for him [his child] to do. He thinks he's looking for clues. To him that's very exciting. [male, 35]

- Most children did not read the text; however, some adults read the text aloud to their children while using the exhibit and facilitated their child's experience by asking them questions (see the quotation below). These children tended to stay engaged longer than did those who used the exhibit alone or with other children.

> I was reading this [scenario] to her and I was asking her questions about what [she] would rather do, like—let's see which one was it—I was trying to get her to understand the wetlands versus the green space, I think it was. [This scenario] where it's talking about using up all the green [space] and I was asking her did she know what the green was—the grass, the trees and the forest—[and] would she rather have this area [with more green space] or would she rather have more of this [cities and buildings]? She said she would rather have more of this type of area [the city area]. So, then, I was asking her—she knows I plant flowers—so I connected [this scenario] with me planting flowers at my house and I told her 'Would you rather have more of the bugs being able to [live] or the chemicals to get rid of them?' She said she'd rather kill the bugs because she doesn't like the bugs because they bite. And, then, [for the] recycling [scenario], she said she would want to recycle and take care of the land. What did you say it [using landfills] was doing to the land? *Making the world sick. *So, she said she would rather recycle than make the world sick. [female, 49; female, 6]

- Most adults said the exhibits were too text-heavy and, under normal circumstances, would not have engaged them or their children for long (see the quotation below). A few explicitly expressed a desire for the exhibits to be more interactive, visually-oriented, and/or more intuitive to use without having to read text.

> (I know you already said for her age group this is a little too much text. And can you just reiterate why you think that, for her age group, [these exhibits] are challenging?) Well, it's partly because of everything else in the Boonshoft Museum. Much of it [gives you an] immediate reaction. [Kids] punch a button, something happens. So, when you come to exhibits that require a lot of reading like these first two, there's no way first-graders can do it. They can't read that fast to begin with. But, even an adult, they won't want to invest as much time as you need to read through all that information, especially [when] you are standing in the dark with a voice in the background, which is constantly distracting [you]. [male, 50]

- The evaluator asked participants whether they would wait for a selection to appear on the sphere regardless of their success in making a connection between the buttons, the flat panel television, and the sphere. Most said they would expect an immediate result after having pushed the button and probably would not wait. The evaluator observed one group wait for and watch their selection (*Frozen*).

VISITORS' LEVEL OF UNDERSTANDING

- Other than a few participants realizing that the buttons controlled selections on the sphere, most could not articulate a connection between the sphere and the interactive exhibits or forced a vague or general connection (e.g., One visitor commented, "the sphere and the exhibit both mention oceans"). One adult participant said the messages of *Energy Planet* and Global Connections were similar (see the quotation below).

> (What—if any—connections did you see between these exhibits and the sphere?) The [film about the] renewable energy [*Energy Planet*] goes along with the recycling [scenario at Global Connections] really well. I think we might have missed some of the earlier [films] [about] global warming. [female, 34]

- When asked to discuss what was playing on the sphere, many adult participants said they did not pay attention to what was playing on the sphere while engaging with the interactive exhibits because they were trying to concentrate on one experience at a time (see the quotation below). A few talked about data sets that they saw *before* engaging with the interactive exhibits.

> It was pretty much one [the interactive exhibits] or the other [the sphere]; I [went] here [to press the buttons] and then look[ed] up to see if I could see a connection. If there wasn't [one], [I] just kept [using the interactive exhibits]. The sphere is fascinating, but . . . [male, 40]

- Not surprisingly, because most younger children engaged with the exhibits by haphazardly pushing buttons or flipping panels, they had difficulty articulating what they discovered; however, a few older children more clearly articulated what they did or discovered (see the quotation below).

> (And did you figure anything out at that exhibit [Frozen Connections]?) Only that stuff in ice is not really dead. (And how did you figure that out?) Just [by] reading the highlighted parts. (And what about this other exhibit with the flip panels? What were you doing there?) I didn't really use that part. I only used the [rotating] part and I read both sides. (And what did you find out from [reading]?) Just bits and pieces of information that I didn't know before. (Like what, for example?) Like it's not good to use fertilizers that drive away other insects. [male, 14]

- The few adult participants who looked at the cause-effect pictures at Global Connections (i.e., those depicting what would happen to the Gulf of Mexico as a result of their choice) said they did not understand what some of the pictures were depicting (see the quotation below).

> (Were the pictures clear to you?) Can you see anything in that picture? *No. *I can't either. Part of it is the light is a little bit low in here. . . . The buildup of sediment [picture] . . . that's a bad picture. Is this the shoreline? (That's the sediment runoff. So, it's not immediately clear to you what that is?) No. Is that the Gulf [referring to the "clean" picture]? (It is.) So, then what would that be, [the Gulf] in the 1930's or 1940's before all the [pollution] went down the river? (It's just showing a clean gulf. So, was that clear to you?) No. [male, 50; female, 6]

- When asked what they thought the overall exhibition, including the interactive exhibits, is trying to communicate to visitors, most adult participants and a couple older children said the overall message had something to do with global warming or taking care of the environment (see the first quotation below). Some of these participants made a specific local-global connection (see the second quotation).

  > (Overall, what do you feel like these exhibits and the sphere are trying to teach kids or tell people?) [It's about] global warming, greenhouse gases, and protecting the planet. (What makes you think that is what the exhibition is trying to tell you?) Because over there [the Global Connections exhibit], it [the exhibit] is telling you what not to do to the Earth. [male, 14]

  > I was reading everything there on the [exhibit panel] and then we were watching this sphere to see the movie on how things affect the world, and then, specifically, we were seeing the melting ice and so forth—[how the melting ice] affects the algae and plant life's growth and how it kind of trickles down into the rest of the world. And seeing how specifically things that we do in our own neighborhoods, our own lives, affect what goes on in the rest of the world. [female, 50]

- Most adult participants said the ideas presented in the exhibits were too complex for their children or that their older children were just beginning to have the capacity to understand these ideas (see the quotation below).

  > (For your daughter's age, what are your thoughts about these exhibits?) [My daughter is] the oldest—nine years—and is just barely starting to get to the point where this [the exhibit ideas] are even comprehendible. It's interesting stuff, but I would need probably a half hour to 45 minutes to really work through it and get some kind of understanding of it. It would be tough. [male, 40]

- A couple adult participants said they thought it was interesting that the Global Connections exhibit was not black and white and acknowledged both sides of environmental issues; however, they also said that they were concerned that confronting children with scenarios about environmental issues might make them worry unnecessarily (see the quotation below).

  > In terms of the message, I think there's a danger of just beating stuff over people's heads. It's good to make people aware but I also think sometimes we put too much pressure on kids [about] some of these things. If it's a confusing topic for adults, I just think it makes younger kids even more confused and could cause them to worry about stuff that they really shouldn't be worrying about at this age. Stuff like this [climate change] is more of an adult issue than a kid issue. [male, 40]

RECOMMENDATIONS

INTRODUCTION

While visitors were engaged with the sphere, findings from observations and interviews about interactive exhibits highlight operational and content-related aspects of the exhibits that staff might consider remediating. RK&A held conversations with Boonshoft staff to learn about aspects of the exhibition that could or could not be altered. The following recommendations take those limitations into consideration.

ASPECTS TO CONSIDER REMEDIATING

- While group interaction occurred sporadically, visitors were more likely to sit and quietly watch the films on the sphere. If the Museum hopes to encourage more visitor interaction, staff might consider including some shorter data sets without audio. Several visitors were observed walking around the sphere, actively pointing things out to their children when data sets without audio were playing (e.g., *Sea Level Rise*).
- Low light levels and the position of components made it challenging for participants to see exhibit text and graphics. Consider the following ways to combat this issue:
  - Find a way to backlight the flip panels in Global Connections and/or any instructional text that will be added to the exhibit.
  - For Global Connections, use clearly defined symbols (e.g., star, circle, or square) instead of colors for visitors to link their choice with the effect that it has on the Gulf of Mexico. Alternatively, consider placing colored dots with a black border on each picture (instead of having visitors determine the border color of the picture), since a circle more clearly links to the idea of pushing a button compared with a colored band or border.
  - If possible, change the size or color of the text on the introductory television screen so it is easier for visitors to read from behind the interactive exhibits. Alternatively, find another way to inform visitors when their selection will play.
  - Consider enlarging the cause-effect pictures on the Global Connections LED map and adding a concise description of what each picture represents (on the picture itself). Those participants who looked at the pictures struggled to figure out what they represented.
- Consider switching the Global Connections panels so that the LED map with the instructions comes before the scenarios and flip panels. Participants did not understand how the two parts of Global Connections connected and, while installation of the map component likely will help, participants usually began by reading the scenarios and flipping the panels, missing the instructions. Alternatively, move the instructions to the panel with the scenarios and flip panels.
- Consider reducing the amount of text accompanying both exhibits by prioritizing the ideas needed to communicate the exhibit's key message. Also, consider communicating more of the ideas visually or interactively instead of with text. Adult participants commented that the

exhibits were too text-heavy and children were most engaged by the interactive components of both exhibits (e.g., the magnifying glass).[5]

- Consider adapting the exhibit design to increase adult-child interaction (e.g. include more questions that adults can ask their children—similar to the "What would *you* do?" question on the Global Connections exhibit). Most adult participants said they felt exhibit ideas were fairly complex and children whose caregivers facilitated their experience by asking questions remained engaged longer than those whose caregivers did not.
- Consider whether allowing visitors to control selections on the sphere will result in a valuable experience. Many participants did not understand what the buttons did; they expected an immediate reaction, did not read the instructions that indicated to look at the television screen, and/or said they most likely would not wait for their selection to play. Further, the inevitable activation of the lock-out mechanism by children or other groups frustrated the few participants who realized the purpose of the buttons.[6] If staff choose to keep the buttons, consider reducing visitor wait time and eliminating the lock-out issue by:
  - Offering fewer button options (i.e., one option per exhibit);
  - Offering selections that are short (not long films like *Frozen*); and
  - Including shorter data sets in the regular sphere rotation (instead of *only* long films like *Energy Planet*, *Largest*, etc.).
- Staff are already planning to add signage and design components that alert visitors to the presence of the interactive exhibits (i.e., silver paneling and the title "Global Connections Control Center"). As part of the signage, consider adding the word "exhibits" or "experience" so that visitors know it is for them. Most visitors said they did not notice the interactive exhibits or thought the area was a "staff-only" control center used to operate the sphere.
- Because a portion of their audience tends to skew younger and findings show that young children struggled to meaningfully engage with the interactive exhibits, staff is considering designing separate programming for young learners (children 2 to 5 years) to engage with the sphere. For example, using the sphere to communicate simple, developmentally appropriate messages about Earth systems (e.g., the idea that the Earth is round, not flat, as is often depicted in books) and engaging children in role or imaginative play related to science or being a scientist.
- A couple adult participants expressed concern about introducing a complex idea like climate change to young children, explaining that it might make them worry unnecessarily. If the Museum is concerned about the age-appropriateness of exhibit messages, staff might consider building a foundation of knowledge for young learners, helping them to first appreciate the environment before being asked to save it (Sobel, 2008).
- Continue to conduct formative evaluation to gauge visitors' use of and response to select exhibition components (e.g., text labels, interactives, etc.), including what strategies are most effective for helping visitors draw connections between the interactive exhibits and the sphere.
- After reflecting on findings, staff asked RK&A how they might encourage visitors to practice more environmentally friendly behaviors, as this is one goal of the exhibition. As part of exhibit text or programming, consider including one simple, concrete change visitors can make in their

[5] Prioritizing key messages and limiting the amount of text in exhibits is a common design challenge for museums. Research suggests that less text increases visitors' reading behavior (Serrel, 1996).

[6] Maryland Science Center also created interactive exhibits (or kiosks) to accompany the *Science on a Sphere®* and learned that the logistical reality of allowing visitors to control content on the sphere was too complicated. Instead, they created exhibits that visually and conceptually incorporated sphere data sets and ideas (People, Places, and Design Research, 2007).

everyday lives that would address current environmental concerns. Staff might even consider using props to emphasize this change—for example, show visitors two light bulbs—one more environmentally-friendly than the other—so they know what to look for when shopping.

REFERENCES

People, Places, and Design Research, Inc. (2007). Formative Evaluation of *Science on a Sphere*® Supplemental Interpretive Components. Baltimore, MD: Maryland Science Center.

Serrell, B. 1996. *Exhibit Labels: An Interpretive Approach*. Walnut Creek, CA: AltaMira Press.

Sobel, D. 2008. *Childhood and Nature: Design Principles for Educators*. Portland, ME: Stenhouse Publishers.

APPENDICES

APPENDIX A: OVERALL EXHIBITION GUIDE

Removed for proprietary purposes

APPENDIX B: INTERACTIVE EXHIBIT GUIDES

Removed for proprietary purposes

APPENDIX C: *FROZEN CONNECTIONS* GRAPHIC PANEL

FROZEN CONNECTIONS

Ice shows deep, persistent, global changes more readily than other kinds of geographic features. Where the world stays cold over time, liquid water freezes. Where the world persistently grows warm, ice in its many forms thaws.

- **Focus your attention on those parts of the Earth that historically depend on ice. Press button A to view the NASA-produced movie, *Frozen*.**

Scientists today are looking to the poles as indicators for climate change.

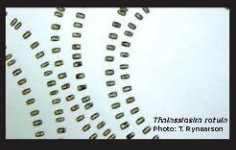
- **Explore the sea ice concentration data yourself. Press buttons B and C.**

You'll notice in the northern latitudes that the sea ice concentration has decreased over the past 30 years. This disappearance of sea ice can have a major impact globally. Melting sea ice can disturb the global ocean conveyor belt, impact sea life and the fishing industry, and change the Earth's energy budget. Sea ice cools the climate because it is reflective and so returns much of the sun's warming back to space.

As the ice melts, scientists continue to look for indicators at the ice edge for climate change. While the ocean temperature rises, it brings an abundance of new life as phytoplankton photosynthesize and multiply after being trapped in the ice.

These blooms of life are the foundation of the food chains at the poles. Scientists follow the retreating ice to measure and identify the organisms responsible for the blooms and the consumers that come to feed. Ever wonder how a single diatom can make this incredible journey?

- **Witness the role of phytoplankton in the Arctic and the effects of warming by viewing *The Important Little Life of Dylan Diatom*. Press button D.**



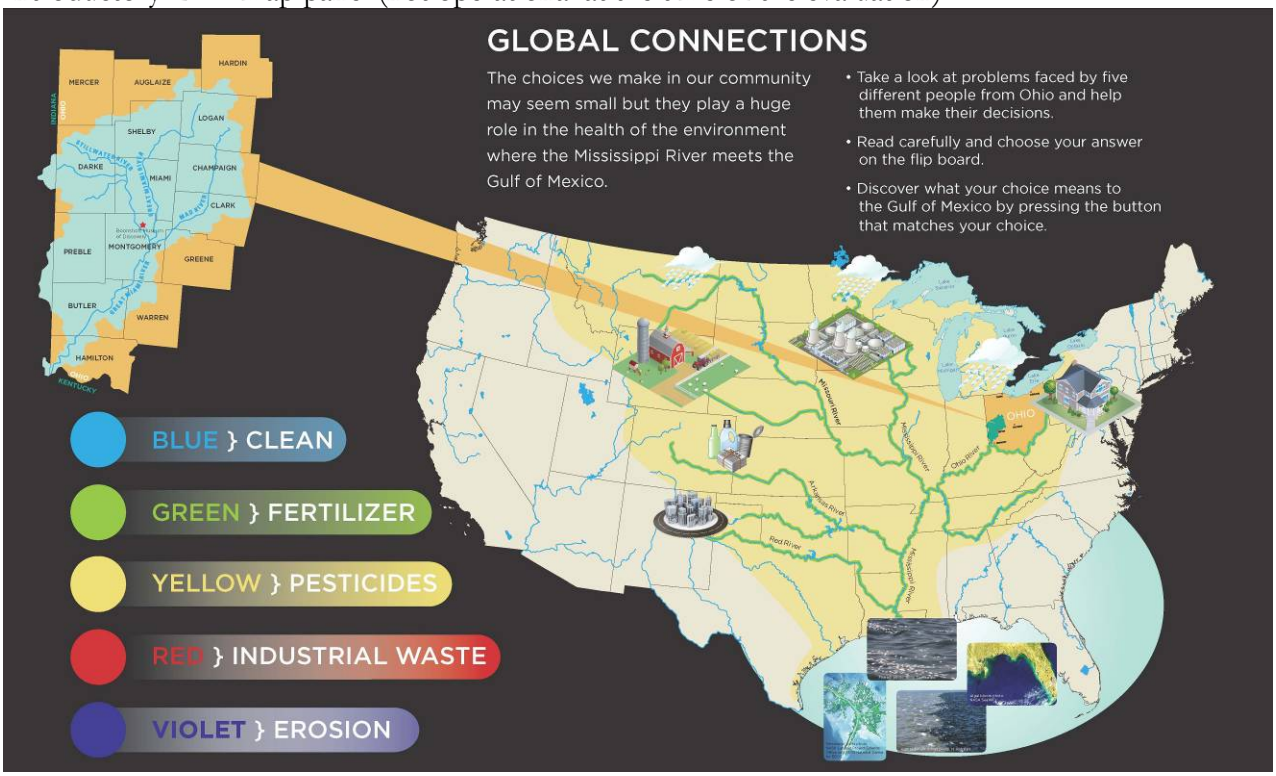
Identifying specific types of diatoms in the soupy, green mix is a huge task for scientists. A few photographs of typical sea ice algae will guide you as you take a look for yourself.

- **Five samples are ready for viewing under the magnifier. Can you find the diatoms? Which sample contains *Thalassiosira*?**

Photos: R. Sambrotto

APPENDIX D: *GLOBAL CONNECTIONS* GRAPHIC PANELS

Introductory LED map panel (not operational at the time of the evaluation)



Flip Panel Choices (side one)

Flip Panel Choices (side two)

APPENDIX E: INTERACTIVE EXHIBIT INSTRUCTIONS

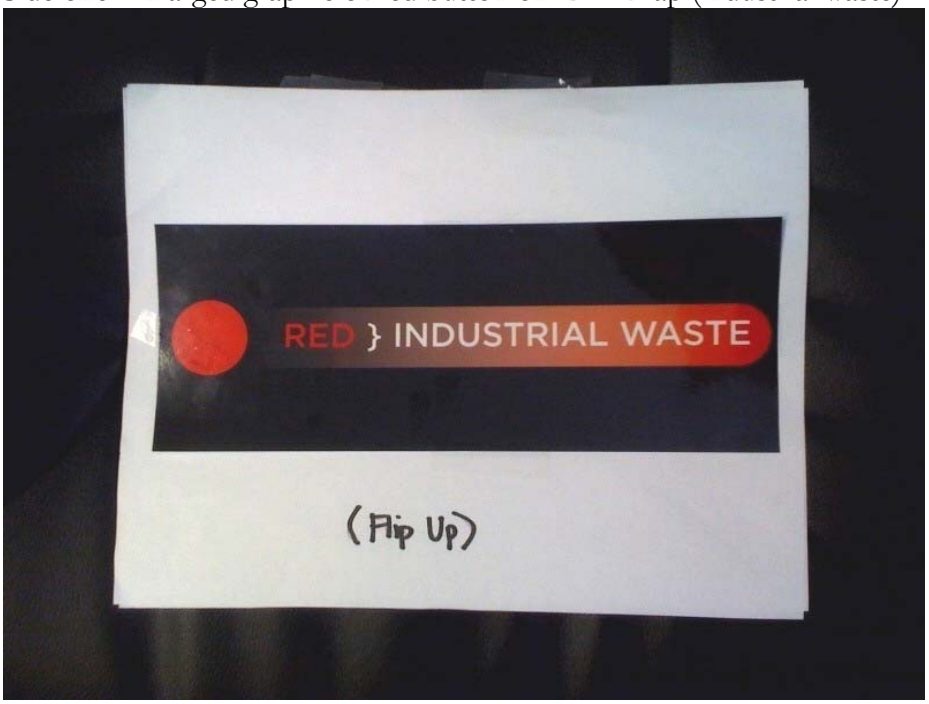
Instructions for orange button boxes:
Only one button can be selected at a time. To see when your selection will play on the sphere, look at the television screen on the left wall. Selections are played in the order they were pushed.

Frozen Connections:
Press button A to see the NASA-produced movie *Frozen*.
Press button B or C to explore data on sea ice concentration.
Press button D to learn about the role of phytoplankton in the Arctic.

Global Connections:
Press button A to learn about dead zones.
Press button B to learn about humans' impact on oceans.
Press button C to see global electricity use (Earth at night).
Press button D to learn about the sea level rise.

APPENDIX F: MOCK-UP OF *GLOBAL CONNECTIONS* EXHIBIT PANEL

Side one: Enlarged graphic of red button on LED map (industrial waste)



Side two: Cause-effect pictures associated with industrial waste