



*Department of Evaluation
&
Research in Learning*

Science On a Sphere

Front-End Evaluation Report

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May 25, 2006

Background

The Science Museum of Minnesota (SMM) is currently prototyping interpretive approaches to using an innovative scientific visualization system developed by the National Oceanic and Atmospheric Administration (NOAA) called Science On a Sphere (SOS). SOS is composed of a wide variety of visualizations projected onto a six-foot sphere creating animated, whole-planet views of the Earth, other planets in our solar system, and their moons. Visualizations of the Earth cover topics such as weather, climate, topography, earth system dynamics, and geophysical processes. A challenge of SOS is making the content accessible and engaging as a stand-alone exhibit where visitors can interact with SOS to create their own meaning from the content rather than simply reacting to its visual displays. This report discusses a front-end study carried out to start addressing this challenge by providing baseline information about visitors' reactions to the Sphere, how they comprehend the visualizations, what they would like to see on the Sphere, and interactions they would like to have with the exhibits' content.

Methodology

The study was carried out January 28 to February 4, 2006. During this time, a series of four narrated NOAA visualizations (Blue Planet, Topographic Earth, Wild Fire, and Earth at Night) were projected onto the Sphere and played continuously. Observational data was gathered to understand how visitors viewed the visualizations and how long they stayed at the Sphere. Upon leaving the exhibit, visitors were interviewed to gauge their reactions to the Sphere, understand their comprehension of the visualizations, and gather feedback about potential exhibit interactions and visualizations.

A continuous random sampling method was used for data collection. There were always two data collectors at Science On a Sphere. While one person was collecting data, the second person supervised the computers running the projectors. The first data collector would position himself near the exhibit entrance and observe the first person age 8 or above to enter the Science On a Sphere exhibit area. The visitor was approached for an interview as they exited the exhibit. Upon completion of the interview, the first data collector would switch with the second data collector. The second data collector would then position herself near the exhibit and repeat the sampling method above. In order to gather additional observational data, the individual who was supervising the computers would wait until the other data collector started to observe a visitor, and then they would observe the next eligible visitor to enter the exhibit. A total of 81 visitors were observed and 50 of these visitors were also interviewed.

Observation Results & Discussion

A. Observation Demographics

Visitor demographics were recorded based on observation only. Similar numbers of males (49%) and females (51%) visited the Sphere. More groups composed of adults and kids (59%) visited the exhibit than groups of adults only (41%). Table 1 shows the observed ages of visitors to the Sphere. The most frequent age ranges were 25-34 (33%) and 35-44 (33%).

Table 1: Ages of Visitors Tracked (n=81)

Age Range	Percent of Visitors
Ages 9-12	6%
Ages 13-16	4%
Ages 17-24	10%
Ages 25-34	33%
Ages 35-44	33%
Ages 45-54	7%
Ages 55-64	5%
Ages 65+	1%

B. Total Time Spent Viewing Science On a Sphere

A total of 81 visitors were observed to see how long they spent viewing visualizations on the Sphere. The loop of four visualizations ran 6 minutes and 55 seconds. Visitors spent a median total time of 3 minutes in the exhibit, with a minimum time of 16 seconds and a maximum time of 14 minutes, 4 seconds (two loops of the visualizations). For comparison, a previous study found the heart video in the Human Body Gallery had a median viewing time of 23 seconds.

C. How Visitors Viewed Visualizations

Visitors were also observed to understand how they viewed the Sphere. Three of the four visualizations rotated so a visitor could stand in one location and view an entire visualization. However, visitors had to walk around the Sphere to experience both daytime and nighttime for the Wild Fire visualization. The narration encouraged visitors to walk to the other side of the exhibit and 63% of visitors were observed circling more than half of the Sphere. However, the most frequently mentioned confusion with the exhibit was where to stand. The narration told visitors to “walk to the other side of the Sphere”, but the exhibit lacked cues to direct visitors where to stand when they entered and where to move to when directed.

Interview Results & Discussion

A. Interview Demographics

A total of 50 visitors were interviewed upon exiting Science On a Sphere. These visitors were from the population of visitors observed. Visitor demographics for interviews were similar to those for timing.

B. Interest in the Sphere

Visitors were asked what they found most interesting about the Sphere. Responses were coded into themes, and representative responses are included for each. Visitors were most interested in the unique technology of the exhibit (40%). The next most common responses were related to visualization of the Earth (30%) and the affective experience (26%).

Tell me one or two things you found most interesting about the Sphere. (n=50)

*Some visitors provided more than one response.

40% The Exhibit's Technology

- Projection system. Curious about how you were synching cameras.
- Can't see a break between cameras. Very fluid motion.
- The size. Being able to go all around it.
- You always see maps on the wall, this is something you can walk around.
- Looks like it's floating.

30% Visualization of Earth

- Visual presentation of the Earth.
- The large display of the globe.
- How it looks from outer space.

26% The Affective Experience

- Great exhibit. Impressive.
- Pretty cool. Never seen such a thing before.
- It's beautiful.
- I'm here. I'm somewhere in this world.

16% Lights at Night

- City lights were fascinating.
- Interstate highway system.
- Electricity patterns/Where people are inhabiting

14% Geographic Features

- Depths and elevation of land and water.
- Being able to visualize environment and topography.
- Being able to see texture of the Earth. More realistic.

10% Night & Day

- For kids to see night and day.
- The sun on one side, nighttime on the other.

6% Geologic Features

- Plates shifting.

6% Other

- Fire (2)
- Color showing heat on Earth.

C. Visitor Understanding of Visualizations

Four visualizations were projected onto the Sphere with accompanying interpretive audio narration. During the interview visitors were shown an image of each visualization, asked if they viewed the visualization, and questioned about their understanding of what they saw. This

provided information of how visitors understand the visualizations when their experience is limited to visual images with audio interpretation. Table 2 shows the percent of visitors who reported to view each of the visualizations.

Table 2: Percent of Visitors

Visualization	Percent of Visitors
Earth at Night (n=49)*	76%
Wild Fire (n=49)*	67%
Topographic Earth (n=50)	66%
Blue Marble (n=50)	64%

*One visitor did not complete the interview.

Earth at Night

Thirty-seven visitors viewed Earth at Night, which as its name suggests, is a visualization of the Earth at night with white areas representing lights from populated regions. Responses of what visitors saw on this visualization were coded into themes, and representative responses are included for each. A majority of visitors mentioned the lighted areas of the planet at night (68%), while 16% stated the image was of Earth at night with no description of what the white areas represented. Only 14% of visitors were unable to describe what they saw on the Earth at Night visualization.

What do you think you are seeing here? (n=37)

68% Lights at Night

- Electric lighting at night.
- Cities at night.
- Fire and street lights.
- Fascinated to see the populated and developed areas.

16% Earth at Night

- Earth at night.
- Nighttime.

3% Other

- Europe and Asia.

14% of visitors were unable to describe what they saw on the visualization.

Wild Fire

Thirty-three visitors viewed Wild Fire, which visualizes nighttime on one side of the Sphere and daytime on the other. The side with Earth at night includes fires over Africa and white areas to represent lights from populated regions. The side with daylight shows topographic features of the planet. Responses of what visitors saw on this visualization were coded into themes, and representative responses are included for each. Visitors most frequently mentioned that they saw fires (55%), specifically in Africa. There were 27% of visitors who mentioned geographic

features, with almost half of these visitors specifically using the term “topography”. The narration for this visualization also directs visitors to the colored lights of fishing boats, which was mentioned by one visitor. Only 15% of visitors were unable to describe what they saw on the Wild Fire visualization.

What do you think you are seeing here? (n = 33)

*Some visitors gave more than one response.

55% Fire

- Fires in Africa.
- Fires in the world.
- A brush fire in Africa.
- Fires across Africa because they were burning to replenish the soil.

27% Geographic Features

- Desert.
- The ocean and land.
- The trenches, the ocean floor.
- Showing topography.

9% Other

- Latin America and North America.
- White, green, red lights.
- Heat sources.

15% of visitors were unable to describe what they saw on the visualization.

Blue Marble

Thirty-two visitors viewed Blue Marble, which is a visualization of what the Earth looks like from space and includes cloud cover, oceans, and landmasses. Responses of what visitors saw on this visualization were coded into themes, and representative responses are included for each. Visitors most frequently mentioned seeing weather features (54%). Visitors also recognized this visualization as how the Earth would look from space (31%), with two visitors calling the visualization the “Blue Marble” as it is referred to in the visualization’s narration. Only 13% of visitors were unable to describe what they saw on the Blue Marble visualization.

What do you think you are seeing here? (n = 32)

*Some visitors gave more than one response.

50% Weather Features

- Cloud cover.
- Just a bunch of clouds. Cloud formation.
- Weather patterns.
- Snow.
- Effects of wind.
- Atmosphere.

31% Earth From Space

- Recreation of our Earth as you would see from space.
- NASA's Blue Marble.

13% Geographic Features

- Land and water.
- Ocean.
- Ocean depth.

6% Other

- South America and North America.

13% of visitors were unable to describe what they saw on the visualization.

Topographic Earth

Thirty-three visitors viewed Topographic Earth, which visualizes the topographic features of the planet. Responses of what visitors saw on this visualization were coded into themes, and representative responses are included for each. Visitors most frequently mentioned viewing topographic features (45%). Additionally, 6% of the visitors mentioned the colors on the visualization, but did not say anything about how the colors related to topography. Only 15% of visitors were not able to describe what they saw on the Topographic Earth visualization.

What do you think you are seeing here? (n = 33)

45% Topographic Features

- Topography.
- Elevation. Green is the lowest.
- Mountains and valleys.
- Depth of ocean.
- Tectonic plates and view of the ocean.

18% Continents

- Saw Africa, not North America.
- Continents.

6% Colors

- The different colors.
- Different oceans and colors seen.

15% Other

- View from space.
- Ocean or landmass.
- Vegetation or rainfall.
- Heat.

15% of visitors were unable to describe what they saw on the visualization.

D. Visitor Confusion With Science On a Sphere

Visitors were asked if they found anything about the Sphere confusing. Responses of what was confusing were coded into themes, and representative responses are included for each. Less than half of the visitors (42%) experienced confusion, with some visitors noting more than one aspect of the exhibit they found confusing. The most frequently mentioned confusing aspect of the exhibit was where to stand (52%). Visitors were referring to the narration during the Wild Fire visualization, which urges visitors to walk to the other side of the Sphere. However, as mentioned earlier in the report, there were no cues to alert visitors to where “the other side” was. Visitors were also confused about some of the content shown on the Sphere (38%).

Was there anything you saw that was confusing? (n=21)

*Some visitors gave more than one response

52% Where to Stand

- Which side to stand. It should have a spot for you to be directed to.
- It was confusing when they said ‘go to the other side to see something different’ and there wasn’t really anything different.

38% Content

- Didn’t know what white spots were.
- Confused about rifts.
- Why the fires?
- Need to explain purple line. Needs to be distinction of color coding and explanation.
- Make lighting fit with narratives.

19% Other

- Thought it would be more than Sphere.
- Didn’t know if you could go in (the area where the Sphere was located).
- Crashed halfway through.
- Hard to hear.

E. Potential Visitor Interactions with the Sphere

During this front-end study, visitors were unable to interact with the Sphere. Their experience was limited to viewing the visualizations and listening to the narration. To guide developers in making the visitors’ experiences with the Sphere interactive, visitors were asked about their level of interest in three potential interactions: controlling the speed of rotation of the images on the Sphere, selecting the images displayed on the Sphere, and having the ability to display temporary labels on the Sphere. For each of these potential interactions, visitors were asked to rate their interest level on a scale of 1 to 10 where 1 was “not at all interested” and 10 was “extremely interested”. Visitors were most interested in selecting images to be displayed on the Sphere (96% with an interest level of 5 or above) and displaying temporary labels on the Sphere (94% with an interest level of 5 or above). Visitors were interested in selecting images so they could “*pick up a topic and talk more about it*” and “*be able to recap*”. Visitors felt labels would be beneficial for pointing out specific features on the visualizations. “*Select one thing to highlight at one time such as all the trenches.*” “*It would be helpful for other countries besides the U.S. Many people only know what’s in the U.S. and not anywhere else.*” A few of the visitors with low interest in

labels were concerned the labels would ruin the visualization. Visitors were least interested in controlling the speed of rotation of images (74% with an interest level of 5 or above). This may be attributed to concerns visitors had with more than one person controlling images at a time. *“I don't want to see what other little kids are flipping through. If they are the only person, yes.”* *“Good if there were one person only, but it would be unfair with 10 other people.”* However, if these concerns are addressed, there were some visitors interested in the ability to control images on their own. *“Would like to be able to control and experiment. But this would be hard if there were groups.”*

F. What Visitors Would Like to See on the Sphere

Visitors were limited to viewing four visualizations of the Earth. To help gather ideas for developing future visualizations, visitors were asked what else they would like to see on the Sphere. Responses were coded into themes, and representative responses are included for each. Visitor responses were spread evenly across most themes. The variety of themes provides developers with a range of ideas to help guide development of Science On a Sphere.

What else would you be interested in seeing on the Sphere? (n=49)

* Some visitors gave more than one response. One visitor did not complete the interview.

20% Astronomy Images

- Stars. Planetarium thing.
- Different planets.
- Showing the Earth during an eclipse.
- Movement of sun.

20% Weather and Climate Images

- Average temperatures
- Current weather on the planet
- Climate change
- Any natural disaster, how they occur and the devastation
- Glacial/ice age melting

16% Points of Reference

- Grid patterns, longitude, latitude, equator, what it means. Time zones. Dividing the different Spheres.
- Major cities.
- Country boundaries. How countries intersect with geographic boundaries.
- Showing the different continents for people who don't know what it is.
- Earth landmarks, for example: Great Wall.

16% Population Density

- Population of different regions.
- Population areas versus non-populated areas.
- Population of people.

16% Geographic Images

- Desert versus rainforest.
- Vegetation density.
- Highlight mountains and rivers.

10% Geological Images

- Continental drift and how it's moving now.
- Pangaea mega continent and splitting apart.
- See how Earth was formed from ice age to today.
- Internally what's going on, like lava flows.

8% Biological Images

- Molecules.
- HIV/AIDS.
- Animal habitation to certain areas.

8% Regional and Local Images

- I would like the idea of maybe having you zoom into a particular area, like Minnesota and talk about it more.
- I would like it if you talked more about a particular region or area.
- My backyard

4% Different Point of View

- To see the top of the Sphere, especially North America
- See it from top down to bottom up

10% Other

- Current events
- Don't know how text would look but you could probably use it to project that on there in an auditorium. Use it in businesses and schools. Would help to make auditoriums smaller but the expense might be big.

16% of visitors did not mention anything else they'd like to see on the sphere.

G. Additional Comments

Visitors were given a chance to share additional comments at the end of the interview. Sixty percent of visitors had additional comments. Responses were coded into themes, and representative responses are included for each. Around one-fourth of these comments (23%) were related to images visitors would like to see on the Sphere, so they were included in the analysis for that question. The rest of the visitors' comments were related to the affective experience (47%) and ideas to improve the exhibit's format (37%). A third of the ideas to improve the exhibit were related to visitors wanting to be able see what was on the top of the Sphere.

Is there anything else you would like to share with us regarding Science On a Sphere? (n=30)

*Some visitors provided more than one response.

47% Affective Experience

- Looks cool. Caught my eye from on museum floor.
- Impressed. At first when I came in I thought it was just a projector, but then it started spinning. It would be boring if you just looked at it spinning but when you put all those other things up there then its interesting.
- Will be neat thing. Will definitely come back to see it.
- Very cool. Love to see more stuff. I can watch it several times and don't see it all.
- Really liked it; kids loved it.
- Made me think what a small planet we live on.

37% Exhibit Format

- Add a mini staircase so people can see the Earth from a higher angle.
- It's a little high. It's hard to see the top, especially for little kids.
- I would rather have someone telling what I'm seeing rather than a pre-recorded audio.
- Interactions. Computer terminals to learn.
- Individual computer consoles so you could adjust/select Earth images on your own without interfering with the large Sphere.
- Hard to hear.

Summary

A. Demographics of Visitors to the Sphere

- Similar numbers of males (49%) and females (51%) visited the Sphere.
- More groups of adults with kids (59%) visited the exhibit than groups of adults only (41%).
- The most frequent age ranges were 25-34 (33%) and 35-44 (33%).

B. Visitor Behaviors At Exhibit

- The loop of four visualizations ran 6 minutes and 55 seconds. Visitors spent a median time of 3 minutes viewing the Sphere. This is a high amount of time to spend at an exhibit, especially when compared to data from the heart video in the Human Body Gallery which had a median viewing time of 23 seconds.
- Almost two-thirds (63%) of visitors were observed circling more than half of the Sphere.

C. Visitor Understanding of Visualizations

- Thirty-seven visitors viewed Earth at Night, which as its name suggests, is a visualization of the Earth at night with white areas representing lights from populated regions. A majority of visitors mentioned the lighted areas of the planet at night (68%), while 16% stated the image was of Earth at night with no description of what the white areas represented.
- Thirty-three visitors viewed Wild Fire, which visualizes nighttime on one side of the Sphere and daytime on the other. The side with Earth at night includes fires over Africa and white areas to represent lights from populated regions. The side with daylight shows

topographic features of the planet. Visitors most frequently mentioned that they saw fires (55%), specifically in Africa. There were 27% of visitors who mentioned geographic features, with almost half of these visitors specifically using the term “topography”. The narration for this visualization also directs visitors to the colored lights of fishing boats, which was mentioned by one visitor.

- Thirty-two visitors viewed Blue Marble, which is a visualization of what the Earth looks like from space and includes cloud cover, oceans, and landmasses. Visitors most frequently mentioned seeing weather features (54%). Visitors also recognized this visualization as how the Earth would look from space (31%), with two visitors calling the visualization the “Blue Marble” as it is referred to in the visualization’s narration.
- Thirty-three visitors viewed Topographic Earth, which visualizes the topographic features of the planet. Less than half of these visitors (45%) mentioned topographic features they viewed on the visualization.

D. Visitor Confusion with Exhibit

- Of the 21 visitors who found something confusing about the exhibit, the most common confusion (42%) was where to stand when viewing the Sphere. These individuals were referring to the Wild Fire visualization, which directs visitors to move to the other side of the Sphere. More explicit visitor cues should be included in future renditions of the exhibit when it is necessary to direct visitors to particular features of a visualization.

E. Visitor Interest in the Sphere

- When asked what visitors found most interesting about the Sphere, they most frequently mentioned the technology of the exhibit (40%). Similarly, a fourth of the visitors were interested in the exhibit’s impressive nature (26%). To address visitors’ interests, it is recommended to provide interpretive information about the technology of the exhibit, especially since this is a new method for visualizing representations of the Earth and other planetary bodies.
- Visitors were most interested in selecting images to be displayed on the Sphere (96% with an interest level of 5 or above) and displaying temporary labels on the Sphere (94% with an interest level of 5 or above). Visitors were least interested in controlling the speed of rotation of images (74% with an interest level of 5 or above).
- Visitors had a wide range of interests in visualizations they would like to see on the sphere including astronomy, weather and climate, geography, geology, and biology.