Planet Earth Decision Theater Live Performance: Visualization Evaluation

By Molly Phipps and Zdanna King

Questions or Comments may be directed to:

Molly Phipps at the Science Museum of Minnesota

mphipps@smm.org (651) 221-4570

Science Museum of Minnesota

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Background

Planet Earth Decision Theater (PEDT) is a NOAA-funded project for Science on a Sphere (SOS) about the impact that humans have on the planet (grant # NA10SEC0080021). For this grant, he Science Museum of Minnesota is developing three versions of the SOS presentation: a facilitated presentation where presenters use an audience response system to engage visitors (the subject of this evaluation), one that is facilitated without the personal response system, and an unfacilitated auto-run version. PEDT is a part of a larger museum effort, Future Earth Initiative, dedicated to highlighting human's impact on the planet and what we might do to mitigate those impacts. The Future Earth exhibition opens on April 21, 2012 and is located in and around the SOS space. In this round of evaluation the program's data visualization and animations were tested *in situ* for clarity and attractiveness. This work will also inform other versions of the show.

Performances of PEDT take place in SMM's newly refurbished Science on a Sphere space, which seats 24 visitors. The new space represents a different configuration for the SOS based on findings of earlier evaluation studies (Grack Nelson's, 2006) as well as professional judgment. Grack Nelson (2006) found visitors spent significantly more time at SOS if they sat then if they did not sit and that few visitors circled the sphere. The new space is more isolated than the original space to combat issues with sound and light, high definition projectors were installed, the entire system is run with one computer instead of six, and tiered seating (with better seats) were installed. The biggest change to the space is that one can no longer walk around SMM's SOS and only three quarters of the sphere are illuminated. These changes give visitors a better view of the northern hemisphere, ensure all visitors can see the same part of the image at the same time, and allow for a presenter to face all visitors at once.

For PEDT, SOS is used to display global data while a flat screen displays local data, multiple-choice questions and results from visitor polls. At specified times throughout the show the presenter asks the visitors a multiple-choice question, visitors vote for their selection by pressing a button on their iClicker (http://www.iclicker.com/) (Figure 1), a personal response system. Aggregate responses are displayed for the group on the flat screen and the presenter summarizes the results. Questions focus on gauging visitors' understanding of images and opinions about humans' impact on the planet as well as humorous questions to help familiarize visitors with the technology.
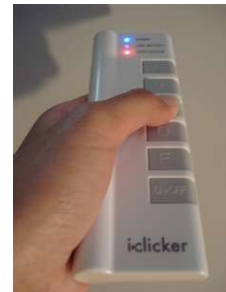

Figure 1: iClicker
keep3.sjfc.edu/students/emm00561/e-port/msti260/iclicker.htm

Methods

Data for this evaluation were collected at three live performances of PEDT on December 31, 2011. Each show was almost filled to capacity with 18, 23, and 21 visitors attending the performances. Starting about 10 minutes prior to show time, the presenter made announcements over the PA system in order to recruit visitors for the evaluation. Here is an example of how she usually phrased the announcements:

"Welcome to the Science Museum of Minnesota. In just a few minutes, Science Live will be testing a brand new presentation: Planet Earth Decision Theater. This interactive show allows visitors to cast their votes and opinions about life on a human-dominated planet. Come be one of the first people to see this brand new show--give us your feedback and get a prize. This presentation will last approximately a half hour."

An evaluator handed a survey to one adult in each group of visitors as they entered the theater. While they were waiting for the show to begin, visitors were asked to fill out the demographic portion of the survey and then wait for more instructions from the presenter. As the show progressed, visitors were directed to answer questions in the survey about SOS visualizations and animations they had just seen. Visitors who participated in the evaluation were given a bookmark with some wildflower seeds as a small token of our appreciation.

A total of 25 visitors filled out surveys; 7 from the first show, 9 from the second show, and 9 from the third show. Although surveys were given to and were intended for adults, three completed surveys (an 8, 9 and 12 year old). Their responses are included in the data, and comments made by these children are followed by their age in brackets because their comments would not always seem appropriate coming from adults.

Results

Image Interest

SOS is a very attractive medium for projection (e.g., Barthel, Phipps, Rowe, 2010, Haley Goldman, Kessler, Danter, 2010), and visitors found the visualizations used in this show interesting. All of the visitors who responded found the airplane traffic and Facebook connection visualizations interesting and most visitors found all visualizations interesting (Table 1).

Table 1. Do you think this animation/image is interesting to look at?

	Yes	No
Airplane Traffic Animation (n=22)	100%	-
Facebook Image (n=21)	100%	-
Cropland Image (n=25)	92%	8%
Pastureland Image (n=25)	92%	8%
Ocean Impacts Image (n=23)	96%	4%
Temperature Anomaly (n=23)	96%	4%

Understanding Images

Although SOS presentations are almost universally visually interesting, they are not always easy for visitors to interpret. Most visitors found the visualizations and animations understandable (Table 2). The Facebook image was the only one that had over 10% of visitors remarking that they had difficulty understanding it, but these visitors' later comments reflect an ability to describe aspects of the images (the white lines, black spaces) appropriately. One of the visitors who found the image difficult to understand was also 8 years old and not a part of our intended sample. However, visitors' answers to this question do not necessarily correlate with understanding. Although 96% of visitors claimed the Sea Animation was easy to understand, open-ended responses indicated poor understanding from all visitors.

Table 2. Do you think this animation/image is difficult to understand?

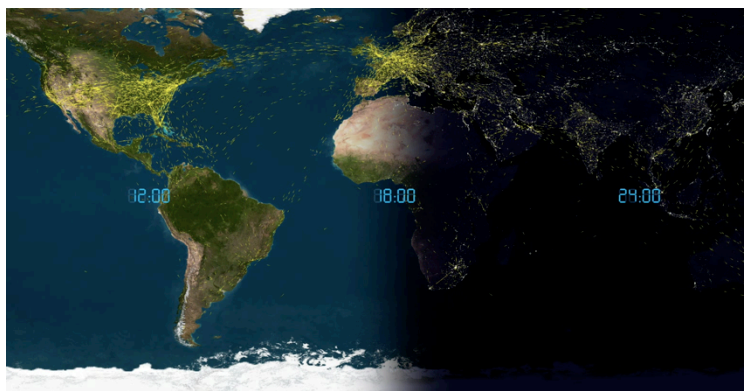|	Yes	No
Airplane Traffic Animation (n=22)	5%	96%
Facebook Image (n=22)	14%	86%
Cropland Image (n=24)	4%	96%
Pastureland Image (n=24)	8%	92%
Ocean Impacts Image (n=21)	-	100%
Temperature Anomaly (n=22)	5%	96%

Airplane Traffic

Figure 2: Airplane traffic around the world.

The first animation tested showed airplane traffic across the globe over the course of 24 hours. Yellow trails moved from city to city with flight patterns changing over the course of the day. As the image played, visitors were asked what they thought the animation was A) Ship traffic, B) Wind patterns, C) Bird migration, or D) Air traffic. Once everyone had voted visitors' responses were tallied on screen, the presenter thanked visitors for their ideas, and told them the correct answer. At that point the show stopped for the evaluation; visitors answered the questions about the airplane traffic animation before continuing the show. Four-fifths of visitors reported that they thought the animation showed airplane traffic before the presenter told them. For those who said they knew before the presenter told them, we asked them what clues they used to figure it out. Half of the visitors keyed into the movement of the dashes, saying they were recognizable patterns. Another quarter of the visitors saw that the dashes originated and ended at major cities. See a selection of their comments below or a complete list in the appendix.

If so, what clues did you use to let you know? (n=17)

53% (9) Pattern of movement
- Typical traffic patterns.
- The direction the points were moving in are popular flight routes.
- Over land couldn't have been ships. Knew there is lots of airplane traffic.

24% (4) Recognizable locations
- It went over land, then moved across water and long distance and, as a frequent flyer, I recognized the airport hubs.
- Over land and sea, between major cities.

24% (4) Other
- Have seen visuals like this before - family used to work for airlines.
- Moving yellow lines.

The visitors who didn't know what the Airplane Traffic image was at first, were asked for suggestions on how to make the animation easier to understand. Their suggestions included changing the shapes of the dashes to miniscule planes flying around the world and adding sounds to the animation.

Facebook Users

Figure 3: Sample of 10,000 Facebook connections.

In this presentation, the number of active Facebook users is used as a proxy for the extreme interconnectedness of global citizens. This visualization mapped a representative sample of 10,000 Facebook friendships. The presenter showed visitors different views of the earth that illustrated the dense web of connections within the US and Europe and the lack of connections in most of Africa, parts of South America, and China. For this visualization, visitors were asked how many active Facebook users there are A) 55 million, B) 800 million (the correct answer), or C) 1 billion. After visitors' answers were shown, the correct answer is revealed and the blackness of China is pointed out. At this point the show stopped and visitors were asked to answer the set of questions about the Facebook visualization.

Facebook Image Surprise Factor

Visitors were asked if the Facebook image was surprising. Half said no and a couple people did not specify what they thought. Of the two-fifths who were surprised, most were amazed by the shear number of Facebook connections and that these connections spanned most of the world.

Is this image surprising to you? If so, in what ways? (n=22)

50% (11) No
- No. [9]
- Not surprising

41% (9) Yes
- I didn't know Facebook is banned in China.
- Yes, it involves the entire world.

9% (2) Not specified
- Very cool.
- Hard to tell where the countries are.

For the most part, visitors seemed to have a good idea what the white lines in the Facebook image represent. Four-fifths of the visitors thought the white lines represented "connections" or friendship. Those who didn't say that thought that the lines represented "air waves", "signals", "transmissions" or a specific number of friends. See a selection of the comments below.

What do the white lines represent? (n=24)

83% (20) Connections or Friends
- Facebook connections. [3]
- Interconnected people.
- The "friendship" between 2 people.

17% (4) Other
- Facebook signals.
- Air waves.

Most visitors seemed to understand that black spaces on the Facebook image were connected to areas with limited internet access or countries where Facebook is banned. More specifically, four fifths noted that these were places that had blocked or restricted access to the Facebook website. A fifth of visitors said that these were areas with limited internet access. Thirteen percent simply said that there were "no connections," and another 13% of visitors said something that could be

interpreted as having a muddled idea of what the image represents. Of these, one visitor said it could be related to a low population of people in the black areas, another said it could be lack of popularity of Facebook in those places. See below for a selection of visitor comments.

Why are some places black? (n=24*)
*Some visitors gave more than one response.

79% (19) Blocked or restricted access to Facebook site
• Because it's blocked there.
• China blocks Facebook.

21% (5) Limited access to the internet
• Do not have capability in some remote areas.
• No access in China, less technologically advanced areas.

13% (3) No Facebook connections
• Do not have capability in some remote areas.

13% (3) Visitor stated something we weren't looking for
• Facebook is blocked or unavailable (is it only a sampling, so may be less population in those countries).
• No Facebook or people. Water, air.
• None - or not many Facebook users. Lack of popularity/access.

13% (3) Other
• No use of Facebook in those areas.
• No friends/Facebook.
• Facebook rare in Africa and old USSR.

Cropland versus Pastureland
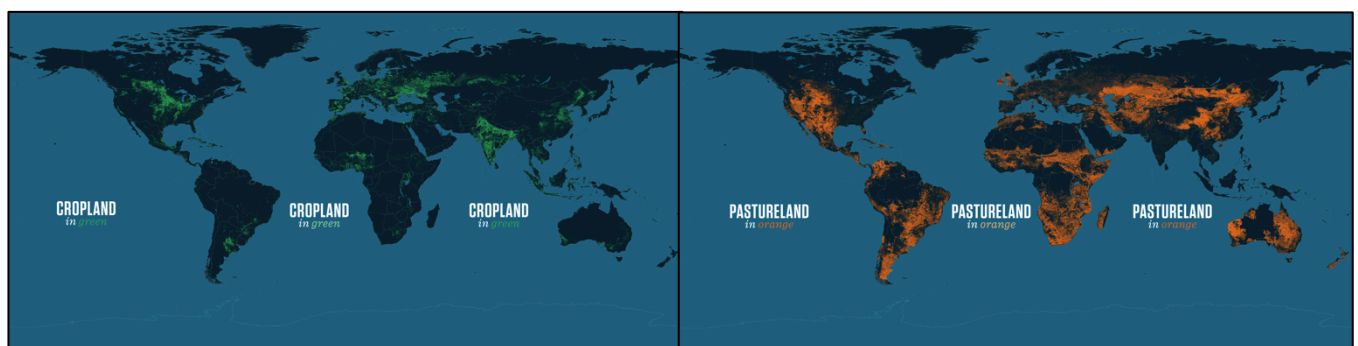
Figures 4 & 5: Insert images of cropland (left) and pastureland (right)

The next visualizations tested were of the extent of pastureland and cropland around the world. Visitors were asked how much of the earth's ice-free land is currently used for agriculture: A) 10%, B) 20%, C) 30%, D) 40% (correct answer), or E) 50%. The presenter shared the answer then showed visualizations of the extent of cropland and pastureland. Again, the show was stopped after each visualization for visitors to answer the evaluation questions.

Because most urbanites are not intimately familiar with the details of farming, the design team was interesting in knowing how visitors think about the terms "cropland" and "pastureland." To assess this, we asked visitors to define each term and then to tell us what they thought the difference was between the two. Most people defined cropland in terms of what it produces, but one quarter of visitors specified that it is used to grow food for people. Three-fourths of the visitors defined pastureland as land used to support animals or livestock. When asked to contrast the two terms, half of the visitors specified that crops grow food for people, while pastureland supports animals which people eat. The other half of respondents used very general phrases, such as "animals and crops" or "plants versus animals" as their explanations. While these responses begin to get at the differences between cropland and pastureland, they are not exactly correct. Since growing crops for animals to eat represents a major use of cropland in some areas of the world (e.g., North America, Western Europe), this is not a subtle difference. Cropland is any land cultivated that is harvested before it is eaten, so corn grown to be fed to animals is included in cropland. Pastureland is any land where animals directly graze on the plants whether what they graze is naturally occurring or is planted for their use. Visitors are not fully getting this distinction. A change in the script may alleviate this confusion, because the script refers to cropland as "the amount of land currently being used to feed the world's 7 billion people" and pastureland as "land used for raising livestock."

How would you define cropland? (n=25)

64% (16) Farming, agriculture, or growing food
- Areas able to grow crops.
- Areas for growing food.
- Land to grow edible foods and materials.

24% (6) Growing food for people
- Land used to grow plants/crops for human consumption.
- Land where plants are easily grown, controlled and harvested by humans.

13% (3) Other
- Capable of growing plant life.
- Crops in different places.
- Greenery - more natural.

How would you define pastureland? (n=24)

75% (20) Land for livestock, animals
- Land used to keep livestock.
- Where animals are feeding, being raised.

21% (5) Other
- Pasture places.
- Plants that naturally grow and feed wildlife.
- Where animals eat.

4% (1) Unsure
- Don't know. [Age:9]

What is the difference between crop and pasture land? (n=24)

50% (12) Food for humans versus food for animals
- One has animals feeding off/living there, while plants are harvested from cropland and moved elsewhere.
- Cropland = plants for food. Pastureland = animals for food.
- Crops for humans. Pasture for animals.

46% (11) Other
- Pastureland is for animals, crops for growing plant life.
- Plants versus animals.

4% (1) Unsure
- Don't know what pastureland is. [Age:9]

The design team was also interested in knowing how visitors thought about the distribution patterns of cropland and pastureland. After each of these images, visitors were asked, "Do you think this pattern is mostly natural, mostly human-made, or about half natural and half human-made?" Over half of the visitors opted that the distribution patterns of both cropland and pastureland were about half natural and half human-made (Table 3).

Table 3. Do you think this pattern is…?

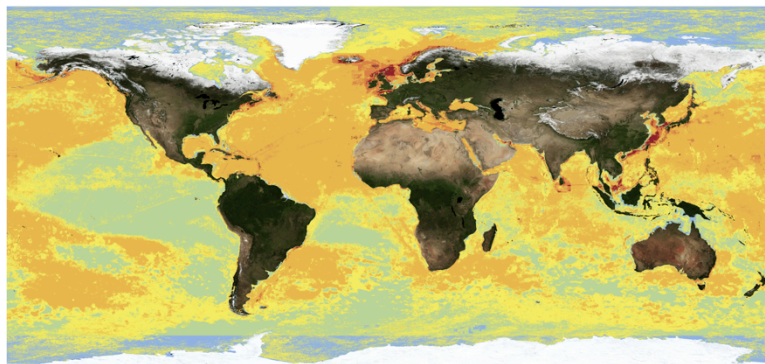|	Cropland Image (n=25)	Pastureland Image (n=25)
Mostly natural	20%	28%
Mostly human-made	24%	12%
About half natural and half human-made	56%	60%

Ocean Impacts

Figure 6: Human impact on the oceans blue=low impact, red=high impact

The fifth image tested during the presentation features the impact that humans have had on our oceans and seas. The visualization uses a spectrum ranging from blue = little impact to yellow = medium impact, and red = high impact. There were no audience response questions about this image. The presenter noted to the audience all areas of the ocean are impacted by human activity to some degree and shared some examples of these impacts including pollution, over fishing, and oil spills . The presentation stopped at this point to evaluate this visualization. The top three responses visitors suggested were the three mentioned in the presentation. Two fifths of visitors came up with things that weren't explicitly talked about in that part of the presentation.

What are some things that negatively impact the ocean? (n=24)*
*Some visitors gave more than one response.

50% (12) Pollution
- Pollution. [12] [Age:12]

46% (11) Overfishing
- Fishing.
- Over fishing. [10]

33% (8) Oil spills & drilling
- Oil drilling.
- Oil spills. [7] [Age:8]

38% (9) Other
- Toxic waste.
- People.
- Traffic, waste disposal.
- Melting glaciers, temperature changes.
- Everyday about 1,000 people are polluting the oceans. Just a guess. [Age:9]
- Boat travel, polluted water run-off leading to the ocean, dumping off other chemicals, moving invasive species, global warming, changing Na+ concentration.
- Run off from industry and farming.
- Whaling.
- Bleaching coral reef.
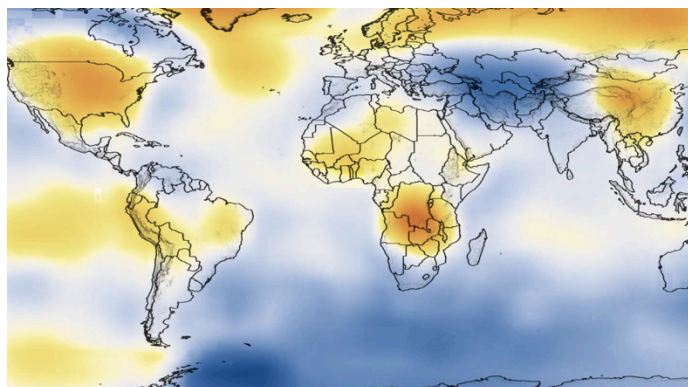
Temperature Anomaly

Figure 7: Screen capture of atmospheric anomaly 1884-2008

This animation was problematic for visitors, even though they said that it was not difficult to understand. The animation shows five-year averages of atmospheric temperature anomalies from 1884-2008 using the time frame from 1951-1980 as the normal reference point. Temperature readings were collected by meteorological stations, ships, and satellites (http://sos.noaa.gov/datasets/Atmosphere/giss_temp_anom.html). Visitors could only describe the visualization in vague terms. Three-fourths of the visitors said it was showing a change in temperature. Not one visitor thought it was an anomaly or difference from an average, but some visitors mentioned the small temperature changes shown. Given people's skepticism about the severity of climate change, this might not be the best animation to use. Examining the script, the results are not too surprising. The description of this visualization is inaccurate. "Now if you'll look on the sphere you'll see how the planet's average temperature has increased starting from 1884 through 2008. The dark red areas demonstrate the largest increase in warming and the blue less increase." This is not what the animation is showing, it is showing deviation from a normal reference point where red=hotter than normal and blue=colder than normal.

What is this animation trying to show? (n=23)

74% (17) Change in general temperature, global warming
- Climate change/Global warming.
- Change in overall temperature over the last 100+ years.
- How much the temperature has changed over time - global warming? Should have been mentioned how little the temp change is.
- Temperature differences from 1888 - 2008.
- The increase versus decrease in average yearly temperature over the last 100 years. The decreased temp was not well mentioned.

9% (2) Human activity
- Human impact on oceans.
- How much human activity is going on, on our earth. [Age:9]

17% (4) Other
- How the years change. [Age:8]
- Pollution in the ocean.
- The change in environment over the last century.

- The amount of CO2 in the atmosphere over a 100-year span.

Understanding the Difference Between Direct Representations of Data and Computer Modeling

The PEDT show uses visualizations that are all based on real data and observations, not models or computer projections. The choice to use only real data was a conscious one because many detractors of climate change are highly doubtful of the veracity of climate models. To understand if visitors knew that these visualizations were all derived from real data; we asked what they thought for each visualization. This was not a binary question (model or real data); visitors responded to a yes or no question about each visualization being 'based on real data and observations' and another yes or no question 'based on computer models.' Most visitors thought that images and animations were based on computer models *and* real data and observations with more visitors reporting they came from real data and observations than from models (Table 4). This topic requires further investigation. There is little to no emphasis in the script about each visualization being based on real data and observations, not model output, but there is also no mention of the word 'model' or the phrase 'computer model.' If more emphasis in the script does not change this perception, it would be worth conducting some interviews with visitors about their understanding of the terms 'real data and observations' and 'computer model.' There is a possibility the language in our survey may have been confusing. Even computer projections are *based* on "real data and observations", since these are used to create the parameters of the projections.

Table 4. Percent of Visitors that said Each Image or Animation was Based on Real Data and Observations or Based on a Computer Model*

	Real Data & Observations	Computer Model
Airplane Traffic Animation	88% (24)	77% (22)
Facebook Image	96% (25)	73% (22)
Ocean Impacts Image	92% (24)	77% (22)
Temperature Anomaly	92% (25)	67% (21)

* Numbers in parentheses behind percentages reflect the sample size for each response.

Additional Visitor Comments

Visitors could leave additional comments on the back of the survey booklet if they wanted to talk about something in more detail or that wasn't addressed in the survey. Of the eight visitors that responded, seven of them gave glowing praise for the show. They said it was "interesting", "awesome" and "fun". The other visitor commented that the theater looked "very haphazard". This comment is not that concerning, however, since the space was not intended to look finished and visitor-ready as it is still under construction. All comments are listed in the appendix.

Recommendations

With one exception, the SOS visualizations for PEDT are clear and attractive to visitors. The presentation also communicates some things very well, including the impacts that we have on the ocean, and how connected we are via airplane and social media. To make the show stronger, we would recommend a few changes to both the images and the script:

- Add flying planes in the Airplane Traffic animation, as suggested by visitors at the show.
- Be more specific in the script about the differences between cropland (land where food is harvested before being consumed by people or animals) and pastureland (land where food is eaten in the field by animals)
- Be more explicit about the visualizations showing real data and observations, not models
- Reworking the section using the atmospheric temperature anomaly to include text properly explaining the animation and emphasize that it is showing an anomaly. The other option would be to use an animation of changing atmospheric temperature over time, not an anomaly.

Overall, Planet Earth Decision Theater was well received and the visualizations were apprehensible and interesting to visitors.

References:

Barthel, C. F., Phipps, M., & Rowe, S. (2010). *Making Meaning from Spherical Displays*. Paper presented at the Ocean Sciences Meeting, February 22-26, Portland, OR.

Grack Nelson, A. (2006). Science on a Sphere formative evaluation report. Science Museum of Minnesota: St. Paul, MN.

Haley Goldman, K., Kessler, C., & Danter, E. (2010). Science On a Sphere: Cross-site summative evaluation (pp. 59). Edgewater, MD: Institute for Learning Innovation.

Demographics

Table 5. Age of Survey Takers (n=25)

Age Ranges	% of Visitors
6-8*	4%
9-12*	8%
13-17	-
18-20	-
21-29	8%
30-39	40%
40-49	12%
50-59	12%
60-69	16%
70-79	-

*An 8, 9 and 12 year old filled out surveys, though the survey was given to adults in their party.

Table 6: How would you rate your interest in science on a scale of 0 to 10? [Zero being "not at all interested" and ten being "Extremely interested".] (n=25)

Rating	% of Visitors
10	36%
9	16%
8	28%
7	4%
6	8%
5	8%

Table 7: Who did you come to the museum with today? (n=25)

	% of Visitors
Adults only	28%
Adults and children	72%
Alone	-

Table 8: Gender (n= 25)

	% of Visitors
Male	32%
Female	68%

Table 9: With which group do you identify? (n=25)

	% of Visitors
African American	8%
White	84%
South Asian	4%
Asian	8%
Other	-

Table 10: Before today, how many times have you visited the museum in the last 2 years? (n=25)

	% of Visitors
None	16%
1-2 times	28%
3-4 times	16%
5 or more times	40%

Table 11: [If you homeschool your children] Are you using the museum today for homeschool activities? (n=1)

	% of Visitors
Yes	-
No, but we have in the past	100%
No, we don't use the museum for homeschooling needs	-

Appendix

The appendix contains the full range of responses to the open ended questions. They are organized by the image or animation with which they were associated in the survey booklet.

Airplane Traffic Animation

Did you think it was airplane traffic before the presenter told you? (n=24)
- 79% Yes
- 21% No

If so, what clues did you use to let you know? (n=17)

53% (9) Pattern of movement
- Movement all over the developed world both to and from.
- Typical traffic patterns.
- The direction the points were moving in are popular flight routes.
- The movements across the globe.
- Over land; couldn't have been ships. Knew there is lots of airplane traffic.
- The back and forth movement.
- Closeness of arrows in opposite directions.
- Following the consistent movements.
- There were many dashes going across the ocean. [Age:12]

24% (4) Recognizable locations
- It went over land, then moved across water and long distance and, as a frequent flyer, I recognized the airport hubs.
- The concentration around cities.
- Land destinations.
- Over land and sea, between major cities.

24% (4) Other
- Have seen visuals like this before - family used to work for airlines.
- Moving yellow lines.
- Just a guess.
- I know. [Age:9]

If not, now that you know, what would help you know that without being told? (n=6)
- Shapes of moving objects on sphere in the shape of planes.
- Picture of planes.
- Shape of yellow lines.
- What the numbers were...moving across the globe...
- Make sounds. [Age:8]
- ?

Facebook Image

What do the white lines represent? (n=24)

83% (20) Connections or Friends
- A connection between 2 Facebook users.
- Facebook connections. [3] [Age:9]
- Facebook friends.
- Facebook friends - 1 million.
- Facebook users. [2]
- Connection.
- Connections. [3] [Age:8]
- Connections among users.
- Connections between people. [Age:12]
- Connections (friends) on Facebook.
- Connections on Facebook.
- Interconnected people.
- People connections.
- The "friendship" between 2 people.
- Users of Facebook - friend connections.

17% (4) Other
- Facebook signals.
- Transmissions.
- 10,000 friends.
- Air waves.

Do you see anything recognizable in this image? (n=24)
- 75% Yes
- 25% No

If so, what do you see? (n=17)

53% (9) General countries, continents and/or cities
- Continents. [2]
- Countries.
- Countries/Continents.
- Countries, continents.
- Different countries.
- Heaviest use areas are in the most developed parts of the world.
- Outlines of continents/Countries.
- Places/Countries.

47% (8) Specific places
• Italy, Spain.
• USA.
• A black spot where China is. [Age:9]
• Strongest connections in US and Europe.
• China gap.
• Europe, America, cities. [Age:12]
• Country outlines, absence of China.
• Europe and US heavily involved.

Why are some places black? (n=24*)
*Some visitors gave more than one response.

79% (19) Blocked or restricted access to Facebook site
• Because it's blocked there.
• Blocked.
• China blocks Facebook.
• They banned Facebook.
• Facebook illegal in China.
• Facebook is banned (not allowed to use Facebook).
• Facebook is not allowed to use.
• Banned in China.
• Illegal to use Facebook there.
• No users-banned.
• No Facebook or connection. [Age:12]
• No Facebook allowed. [2]
• No access in China, less technologically advanced areas.
• None - or not many Facebook users. Lack of popularity/access.
• Restricted - China.
• 2. Are not legal. [Age:9]
• Facebook is blocked or unavailable (is it only a sampling, so may be less population in those countries).
• No Facebook or people. Water, air.

21% (5) Limited access to the internet
• None - or not many Facebook users. Lack of popularity/access.
• 1. Don't have computers. [Age:9]
• Do not have capability in some remote areas.
• No access in China, less technologically advanced areas.
• No signal.

13% (3) No Facebook connections
• No connection.
• No connections. [Age:8]
• No Facebook or connection. [Age:12]

13% (3) Visitor stated something we weren't looking for
- Facebook is blocked or unavailable (is it only a sampling, so may be less population in those countries).
- No Facebook or people. Water, air.
- None - or not many Facebook users. Lack of popularity/access.

13% (3) Other
- No use of Facebook in those areas.
- No friends/Facebook.
- Facebook rare in Africa and old USSR.

Is this image surprising to you? If so, in what ways? (n=22)

50% (11) No
- No. [9] [Age:12]
- No, because I know lots of people are addicted. [Age:9]
- Not surprising.

41% (9) Yes
- By how connected. [Age:8]
- I didn't know Facebook is banned in China.
- It is surprising.
- Yes - amazing how connected we all are.
- Yes - the vast network of connections.
- Yes- how connected the white lines are to other continents.
- Yes, it involves the entire world.
- Yes, the amount of Facebook traffic.
- Yes, actually - that is, a lot of "friends".

9% (2) Not specified
- Very cool.
- Hard to tell where the countries are.

Cropland Image

How would you define cropland? (n=25)

64% (16) Farming, agriculture, or growing food
- Areas able to grow crops.
- Areas for growing food.
- Farmland used to grow food product.
- Farming.
- Garden or farm. [Age:9]
- Land used to grow food.
- Land that can support crop life.
- Land sustainable for crops.

- Land that is farmed for food.
- Land to grow edible foods and materials.
- Land being farmed.
- Land where crops grow.
- Land involved in agriculture.
- Places you can grow crops. [Age:8]
- Use for growing crops.
- Worked to get food.

24% (6) Growing food for people
- Land used to grow plants/crops for human consumption.
- Land where plants are easily grown, controlled and harvested by humans.
- Supply us with farmable foods.
- Used to food for men and farm animals.
- Where plants are grown by people. [Age:12]
- Where people farm plants.

13% (3) Other
- Capable of growing plant life.
- Crops in different places.
Greenery - more natural.

Pastureland Image

How would you define pastureland? (n=24)

75% (20) Land for livestock, animals
- Land used to keep livestock.
- Land used to feed and house animals.
- Land used to feed animals.
- Used for growing animals.
- Land used to raise animals.
- Pastures are for raising animals. [Age:8]
- Land where animals are enclosed by humans to control and create products or use for services.
- Land that is used to sustain livestock.
- Where animals are feeding, being raised.
- Land to raise cattle.
- Where animals are raised by people. [Age:12]
- Land for domesticated animals to feed.
- Land used by farm animals.
- Grassland for animals.
- For animal growth/future food.
- Land for livestock.
- Land used for livestock.
- Land for grazing animals.

21% (5) Other
- Land where animals are pasturing.

- Open land, fences and animals.
- Pasture places.
- Plants that naturally grow and feed wildlife.
- Where animals eat.

4% (1) Unsure
- Don't know. [Age:9]

What is the difference between crop and pasture land? (n=24)

50% (12) Food for humans versus food for animals
- Crop is food product. Pastureland is to support livestock, which can be a food product.
- Cropland for humans, pastureland for animals.
- Cropland -> grow plants. Pastureland -> grazing animals.
- One has animals feeding off/living there, while plants are harvested from cropland and moved elsewhere.
- Cropland is used for producing crops. Pastureland is used for producing livestock and feeding them.
- Ones for food - ones for feeding cattle.
- Crops - are used directly. Pasture - animals use directly, we use the animals.
- Cropland - farming of planted crops. Pasture - natural land plants for farmed animals to roam.
- Crops for humans, grassland for animals.
- Cropland is where crops grow. Pastureland is where animals graze.
- Cropland = plants for food. Pastureland = animals for food.
- Crops for humans. Pasture for animals.

46% (11) Other
- Animals and crops. [2] [Age:8]
- Crop - plants. Past - animals.
- Cropland is for agriculture.
- Cropland is tilled and planted.
- Crops - Humanly grown. Pastureland - Naturally and sometimes humanly grown.
- Horses, cows on pasture.
- More pasture than cropland.
- Pastureland is for animals, crops for growing plant life.
- Plants versus animals.
- Plants are crops, animals are pastures. [Age:12]

4% (1) Unsure
- Don't know what pastureland is. [Age:9]

Ocean Impacts Image

What are some things that negatively impact the ocean? (n=24*)
*Some visitors gave more than one response.

50% (12) Pollution
• Pollution. [12] [Age:12]

46% (11) Overfishing
• Fishing.
• Over fishing. [10]

33% (8) Oil spills & drilling
• Oil drilling.
• Oil spills. [7] [Age:8]

38% (9) Other
• Toxic waste.
• People.
• Traffic, waste disposal.
• Melting glaciers, temperature changes.
• Everyday about 1,000 people are polluting the oceans. Just a guess. [Age:9]
• Boat travel, polluted water run-off leading to the ocean, dumping off other chemicals, moving invasive species, global warming, changing Na+ concentration.
• Run off from industry and farming.
• Whaling.
• Bleaching coral reef.

Sea Animation

What is this animation trying to show? (n=23)

74% (17) Change in general temperature, global warming
• Temperature changes over the years. Global warming.
• Climate change/Global warming.
• Changing in temperatures over the years.
• Change in overall temperature over the last 100+ years.
• Global warming. [2]
• How much the temperature has changed over time - global warming? Should have been mentioned how little the temp change is.
• Heat difference. [Age:12]
• How much warmer the earth is now.
• Heat changes over time.
• The increased deviation in temperature over the years.
• Temperature differences from 1888 - 2008.
• Temperature through 1800-2008.
• The direction from the norm of temperature.

- The increase versus decrease in average yearly temperature over the last 100 years. The decreased temp was not well mentioned.
- Temperature change over years.
- Warming of our planet during a time frame. CO2 in the atmosphere.

9% (2) Human activity
- Human impact on oceans.
- How much human activity is going on, on our earth. [Age:9]

17% (4) Other
- How the years change. [Age:8]
- Pollution in the ocean.
- The change in environment over the last century.
- The amount of CO2 in the atmosphere over a 100 year span.

Additional Visitor Comments

Any other comments? (n=10)
- [Under Question 8 about Cropland Image 3 where they said "No" to "Is the image interesting to look at?" visitor wrote in, "Just not as interesting as the other."]
- [After Question 10 about Cropland Image 3, visitor wrote in, "Would be nice if she showed them slower."]
- Interesting use of clickers.
- The show is AWESOME!! Don't change this show at all!! Thank you! [Age:9]
- Interesting info - loved the global sphere - the 5 year old loved it.
- Very fun presentation! Kids really enjoyed the show! [Children were 9 and 5 years old.]
- Presentation was excellent. We enjoyed it so much. Would like to see again.
- The theater was very haphazard - I assume you'll unwrap the alligator, though.
- Fun - enjoyed it.
- Great presentation!