Summative Evaluation Report for

Earth from Space: Exploring Satellite Data to Better Understand Global Systems

Internships with Oregon Space Grant Consortium College and University Students
Live Programming for the Oregon Museum of Science & Industry Science On a Sphere® Exhibit
Rural Outreach with Magic Planet® Tabletop Exhibits

By

Chris Cardiel

Liz Rosino

Hever Velázquez

OMSI Evaluation & Visitor Studies Division

August 2013

The material is based upon work supported by NASA under award No. NNX10AD90G

Table of Contents

Acknowledgements

The authors wish to extend their deepest gratitude to the following people and organizations:

The Oregon Space Grant Consortium, for the recruitment of interns by communicating with committee members in the Oregon University System.

The Libraries of Eastern Oregon network, for promoting the Magic Planet tour by creating press releases and newspaper advertisements as well as moving the Magic Planet between libraries.

ScienceWorks museum, for hosting the Magic Planet and coordinating educational program for the public.

Steve Utt, for his expertise on Magic Planet and helping train interns on developing datasets.

Peter Wu, at Southern Oregon University for his recruitment and mentorship of rural southern Oregon interns.

The twelve interns who participated in project internships, for their enthusiasm in researching, developing, and delivering educational programming to OMSI audiences.

And the OMSI *Earth from Space* project team, including Jamie Hurd, Dr. Marilyn Johnson, Nate Lesiuk, Kate O'Neil, Kate Simmons, Sue Wu, and Brian Berry, as well as many others who offered their support over the course of the project, for their unparalleled insight, expertise, and dedication.

PART 1: PROJECT BACKGROUND

This document reports on the findings of summative evaluation activities undertaken in the course of the National Aeronautics Science Administration (NASA) CP4SMP grant project, *Earth from Space*: *Exploring Satellite Data to Better Understand Global Systems* (Grant No. NNX10AD90G). During this project, the Oregon Museum of Science and Industry (OMSI) collaborated with NASA staff, college and university student (or recent graduate) interns from Oregon Space Grant Consortium (OSGC) institutions and other colleges, and rural library partners in the Libraries of Eastern Oregon (LEO) network. The purpose of these collaborations was to create programming related to the Earth Science Division of NASA's Science Mission Directorate, with particular emphasis on Earth Observing Systems (EOS) datasets. The project content focused on personally relevant, NASA-identified issues such as climate change, weather and climate, and the monitoring of environmental hazards. Through project programming and demonstrations, the project team and partners hoped to improve public audience understanding of the Earth as an integrated system.

Project Description

The project included live Science On a Sphere (SOS) demonstrations at OMSI (Figure 1), live Magic Planet demonstrations at ScienceWorks in Ashland, OR, and traveling Magic Planet spherical display system tabletop exhibits (Figures 2 and 3) to rural outreach venues in Eastern and Southern Oregon (see Appendix A for a complete list of Magic Planet hosting locations). The project also included student interns who were recruited from OSGC institutions and other colleges and universities and trained to develop and disseminate live *SOS* demonstrations at OMSI and Magic Planet demonstrations at ScienceWorks.

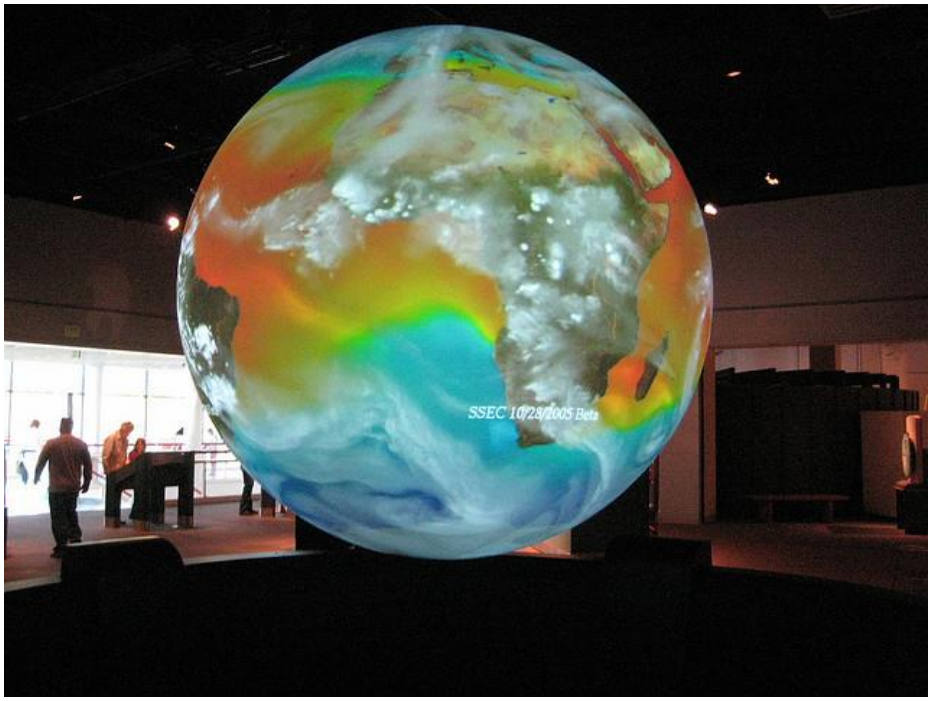


Figure 1: Science On a Sphere *display in OMSI Earth Hall*

Figure 2: Magic Planet display at The Dalles Public Library

Figure 3: Magic Planet display at ScienceWorks, Ashland, OR

Project Intended Impacts and Outcomes

This study focused on the public impact of the SOS and Magic Planet demonstrations and the impact on the interns as a result of participating in the development and implementation of the SOS demonstrations. Table 1 provides a complete list of impacts and outcomes, as well as related evaluation questions employed to guide data collection and analysis. It should be noted that these impacts and outcomes were adapted slightly from those originally included in the project proposal; these adaptations were made in order to more fully and accurately capture the experiences of both audiences and to permit meaningful interpretation of data collected in the course of the project.

Table 1: Earth from Space *project impacts and outcomes*

Public Audiences (Rural and Portland Metro)	
Impact (The project will…)	**Outcome (Measure of Success)**
1. Facilitate an understanding of how NASA *Earth Observing Systems (EOS)* satellite data is collected and interpreted for various uses	**1.** 70% of visitors to both SOS and Magic Planet programming will understand how NASA EOS data is collected through remote sensing systems and is interpreted for various uses
2. Provide new knowledge about the connection between NASA EOS data and the area in which they live	**2.** 75% of visitors to both SOS and Magic Planet programming will recognize the connection between NASA EOS data and the area in which they live
3. Provide new knowledge about the relevance and value of NASA data for understanding changes in the Earth related to where they live	**3.** 75% of visitors to both SOS and Magic Planet programming will recognize the relevance and value of NASA data for understanding changes in the Earth related to where they live
Professional Audience (Program Interns)	
Impact (The project will…)	**Outcome (Measure of Success)**
1. Engage interns with NASA datasets to share with the general public	**1.** 100% of the interns/collaborators report that the project engaged them with sharing datasets with the public
2. Help interns understand the connection between formal research and educating the public	**2.** 100% of the interns/collaborators report that the project helped them understand the importance of the connection between formal research and educating the public
	3. 100% of the interns/collaborators report that the project increased their interest in educating the public
3. Foster a sustained interest in STEM (Science, Technology, Engineering, Mathematics) careers.	**4.** 100% of the interns/collaborators report that the project sustained their interest in STEM careers

Project Deliverables

Over the course of the three-year project (2010-2013), OMSI staff worked with project partners to develop and implement a set of deliverables contributing to the accomplishment of the intended project impacts stated above. Table 2 provides a complete list of the general deliverables developed for this project, as well as more specific operationalizations of these deliverables.

Table 2: Earth from Space *Project Deliverables*

Public programs to showcase how NASA datasets help us use STEM to understand Earth systems*
○ Programming for OMSI's SOS ○ Rural outreach with Magic Planets to extend the reach of SOS programs
Internships with OSGC college and university students converting "data to demos"*
Hands-on demonstrations and exhibit updates to interpret how satellites are used to collect data
○ Updates to OMSI's permanent version of the NASA-funded exhibit *A View from Space* to further connect its content to SOS ○ Two tabletop "micro" versions of *A View from Space* that provide similar context to the Magic Planet-based programs and tour with the units to rural libraries and schools
Linking to NASA Resources (OMSI/rural outreach)
○ Promote awareness of MY NASA DATA, a NASA citizen science program ○ NASA professional development for teachers through the Aerospace Education Services Project (AESP)

**For this summative evaluation study, only the live public programs delivered through OMSI's Science On a Sphere and the Magic Planet at ScienceWorks, the rural outreach with Magic Planets, and the internships with Oregon Space Grant Consortium (OSGC) college and university students were included and only these deliverables are assessed below.*

Project Evaluation

In addition to being the primary focus of the summative evaluation activities described below, the components developed in the course of the project (i.e., SOS and Magic Planet program development and demonstrations, Magic Planets table top exhibits, OSGC student interns) were also part of formative evaluation in order to provide preliminary feedback to the project team. That evaluation work provided the team with feedback to address any potential issues and offer an opportunity to make project improvements.

Formative and Remedial Implications for the Summative Evaluation

Formative evaluation activities are conducted with the intent of providing actionable data to facilitate the improvement of project components and activities. Ideally, post-formative changes based on evaluation results should improve the project components included in the evaluation. These improvements can also address specific content elements that will increase the potential for measured successes during summative evaluation.

For example, the findings at the formative phase of the project suggested that participants demonstrated understanding at some level how NASA *Earth Observing Systems (EOS)* satellite data is collected and interpreted for various uses. Most responses (58%) included topics related

to planet earth and its climate/weather systems, while 18% of responses dealt directly with the technology used to examine these systems. These findings, along with several others, were shared with the project team, and were discussed in terms of how well the programming was currently meeting its goals in order to inform any ongoing changes.

Summative Evaluation Methods

The following paragraphs outline the study methods employed for both the public and professional (intern) audience components of this project. Public and professional audience participant demographic and related information is provided in the Findings section below.

Public Audience Sampling and Data Collection

A self-administered survey (available in Appendix B) was provided to visitors who participated in the Science On a Sphere demonstrations at OMSI in the museum's Earth Hall. For these purposes, visitor participation is defined as visitors who listened to and engaged with the demonstrations carried out by OSGC student interns. The surveys were handed to visitors by evaluation staff at the conclusion of each presentation. Student interns were also advised on the purposes and parameters of the study so that they could directly and indirectly assist in the data collection protocols. Before and after the demonstrations, program presenters made formal announcements using the Earth Hall's speaker system in order to encourage visitor participation. Evaluation staff also assisted in rounding up visitors by walking around the Earth Hall and formally inviting attendees to "check out" the demonstration.

Evaluation staff members were present throughout demonstrations but did not participate as audience members; instead, they prepared a materials "station" that consisted of a rolling cart which included the necessary materials to conduct the study. These materials included copies of the survey, writing utensils (pencils), and extra clipboards, as well as chairs and a table where participants could fill out the surveys if they preferred to sit down. To ensure adequate visitor participation in the study, evaluation staff approached as many visitors who had watched and/or engaged with the demonstration as they were walking away and asked them if they would like to complete the survey.

In addition to the data collection activities conducted at OMSI, an evaluator traveled to Moro, The Dalles, and La Grande Public Libraries and the ScienceWorks museum in Ashland to train staff there on how to collect data for the project. Staff were provided a "cheat sheet" with at-a-glance instructions and considerations (see Appendix C) on how to approach and ask members of the public audience to complete the self-administered survey shown in Appendix B. This training involved going over the goals of the evaluation as well as a brief overview on confidentiality and overall human subject ethical considerations (e.g., voluntary survey completion, privacy, identification, psychological trauma, etc.). Staff were instructed to only select participants who interacted and engaged with the Magic Planets table top exhibit for more than five minutes.

Public Audience Data Analysis

All data were analyzed through the use of Microsoft Excel or IBM SPSS Version 20. Open-ended responses were read and coded, when appropriate, for persistent themes which emerged across participants with a subsample of at least 20% of responses coded by a second evaluator to assess inter-rater reliability (which ranged from .793 to .966 using basic percent agreement). Independent samples *t* tests, Pearson product moment correlation, and one-way analyses of variance were performed to confirm that no statistically significant differences or relationships existed on the basis of participant demographic variables.

Professional Audience (Intern) Sampling and Data Collection

Program interns were recruited and selected by OMSI's Human Resources and Volunteer Services departments with the participation of the program development team. Once interns were selected and offered the position, the program development team advised participants (i.e., interns) that they would be participating in research and evaluation activities related to the project in order to assess the degree to which the project succeeds in meeting its objectives. Once interns voluntarily agreed to participate in the project, they were briefly interviewed by evaluation staff and were asked to complete a self-administered Entrance Survey (See Appendix D). The brief interview was used as an "ice-breaker" and to explain the purpose and instructions for the survey as well as to address confidentiality and identity protection protocols.

Some interns took the survey in person while others had to be emailed an electronic version of the survey to complete on their own time and were given a deadline to return the completed form to evaluation staff. The multi-regional design of the project called for alternative options for survey administration – the location and availability of student interns were used to determine the method of survey implementation (i.e., in-person or email). In addition to the Entrance Survey, the intern portion of the study also required that student interns take a self-administered Exit Survey (provided in Appendix E) after they completed their service on the project. The focus of the surveys was to assess the success of the project objectives and to capture overall feedback on their experience with the project. It should be noted that some interns continued their work with OMSI in another capacity after the conclusion of their *Earth from Space* internship. In these cases, however, the exit surveys were still completed prior to their transition to their new role.

In addition to the entrance and exit surveys, a third method of data collection was also used with this audience to gather more in-depth qualitative data. Evaluators contacted a subsample of *Earth from Space* interns (n = 3) via email several months after the conclusion of their internships and asked them if they would be interested in participating in brief interviews to discuss their experiences with the project. All three of the interns agreed to participate in these interviews, which were conducted either in person or over the phone and were audio recorded in full after receiving written consent from each participant. The interviews consisted of four open-ended questions specifically designed to address the four intended outcomes for the project's professional audience, as well as probes to be used when initial responses failed to

provide sufficient depth to tell the story of the interns' experiences. (The interview guide, including probes, is provided in Appendix F.)

Professional Audience (Intern) Data Analysis

All data were analyzed through the use of Microsoft Excel or IBM SPSS Version 20. Open-ended responses were read and coded, when appropriate, for responses which were repeated across participants. The responses to the three brief follow-up interviews were transcribed verbatim and double-checked for accuracy by a second evaluation staff member. The interview responses are provided in the following pages with particular concepts and themes noted in the Results and Discussion sections.

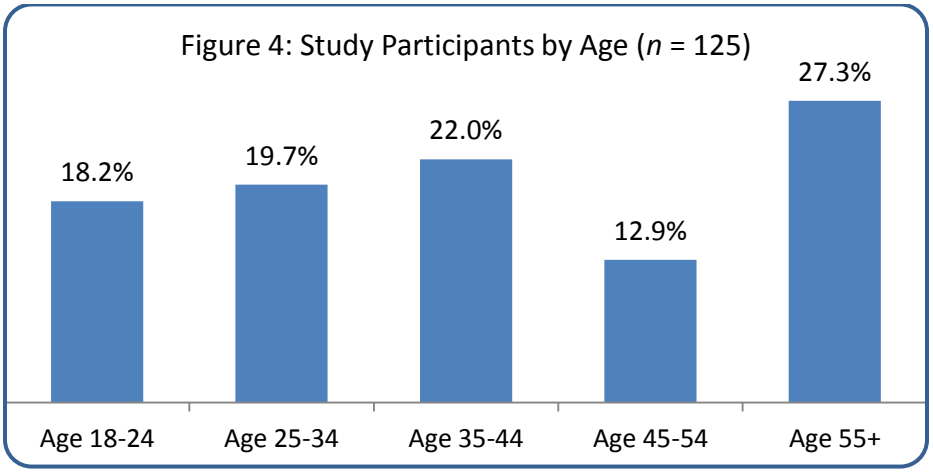
PART 2: PUBLIC AUDIENCE STUDY PARTICIPANTS AND RESULTS

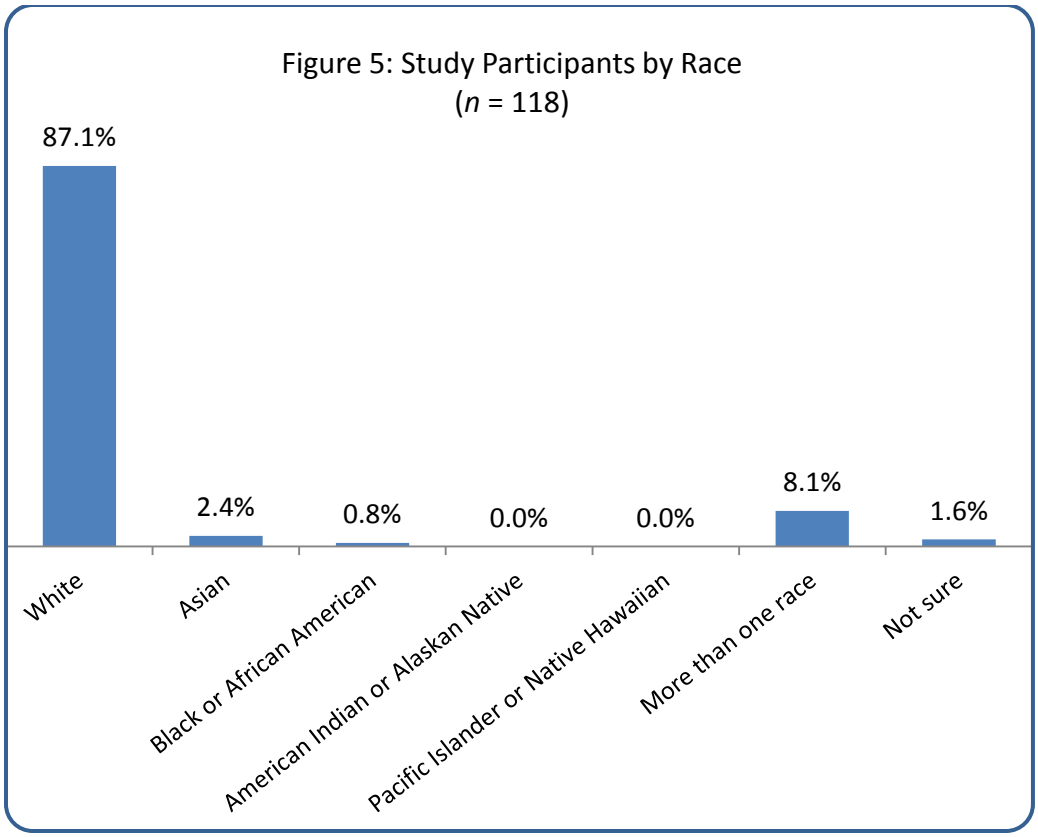
> *"I really enjoyed it and appreciate OMSI sharing it with Wasco County. Thank you!" – Magic Planet Audience Member, The Dalles Public Library*

Participants

A total of 144 public audience participants were included in this study, with 102 (67.5%) of these being general audience members recruited after viewing a live Science On a Sphere presentation at OMSI. The remaining 49 (32.5%) were recruited for participation after interacting with the Magic Planet tabletop exhibit at one of four rural outreach locations in eastern Oregon; these included The Dalles Public Library (13.2%, *n* = 20), La Grande Library (6.0%, *n* = 9), Moro Public Library (8.6%, *n* = 13) and the ScienceWorks Museum in Ashland (4.6%, *n* = 7).

The sample included slightly more women (51.7%, *n* = 78) than it did men (37.7%, *n* = 57), with 16 individuals declining to provide their gender. Similarly, participant distribution across age groups was remarkably consistent, with a slightly greater proportion of individuals reporting their age as 55 and over (see Figure 4). Of the individuals who provided this information, participants were disproportionately likely to be white (see Figure 5) and non-Hispanic.





Also, while 87% of participants in the sample overall tended to have completed at least some college and the median income level reported was $50K—$59,999, there were significant differences in both income and education between OMSI visitors and participants at rural outreach locations.

On a seven-point response scale, OMSI visitors reported higher average household incomes (approximately $60K—$69,999) than did visitors to rural outreach locations (approximately $30K—$39,999). This difference was statistically significant, $t(100) = 6.21$. $p < .001$. Likewise, on a five-point response scale, visitors to OMSI Science On a Sphere demonstrations reported a higher average education level (tending toward "Graduated College") than did rural outreach audience members (who tended toward "Some College"), with this difference also being statistically significant, $t(115) = 2.58$, $p = .01$.

Results

Intended Outcome 1.1: 70% of visitors to both SOS and Magic Planet programming will understand how NASA EOS data is collected through remote sensing systems and is interpreted for various uses

RQ1: To what extent do visitors understand how NASA EOS data is collected through remote sensing systems and interpreted for various uses?

When asked to describe something new they had learned, a total of 74.5% of visitors (80% at OMSI, 61.9% at rural outreach locations) provided specific descriptions of accurate, presentation- or program-specific content, demonstrating a high level of understanding of the ways NASA EOS data can be interpreted for various uses. Similarly, when asked what they thought the main idea of the presentation was, over 90% of visitors (90.1% at OMSI, 90.2% at rural outreach locations) were able to provide either basic or sophisticated descriptions of the program or presentation they had just watched. Furthermore, 87.8% of visitors stated that they were "Satisfied" or "Very Satisfied" with the topic clarity and ease of understanding. A possible area for improvement in future similar programming is in relation to the link between the visual interpretation of data and how the data are *collected*, as only a small number of visitors explicitly mentioned satellite systems in their responses to these questions.

Educational Take-Away

When audience members were asked to describe some of the new things they had learned as a result of participating with the program or presentation, 74.5% of responses included clear and accurate messages related to the presentation content, while an additional 12.4% included messages which were at least somewhat relevant but which were vague rather than specific. Please refer to Table 3 for the complete distribution of responses to this question.

Table 3: Participant responses, "What are some new things that you learned today as a result of your participation with the program/presentation?"

Code	Total		OMSI		Rural	
	#	%*	#	%*	#	%*
Clearly articulated content messages from program/presentation	102	74.5%	76	80%	26	61.9%
Vague comments regarding program/ presentation content	17	12.4%	10	10.5%	7	16.7%
Non-content-related responses	18	13.1%	9	9.5%	9	21.4%

*Percentage of participants who responded to this question

Responses which included clearly articulated content messages tended to move beyond a simple surface-level restatement of the general presentation topic:

> *"A sea level rise of 1m would have a very large impact, but the change from 1m to 5m of sea level rise is much less."*
>
> *"Differences in vegetation density, amounts of precipitable water vapor."*
>
> *"Did not really think that gravity changing based on location/elevation."*

Vague comments, by contrast, generally related only to the broad topic which was discussed in the presentation:

> "*How the atmosphere works."*
>
> *"Be mindful about water."*
>
> *"Amount of sea rise."*

A small percentage (6.6%) of participants also explicitly mentioned satellites in their responses to this question.

> *"How GRACE works and how aquifer levels can be used to evaluate droughts."*
>
> *"That a pair of satellites are used to measure gravity."*
>
> *"We use satellites to tell us about H2O patterns."*

This may indicate that the *processes* by which EOS data are collected may not be what sticks in audience members' minds; however, the high percentage of relevant content responses suggests that the presentations were successful in helping visitors understand the *uses* for such data interpretation. While the percentage of visitors who provided clearly articulated content messages was somewhat higher at OMSI than at rural outreach locations, the combined percentages for clear and vague content-related responses was well over 70% for both audiences.

Visitor Understanding of Topic and Program/Presentation "Big Idea"

In order to understand the extent to which the programs and presentations administered during the *Earth from Space* project were comprehensible by audience members, evaluators asked study participants to describe (in their own words) the main idea of the program or presentation they had just watched. Due to the wide variety of content included in these programs and presentations, the analysis of participant responses does not include topic-specific coding; however, a review of the responses does provide some interesting insight into visitors' levels of understanding regarding the programs and presentations. A total of 54.4% of participants (n = 81) responded with basic, surface-level descriptions of the program or presentation topic, while an additional 37.6% (n = 56) were able to make more sophisticated

connections between ideas and within specific concepts. The distribution of responses at OMSI and rural outreach locations is illustrated in full in Table 4.

Table 4: Participant responses, "What do you think was the main idea of the program/ presentation?"

Code	Total		OMSI		Rural	
	#	%*	#	%*	#	%*
Deep connections made within and between concepts	56	37.6%	37	36.6%	19	39.6%
Basic restatement of program/presentation content	81	54.4%	54	53.5%	27	56.2%
Non-content-related responses	12	8.1%	10	9.9%	2	4.2%

*Percentage of participants who responded to this question

Again, responses involving basic restatements of program or presentation content tended not to go beyond a broad surface level:

> *"Magnetic fields."*
>
> *"To educate display user about various global science."*
>
> *"To teach about weather."*

Responses which indicated deeper connections being made between and within program or presentation concepts, however, tended to be somewhat more complex:

> *"Showing all the different ways satellites influence our daily lives/ Also showing us what our daily lives do to influence our planet.*
>
> *"Showing the possibilities of life on other planets from them having ice (water)."*
>
> *"Inform visitors about migration patterns and human impact on the aquatic environment."*

The percentage of visitors who made such connections was slightly greater at rural outreach locations (39.6%, *n* = 19) than at OMSI (36.6%, *n* = 37), but not significantly so. In addition to these descriptions of the program or presentation content, 13.4% of participants (*n* = 19) made explicit connections between scientific or satellite data systems or information and the content they described:

> *"Give information about what gravity does and how it's used to detect water using satellites."*

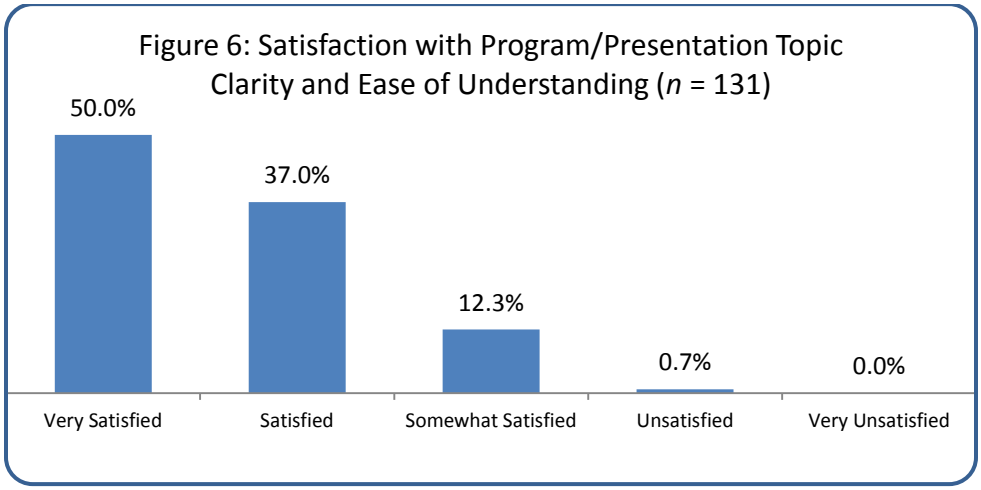
"To show what can be taught over long distance thru satellites/computer."

"To better inform the public on how satellite data can be useful."

While percentage of visitors who mentioned satellites might appear low, the distribution of participant responses shown in Table 5 below does indicate that audience members were overwhelmingly able to make a variety of connections between the program/presentation ideas and concepts and NASA satellite or data systems when specifically prompted to do so.

In addition to providing their own open-ended descriptions of what they learned, participants were asked to rate their satisfaction with the program or presentation's topic clarity and ease of understanding on a five point scale from "Very Unsatisfied" to "Very Satisfied." In general, the visitors who answered this question reported a high level of satisfaction, with 87% stating they were either satisfied or very satisfied. The complete response distribution is illustrated in Figure 6. An independent samples *t* test indicated no significant differences in mean scores between OMSI participants and those from rural outreach locations.

Figure 6: Satisfaction with Program/Presentation Topic Clarity and Ease of Understanding (*n* = 131)



Intended Outcome 1.2: 75% of visitors to both SOS and Magic Planet programming will recognize the connection between NASA EOS data and the area in which they live

RQ2: To what extent and in what ways do visitors make connections between NASA EOS data and their everyday lives?

A total of 83.9% of visitors (80.8% at OMSI, 91.2% at rural outreach locations) made specific connections between satellite information and their communities. Additionally, another 4.5% of visitors (5.1% at OMSI, 2.9% at rural outreach locations) indicated that they felt connections existed but did not provide details about these connections.

Connections between Satellite Data and Everyday Life

Audience members at OMSI and the four rural outreach locations were asked to share their thoughts regarding the connections between satellite information and the community where they live, with responses coded for persistent themes. The vast majority (88.4%, *n* = 99) of those who responded to the question were able to make at least one connection, and many audience members saw multiple ways in which their communities were affected by satellite information. The percentage of audience members who were able to make at least one connection was slightly (but not significantly) greater at rural outreach locations (94.1%, *n* = 32) than at OMSI (85.9%, *n* = 67), and there were a few individuals at both OMSI (5.1%, *n* = 4) and rural outreach locations (2.9%, *n* = 1) who indicated that connections existed but who did not provide specifics. Even taking these factors into account, however, the total percentage of audience members who were able to clearly articulate specific connections between satellite information and their communities was well over 75% among both OMSI and rural audiences. (Please refer to Table 5 for the complete distribution of responses to this question.)

Table 5: Participant responses, "What connections do you think there are between information from satellites and our community?"

Code	Total		OMSI		Rural	
	#	%*	#	%*	#	%*
Understand earth/environment/weather systems (e.g. *"Satellites show [e]ffects of human behavior on the environment."*)	49	42.2%	30	38.5%	19	50.0%
More or better information/understanding in general (e.g. *"Satellites provide data to study, so we can better understand what is happening."*)	41	35.3%	26	33.3%	15	39.5%
Media/communications (e.g. *"Satellites connect w/ our community because of cell phones and other methods of communications."*)	14	12.1%	6	7.7%	8	21.1%
Technological effects or benefits (e.g. *"If we are using equipment that relies on magnetic poles, changes in the poles will [a]ffect it."*)	13	11.2%	9	11.5%	4	10.5%
Connections made, but no specifics provided (e.g. *"too much to answer."*)	5	4.3%	4	5.1%	1	2.6%
Learn about space/the solar system (e.g. *"Lots: satellites are very important for gathering knowledge about space & learning about space is important to everyone."*)	4	3.4%	3	3.8%	1	2.6%
No connection made (e.g. *"Not sure."*)	14	12.1%	11	14.1%	3	7.9%

*Percentage of participants who responded to this question. Responses could include more than one code, so percentages do not total to 100%.

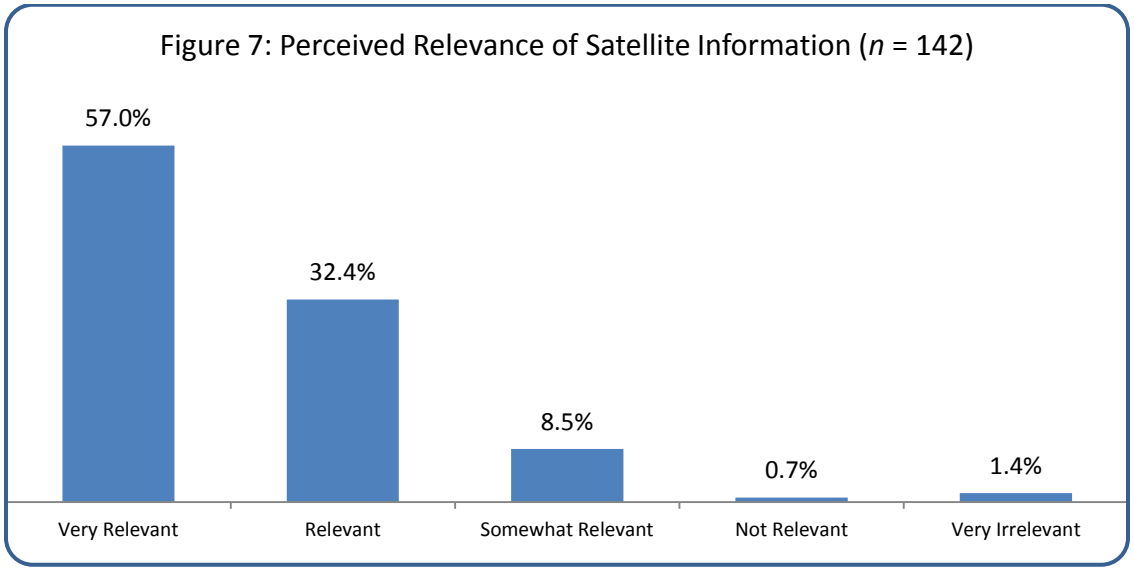
Intended Outcome 1.3: 75% of visitors to both SOS and Magic Planet programming will recognize the relevance and value of NASA data for understanding changes in the Earth related to where they live

RQ3: To what extent and in what ways do visitors recognize the relevance of NASA data for understanding changes in the Earth related to where they live?

A total of 89.4% of visitors stated that they felt satellite information was "Relevant" or "Very Relevant" to understanding everyday life after watching the *Earth from Space* program or presentation. Similarly, 86.5% of visitors reported being "Satisfied" or "Very Satisfied" with the relevance of the program or presentation they watched. These findings were consistent across OMSI and rural audiences.

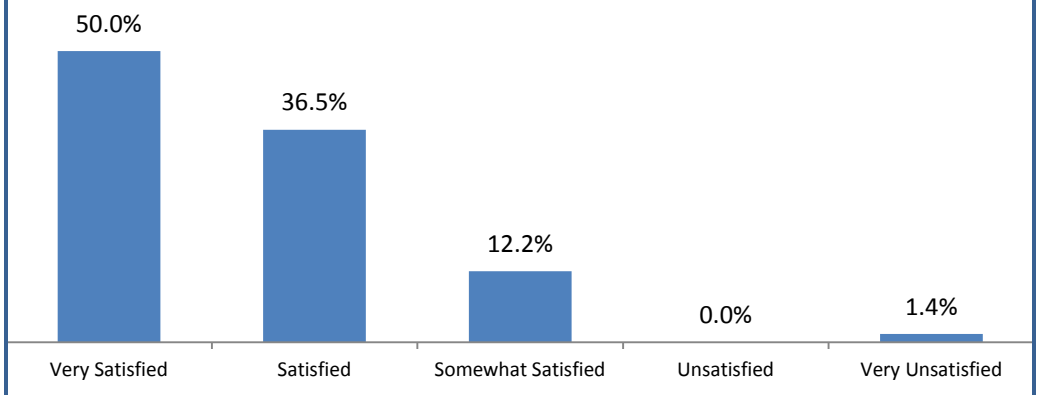
Perceived Relevance of Satellite Information

To explore the overall level of perceived relevance among audience members, participants were asked "After watching this program/presentation, how relevant do you think satellite information is to understanding everyday life in our communities?" There were five possible responses to this question, ranging from "Very Irrelevant" to "Very Relevant." Visitors generally expressed a relatively high level of perceived relevance, with 89.4% of those who responded stating that they found satellite information either relevant or very relevant. The complete response distribution is illustrated in Figure 7. An independent samples *t* test indicated no significant differences in mean scores between OMSI participants and those from rural outreach locations.



In addition to this question, audience members were also asked to think about the program or presentation they had just seen and to rate their level of satisfaction with its relevance to their everyday life and local community. As with the previous question, five possible responses were provided ranging from "Very Satisfied" to "Very Unsatisfied." Also in keeping with the findings from the previous question, visitors appeared to be highly satisfied with the relevance of the programs, with 86.6% of visitors responding with either "Satisfied" or "Very Satisfied." The complete response distribution is illustrated in Figure 8. An independent samples *t* test indicated no significant differences in mean scores between OMSI participants and those from rural outreach locations.

Figure 8: Satisfaction with Program/Presentation Relevance
(*n* = 148)



RQ4: To what extent and in what ways do visitors recognize the value of NASA data for understanding changes in the Earth related to where they live?

When visitors were asked to describe the connections they saw between satellite data and the communities in which they live, five broad types of connection were consistently made. The most common of these were connections related to understanding Earth and its weather and environment, as well as more and better information about life in general. Visitors also saw connections between satellites and technology, communication, and a better understanding of space and the solar system. Over 80% of visitors (80.8% at OMSI, 91.2% at rural outreach locations) were able to clearly articulate one or more of these connections.

Perceived Value of Satellite Information

As illustrated in Table 5 above, after viewing an *Earth from Space* program or presentation, study participants were able to make several different connections between NASA satellite data and their own lives and experiences. The most commonly cited way in which participants felt that satellite data impacted their communities was by facilitating an understanding of the Earth and its weather and environmental systems, followed closely by their ability to provide more or better information than would otherwise be available. Both of these connections were proportionately more common among rural audiences than OMSI visitors, but were by far the two most common types of response regardless of location. In addition to these responses, participants also made connections between satellite data and effects or advances related to technology and communication, as well as the ability to learn more about space and the solar system.

While the participants in this study were not explicitly asked to describe the level of value they would assign to the connections they might make between satellites and their own communities, the frequency and variety of these connections appears to indicate a generally positive perception regarding the utility of satellite data. Furthermore, even without being specifically prompted to think of these connections in terms of their perceived level of value, many visitors provided responses which clearly indicated some level of appreciation for the opportunities and information afforded by remote sensing data. Such responses ranged from broad statements regarding the utility of satellite data:

> *"Communities gather an abundance of information from satellites."*
>
> *"We are all affected by the world in which we live, and satellites help us gather information about it."*
>
> *"We can connect basic small scale understanding of our communities, towns, county and expand those to our world."*
>
> *"The satellites give us the information we need to learn about other planets and the possible future of our planet."*

To more detailed descriptions of the particular ways in which satellite data can be used to address specific needs:

> *"Helps us to plan trips, activities. Prepare for emergency situations – storms."*
>
> *"They give us info we use to impact H2O policy and ecological impact."*
>
> *"Satellites can tell us what's happening on the earth and give information, temperatures and relevant data to the effects of weather and human made dangers to the earth."*
>
> *"Satellite information can help us learn more about our solar system, which could eventually impact our communities."*

Through responses like these, visitors clearly demonstrated the value they assigned to data collected by remote sensing systems. The range and number of value-laden responses to this question also suggest that while explicit linkage between satellites and *Earth from Space* demonstrations was rare during some of the questions described earlier, visitors may in fact have been able to make such connections had they been asked to do so.

PART 3: PROFESSIONAL AUDIENCE (INTERN) STUDY PARTICIPANTS AND RESULTS

Participants

From March 2011 to August 2013, a total of 12 Oregon Space Grant Consortium (OSGC) college and university students participated in the *Earth from Space* project through an internship program established by OMSI. This group included interns who worked primarily at OMSI during the course of the project, as well as some who were managed and coached at the ScienceWorks museum in Ashland. At the commencement of the internship period, each student was asked to complete an entrance survey which allowed them to share their intentions and hopes regarding the internship and to describe the resources which they had used to prepare for the position. Entrance surveys were collected from nine of the 12 students. Several of these questions were closely mirrored by questions on the exit survey which was intended to be completed by each student at the conclusion of their internship period. (Due to early departures and other complications, only six of the 12 students completed the exit survey.) By including similar questions at two time points, evaluators had the opportunity to assess the extent to which the *Earth from Space* internship experience met the expectations of students involved therein.

Although intern demographic information was not tracked, responses to the entrance and exit surveys can be used to provide an understanding of the OSGC students who participated in the *Earth from Space* project. Of the nine students who completed the entrance survey, eight (88.9%) stated that their primary role on the project would be as a program intern, with the remaining student stating that they were unsure of their intended role. This uncertainty was likely due to initial confusion regarding the differences between the job description choices provided. Unsurprisingly, this response was no longer evident during the exit survey, with 100% (n = 6) of students indicating they had served in the role of program interns.

When they were asked to share what they expected to gain from the internship experience from a list of possible choices, the most common responses among students who completed the entrance survey were “Professional/work experience,” “Learn how to engage the public with difficult or complex information,” and “Learn more about museum science education techniques and how to present scientific data.” These were also the three most common responses to a corresponding question on the exit survey which asked interns to share which of a list of possible outcomes they felt they had actually gained from their experiences, indicating that the program was potentially successful in meeting the needs and expectations of student interns. (A complete overview of responses to these questions is provided in Table 6.)

Most students reported gaining from the experience what they had initially expected to gain. Experience with science education program development, however, was not highly anticipated, but was strongly reported as an outcome of involvement with the project (as indicated by an increase of 27.7% from the entrance survey to the exit survey). While “Learn about Adobe software” decreased by 22.2%, it was in fact not one of the choices provided on the entrance and exit surveys (two interns wrote it in under “Other” on the entrance survey); as a result, it is possible—or even likely—that this decrease would not have occurred if not for this dynamic. It

should be noted that the sample sizes for these surveys were too small to provide statistical significance when comparing responses.

Table 6: Participant responses, "Besides academic credit, [what do you expect to gain] / [what did you gain] from this experience?

Expected/Reported Outcome (participants could select more than one outcome from the list)	Entrance Survey (*n* = 9)		Exit Survey (*n* = 6)	
	#	%	#	%
Professional/ work experience	9	100%	6	100%
Learn how to engage the public with difficult or complex information	9	100%	5	83.3%
Learn more about museum science education techniques and how to present scientific data	9	100%	6	100%
Advance my training for a STEM career	7	77.8%	4	66.7%
Ability to understand NASA satellite datasets	6	66.7%	4	66.7%
Interest in pursuing a STEM (Science, Technology, Engineering, Math) career	6	66.7%	4	66.7%
Understand the connection between formal research and educating the public	6	66.7%	4	66.7%
Public speaking skills	5	55.6%	3	50.0%
Science education program development	5	55.6%	5	83.3%
Learn how satellites work	2	22.2%	1	16.7%
Other: Learn about Adobe software	2	22.2%	0	0.0%

Interns were also asked during the entrance survey to read a list of program components and indicate the specific components on which they would be working, with 88.9% stating that they would be working on Science On a Sphere. In addition to this component, the Magic Planet and *Earth from Space* program components were each mentioned by approximately half of the survey participants. Interestingly, during the exit survey, the percentage of interns who reported working on the Magic Planet component was substantially lower, while the percentage who worked on *Earth from Space* was moderately higher. Response distribution is illustrated in full in Table 7. Again, the survey sample sizes did not provide sufficient power to determine statistical significance.

Table 7: Participant responses, "What [are] / [were] the specific components of the program that you [will be working on] / [worked on]?

Program Component (participants could select more than one option from the list)	Entrance Survey (*n* = 9)		Exit Survey (*n* = 6)	
	#	%	#	%
Science On a Sphere	8	88.9%	6	100%
Magic Planet	5	55.6%	1	16.7%
Earth from Space	4	44.4%	4	66.7%
Library presentations	0	0.0%	1	16.7%
Program Development	0	0.0%	0	0.0%
Not sure	0	0.0%	0	0.0%

In order to understand the ways in which students prepared for and engaged with their internship duties, entrance survey participants were asked to list up to five outside resources they had used to prepare for their role in addition to what was provided by OMSI staff, while exit survey participants were asked to describe their day-to-day activities. Responses to these questions were coded by evaluators. Complete distributions of responses are provided in Figures 9 and 10, respectively. The most commonly-cited resources used by students *to prepare for their internships before they began* were those available through the National Oceanic and Atmospheric Administration (NOAA), as well as other Internet research and resources. Of the interns who completed the exit survey, 100% reported that the preparation and development of their presentations was among their day-to-day activities. Also, it is worth noting that the exit survey did not ask interns to list the resources they used to prepare for their presentations on a day-to-day basis—it is very likely that NASA resources (in particular the NASA data sets from satellites) were utilized with far greater frequency once interns entered their roles on the project than they were during preparation for these roles.

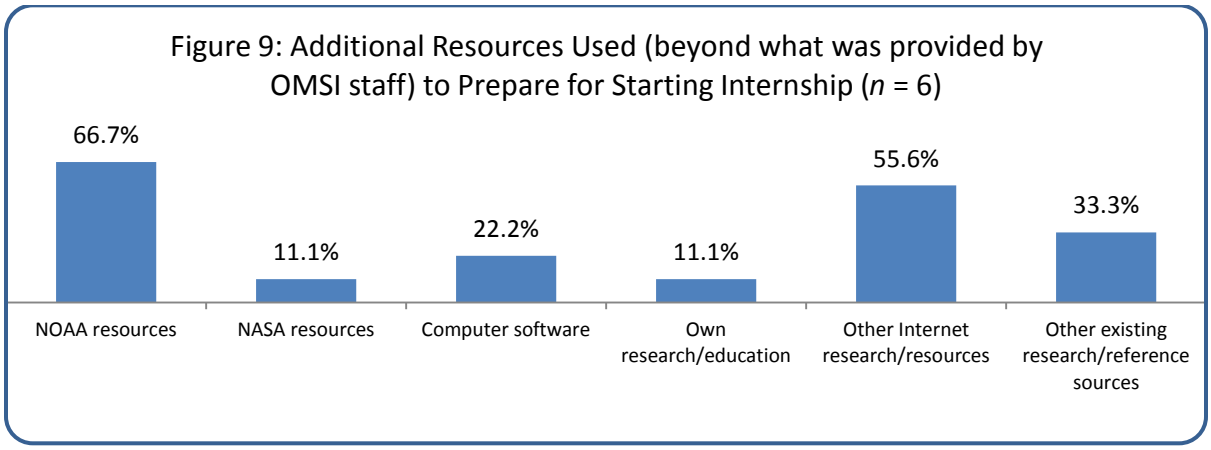
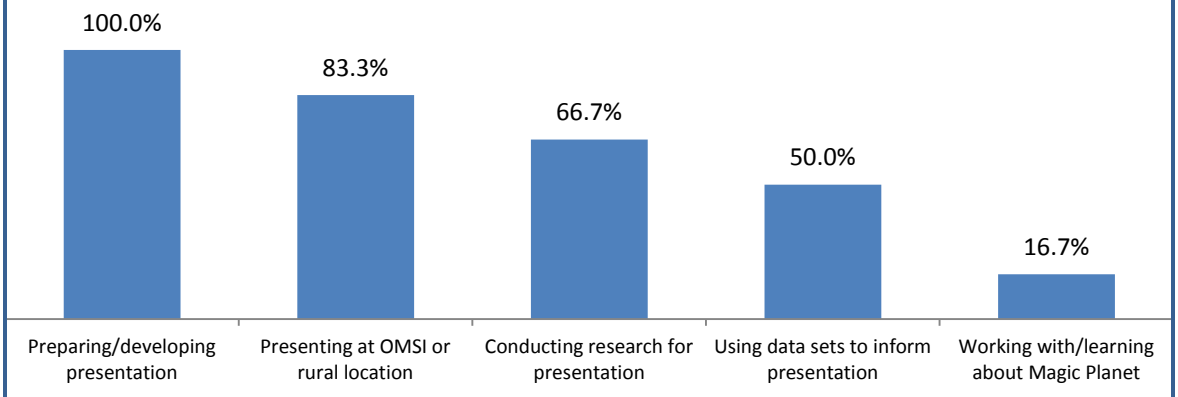


Figure 10: Day-To-Day Tasks and Responsibilities Reported by Interns
(*n* = 6)



Results

Intended Outcome 2.1: 100% of the interns/collaborators report that the project engaged them with sharing datasets with the public

RQ6: To what extent do project interns feel that the project engaged them with sharing datasets with the public?

All nine interns who completed the entrance survey stated that they expected to learn more about museum science education techniques and how to present scientific data to the public, and every one of the six who completed the exit survey reported feeling that the internship experience had provided them with this knowledge. Additionally, 50% of interns mentioned using datasets during their day-to-day project activities with no prompting whatsoever, and each of the three interns who participated in follow-up interviews mentioned engaging with the public, learning about the SOS system, or both.

As illustrated in Table 6 above, not only did 100% of the interns who provided responses to the entrance survey state that they *expected* to learn more about museum science education techniques and how to present scientific data to the public, but 100% of those who completed the exit survey felt the internship experience had in fact helped them achieve this goal. Likewise, 100% of entrance survey participants stated that they expected to learn how to engage the public with difficult or complex information, and all but one of the exit survey participants reported that their expectations were met. Of particular interest, however, is the fact that with no prompting whatsoever, 50% of the interns who described their day-to-day tasks and responsibilities specifically mentioned using existing datasets to inform their presentations (see Figure 10). While this percentage may appear low, the fact that this aspect

of the internship was so salient that half of the survey participants mentioned it without being prompted is likely indicative of a high degree of importance ascribed to this task.

In order to gain a deeper understanding of the *Earth from Space* internship experience, the three former project interns who participated in follow-up interviews several months after their internships ended were asked to reflect on their experiences over the course of the project. Responses to the first question of the interview, "Thinking back on the time you spent as an intern on the *Earth from Space* project, what are your overall thoughts on your experience?", are shown below.

> *"I was told by my advisor at school, you need to find an internship…and so I just went out to the zoo and to OMSI, because I live in the area, those are my favorite sites, locations. And I was just like pleeease take me, I have some talents. And so, I went out and this thing popped up that was actually like, it actually had a stipend attached to it, and so I was super surprised to find that at all 'cause I was expecting to just kind of do what I'm doing now, which is kind of volunteer work. So I was super excited for that, and* ***it was also doing something that was along the lines of what I really enjoyed, which is Earth Science, but it was also using something that I had never used before. It was kind of learning the ins and outs of the SOS system****."*

> *I thought it was a really educational experience for me, I wasn't a science major in college, so* ***going through all the datasets I did feel like I learned things I otherwise didn't learn in my field at college. I really enjoyed speaking with the public and sort of learning the system of SOS****, and overall I thought it was a good experience."*

> *"Well, I think that my experience, I didn't really know what to expect because it was my first time as an intern, and it went beyond my expectations. I think that, not just, you know, job experience, but also just getting to know more of the real world, I was really excited…I'm a bilingual intern, so* ***I was really excited to be able to, you know, participate with the public in both English and Spanish.*** *So I thought it was a great, great experience. I loved the staff and the people I was working with, it was great."*

During the interviews, all of the interns mentioned engaging with the public, learning more about the Science On a Sphere system (which was integrally tied to the use of NASA datasets), or both. While each of the three interns focused on slightly different elements of their experiences, they all reported being excited about their internship and enjoying the time they spent as part of the *Earth from Space* project. The responses to this question strongly indicate

that although the interns came from different backgrounds, the opportunities which they were afforded through the project were generally felt to be useful and meaningful.

Intended Outcome 2.2: 100% of the interns/collaborators report that the project helped them understand the importance of the connection between formal research and educating the public

RQ7: To what extent do project interns feel that the project helped them understand the importance of the connection between formal research and educating the public?

Sixty-seven percent of interns who completed the entrance surveys stated that they expected to learn about the connection between formal research and public education, with an identical percentage later confirming this outcome. Similarly, two-thirds of the interns who completed the exit survey indicated that conducting research for their presentations was a regular part of their day-to-day activities. Across the three follow-up interviews, a common theme was the challenge of finding ways to present complex and frequently-misunderstood scientific topics so they can be understood by public audience members.

As illustrated in Table 6 above, two-thirds of program interns reported expecting to learn more about the connection between formal research and educating the public, with the same percentage later reporting that their internship experience had helped them succeed in understanding this connection. Similarly, as shown in Figure 10, two-thirds of the interns who completed the exit survey mentioned that they conducted research for their presentation on a regular basis, indicating a potentially more concrete, practical level of connection between research and public education. During the follow-up interviews with former interns, each participant was asked to think back on their experiences on the project and respond to the question “Do you feel like the internship had any effect on your understanding of the connection between formal research and public education?” The interns’ responses to this question are provided below in verbatim form.

"Yes. Oh man. So for my presentation I was talking about weather and climate in the Northwest. And so basically, the main portion of that I had to explain the rain shadow effect, and I had to explain how when water goes over a mountain you end up with the rain clouds. And ***a lot of sort of popular science has explained it wrongly****. People tend to talk about how water is like, as it goes up, the air thins out, and it can't hold as much water, quote unquote. And so that's not how, 'cause water isn't held by air, it's all a mixture of water particles. So that's not how it was.* ***So I had to get the correct information and then translate that into something that people understand. Because I knew that I'm going to be speaking to families, probably small children, and I need to say the correct thing, but I need to kind of give it in a way that they will be able to understand because I can't get into super hard science here.*** *So that was definitely, 'cause my research went into far more depth than I ended up in the presentation. And that's just kind of how it goes for research projects, you're like, 'Wait, I know so much more' and you know and if they ask questions later then I can kind of focus on that. But there was just much more research to the amount of stuff that ended up going in there…There's an aspect to it, like, public education needs to be accessible and that means that people need to be scientifically literate. So* ***half of educating people in science is not actually teaching them science but teaching them how to understand science****. And so the research part is like,* ***you want to be able to share that with people, but you also want to be able to give them the tools to understand them when they come across that****. Because I mean science is something that we encounter every day. And it's important that people understand how it works, so they're not duped, I suppose. We get a lot of interesting folks in the paleontology lab and the climate areas, and so, yeah, it's an important part, I think.* ***It's kind of driven home the emphasis that you need to place on the translation between research and popular science****. I mean, unless, you're talking to a college class, who are like, people who like really understand, are researchers who totally love this stuff.* ***You're going to get a few who are kind of ambivalent, and that's OK. But there needs to be something that makes it engaging****."*

"I definitely understood the connection between formal research and public education through other jobs that I had held before this internship. We didn't necessarily have any training beforehand to figure out what like that, the connection between those two things. But ***I guess after doing the actual presentation with visitors at the museum, we did get some feedback from actual visitors, [and] we also got some feedback after our presentations from like our supervisors and stuff****. Sue was really good at that because she just does that regularly in the earth science hall."*

> *"Yeah, because, you know, you are,* ***you are informing the public about subjects that we are not usually aware of****, so I think it did."*

Across each of the three interviews, the common theme which emerged most strongly was one of negotiating ways to present complex and frequently-misunderstood scientific topics in a format which was comprehensible by public audience members. As with the previous question, the interns' unique backgrounds and experiences provided different frames for their responses. Two of the interns explicitly mentioned the importance of dealing with subjects which tend not to be accurately presented or understood; another intern described the process of soliciting and receiving feedback from both visitors and project team members. While one participant noted that interns did not necessarily receive training regarding the connection between formal research and public education, she also noted that her background had already helped her to see the connections between research and educating the public. In sum, it seems safe to say that all of the interns who were interviewed did feel their involvement in the *Earth from Space* project helped them appreciate the importance of these connections.

Intended Outcome 2.3: 100% of the interns/collaborators report that the project increased their interest in educating the public

RQ8: To what extent and in what ways do project interns feel that the project affected their interest in educating the public?

There was a substantial increase in the percentage of interns who mentioned learning about science education program development, with 55.6% indicating on the entrance survey that they expected to learn more about this skill and 83.3% later stating on the exit survey that they had indeed gained this knowledge through their internship. Additionally, every one of the interns who participated in the surveys indicated both that they expected their experiences to provide them with an understanding of museum science education and scientific data presentation techniques and that they felt the internship had done so. Each of the three interns who participated in the follow-up interviews also expressed a deep appreciation for the public education element of the project; one intern noted that she now intends to pursue a graduate degree in education after completing her undergraduate degree in science.

As illustrated in Table 6 above, while only 55.6% of the program interns who provided responses to the entrance survey reported expecting to learn more about science education program development, all but one (83.3%) of those who completed the exit survey indicated that their experience had in fact helped them accomplish this goal. Additionally, as noted earlier, 100% of the interns who participated in the entrance and exit surveys stated that the internship experience had met their expectations in facilitating a greater understanding of

museum science education techniques and how to present scientific data. These findings were mirrored without exception in the words of the interns who participated in follow-up interviews, particularly during responses to the question, "Do you think the internship changed anything about how interested you are in educating the public?" Again, the verbatim transcripts of these responses are provided below.

> *"Yeah. I kind of came in and I, my first presentation, I was like terrified. And that was in front of my boss and the other interns pretending to be five-year-old children. Like, that was not intimidating at all and it was terrifying. But after a while, it gets easier. It's actually, it's really, I liked it a lot. It's sort of my, I'm at this point right now in my schooling,* ***I'm going to complete my degree in science then I'm going to go on to get my master's in education on a scholarship to teach. It was kind of one of those things, 'Hey, this is fun, I like this!' moments. Oh yes, it has definitely influenced****."*

> *"****Yeah, I mean it definitely reinforced my interest in doing that****. I've done a lot of that before the internship and so doing it in the museum was,* ***it was probably more of a formal venue than I had done, like, public education before, and I really liked it and it definitely reinforced my preexisting interest****."*

> *"Yeah, yes, actually, because like I said, it's a lot of topics that we don't really know anything about, and* ***I feel like when you know something, you have a responsibility to let others know. Especially 'cause it's science, you know, it's relevant to everyone****."*

The three interns who participated in follow-up interviews all expressed overwhelmingly positive attitudes regarding their involvement in the public education element of *Earth from Space*. Whether because of a preexisting interest, a sense of responsibility to share relevant scientific knowledge and information with others, or a newfound sense of enjoyment, project interns appear to have a deep appreciation for the opportunities afforded through the internships. Indeed, one of the three interns stated an intention to pursue a graduate degree in education after the completion of an undergraduate science degree, which is a remarkable testimonial to the efficacy of the internship program.

Intended Outcome 2.4: 100% of the interns/collaborators report that the project sustained their interest in STEM careers

RQ9: To what extent and in what ways to project interns feel that the project affected their interest in pursuing a STEM career?

Two-thirds of the interns who completed the entrance survey stated that they expected to develop their interest in pursuing a STEM career, with the same percentage later reporting that this was in fact an outcome of their internship experience. Similar responses were provided to entrance and exit survey questions regarding expected (77.8%) and actual (66.7%) advancement of training for a STEM career. It seems possible, based on follow-up survey responses, that many interns were already on a trajectory toward a career in the STEM fields even without this experience. The internships reinforced interns' interests and beliefs regarding science. This is not to say, however, that interns did not appreciate the opportunities the internships provided–on the contrary, their experiences as part of the *Earth from Space* project appeared to be extremely meaningful and relevant.

Again, as illustrated in Table 6 above, 66.7% of program interns reported expecting to develop their interest in pursuing a career in the STEM fields, with an identical percentage later reporting that their internship experience had accomplished this objective. Similarly, 77.8% of interns who completed the entrance survey stated that they expected the internship to advance their training for a STEM career, and a nearly equal percentage (66.7%) of exit survey participants indicated that their experiences as interns had allowed them to achieve this goal. Although these percentages are neither astronomically high nor worryingly low, the responses of interns during follow-up interviews may help to shed light on the survey data. The final question asked by evaluators during the interviews was "Did you come out of your internship feeling any differently about the possibility of pursuing a career in the STEM fields?" Again, verbatim responses are shown below.

"Oh yes. So, I'm already in the STEM fields. I'm an environmental science major. At the time, oh gosh, I'm trying to think. Because I came into college undeclared, and I declared at the end of my freshman year, so last summer I would have known, I would have known by then. I had a very nice influential teacher who taught earth science, and I was like, I like this. And so, yeah, ***it was a renewed interest, specifically it was a renewed interest in the earth science, it was kind of an affirmation of this is the kind of science I enjoy****. Because I like chemistry and biology and stuff but the earth science is where I really, really like to dig my roots in.* ***And so, yeah, it was already there. It probably kind of helped solidify the 'Yes, this is the right path for me' kind of feeling****."*

> *"Oh, yeah, science for sure, I'm not sure about technology and engineering for me. But **I have always been really interested, and definitely became more interested after OMSI, in educating the public and educating everyday normal people on scientific ideas**. I remember saying earlier I was never a science major in college, although I've always been really, really interested in it, and **I think it's important for people who aren't educated in the sciences to still have some idea and still get excited about the scientific world, and so it definitely made me even more excited to keep pursuing that type of work…Just actually like giving the presentations to the public, and seeing how they responded to things that I was saying, hearing their questions face to face, and being able to sort of explore those ideas with them, in person, definitely**."*

> *"Well, **I've always considered myself a science person, and yeah, so I think I'm gonna keep on doing what I'm doing right now**…especially because in school I'm already learning a little bit about that, so **the internship really helped out a little bit more, besides what I'm doing in school, so I think I'm gonna keep doing the same**."*

Perhaps the most interesting aspect of the responses to this question is the fact that without exception, each intern mentioned that they were interested in science before enrolling in the internship program. Rather than acting as an introduction to a possible STEM career, the internships served to reinforce their beliefs and interests regarding the importance of science. These facts may contribute in part to the middling survey percentages noted above – if the experiences of the three interns who participated in follow-up interviews are typical, the internships may not have developed interns' interest in STEM careers so much as supported their preexisting desire to pursue such careers.

PART 4: DISCUSSION AND RECOMMENDATIONS

Taken as a whole, the findings from the *Earth from Space* project's public and professional audiences provide insights into the project's impact on visitors and program interns alike. Of equal importance, however, are the implications of these findings for future similar projects. While *Earth from Space* has come to a close, it is our hope that the following synthesis and recommendations can be used to help guide the ongoing development of similar programs and activities, both at OMSI and in other institutions.

In regards to the public audience element of this project, the data collected both at OMSI and at rural outreach locations strongly suggest that both Science On a Sphere and Magic Planet displays are effective at engaging visitors with scientific concepts and datasets. This appears to be particularly true for topics related to the Earth and its environment and weather systems, although audience members were somewhat less likely to identify connections between the presentations and, for instance, technological effects or benefits. Given the substantial percentage of visitors who made connections of some sort between the presentations they saw and at least one aspect of their own lives and communities, this may present a promising avenue for continued exploration and improvement. Particularly in light of the high level of perceived relevance expressed by visitors, the potential should exist for Science On a Sphere and Magic Planet presentations to articulate a wide range of sociocultural implications. Of course, the specific use of these exhibit interfaces is delimited to some extent by the software itself, but sufficient flexibility exists to provide a wide range of applications by educators, researchers, or (preferably) both.

One area in which the findings of this study might be put to use in improving future implementation of Science On a Sphere and Magic Planet demonstrations is in regard to the connection between NASA and NOAA datasets and the images shown to visitors. In general, with a few exceptions, the audience members included in this study tended not to specifically mention where these data visualizations came from when discussing their experiences. Based on their survey responses, audience members tended to appreciate and enjoy the use of the Science On a Sphere and Magic Planet interfaces to demonstrate complex global trends and weather systems. However, even if the connection between scientific data and the data visualization images being shown was understood on some level, it tended not to be the most salient aspect of the overall experience. This is not to say that they did not understand the educational messages, of course, but to allow visitors to understand the link between scientific datasets and the visualization of those data, this may need to be a more explicit part of the presentation.

While the responses provided by audience members at OMSI and rural outreach locations were generally quite similar (which is itself an interesting finding), one difference did stand out. A substantially larger percentage of OMSI visitors provided clear descriptions of things they learned during the presentations; however, slightly more rural outreach location visitors were able to make deep connections within and between the program topic(s) when they were asked what they thought the main idea was. These findings, while seemingly contradictory at

first, may in fact point to important distinctions between the Science On a Sphere presentations held at OMSI and the Magic Planet tabletop exhibits provided to rural outreach locations. OMSI visitors were asked to complete the survey after watching a presentation on a specific topic facilitated by an *Earth from Space* intern, whereas visitors to rural outreach locations were approached by staff members after they were observed using the Magic Planet exhibit in a self-guided, unfacilitated manner. With this in mind, it seems possible, or even likely, that the differences in visitor response across locations may have had more to do with the types of interaction with program content than with any underlying differences between audiences. Project interns were told that best practices for live Science On a Sphere presentations were to keep the presentation clear and focused, only have two to four content goals, and avoid trying to cover too much ground. The Magic Planet tabletop exhibits, by contrast, were self-exploratory. When interacting with these exhibits, visitors were able to jump between topics on the kiosk, and since there were no specified content goals, visitors may have had the opportunity to build their own connections based on the exhibit and their prior knowledge. Perhaps intern-facilitated SOS presentations were better-suited to providing discrete educational messages, while the self-guided exploration of program content made possible through the Magic Planet exhibits allowed visitors to make slightly deeper and more complex connections. More research is necessary to confirm (or disconfirm) these hypotheses, but they may provide valuable information regarding the most efficacious use of these interfaces.

In general, the internship program succeeded in meeting or exceeding the expectations of student participants in regard to nearly every one of the outcomes measured. The main exception, based on responses to the entrance and exit surveys, was "Learning more about Adobe software"; however, it is worth mentioning that this wasn't actually a response option which was provided on the surveys, but was written in under "Other" by two participants. While it is not possible to say for sure, this makes it somewhat more likely that even if those two interns were two of the six who completed the exit survey, they may have simply forgotten that this was something which they had mentioned hoping to get out of their experience. It should also be emphasized that student names were not attached to entrance or exit surveys, and since neither survey was completed by the entire cohort of interns with fewer exit than entrance surveys received, it is certainly possible that the discrepancy may be smaller than the percentages make it appear.

As noted above, some time after the internships came to a close, evaluators made the decision to contact some of the students who had participated and conduct brief interviews to help understand more about what the internship experience was like. When asked to share their overall thoughts about their experiences, all three project interns interviewed talked about how the internship gave them opportunities to do things which they hadn't done in their college classes. Whether by "learning the ins and outs of the SOS system," using scientific datasets to compliment the lessons taught in college classes, or moving beyond simple job experience to get a true sense of what things are like in the "real world" of informal science education, students were able to use their internships as opportunities for personal and professional growth and enrichment. These comments might help to explain why during the exit survey, one of the most frequently-mentioned outcomes—and by far the one which most dramatically

exceeded students' expectations—was learning more about science education program development. What is particularly exciting about this outcome is that it seems to signify deep involvement in the project. It is possible that students initially thought they would be participating in a more surface-level fashion and would not be as integrally involved in the actual development of the programming as they ended up being. In any case, if similar internships are offered either at OMSI or elsewhere, they should strive to capitalize on the ability of the SOS interface to allow participants the opportunity to engage in as much of the program development as possible.

Another particularly exciting and promising outcome of students' internship experiences is the understanding the internships provided regarding the intricacies of public science education. During follow-up interviews, the students who had participated in these internships clearly articulated the need to translate complex scientific information into language which is understandable for general audiences, particularly when dealing with issues which tend to be misrepresented in popular culture. The descriptions these students provided make it clear that the internships were more than just jobs which offered work experience; the students who held these positions cared very deeply about sharing scientific data and findings with the public and educating them about topics of which they might otherwise be unaware. One former intern mentioned the importance of receiving feedback after presentations not only from project staff and supervisors, but also from audience members. The importance of this point should not be underestimated, as it speaks to a means by which interns and project staff alike can assess how clear and comprehensible the demonstrations are and make changes if necessary. For future implementations of similar programming, it seems advisable to ensure that feedback mechanisms such as this are incorporated throughout the process. Additionally, when possible, it is immensely beneficial to include sufficient programming flexibility to allow for changes to be made to the demonstrations based on consistent trends in audience feedback.

Lastly, the responses of the former interns to the last two questions of the interview overwhelmingly indicate a high degree of interest in science and STEM topics and careers even prior to the commencement of their internships. While one student in particular stated that her experiences on the *Earth from Space* project had contributed to her decision to pursue a graduate degree in education, for the most part it seems the internships did not so much *develop* interest in STEM careers or public education as *reinforce* preexisting interests and career plans. This is by no means an undesirable outcome of projects such as this—particularly as there is no way to tell whether the interests and plans of student interns might have changed if they had had difference experiences—but it does suggest certain avenues for expansion in future projects. By definition, the internship job postings associated with projects like *Earth from Space* will most often appeal to students who already possess at least some level of interest in STEM topics. In order to reach beyond this group, additional steps will need to be taken, likely involving more proactive recruitment techniques. Projects such as this provide an immensely promising means of introducing students to the complex and rewarding "real world" of science education, and every effort should be made to ensure that these opportunities are made available to a diverse range of potential participants. It is our hope that

the protocols, results, and suggestions provided above can serve in some small way to guide future programming and exhibit development efforts, both at OMSI and across the field.

Appendix A: Rural Hosting Locations for Magic Planet Tabletop Exhibits

Location	ZIP Code	Project Year
Boardman	97818	2
Hood River	97031	2
Moro*	97039	2
ScienceWorks, Ashland*	97520	2
The Dalles*	97058	2
Baker City	97814	3
Burns	97720	3
Hermiston	97838	3
John Day	97845	3
La Grande*	97850	3
Milton-Freewater	97862	3
Pendleton	97801	3
Stanfield	97875	3

**Public audience surveys were collected at this location*

Appendix B: NASA Earth from Space *Public Audience Survey Instrument*

To be filled out by Data Collector only
Date: _____ Location:_____ Time:_____ Survey #_____
Program/Presentation:_____

Hi, my name is _____ , and I work/volunteer for OMSI. We would very much appreciate you taking the time to give us your responses to some questions as they will help us understand what you learned from this exhibit/presentation. These responses will be kept completely confidential and will help improve the program. Your participation in this survey is voluntary and you can stop at any time or decide not to answer any questions you don't feel like answering. Can we continue with the survey?

Yes____ No____ (Data Collector: Thank and move on.)

Thanks!

---

1. What do you think was the main idea of the program/presentation?

2. What connections do you think there are between information from satellites and our community?

3. What are some new things that you learned today as a result of your participation with the program/presentation?

4. After watching this program/presentation, how relevant do you think satellite information is to understanding everyday life in our communities?

❍ Very relevant ❍ Relevant ❍ Somewhat relevant ❍ Not relevant ❍ Very irrelevant

---

5. Please tell us how satisfied you are with each of the following program/presentation components.

A. Program presenter

❍ Very Satisfied ❍ Satisfied ❍ Somewhat Satisfied ❍ Unsatisfied ❍ Very Unsatisfied

B. Program relevance to our everyday life and local community

❍ Very Satisfied ❍ Satisfied ❍ Somewhat Satisfied ❍ Unsatisfied ❍ Very Unsatisfied

Please turn over page ➡

C. Topic clarity and ease of understanding

❍ Very Satisfied ❍ Satisfied ❍ Somewhat Satisfied ❍ Unsatisfied ❍ Very Unsatisfied

D. Overall presentation (graphics, visuals, sounds, etc.)

❍ Very Satisfied ❍ Satisfied ❍ Somewhat Satisfied ❍ Unsatisfied ❍ Very Unsatisfied

6. Please tell us about your overall experience with this program/presentation, including anything you would do to improve it.

Please tell us little bit about you

1. Your zip code:_____

2. What is your age (circle one): 18-24 25-34 35-44 45-54 55+

3. What is your gender?
□ Male □ Female

4. What is your ethnicity? (Check one)
□ Hispanic □ Not Hispanic □ Not Sure

5. What is your race?
□ American Indian or Alaskan Native
□ Asian
□ Pacific Islander or Native Hawaiian
□ Black or African American
□ White
□ More than one race
□ Not sure

6. What is your annual household income?
□ Less than $19,999
□ $20K - $29,999
□ $30K - $39,999
□ $40K - $49, 999
□ $50K - $59,999
□ $60K - $69, 999
□ $70K +

7. What is the highest level of education you have completed?
□ Some High School
□ Graduated High School (or equivalent)
□ Some College
□ Graduated College (4 year)
□ Graduate degree +

Thank you!

Appendix C: NASA Earth from Space *Public Audience Survey Instructions*

Version 10.5.2012

Location:

Dates:

Number of surveys needed:

Materials: Survey instrument to be filled out by participants.

Location of Materials: Library (location) management

Who is eligible: Any person (age 13+) at the location who participated in the program/presentation. Participation is defined as viewing, listening, or interacting with the program/presentation content for a reasonable period of time.
Sampling/Choosing Participants: We are using convenience sampling, in that we are not going to randomly sample participants.

Informing potential participants about the surveys: Prior to the beginning AND at the end of any presentation, please have the presenter or library data collecting staff enthusiastically announce the important option to voluntarily complete the survey. Important things to mention during this announcement:

1. Survey completion will help OMSI improve its educational program/exhibits.
2. It is completely voluntary and confidential (and anonymous).
3. Try to respond with as much detail as possible.
4. Return completed (front and back) surveys to presenter or library data collecting staff.
5. Thank. Thank. Thank.

Questions? If you have any questions, please contact:

Hever Velázquez
503-797-4684
hever.velazquez@omsi.edu

THANKS SO MUCH FOR YOUR HELP.

Appendix D: NASA Earth from Space *Internship Entrance Survey*

Version 6.7.11

Your input is extremely valuable to this project. We very much appreciate you taking the time to give us your responses to these questions as they will help us understand what your expectations are during the program. These responses will be kept completely confidential and will help ensure a positive experience. Your name will not be associated in any way with this data; but, due to the small number of interns, there is a slight possibility that your answers could be identified by someone who knows you very well. To protect against this, we will only allow trained evaluators to see your individual data. Your supervisors or coworkers will never see your answers. Participation in this survey is not required for continued employment in the program. You also have the option to stop at any time or skip any questions you can't or do not want to answer.

---

1. What will be your primary role in the *Earth from Space* program?

❍ Programmer/Educator ❍ Educator Assistant ❍ Program Intern ❍ Not sure

2. What are the specific components of the program that you will be working on?

❍ Science On a Sphere
❍ Magic Planet
❍ Earth from Space
❍ Library presentations
❍ Program Development
❍ Not sure

3. What outside resources did you use (if any) to prepare for your role in this program in addition to what was provided to you by OMSI staff?

1. _____
2. _____
3. _____
4. _____
5. _____

4. On the scale below, please indicate your current understanding of the content you will be demonstrating. 1 is the lowest level of understanding whereas 10 is the highest.

Low 1 2 3 4 5 6 7 8 9 10 **High**

5. Besides academic credit, what do you expect to gain from this experience? (Check all that apply.)

❍ Ability to understand NASA satellite datasets
❍ Professional/Work experience
❍ Interest in pursuing a STEM (Science, Technology, Engineering, Math) career
❍ Advance my training for a STEM career
❍ Public speaking skills
❍ Science education program development
❍ Learn how to engage the public with difficult or complex information
❍ Understand the connection between formal research and educating the public
❍ Learn how satellites work
❍ Learn more about museum science education techniques and how to present scientific data
❍ Other:

_____
_____
_____

6. Please tell us how you feel about this opportunity (check all that apply).

□ Indifferent
□ Excited
□ Bored
□ Looking forward to
□ Motivated
□ Uneasy
□ Confident
□ Other: _____

7. Please indicate how satisfied you feel with the training that was provided to you for this position.

❍ Very Satisfied ❍ Satisfied ❍ Somewhat Satisfied ❍ Unsatisfied ❍ Very Unsatisfied

Please provide any questions or general feedback you have about the program, activities, responsibilities, etc.

_____
_____
_____
_____

Thank you

Appendix E: NASA Earth from Space *Internship Exit Survey*

Version 3.30.11

Your input is extremely valuable to this project. We very much appreciate you taking the time to give us your responses to these questions as they will help us understand what you gained and learned from the program and your internship experience. These responses will be kept completely confidential and will help ensure a positive experience for future internship opportunities and program development needs.

---

1. What was your primary role in the *Earth from Space* program?

❍ Programmer/Educator ❍ Educator Assistant ❍ Program Intern ❍ Not sure

2. What were the specific components of the program that you worked on?

❍ Science On a Sphere
❍ Magic Planet
❍ Earth from Space
❍ Library presentations
❍ Program Development
❍ Not sure

3. Please tell us about your day-to-day tasks and responsibilities.

_____
_____
_____
_____
_____

4. On the scale below, please indicate your level of understanding of the content you helped develop/demonstrate. 1 is the lowest level of understanding whereas 10 is the highest.

Low 1 2 3 4 5 6 7 8 9 10 **High**

4a. Can you tell us why you chose that level/feel that way?

_____
_____
_____

5. Besides academic credit, what did you gain from this experience? (Check all that apply.)

❍ Ability to understand NASA satellite datasets
❍ Professional/work experience
❍ Increased interest in pursuing a STEM (Science, Technology, Engineering, Math) career
❍ Advanced my training for a STEM career
❍ Public speaking skills
❍ Science education program development
❍ Skills in how to engage the public with difficult or complex information
❍ An understanding of the connection between formal research and educating the public
❍ Learned how satellites work
❍ Learned more about museum science education techniques and how to present scientific data
❍ Other:
_____

6. Please indicate how important you think this internship has been with your academic and professional goals.

❍ Very important ❍ Important ❍ Somewhat important ❍ Not very important ❍ Not important at all

7. Please indicate how satisfied you are with your overall internship experience.

❍ Very satisfied ❍ Satisfied ❍ Somewhat satisfied ❍ Unsatisfied ❍ Very unsatisfied

7a. Can you tell us why you feel that way?

_____
_____
_____

8. In order to help us with future science education programming development and internship opportunities like the one you participated in, please provide any feedback you have about the program, activities, responsibilities, etc.

_____
_____
_____
_____
_____

Thank you

Appendix F: NASA Earth from Space *Internship Follow-Up Interview Guide*

Question 1: First off, thinking back on the time you spent as an intern on the Earth from Space project, what are your overall thoughts on your experience?

Question 2: Do you feel like the internship had any effect on your understanding of the connection between formal research and public education?
Probe: How did your understanding change? Or if it didn't change, did the internship do anything to support the understanding you began with?

Question 3: Do you think the internship changed anything about how interested you are in educating the public?
Probe: What about your experience as an intern made you more [or less] interested in public education [or helped you maintain the same level of interest you began with]?

Question 4: Did you come out of your internship feeling any differently about the possibility of pursuing a career in the STEM fields? [Explain STEM, if necessary]
Probe: What about your experience as an intern made you more [or less] interested in a STEM career [or helped you maintain the same level of interest you began with]?