

HOW ARE MONTANA'S SCIENCE TEACHERS USING THE TAYLOR  
PLANETARIUM AS A TEACHING TOOL?

by

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## ABSTRACT

This project evaluated how teachers bringing groups to the Museum of the Rockies used the Taylor Planetarium as a learning tool. Teachers who visited the Museum between October 2013 and March of 2014 were asked to participate by answering questions via online surveys and phone interviews. Each teacher was asked to do this before and after their visit to the Taylor Planetarium to measure how their preparation before the visit impacted their students and themselves. After their visit, each participating teacher completed a survey to gather data on the purpose of school group visits, perceptions of student engagement, and instructional techniques used during their visit. Additionally, I contacted planetarium directors from the Pacific Northwest to gather data on their practices and ideas. This project generated evidence that there is a considerable need to increase the communication level between Montana's teachers and the Museum of the Rockies to enhance the learning experience of the students they bring in to see a planetarium show.

## INTRODUCTION AND BACKGROUND

The Museum of the Rockies (MOR), located in Bozeman, Montana, is the most visited museum in the state of Montana. The Taylor Planetarium at MOR is a state-of-the-art planetarium featuring one of the world's more advanced projection technologies. The projection system was developed by Evans & Sutherland and is called Digistar 5. On average there are four shows per day and 70,000 visitors per year in the planetarium. In 2013, there were 1,873 shows, 139 being seen by school groups. The Taylor Planetarium has 110 seats and uses 2 projectors to allow visitors to experience our Universe and world. During my study, there were seventeen shows available for teachers and educators to choose from, and each of these shows were accompanied by online educator guides and toolkits.

These seventeen shows include all science abilities, ranging from first grade and lower through the high school level. They also cover a wide range of content. Teachers looking for a 'local' experience can choose the show *Big Sky Tonight* which covers seasonal constellations that can be viewed right here in Montana. As it is a live show, content can be tailored to any age group, for any amount of time, and almost any astronomical subject can be discussed. For those who would want more of a universe-wide show, there are eight different professionally produced shows covering topics ranging from dark matter, to finding the edge of our very own solar system. Teachers can also find four shows about science on our own planet, Earth. This material covers super volcanoes, the history of flight, Earth's climate system, and auroras. There is even a show just for younger scientists featuring some of their favorite characters, Big Bird and

Elmo. The diversity of information found in a planetarium is one of the many reasons why I enjoy working in this type of atmosphere.

In the fall of 2013, I decided to contact the MOR in hopes of conducting a research project in the Taylor Planetarium. I chose to do this because of my background in astronomy, my prior experience with a planetarium, and my love for science communication. My first contact was with Ms. Angie Weikert, the Education & Public Programs Director; she set up a meeting for me to connect with the Planetarium Director, Mr. J. Eric Loberg. Mr. Loberg was happy to have me conduct research in the planetarium. During our meeting I asked him some questions that would help lead me to a specific research topic. The following are the three most important questions that were discussed during that meeting and Mr. Loberg's responses.

1) What would you like to see me research?

-“Are teachers doing any pre/post research before coming into the planetarium? Or are they coming in to see *just any show*?”

2) Are there any specific questions you having concerning teachers' use of the Taylor Planetarium?

-“Do teachers know about any of our other offerings here at the Taylor Planetarium?”

-“Do teachers use our website to prepare students before they are coming to see a show?”

-“Do teachers use our prepared teacher guides?”

3) How would you like to see the Taylor Planetarium be used (ideally) by school groups?

-“ It would be good if more schools said ‘this is the specific space content we want’, or [if they used] pre/post info[rmation] around [the time of their] visit to be sure they know what the show is about.”

From his specific answers, I could tell Mr. Loberg was concerned that teachers are not using the planetarium to its full potential as a learning tool. Therefore, I decided to research how teachers/educators bringing their classes to the MOR utilize the resources of the Taylor Planetarium. Once this was decided, I sat down with Ms. Weikert and discussed what these resources are. She informed me of the online resources embedded within the MOR website. They included descriptions of every show accompanied by video trailers, educational toolkits, educator guides, and student worksheets. There are also lists of tips for teachers to follow before their visits and links to different (suggested) activities put together by NASA and other affiliates.

Once these were discussed, Ms. Weikert also informed me of one of the more important resources that assist students and educators in utilizing the MOR; the *Opening Doors for Montana’s Schoolchildren* fund. This fund allows every Montana schoolchild to come to the museum for free as part of an organized field trip. It also alleviates field trip transportation costs for all Montana schools (public, private, tribal, and homeschooled) from all 56 counties throughout Montana. This fund was started in 2005 due to the fact that during the 2003-2004 school year the museum saw a decrease in school group visitation. Numbers fell from approximately 11,000 students per year to less than 6,000. Since its inception, the fund has raised over \$250,000 and has helped

almost 50,000 schoolchildren visit the MOR. Because of the importance of this fund, I decided to make it part of my research as well. My research questions are as follows:

Primary Question: How are teachers/educators using the available resources before bringing their classes to the Taylor Planetarium?

Secondary Questions:

→ How can I help the Museum of the Rockies assist teachers to use the Taylor Planetarium as a more effective teaching tool to improve the impact of their student's learning experience?

→ How are teachers informed about the (arguably) most important offering concerning the Taylor Planetarium; the *Opening Doors for Montana's Schoolchildren* fund?

I feel it is important to research these questions for two reasons. One, they are important topics to the Taylor Planetarium Director, Mr. J. Eric Loberg. And the second reason is that similar research projects have shown a need for further research on this subject.

## CONCEPTUAL FRAMEWORK

Out-of-school time settings, such as museum visits, play an important role in promoting science learning. They provide students with memories that could last a lifetime, and have even shown to raise the test scores of students pre- to post- visit (Chang, Huang, Chen, 2012). Research suggests that teachers take their students to museums and planetariums to complement and supplement their classroom instruction (Tran, 2006). But, it was also shown in a 2007 study (N=67) that most students experience a planetarium visit as a field trip, not as a learning environment (Plummer,

2009). Many teachers who choose not to bring their classes into a planetarium have a hard time justifying a trip to the museum if they are not familiar with how it connects to their curriculum (Chang, et al., 2012). This is in spite of many museums, including MOR, adapting how they present their offerings. For example, the teacher guides that accompany each show within the Taylor Planetarium list the state standards that are being met (Appendix A). So it seems there is a need within the museum community to monitor how their services are being used and delivered, and from that to define contributing and influencing improvements that must be made (Peck & Travers, 2013).

Including programs and experiences that teachers prefer is critical for a museum's success as it helps teachers decide to visit a museum. In a 2003 study (N=139), researchers asked teachers what museum programs they were most likely to use and their preferences regarding museum program environments. From this data they showed that teachers were most likely to use in-class programs presented by museum staff, staff-guided museum visits, traveling exhibits, resource kits, and planetarium shows. It also showed that teachers were least likely to visit a museum multiple times a year (Mackety, 2003). This study then showed that meeting curriculum standards was the most important subject to teachers with priority given in the following order: school standards, classroom standards, state standards, national standards, and county school district standards. Teachers in this study also stated they would like to use museum resources because they tend to incorporate a variety of learning styles, but reported the maximum time they could devote to a museum would be one to two hours per year (Mackety, 2003).

With teachers allotting such little time for museum and planetarium visits, these researchers asked teachers which specific museum programs they found to be most

helpful. There were ten “most-popular” answers, and six of them linked directly to my research. They were as follows: museum staff visits to schools; pre-lessons followed by a museum visit; orientations to the museum for teachers; pre-lessons, followed by museum visits, followed by post-lessons; pre-service for teachers; and resource kits for teachers to use in a classroom (Mackety, 2003). These subjects are highly important to museums and planetariums as studies have shown that teachers have the strongest influence on a schools decision to participate in museum programming (Institute of Museum and Library Services, 1998). Teachers want museums and planetariums to be places that help teachers improve their pedagogical goals (Rebar, 2009). This means that establishing a clear understanding of what teachers want and the role of the museum in advance would help to improve the museum experience for all. What is needed is a way to help teachers utilize the resources made available to them by museums and planetariums.

When researchers asked museum educators what their goals were for student visits, their responses tended to parallel teacher responses by claiming they would like students to learn more while in the museum. A study completed in 2013 exhibited that planetarium shows using a learner-centered perspective created a more memorable and informative experience. This study queried 36 planetarium professionals to assess their goals for their audiences and attitudes regarding the design of their learning environment. It also showed they believed that using a learner-centered perspective created a more memorable and informative experience (Plummer & Small, 2013). To the researchers, this meant that giving the students a learning target before the show would lead them to feel ‘closer’ to the show itself and would allow for learners to construct connections

between their planetarium experience and their own lives. From the teacher perspective, it has also been demonstrated that giving students a focus to their museum visit allows them to be more informed consumers of the material available. They take charge of their learning and leave with a genuine understanding of their findings (Morris, 2012).

Additionally, a study completed within the MOR in 2010 evaluated the effects of self-tours versus guided tours and tours accompanied by an activity. Students were asked to complete content quizzes and attitude surveys before and after their visits to measure changes in student understanding and attitudes (N=22). This study produced evidence that students have an increased understanding of exhibit concepts when provided an activity during tours of the museum (Hewitt, 2010). From this evidence one can clearly see that by using material provided by/for a museum, teachers will draw better educational outcomes from out-of-classroom opportunities.

For teachers, curriculum standards and assessment have been, and always will be major concerns (Peck & Travers, 2013). With this being the case, museums and planetariums need to do their best to assure teachers they can achieve a superior learning experience for their students, resulting in achievement of learning goals. The primary purpose of science education is to improve science literacy, and science museums do this by utilizing multiple senses rather than learning simply from listening and reading (Chang, et al., 2012). Accompanying this ideal, most teachers like the notion of having hands on, real life experiences to augment their classroom studies (Michie, 1998). While classroom teachers may be encouraged to conduct pre- and post- visit activities, and many teachers state these are the materials they would be most likely to use, research has shown that many teachers do not use such resources (Tran, 2006). So, there appears to

exist an opportunity to develop a model for field trip preparation involving museums and the teachers who intend to bring their classes in for a visit (Rebar, 2009).

## METHODOLOGY

Once it was distinguished that there was a need for my research, I enlisted the help of the MOR staff. As teachers from all over central Montana made reservations to bring their classes of all ages to the Taylor Planetarium, I was provided with reservation lists and contact details. After a reservation was made, I attempted to contact each teacher directly requesting his or her participation in my research. Building this relationship initially was the key to my research project. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix B).

After an introductory contact was made, I sent each teacher a link to a *Survey Monkey* survey (N=14). I did this through personal emails, which included additional information on myself, and my research (Appendix C). The pre-visit online survey contained questions asking how teachers were currently preparing their students for their upcoming visit to the planetarium. It also asked the teachers about how informed they were of the offerings made by MOR and Taylor Planetarium. Particularly, I asked about the extensive library of in-museum learning resources and the *Opening Doors for Montana's Schoolchildren* fund (Appendix D). Of the teachers who agreed to participate in the online survey, I also asked everyone, who had their visit planned before winter break, to partake in a phone interview (N=7).

During these phone interviews, I was able to ask the teachers supplementary questions pertaining to their preparation before their planetarium visit. I also re-asked

them questions regarding their knowledge of resources made available by the Taylor Planetarium. In this setting I was able to get more in-depth answers as to why they did or did not use teacher guides. In addition, I was able to ask these teachers about themselves, their teaching histories, and practices within their classrooms (Appendix E). Speaking with the teachers directly also allowed time for them to ask me questions about their upcoming visit.

After the teachers had taken their groups to the planetarium, I sent each another email. Within this email was a link to a different *Survey Monkey* survey. Questions on this survey pertained to how their visit went, why they structured their visit the way they did, and asked for their input as to how they thought would be the best way for the museum to communicate with Montana teachers (Appendix F).

Before I finished collecting data for my research project, I found ten similar planetariums from the northwest region of the United States (Oregon, Washington, Wyoming) and attempted contact with their directors. I was successful in contacting nine of them. Once I had spoken with them over the phone, I sent them each a personal email containing a link to a *Survey Monkey* survey (Appendix G). This survey included questions concerning their own ideals as directors, asking for their input on how they feel teachers are currently using their planetariums, and also questions seeking advice as to how they feel would be the best method of communication to connect with local teachers. From these treatment tools, I collected sufficient data to help me understand how teachers are currently using the Taylor Planetarium and how to help the MOR assist Montana's teachers in using the planetarium as a pedagogical device.

To ensure validity and reliability in my project, I followed a few rules of action research. Throughout my research, my questions remained consistent. I did not change the nature or phrasing of any questions presented to teachers throughout the duration of the entire research period. By allowing overlap in the pre-visit surveys and interviews, I created dependability in the instruments themselves. Before I asked even one teacher to attempt the first survey, I assured my questions were researchable given my limitations and could be answered with the collected data. After speaking with and surveying other planetarium directors, I confirmed generalizability of my project. This was accepted because most of the other director's perspectives aligned with what has been observed at the MOR. Also, because my topic is an observational project, driven by qualitative data, I needed to be sure of my participant's perspective. It was vital to understand what the teachers were telling me through their answers to my questions. I confirmed credibility of this by the triangulation of data sources. The Triangulation Matrix for this study is presented in Table 1.

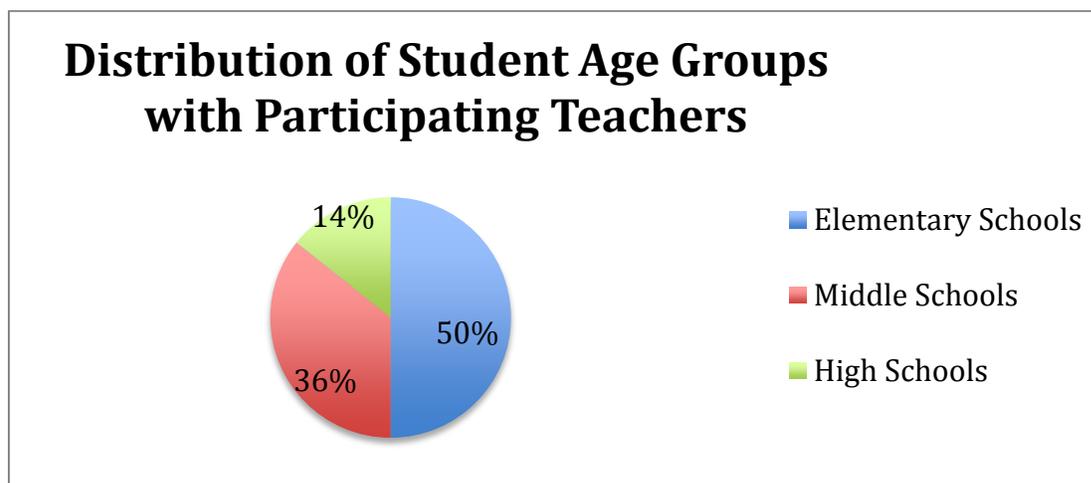
Table 1  
*Data Triangulation Matrix*

<b>Focus Questions</b>	<b>Data Source 1</b>	<b>Data Source 2</b>	<b>Data Source 3</b>
<i>Primary Question:</i> How are teachers/educators using the available resources before bringing their classes to the Taylor Planetarium?	Pre-Visit Surveys	Pre-Visit Interviews	Post-Visit Surveys
<i>Secondary Questions:</i>			
1. How can I help the Museum of the Rockies assist teachers to use the Taylor Planetarium as a more effective teaching tool to improve the impact of their student's learning experience?	Pre-Visit Surveys/Interviews	Post-Visit Surveys	Planetarium Director Surveys
2. How are teachers informed about the (arguably) most important offering concerning the Taylor Planetarium; the <i>Opening Doors for Montana's Schoolchildren</i> fund?	Pre-Visit Surveys	Pre-Visit Interviews	Post-Visit Surveys

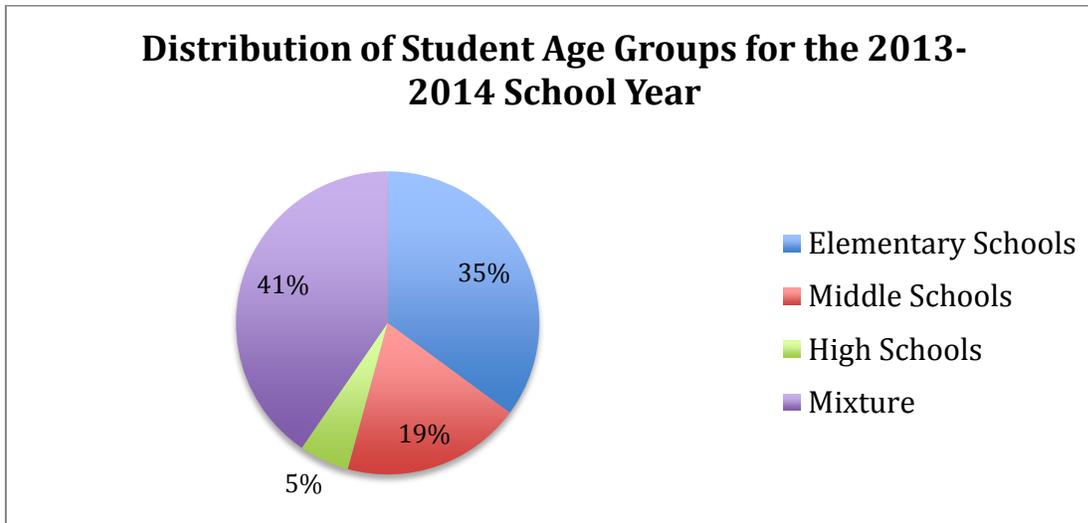
After all data was collected, it was easy to see trends regarding how teachers have been using the Taylor Planetarium. The following section is an analysis of the collected data.

### DATA AND ANALYSIS

According to data shared with me (through the end of my research period) by the MOR reservation staff, 94 school groups visited the Taylor Planetarium during the 2013-2014 school year. During my research period (the five months between 10/19/2013 – 03/20/2014) 32 school groups saw a show at MOR. I attempted contact with 27 of them, spoke with 18 teachers, and had 14 teachers agree to be part of my research. Of these 14 teachers, seven teach in k-5 classrooms, five teach in middle schools, and two teach at the high school level. This seems an accurate representation of the spread for the entire year as 33 elementary groups made reservations, 18 middle school groups, and five high school groups came in as well. Mixed age groups, Montessori and homeschooled children, and after-school clubs represent the other 38 school groups.



*Figure 1* Pie Chart representing the Distribution of Student Age Groups with Participating Teachers,  $N=14$ . The elementary school groups makes up 50% of teachers participating, middle school groups make up approximately 36%, and high school groups represent only 14%.



*Figure 2* Pie Chart representing the Distribution of Student Age Groups for the 2013-2013 School Year,  $N=94$ . The elementary school groups makes up 35%, middle school groups make up approximately 19%, and high school groups represent only 5%. The other 40% is a representation of mixed age groups, Montessori and homeschooled children, and after-school clubs.

Once teachers had agreed to participate in my research, I sent them a 16-question *Survey Monkey* survey. Many of the questions were filled with qualitative data, but there were also three yes-or-no questions that were directly linked to my research questions.

They were:

*#4 Have you already seen the show you will be attending with your class?*

*#9 Are you going to be using any teacher guides during your visit?*

*#16 Have you heard of the 'Opening Doors for Montana's Schoolchildren fund?'*

Questions four and nine gave me quick insight as to how many teachers were preparing before bringing their students in to see a show. Only four out of 14 teachers had previously viewed the shows they were bringing their students to see. Of these four, two

teachers chose to use 'self-made' teacher guides based on previously seeing the show. "Several years ago we accessed MOR resources and used them as a guideline to write guiding questions for each [show]." The second teacher who chose to use a self-made guide had previously worked for NASA as an education and public outreach coordinator. The other two teachers who had already seen the show that they would be attending with their class elected not to use any teacher guides during their visit. When asked what they would be providing for their students, both of these teachers chose not to respond to the question. Of the teachers surveyed, four total claimed to be using teacher guides. The two previously mentioned using self-made guides, and two more (N=14). When asked appropriate questions, it was discovered that not either of these two additional teachers were actually using educational guides. One of the two responded that they would be using the "rules and policies of behavior and the museum website to instruct [students] for pre-trip visitation."

Also, only one out of 14 teachers had heard of the *Opening Doors for Montana's Schoolchildren* fund and chose not to use this funding for their trip. When asked why, he replied that they were a local school with low fuel costs and were taking a parent-funded school trip. Although during his phone interview, this teacher did state, "it would be nice to see this program promoted more."

During the pre-visit phone interviews, I also asked the teachers a question regarding the shows they chose to take their students to: *Why is it that you picked this particular show?* Three out of seven teachers interviewed stated they chose a particular show because it was age appropriate. However, two teachers gave striking answers referring to MOR communicating with them about the shows. The first teacher had never

brought her students to MOR, but she has a personal membership for her family. When asked why she chose to see a particular show with her students, she replied, “I saw a description for the new show in my personal member email.” Seeing a show description prompted this teacher to schedule a visit with her class. The second intriguing reply came from a teacher who was attending a *Child Care Connections, Inc* training at the museum. “While at the training they told us that *Big Sky Tonight* could be a custom made show and could be altered to be age appropriate.” These two instances are evidence of communication with teachers being key to maintaining a strong relationship and increasing teacher awareness of resources made available by the Taylor Planetarium.

Another question I asked the teachers during the phone interviews was: *What kind of science do you do during class?* A middle school teacher taking their class to see *Big Sky Tonight* replied, “We usually have a 15-20 minute lecture followed by a lab or demonstration. I also have my eighth graders answer a ‘daily question’.” The teachers who are in elementary schools referenced to more “hands-on” activities such as picture cards, inquiry kits, and investigative activities. A first grade teacher stated that “our school has adopted the *Common Core*, so our main focus is language arts. Most of our science is integrated with reading and the students write down facts.” Another teacher who is in a fifth grade classroom said “I use Montana State Science Standards based teaching.”

From asking various other questions during the pre-visit phone interviews, I found significant correlations concerning teachers and the shows they chose to see with their classes. Two out of the seven teachers I interviewed chose to see an interactive show where the students could ask questions and learn about the local night sky. Both teachers

who chose this option taught middle school aged students, and both had significant science backgrounds. Of the other five teachers, not one had previously seen the show they were taking their class to see, all five had very little, to no formal science training, and most stated their reason for choosing the show as “because it was age appropriate.” All five of these teachers taught in elementary school classrooms.

As stated above, MOR offers customized shows for school groups that request this type of program. When asked on the survey, 13 out of 14 teachers said they would be interested in this service for their next visit. (The only teacher who disagreed does not teach in a traditional classroom.) All 14 teachers mentioned that they would like to know more about the materials provided by the Taylor Planetarium. When asked what kind of materials they would like to see, they provided answers such as the following. “Pre-teach and Post-teach [lessons] would be nice.” “I would like to see lesson plans that correlate to Montana Science/Next Generation Science Standards.” “I wish I had known about the teacher guides, where are they?” From these remarks alone, it can clearly be seen that an increased level of communication is necessary.

The last question I asked the teachers during the phone interviews was, “Do you have any questions for me?” Four of the seven teachers expressed interest in finding the teacher guides on the MOR website. “I would like to know where the materials and resources are. I want to hold my students accountable.” One teacher had two very distinct and very valid questions. “How does the museum decide which shows are going to be offered? Could teachers come in and view the shows before we bring our classes in?” These two were questions I wasn’t expecting to hear, and they came from a very experienced teacher of 24+ years who has been bringing their classes to the MOR for 14

years. Again, this shows a need for a better communication system with the teachers who use the Taylor Planetarium as a teaching tool.

During my research period, sixty-four percent of the groups surveyed saw two particular shows, *Supervolcanoes* and *Big Sky Tonight* (N=14). *Supervolcanoes* is an immersive planetarium show that explores the impact of past explosions, volcanoes around the solar system, and asks the question: *Can a supervolcano erupt in our time?* It is accompanied by a full website containing general information about the show, a video preview, and a thirty page educator guide. The guide contains pre- and post-visit student activities and outlines National Next Generation Science Standards that are met. *Big Sky Tonight* covers seasonal constellations as well as deep space objects. It is updated regularly and can be tailored to any age group for any amount of time. When these teachers were asked (N=14) why they made these selections, thirty-three percent replied with an answer paralleling “because it was recommended by the reservation staff.” Another thirty-three percent of these teachers acknowledged the fact that *Big Sky Tonight* has a connection to Montana, current viewable solar system objects, and the constellations available for viewing that evening (N=14). One teacher who brought 10-12 year olds had very noteworthy reasoning for viewing *Supervolcanoes* with her class:

The Earth’s Structure is our theme in science this trimester. We have been learning about the Earth’s layers, landforms (volcanoes), and [I chose this show] because this showing was aligned with our science standards and because we live near a super volcano. I thought [it] would be a good conclusion to our unit of study.

Only two of the groups who chose to view these two particular shows brought students younger than the middle school age level. The three teachers who brought the

youngest age groups, all chose to see *Sesame Street*-themed shows starring Big Bird and Elmo (N=14). Also, all three of these teachers claimed “age appropriateness” as their rational for show selection.

The post-visit surveys provided some very curious data. After having gone through the pre-visit surveys and interviews, five teachers went back and found guides to use for their visits (N=14). Not all used them in the planetarium, but expressed how much they appreciated the extra advice. “I did not know MOR had such great teacher resources until I was getting ready for this field trip. I am now excited to use the planetarium shows (I did not know there were so many on such varied topics) to support science lessons and activities in our program.” “I wish I had thought to look on the website, but wasn’t aware at the time that there were educational materials there.” The pre-visit surveys showed that none of the teachers involved in my research were going to use MOR provided teacher guides for their visit to the Taylor Planetarium. But after partaking in my research and being informed of these resources, that number increased to thirty-six percent (N=14). This was only because it was communicated to them that these resources were available.

The post-visit survey asked the teachers if they were satisfied with the educational tools the MOR provides. Of the teachers who responded to this question, all of them stated that they were satisfied. “Yes, now that I know where they are!” As stated earlier, it has been shown that students who are given an activity during a museum visit are more engaged and have an increased understanding of major concepts learned (Hewitt, 2010). If teachers were more informed of these available resources, it seems they would use them to prepare their students before their visit, provide an activity during the visit, and

follow up with future classroom activities. After going through the data collected, I did not find a connection that links any certain category or demographic of teacher and how they used the planetarium as a particular learning tool, and it seems further research could be conducted on this topic.

In the last question of the teacher post-visit survey, I asked teachers how they felt was the best way to share information on the resources available through the MOR website. The most popular response was to send out an email, this came from sixty-three percent of the teachers who commented on the question (N=7). These responses included sending “e-blasts” to local schools and having administrators pass the information on to science departments. Another idea, which came from twenty-five percent of those surveyed, was to send a quick link to the exact page of the resources available after the reservation is made. Commenting on this, one teacher even stated “it would be nice because I printed off and handed out everything that was emailed to me.”

I have found, through online surveys, that regional directors feel their planetariums are being greatly under used as a pedagogical resource. “Some [teachers] just want to ‘round out’ their trip so to speak, with a show” (Planetarium Director #4).

Through the online surveys, I found that most planetarium professionals share the same beliefs and attitudes towards designing their learning environments. Increasing interest in returning to the museum, increasing motivation to pursue further science learning, helping to learn content, and connecting to school curriculum/standards topped the list as ‘most important’ (Appendix H). A study completed by Plummer & Small in 2013 shows similar data along with creating a positive experience heading their list. I also found that planetariums similar to the Taylor Planetarium are struggling with

communication issues regarding teachers. “I’m slowly shaping the relationship I want” (Planetarium Director #7). The directors made it apparent that the ‘ideal’ use of a planetarium visit would involve teachers providing background to their students pre-visit. “If they already have some background, they tend to understand more and ask better (more in depth) questions” (Planetarium Director #2). Planetarium directors see their space as a teaching tool that can be used to link astronomy content to a visible place in space – not the only situation in which they come across this type of information. “This would include pre-visit activities, the show itself along with an illustrative activity followed by a post-visit activity in the classroom” (Planetarium Director #5).

Typically, a group of students are in the planetarium for about an hour and then they are gone, never to return as a group, for the rest of the academic year. In that hour, it is totally unreasonable to expect the students to remember everything presented in the show (Planetarium Director #6).

While being asked how teachers use their planetarium, one of the directors I surveyed stated, “Those who ‘get it’ may bring their students back multiple times for multiple shows and activities. These teachers see it as a learning tool to further their curricular needs” (Planetarium Director #5). Another director said that some teachers “use us as ‘just a show’ or a day they don’t have to plan for” (Planetarium Director #7). This was a major concern for the Taylor Planetarium’s director, Eric Loberg, as well.

Six out of the nine directors I surveyed stated that they too are struggling with finding the best way to communicate with their local educators. “Methods for communicating with educators have been a little baffling at times” (Planetarium Director #6). One director declared a problem that seems to be very similar to an issue we would

have here in Montana. “We are in the process of trying some face to face contact with schools, but that has limited effectiveness when you are trying to draw in school groups from a large rural geographic area” (Planetarium Director #4). However, there was one director who runs a planetarium funded by a school district, who felt they have a good relationship with teachers in that district and said email tended to be one of the best forms of communication. “We have a strong culture already in place, which is great. But I’ve found the best way to communicate [with teachers] is through email” (Planetarium Director #7).

The evidence provided by both teachers and planetarium directors overwhelming shows that a better form of communication is needed to help teachers use the Taylor Planetarium as a more effective learning tool.

#### INTERPRETATION AND CONCLUSION

When I asked the question pertaining to how Montana’s teachers are using the resources made available by the Taylor Planetarium, I didn’t know what to expect for results. I had only concluded from the Planetarium Director’s concerns that he did not feel the resources were being utilized to their full potential. After looking through survey results and conducting interviews, I can clearly see that communication levels from both Montana’s teachers and the MOR must be increased. Teachers do seem to be under using these resources, but only because they are unaware of their existence. Also, due to further research with other regional planetarium directors, I found that this is not an issue that the MOR is dealing with on its own.

What I did find during this project was evidence that a very small percentage of teachers are using the resources made available by the Taylor Planetarium. Only twenty-

nine percent of teachers surveyed had previously viewed the show they were bringing their students to see (N=14). Fourteen percent of teachers surveyed were using self-made teacher guides; while zero percent were using MOR provided teacher guides (N=14).

But, this project has shown evidence that ninety-three percent of teachers surveyed would like to know more about the resources made available by the MOR and Taylor Planetarium (N=14). Fifty-seven percent of teachers who were asked, expressed direct interest in finding the teacher guides for planetarium shows on the MOR website (N=7). And after participating in my research, thirty-six percent of teachers surveyed actually went to the MOR website and found guides to use during their visit to MOR (N=14). Also, when communicating with teachers it is imperative that the *Opening Doors for Montana's Schoolchildren* fund be mentioned. It is a program specifically designed to help teachers use the MOR as a learning tool. And, when asked, only one teacher bringing their class into the Taylor Planetarium had even heard of this program (N=14).

This project has shown me that both teachers and the MOR staff work incredibly hard to keep Montana's students well informed regarding scientific topics. And in the end, I think it is important to mention that a trip to the museum without prior preparation will still positively impact a child's science knowledge. However, it has been shown that teachers who have a structured, comprehensive plan for their students' visit to a museum, results in a more complete learning experience (Hewitt, 2010). So as I have already stated, there is a considerable need to increase the communication level between Montana's teachers and the dedicated staff at the Museum of the Rockies.

## VALUE

When I asked the teacher participants on their thoughts regarding the most effective way for the MOR to communicate information with them, they overwhelmingly said email. And when I asked for the advice of planetarium directors they said the same thing, email. Contacting local teachers via email is an exemplary design for 21<sup>st</sup> century communication of ideas and plans. Just getting some extra information to local educators regarding planetarium shows and current happenings can go a long way. This was shown by a teacher who brought her entire class to the Taylor Planetarium based on a personal member email. While conducting my research, I tended to use mostly email messages to communicate with participating teachers. For a few even, this was our only form of communication. I found this to work very well, as most teachers check their 'inbox' multiple times a day. By sending multiple emails leading up to their visit, a stronger relationship with those teachers coming into the museum would be built. I believe MOR and Taylor Planetarium would benefit from communicating with Montana teachers through email. Sending emails to teachers a few times throughout the school year would keep them current on shows and exhibits, keep them updated on resources available, and solidify the relationship between the museum and local teachers.

I also believe it would make a good impression to either meet with or speak with local administrators since they are the final decision-makers regarding whether school groups can go on a 'field-trip'. Communicating the importance of out-of-school learning opportunities is necessary to receive support from these stakeholders in the community.

Another idea would be to hold teacher workshops at the museum. It would help increase knowledge of resources available within the museum as well as increase teacher

knowledge. Getting teachers into the planetarium is an excellent way to help them prepare their classes for a show and would promote positive feedback for the museum. This was shown to work by a teacher attending a class at the MOR, and she too brought her students to the museum to see a show in the planetarium.

Lastly, when researching possible ways to communicate better with teachers, I came across two organizations I think would be beneficial for the museum to contact. The first would be to enroll with the National Science Teachers Association, Science Matters e-blast. This is a monthly ‘publication’ that gets sent to 600+ Montana science and math teachers. An article or ‘blurb’ about the classroom resources available could prompt educators to use MOR programs in their classroom if a museum visit is unattainable. Having a “tips from the museum” section could be a way to share knowledge with the teachers while informing them of different resources available at the museum. This could also allow the MOR to share a link that would grant teachers access to the different shows provided by the Taylor Planetarium, prompting them to schedule a visit. The second is the 21<sup>st</sup> Century Community Learning Centers program, which utilizes time after school to get students involved in extracurricular activities. MOR and Taylor Planetarium could invite schools that have received this programming to visit the museum after school hours.

The main function of my research was to observe how teachers are currently using the Taylor Planetarium as an educational resource. In doing so, I found a great need for an increased communication system between the Museum of the Rockies and Montana’s teachers. From this project I hope to see a strong culture set into place so

educators from around the state will be able to utilize the resources shown necessary to improve educational experiences within the Taylor Planetarium.

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APPENDICES

APPENDIX A:  
VOILENT UNIVERSE TEACHER GUIDE



*Teacher's Guide to*

## **VOLENTUNVERSE**

### **OBJECTIVES:**

- To document some of the violent processes in the universe
- To examine how some of these process could potentially affect the Earth
- To locate where the asteroid belt is in our solar system and how many asteroids come somewhat close to the Earth.

This show conforms to the following state science standards: 12.F.2b, 12.F.2c, 12.F.3a, 12.F.3b, 12.F.3c, 12.F.4b, 12.F.5a

### **BRIEF SHOW DESCRIPTION:**

The beauty of a starlit sky conceals the violent forces at work within our universe. From the upheaval of a giant star that explodes to release its material into space, to a future encounter between the Earth and a large asteroid that is too close for comfort, we will witness the forces that hold the universe together and occasionally try to rip it apart. Narrated by Patrick Stewart of Star Trek: The Next Generation and the X-Men films. We also add a section on the current night sky, the solar system and location of the asteroids in the asteroid belt.

### **PRE-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Try making craters in your classroom. Bring in a small wading pool filled out about halfway with sand and then put a thin layer of flour on top of the sand. Then drop rocks into the sand and see the craters. Make a table of what you see by varying the size of the rock, mass of the rock, height you drop the rock, angle you toss the rock. Can you vary the size of the crater?
- Talk about the difference in "possibility" and "probability." Just because it is possible that a something could happen, doesn't mean it will happen. For example, is it possible to kick a ball from one end of the field and make a goal on the other end? Sure! But is it probable? The show talks about many things that could happen to the Earth, but the chances of the event actually happening is quite small.

### **POST-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Talk about how students feel about the show after watching it. Do some of these events frighten you? Which ones and why?
- Look up the space weather link below. Page down to the Near Earth Asteroid numbers. What is the closest asteroid to miss us? Note how "LD" means "lunar distance." "2S" "L D" means twice as far from us as the Moon. On this same web site, on the left, look at the Sun. Are there any major sunspot groups on the sun? Are Northern lights forecast for where you live? Look for the  $K_p$  index. When the  $K_p$  numbers reaches six or more, start looking for northern lights in the sky.
- Make a comet in your classroom! The recipe is below though be careful handling the dry ice. You can purchase dry ice from the local blood bank. Do not let students near the dry ice!
- With a telescope, check out the Moon in the sky (and keep in mind that you can see the Moon in the daytime near first quarter phase (afternoon) or third quarter phase (mornings). Can you

identify any of the craters? How large are they? Which craters are the youngest? Craters that appear on top of other craters are younger.

**VOCABULARY LIST:**

Asteroid	Crater	Meteor
Black Hole	Galaxy	Supernova
Comet	Gravity	

**INTERNET RESOURCES:**

- Near Earth Asteroid project (including news): <http://neo.jpl.nasa.gov/>
- Tracking Near Earth Asteroids: <http://neat.jpl.nasa.gov/>
- Asteroid classes and definitions: [http://airandspace.si.edu/etp/asteroids/ast\\_near.html](http://airandspace.si.edu/etp/asteroids/ast_near.html)
- Spaceweather: <http://www.spaceweather.com>
- Comet recipe: <http://www.noao.edu/education/crecipe.html>
- Supernova basics: [http://imagine.gsfc.nasa.gov/docs/science/known\\_12/supernovae.html](http://imagine.gsfc.nasa.gov/docs/science/known_12/supernovae.html)
- Black hole animations: [http://hubblesite.org/explore\\_astronomy/black\\_holes/](http://hubblesite.org/explore_astronomy/black_holes/)
- Arizona's meteor crater: <http://www.meteorcrater.com/>
- Moon craters:  
[http://www.lunarpedia.org/index.php?title=Geologic Processes on the Moon/Cratering on the Moon](http://www.lunarpedia.org/index.php?title=Geologic_Processes_on_the_Moon/Cratering_on_the_Moon)
- Google Moon: <http://www.google.com/moon/>

APPENDIX B:  
IRB APPROVAL LETTER



# INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects

FWA 00000165

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## MEMORANDUM

**TO:** Alecia Jongeward and Walter Woolbaugh  
**FROM:** Mark Quinn, Chair *Mark Quinn*  
**DATE:** November 27, 2013  
**RE:** "What is the Relationship between the Taylor Planetarium and Teachers/Group Leaders from Montana that Bring Their Students" [AJ112713-EX]

The above research, described in your submission of November 27, 2013, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX C:  
COPY OF INITIAL EMAIL SENT TO TEACHERS,  
AND TEACHER PARTICIPATION AGREEMENT

Good Morning \_\_\_\_\_,

I am sure you remember our phone conversation yesterday; I am the graduate student conducting my research in the Taylor Planetarium. I am getting a hold of you asking for your help. The following is an introduction to my research, followed by a link to a short Survey Monkey survey.

I would like to reintroduce myself to you before we get too far. My name is Alecia Jongeward and I just moved to the Gallatin Valley this past summer. (I love it here!) I am a graduate student in the Masters of Science in Science Education program, and I am conducting my research within the Taylor Planetarium at the Museum of the Rockies. This is why I am writing you today.

You have made arrangements to take your class/group to the planetarium sometime in the near future, and I would like to ask for your help. I am hoping to find out how teachers/group leaders are using the Taylor Planetarium, and how to help the Museum of the Rockies have a more symbiotic relationship with these youth leaders (you!).

I would appreciate the opportunity to ask you a few questions through a Survey Monkey survey. If a phone interview were to be a possibility after your visit, please let me know when would be a convenient time for you. You can either email me back, or call/text me at: [406-490-2336](tel:406-490-2336).

The link below is the link to the survey, all you have to do is click on the link (or copy/paste it into your address bar) and answer the questions. I very much appreciate your participation in my research; without your cooperation it would not be possible!

<https://www.surveymonkey.com/s/TAYLORPLANETARIUM>

Please let me know if you ANY questions!

Thank you, thank you, thank you,  
Alecia Jongeward

Dear (enter teacher/leader name here),

You have been asked to participate in a study looking for answers as to how local educational leaders are currently using the resources made available by the Taylor Planetarium. The purpose of this study is to gain an understanding of and improve the use of planetarium based educational materials for visiting groups within the Taylor Planetarium. You have been selected because your class will be visiting the Museum of the Rockies and seeing a show in the Taylor Planetarium during the study period.

If you agree to participate, you will be asked to fill out a pre-visit survey (via the Survey Monkey website) and to participate in a short telephone interview. After your visit, you will be asked to fill out a post-visit survey (via the Survey Monkey website).

You may choose not to participate or to withdraw your consent at any time without penalty. Your decision to participate/not to participate in this study will not result in any benefits or disadvantages.

There are no costs for participating in this project.

Any personal information collected with the survey or interview will be deleted, masked, and/or otherwise changed to ensure confidentiality consistent with professional standards for this kind of research. No one outside the principal investigator will have access to the data. Your responses will be tallied and combined with all other respondents as summative/cumulative data.

Please feel free to ask any questions regarding this study prior, during, or after your participation. Your participation in this study is confidential and voluntary.

Thank you in advance for your help and participation!

Alecia Jongeward  
[ajongeward@gmail.com](mailto:ajongeward@gmail.com)  
406-490-2336

*Please sign and return the following for to confirm your participation in this project.*

**AUTHORIZATION:**

I have read the above and understand the discomforts, inconvenience and risks of this study. I, \_\_\_\_\_ (name of subject), agree to participate in this study. I understand that I may later refuse to participate, and that I may withdraw from the study at any time.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

APPENDIX D:  
PRE-VISIT TEACHER SURVEY QUESTIONS

### Pre-Visit to the Taylor Planetarium Survey

Participation in this research is voluntary and participation or non-participation will not affect your visit to the Taylor Planetarium and the Museum of the Rockies. Your contact information is needed to match your comments with other Taylor Planetarium visit data collected. All comments from this survey will be made anonymous. Your name and your school/group's name will not be attached to your comments.

1. What is your name, what school (organization) do you teach at, and what is the age of the students/group?

2. What show did you choose to see with your group?

3. Why did you choose this particular show?

4. Have you already seen the show you will be attending with your class?

- Yes
- No

5. What are your overall goals for your visit to the Taylor Planetarium?

6. My students get excited about science activities.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

7. My students' attitudes towards science are generally positive.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

8. The show I chose for my class to see correlates with my classroom curriculum.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

9. Are you going to be using any teacher guides during your visit?

- Yes
- No \*If No, please skip to question 11

10. Please list the materials you will be using provided by the MOR website during your visit.

11. What other materials did you provide for your students during their visit to the planetarium?

12. I find the MOR website to be helpful when choosing a show for my students to see in the Taylor Planetarium.

- Strongly Agree       Agree       Disagree       Strongly Disagree

What did you find especially helpful or unhelpful?

13. I would like to learn more about the materials provided by the Taylor Planetarium.

- Strongly Agree       Agree       Disagree       Strongly Disagree

What type of materials would you most be interested in?

14. I would be interested in planning a customized planetarium show for our next visit.

- Strongly Agree       Agree       Disagree       Strongly Disagree

Any ideas on this that you want to share?

15. Have you heard of the “Opening Doors for Montana’s School Children” program?

- Yes  
 Yes, we are utilizing that program for our visit  
 No

16. Is there anything else you would like to know about the resources available through the Taylor Planetarium before your visit?

APPENDIX E:  
PRE-VISIT TEACHER INTERVIEW

### Pre-Visit Interview

Participation in this research is voluntary and participation or non-participation will not affect your visit to the Taylor Planetarium and the Museum of the Rockies. All comments from this interview will be made anonymous. Your name and your school/group's name will not be attached to your comments.

What grade (age group) is your group of students?

What Show are you going to be seeing in the TP?

Why is it that you picked this particular show?

Have you ever been to the TP before?

(If yes) How often do you take your class?

How long have you been a teacher?

What kind of science training do you have?

What kind of Science do you do in class? Labs, lectures, demos, etc?

Do you have any questions for me?

APPENDIX F:  
POST-VISIT TEACHER SURVEY QUESTIONS

Participation in this research is voluntary and participation or non-participation will not affect your visit to the Taylor Planetarium and the Museum of the Rockies. All comments from this interview will be made anonymous. Your name and your school/group's name will not be attached to your comments.

Name? School? Grade? Show?

Why did you choose to come to the TP when you did?

How did you structure your group's visit to the TP?

Why did you choose this method?

Did you provide any worksheets or educational tools for the students before they visited the TP? Y/N

If so, were these worksheets provided by the MOR website? Y/N

If you created this tool yourself, please describe the types of questions or activities you included on your educational tool.

Are you satisfied with the educational tools the MOR provides for teachers that choose to see a show in the TP? Why or why not?

How would you like to change your visit if you were to come back to see another show?

Is there anything else you would like me to know? Or, do you have any other feedback for this study?

How do you feel is the best way to share information with teachers about the resources available for the MOR website?

APPENDIX G:  
COPY OF EMAIL SENT TO PLANETARIUM DIRECTORS,  
AND PLANETARIUM DIRECTOR SURVEY

Good Afternoon \_\_\_\_\_,

I am sure you remember our telephone conversation this afternoon, but I will give you a quick reminder of who I am. My name is Alecia Jongeward and I am the graduate student from Montana State University completing my research within the Taylor Planetarium at the Museum of the Rockies. I am studying how the local teachers use the planetarium as a learning tool, in hopes of helping the museum come up with a plan to create a more symbiotic relationship with these educators. I have been asking teachers/educators to fill out different surveys and answer interview questions, and now I am asking for your help. I would very much appreciate if you could fill out this short (9 question) survey through the Survey Monkey website. The link is below, but if you cannot click to follow it please copy/paste it into your browser. Also, if you would like to share any more information with me please feel free. My research would not be possible without participation from people like you, so a BIG THANK YOU is in order!!

<https://www.surveymonkey.com/s/planetariumprof>

Let me know if you have any questions, or if you cannot connect to the survey.

Have a great day, and thanks again,

Alecia Jongeward

[406-490-2336](tel:406-490-2336)

This survey contains questions for planetarium professionals asking questions about the goals and designs of their own learning environment. No personal information will be recorded. Thank you for your participation.

1. I believe one of the most important goals for our planetarium is to increase interest in returning to the museum.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

2. I believe one of the most important goals for our planetarium is to increase motivation to pursue further science learning.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

3. I believe one of the most important goals of our planetarium is to increase visitor content knowledge.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

4. I believe that one of the most important goals for our planetarium is to create a positive visitor experience.

- Strongly Agree

- Agree
- Disagree
- Strongly Disagree

5. I believe one of the most important goals of our planetarium is to connect our shows to school curriculum and standards.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

6. I believe one of the most important goals of our planetarium is to develop interest in science and increase the understanding of science knowledge.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

7. Do you feel local teachers use the planetarium as an appropriate learning tool? Or, do you feel they come in to see "just any show"? Please explain.

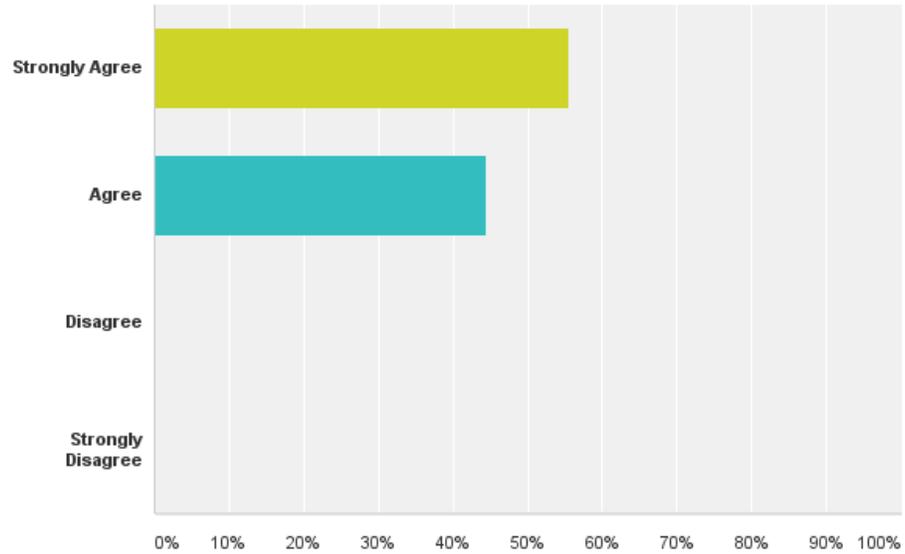
8. How would you explain the "ideal" use of a planetarium visit by local educators?

9. What is the best method of communication you have found to connect with local educators?

APPENDIX H:  
PLANETARIUM DIRECTOR SURVEY RESULTS

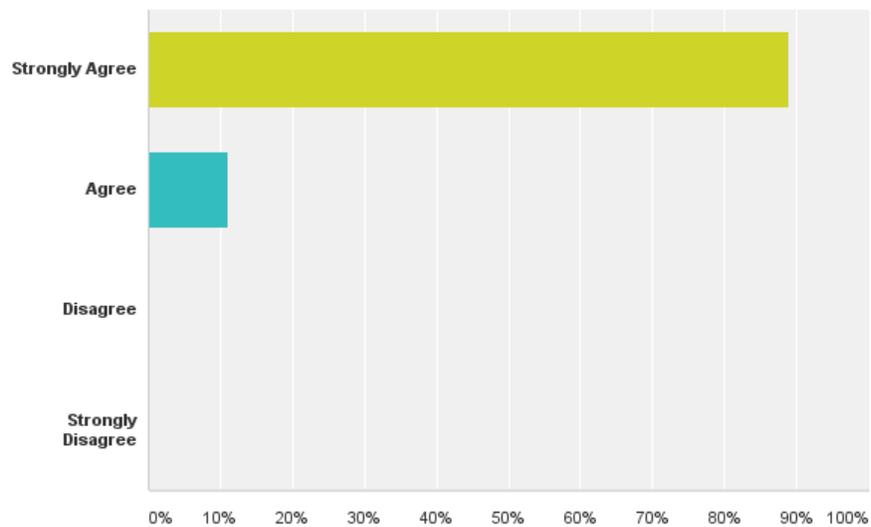
**Q1 I believe one of the most important goals for our planetarium is to increase interest in returning to the museum.**

Answered: 9 Skipped: 0



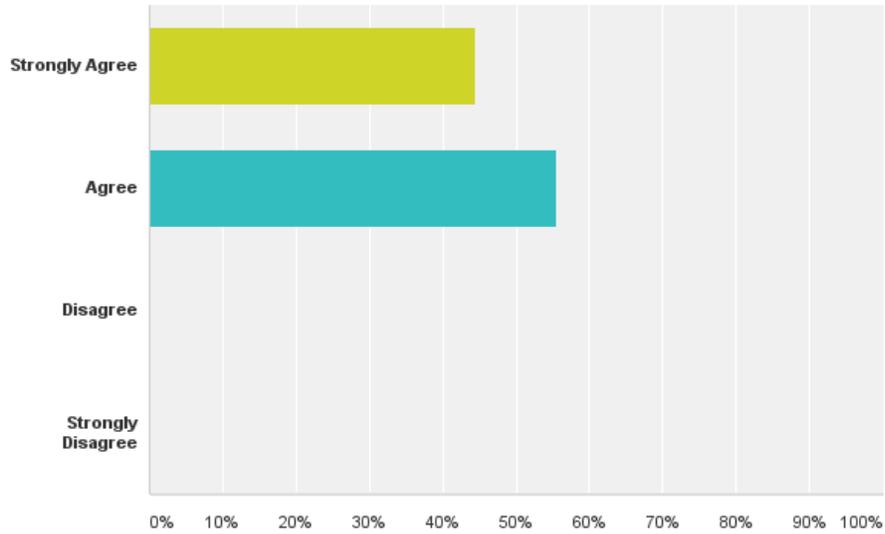
**Q2 I believe one of the most important goals for our planetarium is to increase motivation to pursue further science learning.**

Answered: 9 Skipped: 0



**Q3 I believe one of the most important goals of our planetarium is to increase visitor content knowledge.**

Answered: 9 Skipped: 0



**Q5 I believe one of the most important goals of our planetarium is to connect our shows to school curriculum and standards.**

Answered: 9 Skipped: 0

