Maya Skies External Evaluation Report

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June 2010
INVERNESS RESEARCH

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I. Introduction

In 2007, the Chabot Space & Science Center[1] in Oakland, California, in collaboration with LodeStar Astronomy Center,[2] and the Institute for Learning Innovation[3] received a grant from the National Science Foundation to design, create, research, and distribute a planetarium show called *Tales of the Maya Skies*.[4] The project was an ambitious effort that set out to accomplish multiple goals, including the production of an innovative full dome planetarium show, the demonstration of an innovative production model, and sharing lessons learned with the field. A description of the three major components of the project's theory of action follows.

The show: The project set out to create a full dome planetarium show using immersive, 3D technology within the context of Maya cosmology. The aim was to show how this early civilization observed and recorded the movements of objects in the sky and how they made meaning of their observations. It was hoped that this context would be a compelling entry point into the present day science of astronomy. The intent was for the show, *Tales of the Maya Skies,* to interpret celestial phenomena in both an historical, Maya context and a contemporary astronomical one. In front-end evaluations, the topic of the Maya was identified as holding high interest for general audiences. Part of the rationale for using the ancient Maya as a cultural context for the show was also that the topic would attract Latino/Hispanic audiences in a culturally responsive way, to increase their participation in informal science education. The project produced a full-dome and a flat screen version of the show narrated in English, Spanish, and Yucatec.

The production model: In producing the show, the project proposed to demonstrate an innovative model for full-dome collaborations by employing the expertise of several different technical and production houses, and the capacities of several leading full-dome planetaria. This distributed expertise design is a familiar design for Hollywood films, but until this project, it had not been used in producing planetarium shows. Typically in creating planetarium shows, some aspect of the production

[1] For more information, see www.chabotspace.org.
[2] For more information, see www.nmnaturalhistory.org. The co-PI at LodeStar had moved to ArtsLab by the time the grant was awarded and continued as co-PI.
[3] For more information, see http://www.ilinet.org/display/ILI/Home
[4] NSF award number 0610253.

is outsourced but what was unusual with *Tales of the Maya Skies* was the number of partners involved in the production and the geographic distance between them. The appeal of the model was that it would allow for specialists with expertise in particular, different cutting edge technologies, such as laser scanning for creating realistic 3D animated images, to contribute to the show. The idea was that this collaboration would result in a show that none of the entities could produce alone and all of the entities could share in the risk and the success. The following institutions and production houses contributed to the show:

- Chabot Space & Science Center: A co-PI of the project is based here. Chabot is the "institution of record" with multiple roles, including serving as the grant recipient and fiscal agent, being responsible for monitoring the work of the collaborative, and co-producing the show (particularly in terms of the astronomy sequences).

- ARTS Lab, University of New Mexico: A co-PI is based here. ArtsLab co-produced the show and rendered the 2D animation of Maya cosmology.

- Institute for the Study and Integration of Graphical Heritage Techniques (INSIGHT): This company specializes in capturing archeology sites on computer. Their role in this project was to recreate the images of Chich'en Itza featured in the show "as it is today and at the apogee of the Mayan culture." They received assistance from CyArk.

- Digitrove, Inc: This San Francisco production house contributed the 3D and some 2D sequences in the show, as well as the show scene assembly, lighting, texturing, and final 4K rendering.

- Palma Vfx, also in San Francisco, provided the 2.5D animation.

- Institute for Learning Innovation: A co-PI is based here. ILI conducted front-end research that was intended to inform the development of the show and script. ILI will conduct research with audiences of the show. ILI has also served as a member of the general development team, offering feedback along the way in terms of the script and the flow of the show.

- Contemporánea: This group serves in an advisory capacity in understanding the Latino community with particular expertise in marketing to Latino communities.

- Inverness Research: This group is providing external evaluation to the project.

Sharing lessons learned: In addition to creating the show *Tales of the Maya Skies*, the project proposed to share important lessons learned from its innovative approach with the field of planetaria interested in undertaking similar projects. The *Maya Skies* team planned to augment their own knowledge, as well as share what they learned, by 1) working with and training consortium partner museums through professional development workshops, and 2) conducting audience research.

To accomplish the first strand of work, *Maya Skies* organized a consortium of six partner planetaria—Lodestar in Albuquerque, Gladwin Planetarium in Santa Barbara, Clark Planetarium in Salt Lake City, Fels Planetarium in Philadelphia, Planetaria Luis Enrique Erro at the Instituto Politecnico Nacional (IPN), Mexico City, and Planetario Arcadio Poveda Ricalde in Merida, Yucatan. The agreement was that all members of the consortium would receive the full-dome show, and would be invited to participate in professional development based on lessons learned from the process—i.,e., how to create a planetarium show through a collaborative process. And the consortium institutions agreed to provide audiences for, and participate in, the learning research strand.

To accomplish the second strand, ILI was responsible for conducting learning research with a range of audiences in several venues once the show was complete. They proposed to share with the field, via publications and presentations at conferences, how and what visitors learned in the context of, and through the medium of, this full-dome, "immersive" planetarium show. This report does not include an independent assessment of this learning research because to date, this strand of work has not begun.

Inverness Research

The *Tales of the Maya Skies* project contracted Inverness Research as the summative evaluators of the project in 2007. In this role, Inverness studied the production process and model, communicated with consortium institutions about their interactions with the project, and conducted interviews with the staff of Institute for Learning Innovation (ILI) about their role in and work on the project.[5] Post-production,

[5] Part of Inverness' original evaluation plan for the project was to include an independent assessment of the ILI research on audience
(footnote continued)

Inverness gathered feedback and different perceptions of the show from three different groups. We surveyed audience members and conducted focus groups about the public's perceptions of the show, interviewed point people at the consortium planetaria, and elicited reviews of the show from outside experts in astronomy and Maya culture and cosmology. The evaluation uses data from these multiple sources to assess how closely the viewer experience matches the developers' intentions.

At the request of the project, Inverness also provided formative evaluation at one point during the production. For this piece of work, Inverness studied the efficacy of the collaborative process for creating the show by interviewing the production team members and attending meetings of the production team. Formative feedback was offered to the project PI and project manager in 2008.

The evaluation team conducted the following activities:

Interviews with key players: Inverness conducted interviews with project staff and partners during the production, as well as after the production was completed, to gain an understanding of the process of creating the show, and the strengths, challenges, and lessons learned from the collaborative model. Post-production, we gathered project staff and partners' perceptions of the quality and value of the show, asked them to characterize the audiences attending the show and their perceptions of the ways in which the audiences experienced *Tales of the Maya Skies*. Inverness also conducted interviews with production team members who are in the process of sharing, in online venues, the technical aspects of creating the show and the lessons learned from this process, for the benefit of the field of astronomy education.

Audience surveys and focus groups: Inverness designed surveys to capture audiences' impressions of the show and to explore what dimensions visitors found interesting and appealing, and what they thought they learned about astronomy and Maya cosmology. Audience members completed the surveys voluntarily after viewing the show at two U.S. institutions, Chabot and Gladwin Planetarium in Santa Barbara, and two in Mexico—El Planetario Luis Enrique Erro in Mexico City and Planetario Arcadio Poveda Ricalde in Merida, Yucatan. For a more in-depth understanding, Inverness held focus groups with both English and

learning. We were not able to conduct this review because as of the writing of this report, that work had not yet begun.

Spanish audience members at Chabot after several different screenings. See Appendix A for copies of the surveys and Appendix B for the focus group protocols.

External expert reviews: Inverness invited six specialists in astronomy education and/or Maya culture (who were independent of the production of *Tales of the Maya Skies*) to review the show and offer their perceptions of the quality of the show, and the accuracy and value of the content. Three reviewers were knowledgeable about the Maya and Maya cosmology and four were astronomers or astronomy educators. (One reviewer was an archeoastronomer specializing in the Maya and so provided expertise in both areas.)

This Report

This report presents an overview of the production model and process, presents different perspectives on the content and value of the show, reflects on the experience and participation of the consortium institutions, and draws lessons learned about making a full dome digital show, using a culturally-based storyline as the context for presenting some basic present day Western astronomy concepts. It concludes by identifying lessons learned about the production model and the production process for the benefit of the larger field of planetaria.

Below, Section II describes the process of creating *Tales of the Maya Skies* and provides background and context for understanding the accomplishments of the project. Section III offers different perspectives on the show—from audience members who viewed the show and completed surveys afterwards and/or participated in face-to-face focus groups; from consortium planetaria point people who received the show; and from six invited external expert reviewers. Section IV discusses the experience of the consortium institutions with the project. Section V presents the lessons learned drawn from all of the data collected and offered from the perspective of Inverness Research.

The intended audience for this report is the NSF, the major participants in the project, and the planetarium field at large, including but not limited to the *Maya Skies* consortium members. Results of this summative study will be posted on *fulldome.org* and *informalscience.org* and will provide an independent validation for the educational potential of the *Maya Skies* show and a full description of the production issues involved in creating it.

II. The Process of Creating Maya Skies

The *Maya Skies* project produced a visually impressive full-dome planetarium show, which could emerge as a leader in the field as a culturally contextualized astronomy show. The show is available in three languages—English, Spanish, and Yucatec—and two versions—full-dome and flat screen—and has been well received by audiences in various parts of the United States, and internationally in Mexico and Germany. It has received favorable reviews from planetarium directors, astronomer educators, and Maya specialists, and it was recently honored as the second-favorite in an audience poll of 25 full dome shows at Full Dome Festival in Jena, Germany.

This success is particularly noteworthy given the challenges encountered in the production process. The NSF funding for the project arrived later than expected, and by that time, key project leaders named in the proposal had changed positions and/or taken on new commitments that compromised their ability to give priority to the *Maya Skies* project. This resulted in mid-course adjustments, time lost, and a leadership void, as changes were made in PIs, production managers, project management, and directors. The production model of collaboration between multiple people with highly specialized skills in different production houses, set in geographically distant places, relies heavily on strong leadership from the outset. The initial challenge that the project undertook—to create a show using this distributed expertise model—was significant, and the task was intensified by the absence of an experienced producer and changes in leadership.

The original *Maya Skies* team was made up of highly qualified individuals who were in some cases breaking new ground in their own fields. The coordination and integration of these innovative, but separate, efforts required strong leadership, and for the first two years of the production, team members did not feel there was one clear leader who had the "final say" for the project. In our mid-project interviews with key people on the production team, we heard from nearly every interviewee that there was a lack of leadership, shared vision, coordination, and communication. There was also no agreed upon storyline. There had been few opportunities for the entire collaborative to stay connected to the vision of the project, and for the team to share their ongoing—and sometimes changing—vision (as well as the progress, process, and challenges associated with accomplishing their goals).

Members of the production team, with ten years of experience prior to Maya Skies in applying laser scanning to archeological research, took on

the task of adapting computer graphics and computer vision research to the full dome for the *Tales of the Maya Skies* planetarium show. They found that the pipeline from capturing the imagery to translating it to full domes changed the length of production. It turned out that the production process was a much slower and longer than they had originally predicted.

A key communication tool for the production team during the early process of creating the show was a website **www.mayaskies.net**. It kept the teams in touch with each other to some extent, and also created a record of the process. It provided scheduling, threaded discussions, shared download zones, and wikis. The site is still active to date.

The final production team, which came together in Fall 2008, included a new producer and director who shepherded a re-creation of the storyline and the successful completion of the visual sequences for the show in nine months. Soon after taking on the job, the producer and director learned that the existing production team did not include a company to render the show, and that the remaining budget would not allow for paying market rates for this work. Digitrove rescued the production by rendering the animation for payment well below market rate, which they were able to do, at least in part, by providing students to do much of the work. The show was completed on a shoestring budget, which required compromises in both the visuals and storyline. The final version of the show was an animated depiction of Chich'en Itza as it might have been in its heyday, but it did not achieve the hyper-realistic representation of Chich'en Itza, which was the original intent of the project. As one PI said, bringing together all of the pieces and blending them into one show was significant work:

> *"We had to bring in a whole team. [ArtsLab] in New Mexico, Digitrove doing the 3D, [Chabot] doing the space sequences. That had to all blend together in the end. I think we got that as smooth as can be, given how many hands were involved in the production."*

The show premiered on October 21, 2009 at *Luis Enrique Erro Planetarium* at the *Instituto Politecnico Nacional* in Mexico City to very favorable reviews. The U.S. premier was November 12, 2009 at Chabot Space and Science Center, and *Tales of the Maya Skies* opened to the U.S. public in a special opening day event on November 21, 2009, also at Chabot.

III. Perspectives on the Show

This section presents the perspectives of different audiences who viewed the show, as to its appeal, educational value, and accuracy. It includes the perspectives of audience members, consortium point people, and external experts in astronomy education and the Maya.

PUBLIC PERSPECTIVES

Summary of Audience Survey Results

To capture the perspectives of audience members, Inverness Research distributed a paper survey to visitors attending shows between December 2009 and April 2010. The surveys were collected at Chabot Space & Science Center, as well as at three consortia sites that were running the show: the Gladwin Planetarium at the Santa Barbara Museum of Natural History, Santa Barbara, CA; Planetario Arcadio Poveda Ricalde in Merida, Yucatan, Mexico; and the *Luis Enrique Erro Planetarium*, IPN (*Instituto Politecnico Nacional*), in Mexico City. The general purpose of the survey was to learn what visitors thought of the show in terms of overall quality, favorite and least favorite parts of the show, and the extent to which visitors learned something about the Maya culture and their contributions to the science of astronomy.

Methods

We started by developing three survey versions, in order to ask more questions without burdening any one visitor. All three versions included common questions about demographics. They also included common questions about the overall quality of the show, about how much respondents knew about the Maya, and about how much they learned. In addition, they included common open-ended questions about respondents' favorite and least favorite parts of the show, and about what questions the show raised for them. We then added unique questions to each of the three versions including questions about changes in appreciation for Maya culture and their contributions to science; questions comparing this planetarium show to others they had seen; and about their motivations for attending the show.

After beginning to collect these data, and after conducting several focus groups with viewers, we decided to add two more survey versions to our evaluation. We wanted to test out some emerging hypotheses we had about some of the concepts presented in the show, as well as the format of the show.

The following table reports final numbers of surveys completed for each version:

Survey versions	Response Count (n)
A	253
B	243
C	214
D	88
E	77
Total	**875**

The surveys were distributed as follows: at the beginning of each show when our evaluation was taking place, the planetarium host, manager, or staff member would explain and describe the evaluation process to the audience, and stress the value and importance of their participation in the study. Immediately after seeing the show, visitors voluntarily filled out short paper surveys. These surveys were collected, entered, and analyzed using the online tool Survey Monkey (*surveymonkey.com*).

The following table reports final numbers of completed surveys from each site:

Location of survey distribution	Response Count (n)
Chabot Space & Science Center	619
Planetario Arcadio Poveda Ricalde, Merida	99
Louis Enrique Erro Planetarium, Mexico City	76
Gladwin Planetarium	81
Total	**875**

Findings

The survey results show the following general findings:

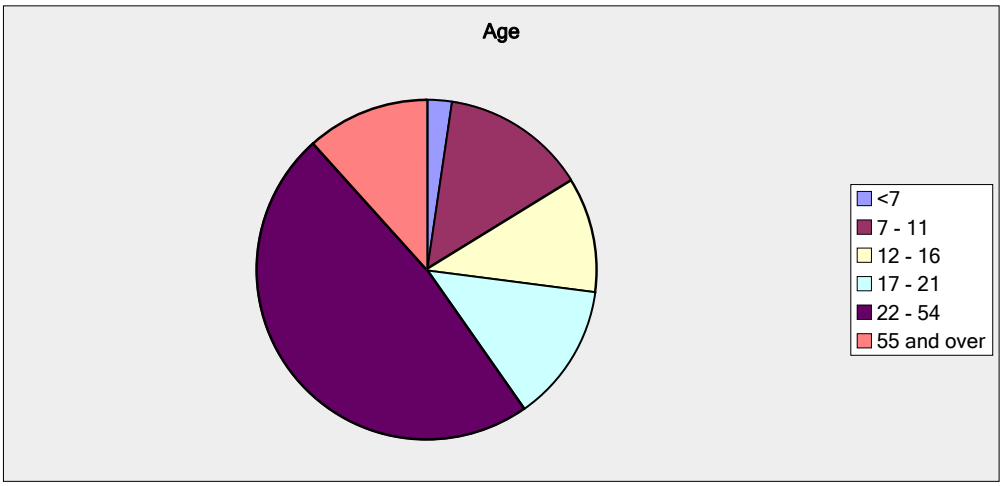
- Viewers felt this show was of high quality
- Viewers enjoyed the show
- The combination of culture, history and science was appealing
- The topic of Maya cosmology was interesting to the people we surveyed, and attracted them to the planetaria where we conducted our evaluation

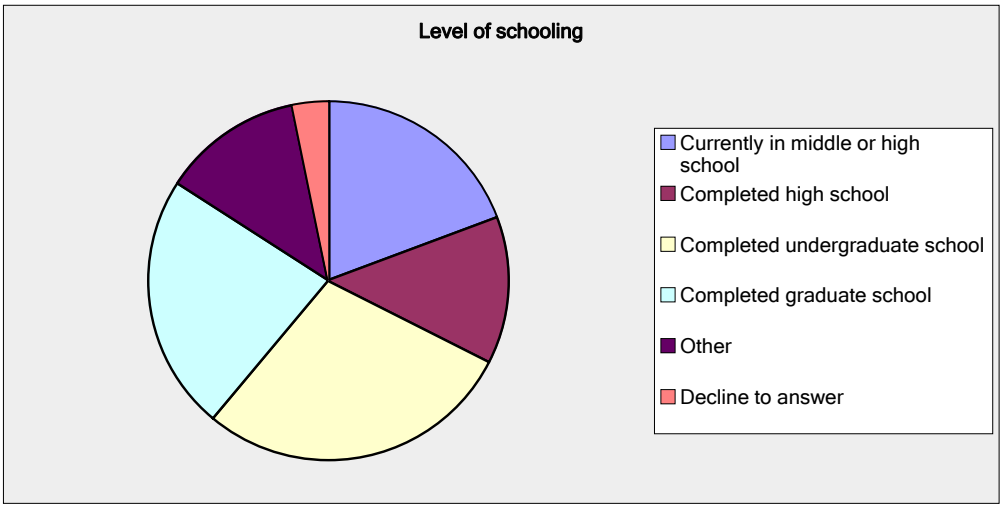
It is also clear from the data that:

- Viewers wanted even more information, and a longer presentation (or a "sequel")
- The attention to December 21st, 2012 and the completion of the Maya long-count calendar cycle at that time was a source of curiosity and questions for many viewers
- The general (all ages) audience that this show is advertised to may not be appropriate, as some of the images from the show were considered to be scary for young children

Who were the viewers of the Tales of the Maya Skies show?

The demographics of the viewers in this evaluation were fairly typical in terms of museum audiences. That is, most (48% of 809) were adults aged 22-55 with a relatively high level of education (52% of 792 respondents reported they had completed undergraduate or graduate school). Just over half (56% of 800 respondents) were female; 44% were male.





The following table shows the racial breakdown of the show's audiences.

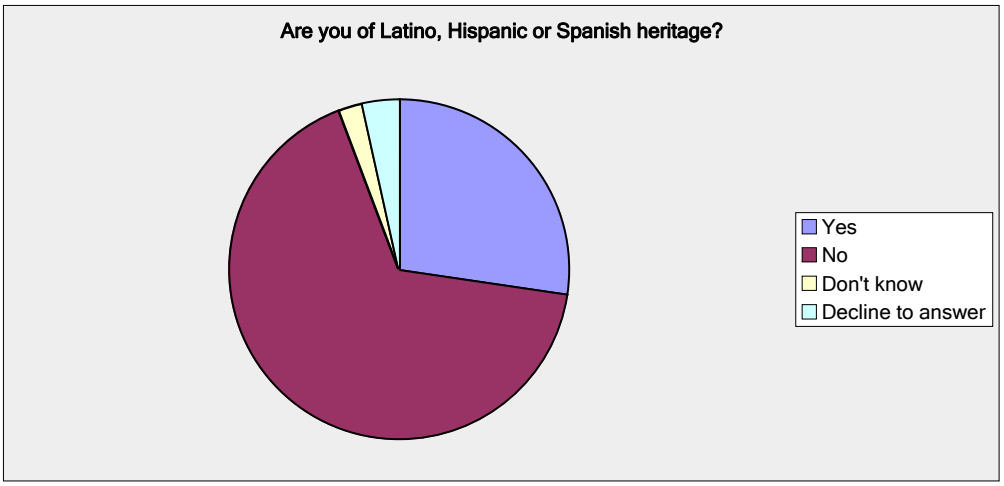
Race[6]	Response Percent*	Response Count
White	49.0%	297
Mixed/Multiple races	15.2%	92
Asian	13.5%	82
Other	12.9%	78
American Indian or Alaskan Native	6.3%	38
Black or African American	4.6%	28
Native Hawaiian or other Pacific Islander	1.8%	11
Decline to state	6.1%	37
Total		**663**

**Percentage total is over 100% as individual respondents could mark more than one option.*

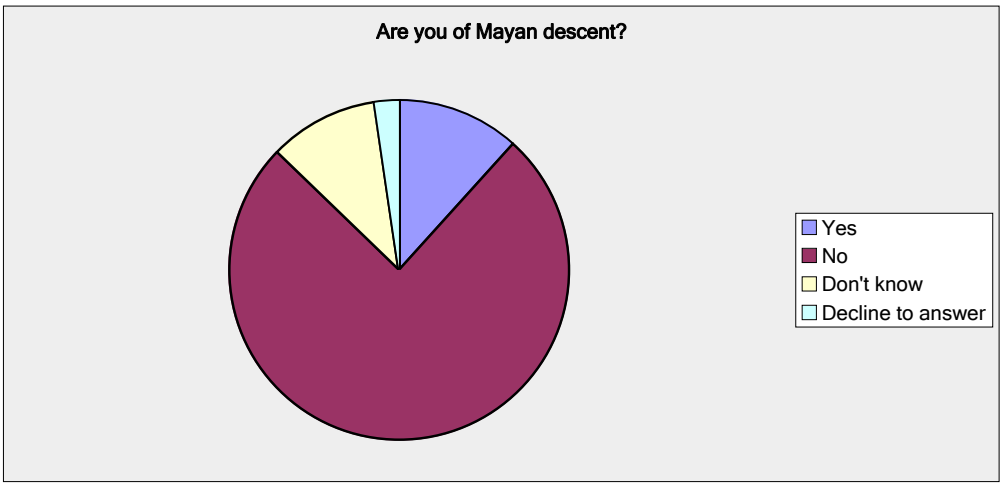
One of the intentions of the *Tales of the Maya Skies* project was to try to increase Latino attendance at Chabot and other planetaria by providing culturally relevant content to groups that do not typically frequent these institutions. In our survey, we asked viewers (in U.S. audiences) to identify whether they have Latino, Hispanic, or Spanish heritage.[7] About one-quarter (27.5%) of the 618 responses were affirmative.

[6] For this question, we used the categories used in the 2000 U.S. Census.

[7] We did not ask the viewers in Mexico to answer this question, as these categories are not relevant to Mexico.



Given the topic of the show, we also asked viewers (in both U.S. and Mexico) to report whether they were of Maya descent. A smaller percentage of respondents (12% of 796) said they are of Maya descent.[8] These data show that the show is attracting both people of Latino heritage, as well as those of Maya descent (although to a smaller extent than Latinos).



What attracts audiences to Tales of the Maya Skies?

Tales of the Maya Skies combines a focus on the cosmology of the Maya and the cultural stories they use to explain scientific phenomena, with modern scientific explanations of some basic astronomy topics. For example, it covers information about why the Earth experiences seasons, the zenith sun, the movement of Venus, the changing position of the rising and setting sun, and eclipses. We wanted to know if this combination of topics was inviting to potential viewers. Indeed, we

[8] 10% of respondents did not know whether they are of Maya descent.

found that of the people who answered this question, the largest percentage (nearly 50% of 205 respondents) reported that they came to see the show because of the combination of the topics.

What attracted you to come to the show?	Response Percent	Response Count
The topic of the Maya people and culture	20.0%	41
The topic of astronomy	11.7%	24
The combination of topics: Maya people and astronomy	**49.8%**	**102**
Something else	14.6%	30
Can't say	3.9%	8
Totals	**100%**	**205**

How do visitors perceive the overall quality of Tales of the Maya Skies?

We asked people to rate the overall quality of the show on a scale of '1' (very low quality) to '5' (very high quality). Most viewers felt that the overall quality of the show was very high: 86% of 698 respondents rated this question a '4' or '5.'

How would you rate the overall quality of the show?	Response Percent	Response Count
1 Very low quality	2.7%	19
2	2.4%	17
3	6.2%	43
4	25.2%	176
5 Very high quality	61.2%	427
Can't say	2.3%	16
Totals	**100**	**698**

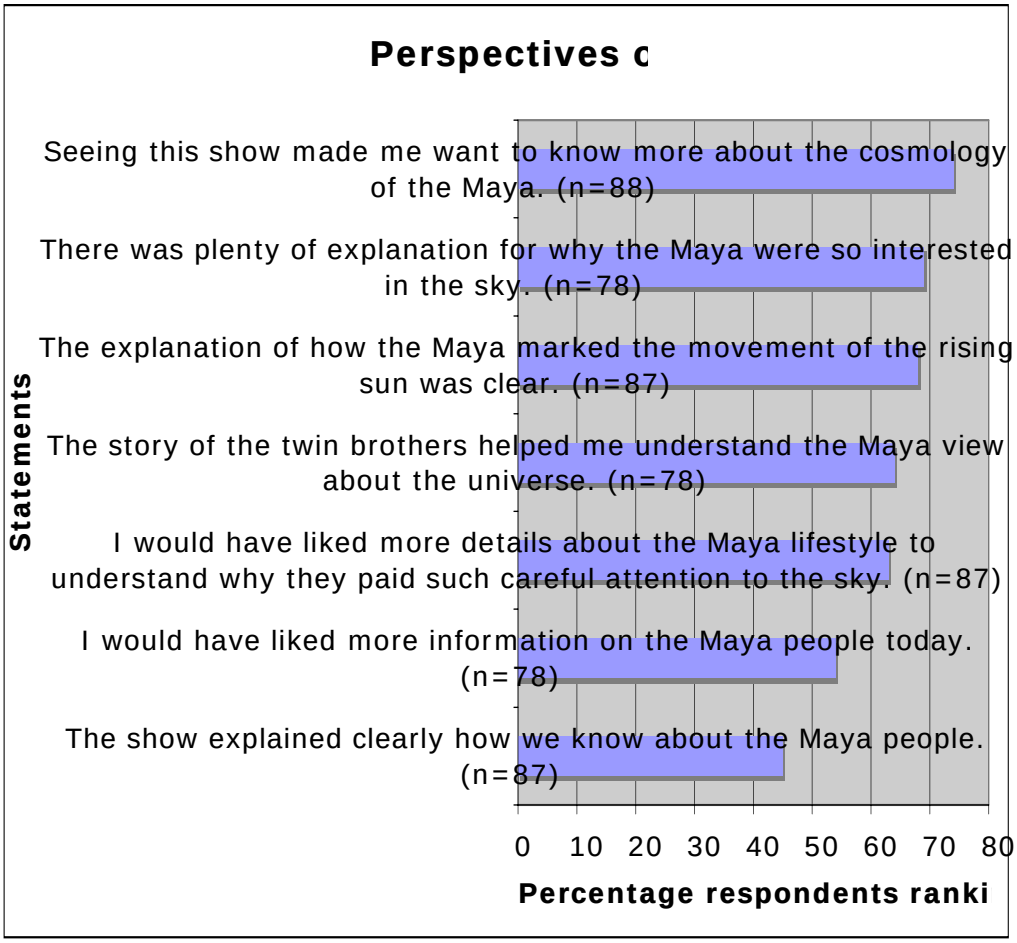
In a different version of our survey, we asked a similar question. We asked people to rate the extent to which they agreed or disagreed with a series of statements. One was: "Overall, I thought this show was of high quality." 77% rated the question a '4' or '5' (n=88) on a scale of '1' (strongly disagree) to '5' (strongly agree).

How much did viewers learn about the Maya from seeing the show?

This planetarium show presents the Maya point of view on cosmology, and on humans' place in the universe. We wanted to know how much people were learning about the Maya people and culture from watching *Tales of the Maya Skies*. Overall, viewers reported learning quite a bit about the Maya: 78% rated this question a '4' or '5' (n=692) on a scale of '1' (I learned nothing") to '5' (I learned a lot).

How much did you learn about the Maya from seeing the show?	Response Percent	Response Count
1 I learned nothing	3.5%	24
2	5.3%	37
3	11.8%	82
4	23.0%	159
5 I learned a lot	54.9%	380
6 Can't say	1.4%	10
Totals	**99.9%**	**692**

We wanted to know how well the show presented details about Maya cosmology. For example, why did the Maya put such an emphasis on learning about and understanding the movements of the stars, moon, and planets? There were mixed responses as to how much detail was provided and how useful it was to visitors.



**Respondents were asked to rate the extent to which they agreed or disagreed with a series of statements, with '1' being "strongly disagree" and '5' being "strongly agree."*

About three-quarters of 88 respondents to this question agreed that seeing the show made them want to learn more about the cosmology of

the Maya, while 69% of 78 respondents agreed that there was plenty of explanation for why the Maya were so interested in the sky. On a different question, 60% agreed strongly that they would have liked more details about the Maya lifestyle to understand why they paid such close attention to the sky. On a fourth question (the last one on the graph above), less than half of the 87 respondents agreed that the show explained clearly how we know about the Maya people. Overall, these results suggest that audience members were engaged with the subject of the Maya and their cosmology and left the show wanting to know more.

We tested the notion that the creation story may not have been clear to viewers. In our survey, we asked people to rate the extent to which they agreed or disagreed with the following statement: "I found the creation story difficult to follow." We learned that the creation story made sense to viewers: 70% of 78 respondents disagreed (rating the statement a '1' or '2' where '1' means "strongly disagree" and '5' means "strongly agree").

But comments indicated mixed reviews about the balance between cosmology and science. Some viewers expected to see more science in this show. *Tales of the Maya Skies* breaks with traditional planetarium shows by combining cultural content with Western astronomy topics. It is not surprising then that audiences might have been disappointed not to see more science. A similar pattern surfaced in visitors' final comments about the show with some people stating that they saw little connection between the story of the Maya and the science and wanted more science, more rigorous content, and generally more depth of coverage. A sampling of comments are below:

I would have liked to see more of the sky and less fable/storytelling but overall the production was excellent.

Inappropriate creationism. Little scientific content. Jumbled content. Could have been really interesting but was a big disappointment.

Relatively little science. Weak connections between cultural myth stories and scientific achievements. Too much "God"/religion disconnected from science findings.

Make it consistent in fact vs. myth.

Very disappointed! Please provide more "facts," not some pagan theory!

I liked the astronomy portion, but the mythology stuff was too long.

We found the movie a little disappointing since the content was shallow.

Too much fluff; not enough how.

More examples - Venus and sun tracks and their relevance very interesting. What else? Also, more explicit graphics of paths, temple features, etc. Make the geometry more visible! Great job!

This should have been a movie, not a planetarium show.

The show's producers put a great deal of effort into the visual effects of this show. We wanted to learn the extent to which viewers were satisfied with its animated, computer-generated style, or whether they wanted (or were expecting) more "real life" images of the Maya people and places discussed in the narrative. We asked this question in two ways and got similar results for both: slightly more people were satisfied with the animated version of the show than wanted more "real life" images.

How much did viewers learn about astronomy from seeing the show?

As noted above, the *Tales of the Maya Skies* show discusses information about basic astronomy; it introduces how the Maya were able to understand the changing seasons as they relate to growing and harvesting crops; that they were able to predict eclipses; and also about how they developed complex calendars and a numbering system. We wanted to learn to what extent visitors were interested in the astronomy of the show (as compared with the cultural strand), and how much they learned about astronomy.

We asked visitors to rate the extent to which they were interested in the astronomy as they watched the show. Most visitors who answered this question reported interest in the show's astronomy: 84% (4's and 5's) were very interested (n=243) on a scale of 1 to 5 with '1' (not at all interested) to '5' (very interested) in the astronomy. We also asked visitors to rate the extent to which they learned about astronomy. Over half the visitors reported learning about astronomy from the show: 65% (4's and 5's) said they learned a lot (n= 241) on a scale from 1 to 5 with '1' meaning "I learned nothing" and '5' meaning "I learned a lot" about astronomy. In another version of the survey, we asked the extent to which viewers agreed with the statement: "I learned plenty of astronomy by watching this show." Just over half (53%) rated this a '4' or '5' (n=78) on a scale of '1' strongly disagree to '5' strongly agree.

Which parts of the show did viewers like best? Which parts did they not like?

We asked the open-ended question: "What was your favorite part of *Tales of the Maya Skies?*" Viewers responded with a wide variety of answers, but there were a few themes that recurred as favorites:

- The story about the twins, and the creation of the sun and the moon
- The design and development of the calendar
- The creation story
- The astronomy information—e.g., about Venus and about the constellations
- The serpent

Also many people said their favorite part was "everything" or "all of it."

We also asked "What did you like the least?" Some of the same themes that were favorites were also liked the least, especially the story of the twin brothers/creation of the sun and moon, and the story of the serpent. These findings suggest that these are the most memorable portions of the show regardless of whether the impressions were positive or negative. Quite a few viewers wanted more details or felt the show was too short as mentioned above. Some audience members mentioned in their comments that they wanted to know more about the Maya perspective on 2012, that the show made them feel dizzy or motion sick, and some felt that some scenes were too scary for young children.

Summary of Focus Group Reviews

In total we talked with seven focus groups of audience members totaling approximately 17 people after viewing *Tales of the Maya Skies* at Chabot. The planetarium manager or host explained to the audiences the purpose of the focus groups and invited people to join them after the show, in order to share their perspectives. Those who volunteered received a free pass to Chabot for participating. Five groups were in English and two were in Spanish.

In general the focus groups reinforced what we learned from the audience surveys.

Focus group participants liked the show

Everyone we talked with thought that the show was visually beautiful, although some wished there were more real-life images included in the show. The topic of the Maya in combination with astronomy was a major draw for them, as were some specific themes, such as interest in

Maya writing, and curiosity about the pop culture hype surrounding 2012.

In general, the focus groups liked the technique of moving between Maya cosmology and contemporary astronomy as in the story of the twins and how they related to the sun and moon.

What focus group participants learned from the show

Participants said they learned about eclipses and movements of the sun, moon, and planets (particularly the pattern of Venus) and how the seasons come about. They said that they learned that the zenith sun can only be seen at the equator, and that two times a year the sun is at its highest point—the spring equinox and the winter solstice. Other learning the audience pointed to was: that the place where the sun rises changes, that days vary in length, about the movement pattern of Venus, that the concept of zero came from the Maya, that the Maya calendar described in the show differed from ours in that it had 18 months plus 5 days but was similar in that it had the same total number of days in a year. One person said that she learned that the Maya were not only intelligent but they were also "disciplined to have succeeded in observing and recording celestial movements as they did."

Focus group participants wanted more depth of coverage and/or greater clarity on the Maya, their cosmology, and on some of the astronomy

Focus group participants tended to agree with the 52 percent of the survey respondents who would have liked more information on the Maya people. The following quote from an adult audience member illustrates.

> *It was far more beautiful than I thought it would be—the drama, artwork and music—but I kept wanting to know more. I wanted much more depth about how the Maya learned these things. They watched the sky, but what techniques did they use and how did they record it and how did people find out and understand? I wanted a little more depth about how the Mayan calendar progresses. I liked the idea that they showed it with 20 days, 18 months, 5 extra days, but then they had the cartoon… I guess I wanted more scientific information in the film than was presented.*

A few focus group participants thought the show romanticized the Maya, and more information about them might have created a more multifaceted and accurate depiction. One adult participant said,

> *There seems to be an effort to say, look how we are recognizing all of these wonderful contributions. The emphasis is on saying that, and not exactly*

describing the contributions and so the description of them was very thin. That kind of sentimental view, I don't think promotes multiculturalism. It is a sort of feel good thing, but you don't know what they actually did. That serpent was pretty exciting to see, but while we were watching the serpent, they could have given us more information.

Several focus group members wanted more information about what the importance of Venus was for the Maya.

The other thing that I found frustrating is that there was this emphasis on the movement of Venus, a whole temple to the movement of Venus, but they never really explained why they thought that was important to the Maya.

Members of at least two focus groups were confused about what the 9-month cycle referred to at the end of the Venus sequence.

They said [Venus] was a 9 month cycle and it showed them when they should be harvesting and planting. I was starting to do the math and said 'wait a minute, 9 months and then 9 months and it goes away for 2 months and they only have 18 months and so how can it show them when to plant and harvest?'

Several focus group members said the show was not always clear about what the Maya knew then, as distinguished from what is more recent scientific knowledge.

It wasn't clear always what they knew and what we know now.

In general the audience liked the narrator's voice and the first person narrative, but some wanted a clearer correspondence between the narrative and the visuals at particular points. One example was when images of Maya script were shown, and some audience members did not know if the narration was about the script or not. About 40 percent of the survey respondents also agreed with a statement that said, "Sometimes I wondered how the narrative was related to the images we were seeing."

What questions focus groups wished the show had answered

Most focus group participants left the show with questions related to the Maya. The fact that the audience was left with lingering questions suggests that viewers were very interested in the topic and that the show engaged them, but it also has implications for the depth of coverage future shows of this nature might aspire to. In general, the more the audience members knew about the Maya, the more ideas they had about ways to enhance the content.

Some of the recurring questions follow.

- How did the Maya's interest in the heavens interface with their religious beliefs, governance, and larger culture?

Having read a little bit more about it and having gone to Tikal, [observing the sun and sky] I learned this interface was important for their governing and their hierarchy, their religious observances. Their emperors' or their kings' rituals were all interconnected and the calendar was a very important part of all of that. I don't think that this movie explained that connection well enough.

~Adult audience member

- Who were the keepers of the calendar and what did they do?

I kept wondering, what did those guys do who were the keepers of the calendar—that seemed to be the most important job. What were their lives like, what sort of things did they do all day?

~Adult audience member

- How did the calendar progress? How did the Maya view the conclusion of the 5,000 year cycle and what significance did it have for them? After the 5000 year period, what did they predict? I was wondering, did they believe that there is going to be another cycle of that 5000 year period?

A few audience members mentioned that they wanted the show to connect with present day Maya and their calendar keepers. One focus group member confessed that she did not even know that the Maya still exist today.

In general, the more the audience members knew about the Maya, the more they expected from the show.

Overall, the survey data and the focus group feedback says that:

- Viewers thought this show was of high quality
- Viewers enjoyed the show and wanted more (either a show with more details or additional shows)
- The combination of culture, history, and science was an appealing focus
- The topic of Maya cosmology is generally interesting and draws audiences to the planetarium

- Viewers identified the movements of the Sun, Moon, and Venus as astronomy topics they learned most about: specifically, the zenith sun; the location of the sunrise; and the movements that create the spring equinox and winter solstice
- Viewers learned about the Maya calendar, that discovery of the concept of zero is associated with the Maya, and that Maya architecture was influenced by the movement of the stars and planets.

These data also suggest that:

- Viewers wanted greater clarity on some of the astronomy
- Viewers wanted more depth of information, and a longer presentation (or a "sequel")
- Viewers wanted a more direct connection between the narration and the visual images

CONSORTIUM SITES PERSPECTIVES

Inverness researchers also talked with point people at the consortium planetaria to capture their own perspectives on the show and how they thought their audiences received the show.

Increases in audience numbers

Three of the six contact personnel at the consortia sites whom we spoke with had seen the show the first time we talked and thought it held great promise for attracting audiences. Only Luis Enrique Erro Planetarium in Mexico City was already running the show when we first interviewed the consortia sites, and for them, audiences were almost double that of any of their other current shows. They started counting visitors as of October 24, 2009 and by February 2010, the show had clocked 15,389 visitors, almost double the number of any of the other eight shows playing concurrently. The next closest audience count was 9,600 visitors for one of their own productions called *Ultimas Noticias Del Sistema Solar* (*The Latest News from the Solar System*).

Attendance at the Chabot Planetarium is up 21 percent for the first seven months of the current fiscal year compared to the same time period last year.

Positive impressions of the show

Three of the consortia site point people we interviewed had seen the show and gave it positive reviews. They praised the archeoastronomical perspective of the show.

One person pointed out that the show "inspires imagination and it does show you that astronomy is important to people." A large part of the rationale for embedding astronomy in the cultural story of the Maya and their belief system was to make science relevant and to affect viewers' attitudes and emotions as much as to affect their cognitive thinking. This person said, "I think the film does really well with that."

This same person thought that the story held together but agreed with views expressed by the expert reviewers (presented below) that the show is more successful in teaching some "core standards for the astronomy—eclipses, the celestial mechanics" than explaining "the Maya view of the heavens and the relationship between science and religion… that is a sticky thing and I don't know if it carried that completely." He specifically expected the show to follow the original intent more closely "really taking audiences to Chich'en Itza as virtually and as realistically as possible, and also in the archeoastronomy of seeing light on the stones as a physical component of the show, which really didn't come out in the end."

EXPERT REVIEWERS' PERSPECTIVES

Inverness Research invited six experts on Maya cosmology, archeoastronomy of the Maya culture, and astronomy education to review the show and respond to a set of questions we developed as part of the summative evaluation. The protocols asked about the reviewers' impressions of the show, their assessments of the astronomy content and the cultural and historical context, the extent to which the show took advantage of full-dome technology (for astronomy educators), and their perspectives on contributions of the show to audiences and the planetarium field.

Overall impressions of the reviewers

Overall the reviewers thought that the show was visually beautiful and that it did a good job of synthesizing cultural material with scientific content.

"I am very favorably impressed: graphically beautiful and a very nice synthesis of cultural and scientific ideas."

~Astronomy educator

"If the main purpose of the show was to portray the belief system and scientific achievements of the Maya and illustrate how these can be used as a lead-in into our current understanding of astronomy, I felt the show was highly successful in this regard."

~Astronomy educator

"I think visually it was wonderful. They did a nice job on the graphics. It was very impressive."

~Archeoastronomer

The immersive quality of the show, which was a stated goal in the production plan, stood out for only one reviewer:

"It took advantage of the "dome of the sky" several times while keeping the earth scenes near the edge. This enhanced the immersive qualities."

~Astronomy educator

Astronomy educators and Maya specialists thought the show would have appeal for a wide range of ages from young to old, but 2 of the 6 reviewers questioned its appropriateness for younger audiences.

"I don't think it is made for children. It may have been made for children, but they won't grasp it. In other words, people would have to really teach it [afterwards]."

~ Professor of Contemporary Maya Spirituality

The reviewers did not think, however, that the show offered the audience suggestions or materials for learning more about ideas introduced in the show. An astronomy educator said that the show did not "provide an obvious way for the viewer to follow up."

Assessments of use of full-dome technology

The astronomers thought the show took advantage of full-dome planetarium technology to a great degree. They rated a question about the extent to which the show took advantage of full-dome planetarium technology. The mean rating was 4.67 with 1 being *not at all* and 5 being *to a great degree*.

One reviewer thought that this show might emerge as a leader in astronomy education for using a "context of mythology with roots in astronomy."

"I was pleased with its refreshingly appropriate use of the dome to portray the sky, the earth, and the underworld. Particularly the sky. My recent experience in planetaria has been that the dome is used as a screen for a movie (with its corresponding distortion of the images) rather than showing the stars and celestial sights appropriately integrated with the other locations and visuals in the show."

~Astronomy educator

Another astronomy educator suggested that there was room for improvement in two parts of the show—the movements of the Sun and the solar eclipse.

"The movements of the Sun (sunrise position, sunset position, and how high the Sun got in the sky at different seasons) was not done very well. I think the full-dome system can be used much better in that section of the show. Likewise, the solar eclipse section could have been much better."

Astronomy educators also mentioned that the schematic of the Earth around the Sun was not proportionally accurate—the Earth was the same size at all times, and it was larger than the Sun.

"I know that it's impossible to show sizes and distances to scale, but I feel it's important to state that in some fashion, as a disclaimer. It's also possible to give a better illusion of the geometry by making the size of Earth larger when it's closer to the viewer (the near side of the Sun) and smaller when its father away (far side of the Sun)."

This same astronomer made a similar comment about the size of the Moon relative to the Sun in the eclipse sequence where the new Moon, about to eclipse the Sun, was noticeably smaller than the Sun itself, presumably viewed from space and not from Earth. It was then followed by another sequence showing an actual eclipse, where the size of Sun and Moon were the same size. He said, "This was a confusing element."

Another reviewer thought that the quality of the animation changed in the second half of the show giving the images an Asian feel rather than Maya.

"I really enjoyed the first part of the animation …but the animation in the second half felt like it was a foreign creature, the Chich'en Itza… It felt like a whole different crew was making them maybe. It almost had an Asian feel to it, which didn't feel like it was part of the Maya."

~ Professor of Contemporary Maya Spirituality

Educational contributions

The expert reviewers offered their thoughts on the educational contributions of the show. Interestingly, the astronomy educators thought there were more educational contributions from the cultural information, and the Maya specialists thought there were more educational contributions from of the astronomy.

> *"More than anything I found it to provide an introduction to the ancient Mayan culture, traditional stories, calendaring system, architecture, and observational recordkeeping."*
>
> ~Astronomy educator

> *"I really did appreciate the astronomy aspect of it, so that was really quite wonderful."*
>
> ~ Professor of Contemporary Maya Spirituality

Both the astronomers and the Maya specialists thought that the show succeeded as an introduction to the Maya—how Maya architecture was influenced by the movement of the heavens and that they recorded these movements meticulously.

> *"If the objective of this show is to simply expose young viewers to some sense of what the Maya were doing and that their architecture was affected by astronomy and that they were making complex recordings of the heavens, then I think they have done a fair job."*
>
> ~Archeoastronomer

The reviewers tended to agree with each other that some aspects of the content were inaccurate, confusing to the audience, or could have been more culturally sensitive.

Assessments of the astronomy content

Reviewers thought the general audience would learn a moderate amount about astronomy from the show. The mean rating for the five reviewers who answered the question—"How much astronomy do you think the general viewer will learn from the show?"—was 3.1 on a scale of 1-5 with 1 being *nothing* and 5 *being a great amount*.

Expert reviewers also rated how likely the show was to make general audiences more interested in astronomy. Again, they thought that it was likely to make them slightly more interested. The mean rating for the six reviewers was 3.25 with 1 being *not at all* and 5 being *to a great degree*.

The astronomers and Maya specialists mentioned the seasons (patterns of the Sun), eclipses, and the tracking of Venus, with a few caveats discussed below, as the astronomy topics best conveyed by the show.

> *"The apparent path and movement of the Sun over the year and the necessity of careful observation to be able to predict position" was best conveyed by the show.*
>
> ~Astronomy educator

> *"I thought the depiction of the movements of Venus was the best done astronomy part, although there was a point of confusion about duration and timing that I'll describe later. Seasons and eclipses were pretty good too with two caveats that I'll talk about later, too."*
>
> ~Astronomy educator

The reviewers echoed a focus group participant's perception that the information about Venus signaling the growing season was confusing. An astronomy educator commented:

> *"There was a statement that the 9 month time span [signaled] the growing time of corn. To me this was at the same time confusing and misleading. The cycle of Venus cannot possibly be synchronized with the annual cycle of Earth in orbit around the Sun that governs agriculture and growing seasons."*

So although the reviewers saw educational value in the show, they also thought the script needed refinement and a few of the visuals could have been more accurately portrayed.

Assessments of the content related to the Maya

Strengths of the content

According to the reviewers, the strengths of the show's content related to Maya cosmology lay at the most general level. The show introduces the idea of archeoastronomy and gives fair treatment to the notion of how advanced the ancient Maya's understanding of astronomy was and how well it measures up with ideas in modern astronomy. At a more detailed level, comments from all three Maya specialists and one astronomer underscored the need for broader consultation and inclusion of more Maya in the production of the storyline of the show.

Learning about and interest in the Maya

Reviewers thought the general viewer would learn a moderate amount about the Maya from the show, with the astronomers rating higher than the Maya specialists. They were asked, "How much do you think the general viewer is learning about Maya culture from the show?" The mean rating for the six reviewers was 3.42 with 1 being *nothing* and 5

being *a very large amount*. (The astronomers' mean rating on this question was 4 compared to 2.8 for the Maya specialists.)

Reviewers thought the show would increase viewers' interest in the Maya. They rated "To what degree do you think this show is likely to make viewers more interested in Maya culture?" The mean rating for the six reviewers was 3.83 with 1 being *not at all* and 5 being *to a great degree*. (Again, the astronomers' mean rating was 4.67 on this question compared to 3 for the Maya specialists.)

Accuracy of archeoastronomy content

The accuracy of the archeoastronomy got mixed reviews. The archeoastronomer agreed that the Maya's Seven Macaw was the Big Dipper as the show accurately depicted: "I do agree with her identification of Seven Macaw as being the Big Dipper. I think there is good evidence for that. It was wonderful to see them do a portrayal of that." And he agreed that the turtle constellation is a small set of stars within Orion and is a modern day Maya constellation. However, he said that Gemini was not accurately presented as the owl constellation:

> *"The idea of this owl constellation… to my knowledge, there is no substantial evidence to identify Gemini as the owl constellation… This is my work, Maya constellations, and there isn't an owl constellation in Gemini."*

The archeoastronomer questioned the accuracy of the reference to the 370 year eclipse cycle because as he explained "the same type of solar eclipse will be visible from the same location on Earth every 18 years, 11 days, and 8 hours. It doesn't take 370 years for this to happen." He added that the 370 year eclipse pattern relies on a lunar phenomenon, the Anomalistic Month, that the Maya were not aware of.

Two reviewers, as well as focus group members, mentioned variations on the creation story presented in the show.

> *"I think the creation story of humans needed to be more accurate because it is Grandmother Ixmucané who grinds the corn that creates the humans and also it was four males [rather than two] that were created first."*
>
> ~ Professor of Contemporary Maya Spirituality

A Misconception

According to the Maya specialists, it is a common misconception that the Maya discovered zero. They explained that the Maya had a place marker for zero, but they did not actually have the number zero.

"It is one of these things that shows up on the Discovery Channel, that the Maya are the first people to discover zero. Functionally no… it is not mathematically a zero. There isn't a Maya word for zero… What they have that we are calling a zero is a space holder, and that is not the same thing. You do not see occasions of 5 – 5 = 0… It is minor, but it does convey something bigger to me and that is, they are stating this to a large audience, that is, the number of people that will see this show."

~ Archeoastronomer

Culturally sensitive aspects of the show

Two pervasive elements of the show stood out as inauthentic to reviewers who are steeped in Maya culture—the music and the narrator's voice. They pointed out that the music was not Maya.

"The music to me had no grounding in any kind of language or cadence or music that I am familiar with among the Maya."

~ Professor of Contemporary Maya Spirituality

A K'iche Maya reviewer supported this view and said that authentic Maya music is available even in the Bay Area.

The Maya specialists thought that the narrator's voice was not Maya, and to use first person narration could be interpreted as culturally insensitive:

"If the objective was to have the narrator speaking from the first person perspective as a Maya, then it would have been appropriate to have someone who was Maya doing it… I think it would have been fair to have Lila Downs not doing this from this first person perspective of 'my people, my ancestors,' and simply having her refer to the Maya, as opposed to 'my people.' I think that could offend some people and especially when you see the end credits. There wasn't anybody Maya. She is not Maya."

~ Archeoastronomer

A reviewer said that the show presents a narrow perspective on the Maya people and culture. The Maya world is diverse with many political religious sites in addition to Chich'en Itza, numerous languages, and distinct cultural groups.

"You would think Chich'en Itza is the only site that has this archaeoastronomy. One wouldn't know that there are many temple pyramids at their many sites and that they were used to establish and maintain power over people. Nor does it mentioned anything about the numerous languages that are spoken among people…It 'essentializes' rather than shows the distinctiveness of Maya people."

~ Professor of Contemporary Maya Spirituality

An astronomy educator agreed. He said,

"I would think that the depictions of Mayan mythology gave precious little insight into their true belief system. To really understand the significance of the symbolism to the Mayan culture would require much more than what was presented in this show."

At the end of the show, a reference was made to "our mythology." Within the context of present day Maya cosmology, the most appropriate term for referring to their cosmovision and religion, according to the archeoastronomer, is *cosmology* rather than *mythology*.

"There was a note at the end of the presentation, one of the last screens, where they are talking about the incorporation of modern Maya and 'our calendar and our mythology'. What is interesting is that a lot of people wouldn't feel comfortable using the term mythology. [They would say] 'it is basically our religion, it is our cosmology'."

The Maya specialists thought that the two consultants, Anthony Aveni and Susan Milbrath, were highly qualified, but the specialists wondered about the extent to which Aveni and Milbrath were consulted on some details of the show.

IV. Sharing Assets with the Field

The previous section summarizes the perspectives of the different audiences—the public, consortium institution point people, and external experts—on a variety of dimensions and contributions of the show. This section presents the efforts made by members of the *Tales of the Maya Skies* production team to share their work and learning with the field. There are at least four different groups they are addressing. They are 1) full dome filmmakers and graphics professionals, 2) art historians, anthropologists and archeologists, 3) university based groups, and 4) the *Tales of the Maya Skies* consortium institutions.

Kevin Cain, in collaboration with others, has published five peer-reviewed articles with the Maya Skies data. The first was about the pre-production phase[9] and the most recent will be published this year. Kevin Cain was invited to organize a course at SIGGRAPH 2009, which he considered an honor given the competitive nature of the event. The course was called Computation & cultural heritage: fundamentals and applications. He said, "The slides for the course were given a web address and have been accessed many thousands of times."[10]

The project is also reaching out to art historians, anthropologists, and archaeologists through the *Tales of the Maya Skies* masters' class, which will offer a focused introduction to the types of visualizations that are possible for the humanities. This is scheduled as a webinar on June 28-29, 2010.

The team has also given numerous presentations on the *Tales of the Maya Skies* work, which include one at the National Gallery of Art (Washington D.C.) and others at conferences, most recently the UC Berkeley Electronic Cultural Atlas Initiative in Hong Kong and Shanghai to introduce archaeologists from diverse backgrounds to *Tales of the Maya Skies* output. Additionally, special Maya Skies research pages[11] are circulated among researchers via listserve lists (*e.g.*, Aztlan, the Mesoamerica listserv).

The consortium institutions generally reported positive experiences working with Chabot and the *Tales of the Maya Skies* project, in terms of communication and the project meeting their expectations. The

[9] For more information, see www.insightdigital.org/VAST_2006/short_paper_1053_060925.pdf.
[10] For more information, see http://vcg.isti.cnr.it/~cignoni/CHCourse.
[11] For more information, see www.insightdigital.org/team/index.php?title=Maya_Color_Reference

consortium institutions are part of the intended audience for the upcoming masters' class webinar.

Additionally, a team from Luis Enrique Erro Planetario at the Instituto Politecnico Nacional in Mexico City received professional development in full dome technology at ArtsLab. This professional development was part of an auxiliary agreement made when the Instituto Politecnico Nacional provided the *Maya Skies* project with supplemental funding. Their team of their planetarium staff went to ArtsLab in New Mexico for a month.

A subgroup from the original production team is also working together to put their assets developed through *Tales of the Maya Skies* onto a website.

> *"Specifically the mythology that we animated. So we are working on building a website, or pages of our website, that discuss the process of doing that from storyboarding to research into looking at Mayan artifacts and understanding the language to depicting the story that the writers gave us as appropriately as possible, and then the production techniques of how we did it."*

A co-PI said that even though much of the laser scanning of Chich'en Itza did not make it into the final show, current efforts are making that work available to the field:

> *"That was a really sad part [about] the final product for me. It was that so little of his assets were utilized and I think it is still great to have that data and he will employ it and get it out there to the archeological world and make it valuable, but that is definitely a sore spot for me."*

Most of the institutions did not have anything to say about the audience learning research because it has not taken place. It is unclear to what extent any of the consortium planetaria will participate in this research. One of the Mexican planetaria contacts expressed explicit interest in participating in the learning research. They were not only interested in ILI's results, but also wanted to learn about the methods for collecting the data and for analyzing it.

V. Lessons Learned

About the production model

- The production of Tales of the Maya Skies, as originally intended, was a highly complex and demanding enterprise that requires the expertise of a filmmaker in addition to the expertise of informal science educators and planeteria.

A major lesson learned was that a highly skilled producer was necessary from the beginning to bring together all the entities needed to produce the show and to wield ultimate authority over the highly talented team members with different expertise, and not in one central location. It wasn't until a professional producer was brought into the production team that the show came together. The distributed expertise model, in combination with the aspiration of creating a visually immersive show, using realistic laser scanned images, required this level of expertise to bring and keep the right team together and focused. The absence of this in the first two years of the *Tales of the Maya Skies* project delayed the production.

About the process for creating the show

- Start with a storyline in place

A second major lesson learned was that the creation of the storyline should precede the production process. An agreed upon storyline is necessary at the outset of a project of this nature to focus and unify the different visual creations. The project started without a completed storyline, and the story went through multiple changes until Alonso Mendez and Carol Karasik rewrote it nine months before the completion of the show. As one production team member pointed out, once the storyline was complete, the technical aspects of the show came together fairly quickly. In retrospect, a more efficient approach would be to invest in creating the storyline first (with strong leadership), and then seek funding for the production.

- Some of the technical aspirations may have been too ambitious for the resources

A third major lesson learned from the Tales of the Maya Skies is that the production team needs to have a single vision, which basically means having a story and a shared understanding of what the vision and visuals will be before the production starts.

It is difficult to sift out the influences on the project of lost time due to changes in leadership and other personnel, the absence of a storyline, and the lack of pre-preproduction team building from the inherent challenges of using the laser scanner technology to create realistic 3D images and textures. The show broke new ground in its attempts to apply this technology to full dome shows and offered the production team the opportunity to learn important lessons about the intricacies and length of the process and the amount of time required to capture laser scanned images and translate them to full dome 3D formats. However, much of this technical work did not make it into the final show. It remains unclear whether the project's aspiration of making a realistic, film-like full-dome immersive experience was beyond the capacity of the resources the project had. A co- PI thought so, but also recognized that other factors intervened:

> *"The aspiration of taking it to a hyper-realistic, film-like level was just beyond the capacity of the resources. The other thing to remember is that this thing started so long ago with a whole set of different folks. All of those people had different jobs by the time it finally got going."*

About the content of the show

- Using storytelling as a portal into science was a good idea

The strategy of storytelling in an astronomy show has appeal for audiences and provides entry points into the astronomy that audiences might otherwise not connect with. The public and the reviewers alike thought that incorporating storytelling in the show was refreshing. The show is engaging at an affective level that traditional planetarium shows usually are not because of the cultural content and connection with a people. The show had embedded within it several stories and areas of focus. This provided viewers with a range of ideas and stories that they could connect with and enjoy.

- Presenting accurate and respectful portrayals of cultural material by those from outside the culture is a delicate and difficult task

The project PI emphasized that the production team went to great ends to make the final content of the show accurate in terms of the astronomy and in representing the Maya. For the most part, these efforts were evident in the show, but representing the cultural and religious beliefs of others is always a delicate matter. There were a few refinements suggested by the data that would have made the presentation of the Maya cosmovision more accurate and respectful.

Reviewers' comments combined with some audience comments about the balance of cultural content about the Maya cosmology with modern, western science content suggested that a disclaimer at the beginning and end of the show might have created a more respectful context for the introductory level treatment of the Maya cosmovision. We suggest a simple statement such as, "The Maya belief system is very complex, and it would take months and months to convey it fairly and accurately. This show serves only as a brief introduction to the notion of Maya cosmology…"

Future planetarium productions that entail the depiction of different cultures would also want to consult multiple people from the culture under consideration to accurately portray the diversity of the culture. The Maya are a present-day diverse people who live in multiple countries, speak more than 22 different native Maya languages, and their cosmology has been passed down through the generations.

> *"I think the final report should be helpful in [highlighting] things like making sure that you can have someone who can speak for, not about a culture is one of those seminal lessons in the whole thing."*
>
> ~ Production team member

> *"I think there are some details that were oversights, but they could have been worse… I think the show was fair. I think if anything, the cultural material could have been done from perhaps a more sensitive or aware position."*
>
> ~ Archeoastronomer

Suggestions for deepening the learning opportunities

People from all three perspectives—the public, the external expert reviewers, and the point people at the institutions in the consortium sites—suggested ways that the content of the show might be enriched to create a deeper learning experience. The project has posted some activities and additional information on a website **www.mayaskies.org**. The additional information clarifies that the Maya have multiple calendars and offers some information on the meaning the Mayas attribute to the completion of a cycle of the long count calendar in 2012.

Even though the production of the show is complete, the topics identified below could be content for a live preface or introduction to the show or for follow up activities, especially on the website.

- Discussion of techniques the Maya used to observe the sky

Reviewers and audience focus groups echoed each other in wanting to know more about the techniques the Maya used to observe the sky and

what it meant to be a calendar keeper. They wanted to know how the Maya predicted eclipses, and how astronomy was integrated into their lives, culture, and practices.

> *"One of the things that I felt was missing [was] how did the Maya predict eclipses. It is sort of vaguely described as, 'Well our astronomer sat and watched,' but it would have been nice for the older end of the target demographic to offer some of the underlying mechanisms behind how a society does these kinds of things… This is what I teach."*
>
> ~ Archeoastronomer

- More connections and extensions in the astronomy content

The external expert reviewers, especially the astronomy educators, said that their advice to other astronomy educators would be "to do a lot of follow-up to illustrate the astronomy themes." The current website www.mayaskies.org expands on the content in the show related to the Maya, but it does not provide activities that would help audience members better understand the astronomy.

Reviewers suggested showing visually how the seasons, the solstice, and the equinox work.

> *"They showed us how the seasons work, but they don't explain to the audience exactly how visually. They could have shown with that beautiful schematic, exactly what a solstice looks like and what an equinox looks like. I think they missed that, yet at the same time, a moment later, they discuss the solstices and the equinoxes. They could have added that."*
>
> ~ Archeoastronomer

Two specific suggestions for enhancing the astronomy content were to label the sunrise/sunset positions to indicate the seasons—summer, fall, winter, spring—associated with the different rising and setting points, and to give more information on the zenith Sun. Indicating how high the Sun is in the sky during different seasons would have connected the seasons sequence with the later references to the zenith Sun. And a nice point of connection for audiences at different latitudes would have been to point out that the zenith Sun never appears at the higher latitudes in North America. An astronomy educator thought that a missed opportunity was to connect the patterns of Venus with the "evening star" and "morning star."

> *"I also thought that the show missed an opportunity to point out the real meaning of "evening star" and "morning star," which is what those apparitions of Venus in west and east are often called."*

~ Astronomer Educator

- Include "real, modern pictures" of the Maya and their structures, giving the present day Mayans a voice.

The show presented Maya cosmology as the beliefs of ancient Maya with no content connected to present day Maya astronomers/calendar keepers. The reviewers and audience recommended reaching beyond Mexico to consult people who are present-day calendar keepers and keepers of the beliefs and traditions of Maya cosmology.

> *"They could have brought it more into the present with modern Mayan astronomers."*
>
> ~ Astronomer Educator

> *"I recently was in Guatemala in a workshop with a group of K'iche'. It was very interesting how right now these people know so much and how they have carried it for so many years, and the new generations are there learning about it. In other words, there are people that tap this knowledge and they are still there. It is different from an academic point of view; it is the practice of the living."*
>
> ~ K'iche' Maya

One place to bring in modern Maya voices was in the coverage of the turtle constellation, which, according to the archeoastronomer, is a modern day Maya constellation.

> *"It would have been interesting if they had called upon some [modern Maya] to have these people have a voice, or to talk about modern Maya [beliefs], the turtle with the 3 hearthstone asterism. It is a turtle constellation and there is a smaller set of stars within [what we think of as Orion] that are 3 stars that are the turtle asterism. But the fact that that exists as a modern K'iche Maya constellation, it would have been cool to note that."*
>
> ~ Archeoastronomer

VI. Inverness Research's Perspective

In addition to our reporting on the multiple perspectives of the producers, the audiences, experts and consortium members, we also provide in this section our own perceptions of the Inverness Research's viewpoint on the major strengths, weaknesses, and lessons learned from this project. Our viewpoint is from the perspective of an evaluation group, which has studied many different NSF informal science education projects. Our criteria are focused around examining the degree to which and the ways in which this project does and does not advance the field of informal science education practice.

- The potential for innovative planeteria shows such as *Tales of the Maya Skies* is high, but achieving that potential is not easy or trivial. The approach of combining cultural and scientific information into a storyline is interesting to viewers, a fresh approach for planetarium shows, and is a good vehicle for imparting both cultural and scientific information. But the approach also demands serious development of *both* cultural information including accuracy, tone, and attention to language, and the scientific information. Equally important is the combining of the science and the cultural material. Achieving all three of these requires special expertise in each of the three areas and may require the active integrated involvement of project members and advisors with different areas of expertise.

- The ultimate quality and power of the show, while engaging to audiences, is not, in our opinion, the breakthrough innovation in full-dome technology that it could have been. There are simple scientific and cultural errors in the show that are manifestations of the confused production process and lack of time and resources the team was left with to produce the show. As a result the show was not all that it could have been.

- The show had been in production for two years when the final production team stepped in to complete it in nine months. By that time, a substantial portion of the funding for the project had been spent. Because of the short timeline and very limited funding, the director and producer, who were filmmakers and not educators, took over the rewriting of the storyline at a greatly reduced rate. As a result, the storyline has more audience appeal than the technological and educational impact that was anticipated.

- A major lesson learned from the *Tales of the Maya Skies* project was that an accurate, careful, and complete storyline should precede the selection of the right production team, including a strong experienced producer. Because this did not happen, the creation process was flawed, and difficult, and resulted in less than what might have been.

- In the end, the distributed expertise production model required to create the proposed innovative show, called for the coming together of very different professional worlds—the world of planetaria and informal science education, and Hollywood style filmmakers. The management of this interface calls for specialized skills and hybrid knowledge of both worlds, perhaps two co-directors, one from each field. But the process continually calls for communication and translation between the different professional worlds, and leadership from day one. Filmmakers, who work with flat screens, need the help of planetarium specialists who can "translate" or illuminate the technical landscape of creating a realistic immersive, full-dome show into their language, and informal science educators need the help of filmmakers to create compelling stories for a range of audiences. The lesson learned is that management of future projects of a similar nature cannot rely on established patterns of producing traditional planetarium shows. A new, more complex model is called for. NSF should make sure that all of the needed production expertise is present when a future effort as innovative and ambitious as *Tales of the Maya Skies* is funded.

- The hope that production and research could be synchronous and symbiotic was not achieved. ILI conducted front-end audience research that suggested that audiences would be interested in a show of this nature, but its post-production audience learning research is still pending. It is important to study the learning resulting from the show in both the affective and cognitive domains as originally proposed by ILI. Inverness Research, in its role as summative evaluator, steered away from this task, as it was the domain of ILI's research. To date, this has left a gap in the learning from the project and in claims that can be made about its educative or experiential value.

- Furthermore, the notion that ILI would serve as the formative evaluators of the project during the development phase was not realized, and we believe that combining research and formative evaluation leads to a flawed feedback design since research does

not serve the same function as evaluation. The project could have benefited greatly from periodic formative feedback on its process, progress, challenges, and recommendations for next steps.

- There are lessons to be learned here about the design of the research component—the first is that research can serve a useful function in providing pre-production, front-end audience studies, as well as post-production study of audience learning. Again, we do not see how research conducted during the development phase can appropriately serve as formative evaluation of that process.

- Finally, when a complicated collaboration model is as much a part of an innovation like *Tales of the Maya Skies* as the final product itself, such projects would do well to monitor the collaborative process continuously and from the very beginning. It was evident two years into *Tales of the Maya Skies* that the collaboration was suffering from a lack of leadership, and mid-course corrections were made shortly after that. However, two years is a long time to wait for such feedback, and by the time the project was ready to move along, it was clear there was not enough funding to create the hyper-realistic show that had been planned. For a project as multi-faceted, complex, and innovative as this, it is important to evaluate the functioning of the collaborative as it progresses.

VII. Summary

Tales of the Maya Skies breaks new ground in the field of planetarium shows by combining cultural storytelling with Western astronomy content. Planetaria running the show have seen increases in their audiences, the public has enthusiastically received the show, and the show has won awards within astronomy circles. In spite of the delays in production, the resulting show justified the investment in the project. In fact, where once there was concern that a show would not be produced at all, a show that is innovative to the planetaria field and that appeals to a broad range of audiences has resulted. While the collaborative production process was complicated by many factors, the organizations involved learned many lessons about how to structure potential future collaborations. The *Tales of the Maya Skies* project has also resulted in many sound and feasible recommendations for those in the field of astronomy education or science education broadly who wish to create programs that blend socio-historical and cultural perspectives with modern scientific understandings.

Appendix A

Maya Skies Visitor Surveys

Chabot Space & Science Center
***Tales of the Maya Skies* Planetarium Show Survey**
December '09-January '10

How would you rate the *overall quality* of the show? (*Circle one*)	Very low quality					Very high quality	Can't say
	1	2	3	4	5		6
How much did you know about the Maya *before* seeing the show? (*Circle one*)	I knew nothing					I knew a lot	Can't say
	1	2	3	4	5		6
How much did you learn about the Maya *from* seeing the show? (*Circle one*)	I learned nothing					I learned a lot	Can't say
	1	2	3	4	5		6

To what extent do you agree with the following statements? *(Circle one rating for each statement)*

	Strongly disagree				Strongly agree	Can't say
I gained an appreciation for how much the Maya understood about the sky and astronomy with limited technology.	1	2	3	4	5	6
Compared to other planetarium shows, this one was more interesting to me personally.	1	2	3	4	5	6
Compared to other planetarium shows, this one was more interesting to watch.	1	2	3	4	5	6
I liked the combination of the story of the Maya people and the astronomy.	1	2	3	4	5	6

-What was your favorite part of *Tales of the Maya Skies*?

-What did you like the least?

-What questions do you have as a result of seeing the show?

CONTINUED ON BACK

Please tell us a little about yourself to help us learn about the audience for Maya Skies.

How old are you? *(Circle one)*	<7	7-11	12-16	17-21	22-54	55 & over

What is your gender? *(Circle one)*	Female	Male

What is your level of schooling? *(Circle one)*	I am in middle or high school now	I have completed high school	I have completed undergraduate school	I have completed graduate school	Other	Decline to answer

What is your race? (*Circle all that apply*)	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed/Multiple races	Other	Decline to answer

Are you of Latino, Hispanic or Spanish heritage? *(Circle one)*	Yes	No	Don't know	Decline to answer
Are you of Mayan descent? *(Circle one)*	Yes	No	Don't know	Decline to answer

-Any final comments or suggestions?

--Thank you for your time in filling out this survey!

Chabot Space & Science Center

Tales of the Maya Skies Planetarium Show Survey

December '09-January '10

How would you rate the *overall quality* of the show? (*Circle one*)	Very low quality				Very high quality	Can't say
	1	2	3	4	5	6
How much did you know about the Maya *before* seeing the show? (*Circle one*)	I knew nothing				I knew a lot	Can't say
	1	2	3	4	5	6
How much did you learn about the Maya *from* seeing the show? (*Circle one*)	I learned nothing				I learned a lot	Can't say
	1	2	3	4	5	6

This show combined science and the culture and beliefs of the Maya people.

As you watched *Tales of the Maya Skies*, how interested were you in the <u>astronomy</u> in the show?

Not at all interested				Very interested	Can't say
1	2	3	4	5	6

How much did you learn about <u>astronomy</u> from the show? *(Circle one)*

I learned nothing				I learned a lot	Can't say
1	2	3	4	5	6

As you watched, how interested were you in hearing about <u>the Maya people</u>?

Not at all interested				Very interested	Can't say
1	2	3	4	5	6

How much did you learn about <u>the Maya people</u> from the show?

I learned nothing				I learned a lot	Can't say
1	2	3	4	5	6

-What was your favorite part of *Tales of the Maya Skies*?

-What did you like the least?

-What questions do you have as a result of seeing the show?

CONTINUED ON BACK

Please tell us a little about yourself to help us learn about the audience for Maya Skies.

How old are you? *(Circle one)*	<7	7-11	12-16	17-21	22-54	55 & over

What is your gender? *(Circle one)*	Female	Male

What is your level of schooling? *(Circle one)*	I am in middle or high school now	I have completed high school	I have completed undergraduate school	I have completed graduate school	Other	Decline to answer

What is your race? (*Circle all that apply*)	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed/Multiple races	Other	Decline to answer

Are you of Latino, Hispanic or Spanish heritage? *(Circle one)*	Yes	No	Don't know	Decline to answer

Are you of Mayan descent? *(Circle one)*	Yes	No	Don't know	Decline to answer

-Any final comments or suggestions?

--Thank you for your time in filling out this survey!

Chabot Space & Science Center

Tales of the Maya Skies Planetarium Show Survey

December '09-January '10

How would you rate the *overall quality* of the show? (*Circle one*)	Very low quality				Very high quality	Can't say
	1	2	3	4	5	6
How much did you know about the Maya *before* seeing the show? (*Circle one*)	I knew nothing				I knew a lot	Can't say
	1	2	3	4	5	6
How much did you learn about the Maya *from* seeing the show? (*Circle one*)	I learned nothing				I learned a lot	Can't say
	1	2	3	4	5	6

What attracted you to come to the show? *(Circle one)*	The topic of the Maya people and culture	The topic of astronomy	The combination of topics: Maya people and astronomy	Something else	Can't say

-What was your favorite part of *Tales of the Maya Skies*?

-What did you like the least?

-What questions do you have as a result of seeing the show?

CONTINUED ON BACK

Please tell us a little about yourself to help us learn about the audience for Maya Skies.

How old are you? *(Circle one)*	<7	7-11	12-16	17-21	22-54	55 & over

What is your gender? *(Circle one)*	Female	Male

What is your level of schooling? *(Circle one)*	I am in middle or high school now	I have completed high school	I have completed undergraduate school	I have completed graduate school	Other	Decline to answer

What is your race? (*Circle all that apply*)	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed/Multiple races	Other	Decline to answer

Are you of Latino, Hispanic or Spanish heritage? *(Circle one)*	Yes	No	Don't know	Decline to answer

Are you of Mayan descent? *(Circle one)*	Yes	No	Don't know	Decline to answer

-Any final comments or suggestions?

--Thank you for your time in filling out this survey!

Chabot Space & Science Center
***Tales of the Maya Skies* Planetarium Show Survey**
January-February 2010

To what extent do you agree with the following statements? *(Circle one rating for each statement)*

	Strongly disagree				Strongly agree	Can't say/ Don't know
The explanation of how the Maya marked the movement of the rising sun was clear.	1	2	3	4	5	6
I would have liked more details about the Maya lifestyle to understand why they paid such careful attention to the sky.	1	2	3	4	5	6
I would have enjoyed the show more if there had been more real-life (not computer-generated) images.	1	2	3	4	5	6
The show explained clearly how we know about the Maya people.	1	2	3	4	5	6
Sometimes I wondered how the narrative related to the images we were seeing.	1	2	3	4	5	6
Seeing this show made me want to know more about the cosmology of the Maya.	1	2	3	4	5	6
Overall, I thought this show was of high quality.	1	2	3	4	5	6

CONTINUED ON BACK

Please tell us a little about yourself to help us learn about the audience for Maya Skies.

How old are you? *(Circle one)*	<7	7-11	12-16	17-21	22-54	55 & over

What is your gender? *(Circle one)*	Female	Male

What is your level of schooling? *(Circle one)*	I am in middle or high school now	I have completed high school	I have completed undergraduate school	I have completed graduate school	Other	Decline to answer

What is your race? (*Circle all that apply*)	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed/Multiple races	Other	Decline to answer

Are you of Latino, Hispanic or Spanish heritage? *(Circle one)*	Yes	No	Don't know	Decline to answer
Are you of Mayan descent? *(Circle one)*	Yes	No	Don't know	Decline to answer

-Any final comments or suggestions?

--Thank you for your time in filling out this survey!

Chabot Space & Science Center
***Tales of the Maya Skies* Planetarium Show Survey**
January-February 2010

To what extent do you agree with the following statements? *(Circle one rating for each statement)*

	Strongly disagree				Strongly agree	Can't say/ Don't know
The story of the twin brothers helped me understand the Maya view about the universe.	1	2	3	4	5	6
I found the creation story difficult to follow.	1	2	3	4	5	6
There was plenty of explanation for why the Maya were so interested in the sky.	1	2	3	4	5	6
I was expecting more real-life (not computer-created) images (e.g. of the temples, jungle, Maya people, etc.)	1	2	3	4	5	6
I learned plenty of astronomy by watching this show.	1	2	3	4	5	6
I would have liked more information on the Maya people today.	1	2	3	4	5	6
Overall, I really enjoyed watching this show.	1	2	3	4	5	6

CONTINUED ON BACK

Please tell us a little about yourself to help us learn about the audience for Maya Skies.

How old are you? *(Circle one)*	<7	7-11	12-16	17-21	22-54	55 & over

What is your gender? *(Circle one)*	Female	Male

What is your level of schooling? *(Circle one)*	I am in middle or high school now	I have completed high school	I have completed undergraduate school	I have completed graduate school	Other	Decline to answer

What is your race? (*Circle all that apply*)	American Indian or Alaska Native	Asian	Black or African American	Native Hawaiian or Other Pacific Islander	White	Mixed/Multiple races	Other	Decline to answer

Are you of Latino, Hispanic or Spanish heritage? *(Circle one)*	Yes	No	Don't know	Decline to answer
Are you of Mayan descent? *(Circle one)*	Yes	No	Don't know	Decline to answer

-Any final comments or suggestions?

--Thank you for your time in filling out this survey!

Appendix B

Audience Focus Group Questions

Tales of the Maya Skies
Audience Focus Group questions
Inverness Research

Explain who we are and our purpose…

How many of you have seen a planetarium show before this one?

How many of you have seen a planetarium show at Chabot before this one?

What brought you here today?

Where did you come from (or where do you live)? [I asked this to get a sense of where the show is drawing from.]

What did you think of the Tales of the Maya Skies show?

What did you like about this show? What surprised you about the show?

What do you wish had been different?

Did the show raise any questions for you that you wished the show had answered but didn't?

What did you learn about the Maya people from this show?

What did you learn about the sky or astronomy from this show?

Why was observing the sky important to the Maya people?

Why were the Maya so aware of the stars and the sky?

Appendix C

Questions for Expert Reviewers

Maya Skies
Questions for Expert Reviewer
Astronomy Educators

Introduction
These interviews are one component of the external evaluation of the Tales of the Maya Skies. Inverness Research has administered audience surveys, held focus groups with audience members, and will compile your views with those of others to add the perspective of "expert" reviewers. Your comments will remain anonymous (as those of an "astronomy education expert") unless you request otherwise. The data will be summarized in the aggregate and specific quotations will be presented without any identifying information.

The following three questions are for internal purposes only
Name_____
Institutional affiliation _____
Job title or role _____

What is your relationship to the planetaria field?

Initial overall impressions

Immediately after watching it, what are your first impressions about the show?

What did you most enjoy about the show and why?

What, if anything, disappointed (or disturbed) you, as you watched the show and why?

What was most memorable about the show?

Who (which audiences) do you think the show is best suited for? Least suited for?

What educational contributions will the show make to these audiences? What will people learn from the show?

What, if anything, surprised you about the show? Why was this surprising?

With respect to astronomy education

What did you learn about astronomy from viewing this show?

On the following question, please circle the rating that most closely represents to your opinion.

How much astronomy do you think the general viewer will learn from the show?

1	2	3	4	5
Nothing	Very little	Some	A good amount	A very great amount

Please explain:

What astronomical topics or ideas are best conveyed by the show?

On the following question, please circle the rating that most closely represents to your opinion.

Is this show likely to make people more interested in astronomy in general?

1	2	3	4	5
Not at all	A very small degree	To some degree	To a good degree	To a great degree

Please explain:

What, if anything, do you think are the contributions this show might make to the field of astronomy education, in terms of its being a model or in terms of illustrating new ways to teach astronomy?

How, if at all, does this show balance portraying the belief system of the Maya, their understanding of science, and what we understand about astronomy today?

How, if at all, could the astronomy aspects of this show be improved?

Is this show similar, in any way, to other planetarium shows you are aware of? If so, how does it compare?

Is there an obvious way for a viewer to follow up on a specific aspect of the show, if they are interested in some particular astronomical or Maya phenomenon that was introduced in this show?

With respect to learning about the Maya

What, if anything, did you learn about the Maya culture from this show?

On the following question, please circle the rating that most closely represents to your opinion.

How much do you think the general viewer is learning about Maya culture from the show?

1	2	3	4	5
Nothing	Very little	Some	A good amount	A very large amount

What topics or ideas are best conveyed about Maya culture through the show?

On the following question, please circle the rating that most closely represents to your opinion.

To what degree do you think this show is likely to make viewers more interested in Maya culture?

1	2	3	4	5
Not at all	To very small degree	To some degree	To a good degree	To a great degree

Please explain:

With respect to the planetarium field

On the following question, please circle the rating that most closely represents to your opinion.

To what extent does this show best take advantage of the new (full-dome) planetarium technology?

1	2	3	4	5
Not at all	To very small degree	To some degree	To a good degree	To a great degree

Is there anything that full-dome technology is particularly well-suited for that, in your opinion, this show did not incorporate, highlight, or address?

Closing

If the National Science Foundation (the agency that funded this production) asked you about this show, what would you want them to know?

If other astronomy educators asked you about this show, what would you want them to know?

If individuals working in planetariums asked you about this show, what would you want them to know?

Please feel free to comment on any issues or topics that we have not addressed…

Maya Skies
Questions for Expert Reviewer
Maya Experts and Archeoastronomers

Introduction

These interviews are one component of the external evaluation of the *Tales of the Maya Skies*. Inverness Research has administered audience surveys, held focus groups with audience members, and will compile your views with those of others to add the perspective of "expert" reviewers. Your comments will remain anonymous (as those of a "Maya expert") unless you request otherwise. The data will be summarized in the aggregate and specific quotations will be presented without any identifying information.

The following three questions are for internal purposes only

Name_____
Institutional affiliation _____
Job title or role _____

What is your relationship to the Maya?

Initial overall impressions

Immediately after watching it, what are your first impressions about the show?

What did you most enjoy about the show and why?

What, if anything, disappointed (or disturbed) you, as you watched the show and why?

What was most memorable about the show?

Who (which audiences) do you think the show is best suited for? Least suited for?

What educational contributions can the show make to these audiences? What might people learn from the show?

What, if anything, surprised you about the show? Why was this surprising?

With respect to learning about the Maya

What, if anything, did you learn about the Maya culture from this show?

On the following question, please circle the rating that most closely represents to your opinion.

How much do you think the general viewer is learning about Maya culture from the show?

1	2	3	4	5
Nothing	Very little	Some	A good amount	A very large amount

What topics or ideas are best conveyed about Maya culture through the show?

On the following question, please circle the rating that most closely represents to your opinion.

To what degree do you think this show is likely to make viewers more interested in Maya culture?

1	2	3	4	5
Not at all	To very small degree	To some degree	To a good degree	To a great degree

Please explain:

What, if anything, does this show contribute to viewers' understanding and/or appreciation of the Maya?

What particular segments or portion of the show do you feel are most significant, in either a positive or negative way, for viewers' understanding and/or appreciation of the Maya?

What, if anything, does this show contribute to viewers' understanding and/or appreciation of archeoastronomy?

What, if anything, do you think this show is missing, in terms of conveying to the public an accurate appreciation and understanding of the Maya and their achievements?

Do you feel this show perpetuates misconceptions or common misunderstandings about the Maya in any way? If so, how?

How well, if at all, does this show balance portraying the belief system of the Maya, their understanding of science, and what we understand about astronomy today?

How, if at all, could the show be improved in terms of how it portrays Maya cosmology?

With respect to astronomy education

What did you learn about astronomy from viewing this show?

On the following question, please circle the rating that most closely represents to your opinion.

How much astronomy do you think the general viewer will learn from the show?

1	2	3	4	5
Nothing	Very little	Some	A good amount	A very great amount

Please explain:

What astronomical topics or ideas are best conveyed by the show?

On the following question, please circle the rating that most closely represents to your opinion.

Is this show likely to make people more interested in astronomy in general?

1	2	3	4	5
Not at all	A very small degree	To some degree	To a good degree	To a great degree

Please explain:

Is this show similar, in any way, to other planetarium shows you are aware of? If so, how does it compare?

Closing

If the National Science Foundation (the agency that funded this production) asked you about this show, what would you want them to know?

If archeoastronomers asked you about this show, what would you want them to know?

If Mayans asked you about this show, what would you want them to know?

If individuals working in planetariums asked you about this show, what would you want them to know?
What would have improved this show? (If it hasn't already been mentioned)

Please feel free to comment on any issues or topics that we have not addressed…