



# CONTEMPORÁNEA



## El Sol nos Une a Todos

*Evaluation Report*

NASA, UC Berkeley, INAH  
October 2007

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Background & Methodology



# Background

The Center for Science Education at the Space Sciences Laboratory, UC Berkeley has been conducting a project, funded by NASA, to inspire Latino children, youth and adult population to explore science and math through public programs that highlight aspects of Ancient Maya astronomy and current NASA scientific knowledge.

## General Objectives:

- To develop a program of archeo-astronomy with three components: scientific research, education, and public outreach.
- Through astronomical and archeological discoveries and knowledge emerging from several Archeological sites, and through data, technology, and activities organized by the INAH, UC Berkeley, and NASA, the program will foster:
  - Increased interest and engagement of children, youth, and the general public in science, mathematics, and sustainable technologies;
  - Research, stewardship, and appreciation of the enduring knowledge and wisdom of long-resident indigenous cultures.

## Specific Objectives:

- Strengthen an integrated concept of research, education, and public dissemination, encompassing science, art, technology, and all forms of cultural expression with astronomy at its center.
- Increase the appreciation and knowledge of children, youth, and the public regarding the legacy of knowledge contributed over thousands of years by native peoples of the Americas in astronomy and indigenous science generally.
- Increase the appreciation and knowledge of children, youth, and the public regarding the latest discoveries in astronomy, in particular about the Sun and its effect on the Earth and other planets in the solar system.
- Increase and facilitate broad access to science content within a cultural context.



# Project Summary

This evaluation effort was conducted to assess the effectiveness of the project “We Are One Under the Sun.” The project is a collaboration of the INAH (National Institute of Anthropology and History) in México, NASA, and UC Berkeley. The project was officially approved by the INAH’s Archeological Council in México City on December 7, 2006.

The project has three components that include archeo-astronomy research, education, and public outreach. Through astronomical and archeological discoveries and knowledge emerging from several Archeological sites, and through data, technology, and activities organized by the INAH, UC Berkeley, and NASA, the program fosters:

- Increased interest and engagement of children, youth, and the general public in science and technology.
- Research, stewardship, and appreciation of the enduring knowledge and wisdom of long-resident indigenous cultures.

Another important goal of the project is to continuously improve the program through deeper experiences and through evaluation, so that it can be adapted and implemented in other areas of the American Continent for the benefit of the general public and, in particular, for the benefit of indigenous peoples.

Over the past 2 years, the partnership has organized and implemented education and outreach events sites in the Yucatán and Chiapas, México and in California, United States. Each country provides in-kind and other resources to support the program at their own locales, in the form of access to sites and venues, participation of professionals (scientists and educators), and engagement and support of participants. Project leaders and associated personnel have implemented a series of workshops, exhibitions, and programs for the public, etc., in Chiapas, the Yucatán, and at community venues and national parks in the United States, which have served as prototypes for “We Are One Under the Sun.”



Throughout the events, three themes are interwoven: astronomy of indigenous people local to the venue of the event; NASA astronomy; and the living indigenous culture. Methods foster hands-on, participatory pedagogies, accessible and engaging content, and use of local resources and venues.

This evaluation project assessed the impact of three education and public outreach events: (a) public talks and student workshops in Mérida, Yucatán, in July 2007; (b) public talks, student workshops, and cultural events in the Archeological Site of Uxmal, Yucatán, in July 2007; and (c) public talks, family workshops, and cultural events at a community center in San Rafael, California in September, 2007. Project personnel included scientists, educators, and community leaders from a variety of institutions and cities including: Universidad Autónoma de Yucatán; Universidad Nacional Autónoma de México; NASA Headquarters; UC Berkeley; Palenque, Mérida, etc. Participants represented mainstream and Mayan communities in Mexico and in the United States (immigrant communities).

#### Future Plans

Our Project has been greatly strengthened through the support and official recognition of the INAH and of the University of California-Berkeley with support from NASA. Project collaborators will organize future events in additional archeological sites and national parks during key dates tied to astronomical events such as equinoxes, solstices, and zenith and nadir passages, taking into account the lessons learned from past projects and the results of this evaluation.

#### **Contemporánea**

Contemporánea is a multicultural communications agency with an emphasis on informal education projects. Evaluation, assessment and research are the base of our strategies, grounded in a multicultural, multilingual approach.

Some of our clients include the California Academy of Sciences, Chabot Space and Science Center, the Legion of Honor museum, the de Young museum, the Contemporary Jewish Museum, etc. We also conduct research projects with corporate clients like New American Dimensions, focusing on Latino populations all around the United States and Mexico.



# Methodology

- Program activities and evaluations were conducted during July in Uxmal and Merida, Mexico and in early September in San Rafael, California. A summary of collected data is as follows:

Date and place	Program Activity	Response Rate	Method
July 14, Merida, Mexico	Talk for the general public at local planetarium. (Adults)	23 attended 15 responded (65.21%)	Adults responded to survey after attending lecture.
Sunday July 15, Uxmal, Mexico	Talks (5) for the general public at archeological site. (Adults)	110 attended, 33 responded (30%)	Adults responded to survey after attending at least one of five lectures.
Sunday July 15, Uxmal, Mexico	Talk (1) for children and tour of the archeological site	119 children 59 responded (49.57%)	Children spent the morning and early afternoon in this program. Children responded to questionnaire after attending lecture and site visit.
Sunday July 15, Uxmal, Mexico	Workshops for children	119 children 54 responded (45.37%)	<i>Continuation:</i> Children completed second questionnaire after completed workshops.
Tuesday July 17, Merida, Mexico	Talk (1) and workshops for children	29 children 29 responded (100%)	Children responded to a single questionnaire that covered the lecture and the workshops
Monday September 3, San Rafael, CA	Workshops for children	14 attended, 14 responded (100%)	Children responded to questionnaire after participating in workshops.
Monday September 3, San Rafael, CA	Talks (5) for the general public. Adults	100 attended, 42 responded (42%)	Adults responded to survey after attending at least one of five lectures.

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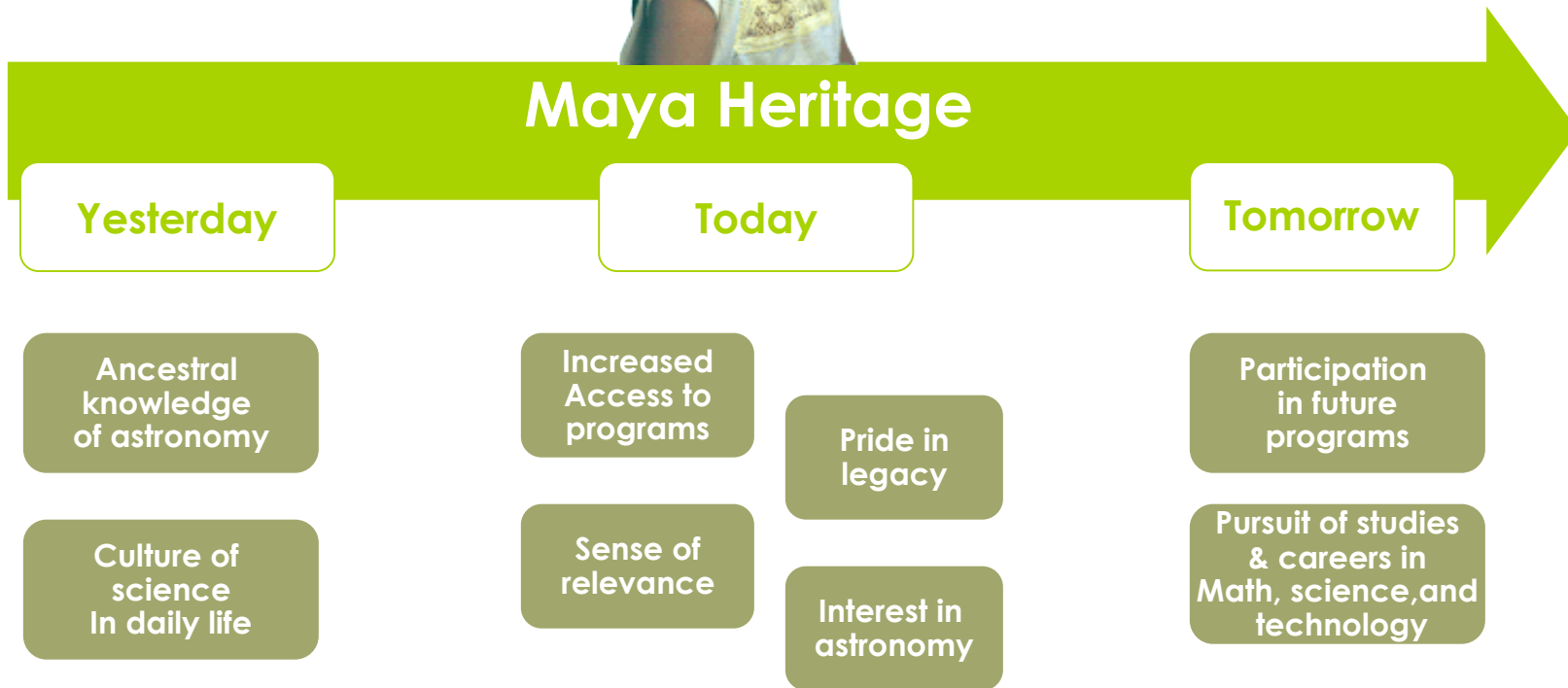


# Highlights & Insights

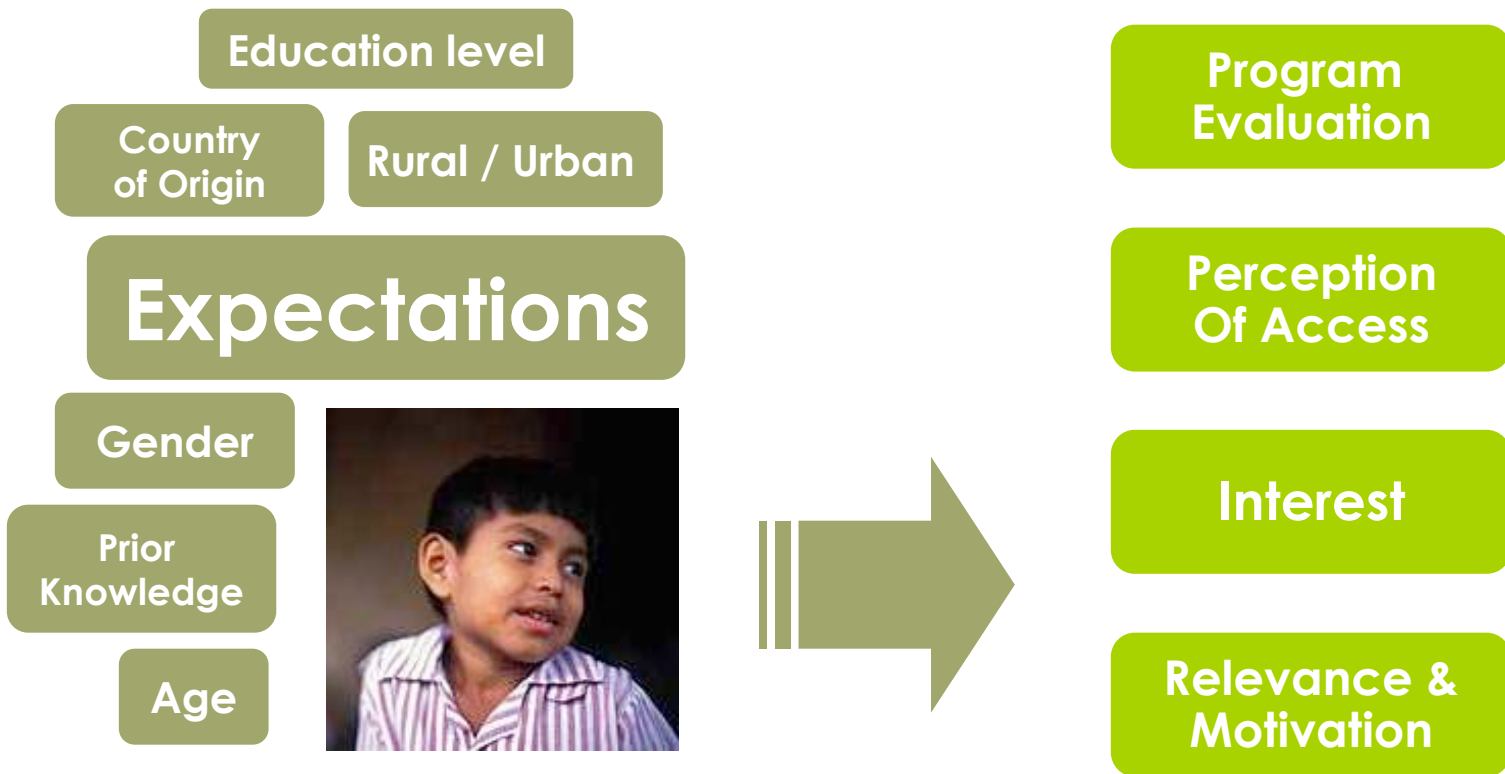
## All Locations



# Ancient Astronomers...Future Scientists



Evaluating the effectiveness of this program requires an intimate understanding of the psychological “starting point” of the attendees. These programs were attended by a mix of indigenous and mestizo people of varying ages, education levels and rural/urban sensibilities. These demographic differences are further compounded by variations in the expectations participants had for the events. As a result, while reactions to these lectures and workshops were very positive, there are some differences in their evaluations, perceptions of access, interest and resulting motivation. Fortunately, clear opportunities exist to address these nuances and enhance this program’s impact.





# Expectations drive reactions to programs.

## Expectations



## Program Evaluation

The programs in Uxmal were attended by children invited by their teachers during their summer vacation. Although the attendees did not know the specific details of the day, being invited by an educator inherently created an expectation that the event would be educational.

Conversely, in San Rafael, most children simply attended with their parents. While they did not know fully what to expect, attendees knew the program included music and traditional dances, creating an emphasis on the cultural and artistic aspects of the program. This informal education offering blends science, education, culture and artistic expression into a holistic experience that demonstrates that science is part of everyday life.

When presented in context as a learning activity, the program is satisfying and appreciated. In Uxmal, the children were fully engaged in the experience and gave high ratings for the workshop activities, particularly the telescope and UV beads, describing them as *fun* and *interesting*. Participants wanted to see even more games (activities?) and expressed interest in attending again in the future.

The “festival” format that was offered in San Rafael was also highly appealing, but presented a unique challenge: attendees arrived with an expectation of arts and culture that may have inhibited the learning components to some extent. The result was an emphasis on the music and dance components of the program. Setting clear expectations that this is an integrated learning experience will help participants get maximum value from all elements of the program. Emphasize the overarching objective of education in invitations.



# Perceptions of access increase with participation.

## Uncertain of Access



## Opportunities Exist!

A primary objective of *El Sol nos Une a Todos* is to increase access to science content within a cultural context.

Adult participants\* varied widely in their perception of personal opportunities to learn about science and astronomy. Adults in urban settings (Merida, San Rafael) were significantly more likely to agree they had access to science education. In Uxmal, however, fewer than one in five strongly agreed they had these same opportunities. Not surprising as these participants tended to be from rural towns near the site and had lower levels of education.



Access is essential! For most, access is interwoven with interest and relevance. While it is difficult to tease out the relationship between these variables, it is clear that the absence of one limits the other. Children with limited access to science education are less likely to develop an interest and pursue it further.

Adults in Merida and San Rafael have access to a wider array of learning opportunities, including museums, lectures and other public services, and they know it. Attending these programs had virtually no impact on perceptions of access for adults in Merida and San Rafael. Roughly 75% of these participants agreed that they had opportunities to learn about science and astronomy...before and after attending the lecture.

In Uxmal, however, there was an atmosphere of eagerness among these participants, only half of whom agreed they had these opportunities. Attending this program appears to have shifted their perceptions positively. After listening to the lecture, nearly 3/4ths now agree they have channels for learning about science. Take advantage of this dramatic shift in perception and encourage attendees to tell children in their families and communities about these previously unknown programs.

\*Not asked in children's questionnaires.



# Bridge new concepts to existing knowledge.

## Baseline Knowledge

Participants in all locations, many of whom were self-reported Maya, had fundamental knowledge of science, astronomy and the accomplishments of the Ancient Maya.

Most knew that the Maya studied astronomy, and used this knowledge for religious, ceremonial, and agricultural purposes. Many knew that the Maya applied their advanced math and science knowledge to create pyramids and temples that are listed among unesco's world heritage sites.

Most had basic scientific knowledge of the sun and the solar system, including the names and positions of the planets, movement of the Earth, and physical phenomena like eclipses and aurora borealis.

These topics were learned in familiar, comfortable environments, at school and at home.



## New Learning

Participants say these events added to their knowledge of the Ancient Maya, science and astronomy. They mention learning something new about:

- Inca and Maya culture, Machu Picchu and Chichen Itza.
- Proportion and distance of the sun and planets.
- Detailed characteristics of the sun (age, composition, temperature and phenomena like solar wind).
- The importance of the sun in everyday life and as a source of sustainable energy.
- Pluto's de-classification as a planet.

Approximately 1/4<sup>th</sup> of children who attended felt that all the information presented was new, but the majority agreed that there were some things they already knew. This foundational knowledge is critical because it can provide context and comfort for children approaching new (and often intimidating) concepts in math and science. These events were successful at linking new concepts to participants' existing knowledge base.

**"The solar clock was fun because I learned something more than what I already knew." - Uxmal workshops**



# A cultural heritage of science and astronomy.

## Inherited Legacy

Adult participants had a rich sense of the cultural and scientific legacy left to them by their ancestors, using “we” and “our” frequently when answering questions about the Ancient Maya.



Many credited their ancestors for today’s successes in math, science, astronomy, and agriculture. Far more than simply creating the Mayan calendar, several commented that their ancestors left a legacy that directly shapes today’s culture and Yucatan lifestyle.

“The Mayan culture comes from studying the stars. Our ancestors were good astronomers.”

-San Rafael

“This legacy is why we are mathematicians. We invented the zero.”

- San Rafael



## Personal Relevance

Nearly 100% of adults and children who attended these events agreed that astronomy is part of Mayan cultural legacy. Furthermore, nearly all adults agreed that lectures and events like these are the *best* way to learn about the scientific legacy of the Maya.

The differences in program format between locations may have affected how personally this theme was interpreted by children:

Science of my ancestors



Science for me today

–In Uxmal, 87% of children agreed they understood the link between the Maya site visit and the lecture. Some experienced this as a personal connection, expressing an interest in learning more about Uxmal and their Maya roots in astronomy.

Science I know



New Science

–For children in Merida and San Rafael, where there was no site visit, the focus was on new scientific learning. The culture-science link was not as pronounced.

Strengthen perceptions of personal Mayan heritage by emphasizing culture and scientific legacy in lectures and workshops.



# Curiosity can become sustained interest.

## Interest

Half or more of our respondents said they attended because they like to learn new things or are interested in science and astronomy.

Children, particularly those in Uxmal, went voluntarily and were unlikely to say “my parents made me come.”  
Two-thirds of adults in San Rafael were repeat visitors and had attended one or more of the previous events (April or October).



## Motivation

After attending these events, children and adults indicated a high level of interest in attending future programs. Roughly 9 in 10 agreed they want to learn more about astronomy and the solar system.

Young children often have difficulty articulating reasons for their opinions, but these respondents, when asked why they wanted to learn more about astronomy, offered the following:

- Being able to explain it to others
- This knowledge could help them in school
- Being able to use this knowledge in everyday tasks, like determining the time.
- Alternative sources of energy and conservation.
- That astronomy is an important subject.

Besides the rational and functional aspects of the program's experience, it is important to consider also the emotional aspects, since those might have a relationship with the motivation to learn more about science/ attend a program like this one

**“I'd like to be an astronomer and learn about the sun and the stars.”**  
-Uxmal workshops

	Merida n=15*	Uxmal n=33	San Rafael n=42
Interest in learning more about science and astronomy	High, Flat	High, Increased	Med-High, Increased
Agree that science and astronomy are for everyone, even me.	Very High, Decreased	High, Increased	Med-High, Increased

\*Caution: Small base size. Results are not statistically significant.

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Recommendations





# Program Leader Recommendations

Six program leaders were interviewed for their perspectives on the program's strengths as well as opportunities for even greater success.

- Program Leaders in all locations were extremely positive about *El Sol nos Une a Todos*, saying the program was well-received and relevant to their constituents. Leaders credit the program for being a holistic, and highly accessible opportunity that is matched well to the community members who participate.
- The unique value of this program, some say, is that it provides a validation of the ancient Maya culture, which some feel gets lost or downplayed in comparison to contemporary /modern science.
- Leaders are careful to point out that this program does not purport to generate future astronomers, but that it is successful in responding to the community's interest and need to access science and astronomy content in an interactive and educational format.
- *That being said, program leaders did recommend that efforts be made to follow up with participants to track over time the effect, if any, of the program. Specifically, leaders suggested re-contacting participants at a later date to determine interest levels in the field of science and astronomy.*
- *To create additional synergies and reinforce learning, leaders in Uxmal and Merida also recommended creating program elements that are aligned with or complement school curriculum.*



# Program Recommendations

Goal 1: Strengthen an integrated concept of research, education, and public dissemination, encompassing science, art, technology, and all forms of cultural expression with astronomy at its center.

- *Set expectations for those attending that the program is an integrated learning experience. Students indicate they enjoy learning in general and specifically about astronomy and science, but San Rafael participants appear to have glossed over scientific and educational elements in favor of cultural and artistic aspects (dance and music). With accurate context and expectations (such as those set in Uxmal) students appear to embrace the learning opportunity.*
- *Explore ways to connect the lecture topics and workshops even further. Workshops are not limited to children any more than the lectures are limited to adults. Since both groups are participating in all elements, creating clear connections between them will help reinforce learning. These connections will likely be unique to each location and program, but consider creating parallels in content, format or scheduling of activities and lectures.*

Goal 2: Increase the appreciation and knowledge of children, youth, and the public regarding the legacy of knowledge contributed over thousands of years by native peoples of the Americas in astronomy and indigenous science generally.

- *The program in Uxmal was particularly effective in demonstrating the science-culture legacy of the Maya. Explore opportunities to create this same level of message impact in other program locations that do not benefit from having an archaeological site nearby.*



# Program Recommendations

Goal 3: Increase the appreciation and knowledge of children, youth, and the public regarding the latest discoveries in astronomy, in particular about the Sun and its effect on the Earth and other planets in the solar system.

- *Explore opportunities to include additional highly interactive workshops for children, who acknowledge that workshops that require their active participation help them learn in a fun, easy way.*
- *Leverage parents' interest in science and astronomy to 1) raise awareness in families and communities and 2) to support or reinforce their children's growing interest in these fields. Invite parents to partner with the program and become advocates of the scientific legacy of the Maya.*

Goal 4: Increase and facilitate broad access to science content within a cultural context.

- *Work to increase perceived access to workshops and programs. Consider 'tell a friend' programs, attendee databases, additional grassroots community initiatives to get the word out – emphasizing the programs are free.*
- *Recognize that strong gender stereotypes and traditional expectations may inhibit and discourage Latino girls from pursuing math, science or astronomy. Consider targeted lectures, workshops, programs or messaging specifically for young girls.*