

# Polarimeter to UNify the Corona and Heliosphere



## **PUNCH Outreach: Shining New Light on Diverse Views of the Sun**

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Outreach Director

NASA PUNCH Mission

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Eclipse Planning Workshop at NMMNHS with AAS Eclipse Task Force

POST-American Astronomical Society 242

Albuquerque, NM

10 June 2023



Outreach  
for the  
**NASA**  
PUNCH  
mission

Dr. Cherilynn Morrow

# PUNCH Public Engagement



PUNCH Outreach Logo

## PUNCH Outreach Motto

Shining New Light on Diverse  
Views of the Sun with our  
Ancient & Modern  
Sun-Watching Theme

**Scientific**  
**Cultural**  
**Historical**

**Personal Observation – DIRECT**  
**Personal Observation - INDIRECT**

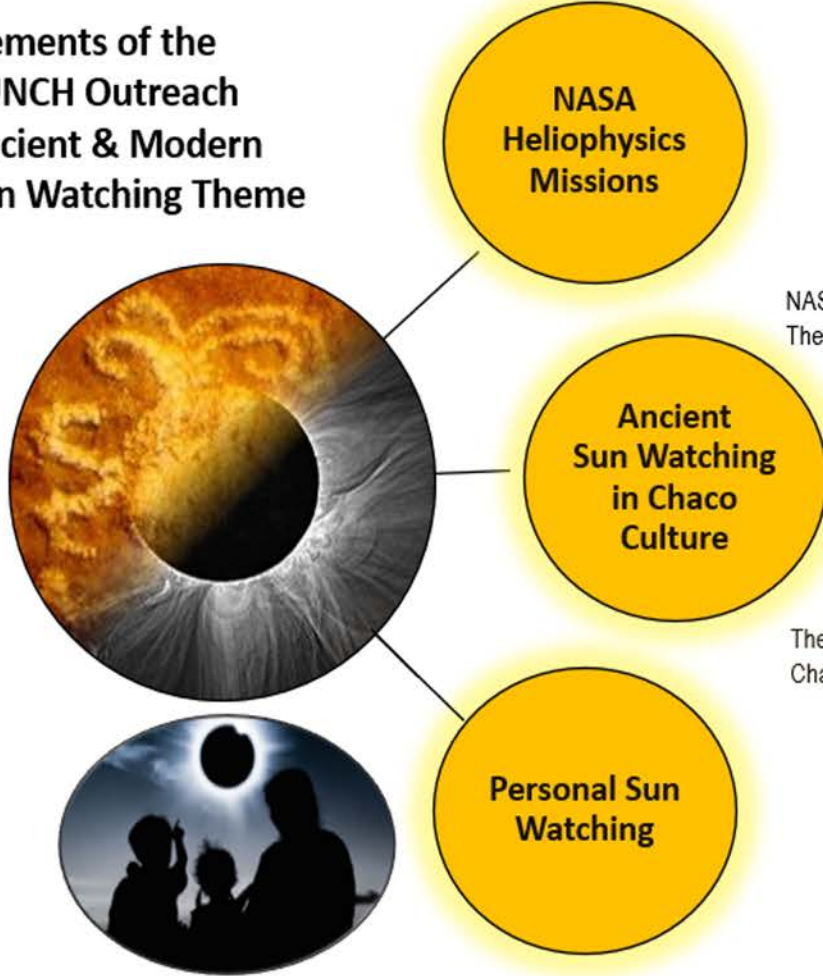


Diverse Views of the Sun	Specific Examples
<b>Scientific</b>	Different wavelengths, spectroscopy, imaging, <b>polarization</b> , in-situ, <b>remote-sensing</b> , ground-based, space-based, etcetera
<b>Cultural</b>	Different cultures' ways of knowing & being present for the Sun
<b>Historical</b>	Evolving ways of recording solar observation: petroglyphs, pictographs & pottery, hand drawings & paintings, ground-based photography, spacecraft instrumentation, "community science"
<b>Personal observation - DIRECT</b>	Naked eye viewing for pre-sunrise & post-sunset, solar telescopes, solar protection glasses & viewers, warmth on your body (e.g., cheeks, palms of hands, back of neck)
<b>Personal observation - INDIRECT</b>	Pinhole projection with a Projector or your hands, seeing naturally formed pinhole projections in your everyday environments, keeping time with a gnomon, other light & shadow play, sonification, tactile representations



## Shining New Light on Diverse Views of the Sun

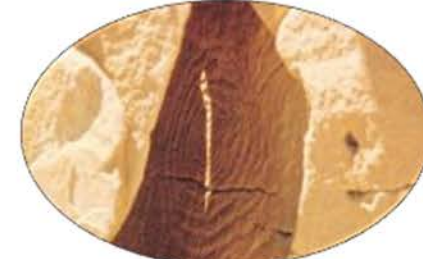
Elements of the  
PUNCH Outreach  
Ancient & Modern  
Sun Watching Theme



Funded collaboration between PUNCH and Parker on planetarium films and openness to collaboration with other missions



NASA Exploration of the Sun is a natural extension of age-old human practice of observation of the Sun rhythms and mysteries. There is world-wide evidence that all human beings are descended from cultures who observed the Sun.



There are >20 indigenous tribes in the 4-Corners region and Mexico who have ancestral and historical ties to Chaco. Chaco is also a World Heritage site with extraordinary evidence of ancient solar observing and thus has broader appeal.



"Modern Sun Watching" includes the invitation to ALL contemporary people to be present for sunrise, sunset, light & shadow effects, and eclipses.

Our outreach theme makes NASA Sun science relevant to **diverse learners** via **personal & cultural connections to Sun-watching**.







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# Populations We are Collaborating With and Learning From



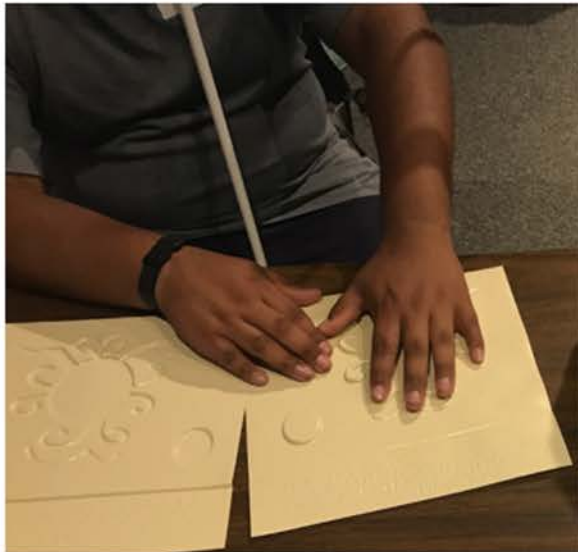
Native American  
& Hispanic/Latinx  
youth & families



Learners at the  
Haak'u Community  
Academy at the  
Pueblo of Acoma



3-D Print based by CU  
ATLAS Institute undergrad  
students doing capstone  
project



A collaborator from the Colorado Center for the  
Blind field testing a thermoform tactile art  
representations of the Ancestral Puebloan  
petroglyph in Chaco Canyon

10 June 2023

*PUNCH Outreach field tests all  
its products and learns from  
scientists, Blind & Low Vision  
learners, the descendants of  
Ancestral Puebloan people, and  
other collaborators how to be of  
greater benefit to ALL people.*

Blind & Low-Vision  
(BLV) Learners

[cherilynn.morrow@gmail.com](mailto:cherilynn.morrow@gmail.com)



Girls in STEM



AAS Eclipse Planning Workshop





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# Sun Fun Day at Pueblo of Acoma on 20 May



Making personal & cultural connections to ancient and contemporary Sun-watching both ongoing within the Pueblo in traditional ways, and in collaboration with NASA missions like PUNCH.



All Acoma photos by Cherilynn Morrow





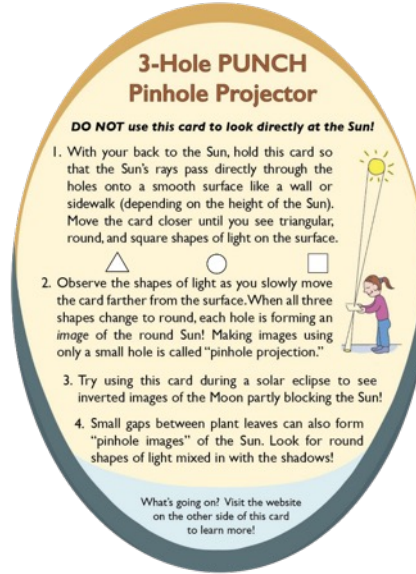


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# Collaborating with the Community to Prepare the Community



FRONT



BACK

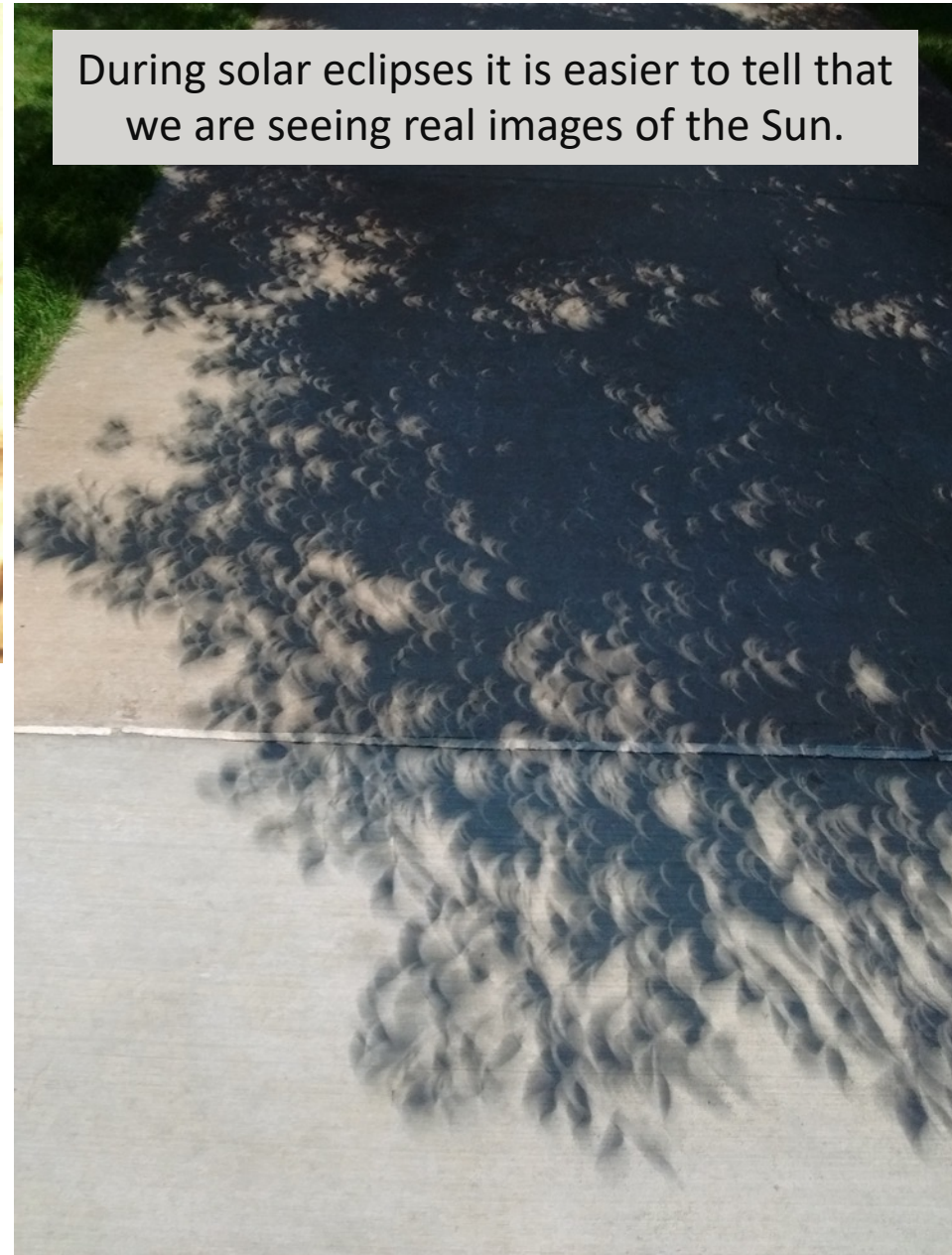
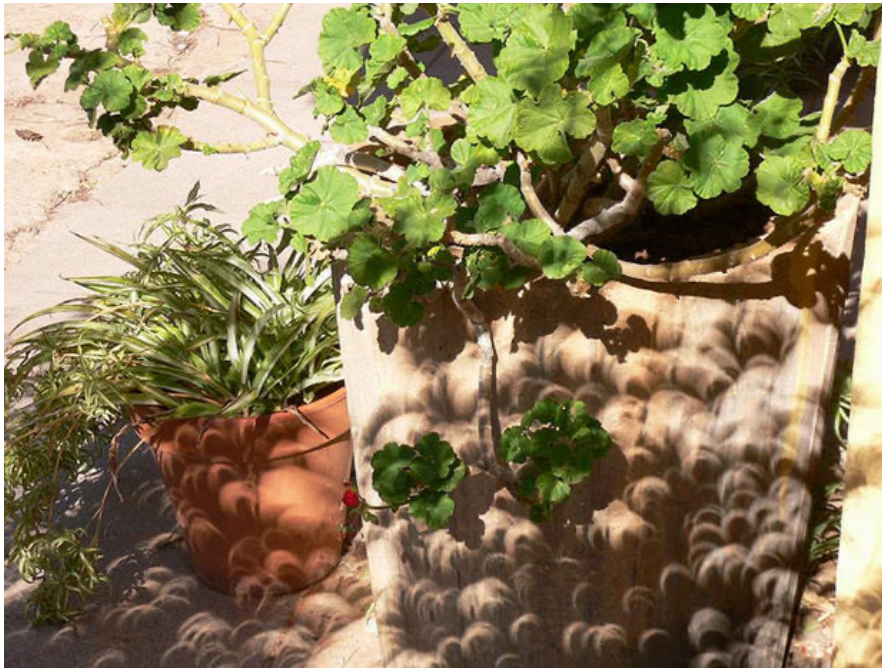
**New Mexico Museum of Natural History & Science**  
**Pueblo of Acoma – Haak'u Community Academy**  
**Chaco Canyon**  
**AAS Eclipse Task Force**

**National Hispanic Cultural Center**  
**Petroglyphs National Monument**  
**Southwestern Polytechnic Institute**  
**Balloon Museum (NASA TV webcast)**

**Indian Pueblo Cultural Center**  
**Museum of Indian Arts & Culture**  
**University of New Mexico, Maxwell Museum**







During solar eclipses it is easier to tell that we are seeing real images of the Sun.



**Gaps between tree leaves make wonderful pinhole image displays as the Moon eclipses the Sun.**

Upper left image by [Cantavestrella](#). See Credits & Acknowledgements for other photo credits.



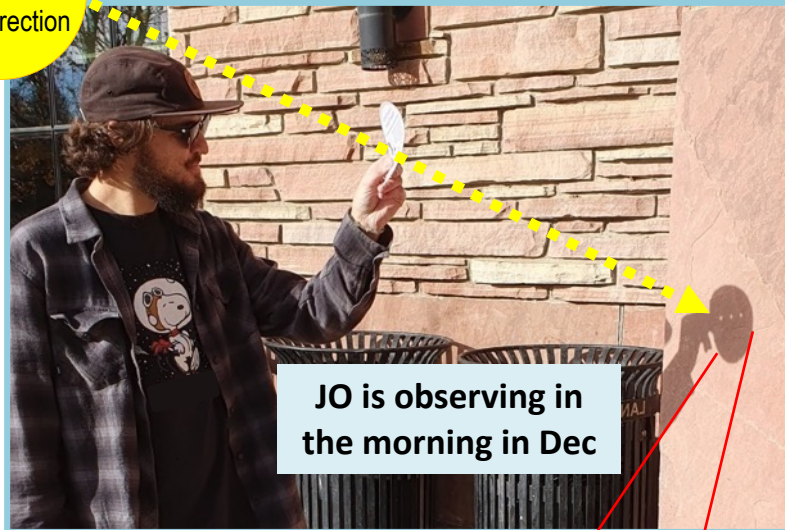


# Pinhole Projection of the Sun

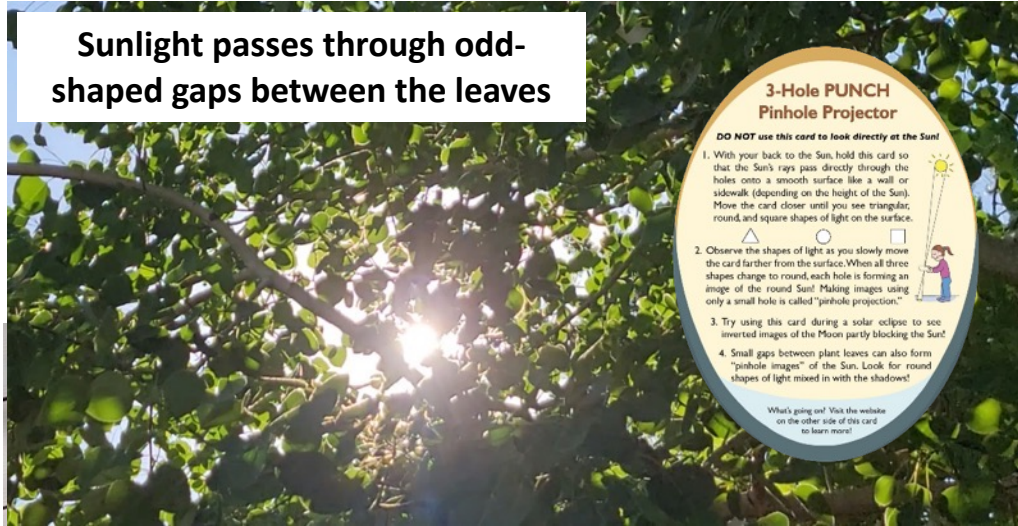


Gaps between leaves are like the “pinholes” of our projector, and even these odd-shaped gaps create round images of our sun!

Sunlight comes from this direction



JO is observing in the morning in Dec



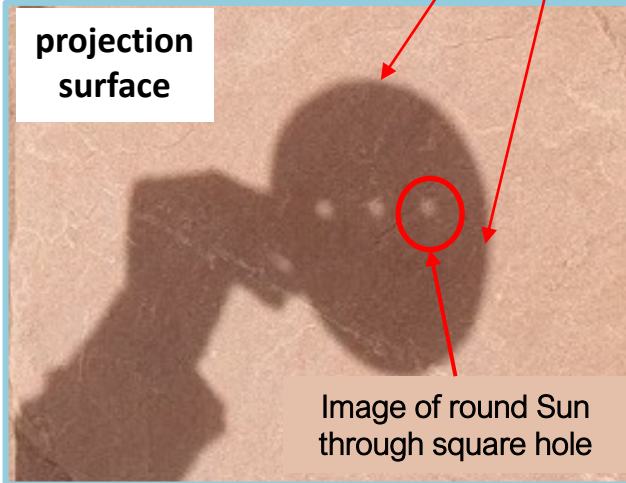
Sunlight passes through odd-shaped gaps between the leaves

**3-Hole PUNCH Pinhole Projector**

**DO NOT use this card to look directly at the Sun!**

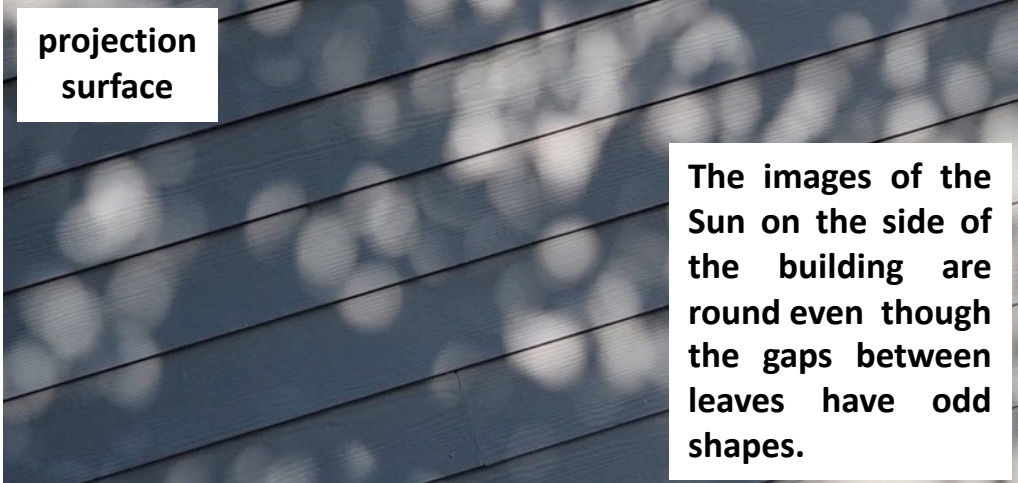
1. With your back to the Sun, hold this card so that the Sun's rays pass directly through the holes onto a smooth surface like a wall or sidewalk (depending on the height of the Sun). Move the card closer until you see triangular, round, and square shapes of light on the surface.
2. Observe the shapes of light as you slowly move the card farther from the surface. When all three shapes change to round, each hole is forming an image of the round Sun! Making images using only a small hole is called "pinhole projection."
3. Try using this card during a solar eclipse to see inverted images of the Moon partly blocking the Sun!
4. Small gaps between plant leaves can also form "pinhole images" of the Sun. Look for round shapes of light mixed in with the shadows!

What's going on? Visit the website on the other side of this card to learn more!



projection surface

Image of round Sun through square hole



projection surface

The images of the Sun on the side of the building are round even though the gaps between leaves have odd shapes.





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# Pinhole Projection of the Sun



We can find “pinhole images” of the round Sun all around us.

These are **REAL** images of the actual Sun – our star!



The images of the Sun come in all sizes and may be more round or more oval-like depending on the angle between the incoming sunlight and the projection surface.





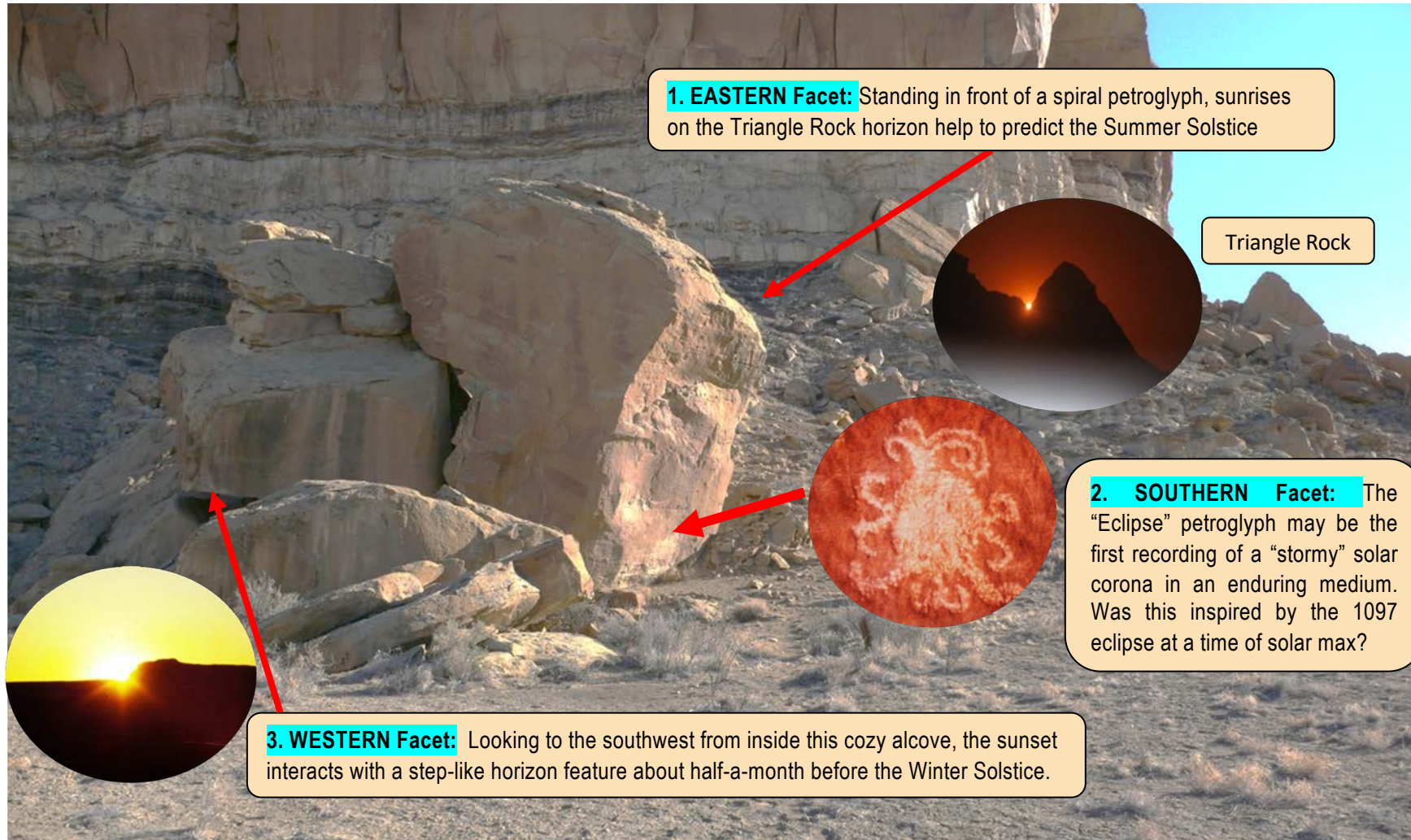
Chaco is a World Heritage Site and an International Dark Sky Park.





# Where is the “Eclipse” Petroglyph in Chaco Canyon?

an Ancestral Puebloan solar observing site in Chaco Canyon, New Mexico







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# The “Eclipse” petroglyph in Chaco

(1097?)



## 1097? Chaco Canyon, New Mexico

Rock carving in sandstone by Ancestral Puebloan people in Chaco Canyon, NM. Was this design inspired by the 1097 total solar eclipse during a period of high human activity in the Canyon and high solar activity on the Sun? (Solar peak of activity independently estimated to have occurred ~1098)  
Interpretation by Solar astronomer Kim Malville and his colleague Vaquero







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# Sample of Other Human Representations of a “Stormy” Solar Corona Through Time



**1097** Petroglyph with  
Prominences and/or CME?



**1860** Hand drawing  
with (now known) CME



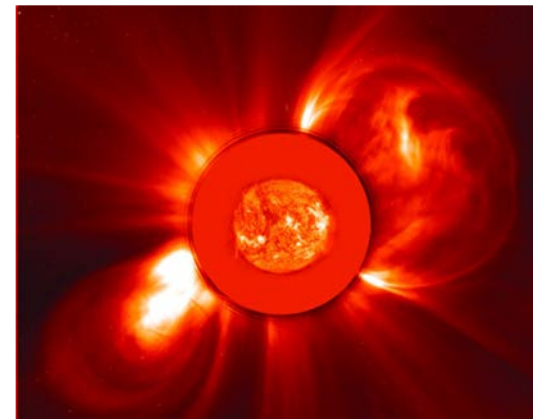
**1918** Painting with  
Prominences (pink)



**1980** Ground-based  
Photograph (solar max)



**2020** Composite  
Photograph with CME



**2000** NASA Spacecraft  
Image with two CMEs

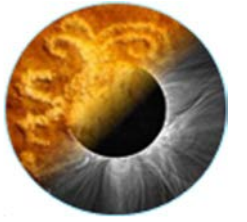




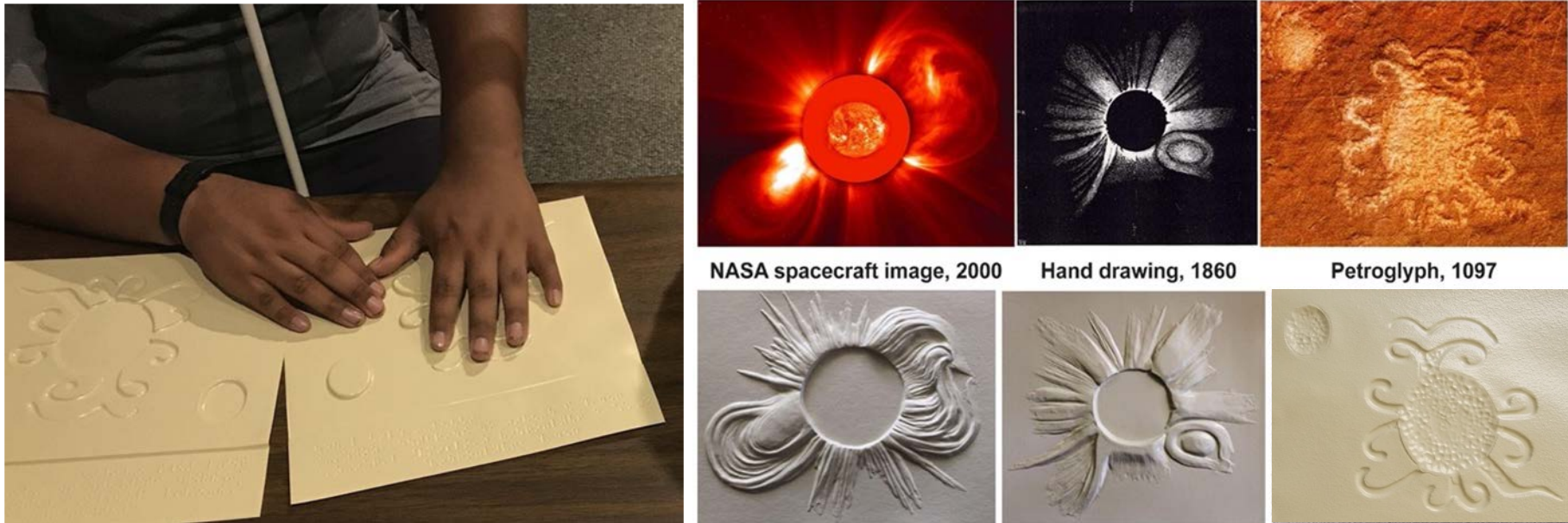


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# Using Thermoform Tactile Art Representations of the Solar Corona



- Field testing with Blind Learners in Colorado and Arizona
- Now working on Mark 3 versions based on feedback received



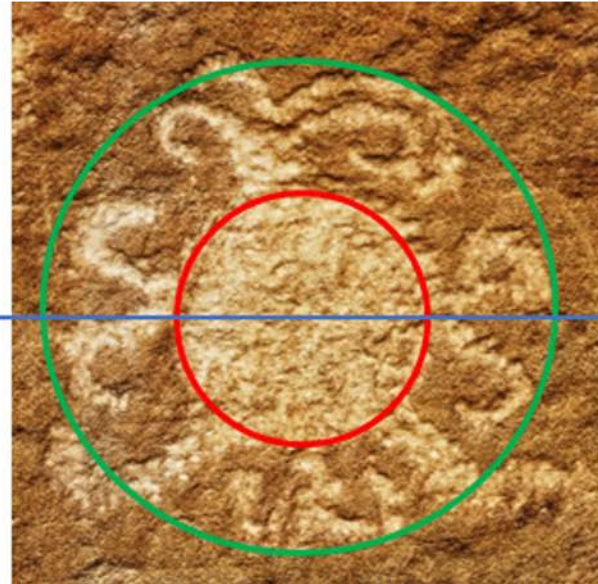
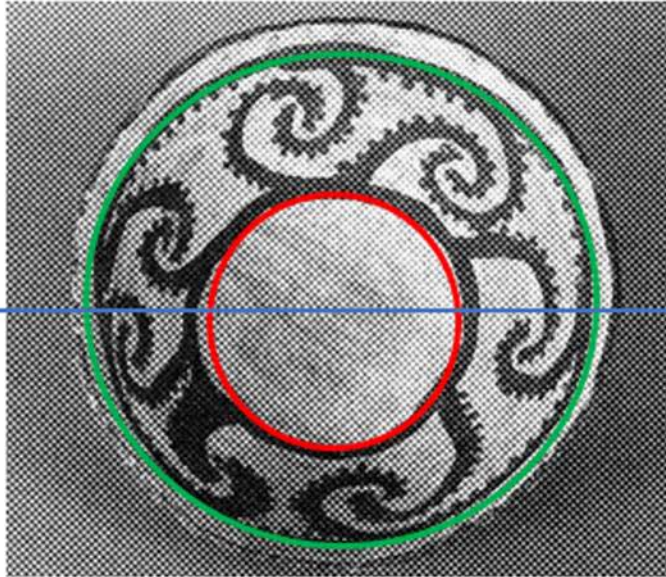
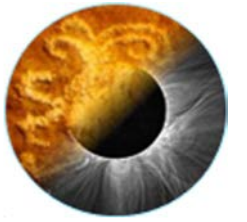
Thermoform tactile art representations of the solar corona created by (now Dr.) Nicole Johnson of the CU Atlas Institute





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# Comparing the Curlicue Designs of an Ancient Pottery Bowl to the “Eclipse” Petroglyph



## Ancient Pottery Bowl from Chaco Culture

Was the curlicue design on this ancient pottery bowl inspired by the 1097 total solar eclipse? Or was it already an artistic motif for representing the Sun prior to this eclipse?

## 1097? Chaco Canyon, New Mexico

Was the curlicue design of this Ancestral Puebloan petroglyph in Chaco Canyon inspired by the 1097 total solar eclipse during a period of high solar activity on the Sun?

Morrow et al. (2023) Contact: [cherilynn.morrow@gmail.com](mailto:cherilynn.morrow@gmail.com)







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# OUTREACH PRODUCTS

## PRODUCTS FOR ENGAGING LEARNERS OF ALL AGES



### 3-Hole PUNCH Pinhole Projector

Find printing instructions & resources to REALLY understand how the round Sun can be imaged through "non-round" holes.



### PUNCH Team Cards

See the beautiful 3-D formatting as you meet diverse members of the NASA PUNCH Team.



### Sun Fun Fill-in-the-Blanks

Play an online "drag & drop" word game to learn about the Sun and its effects on Earth.



### What is Heliophysics?

Web page that mirrors the PUNCH Science Objectives with more basic explanations.

## RESOURCES TO ENGAGE OUR COMMUNITY OF SCIENCE, OUTREACH, AND EDUCATION PROFESSIONALS



### Monthly 1-Page Newsletters

Enjoy these updates for our community on PUNCH Outreach activities and product releases. (Nov 2022 - present).



<https://punch.space.swri.edu/>

# Albuquerque Prepares for Its Day in the Sun

*Jayne Aubele*

*New Mexico Museum of Natural History  
& Science*

*[jayne.aubele@dca.nm.gov](mailto:jayne.aubele@dca.nm.gov)*



Find out more about this image at:  
[science.nasa.gov/annular-solar-eclipse-over-new-mexico](https://science.nasa.gov/annular-solar-eclipse-over-new-mexico)



❖ *Partial Eclipse visible in Albuquerque on April 8, 2024*

❖ *Annular Eclipse - October 14, 2023*  
*(Next annular eclipse in ABQ - 2238)*

❖ In Albuquerque...

❖ Begins ~ 9:15 a.m. MDT

❖ Lasts almost three hours

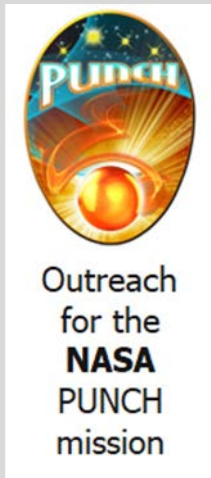
❖ Full Annularity

Starts: 10:34 a.m

Lasts: 4 min. and 45 sec.



Photo by L.S. Crumpler, Rio Puerco Valley 2012



- ❖ **PUNCH Outreach Collaborative**
- ❖ **NASA**
- ❖ **NASA-ASP Eclipse Ambassador**
- ❖ **NOAA**
- ❖ **National Park Service**
- ❖ **The American Astronomical Society**
- ❖ **The Albuquerque Astronomical Society**
- ❖ **Girl Scouts of New Mexico Trails**





❖ **NM Museum of Natural History & Science**

- ❖ NASA, NOAA & PUNCH Activities



❖ **International Balloon Museum & Fiesta Park**

- ❖ NASA TV Broadcast and Activities
- ❖ NOAA Broadcast and Activities



❖ **Petroglyph National Monument**

- ❖ NASA & PUNCH Activities



❖ **National Hispanic Cultural Center**



❖ **City of ABQ Parks and Recreation**

❖ **ABQ Open Space**

❖ **New Mexico State Parks**

**Rio Grande Nature Center**



- ❖ **University of New Mexico**
  - ❖ Students Going to Area Public Schools pre-Eclipse
  - ❖ Event at Johnson Field
  - ❖ NASA Balloon Launch
  
- ❖ **Southwestern Indian Polytechnic Institute (SIPI)**
  - ❖ Pre-Eclipses Events
  - ❖ NASA Balloon Launch
  
- ❖ **CNM (Central New Mexico College)**
  
- ❖ **Native American Community Academy (NACA)**
  
- ❖ **U.S. Forest Service – Sandia Ranger District**
  
- ❖ **Valle de Oro National Wildlife Refuge**
  
- ❖ **Explora**
  
- ❖ **National Nuclear Museum**





❖ **Santa Fe Children’s Museum**

❖ Solar System Ambassador



❖ **Rio Rancho - Rainbow Park Observatory**

❖ Hosted by Rio Rancho Astronomical Society



❖ **Placitas Community Library**

❖ Hosted by the Albuquerque Astronomical Society  
(club members assisting at other sites also)



❖ **Bureau of Land Management  
El Malpais National Conservation Area**



❖ **Pueblo of Acoma - Haaku**

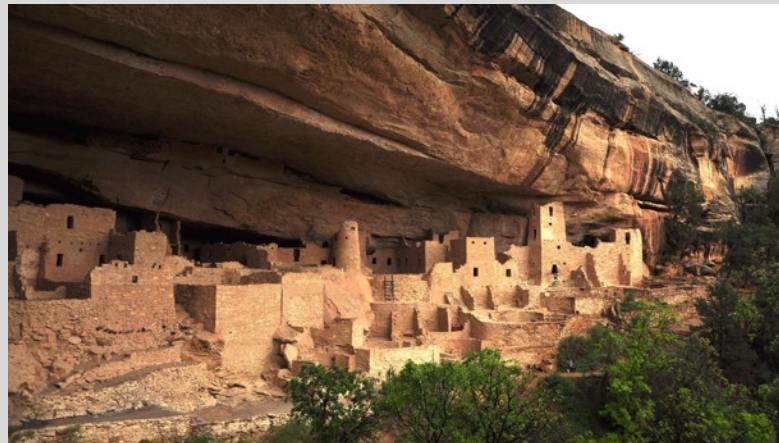


❖ **Jemez Historic Site**

❖ **NRAO – VLA (Very Large Array)**



- ❖ **Chaco Culture National Park**
  - ❖ Cultural Programs
  
- ❖ **El Morro National Monument**
  
- ❖ **Mesa Verde National Park**







NASA PUNCH website:  
<https://punch.space.swri.edu/>

# Thank You!

We are inviting New Mexicans (and all people) to safe Sun-watching during the eclipses along with heightened awareness of the rich world-class historical and cultural heritage of Sun-watching this region exemplifies... as well as enhanced awareness of New Mexico's engagement in collaboration with NASA's exploration of the Sun via missions like PUNCH.



Scan here to receive our 1-page monthly newsletter which provides updates on all PUNCH Outreach products or visit:  
<https://tinyurl.com/PUNCHO OutreachProducts>





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## We would like to hear from you!

Please fill out our short survey using the QR code or the link below.

[www.tinyurl.com/23eclipse](http://www.tinyurl.com/23eclipse)



# Invitation to Your Participation

Who are you and where are you from?

Where will you be for one or both of the eclipses and what will you be doing?

What does this mean to you? Why will you do this?





# GB Cornucopia

Originally from the Pacific Northwest and recently retired from 34 years as an interpretive and dark sky park ranger in Chaco Canyon, NM.

## Where will you be and what will you do during the solar eclipses?

I expect to be in Chaco Canyon in the plaza of the largest Great House with a solar telescope showing visitors the annular eclipse this October.

## What does it mean to you? OR Why will you do this?

To be the messenger for the general public of such an event and to be with them in them in this place of deep traditions of Sun-watching is an honor and privilege. This is amplified by being with fellow humans in one of many constructs from the Ancestral Puebloan builders that are so aligned with the Sun, Sun, is to be a part of a continuum in time from long before written language into into the distant future where ever people remember their true relationship with with the natural **world**. **To see the Sun is to see the source of our world and our and our life on it.**



## Dr. Julia Blue Bird

Oglála Lakħóta from Pine Ridge, South Dakota. Was always looking up as a kid, at the clouds and the stars. Now I am a radio astronomer at the National Radio Astronomy Observatory (NRAO) in Socorro NM.

### **Where will you be and what will you do during the upcoming solar eclipse?**

I will be here in New Mexico during the October eclipse. I will be camping and experiencing the event on one of the Pueblos.

### **What does it mean to you? OR Why will you do this?**

I have been here in New Mexico for about a year and a half. I study galaxies in my work but being here in NM has given me the opportunity to be more in touch with the Sun and the Moon. I have spent time at Chaco Canyon and was deeply moved by the experience. I am looking forward to experiencing the eclipse and its profound connection to nature and to us all.





## Verna Tallsalt (edit of 2-min audio recording)

Dine' doo Chishi' dine' (Navajo & Chiricahua), Hardrock, Navajo Nation, Arizona.  
Navajo language and culture consultant. Elementary school teacher.

### Where will you be and what will you do during the solar eclipse?

I will be at my residence in Hardrock, AZ during the annular eclipse on October 14<sup>th</sup>, 2023 and during the total solar eclipse on April 8, 2024. They will both be partial eclipses where I live. I will be preparing for the eclipse the day before by traveling back to my home from my place of employment. It takes 1 ½ hour to drive through rough terrain. At my home, I will prepare food to partake before the event and will stay inside my dwelling for the period of time of the eclipses.

### What does it mean to you? OR Why will you do this?

As Dine' people, we have been reminded of how to revere this natural phenomenon throughout time. As a mother and grandmother, I encourage my children, grandchildren, and young Dine' children to continue to respect the protocols of our traditional values and ways of doing. During a solar or lunar eclipse, the traditional protocols for Navajo people help to protect their mind and body during the entirety of the eclipse. These include staying inside, fasting (no food or beverage), remaining quiet and reserved, and not attending to broadcasts or publicizing about the eclipse. In my tradition, the men folk who know the ways of "Singing Jóhonaa'éei (the Sun) back to life" are the only ones who are active during an eclipse.



## Dr. Amir Caspi

From Israel via Maryland, then California, now Colorado. Solar astrophysicist studying the corona and space weather, with a passion for science communication. Lead a new miniature satellite, called CubIXSS, to study X-rays from the Sun. Lead the Citizen CATE 2024 and NASA WB-57 2024 solar eclipse missions.

### **Where will you be and what will you do during the upcoming solar eclipse?**

For the annular eclipse in October, I plan to be in Climax, CO, at the site of the first coronagraph in the United States, helping to run a fun outreach experiment. For the total solar eclipse in April, I will probably be at one of the CATE 2024 observing sites, where we will also have the remote mission control for the WB-57 airplanes. In both places, I expect to be sharing a lot of science and excitement!

### **What does it mean to you? OR Why will you do this?**

Solar eclipses are one of the most glorious astronomical phenomena that can be seen by the naked eye. They remind us that we live within a dynamic and truly awesome Universe, and that science can be, at once, both educational *and* thrilling, both cerebral *and* heartfelt. I am fortunate to be able to not just study the Sun and the Universe, but to be able to share that knowledge and excitement with others.





# Dr. Marialis Rosario Franco

Born and raised in Puerto Rico, a small island in the Caribbean. Teaching Faculty member at the University of Colorado, Boulder, where I instruct Introductory Astronomy, conduct planetary science and physics education research, and work with NASA outreach projects.

## **Where will you be and what will you do during the solar eclipses?**

I intend to be in New Mexico for the upcoming annular solar eclipse. I will likely be camping with my dog, Júpiter Aurora, and bring instruments to observe through stenopeic and digital ways.

## **What does it mean to you? OR Why will you do this?**

Ever since my experience in the 2017 total eclipse, I've developed a deep emotional connection to these natural phenomena. Words cannot express the level of harmony with nature I felt. While this event holds tremendous scientific value because it allows us to observe the solar corona in detail and represents a perfect application of similar triangle geometry, experiencing an eclipse is an unparalleled and surreal sensory spectacle; that is the reason I will prioritize being present by all of nature.



# Joe Aragon (Heeyaii siwa)

Eagle Clan and Yellow Corn Child, Pueblo of Acoma, New Mexico

## Where will you be and what will you do during the solar eclipses?

During these events, I will be at the Pueblo of Acoma helping others in our community to experience the Eclipses safely and respectfully and to be cognizant of the natural motion of these objects in the Sky.

## What does it mean to you? OR Why will you do this?

My ancestors knew the motions of objects in the Sky. The people of the Sky were aware of the positions of the Sun, Moon and the Earth. When alignments resulted in an Eclipse, the people are reminded of the power of Nature and the relationships we have with all natural events. Prayers are said to ask for help in our lives and give us strength to overcome our frailties. As Teachers, we have the obligation to assist others in understanding how our world works and learn from all special physical events that are brought to us by our Mother Nature.



Mr. Aragon is adjusting his binocular projection set up for safe, communal viewing of the Sun.



## Milo Buitrago-Casas

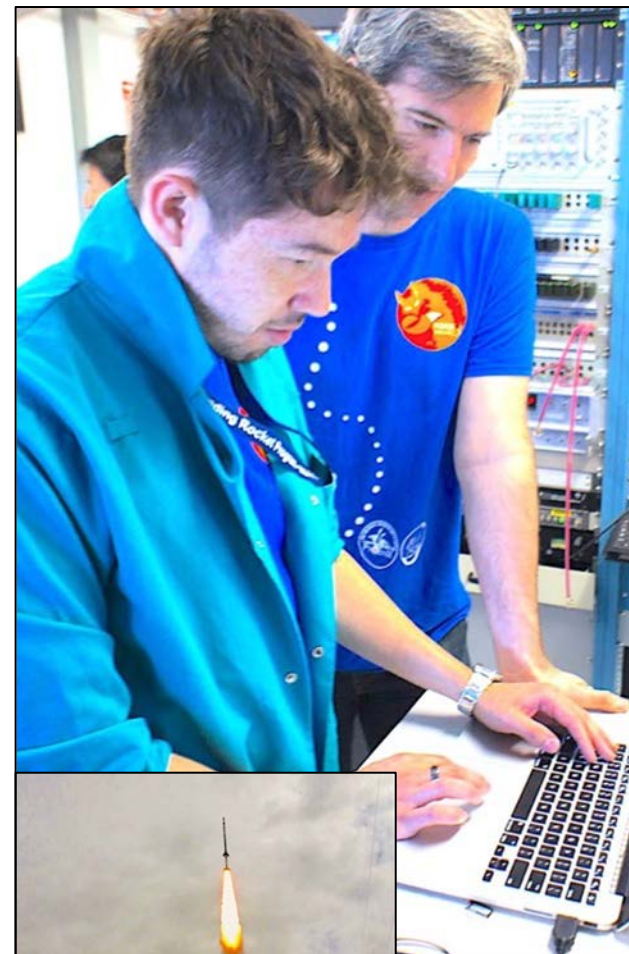
I am from Bogota, Colombia in South America. I'm a member of several scientific teams dedicated to developing cutting-edge instruments for space missions aimed at observing the Sun. I also serve as Chair of the Education and Public Outreach Committee for the Solar Physics Division of the American Astronomical Society.

### **Where will you be and what will you do during the upcoming solar eclipse?**

For the upcoming total solar eclipse, my intention is to be in Alaska. I will be collaborating with a team of fellow solar scientists on a unique project: launching a rocket equipped with an X-ray telescope. Our objective is to capture and observe a large solar flare during the first half of April 2024.

### **What does it mean to you? OR Why will you do this?**

This coming total eclipse will fuel my curiosity as a scientist and will allow me to share and learn from others how the Sun influences our lives. To me, exploring the wonders of the Sun and unraveling its mysteries through scientific research is not only a job but one of my most enjoyed passions. I feel that our discoveries and observations have the power to inspire and educate, fostering a greater appreciation for the Sun's role in shaping our solar system and its impact on Earth.



# Asis Juan Carlos Gonzalez

STEM Educator, Santa Fe Children's Museum. Solar System Ambassador, JPL.



## **Where will you be and what will you be doing during the upcoming solar eclipse**

During the Annular eclipse I hope to do an eclipse event at my place of work The Santa Fe Children's. I hope to obtain many Solar Glasses to hand out for free ourselves at the event and be personally there for safe use of the glasses.

For the Total Solar Eclipse of 2024 I will travel to see it (plan pending), if anyone invites me to do a program I will be game!

## **What does it mean to you? OR Why will you be doing what you will be doing?**

One of the worst things I experienced after seeing the eclipse of 2017 is the immediate and great need to see another eclipse! It was the most beautiful thing I have ever seen! I have always felt a surge of happiness during an eclipse be it either annular or total! My biggest joy is sharing and teaching others about natural phenomena. How could I say no to telling more people about it!