

Polarimeter to UNify the Corona and Heliosphere (PUNCH)

PUNCH Outreach UPDATE



PUNCH 4 Science Meeting

7 July 2023

Boulder, CO

Cherilynn Morrow (presenter)

PUNCH Outreach Director

Consultant, Southwest Research Institute

John Keller, Fiske Planetarium

Duke Johnson, Clark Planetarium

Jayne Aubele, NM Museum of Natural History & Science

Joe Aragon, Pueblo of Acoma

and the rest of the remarkable PUNCH Outreach Team!

https://punch.space.swri.edu/punch_outreach_products.php





Outreach
for the
NASA
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mission

OUTLINE



PUNCH Outreach Motto

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

PUNCH Outreach Logo

1. **Rapid intro to PUNCH Outreach program and team members (Heliophysics Big Year)**
2. Advancing knowledge and interpretation of the Chaco “Eclipse” Petroglyph Site
3. Intense period of field testing and formative evaluation
4. Release of our 3-Hole PUNCH Pinhole Projector (Mark 3 and Mark 3B Spanish) + Resources
5. Public release of our first batch of 18 PUNCH Team Cards (gratitude)
6. Proto PUNCH Bowl of web-based Outreach resources
7. Citizen CATE project as “glue” between PUNCH Science and the Total Solar Eclipse
8. Opportunities for PUNCH Outreach engagement





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PUNCH Outreach Core Contributors



Craig DeForest
PUNCH PI



Sanlyn Buxner
Evaluator



Cherilynn Morrow
Outreach Director



John Keller
Outreach Co-Director



Briana Ingermann
Program Consultant



Jason Trump
Deputy Program Manager



Pamela Harman
Advisory Board Chair



Duke Johnson
Co-Director for Photography



Jayne Aubele
Co-Director for Cross-cultural Outreach



Geoff Skelton



Jim Greenhouse
Events Planner



**Todd
Gonzales**



Nina Byers
SEL Consultant



Mike Zawaski
Activity Consultant



Thor Metzinger
Planetarium Production



Dave Dooling
Activity Consultant



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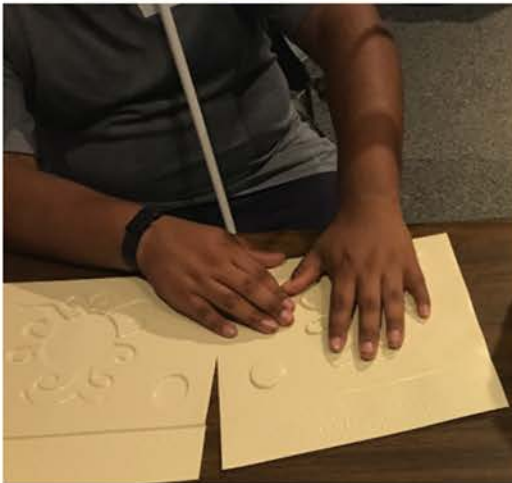
Populations We are Collaborating With and Learning From



Native American
& Hispanic/Latinx
youth & families



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



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



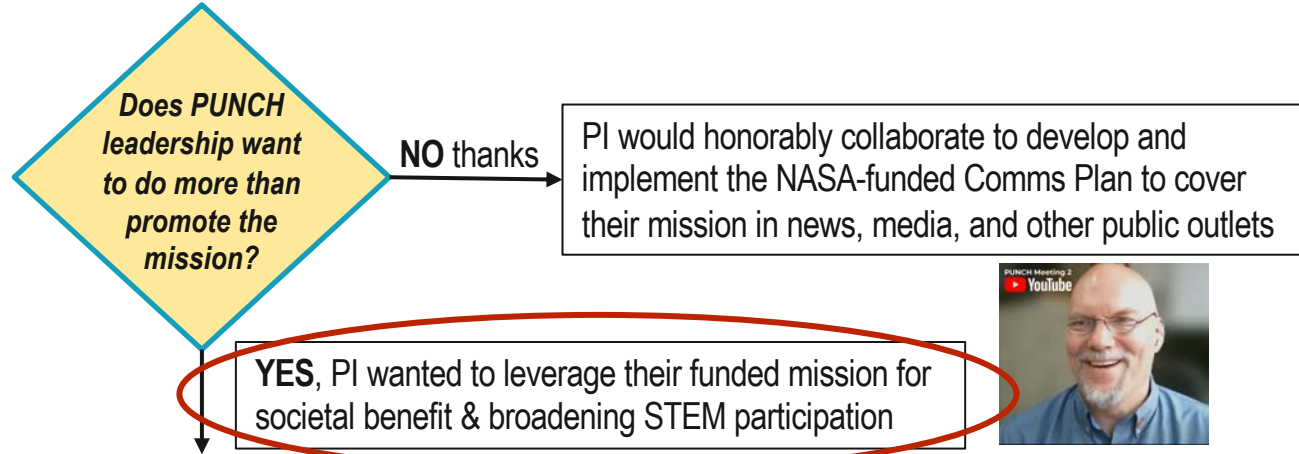
Girls in STEM





REMINDER: Origins of the PUNCH Outreach Program

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1. PI identified, hired, and supported an Outreach Lead with strong professionalism (soon *after* mission selection) who was charged with building an Outreach team and developing a rigorous plan during Phase B:
2. PI collaborated with their Outreach Lead to develop & *submit a proposed* Outreach Plan to NASA Heliophysics
3. PUNCH received NASA augmentation to the budget to implement the Outreach Plan
4. The PI and Project Scientist (Sarah Gibson) welcomed the Outreach Team to the Mission Team and integrated their participation with Science and Communications Teams + web developer Don Kolinski.





PUNCH Public Engagement

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

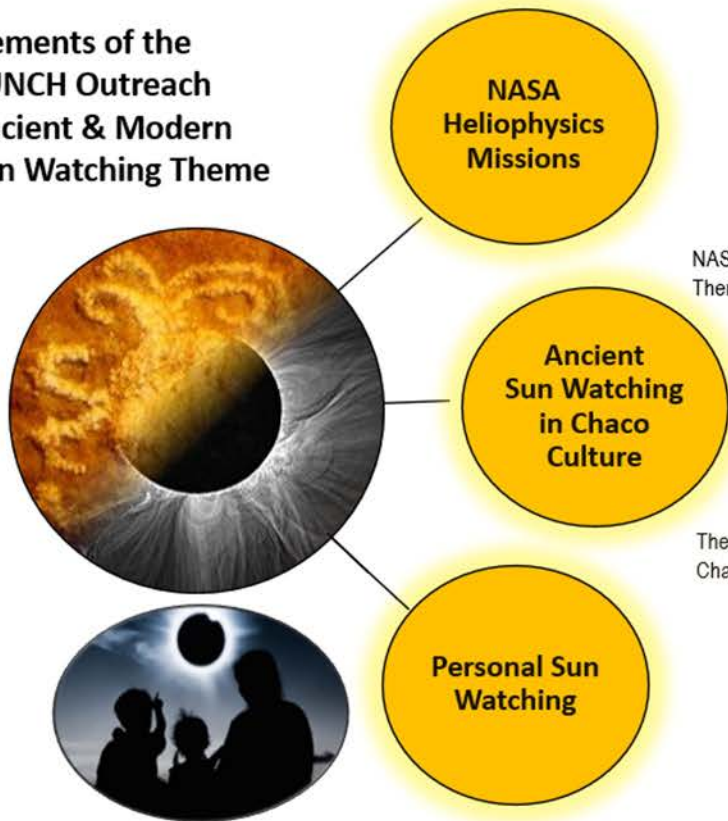


8 GUIDING PRINCIPLES for the PUNCH OUTREACH PLAN

1. Engaging outreach expertise in collaboration with mission leadership
2. Interconnecting the Science, Outreach, and Communication Teams.
3. Coordinating & synergizing with allied NASA groups & missions
4. Identifying a thematic outreach approach to broaden participation
5. Aligning mission attributes with outreach participants & partners
6. Leveraging strengths & partnerships among multiple institutions
7. Learning from those we intend to benefit from the start
8. Integrating evaluative processes throughout implementation

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.

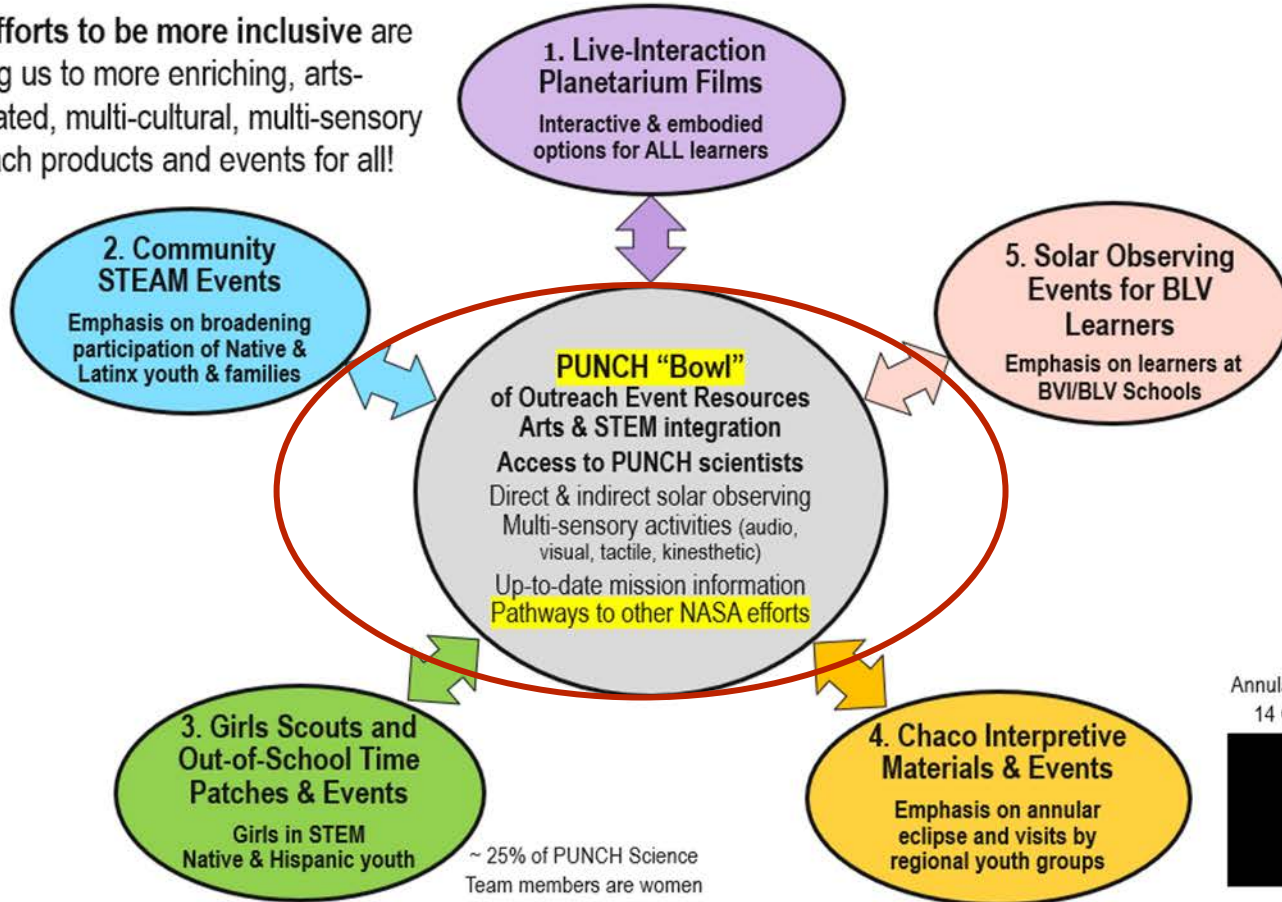
Our outreach theme makes NASA Sun science relevant to **diverse learners** via **personal & cultural connections** to **Sun-watching**.



Outreach for the NASA PUNCH mission

Five Types of PUNCH Outreach Events Use our PUNCH Bowl of Resources

Our efforts to be more inclusive are leading us to more enriching, arts-integrated, multi-cultural, multi-sensory outreach products and events for all!



Annular Eclipse Event
14 October 2023



Annular Eclipse Events in Chaco's Pueblo Bonito

20 May 2012 and 14 October 2023



The yellow star marks the location of the activity depicted below.



The 2023 annular eclipse occurs on the last day of world-famous Albuquerque balloon festival. PUNCH Outreach will also collect photography at this event.



Chaco volunteer, Dr. Cherilynn Morrow, leads an activity about lunar phases with an Apache family in the plaza of Pueblo Bonito during the 20 May 2012 annular eclipse. PUNCH Outreach plans to document a similar event for the Oct 2023 Annular Eclipse



On 20 May 2012, after the "ring of fire" effect of annularity, the Sun set partially eclipsed as viewed from Chaco Canyon, NM



Tiered Model for PUNCH Outreach Support

Tier 1: We are the lead conveners or co-conveners of the event.

Tier 2: We are sending people and resources to support an existing event convened by another.

Tier 3A: We are making resources available with training for use at an event but no outreach team member is on the ground

Tier 3B: same as 3A but without prior training





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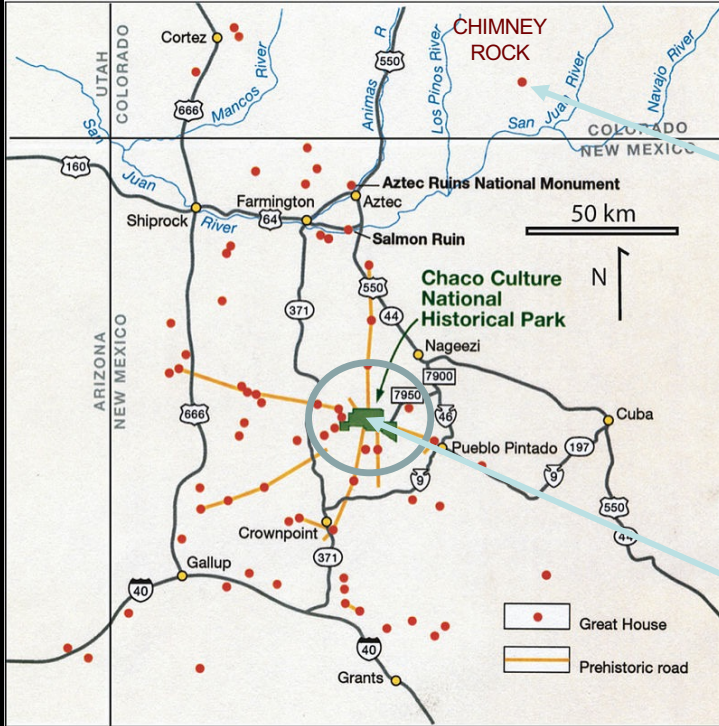
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Chaco is a World Heritage Site and an International Dark Sky Park.





Chacra Mesa

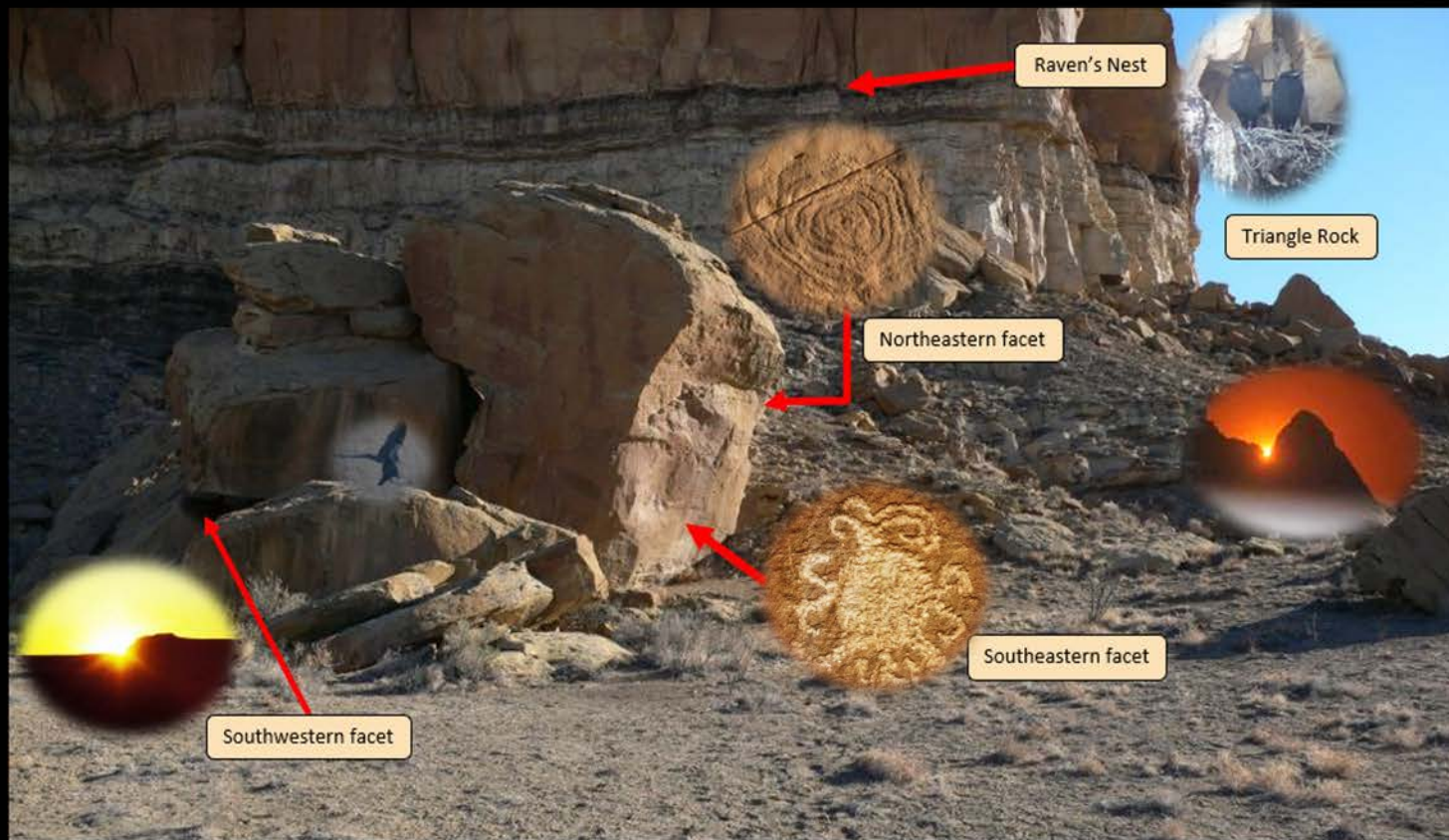
Fajada Butte

Photo by Benjamin Oswald



There are several reasons to consider 29SJ514 as a Sun watching site

This is an Ancestral Puebloan cultural site in Chaco Canyon, NM that requires **special permitting arrangements**



Polarimeter to Unify the Corona and Heliosphere

NASA PUNCH Outreach and the “Eclipse” Petroglyph Site in Chaco Canyon



Dr. Cherilynn Morrow

Duke Johnson

GB Cornucopia

Kim Malville

American Astronomical Society 242

Albuquerque, NM

5 June 2023

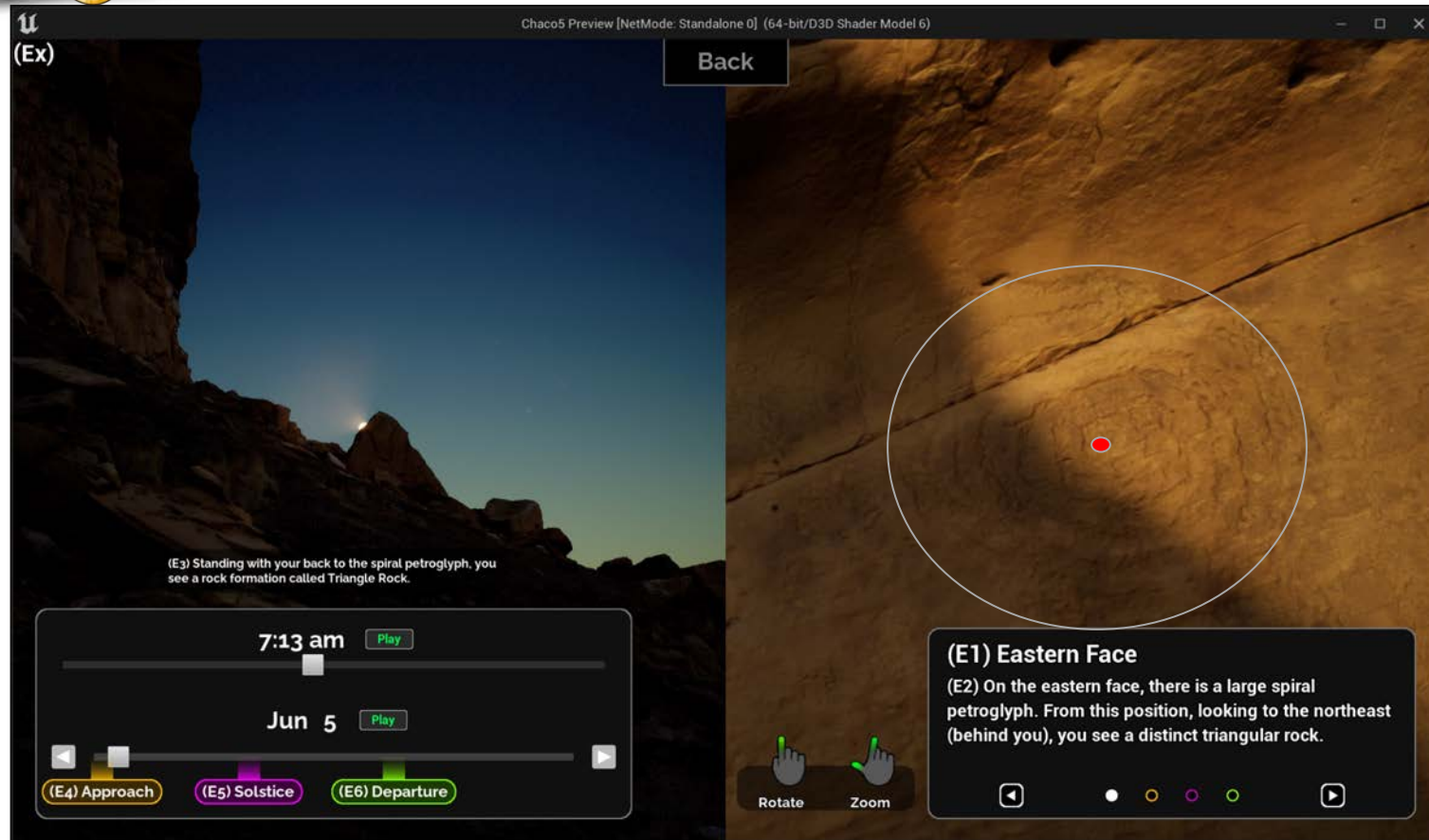
AAS INVITED PRESENTATION

We are advancing knowledge and interpretation of this site....

1. Our research-permitted photo-documentation has corrected and elaborated on previously published data about how the horizon calendar and light-and-shadow-on-spiral phenomena behave on the eastern facet.
2. Our nascent, research-permitted study of pottery with Sun-themed designs has unveiled similar motifs to the petroglyph.
3. Our 3-D printable model of the petroglyph based on RTI data has amplified intriguing details of the petroglyph's features.



Digital Interactive Kiosk based on Photogrammetry

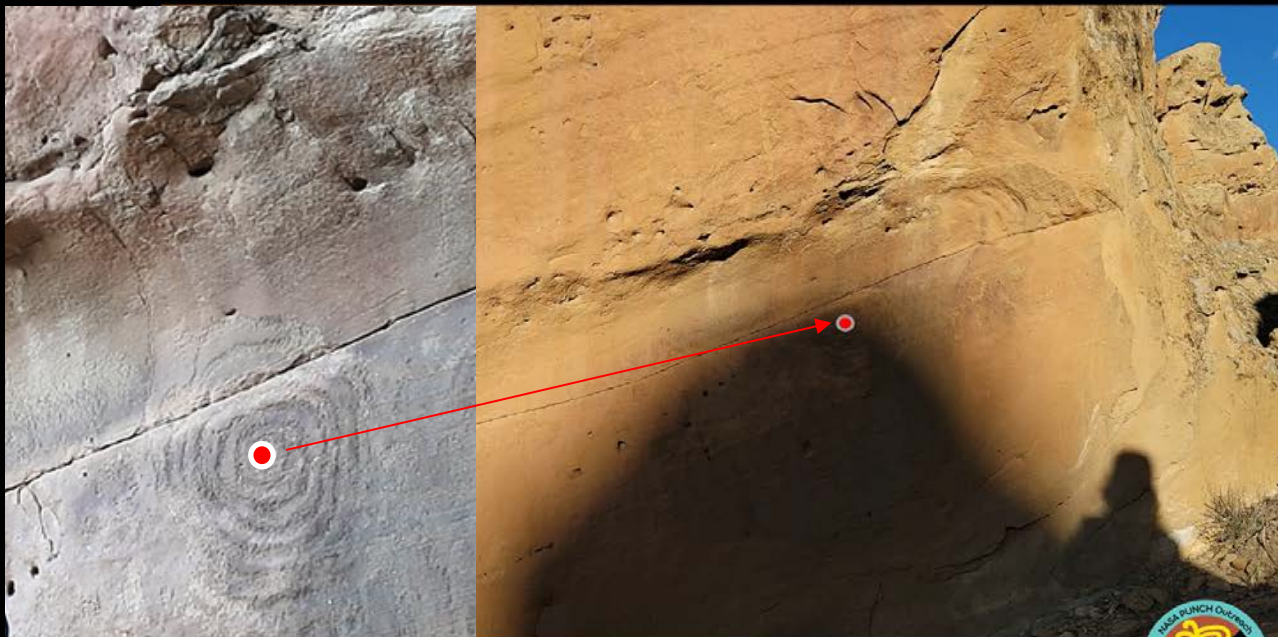


We have released an alpha test model of a digital kiosk for internal review.

First Image of Apex of Shadow Passing Through Spiral Center

Affirmed with 3 June 2023 two-way photography to document spiral-horizon correspondence

Time Lapse Video 9 July 2022 (3 June equivalent)





Time Lapse Video 9 July 2022 (3 June equivalent)

Recorded by C. Morrow on Galaxy S21 Mobile Phone with Tripod



Polarimeter to Unify the Corona and Heliosphere

NASA PUNCH Outreach and the “Eclipse” Petroglyph Site in Chaco Canyon



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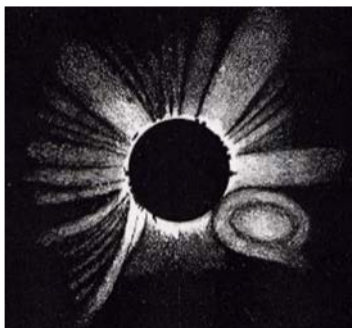


Sample of Other Human Representations of a “Stormy” Solar Corona Through Time

1097 Petroglyph with Prominences and/or CME?



1860 Hand drawing with (now known) CME



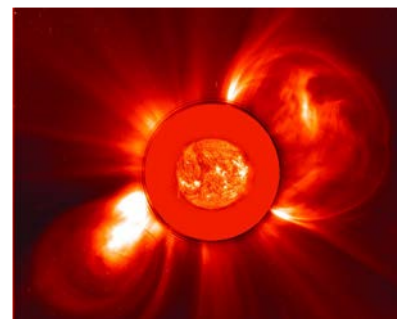
1918 Painting with Prominences (pink)



1980 Ground-based Photograph (solar max)



2020 Composite Photograph with CME



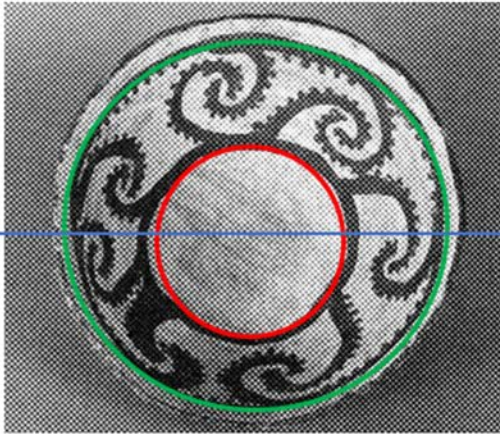
2000 NASA Spacecraft Image with two CMEs



Comparing the Curlicue Designs of an Ancient Pottery Bowl to the Chaco Petroglyph

3

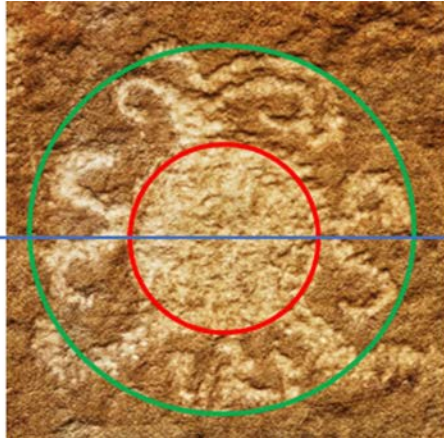
A research project with UNM Maxwell Museum Collections



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?

This pot has not yet been found in the Maxwell Museum collections at UNM



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 and high human activity in the Canyon?



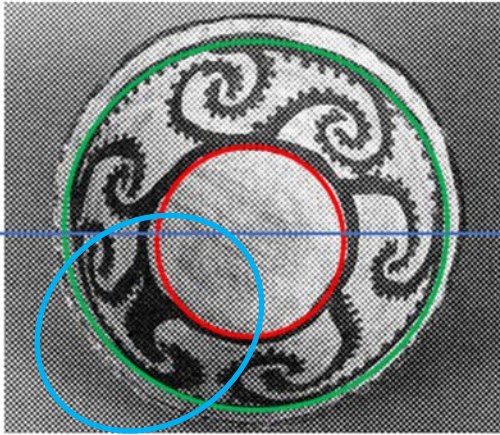
2023 Chaco Canyon, NM

My outstretched hand is about the same size as BOTH the petroglyph and the ancient pottery bowl.



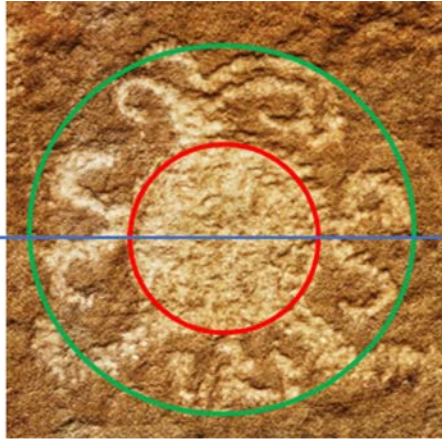
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What is this tail-like feature?

This 3D print with exaggerated relief created by U. Colorado undergraduates as part of a capstone project with the ATLAS Institute helped pay more attention to this notable feature of the petroglyph. Maybe a Tethered Prominence-CME system?

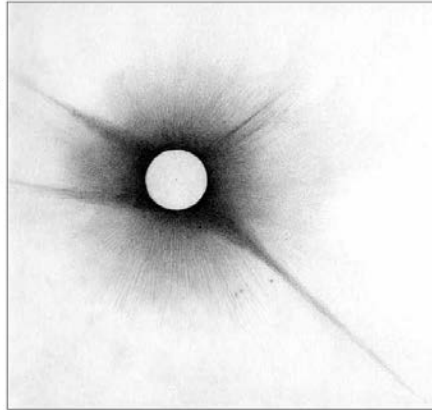


Longest Ray? Tethered Prominence-CME System? What do you think?



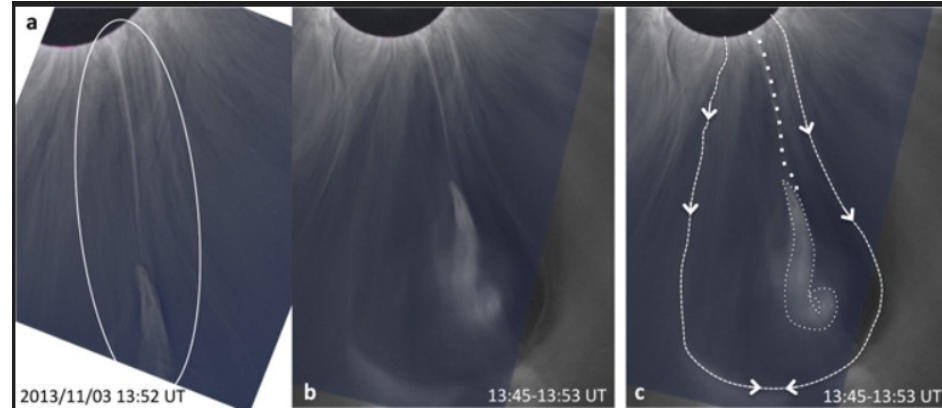
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1898 Annie Maunder (India)

“The longest ray”



2013 Tethered Prominence – CME System?

Citation: Miloslav Druckmüller *et al* 2017 *ApJL* **851** L41

DOI: 10.3847/2041-8213/aa9ed5



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Intense Period of Field Testing & Formative Evaluation

So far in 2023, the Team has collected feedback on “mature” field testing events including:

- Girl Scout Patch events in Ellicott City, MD and Longmont CO [25 Mar and 8 Apr]
- Astronomy Day at the Fiske Planetarium, Boulder, CO [15 Apr, rich Latinx participation]
- Thermoform tactile exploration with BLV learners in Tucson, AZ [Apr]
- 3D printable Tactile exploration during visit to Colorado Center for the Blind [Apr]
- Classroom Visits to Haak’u Community Academy, Pueblo of Acoma, NM [Apr]
- Sun Fun Community Day at the Pueblo of Acoma, NM [20 May]
- AAS Eclipse Planning Workshop, NM Museum of Natural History & Science [9-10 Jun]
- Girl Scout Patch Event Planning Guide: US Planetarium Conference, TN [Jun]
-



March 2023 School Outreach Visit - Pueblo of Acoma

Bi-cultural team



Multi-lingual Kinesthetic Astronomy

Exploring PUNCH Team Cards



Seeing the Corona w/your Hands

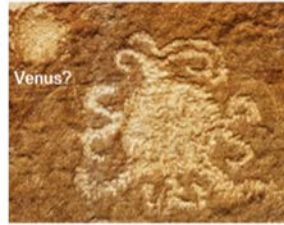
Birthdays on Chaco Horizon



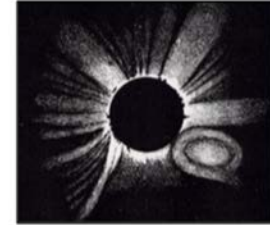


Pay close attention to details that can distinguish these images.
Which of these images are you “seeing with your hands”?

A Ancient petroglyph in Chaco Canyon (1097?)



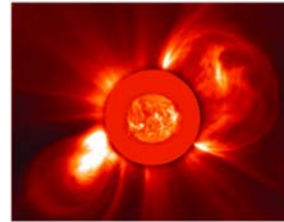
B 1860 hand drawing of a total solar eclipse



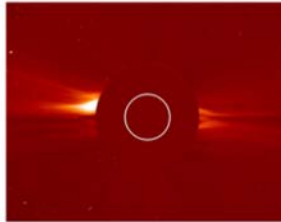
C Pottery bowl from Chaco Culture (11th century?)



D NASA spacecraft image of Sun at solar maximum



E NASA spacecraft image of Sun at solar minimum

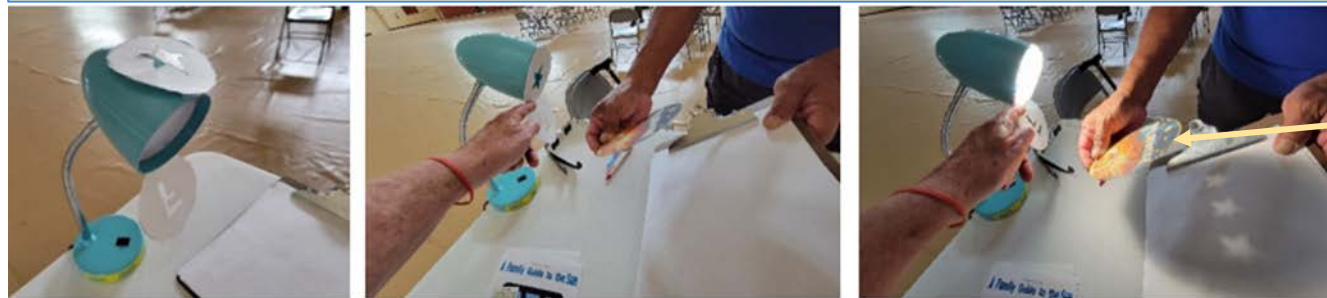


F Sunflower





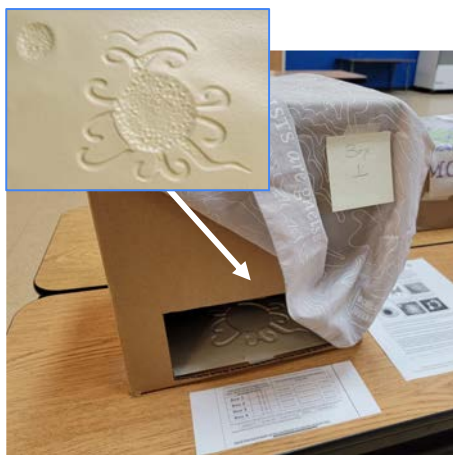
The 3-Hole PUNCH Pinhole Projector: Indoors and Outdoors



Birthdays on Chaco Horizon



'Seeing' with Your Hands



PUNCH Team Cards





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1. Projector close to surface.
Triangle, round, and square
shapes of light are sharp.



2. Projector farther away from surface. All three shapes of light become round, fuzzier, and can become larger than the holes of the projector.



In Case 2, we are seeing images of the round Sun. Field testing has revealed the power of next asking learners to directly experience the Sun's roundness using solar protection glasses. An indoor demo that alters the shape of the light source before the Projector will delightfully re-enforce the pinhole imaging effect.



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Just want to let you know how much this little guy loved the 3-Hole PUNCH pinhole projector. He must have spent 10 minutes moving it up and down to figure out what was happening. So many great questions from a 4- year-old!" - Vivian White, Director of Free Choice Learning, Astronomical Society of the Pacific





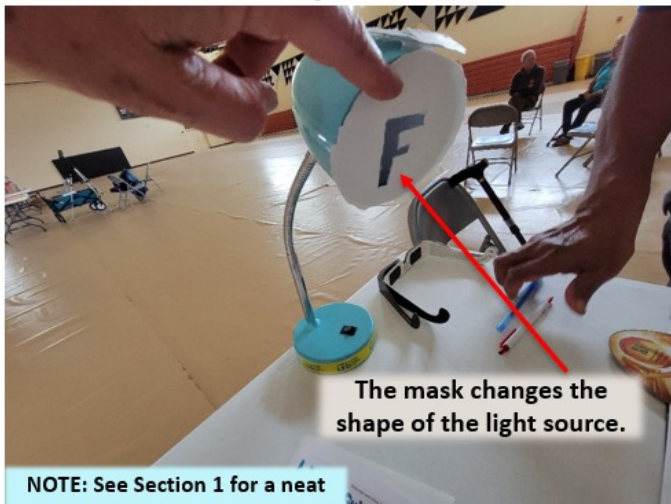
APPENDIX A1

A Pinhole Projector's Images are Inverted Top-to-Bottom and Left-to-Right



The images on the projection surface are F-shaped because the cut-out makes the light source F-shaped. But notice the pinhole images are upside down and flipped left-to-right.

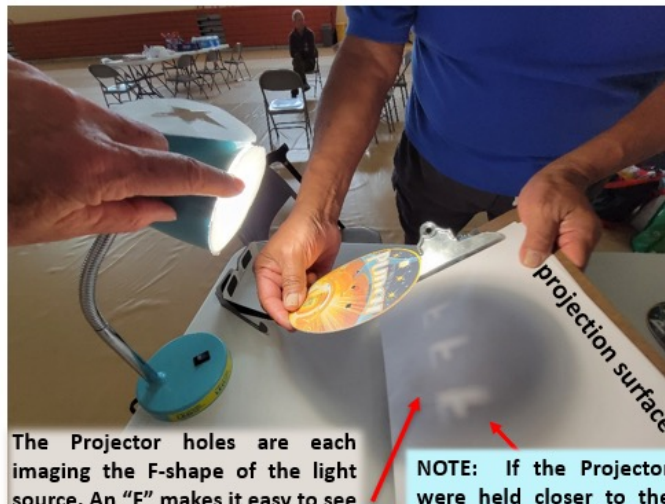
Lamp OFF



The mask changes the shape of the light source.

NOTE: See Section 1 for a neat demo using a star-shaped mask.

Lamp ON



The Projector holes are each imaging the F-shape of the light source. An "F" makes it easy to see how pinhole images are upside down and flipped left-to-right.

NOTE: If the Projector were held closer to the surface, we would still see the triangular, round, and square-shaped holes.

CONTACT:

Dr. Cherilynn Morrow, Outreach Director for the NASA PUNCH mission [cherilynn.morrow@gmail.com]



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APPENDIX A6

Discovering How Pinhole Images of Eclipses Are Inverted

The next 5 slides guide you through an inquiry to discover how pinhole images of eclipses are inverted compared to direct, filtered viewing of what is in the sky.



The two images (elbow pinhole images, and the filtered view of how the eclipse appeared in the sky) were made within minutes of one another while observing the 20 May 2012 annular solar eclipse from the plaza of Pueblo Bonito in Chaco Canyon, New Mexico. Enjoy!



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Visit our webpage:

- Outreach activities
- Facilitator guides
- Instructions to print/access materials
- Info on PUNCH science
- Other resources to stay connected



https://punch.space.swri.edu/punch_outreach_products.php

PUNCH Polarimeter to UNify the Corona and Heliosphere

Home About Science Media Outreach

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 "pinholes."
- 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.
- Seeing the Sun's Corona with your Hands**
Explore tactile art representations of the Sun's corona, from an ancient petroglyph to NASA spacecraft imagery.
- Birthday Sunrises on a Chaco Canyon Horizon**
Learn how the sunrise position changes throughout the year on an eastern horizon viewed from a Great Kiva in Chaco Canyon.
- Dancing Up A Solar Storm**
Use body motions to represent key features of "space weather" before playing a dance-based learning game about levels of solar activity.

Outreach Overview
Outreach News
What is Heliophysics?
Outreach Team
Support for Scientists
Outreach Products
Monthly 1-Page Newsletters
Publications/Presentations



Outreach
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Receive our monthly 1-page newsletter

- Provides updates on our latest activities and outreach product releases.
- Invites you to contribute photos and ideas for our "Did You Know" and "Your Solar Photo of the Month" sections.
- Email us with other ideas to consider



https://punch.space.swri.edu/punch_outreach_products.php



Did You Know...
...that the science of solar physics extends back to ancient Babylonia? Cuneiform records of solar eclipses date back as far as 1375 BCE, so we know that observations of the corona pre-date the Roman republic by nearly a thousand years.

Showcasing Girl Scout Prototype Patch Activities at the US Planetary Conference

PUNCH Outreach convened an interactive workshop at the US Planetary Conference (June 23) that generated excitement for our *Ancient & Modern Sun-Watching* Girl Scout patch. After experiencing a selection of the patch activities, planetary professionals engaged in a documented discussion about what to include in our Event Planning Guide to support them in providing Girl Scout patch-earning events. Find our current [activities and facilitator guides on the PUNCH Outreach Products webpage](#). Our Mark 2 Prototype Girl Scout Patch & Event Planning Guide are combining these and other activities that are unique to Girl Scout needs and values.

Helping Colleagues to Touch Chaco Culture



Photo by Jason Trump

PUNCH Outreach provided a unique 2-day excursion for ~20 astronomers and educators from around the US just prior to the June meeting of the [American Astronomical Society](#). The Day 1 trip to [Chaco Canyon](#) included a multi-sensory tour of Pueblo Bonito, the largest excavated Great House, and a visit to the "eclipse" petroglyph. PUNCH Outreach Director, Cherylynn Morrow, and retired ranger, GB Cornucopia, offered a combined 45 years of experience in interpreting Chaco. They emphasized evidence for the Sun-watching mastery of the [Ancestral Puebloan](#) people and empowered participants to enrich their own eclipse outreach with stories of Chaco.

On Day 2 in Albuquerque, participants engaged with a suite of PUNCH Outreach activities. One was [Seeing the Sun's Corona with Your Hands](#), where learners explore thermoform tactile art representations of the solar corona (pictured below).

Right: Participants can feel how the structure of the corona at solar maximum compares to that at solar minimum.



Photo by Jason Trump



Left: Chaco's "eclipse" petroglyph in thermoform tactile art. Other tactiles include NASA & H&O images.

Your Solar Photo of the Month

Every month we feature a photo [submitted by readers](#) that portrays a personal experience of the Sun.



Photo by Jayne Aubelle

This is my back patio in Albuquerque with the early afternoon sunlight filtering through the [lattices](#) in the roof. I love to sit here when this particular Sun pattern appears and I am surrounded by it. It looks like an artist's brush strokes but made with light rather than paint!

Visit punch.space.swri.edu for more about the NASA PUNCH mission and its Outreach program. For questions or photo submissions: Outreach Deputy Program Manager (jtrump@slco.org) & Outreach Director (cherylynn.morrow@gmail.com). [View the Newsletter Archive](#).



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CITIZEN CATE 2024: DISTRIBUTED OBSERVATIONS OF THE 8 APRIL 2024 TOTAL SOLAR ECLIPSE WITH COMMUNITY VOLUNTEERS

A. CASPI¹, P. BRYANS², C. DEFOREST¹, S. KOVAC¹, D.B. SEATON¹, P. YANAMANDRA-FISHER, D. ZIETLOW²,
AND THE CITIZEN CATE 2024 TEAM

¹SwRI, ²NCAR, ³SSI



NASA Grants: 80NSSC21K0798, 80NSSC23K0946

NSF Grant: 2231658, (+ pending)





We are re-assessing our decision to delay a PUNCH polarization activity until after the eclipses due to learning more about the SwRI-based Citizen CATE project which will observe the solar corona in polarized light with 40 stations all along the 8 April 2024 path of totality.

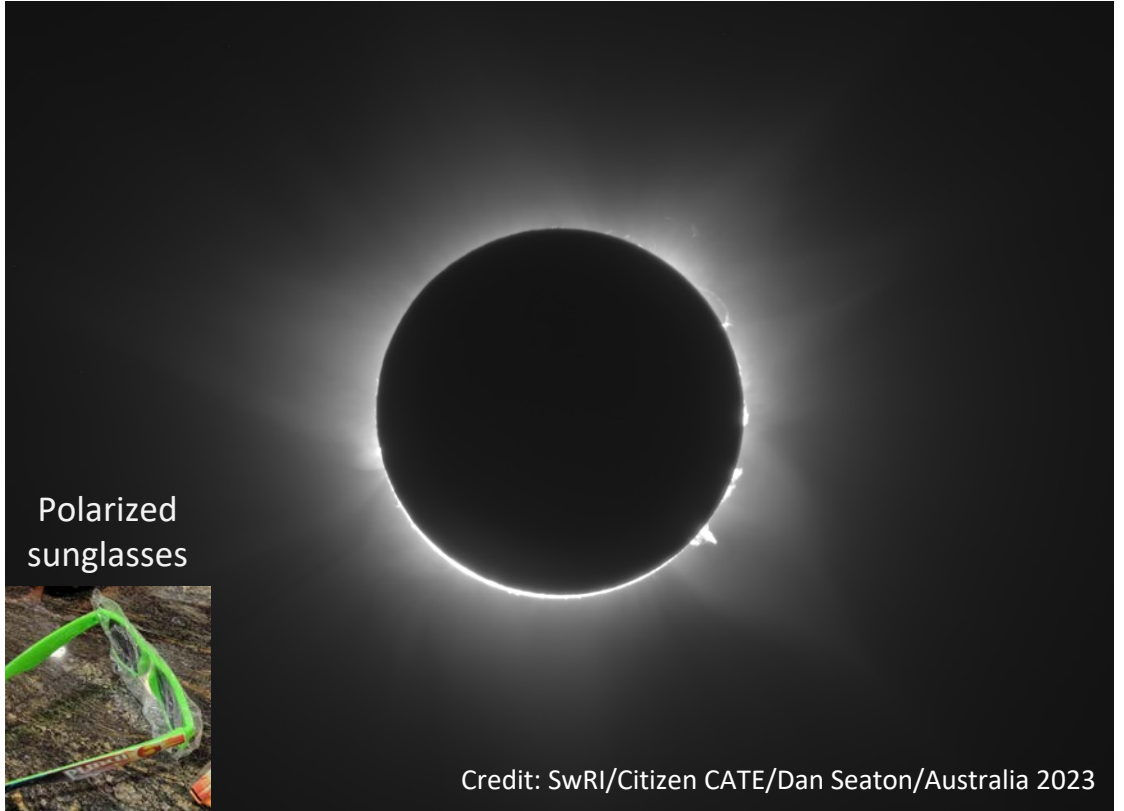
Cherilynn asked:

What would happen to the view of the solar corona during totality if you looked with polarized sunglasses and then rotated the lens?

Dan Seaton replied:

You would see the difference. As you rotated the lens, different parts of the corona would become bright.

Compare these two minimally processed views of the raw data from polarizers at 90° from one another. This is a lot like what you would see.



Credit: SwRI/Citizen CATE/Dan Seaton/Australia 2023



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OUTLINE



1. Rapid intro to PUNCH Outreach program and team members (Heliophysics Big Year)
2. Advancing knowledge and interpretation of the Chaco “Eclipse” Petroglyph Site
3. Intense period of field testing and formative evaluation
4. Release of our 3-Hole PUNCH Pinhole Projector (Mark 3 and Mark 3B Spanish) + Resources
5. Public release of our first batch of 18 PUNCH Team Cards (gratitude)
6. Proto PUNCH Bowl of web-based Outreach resources
7. Citizen CATE project as “glue” between PUNCH Science and the Total Solar Eclipse
8. **Opportunities for PUNCH Outreach engagement**





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Ways Heliophysicists Have Engaged with PUNCH Outreach

1. Advocated for our outreach program and for mission team engagement in outreach
2. Participated in PUNCH Team Card Initiative [18 so far, and others are welcome]
3. Contributed to a PUNCH Science Panel at the PUNCH Outreach Annual Retreat in NM
4. Staffed a booth or tabletop at a conference [e.g., AGU 2022, AMS 2023, AAS 2023]
5. Interacted with planetarium/museum visitors at tabletop activity (e.g., Adler, NMMNHS)
6. Served as moderator or participant in a panel about public engagement programs embedded in scientific research environments.
7. Served as co-author of Decadal white paper about mission-embedded outreach strategy
8. Co-author of conference abstract about PUNCH Science & Outreach
9. Presented relationship between PUNCH Science and Eclipses to Outreach Professionals
10. Provided ideas and links to new potential outreach partners
11. Contributed a presentation to Science Friday's Sun Camp Q & A sessions [Fall 2022]
12. Helped convene field test event for Girl Scout patch activities with daughter's troop
13. Addressed science questions related to educational product development
14. Reviewed and/or contributed to our 1-page monthly Newsletter
15. Collaborate on PUNCH science and/or outreach presentations for outreach professionals
16. Collaborate on PUNCH science and/or outreach-related presentations for the public
17. Developed and contributed an art-science-outreach product [music, poetry, visual art, etc]
18. **NOTE:** We want this form to be quick & easy! Please send feedback to Cherilynn or Sanlyn (cherilynn.morrow@gmail.com) and/or to our evaluator Sanlyn Buxner (buxner@psi.edu)





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Summary of Key Updates & Invitations

1. PUNCH Outreach is living up to its original guiding principles and is well-regarded in the national eclipse outreach community [ASP, AAS Eclipse Task Force, and NASA Comms]
2. PUNCH Outreach is taking the science commo of pinhole projection to a whole new level and inviting others to share in the wealth of innovation and resources.
 - a. We invite you to equip yourself with the newly released *3-Hole PUNCH Pinhole Projectors* to support your personal & institutional outreach efforts for the upcoming eclipses *and beyond*.
 - b. We are inviting learners to observe & explore pinhole projection as a source of delight, curiosity & life-enriching experience, with or without an eclipse, and with a lead to PUNCH.
3. Contact Cherilynn if you would like to weigh in: Please share your thoughts & ideas
 - a. Our photography & archival research (in support of our product development) is advancing cultural astronomy knowledge & interpretative possibilities of the Chaco “eclipse” petroglyph.
 - b. PUNCH Team Cards: 1st batch of 18 is on-line & in printable downloads at AAS. Open to others.
 - c. We are re-assessing our decision to delay a PUNCH polarization viewer until after the eclipses.
 - d. We are exploring the “science communication” value of a “life-story” analogy for solar wind blobs, from “birth” in the corona to “death” at the heliopause. What do you think?
4. **PLEASE help us to support and keep an accounting of mission team outreach activities**
Please let us know if you will (or would like to) support an upcoming eclipse or Sun-related event

FIN

Thank you for your time and attention!