

Polarimeter to UNify the Corona and Heliosphere



Update on the PUNCH Outreach Plan

Cherilynn Morrow, PhD
PUNCH Outreach & Communications Lead
SWRI Consultant

PUNCH Science Team Meeting #2
Thursday 03 December 2020
10:30 – 3 pm MDT on ZOOM

Hey I want to light up some underrepresented kids in the Southwest. How about if I pay you in phase B of our PUNCH mission to make a plan for doing that. Make it a plan you'd love to carry out! – Craig DeForest



Eight Guiding Principles for the PUNCH Outreach Plan

1. Engaging outreach expertise in collaboration with mission leadership
2. Synergizing the Science, Outreach, and Communication Teams (e.g., on website)
3. Coordinating & synergizing with allied NASA groups & missions
4. Enacting a thematic approach to broaden participation
5. Aligning mission attributes with outreach participants, partners, and products
6. Leveraging strengths & partnerships among multiple institutions
7. Learning from those we intend to benefit from the start
8. Using evidence-based practices & integrating evaluative processes

Eight KEY principles guide the development **and implementation** of the PUNCH Outreach plan



Figure 9: OVERARCHING GOAL for PUNCH OUTREACH:

To leverage the PUNCH mission to inspire historically marginalized youth in the Southwestern US to learn about NASA heliophysics in ways that honor their identities related to culture, gender, and disability, and thereby increase their confidence and consideration for pursuing STEM career pathways



Figure 1: PUNCH Outreach considered these factors in choosing outreach participants and products

Native American and Hispanic/Latinx youth have low high school graduation rates and are much more likely to live in impoverished conditions in both urban and rural areas of New Mexico. There is a deep need to inspire these young people to see science learning as an important and enjoyable part of their identity. Minority students tend to think of science as a fortress that only non-minorities can enter. **Linking a NASA mission, that will be in the news, to their own cultural history and ancestral lands can be a great source of inspiration. Using a blend of art, history, and science is an essential strategy.**

– **Jayne Aubele**, New Mexico Museum of Natural History & Science (PUNCH Outreach Partner)

Hispanic/Latinx children and families need opportunities to examine and learn about their cultural histories and stories while learning about science. **Creative, holistic experiences in culture, art, science, and personal histories lead to the creative thought needed for the cultivation of future working scientists.**

– **Elena Baca**, Latina STEAM Educator, National Hispanic Cultural Center, Albuquerque, NM (Advisory Board)



PUNCH Outreach is founded on authentic needs & opportunities

I applaud the work of the (**NASA**) solar scientists for many reasons, but, in particular, because I know their work will augment and enhance Native Traditional Knowledge. It will **expand and complement the mystery explored by our Puebloan Ancestors.**

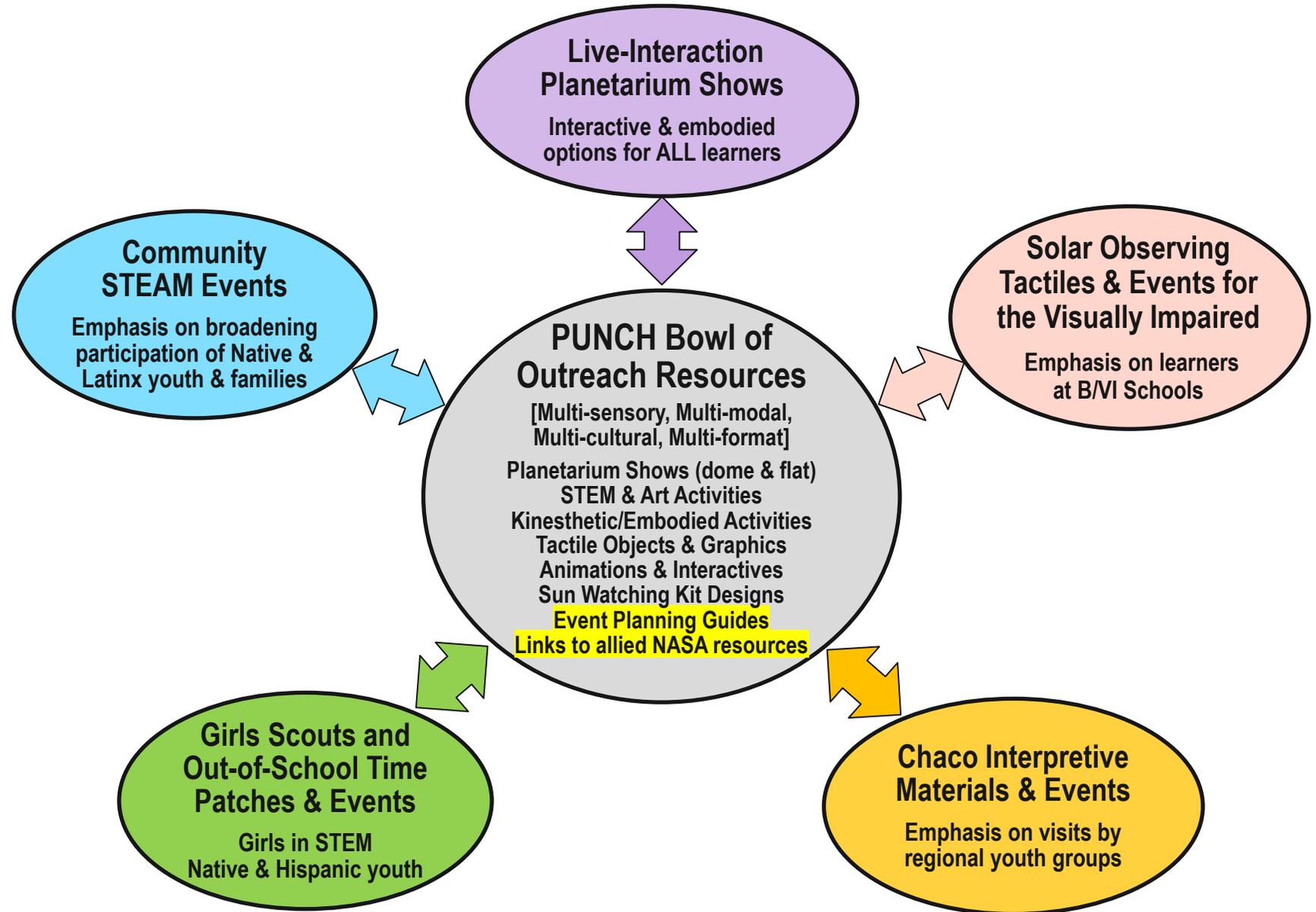
– **Phillip Tuwaletstiwa**, Hopi Elder (Episodic Advisor)

I am interested in the overlap of cultural significance and **NASA** science learning that is possible, including potential links to the Acoma **language revitalization project**, emphasis on our **ancestral connection to Chaco**, and increased understanding of the movement of the Sun through its cycles. **This project can provide a way for our Acoma students to experience NASA science and envision a future career in science, without losing touch with their culture.**

– **Joe Aragon**, STEM Educator (retired), **Acoma** Elder, Acoma Pueblo, NM (Advisory Board)

PUNCH public engagement events feature:

1. access to SMEs
2. arts integration
3. direct & indirect solar observing
4. multi-sensory activities (audio, visual, tactile, kinesthetic)
5. news and up-to-date information on mission milestones and discoveries
6. pathways to more enduring NASA options for STEM engagement including citizen science programs (e.g., Sungrazer)



Exploring the Artistry of PUNCH Scientists



Dr. Heather Elliott – SWRI San Antonio

The movement of the veils can represent features in the solar corona and solar wind. Dr. Elliot has expressed interest in contributing to our Girl Scout patch events and Community STEAM events.



Diverse Roles for Scientists in Outreach

“PUNCH needs a broader community of scientists to achieve its full potential”

PUNCH Outreach needs a community of scientists and outreach professionals to achieve its full potential.

Diverse roles for scientists and other SMEs in PUNCH Outreach

1. Facilitator of data access for planetarium show
2. Advisor, reviewer, or collaborator on outreach product development
3. Presenter, Artist, or Ask-a-Solar-Astronomer at **outreach event** for **Girl Scouts, Latinx/Native Americans, Blind/ Visually Impaired, Chaco visitors**
4. Solar telescope operator at outreach event
5. Episodic advisor for Girl Scouts earning a Sun-watching patch
6. Interviewee for Scientists as Hobbyists and Artists (Sci-HArt) series
7. Professional developer of outreach team in heliophysics
8. Leadership that encourages outreach participation

Please contact me with your interest in contributing to PUNCH Outreach



PUNCH Outreach Plan – Science Team Enthusiasm!

Survey of PUNCH Science Team (N=30) 1-3 June 2020	I love to teach	I love to communicate my science to diverse audiences	I enjoy being a resource for the news media
% who “Agree” or “Strongly Agree”	> 60%	> 85%	> 65%

PUNCH is providing an environment where an integrated program of outreach can THRIVE



PUNCH Outreach Plan – a thematic approach

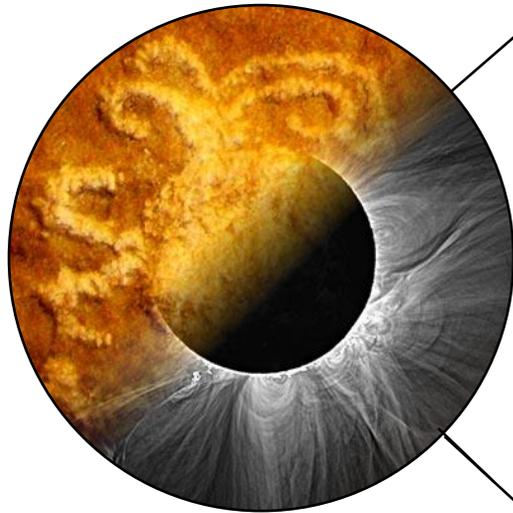
- Phase B planning process began in March 2020
- Surveyed Science Team regarding outreach interests and experience in June 2020
- Built a strong regional team with national partners
- 5-year plan **submitted to NASA** on 19 November 2020 for consideration
- Aiming to execute the outreach plan **in sync with Phases C/D** of the PUNCH mission
- Plan takes full advantage of the upcoming eclipses as “hooks to heliophysics”, but all products and events to be of **enduring value**.
- Strong emphasis on realizing the benefits of an outreach project closely **integrated with a mission** *but not focused exclusively on the mission*. [The plan calls for evaluation & documentation of how well we accomplish this for **peer review**].



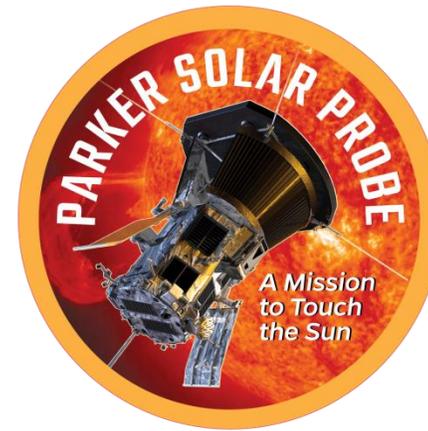
Ancient & Modern Sun Watching Theme

Integrating an Outreach program within a NASA mission is not a new idea, but our plan offers a powerful new approach to it.

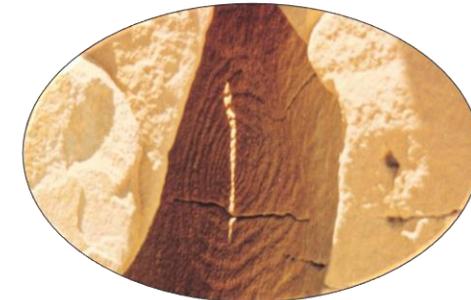
Elements of the Ancient & Modern Sun Watching Theme



NASA Heliophysics Missions



Ancient Sun Watching in Chaco Culture NHP



Personal Sun Watching in modern times

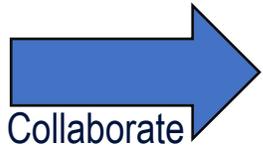


I greatly appreciate the Ancient and Modern Sun watching theme you have chosen and that you will be encouraging children to observe the sunrise and sunset. The Dine' people honor the Sun (Johonnaa) I see using the context of a **NASA** mission to explore the Sun interwoven with cultural traditions as beneficial.... – **Verna Tallsalt**, Navajo Culture & Language Consultant

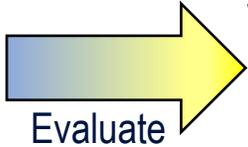


PUNCH Outreach
*Shining a Light on Diverse Views
of the Sun with an Ancient &
Modern Sun Watching Theme*

INPUTS



**OUTREACH
ACTIVITIES**



**OUTPUTS &
OUTCOMES**

**EIGHT GUIDING PRINCIPLES
for the PUNCH OUTREACH PLAN**

PHASE B ACCOMPLISHMENTS
Partners: POCC & POCA + Evaluator
PUNCH Scientists: Outreach Interests
Theme: Ancient & Modern Sun Watching
Advisory Board: Inclusive Representation
NASA links: 5 Sci Acts, Heliophysics Comms
Science + Outreach: SWRI-PUNCH Website

**Objective 1:
Support SME
Engagement**

**Objective 2:
Enhance
Partnerships**

**Objective 3:
Create
Products**

**Objective 4:
Convene
Events**

**Objective 5:
Disseminate
Strategically**

**NASA &
Societal
Benefits**

**More diverse
public engagement
in heliophysics**

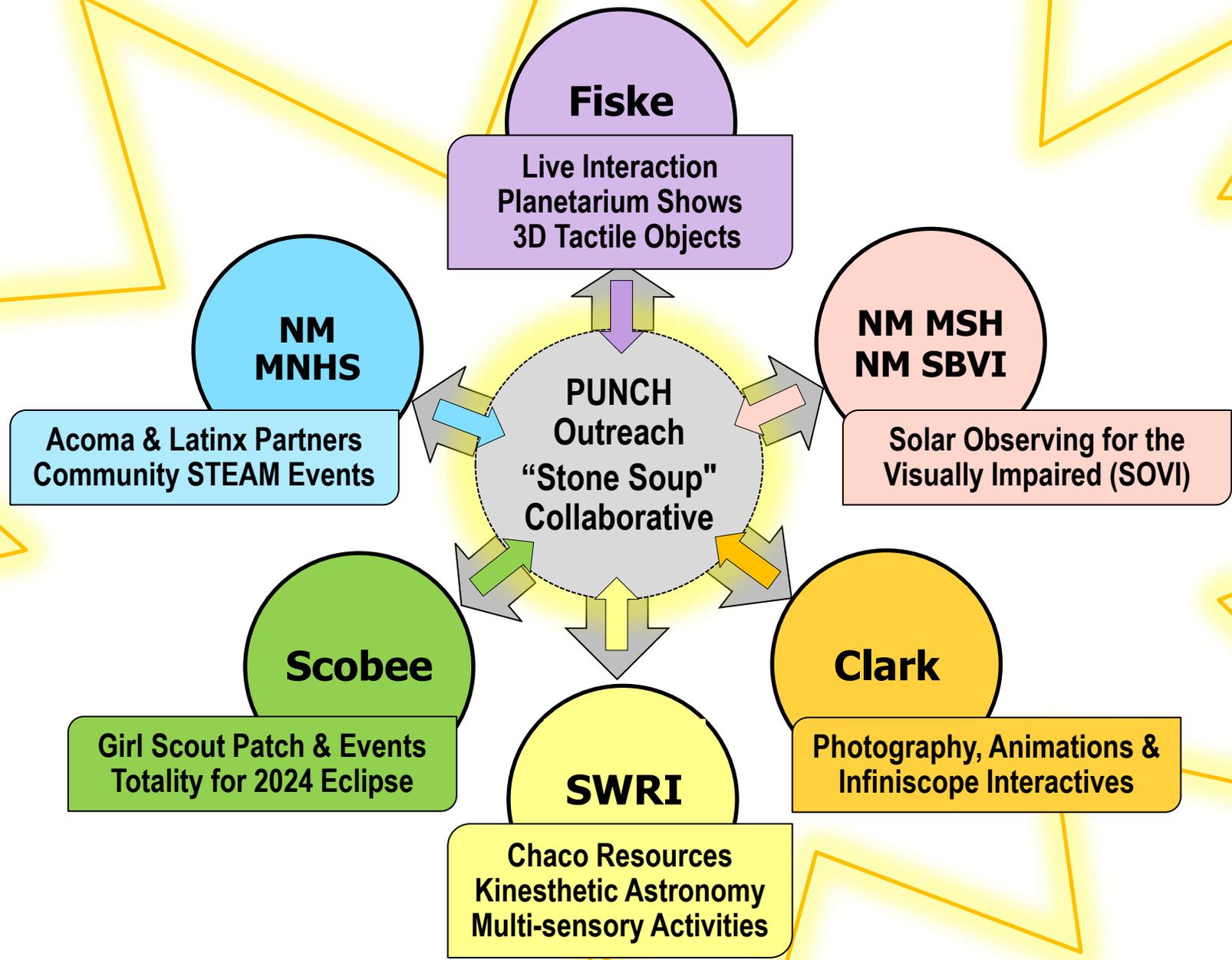
OVERARCHING GOAL for PUNCH OUTREACH
To leverage the PUNCH mission to inspire historically marginalized youth in the Southwestern US to learn about NASA heliophysics in ways that honor their identities related to culture, gender, and disability, and thereby increase their confidence and consideration for pursuing STEM career pathways.

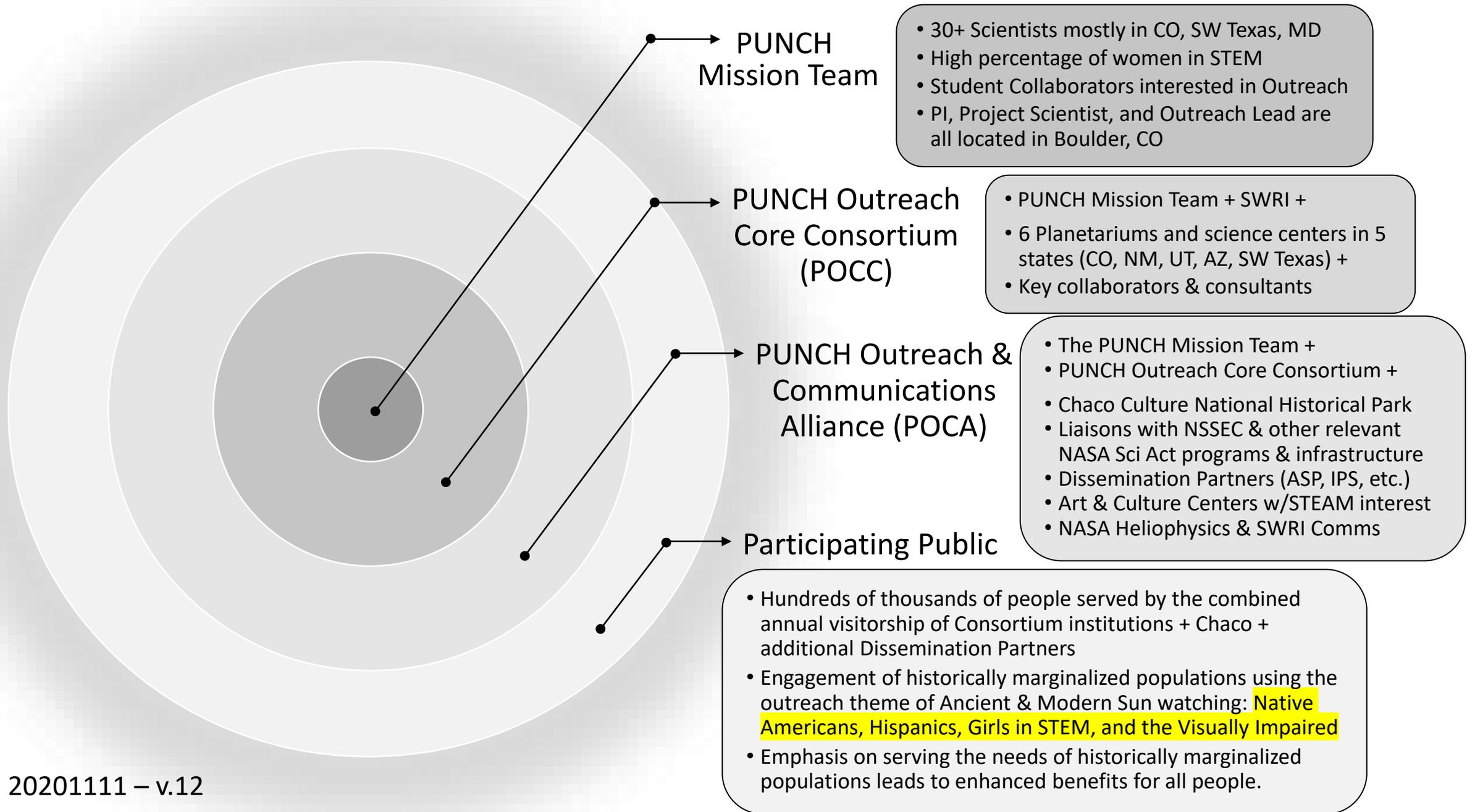


The PUNCH Outreach Consortium

[POCC, pronounced "pock"]

SWRI + Six Outstanding Outreach institutions in the US Southwest





PUNCH Mission Attributes: Science, Data, People	Effects on Outreach: Participants, Partners, Products
<p>1. The home base of the PUNCH mission is the Southwest Research Institute (SWRI). The PI and the OCL are committed to leveraging the mission to benefit the diverse people of the Southwest and beyond.</p>	<ul style="list-style-type: none"> • Emphasize underserved and/or underrepresented populations in the Southwest: Native American and Hispanic/Latinx youth & families. • Choose outreach partners with access to (and existing partnerships with) these populations in the Southwest • Leverage Dr. Morrow's development and use of embodied activities in arts-integrated, culturally relevant outreach programs for Navajo teachers & Chaco visitors.
<p>2. PUNCH data is imagery of the solar wind features in unprecedented detail with physically meaningful transitions in visual texture of the solar wind.</p>	<ul style="list-style-type: none"> • Make a planetarium show a primary outreach product • Choose planetariums as organizational partners • Add B/VI learners as a focus & tactile graphics as products
<p>3. The PUNCH science team has a high percentage of women in any NASA mission (~25%, 8/32)</p>	<ul style="list-style-type: none"> • Make Girls in STEM a focus of the Outreach plan due to the potential source of Women-in-STEM role models • Add an Ancient & Modern Sun Watching Challenge Patch for Girl Scouts plus patch-earning events
<p>4. PUNCH studies the Sun's corona and heliosphere and will be observing during a time of high solar activity (Cycle 25 maximum predicted between 2023 and 2026)</p>	<ul style="list-style-type: none"> • Link to "eclipse" petroglyph in Chaco Culture NHP where Dr. Morrow has served as volunteer for >10 yrs. The rock art may be humanity's first recording of a CME disrupting the corona during the total eclipse of 1097. Solar max ~1098. Infuse NASA content in Chaco interpretive materials. • Use the 2023 and 2024 solar eclipses as outreach milestones. Plan events using them as hooks to heliophysics. • Link the solar corona people can see to NASA missions – the region of space PUNCH is observing & PSP is flying in.

The choices of outreach **participants**, **partners**, and **products** for the PUNCH Outreach Plan have been strongly influenced by the attributes of the PUNCH mission: **science, data, and people** as well as the strengths and interests of the Outreach Lead and the Principal Investigator.

Dr. Cherilynn Morrow

PUNCH Outreach & Communications Lead (SwRI Consultant)



This is Cherilynn in Chaco Culture National Historical Park – a World Heritage site in northwest New Mexico. Her hair is grayer now, but she loves this photo so much she'll probably never stop using it. **Cherilynn has worked as a volunteer interpreter and/or archaeoastronomy research assistant in Chaco for 15+ years.**

Since March 2020, Cherilynn Morrow has been happily under contract with SwRI to build an Outreach Team and lead the development of an Outreach plan for the PUNCH mission.

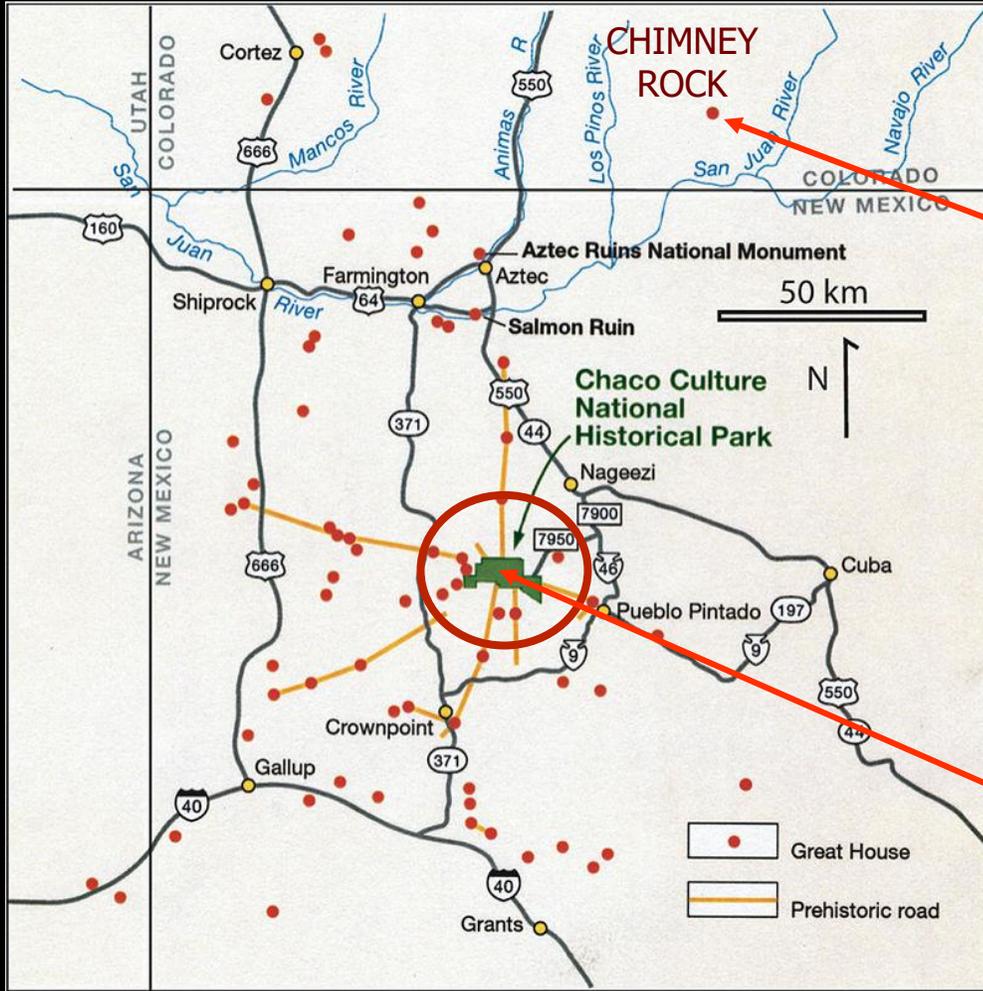
She is an award-winning space science educator and a **solar physicist by training** (PhD, 1988 CU/NCAR/HAO). She worked for more than a decade with NASA and NSF on the effective **integration of education and public outreach (EPO) programs in scientific research environments**, including space science missions. She has facilitated dozens of workshops for scientists in education, led the pioneering AGU SPA EPO Committee for 4 years, and co-chaired an Education & Human Resources subcommittee with Mark Moldwin in support of the 2013-2023 Heliophysics Decadal Report.

She is lead developer of ***Kinesthetic Astronomy*** – a widely adopted, embodied approach to teaching & learning 3-D astronomical concepts. She also sings “Stormy Weather – Solar Style” as part of her *AstroJazz* repertoire and her love for **integrating the arts** in STEM education (STEAM). She has guided **hundreds of multi-sensory programs for visitors to Chaco Culture NHP** and facilitated **dozens of cross-cultural STEM programs for Native American learners.**



Chaco has been a pioneer among National Parks for its consultations with 21 affiliated “tribes” in the 4-corners region, including Hopi, Zuni, Navajo, and Apache.

It is a ready topic of “cultural relevance” to the descendants of Ancestral Puebloan people and other Southwest Indians in the 4-corners region.





I'm using the real setting Sun to teach about the Phases of the Moon to an Apache family before the 2012 annular eclipse "Moon Walk" Program in the east plaza of Pueblo Bonito. The Sun set partially eclipsed.

The PUNCH Outreach plan includes a similar program for the October 2023 Annular Eclipse, only this time with full dome photography.

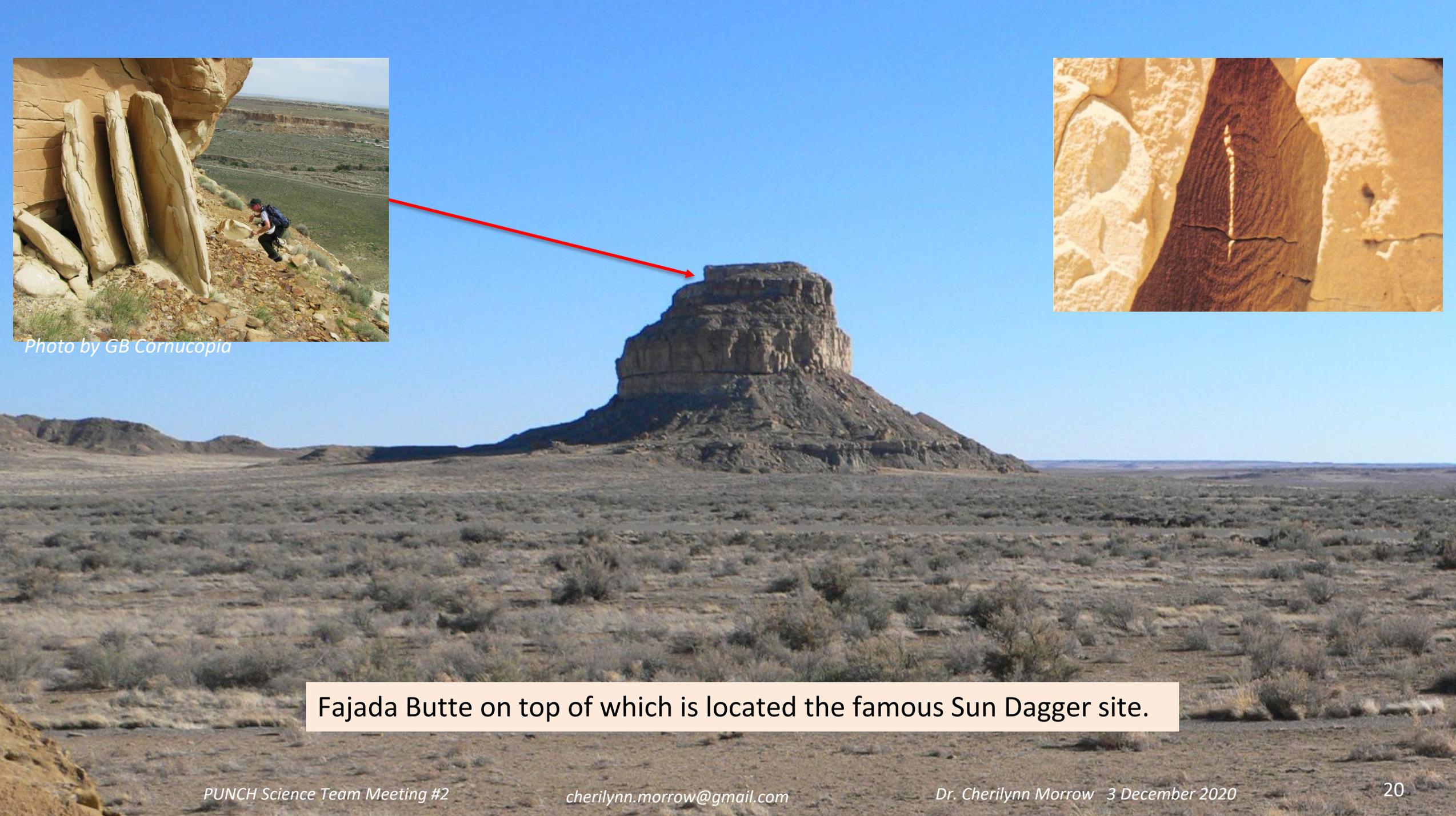
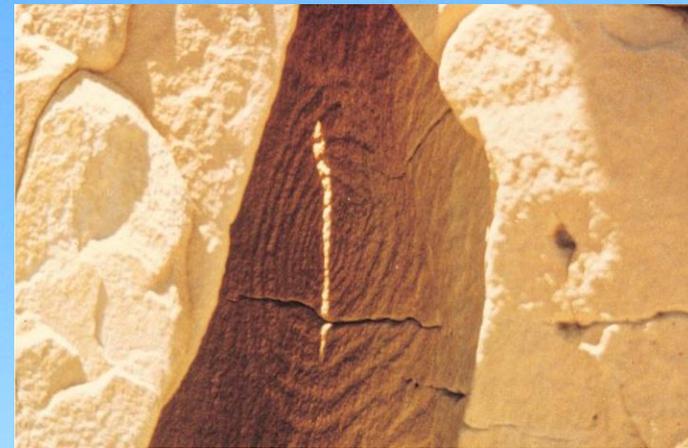


Photo by GB Cornucopia





Photo by GB Cornucopia



Fajada Butte on top of which is located the famous Sun Dagger site.



The view from a pecked spiral on the eastern facet of a rock complex known as 29SJ514 near the Chaco Visitor Center



This is 5 June 2008

A striking sunrise interaction occurs approximately two weeks prior to June solstice





5 June 2008

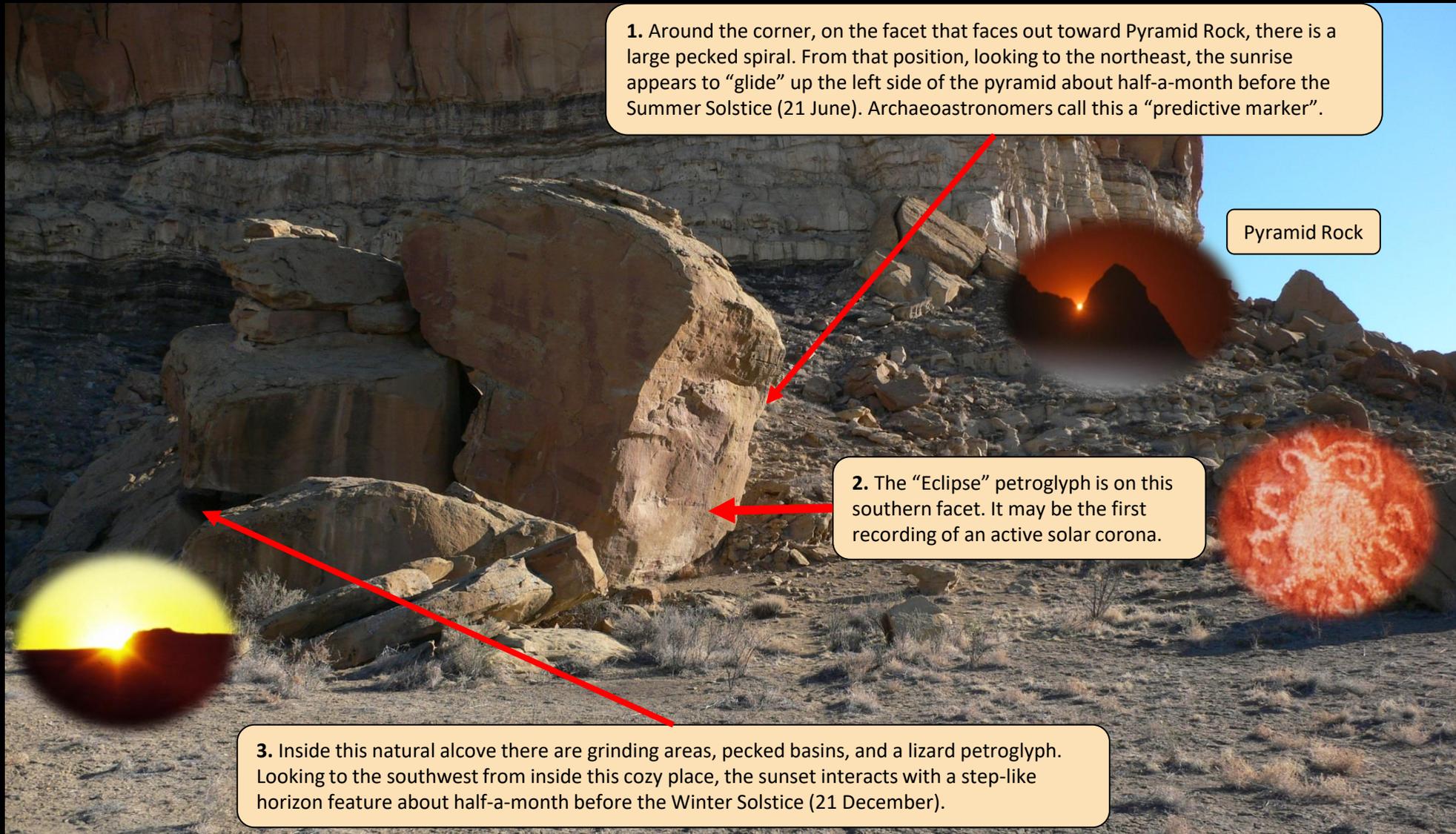
There is a data set 12 photos over ~ 11 minutes with uneven cadence



AERIAL VIEW of Chaco Visitor Center area. Red Circle is 29SJ514 or “514” for short – the Ancient Solar Observatory that is focus of our PUNCH Outreach efforts.

The Three Sun Watching Facets of 29SJ514

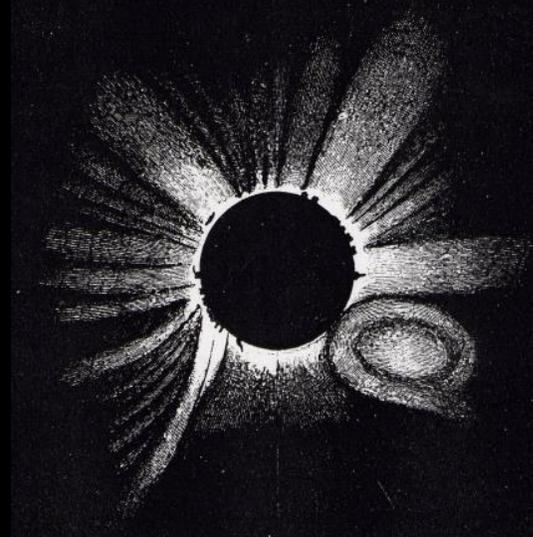
an Ancestral Puebloan solar observing site in Chaco Canyon, NM



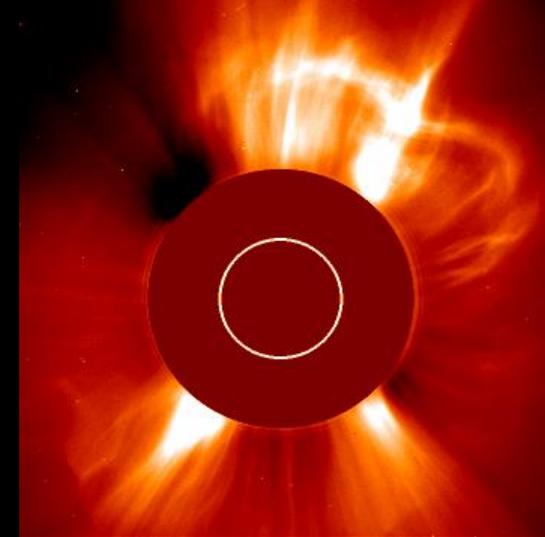
This Petroglyph is the Cross-cultural Portal for PUNCH Outreach



Ancestral Puebloan petroglyph in Chaco Canyon, interpreted to depict the **1097** total solar eclipse during high solar activity and a CME? 1098 solar max.

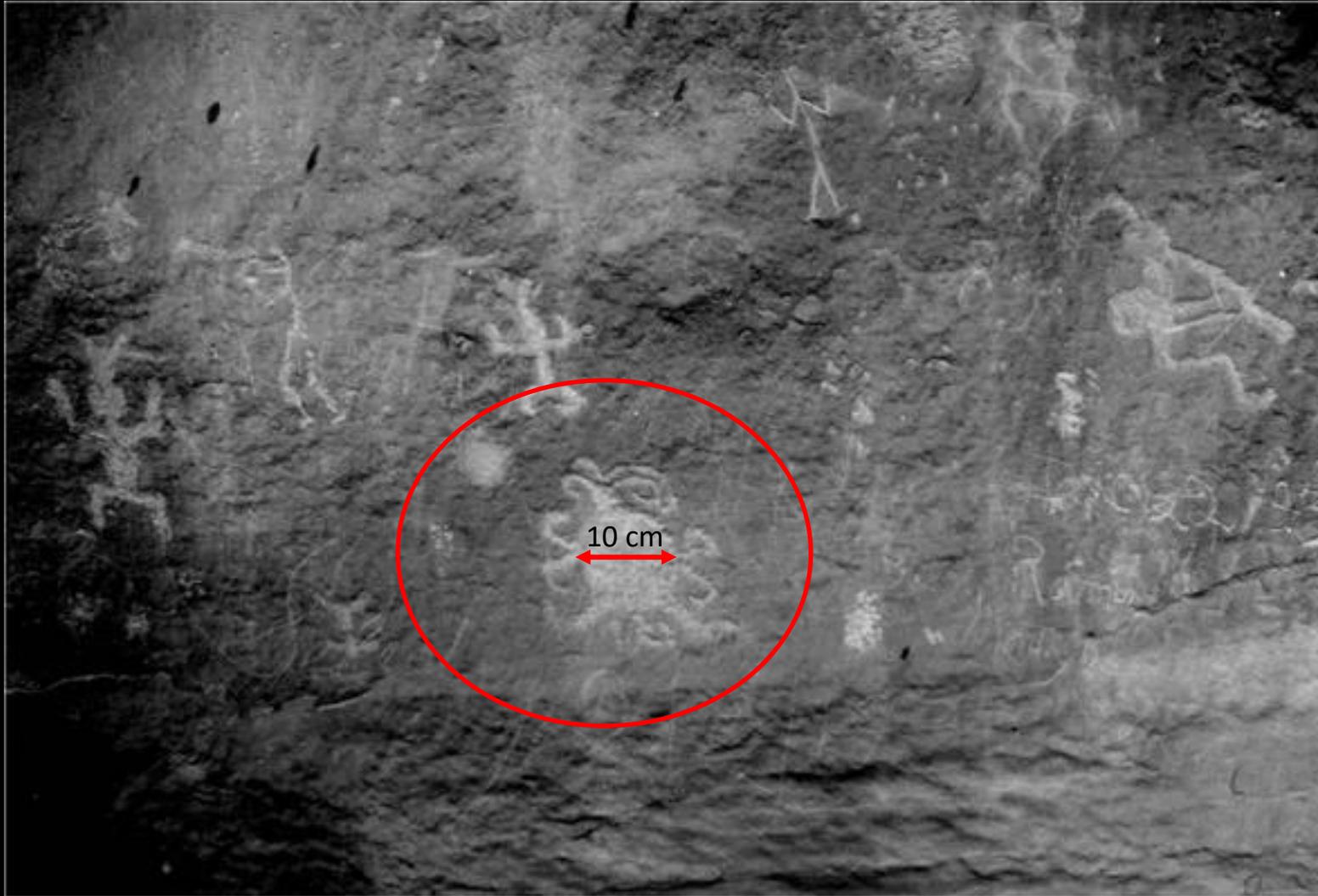


An **1860** drawing of a total solar eclipse from Spain (G. Tempel). Distortions of the striations were also rendered in other drawings.



2005 coronagraph image from the NASA SOHO spacecraft with a CME in progress. The white circle defines the solar disk.

<https://science.gsfc.nasa.gov/heliophysics/> - We can collaborate to update this video



The petroglyph is interpretable as a Chacoan representation of the 1097 total solar eclipse of the Sun during a time of high solar activity.

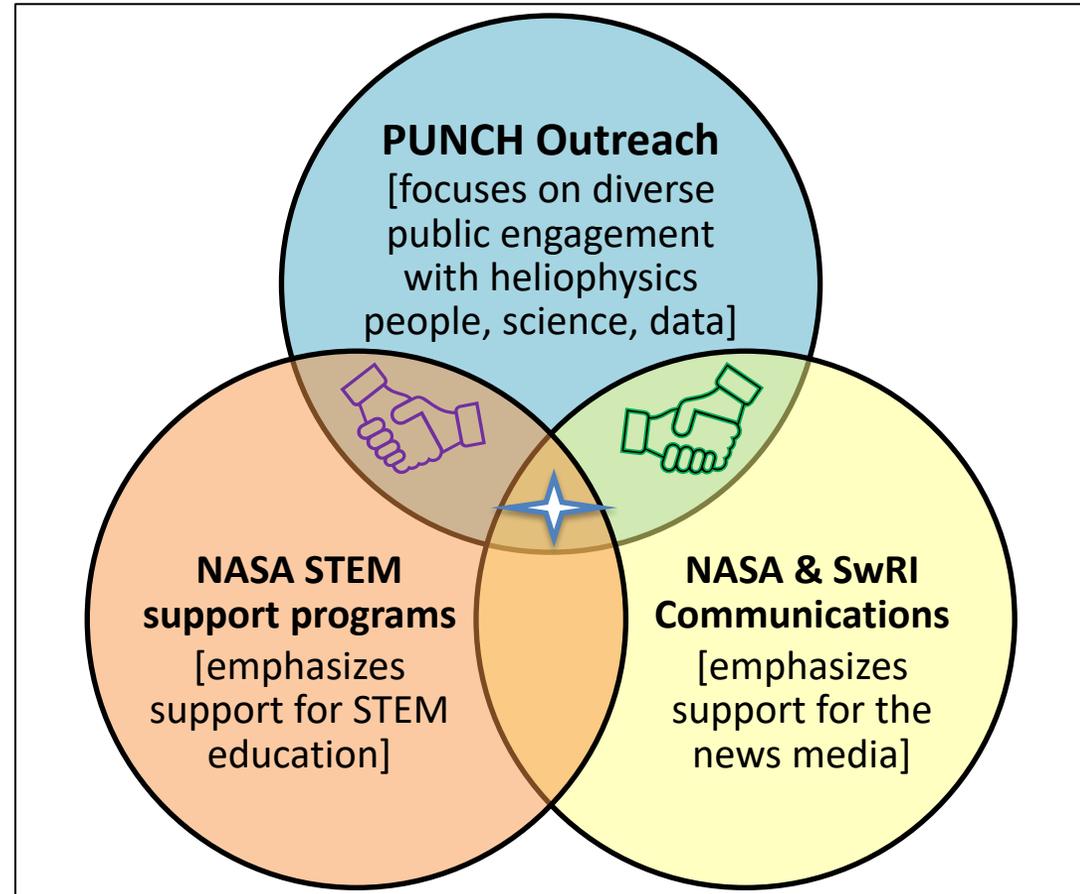
This Rock panel at the Chaco Solar Observing site “514” got a LOT of media attention leading up to the 2017 Eclipse (e.g. Scientific American podcast, Smithsonian article, and TV news).

It will be newsworthy again in companionship with the PUNCH launch between the 2023 annular eclipse and the 2024 total eclipse at a time of high solar activity.



Outreach = Public Engagement ≠ NASA Communications

- PUNCH Outreach serves as a **complementary bridge** between the work of newsworthy discoveries that NASA and SWRI Communications address and the more formal support of STEM education that NASA SMD sponsors via its Science Activation (Sci-Act) portfolio.
- PUNCH Outreach **leverages, complements, and seeks synergy** with these other important domains of activity.



PUNCH Outreach complements and supports the work of NASA Communications and other NASA-sponsored STEM efforts.



Polarimeter to UNify the Corona and Heliosphere

Home About Science Media Outreach

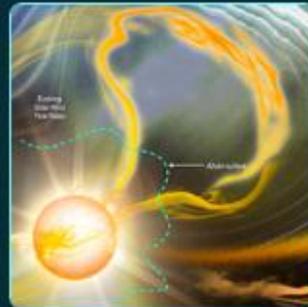
WHAT IS PUNCH?

PUNCH is a NASA Small Explorer (SMEX) mission to better understand how the mass and energy of the Sun's corona become the solar wind that fills the solar system. Four suitcase-sized satellites will work together to produce images of the entire inner solar system around the clock.



THE MISSION

Fast Facts About PUNCH and its Instruments



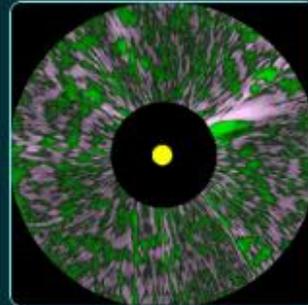
THE SCIENCE

A New View of the Corona and Heliosphere



GET INVOLVED

Science Outreach with PUNCH



USE THE DATA

Data Access and Analysis Tools

WHY PUNCH?

Every second, over 300 million tons of solar material streak outward into space in the solar system, in the form of the solar wind. It also causes the northern lights. It also affects our power grids, satellite communications, and GPS. PUNCH will track the solar wind to help us better understand its effects on humanity.

- Outreach Overview
- What Is Heliophysics?
- Outreach Team
- Support for Scientists
- Products and Presentations
- Inspiration for Science Learners

NEWS



- First PUNCH Public Science Meeting is on December 3, 2020
2020-10-14
- PUNCH First Science Team Meeting
2020-06-03
- PUNCH Passes System Requirements & Mission Design Review
2020-04-13

<https://punch.spaceops.swri.org/>

PUNCH is a mission in the NASA Small Explorers line



SOUTHWEST RESEARCH INSTITUTE



Southwest Research Institute
1050 Walnut St, Suite 500
Boulder, CO 80502

WHAT IS HELIOPHYSICS?

Related To: [PUNCH Science Objectives](#)

Heliophysics is the exploration of our star, the Sun, and how it influences Earth, space, and planets throughout the Solar System. Heliophysics research helps protect astronauts, spacecraft, and power grids here on Earth.

PUNCH scientists are heliophysicists who research the fundamental physics of the Sun and how it releases energy, magnetic fields, and solar storms that affect conditions (space weather) in interplanetary space. They are divided into Ambient and Dynamic features of the space between Earth and Sun.

Click the image labels or the expanding titles below to see more about each science topic.



Ambient Solar Wind

What is the solar wind?

What is solar wind turbulence?

What is the Alfvén Zone?

Dynamic Solar Wind

SCIENCE OBJECTIVES

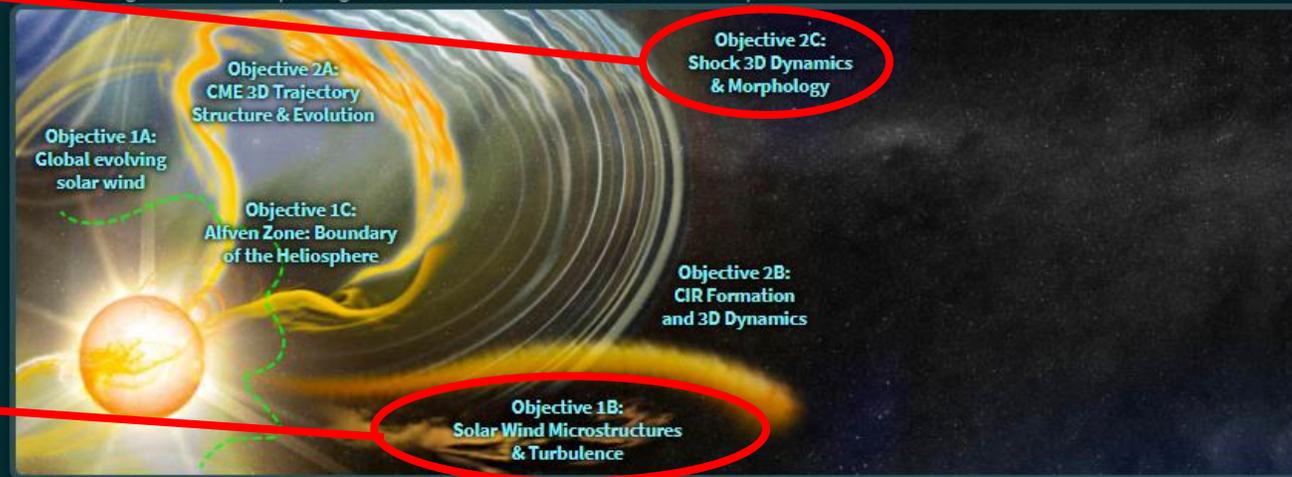
Background knowledge: [What is heliophysics?](#)

PUNCH advances the science of heliophysics. The PUNCH science goal is to determine the cross-scale physical processes that unify the solar corona with the rest of the solar system environment (the heliosphere). **The goal divides into two major science objectives:**

- Understand how coronal structures become the ambient solar wind.
- Understand the evolution of transient structures (such as CMEs) in the young solar wind.

These objectives divide into three specific science topics each, which shape the PUNCH investigation.

Click the image labels or the expanding titles below to see more about each science topic.



Objective 1: Ambient Solar Wind

1A: Global evolving solar wind

1B: Solar wind microstructures and turbulence

1C: Alfvén Zone: Boundary of the Heliosphere



In closing....

PUNCH Outreach will positively affect hundreds of thousands of people in the 5-year period of PUNCH funding, and vastly more people as our sustainably designed products and event planning guides are used for many years afterward. The proposed work will also leave a legacy of interconnection and new institutional capacities of ongoing benefit to NASA's public engagement goals, even after the PUNCH mission is complete.

PUNCH Outreach will leave a legacy of products, event planning guides, and partnerships that endure!



Please take a few minutes to complete our short survey

2. What are your interests in PUNCH? (check all that apply and leave comments if desired.)

- come to the science meetings and learn about/present PUNCH related science
- help guide development of data products (by letting us know what you need for your science)
- help contribute to development of data products (by collaborating on analysis techniques)
- use the data when it becomes available
- contribute to outreach activities
- other (please describe in comments)

Comments:

4. What did you value most about this meeting?

5. What ideas or suggestions do you have for PUNCH science?

6. What ideas or suggestions do you have for PUNCH outreach?

https://www.surveymonkey.com/r/2020DEC_PUNCH_ScienceTeam