



Visuals to Support the PUNCH-CATE 2024 Outreach Collaboration

Slides:

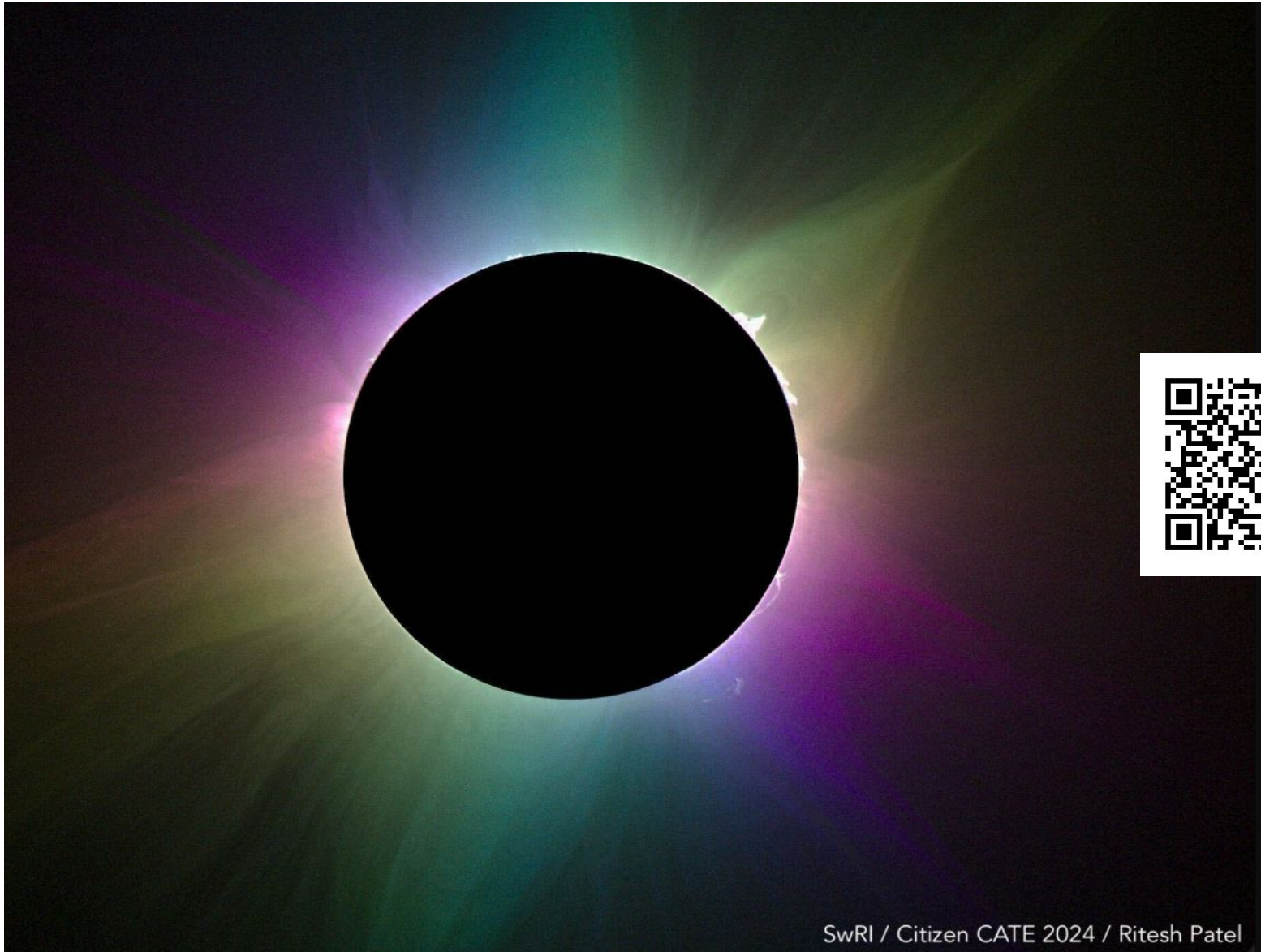
1. Title and Table of Contents
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3. One-slide summary of the NASA PUNCH mission
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The Light of the Solar Corona is Polarized

The colors represent differences in polarization



SwRI / Citizen CATE 2024 / Ritesh Patel





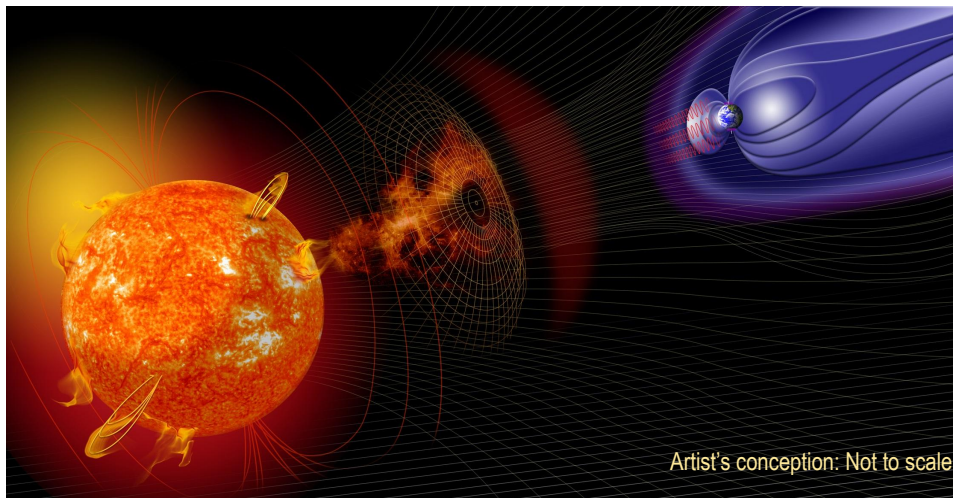
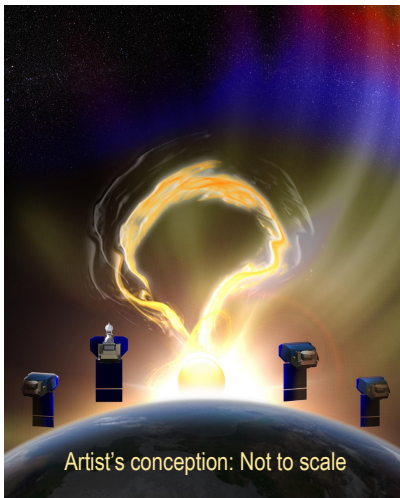
The NASA PUNCH Mission



PUNCH = Polarimeter to Unify the Corona and Heliosphere

PUNCH studies the Sun and the space between Sun and Earth as one *UNIFIED* system.

PUNCH studies the Sun's outer atmosphere (called the solar *CORONA*) and how it expands to become the "solar wind" that fills the space between Sun and Earth (called the inner *HELIOSPHERE*).



PUNCH uses *POLARIZED LIGHT* to study the science of "Space Weather." Its four cameras (each one on an Earth-orbiting satellite) combine to track solar storms better than ever before!

Activity CONNECTION: *What's the P in PUNCH?*

- * PUNCH is designed to study bursts of particles streaming away from the Sun like solar storms and other space weather features.
- * When particles (electrons) scatter sunlight the waves of light become aligned in a particular way. We call this polarized light.
- * By measuring how much the light is polarized using a *POLARIMETER*, PUNCH scientists can make a 3D map of a particle burst
- * The polarimeter in each PUNCH spacecraft has polarizing filters (similar to polarized sunglasses) in front of ordinary digital cameras.
- * The amount of light that can be seen through these filters reveals how much the light from space weather features is polarized.
- * You can see how this works by using polarized sunglasses to detect whether a source of light (e.g. computer screen) is polarized.

Activity: *What's the P in PUNCH?*

Contact: punchoutreach@gmail.com





How are PUNCH and CATE 2024 Related?

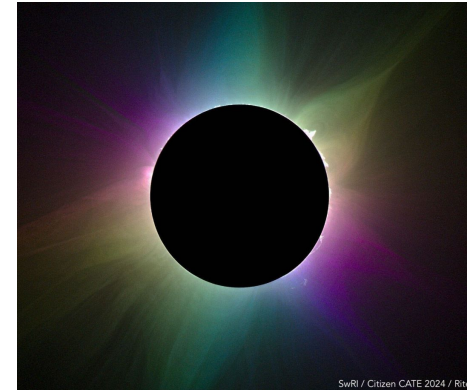


PUNCH

punch.space.swri.edu



1. The NASA **PUNCH** mission uses four Earth-orbiting satellites to observe the outer solar corona and inner heliosphere between Sun and Earth.
2. **CATE 2024** is an NSF and NASA-supported network of 35+ teams using ground-based telescopes distributed along the path of totality to observe the inner corona.
3. Both **CATE 2024** and **PUNCH** examine the solar corona in polarized light, which allows us to measure its complex 3D structure.
4. Both **CATE 2024** and **PUNCH** study the origins of the solar wind that streams out of the Sun to fill the Solar System and defines the heliosphere.
5. **CATE 2024** takes advantage of a total solar eclipse to look much closer to the Sun than we can normally see, even with existing instruments in space.
6. **PUNCH** can routinely observe much farther from the Sun than the corona we see during an eclipse.
7. The data from both **CATE 2024** and **PUNCH** can be used to detect changes in their fields of view (which could be) due to solar storms.



CATE 2024

eclipse.boulder.swri.edu





Observing Polarized Light in the Solar Corona

A one-slide guide for eclipse-knowledgeable facilitators only



CAUTION! Use of polarized glasses is safe *ONLY* during totality.

- ☀ During totality **ONLY** (and at no other time) invite observation of the solar corona through the polarized lenses.
- ☀ Use a digital timer or an eclipse-timer phone app to alert you just before the end of totality.**
- ☀ Warn everyone in the group to stop observing before totality ends — *before* any light of the Sun’s disk re-appears.
- ☀ To avoid confusion, do not loan polarized glasses until totality begins. Be sure to collect just *before* totality ends.
- ☀ Rotate the lenses clockwise 90° and back to look for any changes in brightness and structure in the Sun’s corona.

What’s safe to wear during the eclipse



View the eclipse with special eclipse glasses.



Regular sunglasses are not safe to view the eclipse.



Regular sunglasses are not safe to view the eclipse.



View the eclipse with special eclipse glasses.

Partial Eclipse Phases

Partial Eclipse Phases



Totality

** *Solar Eclipse Timer*, by Foxwood Astronomy is available for both iPhone and Android

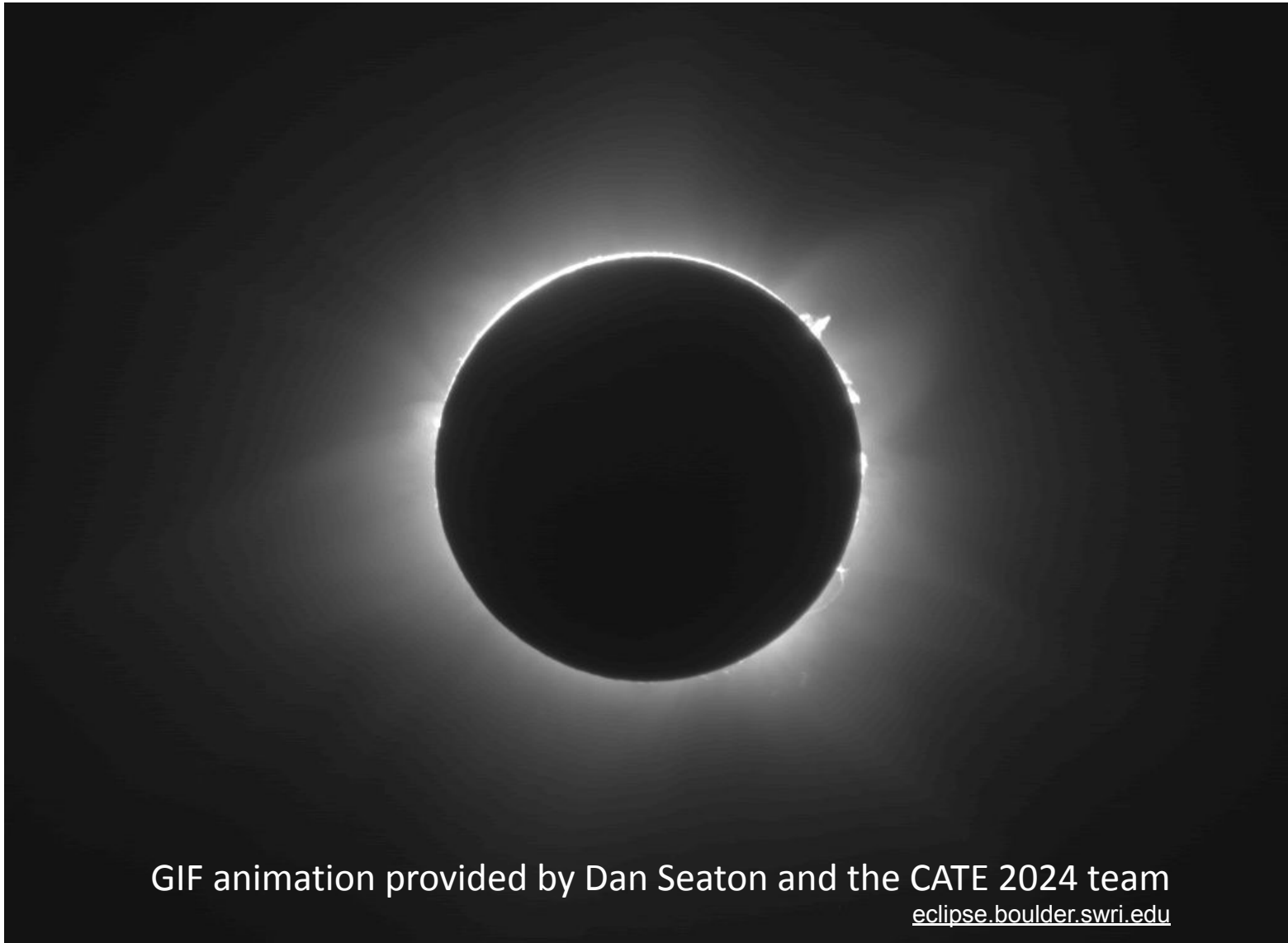
Activity: PUNCH-CATE 2024 Outreach Collaboration

Email: punchoutreach@gmail.com and cate@boulder.swri.edu





A GIF animation of how the corona may appear to change when rotating polarized glasses by 90°



GIF animation provided by Dan Seaton and the CATE 2024 team
eclipse.boulder.swri.edu





For Your EYE Safety Know Which Glasses to Wear When

Solar Protection (“Eclipse”) Glasses
Use these during all partial eclipse phases

PUNCH Polarized Glasses
Use these to observe the corona during TOTALITY ONLY





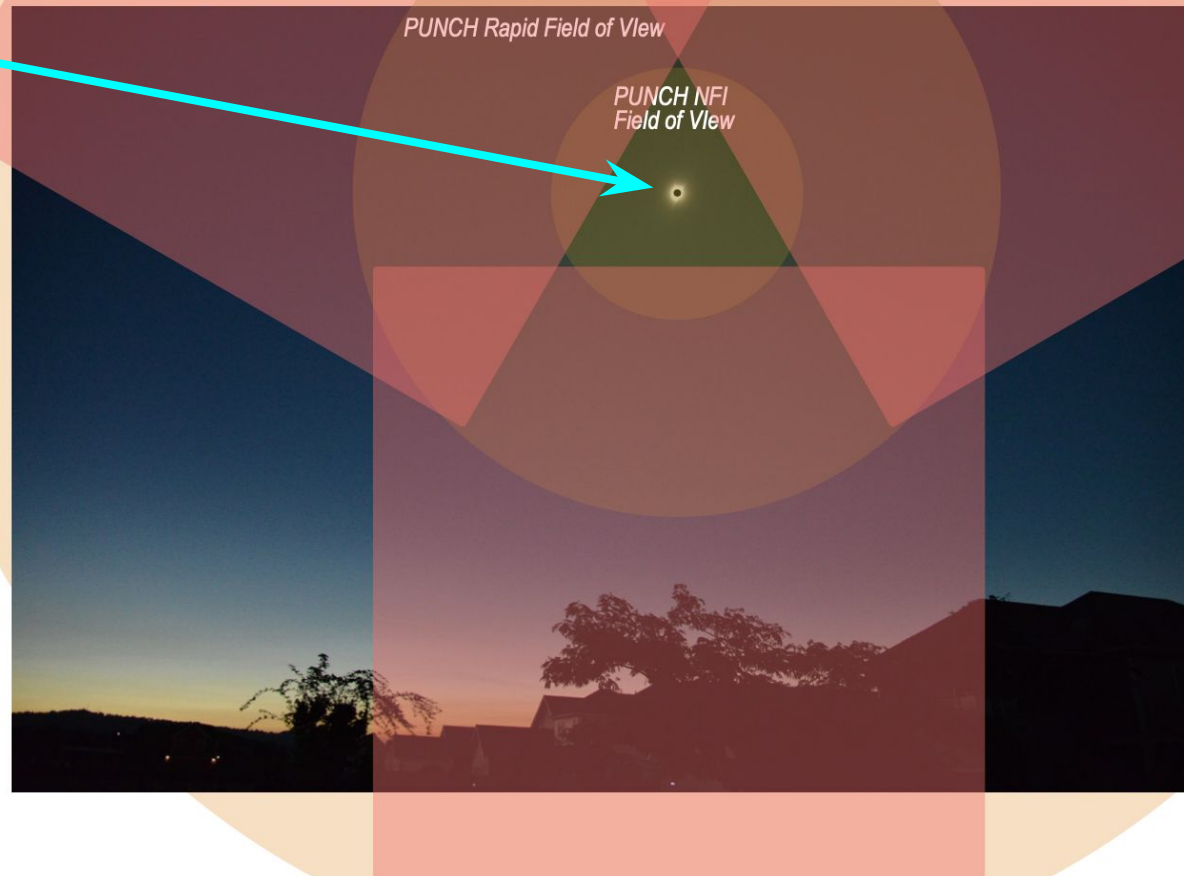
The PUNCH Field of View Compared to What We See During a Total Solar Eclipse



The 2017 total solar eclipse at totality



Overlay by PUNCH Principal Investigator Craig DeForest. Original image of 2017 eclipse at totality by PUNCH Mission Scientist Nicki Viall





Polarized Light in Everyday Environments

Use polarized sunglasses to find polarized light!

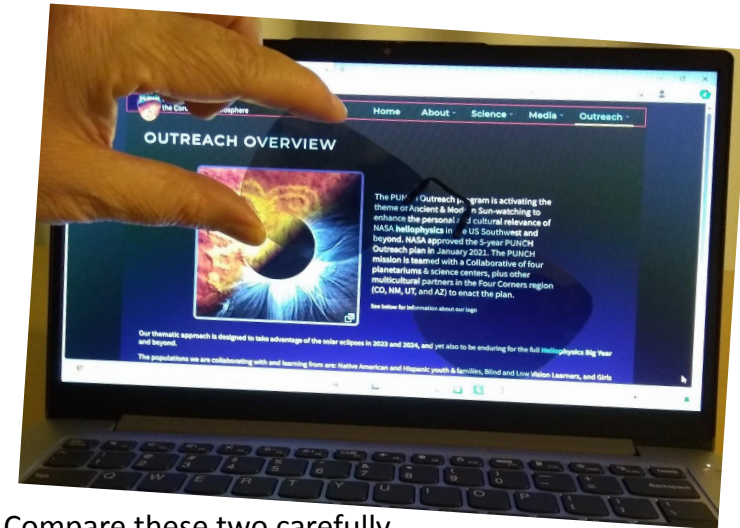


THE SIMPLE TEST:

If the brightness changes dramatically as you rotate a polarized lens, then the light source is strongly polarized (e.g., the light from a computer screen).

Indoor Sources of Polarized Light

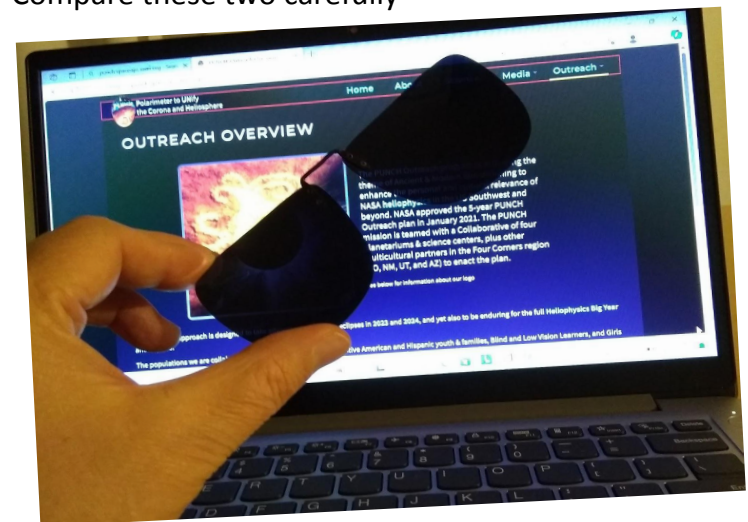
- A. **Light reflected off of a shiny surface**
(e.g. shiny tabletop or floor, glass picture frame)
- B. **LCD screen**
(e.g. computer, TV, cell phone - see demo at right)



Compare these two carefully

Outdoor Sources of Polarized Light

- A. **The solar corona during totality**
(ONLY visible during the totality phase of a solar eclipse)
[For safety this activity requires facilitation by an eclipse expert]
- B. **Sunlight scattered by air molecules**
(at different directions relative to the Sun)
[Requires facilitation by an adult who knows safe solar viewing practices]
- C. **Reflections off of water, snow, shiny surfaces**
- D. **Rainbows**
(polarized along direction of the arc)



Activity: *What's the P in PUNCH?*

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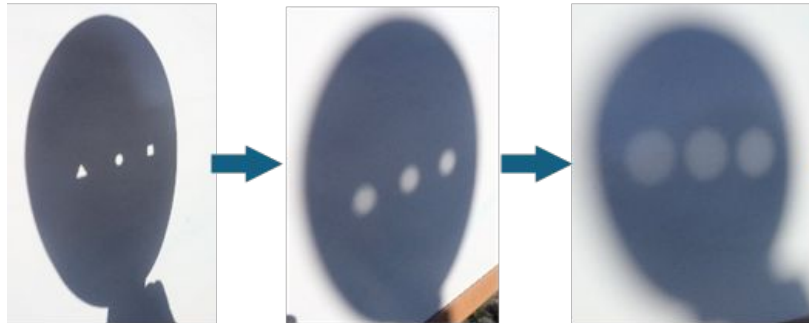


Facilitating Powerful Learning Experiences Using the *3-Hole-PUNCH* Pinhole Projector



We strongly recommend viewing our short videos to prepare you to maximize delight, curiosity, and wonder for yourself and your learners!

tinyurl.com/PUNCHOutreachPinholeVideos



The 3 "AHA" Transitions



Activity: *Pinhole Magic - Indoors and Outdoors*

BAAS Journal article on PUNCH Outreach Products
DOI: [10.3847/25c2cfcb.25cd07d9](https://doi.org/10.3847/25c2cfcb.25cd07d9)

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