



Welcome to Section 2:

Observing Pinhole Images of the Sun in Our Everyday Environments



Scan here to access all PUNCH Outreach products or visit:
https://punch.space.swri.edu/punch_outreach_products.php

For questions or to request our 1-page monthly newsletter:
Contact PUNCHOutreach@gmail.com

Photo: Alan Friedman



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[Really] Understanding Pinhole Projection of the Sun



Follow along with our playful learning adventure!

And **PLEASE** give us
feedback on these questions
at the link below:

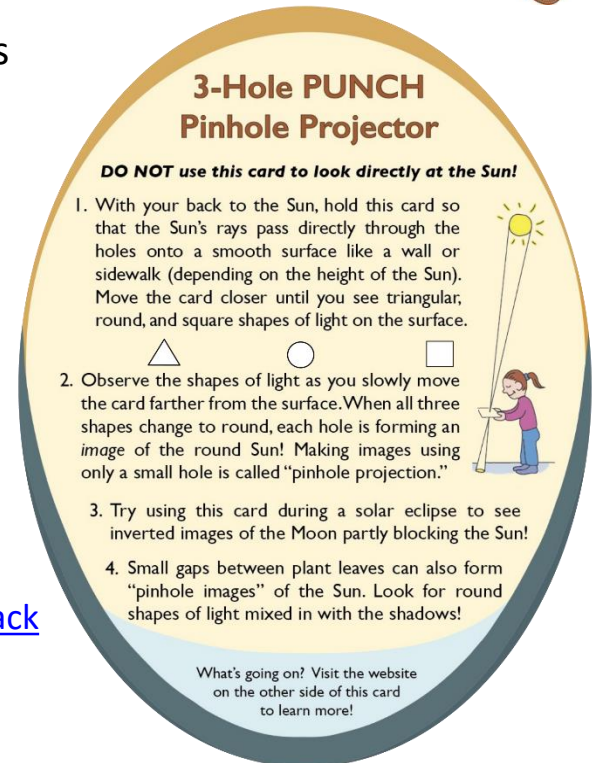
- Insights gained?
- Remaining questions?
- Ideas for improvements?



<https://tinyurl.com/PinholeFeedback>



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MARK 3 Version
Final Release for use up to
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Essential viewing:

[6-minute "how-to-facilitate" video](https://punch.space.swri.edu/punch_outreach_pinholeprojector.php)


[https://punch.space.swri.edu/punch_outreach_pinholeprojector.php]



 Polarimeter to UNify
the Corona and Heliosphere

Home About Science Media Outreach

3-HOLE PUNCH PINHOLE PROJECTOR



The PUNCH Outreach team designed the 3-Hole PUNCH Pinhole Projector (3HPPP) so that everyone can experience and explore the wonder of how a small, lens-less hole of any shape works to create real images of the Sun or other bright light sources, both indoors and outdoors.

Image credit: Vivian White

Our projector allows you to observe the Sun safely during eclipses or on any sunny day!

The 3HPPP is NOT your ordinary pinhole projector nor a simple give-away like a sticker or button, but a powerful learning tool when safely and effectively facilitated.

This **6-minute "how-to" video** shares what we've learned about how to facilitate use of the 3HPPP to excite a lifetime of curiosity and wonder in learners of all ages.



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Introducing Bhanu

[BAH-noo]

Bhanu means
“ray of light”
in Sanskrit

Bhanu helps guide our way through these Sections. You are in **Section 2 of 5.**

Section	Title of Section	Description of Section
1	How to Use the 3-Hole PUNCH Pinhole Projector	introduces the 3-Hole PUNCH Pinhole Projector, demonstrates how to use it both outdoors and indoors, and describes its differences from a pinhole camera/viewer.
2	Observing Pinhole Images of the Sun in Our Everyday Environments	teaches you how to <u>observe the phenomenon</u> of pinhole images of the Sun in our everyday world, both indoors and outdoors.
3	Exploring Pinhole Projection Using Your Own Hands	invites you to <u>explore the behavior</u> of pinhole projection by experimenting with your own hands (try both palms up!)
4	Explaining and Understanding How Pinhole Imaging Happens	interactively guides your <u>quest for explanations</u> and deeper understanding of how pinhole imaging happens. After this, you will <i>really</i> understand why small, lens-less holes can create images.
5	APPENDICES A-E: More Insights & Fun Resources	offers <u>more insights & resources</u> (e.g., explaining the relationship between pinhole images and the view through “eclipse” glasses)

CONTACT:

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



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Pinhole Projection of the Sun



2. Observing Pinhole Images of the Sun in Our Everyday Environments



Bahnu says: Be alert to seeing pinhole images of the Sun every sunny day! The leaves in bushes and trees are like Nature's camera but almost nobody notices. Learn to see this wonder hiding in plain sight and help others to see it too!

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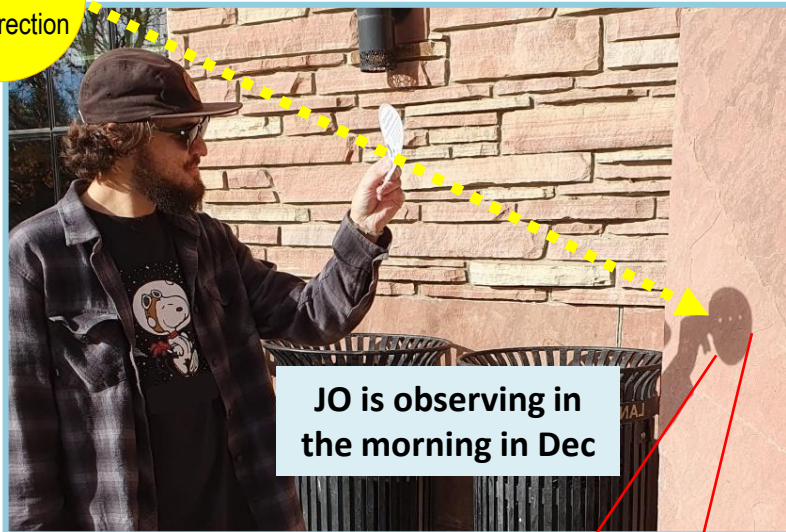


Pinhole Projection of the Sun

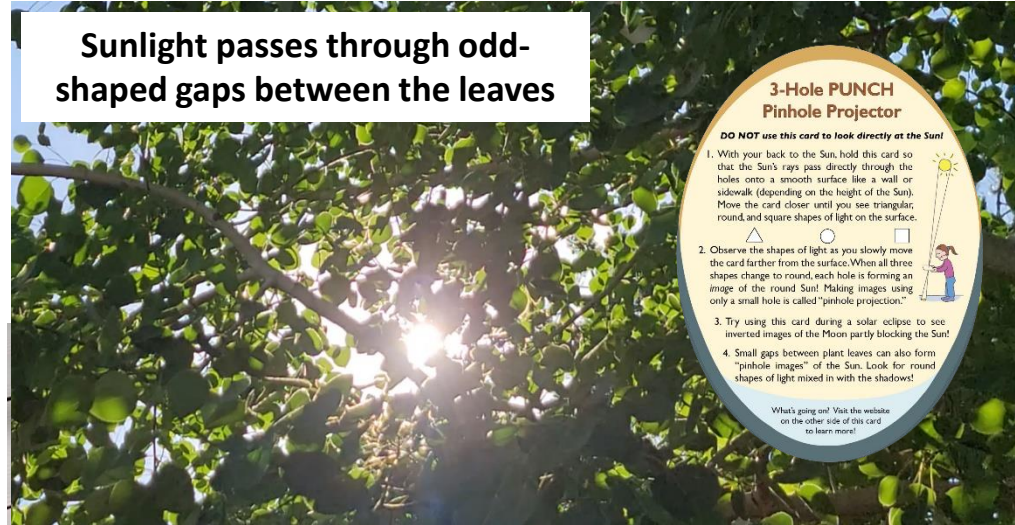


Gaps between leaves are like the “pinholes” of our projector, and even these odd-shaped gaps create round images of our sun!

Sunlight comes from this direction



JO is observing in the morning in Dec



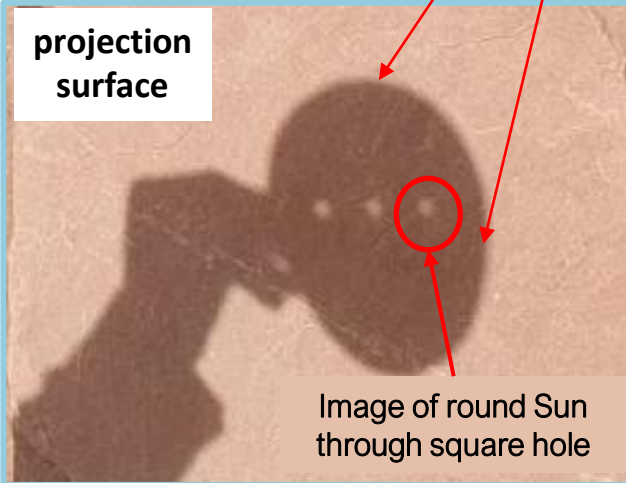
Sunlight passes through odd-shaped gaps between the leaves

3-Hole PUNCH Pinhole Projector

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

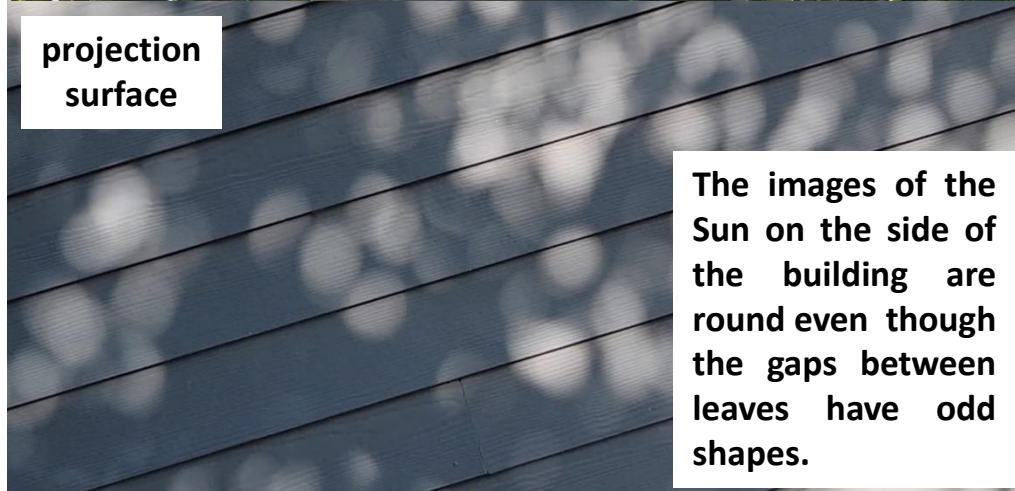
1. With your back to the Sun, hold this card so that the Sun's rays pass directly through the holes onto a smooth surface like a wall or sidewalk (depending on the height of the Sun). Move the card closer until you see triangular, round, and square shapes of light on the surface.
2. Observe the shapes 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



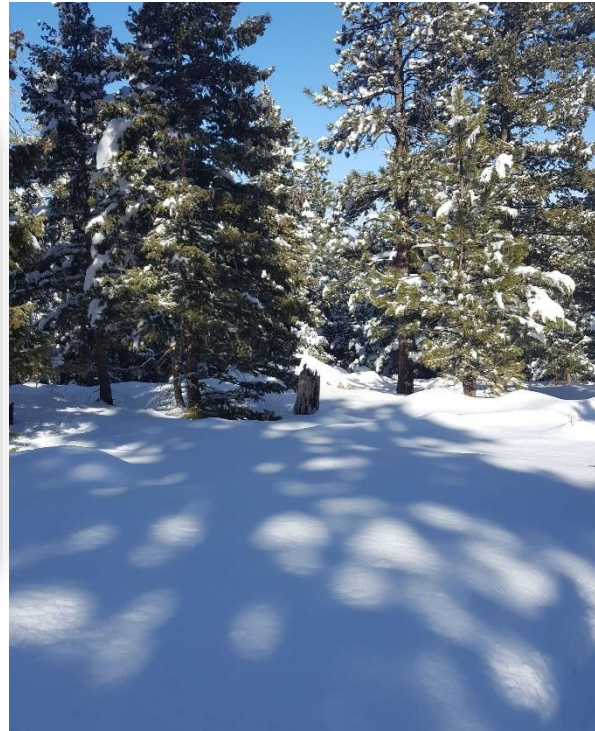
We can find “pinhole images” of the round Sun all around us.

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

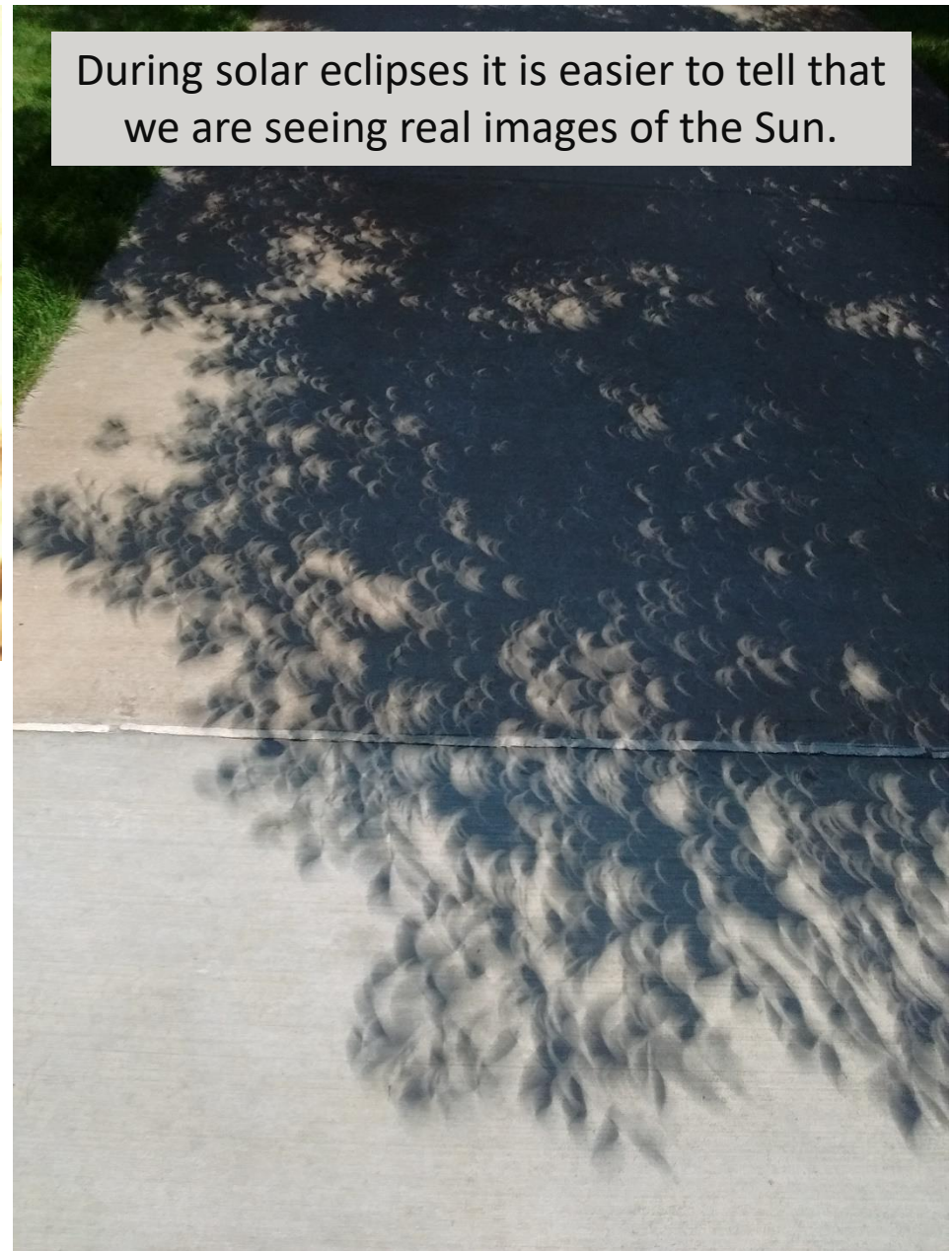
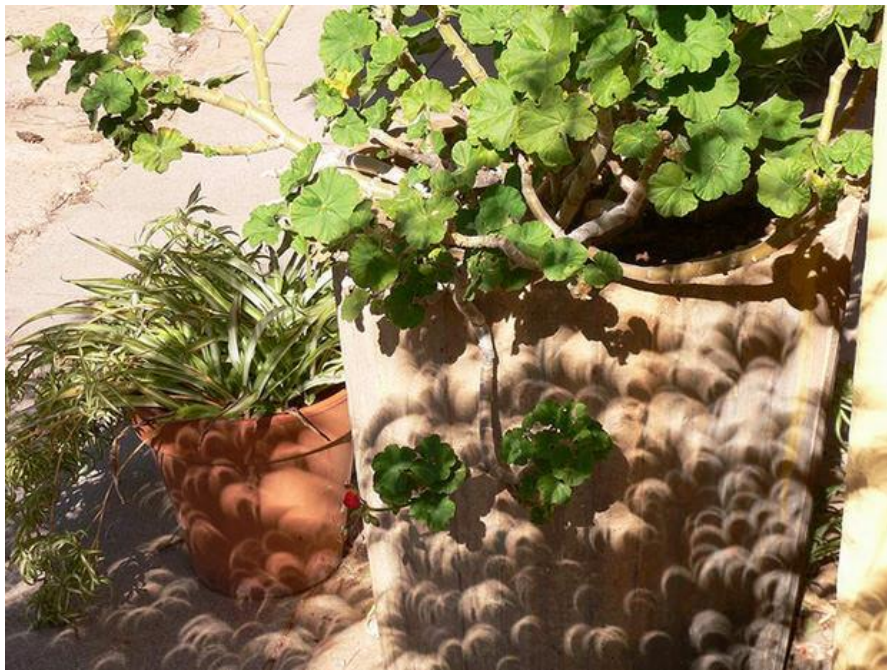
We can find them at all times of the day and all times of the year.

We find them amid the shadows of trees with leaves or needles.

We find them on sidewalks, on snow, on fences, and buildings.



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.

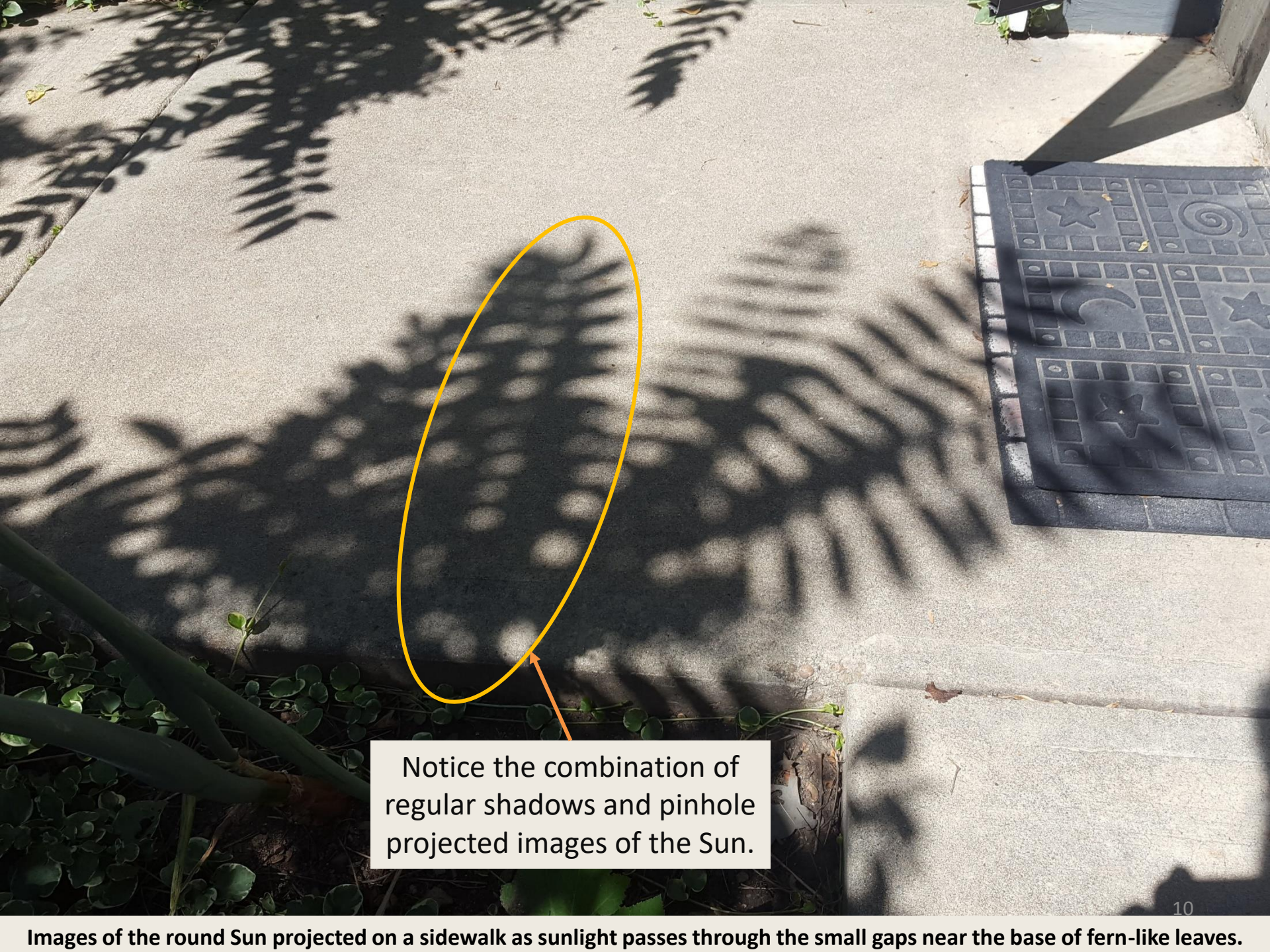


Gaps between tree leaves make wonderful pinhole image displays as the Moon eclipses the Sun.

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



Notice that some of the dimmer images are in sharper focus.



Notice the combination of regular shadows and pinhole projected images of the Sun.

Images of the round Sun projected on a sidewalk as sunlight passes through the small gaps near the base of fern-like leaves.



Notice how much larger these images are beneath the tall Ponderosa Pine trees.



Morning & evening are great times to see pinhole images of the Sun on vertical surfaces. Why?





Pinhole Projection of the Sun



Pinhole images of the Sun projected on a building as morning sunlight streams through gaps between the leaves of an Aspen tree.



When the Sun is lower in the sky (early morning and late afternoon) it is easier to see pinhole images of the Sun on a vertical surface.

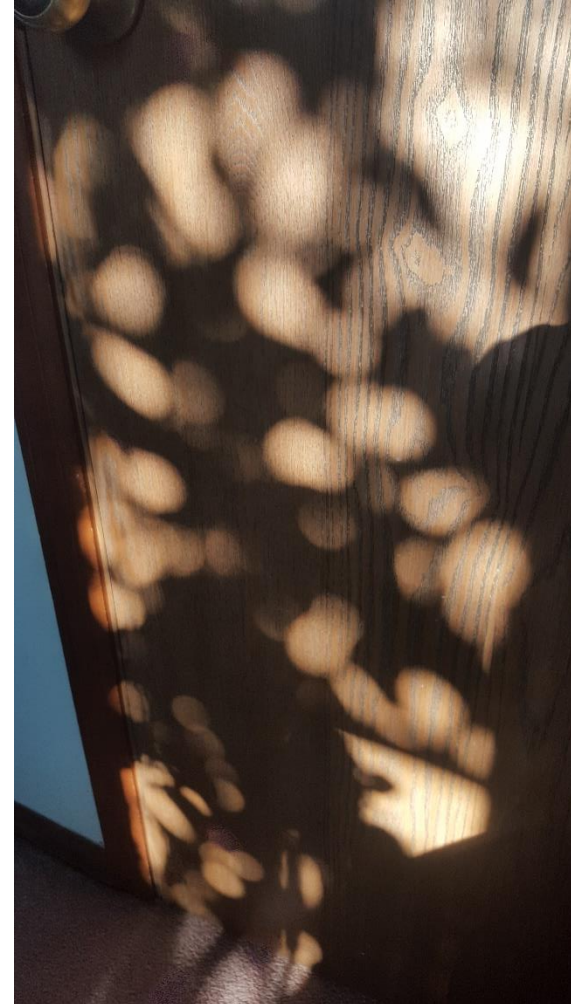


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Pinhole Projection of the Sun



We can also find pinhole images of the Sun **INSIDE** when sunlight shines through the leaves of a tree or bush outside a window



Images of the round Sun projected on a wall as **late afternoon sunlight** passes through leaves outside a window.

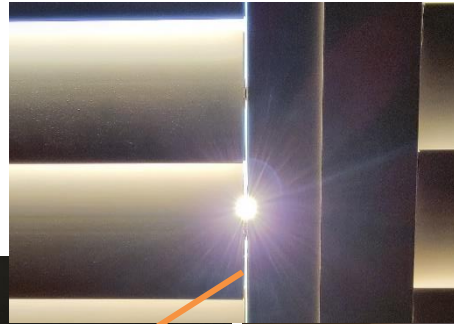


Pinhole Projection of the Sun



Look for pinhole images of the Sun when sunlight passes through the narrow gaps at the edges of window blinds.

These small gaps at the edges of the blinds are long, thin rectangles



But see how perfectly round are the images of the Sun they project on the wall!



Images of the Sun projected on a hotel room wall as **morning sunlight** passes through gaps at the sides of window blinds.



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Pinhole Projection of the Sun

You can also find pinhole images of the Sun as sunlight passes through the tight weave of a straw hat



The size and clarity of pinhole images depend on the size of the hole and the distance between the hole and the surface on which the images are projected (in this case CM's hand).



What else can you find that will create pinhole images of the Sun?

Dozens of pinhole images of the Sun are projected on CM's hand as the Sun shines through the tiny gaps in her straw hat.



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ADDITIONAL INFORMATION



Link for Feedback
Valuable References
Credits & Acknowledgements
Links to PUNCH & PUNCH Outreach Products

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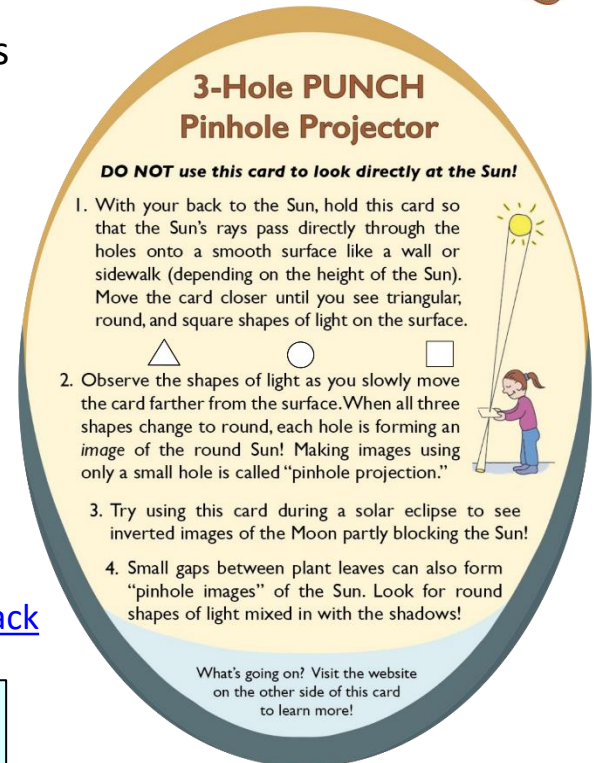
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Valuable References



1. Lenses and Pinholes: What Does “In Focus” Mean?

A brief and clear explanation about what it means to be “in focus”:

<https://www.physicsforums.com/insights/lenses-pinholes-focus-mean/>

2. How a Pinhole Camera Works (Part 1)

Excellent diagrams:

<https://www.scratchapixel.com/lessons/3d-basic-rendering/3d-viewing-pinhole-camera>

3. Real image: Collection of focus points made by converging light rays

We love the simple but insightful stick-figure:

https://www.wikiwand.com/en/Real_image

4. Your Eyes See Upside Down and Reversed

Lucid explanation by an eye doctor (MD) relating human eye to a pinhole camera:

<https://bceye.com/retinal-image-inverted-reversed/>

5. Camera Obscura

The history of this wondrous effect, including reference to a possible paleo-camera:

https://en.wikipedia.org/wiki/Camera_obscura <http://paleo-camera.com/archo-optics/>

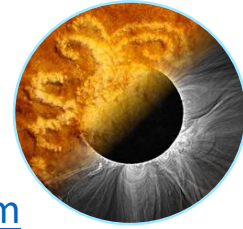
6. Making, Measuring and Testing the “Optimal” Pinhole

A thorough and playful journey through the technical details of pinhole photography:

<https://www.35mmc.com/26/10/2020/making-measuring-and-testing-the-optimal-pinhole-pinhole-adventures-part-3-by-sroyon/>



Credits & Acknowledgements



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Gilly Gilbert (PUNCH Associate Investigator, field tester)

Countless others (who participated in field testing events and gave us their feedback)



Please proceed to Section 3:

Exploring Pinhole Projection with Your Own Hands

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