Eclipse Pinhole Viewer

Safely Observing a Solar Eclipse

Age: 6 +

Activity Time: 5 min

Prep Time: 10 min

Summary

Solar eclipses are an amazing sight to witness! However, looking directly at the Sun can cause serious damage to your eyes. Solar eclipse glasses (which are very different from sunglasses) and welding glasses are two ways to be able to safely look at the Sun during a solar eclipse, but these are not always available. Fortunately, anyone can observe a solar eclipse safely by making a pinhole viewer to project the image of the Sun onto a flat surface. This activity outlines how to make a simple pinhole viewer using household items.

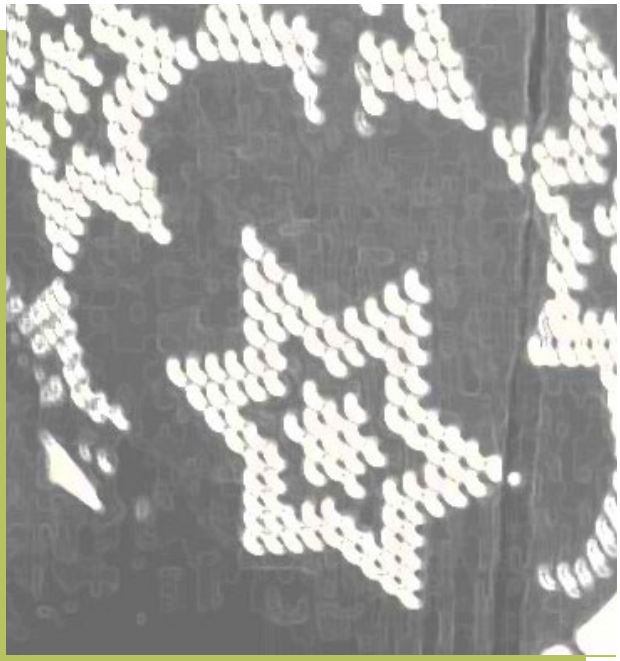
Objectives

- Participants learn the importance of Sun safety! Never look directly at the Sun without the aid of solar eclipse glasses or similar aparatus and how to identify those.
- Participants learn about simple optics and the path of light.
- Participants learn the basics of solar eclipses.
- Participants can use their creativity to make a working pin hole viewer to use on eclipse day.

Materials

Materials Needed (per student)

- ❑ 1 sheet construction paper or cardstock
- ❑ Aluminum foil
- ❑ Scissors
- ❑ Push pin
- ❑ Tape
- ❑ Optional: white paper



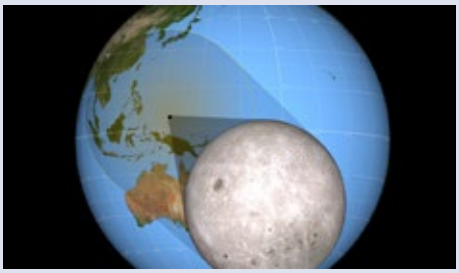
WARNING: Never look directly at the Sun through the pin hole viewer! To avoid damagaing your eyes, look at the image of the Sun projected onto a flat surface (facing away from the Sun) and never directly through the hole at the Sun.

Science Background

Phases of a total solar eclipse, Credit: Justin Ng

A solar eclipse happens at a specific location on the Earth's surface when the Moon passes in front of the Sun, obscuring it. It is an amazing fact that while the Sun is 400 times bigger than the Moon, the Sun also happens to be about 400 times further away from us than the Moon. This means that the Sun and the Moon appear about the same size to us in the sky.

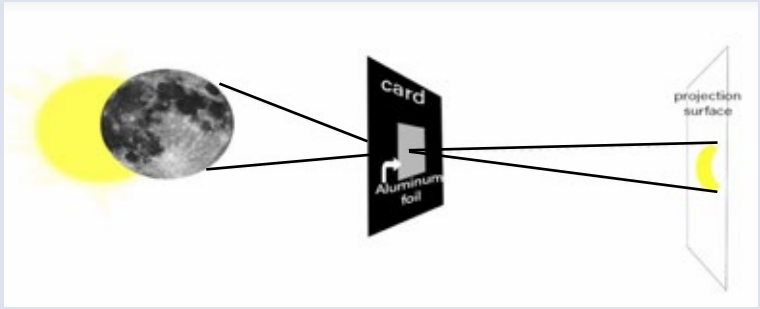
	Diameter	Distance from Earth
Sun	1.4 million kilometers 864,600 miles	150 million kilometers 93 million miles
Moon	3,500 kilometers 2,200 miles	384,400 kilometers 238,900 miles
Ratio	~400:1	~400:1



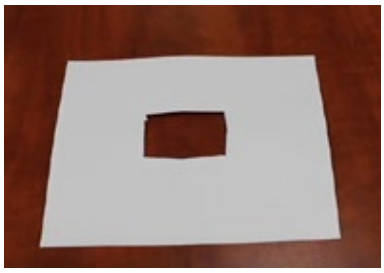
Penumbral and umbral shadows on Earth
Credit: Ernie Wright, NASA Visualization Studio

Because the Sun is so large in diameter, the light emitted from one edge of the disk of the Sun arrives at Earth at a slightly different angle than the light coming from the other edge. This difference in angles means that some sunlight is able to leak into the shadow of the Moon.This partially darkened part of the shadow is called the ***penumbra****. This light does not leak into a small region in the center of the shadow, which is called the* ***umbra****. Locations in the penumbral shadow of the Moon experience a partial solar eclipse and places in the umbral shadow experience a total solar eclipse. During a total solar eclipse, the Moon's shadow sweeps across the face of the Earth and everywhere on the* ***path of totality*** *will experience a partial solar eclipse leading up to and winding down from the total solar eclipse.*

A pinhole viewer is one of the oldest and simplest optical devices, and can be used to observe an eclipse. The image of the sun is projected onto a surface behind the small hole as light rays from the top of the eclipse are relayed to the bottom of the image and light from the bottom of the eclipse creates the top of the image. So the eclipse you see projected is actually upside-down, but because the crescent of the Sun is vertically symmetrical, this effect is not noticeable.



Procedure

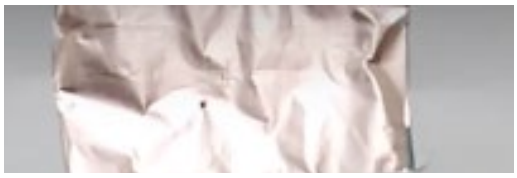


1. Starting with either a full or half-sheet of cardstock, cut a ~1 inch rectangular hole in the center. This will form the window for the aluminum foil.

2. Cut out a rectangle of aluminum foil that is a little bit larger than the window you just cut out.

3. Use four pieces of tape to secure each edge of the aluminum foil onto the cardstock. This will become the "back" of the pinhole viewer.

4. Using a pushpin or tack, make a small hole in the center of the aluminum foil. Aluminum foil is used here because it tends to form a very circular hole with smooth edges, so try not to move the pin around too much as you make the hole.



5. Go outside during bright daylight and practice lining up the Sun with the pin-hole viewer. You will want to put a white piece of paper a few feet behind the viewer, or project the Sun's image onto a smooth surface like concrete. *Be sure not to look at the Sun!* When looking at the image of the Sun, the Sun will be behind you. When you use the pin hole viewer during an eclipse, you will see a crescent of the Sun like the ones below.

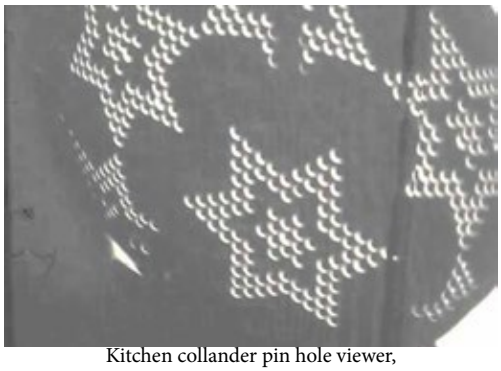
Credit: Eugene Kim

Credit: Dave Pool

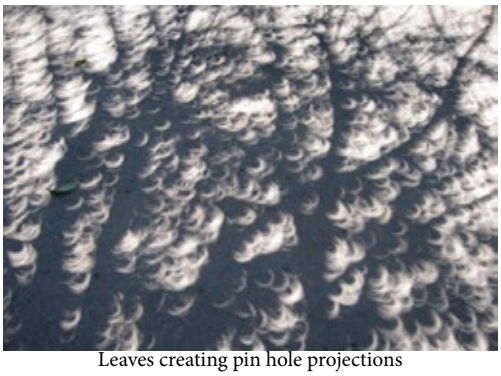
Procedure - More Fun Options

More Fun Options:

One pin hole will give you one perfect projected image of the Sun, but you don't have to stop there! You are free to make more pinholes, creating a series of little Sun projections. Make a design, write your name - the possibilities are limited only by your imagination! In fact, any object with small holes can be used as a pin hole viewer. Collanders can make great pin hole viewers! In fact, the small regions of light that pass between the leaves of a deciduous tree can make a slew of solar projections - that's why those little dappled bits of light are circular (like the disk of the Sun). The next time you're lounging under a tree - see for yourself! During a partial solar eclipse, those circles turn to crescents. Finally, the ultimate DIY pinhole viewer is just your two hands overlapping so that small amounts of light pass through your fingers.



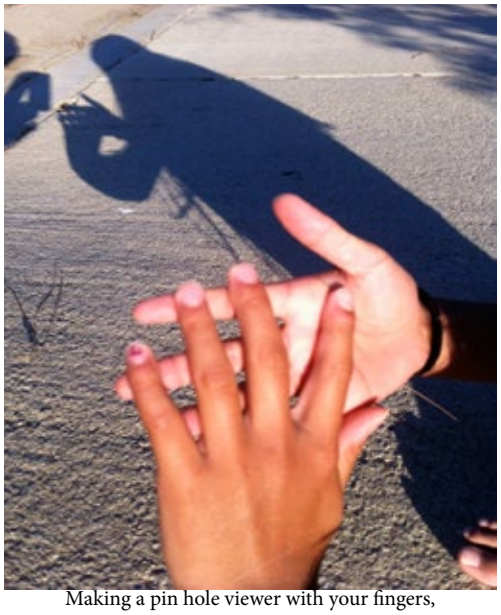
Kitchen collander pin hole viewer,
Credit: John Louie



Leaves creating pin hole projections

Message written in pin holes
Credit: National Astronomical Observatory of Japan

Image credit: Lisa Kunze



Making a pin hole viewer with your fingers,
Credit: Ellie's Enormous Elevator

Watch a video tutorial of this activity on YouTube:
http://bit.ly/MakingAPinHoleViewer

Find out more by watching our solar magnetism webcast:
http://bit.ly/Webcast5-ObservingTheEclipse

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