

How to Safely View a Solar Eclipse

WHAT IS A SOLAR ECLIPSE?

A solar eclipse is when the moon blocks any part of the sun from our view. There are three main types of solar eclipses: total, annular, and partial.

Total Solar Eclipse: In a total solar eclipse, the moon passes between the sun and the earth and completely blocks the sun from our view (Figure 1). Only those who are directly in the path of the moon's shadow will be able to see the "totality phase" of the eclipse (which is when the moon completely covers the sun's bright face and it suddenly gets dark).



Figure 1. Total Solar Eclipse, where the view of the sun is completely blocked by the moon. Photo courtesy of John Bishop, MD

Annular Solar Eclipse: During an annular solar eclipse, the sun is only partially blocked by the moon and may be described as a "ring of fire" (Figure 2). The annular solar eclipse can be seen from any location along the path of the solar eclipse.

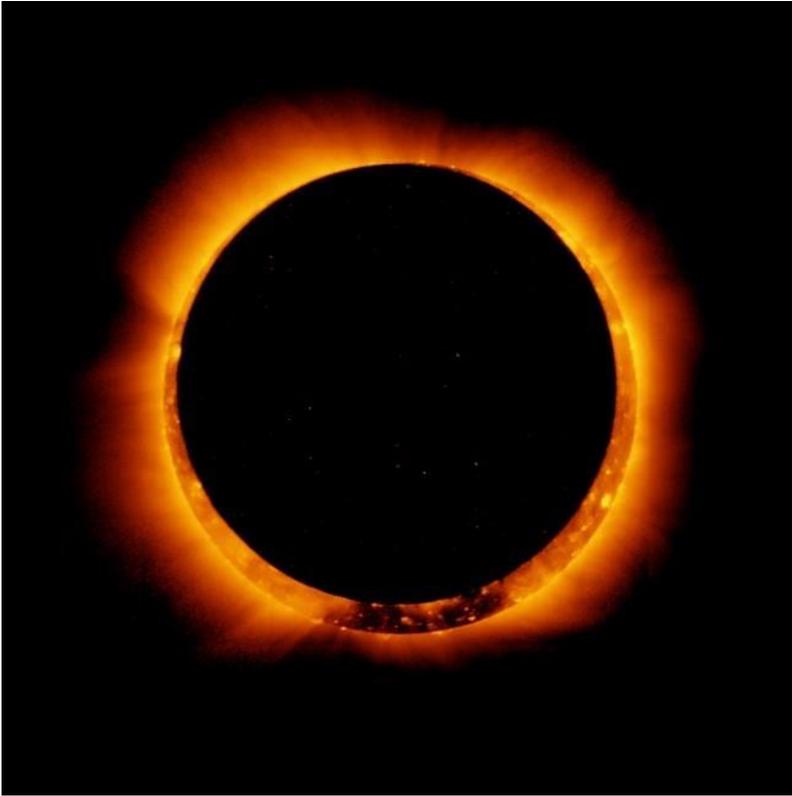


Figure 2. Annular Solar Eclipse, showing the characteristic “ring of fire”. Photo courtesy of NASA

Partial Solar Eclipse: In a partial solar eclipse, the sun is also only partially blocked by the moon. A partial solar eclipse makes different shapes based on how much of the sun is blocked (Figure 3).



Figure 3. Partial Solar Eclipse, where the sun is only partially blocked by the moon. Photo courtesy of John Bishop, MD

IS IT SAFE TO VIEW A SOLAR ECLIPSE?

When done safely, Absolutely! With proper preparation, solar eclipses can be viewed safely by both children and adults. However, it is important you learn how to do it safely to enjoy these rare and awe inspiring events. The experience of sights, sounds, and emotions one feels during a solar eclipse makes it an event worth planning and being prepared for.

Most importantly, you should **NEVER** look directly at the sun without appropriate eye protection. If you plan to look directly at the sun while viewing a total, annular, or partial solar eclipse, always use an approved filter. Only filters that meet the ISO 12312-2 standard are safe for directly viewing the sun. Do NOT use sunglasses, Polaroid filters, certain welding glass, exposed color film, X-ray film, or photographic neutral-density filters to view a solar eclipse. These filters dim the brightness of the sun BUT they do not block the damaging infrared and ultraviolet light rays.

There are also other ways to safely view a solar eclipse, see below.

HOW CAN I SAFELY WATCH A SOLAR ECLIPSE?

There are many ways to safely view a solar eclipse:

(1) Using the pinhole or projector method

(2) Using solar eclipse glasses or filter

(3) Watching the NASA live stream

(1) The pinhole and projector methods: A pinhole projector is easy and cheap to make. The materials needed to make your own simple, pinhole projector include two sheets of paper and a pin. The pin is used to make a small hole in the center of one of the sheets of paper and the sheet of paper with the hole in it is held above a second sheet of paper without a hole in it. You look at the bottom piece of paper without the hole in it to view the sun's image (Figure 4). **DO NOT** look at the sun through the paper with the hole in it.



Figure 4. Example of a pinhole projector. Photo courtesy of <http://solar-center.stanford.edu/observe/>

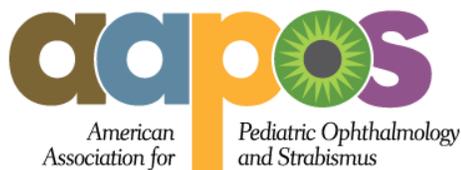
To make viewing easier, these two sheets of paper can be held or placed in a cardboard box. Instructions on making your own pinhole viewers can be found here:

Observing the Sun for Yourself (<http://solar-center.stanford.edu/observe/>)

DIY Box Pinhole Projector to See a Solar Eclipse

(<https://www.timeanddate.com/eclipse/box-pinhole-projector.html>)

(2) Use a pair of solar eclipse glasses or filter: The only way to safely look directly at the unclipsed, partially eclipsed, or annularly eclipsed sun is by using a solar filter that meets the ISO 12312-2 international safety standard. Make sure the solar eclipse glasses or filter you use meets this safety standard so you can protect your eyes from injury. If



you wear glasses or contact lenses, keep them on while using these filters. The solar eclipse glasses are to be worn on top of your normal glasses or contact lenses. Put your solar eclipse glasses on or hold the filter over your eyes BEFORE looking at the sun. After you are done looking at the sun through the solar eclipse glasses or filter, turn and look away before removing the solar eclipse glasses or filter. Children should be supervised while viewing a solar eclipse. For more information on using solar eclipse glasses and filters, visit the American Astronomical Society webpage here:

<https://eclipse.aas.org/eye-safety>

A solar eclipse can also be safely viewed through specialized binoculars and telescopes that have been fitted with an approved solar filter. Never look at the sun through a pair of binoculars or a telescope that does not have an approved solar filter.

(3) NASA live stream: The movement of the sun, moon and earth are very predictable. Scientists are able to predict the exact time and path of a solar eclipse. However, sometimes the best plans for viewing an eclipse fall apart due to cloudy skies. When this happens, all is not lost! One of the most fascinating and safe ways to view a solar eclipse is by watching the NASA live stream. To find out when an eclipse is scheduled in your area, check the NASA Live website for livestream details at NASA

Live: <https://www.nasa.gov/nasalive>.

CAN I EVER REMOVE MY SOLAR ECLIPSE GLASSES OR FILTER DURING A TOTAL SOLAR ECLIPSE?

The ONLY time that you can look at the sun without your solar eclipse glasses or filter or viewer is during the “totality phase” of a total solar eclipse. The “totality phase” of the eclipse is when the moon completely covers the sun’s bright face and it suddenly gets dark. In general, this phase lasts only a few minutes. It is safe to look at this time because you are not looking at the sun, but you are looking at the moon which is blocking the sun. If you are using solar eclipse glasses or filter to watch the transition from the partial to total eclipse, you will know it is safe to remove your solar eclipse glasses or filter when you can no longer see any part of the sun or light through your solar eclipse glasses or filter.

Right when you see the sun start to reappear, known as the diamond ring phase (Figure 5), **immediately** replace the solar eclipse glasses or filter or return to viewing the eclipse

through your viewer.



Figure 5. Diamond ring phase of a total solar eclipse, when the sun starts to reappear, photo courtesy of NASA

WHAT IS THE DANGER OF LOOKING DIRECTLY AT THE SUN?

Staring directly at the sun can cause damage both to the front and back parts of your eye. Ultraviolet light directed onto the clear front surface of the eye (known as the cornea, see Figure 1) and into the inside surface of the back of the eye (known as the retina, see Figure 1) can cause damage to your eye.

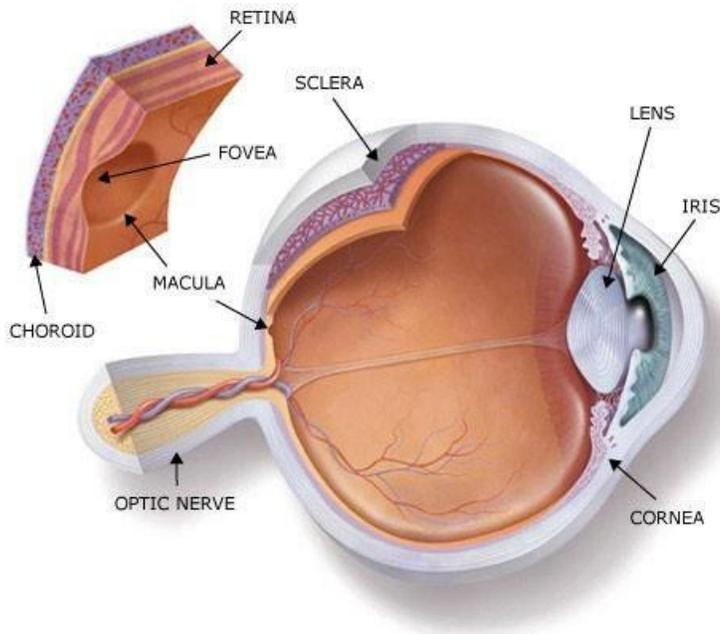


Figure 1: Eye Anatomy. The cornea is the clear front surface of the eye (shown by the blue arrow). The retina is the inner lining of the back part of the eye (shown by the red arrows). More information on eye anatomy can be found at <https://aapos.org/glossary/anatomy-of-the-eye>.

These harmful ultraviolet light rays can quickly burn sensitive eye tissues. Mild light exposure can lead to a sunburn on the front surface of the eye (known as the cornea), called solar keratitis. A burn to the inside surface of the back of the eye (known as the retina) can cause more severe visual damage, called solar retinopathy. More details on solar retinopathy can be found here: <https://aapos.org/glossary/solar-retinopathy>

If you think you have symptoms of solar keratitis or solar retinopathy, contact your ophthalmologist (medical eye doctor) immediately to see if you have any sun damage to your eyes, the severity of the injury, and guide you on possible treatments.

Additional Resources:

- American Academy of Ophthalmology: <https://www.aao.org/eye-health/tips-prevention/solar-eclipse-eye-safety>
- American Astronomical Society: <https://eclipse.aas.org/eye-safety>
- NASA: <https://www.nasa.gov/content/eye-safety-during-a-total-solar-eclipse>