FS No. 017-0623

2023 and 2024 Eclipse of the Sun

Introduction

On 14 October 2023 and 8 April 2024, the skies of North America will darken because of a solar eclipse. Its startling onset and eerie appearance combine to create a unique visual impression. The last total solar eclipse, where the moon almost completely covers the sun, that was visible in the continental United States occurred on 21 August 2017 during the "Great American Eclipse." If you want to view the solar eclipse in 2023 and 2024, be aware that staring at the sun during an eclipse may cause eye injuries, such as permanent blurry vision and central blind spots. This Fact Sheet provides information about how to safely observe this inspiring event using protective devices designed for eclipse viewing or indirect viewing techniques to prevent eye injuries.

Potential Viewing Hazards and Suspected Eye Injuries

Is it safe to watch the eclipse without eye protection? No. Staring directly at the sun is extremely hazardous to the eye and may cause permanent damage to the retina. Figure 1 shows a retinal lesion caused by staring at the sun without proper eye protection. While most people gradually recover their normal vision within 1–6 months, some end up with permanent blurry vision and central blind spots. You would normally never stare at the sun because it is extremely bright. However, during an eclipse you may be tempted to observe the event without suitable eye protection. The lower light levels experienced during a partial solar eclipse, or an annular ring-of-fire eclipse will not render it safe. You will still be at risk for retinal injury.

So why is it less hazardous to watch a common sunset? Prolonged staring at the sun is never a good idea and should be avoided as good safety practice. Sunsets are less hazardous to view because sunlight is strongly filtered near the horizon by the atmosphere. This filtering is the reason why the sun appears to be orange-yellow or even red as it sets. Direct sunlight, when the sun is overhead, is too intense to view directly. The solar eclipse will dim the sun, but the light is still too intense to directly view.

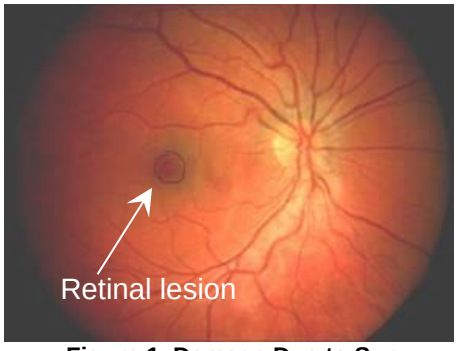

Figure 1. Damage Due to Sun
Image provided by http://astronomyonline.org/SolarSystem/SunspotRotation.asp

Will sunglasses protect my eyes? No. Sunglasses, smoked glass, and photographic neutral-density filters cannot protect you from the hazards of staring directly at the sun during an eclipse. Welding goggles offer sufficient protection, with a minimum shade number 14 arc welding filter.

Can I view the eclipse with binoculars? The worst viewing method is directly viewing the sun through a lens, such as unfiltered telescopes, cameras, or binoculars. A lens will capture even more of that damaging energy and focus it directly onto your eyes. Specialized filters for optics are available if magnified viewing is desired, but this method should only be attempted by a trained observer, as the filter will depend heavily on the level of magnification of the optics.

What should I do if I suspect I have an eye injury? You should get an evaluation by an eye care professional as soon as possible. Symptoms might develop immediately or in a few days. The severity or type of symptoms may also change over time. The most common indications of possible eye injury are blurred vision and central blind spots. Color perception can also change. Staring at the sun will often injure both eyes.

Safe Viewing

Where can I get the protective devices for viewing the solar eclipse? Disposable "Eclipse glasses" are available for commercial purchase. Ensure that your eclipse glasses meet the International Standards Organization (ISO) 12312-2 on Filters for Direct Observation of the sun. Glasses with only CE (European Conformity) certification may not provide sufficient protection.

Are there other techniques to safely view the eclipse? One of the safest techniques is called the pinhole-projection method, which is illustrated in Figure 2: (1) Start with two pieces of stiff paper or cardboard. (2) Use a pin, thumb tack, or

Defense Centers for Public Health–Aberdeen, Nonionizing Radiation Division
8252 Blackhawk Road, Aberdeen Proving Ground, MD 21010
410-436-3932 or DSN 584-3932

paper clip to pierce a *smooth, round* pinhole into one of the pieces of paper. Large uneven pinholes will produce a brighter but distorted image. Smaller even pinholes will produce a dimmer but better focused image. Experiment with different size and shaped holes. (3) With your back to the eclipse, hold up the paper perpendicular to the sun, with the pinhole so that the sunlight shines directly through it. Hint: Align with the shadow on the ground. (4) Hold the second paper about 2 to 3 feet away so that the sunlight is projected onto it. You should see an inverted image of the eclipse on the second paper. (5) Enjoy viewing the image of the eclipse that appears on the paper. Hint: Practice before the eclipse. **Please, do <u>not</u> view the sun directly through the pinhole.**

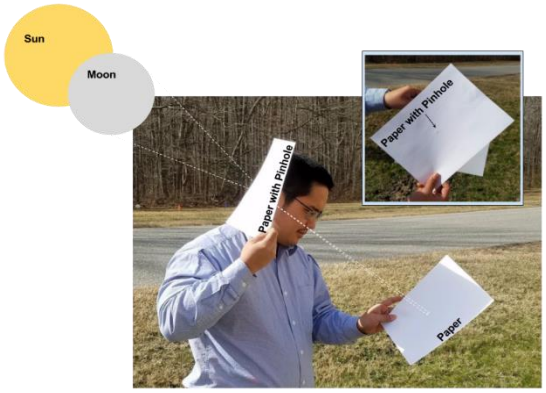

Image from Nonionizing Radiation Division DCPH-A NRD

Figure 2. Pinhole Projection

When and Where to View the Eclipse

On 14 October 2023, those in North America will have an opportunity to view an annular solar eclipse (Figure 3 center), which will create a "ring of fire" effect for those standing in its path of annularity (sweeping from Oregon down to Texas). In an annular solar eclipse, the Moon does not block out the sun completely, as opposed to a total solar eclipse where the moon will completely block out the sun. On 8 April 2024, those in North America will be able to experience a total solar eclipse (Figure 3 left). On both dates, all of the 48 contiguous United States will experience at least a partial solar eclipse (Figure 3 right). The next total solar eclipse that will be viewable across the majority of the U.S. will not be until 2045.

Image from https://solarsystem.nasa.gov/eclipses/about-eclipses/types/

Figure 3. From Left to Right, Images Show Total, Annular, and Partial Solar Eclipses

Figure 4 illustrates the path of the eclipse through North America for both 2023 (the path with the yellow circles) and 2024 (the path with the white circles). The 2023 annular solar eclipse path of annuity enters the U.S. mainland in Oregon starting around 1500 (UTC) and completes its journey in Texas around 1700 (UTC). Some of the major military bases that will be in best position to observe this annular solar eclipse are Kirtland Air Force Base (AFB) and Joint Base San Antonio, Texas. The 2024 total solar eclipse path of totality will begin in Texas starting around 1800 (UTC) on 8 April 2024 and will leave the U.S. mainland in Maine around 1930 (UTC). The military bases that will be able to observe the total eclipse are Laughlin AFB, Joint Reserve Base Fort Worth, Camp Joseph Robinson, Wright-Patterson AFB, and Fort Drum. Many civilians and military personnel in these states will be tempted to look at the event. Wherever you decide to view the eclipse, do it safely. **Never stare at a solar eclipse without proper eye protection!**

Image from https://svs.gsfc.nasa.gov/vis/a000000/a005000/a005073/eclipse_map_10800.png

Figure 4. 2023 and 2024 Solar Eclipse

Technical Points of Contact

- For further information about safety of ultraviolet, visible, and infrared radiation sources, contact the DCPH-A Nonionizing Radiation Division at 410-436-3932. For information regarding vision and ocular damage, contact the DCPH-A Tri-Service Vision Conservation and Readiness Division at 410-436-9083.