Solar Eclipse Eye Safety: Facts and Fallacies

It is perfectly safe to look at the totally eclipsed Sun, but caution is needed at all other times.

By Richard Tresch Fienberg

The total solar eclipse of November 14, 2012, as seen from aboard the cruise ship Paul Gauguin in the South Pacific. This sequence runs from lower right to upper left. During the partial phases, the camera lens was covered by a safe solar filter. No filter was used during totality. The background is an unfiltered, wide-field view of the ocean and sky during totality, showing sunrise/sunset colors along the horizon. Courtesy Rick Fienberg/TravelQuest International/Wilderness Travel.
When it comes to solar eclipses, eye safety is one of the areas that people are extremely confused about. You might suffer a little cognitive dissonance on this, because every telescope you’ve ever seen probably has a little sticker on it that says: “Don’t use this telescope to look at the Sun.” Similarly, your mother probably told you never to look at the Sun…ever!

Looking at the Sun
But you also see lots of pictures of the Sun, and you hear about many solar observations by amateur astronomers. All experienced astronomers know that you just have to have the right equipment. With a proper filter over the front of your telescope, and a cap over your finderscope or any other optics, you can safely look at the Sun.

It’s also perfectly safe to look directly at totality during a total solar eclipse, such as the one crossing the United States on August 21, 2017. In fact, it’d be a shame if you didn’t look at it. It’s one of the most spectacular sights in all of nature. It’s truly beautiful. In fact, I tell people that they may think a total solar eclipse is an astronomical event, but really, it’s a life event. It’s a beautiful thing. You need to see it with your own eyes. And in order to see it, you need to look at it. You can look at it even with binoculars or a telescope. As long as the entire bright face of the Sun is covered, the eclipsed Sun is no brighter than the full Moon and just as safe to view directly.

But this is the crux of the matter: At any other time — whether it’s outside of an eclipse altogether, during a partial eclipse, during an annular or ring-shaped eclipse, or during the partial phases of a total or annular eclipse — you must use proper eye protection, because even the tiniest sliver of the Sun is dangerously bright.

One common fallacy is that people think it’s the infrared, the ultraviolet, or other rays coming from the Sun that are the problem. But that’s not the case. It’s mainly the intense visible light. We evolved so that our eyes are sensitive to sunlight, and sunlight is extremely intense. If you look at the Sun without a proper filter, your retina will be damaged by visible light long before solar infrared or ultraviolet radiation can hurt you.

Looking at the Sun Safely
So you need a way to view the Sun safely, and there are two options. One is direct — looking through safe filters such as those found in eclipse glasses. These not only dim the Sun’s visible light to safe
and comfortable levels but also block solar ultraviolet and infrared radiation. Four companies produce eclipse glasses that have been certified to a new international safety standard: Rainbow Symphony, American Paper Optics, Thousand Oaks Optical, and TSE 17.

The other safe method is indirect observing. For example, take a card, punch a tiny hole in it, let the Sun shine through the hole onto the ground or a sheet of white paper, and you’ll see a little projected image of the crescent Sun during the partial eclipse. It won’t be very bright, so it won’t hurt your eyes.

A lot of people wonder if you can use dark sunglasses, because we keep saying eclipse “glasses.” They look like sunglasses and, in a development that I’m not particularly happy about, the companies that make cardboard eclipse glasses also make plastic ones that look very much like regular sunglasses.

People might think “Oh, those look like sunglasses. Can I use my sunglasses?” No! You cannot use your sunglasses. Eclipse glasses are about 100,000 times darker than ordinary sunglasses! Ordinary sunglasses don’t come close to providing the necessary protection.

As with NASA’s eclipse website, we’re trying to make the eclipse website of the AAS (American Astronomical Society) a gateway through which you can pass and find all the resources and information you need. The eye safety section in particular has pages on how to view safely, how to get eclipse viewers and how to use them, how to tell if your eclipse glasses or handheld solar viewers are safe, how to use different methods of pinhole projection or optical projection, and where to get solar filters for your telescope or binoculars.

**Dangerous Rays?**

Many people ask, “Doesn’t the Sun emit dangerous rays during an eclipse?” To which I reply, well, the Sun emits rays all the time. There are no more or worse rays coming from the Sun during an eclipse than there are at any other time.

One eye doctor, who really should have known better, said, “I thought the Moon’s atmosphere focused the solar radiation onto
Earth and caused it to be much more intense.” Of course, there is no atmosphere on the Moon, and the Moon has no effect at all on radiation coming from the Sun. So don’t be misled. There’s nothing about what’s coming off the Sun during an eclipse that’s any more unusual than at any other time. It’s just that, during a total eclipse, you can see the solar corona, or faint outer atmosphere, which is normally drowned out by the brilliance of the everyday Sun.

One of the things we have on our website (NASA has the same flyer on their site) is a downloadable, one-page flyer (in English and Spanish) that tells you how to use eclipse glasses, which companies sell the ones that are safe, and points to the AAS and NASA websites.

Something we’re very proud of is that we worked with NASA’s heliophysics people and eclipse educators to make sure that they were happy with the messaging. The flyer has been endorsed by the American Academy of Ophthalmology and the American Academy of Optometry. Neither organization has ever endorsed somebody else’s safety message before, so we’re very pleased about that. Also on the AAS website, you can see how to perform the different techniques for safe observing either directly or via projection.

**Eye Safety**

At every solar eclipse the question always comes up: How bad are the eye injuries? Don’t thousands or millions of people hurt their eyes during eclipses by not following the instructions?

The answer is: Eclipse injuries are actually quite rare. There are very few documented cases of permanent eye damage, let alone even serious eye damage. For the most part, especially now that safe filters are so widely available, and because of efforts like ours where we spend months and months preparing the public for an event, there are very few cases of significant eye injury caused by a solar eclipse. And many thousands of amateur astronomers routinely look at the Sun year-round (using proper filters), and they don’t get hurt either.

A document called *Solar Eclipse Eye Safety*, which is not the same as the one-page flyer mentioned opposite, was prepared by Ralph Chou, the dean of eclipse eye safety and Professor Emeritus in the School of Optometry & Vision Science, University of Waterloo (Canada). He is a research eye-care professional who has evaluated all the solar filters on the market and looked at all the published
literature about eye safety and eye injury. He’s saying the same things that I’ve been describing here.

There’s one final thing I’d like to mention. I think it’s very wise and very perceptive, and I credit eclipse-chasing astronomer Jay Pasachoff (Williams College) for it. Suppose you have experts — whether they’re misinformed astronomers, eye doctors, general practitioners, or anybody else who hasn’t taken the time to learn about “safe Sun” — telling the public that they should stay indoors, or not look at the Sun, or stay away from the eclipse, or not let their children look at it. And then millions of people go out and have the experience of a lifetime, and all you read about for the next few days is how much fun and wonderful everything was and that nobody went blind. The people that those experts talked to are no longer going to trust experts. We already have a problem with people not trusting experts, so let’s not make it worse.

My final comment is simple: Get thee to totality!

Solar Viewing Safety Tips from the AAS and NASA

1. The only safe way to look directly at the uneclipsed or partially eclipsed Sun is through special-purpose solar filters ("eclipse glasses" or handheld viewers) that meet the ISO 12312-2 international standard for such products. ([How to tell if your solar viewers are safe](#))

2. Ordinary sunglasses, even very dark ones, are not safe for looking at the Sun. Neither are homemade filters created from neutral density filters (such as those made for camera lenses), smoked glass, exposed film, “space blankets,” potato-chip bags, DVDs, and any other materials you may have heard about for solar viewing.

3. Seek expert advice before using a solar filter with a camera, telescope, binoculars, or any other optical device.

4. Never look at the Sun through an unfiltered camera, telescope, binoculars, or any other optical device while using eclipse glasses or a handheld solar viewer.

5. A solar filter must be attached to the front of any telescope, binoculars, or camera lens.

6. If you are **within the path of totality**, remove your solar filter **only** when the Moon completely covers the Sun’s bright face, and it suddenly gets quite dark. Experience the splendor of totality. Then, as soon as the bright Sun begins to reappear, replace your solar viewer to glance at the remaining partial phases.

7. If you are **outside the path of totality**, you must **always** use safe solar filters to view the Sun directly.

[RICHARD TRESCH FIEBERG](#) is the American Astronomical Society’s Press Officer. He also chases solar eclipses, having made 12 journeys to totality.

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