[How to View an Eclipse]

by Ron Hipschman

This is probably the most important part of this website. If you ever want to view an eclipse, the first thing you must know is this:

> **Never view the sun with the naked eye or with any optical device, such as binoculars or a telescope!**

This is more than advice. Why? As a kid, did you ever take a magnifying glass out into the sun and burn leaves? If so, you probably remember that when the focused sunlight coming through the lens was refracted and concentrated to a small spot, the energy available there was truly remarkable. Guess what? You have a lens just like that in your eye. If you look at the sun, your eye-lens will concentrate the sun's light and focus it to a very small spot on the back of your retina. This can cause permanent eye damage or blindness. Additionally, there are no pain sensors back there so you won't even know it happening! Have I scared the willies out of you? Good!

[Pinhole Projector]

There are safe ways to view the sun. The simplest requires only a long box (at least 6 feet long), a piece of aluminum foil, a pin, and a sheet of white paper.

The length of the box is important. The longer the box, the bigger the pinhole image. To find the size of the image, multiply the length of the box by the number 0.0873. For a box that is 1 meter long, the image will be 0.0873 meters (or 8.77 mm) in diameter. If your box is 5 feet (60 inches) long, your solar image will be 60 x 0.0873 = 0.52 inches in diameter. If you want to round things off, the size of the image is about 1/100th the length of the box.

If you can't find a long box or tube, you can tape together two or more boxes to make a longer one. In the illustrations below we found that taping together two triangular UPS shipping tubes works well. Of course, if you do this you must cut out the cardboard at the ends of the tube that end up in the middle!

1) Find or make a long box or tube.

2) Cut a hole in the center of one end of the box.
3) Tape a piece of foil over the hole.
4) Poke a small hole in the foil with a pin.

5) Cut a viewing hole in the side of the box.
6) Put a piece of white paper inside the end of the box near the viewing portal

Point the end of the box with the pinhole at the sun so that you see a round image on the paper at the other end. If you are having trouble pointing, look at the shadow of the box on the ground. Move the box so that the shadow looks like the end of the box (so the sides of the box are not casting a shadow). The round spot of light you see on the paper is a pinhole image of the sun. **Do not look through the pinhole at the sun!** Look only at the image on the paper.

[Quick & Easy]

If you want, you can use only two pieces of cardboard--one piece colored white to project on to, and the other with a pinhole. Hold up the pinhole as far from the screen as you can. The farther you are from the screen, the bigger your image.

Getting even more basic, you can use your own hands. Just hold up both hands with your fingers overlapping at right angles. The holes between your fingers make pinholes.

If you have some shade trees in your location, try looking at the images of the sun coming through the holes formed by the leaves. A piece of white posterboard is all you may need to have a great viewing session!

[Optical Projection]

Pinhole images are pretty dim and small. There's another projection method that uses a pair of binoculars. **DO NOT LOOK THROUGH THE BINOCULARS!**

1) First, you should firmly fix the binoculars to a tripod. You can do this with duct tape (what else?).

2) Cut out a shield made of cardboard and tape it to the front of the binoculars with the lenses sticking through holes that you cut.

3) Put the lens cap over one of the large binocular lenses or tape over one of the front lenses with duct tape. (You really only need a monocular for this.)

4) Use the duct tape to seal any holes that leak light past the cardboard.

5) Point the binocular towards the sun while holding a piece of white cardboard about a foot behind the eyepiece.

6) It will take a little effort to find the sun. Once you do, you can focus the binoculars to bring the sun to a sharp image.

Be careful not to put your hand or anything flammable near the eyepiece! The concentrated sunlight exiting there can cause a nasty burn or set something ablaze!

Now you can watch a beautiful, bright, magnified image of the sun as the eclipse proceeds. You will have to adjust the tripod to account for the earth's rotation. One possible warning here. You might give your binoculars a cooling break now and then. The eyepiece may become overheated and the lens elements may separate if you leave it on the sun too long. You've been warned!

[Filters]

If you feel that you just have to look directly at the sun, be absolutely sure that you have the correct filter. Just because a filter makes the sun seem dim does not mean that it's blocking invisible infrared or ultraviolet radiation that will certainly cause eye damage in short order.

> **Do not use sunglasses, polaroid filters, smoked glass, exposed color film, x-ray film, or photographic neutral density filters.**

Make sure that the supplier of your eclipse filter is reputable and reliable. A few are listed below. You can, for instance, look at the sun with a number 14 welders glass. Get this from a welding supply store. Silver-based black-and-white photographic emulsions, when exposed and developed fully can be used if you are experienced and knowledgeable in this area. You might need several layers. It's easier, though, to spend a couple of bucks on a filter you know is safe. If you want to use a filter on a telescope, only use the filter supplied by the manufacturer or by a manufacturer who makes the filter specifically for the instrument you are using. In some cases, this is bad advice.

The suppliers of some cheap refractors supply a welder's glass filter that screws on to the eyepiece. DO NOT USE THESE! They may heat up and crack as you are looking through the telescope. A proper solar filter always goes on the front end of the telescope, blocking the sunlight before it enters the optical system.

Do not use this type of telescope filter:

By following the instructions above and using a modicum of good sense, you will be able to enjoy solar eclipse after solar eclipse. I have!

[Links]

Filter suppliers from Fred Espenak's wonderful web site
<http://planets.gsfc.nasa.gov/eclipse/safety.html>

ABELexpress - Astronomy Division, 230-Y E. Main St., Carnegie, PA 15106. (412) 279-0672

Celestron International, 2835 Columbia St., Torrance, CA 90503. (310) 328-9560
<http://www.celestron.com>

Hands on Optics, P.O. Box 10025, Rockville, MD. 20898 (301) 482-0000

Edwin Hirsch, 29 Lakeview Dr., Tomkins Cove, NY 10986. (914) 786-3738
<http://www.rahul.net/resource/regular/products/hirsch/toc.htm>

Meade Instruments Corporation, 16542 Millikan Ave., Irvine, CA 92714. (714) 756-2291
<http://www.meade.com>

Orion Telescope Center, 2450 17th Ave,, P.O. Box 1158-S, Santa Cruz, CA 95061 (408) 464-0446
<http://www.oriontel.com>

Pocono Mountain Optics, R.R. 6, Box 6329, Moscow, PA 18444. (717) 842-1500
<http://www.rahul.net/resource/regular/products/pocono/pg1.htm>

Rainbow Symphony, Inc., 6860 Canby Ave. #120, Reseda, CA 91335 (818) 708-8400
<http://www.rainbowsymphony.com/>

Roger W. Tuthill, Inc., 11 Tanglewood Lane, Mountainside, NJ 07092. (908) 232-1786

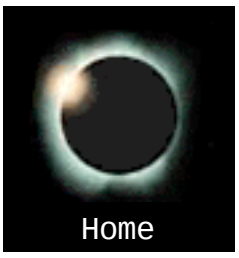
Telescope and Binocular Center, P.O. Box 1815, Santa Cruz, CA 95061-1815. (408) 763-7030

Thousand Oaks Optical, Box 5044-289, Thousand Oaks, CA 91359. (805) 491-3642
<http://www.bintel.com.au/Thousand_Oaks.html>

Khan Scope Centre, 3243 Dufferin Street, Toronto, Ontario, Canada M6A 2T2. (416) 783-4140

Perceptor Telescopes TransCanada, Schomberg, Ontario, Canada L0G 1T0. (905) 939-2313

Eclipse 99 Ltd., Belle Etoile, Rue du Hamel, Guernsey GY5 7QJ. 001 44 1481 64847



How to View an Eclipse

This resource is being presented by The Exploratorium and NASA's Sun-Earth Connection Education Forum.