

Viewing the Sun

1. What are the hazards of viewing the Sun?

The Sun is no more dangerous (but also no less dangerous) to look at during an eclipse than on a normal sunny day. Viewing the Sun directly is hazardous; eye injury or blindness can be caused. There is a very real danger of permanent damage to the retina caused by the radiation emitted by the Sun. Looking directly through pinholes, sun glasses, polarisers, smoked glass, photographic negatives, plastic bags, floppy discs, compact discs, aluminium foil, Mylar blankets, etc does not provide adequate protection. Never look at the Sun directly through any instrument such as a telescope, binoculars or camera. The use of such optical instruments for direct viewing requires expert knowledge and the use of large specialised filters on the main objective lens or aperture (never between the eye and the eyepiece, where the filter is likely to be damaged by heat).

2. Viewing the Sun safely

Methods regularly used to enable an eclipse or other solar phenomena to be observed safely include projection on to a screen for indirect viewing, the use of a special filter for direct viewing and viewing an event on broadcast television.

The method(s) chosen will depend on local circumstances such as the age of, responsibility of, and number of pupils, ease of supervision, etc. In many circumstances, a combination of all three methods will be most appropriate.

2.1 Viewing by projection

This is a safe method, provided observers are turned away from the Sun and cannot look at it by accident. There are several possible arrangements of apparatus and a certain degree of trial and error is required. It is a good idea to set up and test the system well in advance. Five projection methods are given below. In each case the image produced will be larger but fainter as the distance between the focusing device and screen is increased.

Use two pieces of card, the first with a small hole punched in it. The second card, which should be white, acts as a screen. The distance between the two cards should be about 100 to 500 times the diameter of the hole. Try hole diameters between 1 and 7 mm. If the small hole is made in a very large piece of card, this card will provide shade for the screen. Usually the image is neither very bright nor very sharp. However, individual pupils can be more involved in setting up their own systems. **Never use a small hole to view the Sun directly.**

Use a blacked-out or darkened room with a hole up to a 10 mm diameter in a blind enabling projection on to a screen (the camera obscura). A flat mirror held in a clamp can be used inside the room close to the hole to reflect the light rays towards the screen. The disadvantage of this system is that the window has to be facing in the right direction and everyone has to be indoors.

Use a flat mirror. Cover it with a piece of card (or put it in an envelope) with a 15 mm diameter hole, to form a small mirror (note that the hole does not *have* to be circular). Position the mirror in the Sun's rays and reflect the beam on to a shaded screen (under a tree, in a large box or an open room) up to 10 m away. A number of people can observe the image.

Use a telescope or binoculars to project an image of the Sun on to a shaded screen. It is possible to obtain a clear image twice as large as the objective lens. However, extreme care must be taken. Constant supervision of pupils is essential. **The eyepiece must not be looked through, even for an instant.** A

warning notice on the instrument is recommended. The eyepiece can become very hot and damage to the instrument may result where lenses are cemented together. In fact, the concentrated beam of sunlight can set fire to an object placed too close to the eyepiece. Remove, or tape covers over, other optical devices attached (eg, a telescope finder or the unused half of the binoculars). The Sun needs to be continually 'tracked' to keep the image on the screen. The shadow of the instrument can be used to aid alignment.

Use a special solar projector. For the 1999 eclipse, Light Line (UK) Ltd designed an excellent solar projector which safely displays a 12 cm diameter image of the Sun on a screen placed on the ground, allowing viewing for a group of 6 or 7 people at a time. Schools that purchased this viewer can, of course, still use it for solar observations.

2.2 Viewing through a special filter

The Sun should be viewed directly only through a special filter which has been correctly certified as safe for directly viewing the Sun. In most cases the filter will be fitted in a spectacle-style viewer.

The performance of the filter is critical for safe viewing. The wide spectrum of radiation from the Sun includes invisible infra-red and ultra-violet; a filter which looks 'black' may still allow dangerous amounts of these invisible radiations through to the eye. Moreover, there may be no sensation of pain or discomfort until after the eye has been permanently damaged. Research indicates that one of the best types of filter is made from two layers of a special aluminium-coated plastic film (trade names include *Mylar*, *Solar-Skreen* and *Baader's AstroSolar*). The aluminium reflects nearly all the energy from the Sun.

For the 1999 eclipse, several companies were set up to sell solar viewers. It is possible that samples of these viewers are still available. However, if direct viewing of the Sun is attempted, it is important to ensure that spectacle-style viewers are of a good design. We reproduce below part of the guidance given at the time of the 1999 eclipse.

When deciding whether to use a particular viewer, you should ensure that each of the following applies.

- It has both a CE mark and a Department of Trade and Industry 'notified body number' printed on it or in the instructions that accompany it. If the 'notified body number' is not provided, the supplier should be able to let you know what it is. If you have any doubts about the authenticity of the certification, do not purchase or use the viewer. Your local Trading Standards Office should be able to offer advice.
- Full instructions are supplied which include the name and contact details of the supplier.
- The frames are large and sturdy enough to prevent accidental direct viewing of the Sun without a filter.

There are special cases where particular care should be taken or spectacle-style eclipse viewers should *not* be used. These are listed below.

- People with diseased eyes or those who have had eye surgery should not use filters to view the Sun.
- Those who wear spectacles should wear filters as close to their glasses as possible. Solar viewers may be available without side arms for spectacle wearers; these should be held firmly with both hands.
- The cardboard-framed, spectacle-style eclipse viewers are not very secure on small heads and may need elastic to hold them on. Young children may not recognise the danger in spite of instructions from their teachers or parents. They should not be allowed to use eclipse viewers ***without constant supervision***.

Even when viewing through a special filter, CLEAPSS advice is not to look for more than a few seconds at a time to monitor the progress of a solar event. Never move around when using a filter. Keep still in a comfortable position.

2.3 Viewing on television

This option is obviously the safest for any solar phenomenon sufficiently interesting to be broadcast, but not particularly adventurous!