

Don't look at the Sun: imparting the dangers of solar observation

Students of all ages find discussing solar eclipses and the dangers of looking at the Sun fascinating. As a backdrop for these discussions, I show my students an image of a damaged retina. See figure 1 for this image taken by ophthalmologist Charles Hunter and sent to me as a slide by physician Mark Clark, both of Anderson, South Carolina, US. The retina in this image was injured as a result of a patient looking at the Sun during a solar eclipse.

The results of Sun damage

The damage appears as a white region in the midst of dark area. The central portion of the retina, which includes the fovea for the perception of detail, is

darker due to the lesser density of blood vessels. The yellow region near the left edge is where the optic nerve joins the retina, the area of the normal blind spot [1]. To prevent solar eye damage, a safe way to view an eclipse is to look in the opposite direction of the Sun at an image formed by a pin-hole camera [2].

I ask my students why it is so dangerous to look at the Sun. Some respond that the intense light from the Sun focuses on the retina and burns it. Most students have seen a leaf being burned or even set on fire as a result of focusing sunlight with a magnifying glass (converging lens). I compliment the students on making this analogy. Then I proceed to tell

them that researchers have found an even more important factor in causing retinal damage than thermal effects [3–6]. I ask them what they think this second dangerous feature might be.

Negative response

This question draws a blank. So I prod them, asking them if they have ever experienced temporary difficulty in seeing for a few moments after something fairly common happened to them. If this hint doesn't do it, I mention a camera. Just about all the students have experienced a camera flash in their eyes. For a few minutes after the flash, you see a dark spot, i.e., a negative afterimage [7]. This is due to retinal fatigue [8], a photochemical effect. You can easily experience retinal fatigue if you stare at a coloured object or picture for 30 s and then look at a white wall. You see an image of the object in the complementary colour [7, 8].

Stay within the limits

I ask my students what happens if you exceed the limits for the eye to recover. What happens if you stress any part of your body beyond its limit to heal? They quickly see that permanent damage occurs. Since our eyes are so precious and the dangers of retinal harm due to bright light are so real, I conclude the lesson by telling my students 'Don't look at the Sun!'

For anyone interested in using figure 1 in class, a high-resolution JPEG version can be downloaded from the iop.org/journals/physed website. The file size is 700 k with pixel dimensions of 3100 × 2600. The image can be easily resized using readily available image software in order to suit your best needs for class presentation. If you post a version of the image for your students, please include a credit line: courtesy Mark Clark, photo by Charles Hunter, Anderson, South Carolina, US.

References

- [1] Farkas N, Donnelly K M, Henriksen P N and Ramsier R D 2004 The blind spot: re-educating ourselves about visual images *Phys. Educ.* **39** 294–7
- [2] Sang D 1999 The eclipse in the curriculum *Phys. Educ.* **34** 126–9
- [3] Chou B R 1997 Eye safety during solar eclipses – myths and realities *Theoretical and*

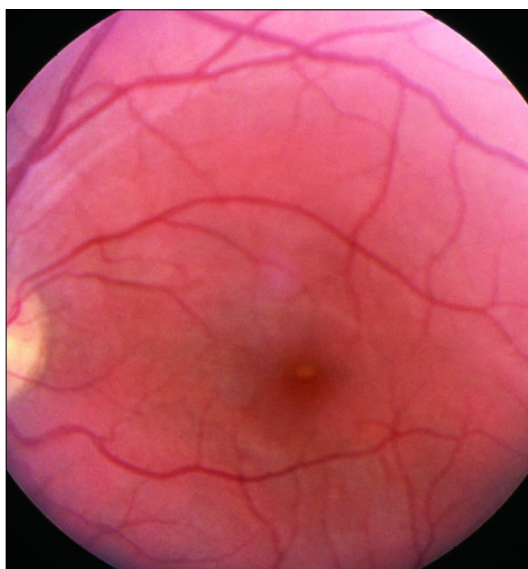


Figure 1. Retina damaged by viewing the Sun. See the white region in the midst of the surrounding dark area a little below the centre of the image. (Courtesy Mark Clark, photo by Charles Hunter, Anderson, SC, US).

- Observational Problems Related to Solar Eclipses* ed. Z Mouradian and M Stavinschi (Dordrecht: Kluwer Academic) pp243–7. Online at sunearth.gsfc.nasa.gov/eclipse/SEhelp/safety2.html
- [4] Voke J 1999 Radiation effects on the eye (Part 2): Viewing the solar eclipse *Optometry Today* June 18 1999 pp24–7. Online at www.optometry.co.uk
 - [5] Del Priore L V 1999 Eye damage from a solar eclipse *Totality: Eclipses of the Sun* 2nd edn ed. M Littmann, K Willcox and F Espenak (Oxford: Oxford University Press) pp140–1
 - [6] Vos J J and van Norren D 2001 Guest Editorial: Some afterthoughts about eclipse blindness *Ophthalmic Physiol. Opt.* **21** 427–9
 - [7] Gardner M 1998 Physics trick of the month: an apparition *Phys. Teach.* **36** 317
 - [8] Rossing T D and Chiaverina C J 1999 *Light Science: Physics and the Visual Arts* (Berlin: Springer) p406

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