

## ACTIVITY 11 – Binocular or Telescope Projection - Indirect viewing of a Solar Eclipse

**Year Level:** Years 3 to 12 (typically 8 to 18 years of age).

**Background:** The Queensland Government has provided advice on how to observe the eclipse safely. One of the recommended methods is to use binocular or telescope projection. Activity 10 describes how to make a pinhole projector. A pinhole projector is simple to make and is effective in showing the crescent shape of the sun during a solar eclipse. But the image is relatively dim and it will not show the observer any surface features on the Sun such as sunspots. Binocular or telescope projection will show not only partial eclipse phases but can also show sunspots. Students can use this method in Senior Physics to plot the rotation of these sunspots to determine the rotational speed of the sun at different Latitudes. Pinhole, Binocular and telescope projection are methods of indirectly viewing the Sun. This has the advantage that no one is looking at the Sun. Observers only view the projected image of the Sun. However it is essential that safety precautions be adopted to ensure that no one attempts to look through the binoculars or telescope at the Sun as this can cause immediate and serious damage to eyesight.

**Aim:** To learn how to construct binocular or telescope projection that will allow indirect viewing of a solar eclipse as well as observing sunspots.

**References:**

- Section 5 “How to Observe the Sun Safely” of the AAQ/STAQ teacher booklet.
- PowerPoint presentation PP05 “Observe the Sun Safely”

**Safety Warning:** Students should be reminded to never look directly at the bright surface of the Sun without suitable eye protection as permanent eye damage may result. This applies at any time and especially during the partial phases of a solar eclipse.

**Risk Assessment:** It is strongly recommended that for any activity involving the Sun teachers conduct a risk assessment before undertaking such an activity. This should include review of the Queensland Government’s safe viewing advice at:  
<http://www.fairtrading.qld.gov.au/safe-viewing-of-astronomical-events.htm>

**Shape of the Australian Curriculum: Science strands on focus areas.**

**Content descriptors: Year 3, 5, 7 and 10**

Science Understanding	Science as a Human Endeavour	Science Inquiry Skills
Yr 3 Earth’s rotation on its axis causes regular changes, including night and day (ACSSU048)		Yr 3 Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports (ACSIS060)

<p>Yr 5</p> <p>The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)</p>	<p>Yr 5</p> <p>Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena (ACSHE081)</p> <p>Important contributions to the advancement of science have been made by people from a range of cultures (ACSHE082)</p>	<p>Yr 5</p> <p>Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts (ACSIS093)</p>
<p>Yr 7</p> <p>Predictable phenomena on Earth, including seasons and eclipses, are caused by the relative positions of the sun, Earth and the moon (ACSSU115)</p>	<p>Yr 7</p> <p>Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world (ACSHE119)</p>	<p>Yr 7</p> <p>Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate (ACSIS133)</p>
<p>Yr 10</p> <p>The universe contains features including galaxies, stars and solar systems and the Big Bang theory can be used to explain the origin the universe (ACSSU188)</p>	<p>Yr 10</p> <p>Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE192)</p>	<p>Yr 10</p> <p>Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS208)</p>

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## Binocular Projection

This method of projection has benefits over the Pinhole Projector method in the sense that you can actually see features on the surface of the sun known as sunspots. You will also be able to easily see the phases of an eclipse of the Sun.

You will need:

- Binoculars;
- a tripod;
- a method of attaching the binoculars to the tripod – a dedicated mounting bracket or some form of sticky/duct tape; and
- a screen eg white paper glued onto cardboard.

Assemble as shown in the picture – it does not have to look pretty as you will see.



## METHOD

- 1) Attach the binoculars to the tripod. If using adhesive tape, attach the binoculars to the tripod so you still have control over the orientation levers.
- 2) Cut two holes in a piece of cardboard so the cardboard fits snugly over both of the objective lenses. The cardboard casts a shadow so the image of the Sun is more visible because it is surrounded by shade and there is better contrast. Cover one side of the binoculars with both eyepiece and objective lens caps. Otherwise you will see two images of the Sun which is not necessary.
- 3) **DO NOT LOOK THROUGH THE EYEPIECE TO FIND THE SUN!!!!** You will have to move the binoculars so they point towards the Sun while holding the piece of white paper on the cardboard about 30cm behind the eyepiece. Move the binoculars until you see the image of the sun appear. This is easier if you temporarily remove the cardboard with the two holes fitted over the objective lenses as you can move the binoculars such that the shadow of the binoculars is minimised. Once found you can use the focus knob on the binoculars to sharpen the image. It should look like the picture below. Then you can replace the cardboard with the two holes over the objective lenses.



- 4) You can experiment with adjusting the distance between the white paper and binoculars. It is better if the paper can be arranged to be a fixed distance from the binoculars to ensure that the image remains in focus. If the Sun is high the paper can be placed on the ground or on a table below the tripod. If the Sun is low then some method of attaching the screen to the binoculars or tripod should be found.
- 5) Do not place any object or body part between the binoculars and paper otherwise there is a danger of burns. Also this is a method of viewing the sun for short periods as components inside the binoculars may become very hot. Having a couple of minutes break every now and then is recommended.
- 6) This method has been used by students to record the daily position of Sunspots for assessment tasks.

# Telescope Projection

Telescope projection can be done in a similar way to binocular projection. You need to arrange a screen to project the image of the Sun from the eyepiece of the telescope and focus the image. Some telescopes come provided with a screen to project images on, otherwise it will be necessary to improvise one.

As with binocular projection it is vitally important that no one attempts to look at the Sun through the telescope. It is also important that any finderscope on the telescope remains covered.

## Solarscope

Commercially manufactured solar projection devices are available. One such example is a Solarscope. A Solarscope is a safe projection device where several people at a time can view the projected image of the Sun. Sunspots are easily visible and the progress of the partial phases of an eclipse can be easily observed.



### Important Safety Precautions:

Be very careful to ensure that for binocular or telescope projection, no one looks through the binoculars or telescope at the Sun. A responsible person must be in charge of the device at all times it is in use to ensure that:

- no one attempts to look through the binoculars or telescope
- the cover remains in place over the second lens for a pair of binoculars and the finderscope of a telescope; and
- no one puts hands or other body parts between the binoculars or telescope and the screen.

### Reference websites:

Listed below are websites that describe binocular and/or telescope projection.

<http://www.exploratorium.edu/eclipse/how2.html>

<http://spaceweather.com/sunspots/doityourself.html>

<http://www.csiro.au/Outcomes/Understanding-the-Universe/Tracking-spacecraft/solar-viewer.aspx>

Solarscope website:

<http://www.solarscope.com/en/index.en.html>