

ACTIVITY 08 – Find the Timing of an eclipse

Year Level: Years 5 to 12 (typically 8 to 18 years of age).

Background: To be able to observe a partial or total solar eclipse you must know the timing of the event. The timing is dependant on the observing location. There are a number of websites that can be used to determine the timing and other circumstances of an eclipse. This activity will allow students to use websites to investigate the 14 November, 2012 eclipse as viewed from their home, school or any other location. The same process can be used to investigate timing of other eclipses.

Aim: Use websites to find the accurate timing and other circumstances for the eclipse for any location, whether from the path of totality or from any location where a partial eclipse will occur.

References:

- Sections 4 “The eclipse on 14 November 2012” of the AAQ/STAQ teacher booklet.
- PowerPoint presentation PP04 “The eclipse on 14 November 2012”.

Safe Observing Message:

When discussing a solar eclipse students should be reminded that it is not safe to look directly at the Sun at any time and that safe viewing methods must be used to observe a solar eclipse.

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

Content descriptors: Years 5, 7 and 10

Science Understanding	Science as a Human Endeavour	Science Inquiry Skills
Yr 5 The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)	Yr 5 Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena (ACSHE081)	Yr 5 With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be (AC SIS231)

<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>Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS124)</p> <p>Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125)</p>
	<p>Yr 10</p> <p>Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community (ACSHE191)</p> <p>Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE192)</p> <p>People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions (ACSHE194)</p>	<p>Yr 10</p> <p>Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS199)</p> <p>Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS200)</p> <p>Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS204)</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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How to find the timing of an eclipse

There are several websites that are available to investigate the timing of solar eclipses. Two are described in detail here:

1. Using the NASA eclipse website.

This uses Google Maps to locate the observing location. There is an overlay which shows the path of totality. On selecting a location a popup window will provide the timing.

2. Using Google Earth and track overlay files (kmz files).

Google Earth must be installed on the computer. Use Google Earth to find the location. After downloading the kmz file and selecting a location, a popup window will provide the timing.

Both methods are able to calculate the timing quite accurately and the calculations are performed using a similar method. Method 2 gives a slightly more accurate result when determining the timing of the total eclipse. It does this by providing correction times using the most recently available (more accurate) data on the exact profile (mountains and valleys) of the edge of the Moon to determine exactly when the Sun will disappear and reappear behind the Moon. Generally the results between the two methods will agree within a few seconds and the difference will vary across the path of totality. The greatest difference will be found in the southern portion of the path (e.g., at Atherton).

Both methods are significantly more accurate than using a simulation program such as Stellarium. Expect results from Stellarium to be accurate to within about 2 or 3 minutes. Expect method 1 to be accurate to within a few seconds and method 2 to be accurate to within a second or so.

There are some online calculators that can also provide timing details of an eclipse.

Two examples are:

The Eclipse Chasers website by Bill Kramer:

<http://www.eclipse-chasers.com/tseCalculator.php>

Solar Eclipse calculator by Xavier Jubier:

http://xjubier.free.fr/en/site_pages/SolarEclipseCalculator.html

See each of these websites for instructions.

Although the instructions here refer to the eclipse of 2012, other eclipses can be investigated using the same resources.

1. Use the NASA eclipse web site

Go to the web site

<http://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2012Nov13Tgoogle.html>

This will show a map from Google Maps showing the path of the eclipse with red for the centreline and purple for the northern and southern limits of the path of totality.



You can zoom in and move the map. To zoom in use the + and – buttons, the zoom slider or roll the mouse wheel. Move the map to centre your location. Do this by click and drag or use the four way buttons at the top left. As you zoom in more and more details become visible.

At any time you can swap between the map view and satellite view or a hybrid view (both) using the buttons at the top right of the map.

When you have zoomed in and found your location click on any spot. A marker will appear and a window will open with a prediction of the eclipse times and other information for that spot. If the window does not open, move the cursor over the marker.

The window will show the latitude and Longitude of the location. At the top right will be whether the eclipse will be partial or total at that location and if it is total, the duration of totality. The date and times are in Universal Time (was called Greenwich Mean Time) and are on a 24 hour clock. For Queensland you will need to add 10 hours so that maximum eclipse should be around 6:30 AM on 14 November.

If the eclipse is total it will show each of the four contact times and the time of maximum eclipse. If the eclipse is partial at that location it will show only first and fourth contact as there will be no totality and the time of maximum eclipse. The altitude of the Sun and its azimuth position around the horizon from true North are also shown. If the eclipse is partial the magnitude of the eclipse (coverage of the Sun's diameter by the Moon at maximum eclipse – expressed as a fraction) will be shown.

The predictions can also be viewed in a new window via the **Eclipse Times Popup** button. You can select and copy this information to paste into a word processor. All markers can be removed using the **Clear Markers** button. Choose the **Large Map** check box to produce a bigger map.

For more instructions, see:

<http://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogleinfo.html>

Event	Date	Time (UT)	Alt	Az
Start of partial eclipse (C1)	2012/11/13	19:44:54.9	001.2°	108.7°
Start of total eclipse (C2)	2012/11/13	20:36:46.7	013.5°	105.3°
Maximum eclipse	2012/11/13	20:39:36.0	013.7°	105.2°
End of total eclipse (C3)	2012/11/13	20:40:25.7	013.9°	105.2°
End of partial eclipse (C4)	2012/11/13	21:40:12.9	027.8°	102.1°

2. Alternative using Google Earth and “kmz files”

To do this you will need Google Earth on your computer.

If you do not have it, go to <http://www.google.com/earth/download/ge/agree.html> and download the program.

Open Google Earth. You may have to close the tip window if it opens.

Go to the Xavier Jubier's eclipse web site:

http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleEarth.html .

Look in the list of Total or Hybrid Eclipses and find the “Total on Wednesday November 14 2012” and click on the link.

When the download window opens click on “Open”. This will download a KMZ file and run it using Google Earth. A KMZ file (Keyhole Markup language Zipped file) has the details of the lines that define the extent of the eclipse.

Google Earth should now appear with a series of lines over it.

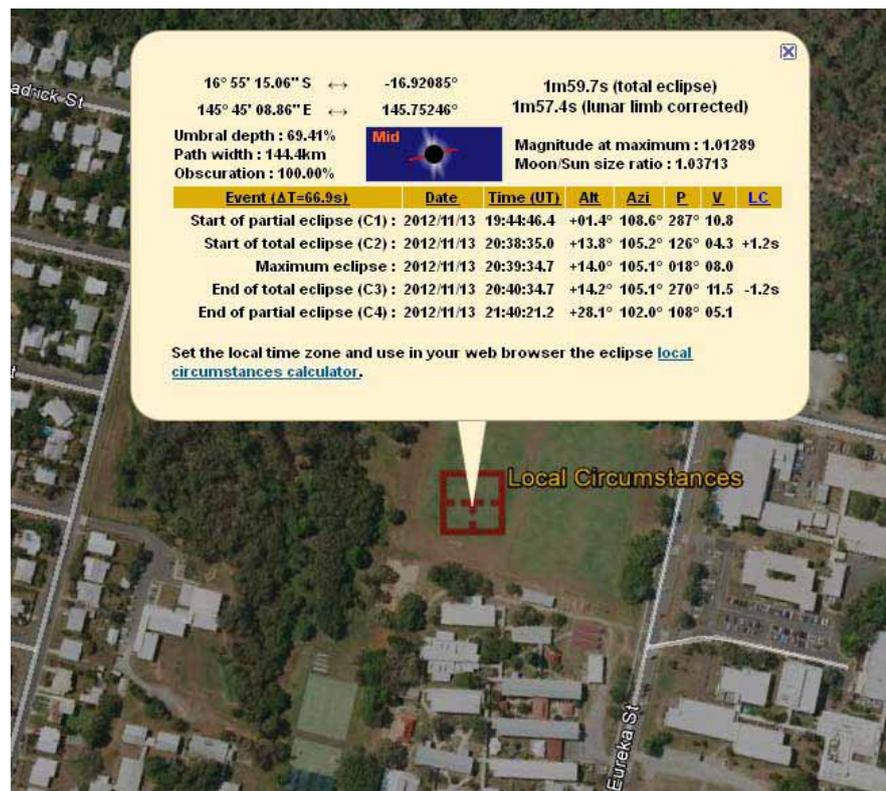
The blue line is the centreline and the red lines are the northern and southern limits of the path of totality. The green lines are the magnitude lines of the eclipse in 20% steps. (The magnitude is the coverage of the Sun's diameter by the Moon expressed as a percentage or a fraction). There are other coloured lines that mark the extremities of visibility of the eclipse.

Zoom in on Google Earth and find your location. To zoom in use the + and – buttons, the zoom slider or roll the mouse wheel. Move the map to centre your location. Do this by click and drag or use the four way buttons at the top right (lower set).

A red marker will appear in the centre of the screen. Move the view so that the red marker is over your location. Click on the red marker and a window with eclipse predictions will open.

This will show similar information to the NASA website but there is more information included. In the top left is the latitude and Longitude of the location. The date and times are in Universal Time (was called Greenwich Mean Time) and are on a 24 hour clock. For Queensland you will need to add 10 hours so that Maximum eclipse should be around 6:30 AM on 14 November.

The altitude of the Sun and its azimuth position around the horizon from true North are also shown for each eclipse event. P and V give a measure of where on the Sun's disk the Moon will contact the Sun. The diagram in the centre will show what the Sun and Moon will look like if you move the cursor over any of the eclipse event lines. LC (Limb Correction) is a measure of the correction that needs



to be applied to second and third contact times due to the irregular shape of the Moon. Including these corrections will give a more accurate estimate of the start and end of the total phase. If the eclipse is total, the duration of totality will be shown in the top right. This is the time calculated from the start and finish times in the table. Underneath that is a lunar limb corrected time that includes the values in the LC column and should be more accurate. If the eclipse is partial from your location the window will show three event lines. For a partial eclipse the magnitude of the eclipse (coverage of the Sun's diameter by the Moon at maximum eclipse – expressed as a fraction) can be seen to the right of the diagram. The obscuration (maximum fraction of the area of the Sun covered) can be seen to the left of the diagram.

A more detailed explanation of each of the above information can be found on this page: http://xjubier.free.fr/en/site_pages/SolarEclipseCalc_Diagram.html