

Activity 02 - Make a Model to Demonstrate an Eclipse

Grade Level: Grades 4–12 (typically from 10 to 18 years of age).

Background: Various objects can be used to make a model of an eclipse. The use of ratio and scale can be used to varying degrees depending upon the year level and skill.

Aim: Students will construct a model of the Earth and Moon to simulate eclipses.

References:

- Section 2 “What are Eclipses” of the AAQ/STAQ teacher booklet.
- PowerPoint presentation PP02 “How Eclipses Occur”.

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
<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>Yr 5</p> <p>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> <p>Compare data with predictions and use as evidence in developing explanations (AC SIS218)</p> <p>Communicate ideas, explanations and processes in a variety of ways, including multi-modal texts (AC SIS093)</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>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>In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task (ACSIS126)</p> <p>Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method (ACSIS131)</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>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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Make a Model to Demonstrate an Eclipse

Grades 4 – 12

It would be very difficult to make a true scale model of the Sun, Earth and Moon because of the very large size of the Sun and the distances between objects in the Solar system but it is possible to use everyday objects that are approximately to scale for the Earth and Moon but placed at distances which are not to scale.

Students can use the data in the table below or research the data by themselves. A good website is www.nineplanets.org.

	Moon	Earth	Sun
Diameter (km)	3 476	12 756	1 392 000
Distance to Earth (km)	384 400	-	149 600 000

By dividing the diameter of the Earth by the diameter of the Moon you find that the Moon is 3.67 times smaller than the Earth so the students need to find two balls where one is about 4 times smaller than the other. Depending on the age and ability of the students they may be able to work out the scale of the model compared to the real objects. Some of the numbers are very large so a scientific calculator using scientific notation or the Windows calculator on a computer may have to be used. They could then use this scale to work out where the objects should be placed and the size of the Sun to make an accurate model. A torch or other light can be used to represent the Sun.

Another useful site is: <http://www.clarkfoundation.org/astro-utah/snippets/scrunch/index.html>

Students can use the following website to automatically calculate the sizes: http://www.exploratorium.edu/ronh/solar_system/.

Student Activity

Find the diameter of and the distances to the Moon and the Sun from the Earth and record the information in the following table. If you have access to the internet a good site is www.nineplanets.org.

	Moon	Earth	Sun
Diameter (km)			
Distance to Earth (km)		–	

Work out how many Moons fit across the Earth using

Earth diameter / Moon diameter = _____

Now you need to find two round objects that roughly fit this ratio.

When you have the objects that will represent the Earth and the Moon and you have a light source (torch) to stand in for the Sun, try positioning your Moon between your Sun and your Earth such that the Moon in its orbit around the Earth passes between the Sun the Earth and casts a shadow on the Earth to create an eclipse.

Scale Activity

If the scale of your model Earth to the real Earth is calculated you can work out how far the Sun and Moon need to be away from the model Earth to be a truly accurate model.

Measure the diameter of your Earth by first measuring the circumference of your Earth using a tape measure or a string and ruler and then divide this by π (approximately 3.14).

Model Earth Circumference = _____ cm

Model Earth Circumference / π = _____ cm

To work out the scale you will need to use the same units of length for the model and real Earth.

Earth's real diameter = _____ km

= _____ m

= _____ cm

The scale ratio can now be written as

Model Earth diameter (cm): Real Earth diameter (cm)

= _____ : _____

Scale and ratios are usually written with a 1 on one side so divide both sides by the Model Earth diameter. This will make the left side of the scale a 1. Don't worry about any decimals, just round it to the nearest whole number.

Model Earth diameter / Model Earth diameter: Real Earth diameter / Model Earth diameter

= **1** : _____

The number on the right side of the ratio tells you how many times the real Earth is bigger than your model. You can now use this number to scale down the numbers that you found in the table at the top of this worksheet but it will be easier if you convert all of the km values into metres.

	Moon	Earth	Sun
Diameter (m)			
Distance to Earth (m)		–	

Now divide each of these values by the large number on the right of the ratio to get the scale diameters and distances.

	Moon	Earth	Sun
Scaled Diameter (m)			
Scaled Distance to Earth (m)		–	

What object could you use for the Sun? _____

Write down where you could place your model objects at your school to make your model accurate.

Challenge - try to work out the scale distances for the rest of the solar system.

Extension activities using the model:

Demonstrate how a lunar eclipse works.

Research and show why there isn't an eclipse every full Moon.