



# Creating eclipses in the classroom

Image courtesy of Dylan O'Donnell / deography.com

During an eclipse, the Sun or the Moon seems to disappear. What is happening? Why not explore this fascinating phenomenon in the classroom, with an easy to build model?

Successive pictures (bottom right to top left) of the Moon as it slowly crosses into the shadow of Earth

By Marissa Rosenberg from EU Universe Awareness

Solar and lunar eclipses are astronomical phenomena that have been shrouded in myth and legend throughout history. The ancient Chinese, for example, believed that solar eclipses occurred when a celestial dragon devoured the Sun. The Chinese word for an eclipse, 'chih', even means 'to eat'.

Because eclipses are frequent and can be observed without a telescope, they are an excellent topic for introducing astronomy at school. This article describes a simple activity to help students aged 6-14 to understand eclipses, our Solar System and the motion of Earth and the Moon within it. The students begin by building and using their own model of the Sun,

Moon and Earth. To consolidate and expand on what they have learned, the UNAWA project<sup>w1</sup> – an astronomy programme that fosters universe awareness – then enables the students to work with other schoolchildren around the globe. What time of day is it for them? What season? What can they see in the sky at a particular moment?

## Lunar eclipses

Although the Moon appears brightly in the night sky, it does not in fact shine but simply reflects the light from the Sun. The shape of the Moon that you see depends on both where you are on Earth and where the Moon is in its orbit around Earth. Every month the Moon completes a cycle, starting as a complete circle (at full moon), shrinking to become almost invisible (at new moon), then swelling

to a full circle again; these stages are called the phases of the Moon (figure 1). To learn more, see Mitchell et al., 2008.

Usually, when the Moon is on the far side of Earth from the Sun (figure 1B), the three bodies do not lie in a straight line; instead, the Moon is slightly above Earth and is still illuminated, so we see a full moon. Occasionally, however, Earth passes directly between the Sun and Moon, and the Moon is completely in the Earth's shadow – we call this a lunar eclipse. You can see it with the naked eye, as the Moon enters the Earth's shadow (the *umbra*) and travels across it, taking on a beautiful dim red glow<sup>w2</sup>. As the Moon crosses in or out of the *umbra*, you can even see the curve of Earth partially shadowing the Moon (see image above). This partial shadow is called the *penumbra*.



- ✓ Physics
- ✓ Astronomy
- ✓ Earth and space
- ✓ Art
- ✓ Languages
- ✓ Ages 8-14

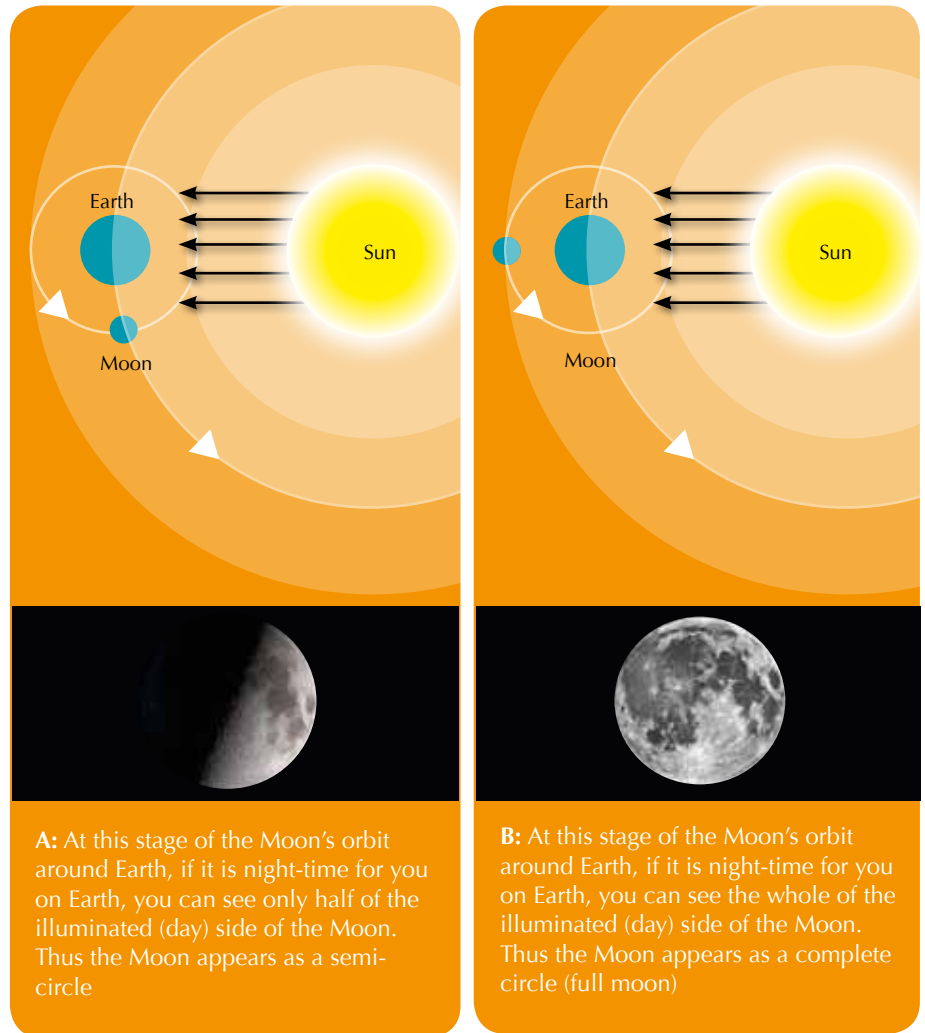
Eclipses provide an excellent opportunity for students to understand how day, night and the seasons are affected by our position on Earth relative to the positions of the Sun and Moon. This article describes hands-on activities in which the students build a model of Earth, the Moon and the Sun to show lunar and solar eclipses. Models of heavenly objects serve to bring fascinating phenomena closer to the learner and enable students to make sense of an otherwise mysterious sky.

The article also raises the possibility for students in different countries to link via video conferencing with other classes around the world and thus better understand how what we see in the sky at any one point is affected by where we are on Earth. Students learn best when they feel that they own the experience. In this way both the receiver and transmitter experience the learning in context.

*Angela Charles, Malta*

REVIEW

Images courtesy of Marissa Rosenberg (diagrams) and NASA (Moon images)



**Figure 1:** The phases of the Moon. The circles represent the orbits of Earth around the Sun and the Moon around Earth. The shaded areas represent darkness: at any one time, one-half of Earth and one-half of the Moon are illuminated by the Sun

### Solar eclipses

Unlike lunar eclipses, solar eclipses are very rare. Most people will never see one because solar eclipses are only visible from relatively small areas of Earth at any one time. Solar and lunar eclipses have somewhat different causes: during a solar eclipse, *we* are in shadow. When the Moon passes exactly in front of the Sun, it casts a shadow on Earth. Because the apparent size of the Moon is so much less than that of the Sun, this shadow will only be seen in a small area of Earth. To understand this, hold your thumb in front of the Sun so that it is com-

pletely covered. Your eyes are in the shadow of your thumb, but it does not affect the person standing next to you, as they are not in the same shadow. They see the Sun as normal. Once the Moon moves directly between Earth and the Sun<sup>w3</sup>, the sky takes on a spooky twilight, which causes animals to become confused. The air cools and, during a total eclipse, the Moon appears as a black disk in the sky surrounded by a crown of fire. That fire is actually the Sun behind the Moon; as the Moon passes, the full burning light of the Sun returns.

## Eclipses in the classroom

Building the Sun-Earth-Moon system described below will allow your class to discover how and why eclipses happen. They will be able to understand exactly what they are seeing if ever they see a real eclipse. Building the model, which is not to scale, takes about 45 minutes.

### Materials

For each model, you will need:

- Adhesive tape
- Glue
- Two cardboard tubes (e.g. empty toilet rolls)
- Torch
- Scissors (suitable for cutting cardboard)

Image courtesy of Marissa Rosenberg



Step 3: making the base to support Earth

Image courtesy of Marissa Rosenberg



Step 5: Placing Earth on its base

Image courtesy of Bill Livingston, NSO / AURA / NSF



Three-quarter solar eclipse observed at the Kitt Peak Vacuum Telescope on 10 June 2002

Image courtesy of Bill Livingston, NSO / AURA / NSF



The 'diamond ring' effect occurs when only a tiny sliver of the Sun is visible around the Moon during a total solar eclipse

- Aluminium foil
- Sturdy but bendable wire (35-50 cm long)
- Styrofoam ball the size of a large orange
- Ping pong ball (or a Styrofoam ball of a similar size)
- Large strip of cardboard (about 60 cm in length and no less than 20 cm in width)
- Stack of books or magazines

### Method

1. Divide the class into groups of three or four. Give each group their own materials to make the model.
2. Take one cardboard tube and make a series of small (2 cm) even, vertical cuts around the circumference of each end.
3. At each end, bend the cut pieces out, then stand the tube upright. At the top, the cut edges should fan out like a flower (see image).
4. Using adhesive tape, fasten one end of the cardboard tube to the strip of cardboard; this is the base of the model. The tube should be at least 30 cm from one end of the cardboard strip.
5. Using tape or glue, attach the larger ball to the open flower of the tube. This ball is Earth.
6. Cover the smaller ball with aluminium foil, shiny side out. This is the Moon.
7. Insert one end of the wire into the top of Earth, so that the wire is vertical.
8. Measure a finger's length along the wire. Bend the wire at a right angle to give a horizontal arm.
9. Insert the other end of the wire into the Moon.
10. About halfway between Earth and the far end of the cardboard strip, measure a finger's length along the wire and bend it downwards at a right angle, toward the cardboard base. The Moon's equator should be at the same height as Earth's equator.
11. Balance the torch on a stack of books or magazines at the other end of the cardboard strip from Earth. Make sure the height is correct: the middle of the torch beam should hit Earth's equator. If the beam is too diffuse, attach the second cardboard tube to the end of the torch to direct the light

Images courtesy of Marissa Rosenberg



Step 10: Bending the wire so that the equators of the Moon and Earth are at the same height



Step 11: Adjusting the Moon and Sun so that the light from the Sun hits Earth's equator and the Moon can directly block the Sun's rays from reaching Earth



Creating a solar eclipse



Creating a lunar eclipse



Image courtesy of NSO / AURA / NSF

The delicately structured glow of the solar corona, as seen during the total eclipse of the Sun on 7 March 1970. The corona is visible to the naked eye only during an eclipse

Physics

horizontally. Ensure the beam hits the nearest half of Earth and the Moon directly. If the beam is not bright enough, move the stack of books closer.

### Using the model

Duration: 30-45 minutes.

1. Ask your students if they have ever seen an eclipse. Was it a solar or a lunar eclipse<sup>w4?</sup> Explain that solar eclipses are much rarer but

today they will be lucky enough to see both.

2. Create a solar eclipse. Stand facing the torch and swing the wire around until the Moon casts a shadow on Earth; if necessary, dim the lights. The Moon is now between Earth and the Sun and is blocking the sunshine for some people on Earth. Point out that only people directly in the shadow see a complete eclipse of the Sun.

You can show how the shadow moves by slowly rotating the wire.

3. Now create a lunar eclipse. Stand facing the torch and swing the wire so that the Moon is behind Earth. No light should be hitting the Moon: Earth is between the Sun and the Moon, casting a shadow over the entire Moon. Explain that unlike during the solar eclipse, the entire 'night side' of Earth can see the lunar eclipse.

## International collaboration

Collaborating with other schools worldwide can help your students to understand the subject even better.

1. Contact UNAWE<sup>w1</sup> to facilitate a Skype session with a school class in another part of the world. UNAWE will strive to connect schools that speak the same language.
2. Put the students in your class in pairs; they will speak to a pair of students from the partner class.
3. Ask each pair of students to make a list of five relevant questions to ask their international partners. The first two questions could be:  
Ages 6-10:
  - What does the sky look like to you right now? What time is it?
  - Do you know any stories or legends about why eclipses happen?Ages 10-14:
  - Are there any superstitions in your culture about eclipses?
  - If there was a lunar eclipse, could we both see it at the same time? What about a solar eclipse? [The answers will depend on the location of the two countries involved.]
4. During the Skype session, the pairs of students can take turns to ask each other their questions and record the answers.
5. After the Skype session, your students can present their international partners and their answers to the rest of the class.

## Discussion

Ages 6-10:

During a lunar eclipse:

- Which bright object is in shadow? Which object is casting the shadow?
- Does everyone in the world see it? Who can't see a lunar eclipse?

During a solar eclipse:

- Which bright object is covered up? Which object is blocking the sunlight?
- Does everyone in the world see it? Who can't see a solar eclipse?

- Draw a picture showing the positions of the Moon, Earth and Sun during a lunar and a solar eclipse. (Use the model to help.)
- Do you see lunar eclipses at night or during the day? What about solar eclipses?
- Why are solar eclipses so much rarer than lunar eclipses?

Ages 10-14:

- During a solar eclipse, what would you see if you stood on the Moon and looked at Earth?
- What is the phase of the moon during a solar eclipse? And during a lunar eclipse?
- Why don't we see a lunar eclipse during every full moon?
- Do other planets have eclipses?

## Reference

Mitchell WA et al. (2008) Science for the Next Generation: activities for primary school. *Science in School* 10: 64-69. [www.scienceinschool.org/2008/issue10/nextgeneration](http://www.scienceinschool.org/2008/issue10/nextgeneration)

## Web references

w1 – UNAWE is an astronomy programme to educate and inspire young children around the world. To learn more and get in touch, visit: [www.unawe.org](http://www.unawe.org)

w2 – For a video explanation of why the Moon looks red during a lunar eclipse, see [www.bbc.co.uk/news/science-environment-13787011](http://www.bbc.co.uk/news/science-environment-13787011) or use the shorter link: <http://tinyurl.com/7v6vxy>

w3 – For more information about how solar eclipses occur, see: [www.mreclipse.com/Special/SEprimer.html](http://www.mreclipse.com/Special/SEprimer.html)

w4 – For a comparison of lunar and solar eclipses, see: [www.moonconnection.com/lunar\\_vs\\_solar.phtml](http://www.moonconnection.com/lunar_vs_solar.phtml)

## Resources

For another classroom activity to model an eclipse, using fruit, see the website of the Lunar and Planetary Institute ([www.lpi.usra.edu](http://www.lpi.usra.edu); search

for 'fruit loops') or use the direct link: <http://tinyurl.com/cz8xxmu>

Lunar Eclipse 2105 is a fun, scientifically accurate story of an eclipse being viewed from our Moon by a young boy. It could be a good starting point for other lunar eclipse activities. See the website of NASA Science ([www.science.nasa.gov](http://www.science.nasa.gov)) or use the direct link: <http://tinyurl.com/2ctfkct>

For photographs and information about the lunar eclipse of 15 June 2011, which could be seen all over Europe, see: <http://eaae-astronomy.org/blog/?cat=38>

To find out how two school students investigated and observed an eclipse in a prize-winning project, see:

Pathmanathan P (2007) Students Catch a Star: researching and observing a solar eclipse. *Science in School* 7: 39-44. [www.scienceinschool.org/2007/issue7/catchstar](http://www.scienceinschool.org/2007/issue7/catchstar)

If you found this article useful, you may like to browse the other astronomy articles in *Science in School*. See: [www.scienceinschool.org/astronomy](http://www.scienceinschool.org/astronomy)

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To learn how to use this code, see page 65.

