

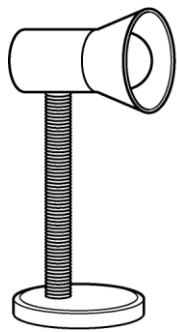
Modelling an eclipse – activity sheet

You are going to model a solar eclipse.

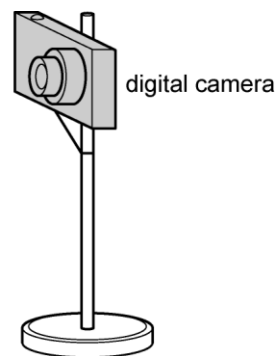
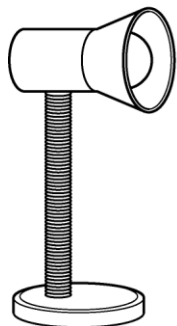
- The lamp will be the Sun in your model.
- The football represents the Earth.
- The tennis ball represents the Moon.

To do and to answer

1 Set up the apparatus as shown in the diagram



- 2 Turn on the lamp and adjust the positions of the football and tennis ball until the shadow of the tennis ball appears on the football.
- 3 Describe the shadow of the tennis ball. It will not be sharp and clear!
- 4 Make sure you can see both parts of the shadow:
 - a dark central area (called the **umbra**)
 - a lighter outer area (called the **penumbra**)
- 5 Why can a solar eclipse only be seen from some places on the Earth, and not from everywhere? (**Hint:** look at the shadow on your model.)
- 6 Replace the football with a digital camera or webcam mounted on a stand, as shown below.



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- 7** If you can, connect the camera to a computer and a data projector (or directly to a data projector) so you can watch the view from Earth 'live'. If this is not possible, set the camera to capture a film clip.
- 8** Line up the tennis ball and lamp carefully, adjusting the distances so that the tennis ball just covers the lamp when seen through the camera.
- 9** Point the camera 90° away from the tennis ball and begin recording. Slowly turn the camera through 180° so that it gradually comes to face the tennis ball and then turns to face 90° away in the other direction.
- 10** Watch your film clip. It should look a little like the clip of a real eclipse you saw earlier, although getting a really good clip of your own may take a few attempts!
- 11** Which way does the 'Moon' appear to move compared to the way in which you rotated the 'Earth'?
- 12** Draw a sequence of pictures to show what you saw in the 'solar eclipse'.

You have just modelled a total solar eclipse.

- 13** If you have time, try using the lamp, football, and tennis ball to model
 - a** an annular eclipse (the Moon is further away from the Earth and does not cover the Sun completely)
 - b** a lunar eclipse (the Earth moves between the Sun and the Moon and blocks the light falling on the Moon)

Modelling an eclipse

Teaching notes

This activity shows the relative positions of the Sun, Earth, and Moon during a solar eclipse and during a lunar eclipse. It also shows that, in a solar eclipse, it is the rotation of the Earth that produces the apparent motion of the Moon across the Sun.

Procedure

The activity sheet is written for students to carry out in pairs but it could be a demonstration. Alternatively, students could do the activity apart from the filming, which you could demonstrate or film in advance. It is best to show a good version to the whole class at the end.

Students start by producing a stationary eclipse and observe the umbra and penumbra. They then rotate a camera in place of the Earth to film the eclipse. You may need to give advice here (see Technical notes). Students then view their eclipse film.

A lunar eclipse can be modelled by changing the position of the football and the tennis ball, and an annular eclipse by moving the tennis ball further from the football.

After showing a good example of the film, explain what is seen in a partial eclipse by observers in the penumbra (a partially covered Sun). Emphasise that it is the rotation of the Earth that makes the Moon appear to move in front of the Sun. This is a good time to show some applets or animations.

Requirements *(per pair)*

- Activity sheets
- football
- tennis ball
- digital video camera, webcam or digital camera capable of taking video clips
- flexible lamp
- clamp stands

Alternatively, this activity can be done as a demonstration.

Technical notes

Blackout is required.

The balls could be fixed permanently on clamp stands and kept for this activity. Or you could hang them from the ceiling with string, although they do tend to swing a little!

Objects should be of the order of a metre apart, depending on the sizes of balls and lamps.

To see the umbra and penumbra clearly, you need either a light and uniformly coloured football or a white screen placed in front of the football.

Producing a good film clip may require some practice. You may want to film one in advance and save it for display in this and future lessons. Step 9: students may obtain a better result by tracking the camera sideways slightly as well as rotating it.

If students are using webcams, they could view their eclipse as it happens.

Health and safety notes

Remind students that they should never view the Sun directly with the naked eye and certainly not with optical instruments.