Key lesson outcomes

<table>
<thead>
<tr>
<th>Students will be able to represent their current understanding as they:</th>
<th>Science*</th>
<th>English</th>
<th>Maths</th>
</tr>
</thead>
<tbody>
<tr>
<td>• identify features of scientific dialogues and debates</td>
<td>AC SHE081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• discuss different theories about the movements of the Earth, Sun and Moon</td>
<td>AC SHE083</td>
<td>AC LA1502</td>
<td>AC LY1699</td>
</tr>
<tr>
<td>• contribute to discussions about Earth’s place in Space</td>
<td>ACSU031</td>
<td>AC LT1609</td>
<td>AC LY1796</td>
</tr>
<tr>
<td>• identify the purpose and features of a science journal and work wall</td>
<td>ACSHE021</td>
<td>AC LA1500</td>
<td>AC LA1512</td>
</tr>
<tr>
<td>• contribute to the beginning of a TWLH chart</td>
<td>ACSIS231</td>
<td>ACELY1699</td>
<td>AC MPS118</td>
</tr>
<tr>
<td>• work in teams to create orals to represent their understanding of the movements of the Earth, Sun and Moon</td>
<td>ACSIS088</td>
<td>ACELY1796</td>
<td></td>
</tr>
</tbody>
</table>

*SU—Science Understanding, SHE—Science as a Human Endeavour, SIS—Science Inquiry Skills

This lesson also provides opportunities to monitor the development of students’ general capabilities (highlighted through icons, see page 5).

Session 1 Eratosthenes’ epiphany

Teacher background information

How scientists think and work

Scientific knowledge is a set of explanations made by scientists based on observations and evidence. These explanations have been built up over time in an attempt to explain how the world works, and continue to be revised as new evidence emerges.

Scientists conduct investigations in order to test ideas and find evidence; however, the conclusions and explanations drawn from the evidence can be influenced by the life experiences and beliefs of the scientists. Scientists are a part of the world they study and their ideas can be influenced by it.

When scientists disagree, they first check the available information. In scientific publications the authors highlight their procedure so that the investigations can be replicated. Scientific debate is, however, generally about what conclusions can be drawn from the available evidence. The example given in this unit is a debate between Eratosthenes (Err-ah-toh-the-neez) — a Greek mathematician and astronomer who lived around 200BC — and a member of the general public who is of the belief that the Earth is flat based on their everyday experience. The theory that the Earth was flat was not a scientific theory, however, it was disproved using a scientific method. It provides a good example for students of how scientists have to examine carefully the ideas and evidence of their everyday lives.
The dialogue presented here is imagined, since various philosophers in previous centuries had argued that the Earth was spherical, including Pythagoras (who noted the shapes of lunar eclipses) and Aristotle. Eratosthenes was chosen as a subject for the play as he used the described investigation not only to show that the Earth was spherical but also to calculate its size.

**The described investigation**

The Greek scholar Eratosthenes' investigation of the size of the Earth occurred during the 'summer solstice' of the Northern Hemisphere in the 2nd century BC. The summer solstice is the day when the North Pole is tipped the closest to the Sun. The Sun therefore rises the highest in the sky on this day, however it will only be exactly overhead for cities that are on the Tropic of Cancer. The ancient Egyptian city of Swenet (Syene to the Ancient Greeks and Aswan today) is on the Tropic of Cancer. The city of Alexandria is north of Swenet.

By measuring the shadows produced at high noon on the summer solstice in Alexandria (the point at which the Sun reaches its maximal point), Eratosthenes could calculate the angle of elevation of the Sun. It was one-fiftieth of a circle, therefore he estimated that the distance between the two cities was one-fiftieth of the circumference of the Earth. He checked the distance between the two cities by calculating travel times between them, and came up with a solution that was accurate with an error less than 2 per cent. This is surprising given the possible sources of error, including using a model that assumed the Sun appeared as a point of light in the sky not a disc, and distances calculated by overland travel were not the most reliable as deviations were sometimes made to ensure water supply.

**Students' conceptions**

Students have a range of conceptions or non-scientific ideas about the Sun and Earth, as it is not obvious that we are on a spherical planet that is orbiting the Sun. Students might say that they think the Earth is round or spherical, but when they respond to questions their answers will often indicate that they believe it is flat like a plate. If most students in the class still have this conception, it might be necessary to review activities in *Spinning in Space*.

**Equipment**

**FOR THE CLASS**

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'But it looks flat' (Resource sheet 1)
- 1 enlarged copy of 'Debating our place' (Resource sheet 2)
- 3 pieces of A4 paper
- *Optional:* cards or paper strips for words for the word wall
- *Optional:* multimedia resources on Eratosthenes (see 'Preparation')

**FOR EACH STUDENT**

- science journal
- 1 copy of 'But it looks flat' (Resource sheet 1)
- *Optional:* 1 copy of 'Debating our place' (Resource sheet 2)