**Modelling the Earth**

This model demonstrates the spin of the Earth and its movement around the Sun that explain a day and a year.

**Safety**

There may be tripping hazards, which can include a cable plugging the light source into the mains

**Apparatus and materials**

* Bright light source, an overhead projector is ideal
* Globe
* A room that can be darkened (closing blinds is often sufficient)

**Procedure**

The globe represents the Earth.

The light source is place in the centre of a room, perhaps on a stool or a desk. This represents the Sun. It is not to scale, and it may be appropriate to discuss this with the class – to scale it will have a diameter a hundred times that of the globe.

**Make sure there are no trailing wires to trip over.**

*The Earth is a sphere*

* Ask students to find places and countries that they know on the globe to help them make the connection between the globe and where they live.

*A day is caused by the spinning of the Earth*

* Stick a small piece of Blu-Tack, or something similar, on the globe to mark where you live.
* In a darkened room shine the bright light at the globe so that half is clearly lit up and half is clearly in shade.
* Slowly spin the globe and notice how the Blue-Tac moves from light to dark and back to light through one complete rotation.
* Note that it takes the Earth one full day to spin once on its axis. \*\*

\*\* In 24 hours the Earth spins slightly more than once, but it has also moved 1/365 of the way around the Sun. These two movements combine so that 24 hours is the time it takes for one point on the surface that exactly faces the Sun to spin round and again point exactly at the Sun.

*A year is defined as the time it takes the Earth to orbit the Sun*

* Walk around the light source (Sun) slowly in a circle.
* Explain the time it takes for the Earth to orbit the Sun is what we call a year.
* It takes 365¼ days for one complete orbit.
* Show the Earth spinning on its axis as it orbits.

*Physics > Big idea PES: Earth in space > Topic PES1: Solar System and beyond > Key concept PES1.1: Planets and the Solar System*

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| **Response activity** |
| **Modelling the Earth** |

**Overview**

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| Learning focus: | In the Solar System: eight planets orbit a star called the Sun; moons orbit most of the planets; and the planets spin on their axes. We live on the Earth where: a year is defined as the time for the Earth to orbit the Sun; a day as the time it takes the Earth to spin on its axis; and the Moon orbits in about 28 days. The planets are very small compared to the huge distances between them. |
| Observable learning outcome: | * Identify that we live on the surface of the Earth which is a sphere. * Describe how the Earth spins on its axis and explain what a day is. * Describe how the Earth orbits the Sun and explain what a year is. |
| Activity type: | Clarifying – demonstration with a model |
| Key words: | Earth, Sun, axis, orbit |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: The Earth
* Diagnostic question: Day and night
* Diagnostic question: Sun, Moon and Earth

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| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

It can be tempting to keep work on the Solar System simple and descriptive when in fact it is conceptually demanding (Osborne, 2011). The scientific explanations for simple observations such as the Sun moving across the sky each day are not obvious and sometimes counter intuitive. The Sun’s ‘movement’ across the sky happens not because the Sun is moving, which is the most obvious explanation, but because the Earth is spinning on its axis.

A study of thirty-two Tasmanian students identified a progression in students’ thinking from a model with the Earth at the centre, which was held by about three-quarters of the 9- and 10-year-olds, to a model with the Sun at the centre that is understood by the majority of the 11- and 12-year-olds (Jones, Lynch and Reesink, 1987). To correctly explain observable phenomena that are caused by movement of the Earth, Sun and Moon students need to understand the correct scientific model. If they are using a model that is incorrect students are likely to form further misunderstandings and about a quarter of 11- and 12-year-olds are using incorrect models.

One of the key findings of Lelliott and Rollnick's (2009) review of astronomy education research (1974-2008) was the need for teachers to use physical models both to scaffold learning and to challenge misunderstanding.

**Ways to use this activity**

This demonstration gives you the opportunity to re-teach a challenging concept, and show your students how it builds up from simpler ideas, using a structured teacher-led discussion.

You should use carefully selected questions to check your students’ understanding of each step, before progressing onto the next one.

The steps you follow in this demonstration might be:

* Show the Earth is a sphere
* Show how a day is caused by the spinning of the Earth
* Show how a year is defined as the time it takes the Earth to orbit the Sun

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’.

**Equipment**

For the class:

* Bright light source, an overhead projector is ideal
* Globe
* A room that can be darkened (closing blinds is often sufficient)

**Technician notes**

The light source used needs to be bright enough to light up a globe so that one side is brightly lit and the other half in deep shade. A fixed whiteboard projector is not usually suitable because reflection of light off the whiteboard means that there is insufficient contrast between light and shade on the globe.

The teacher needs to walk around the light source in a circle. It can be placed on a table or a stool, with no trailing wires.

**Health and safety**

There may be tripping hazards including cables plugging the light source into the mains.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Acknowledgment**

Developed by Peter Fairhurst (UYSEG).

**References**

Jones, B. L., Lynch, P. P. and Reesink, C. (1987). Children's conception of the Earth, Sun and Moon. *International Journal of Science Education,* 9(1)**,** 43-53.

Lelliott, A. and Rollnick, M. (2009). Big Ideas: A review of astronomy education research 1974-2008. *International Journal of Science Education,* 32:13**,** 1771-1799.

Osborne, J. (2011). Earth in Space. In Sang, D. (ed.) *Teaching Secondary Physics.* London: Hodder Education.