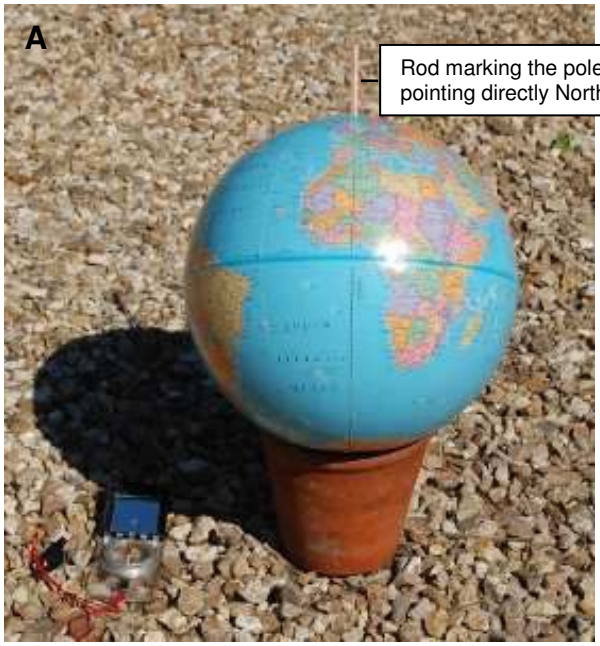
Earth on Earth

Using a globe in the sunshine to show how day/night and the seasons work

Set up a globe outside in the sunshine in a similar position to our globe, as in Photo A – this means that your own country is facing vertically upwards, with the pole in the correct position. Do this by placing your globe on a firm circular base like a flowerpot, in an open space. This may mean taking the globe from its stand and using a rod such as a pencil to show the position of the pole. Ensure that your country is indeed facing vertically upwards and use a compass to make sure that the rod is pointing in the direction of the pole.

In the photo below, taken in the UK, the UK is facing vertically upwards and the polar pointer is pointing towards the North Pole shown by the compass.

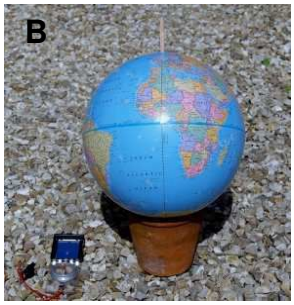


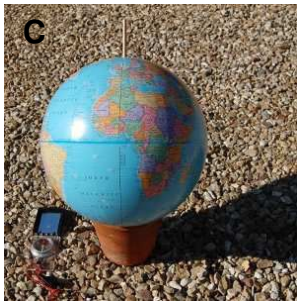
Using the globe to teach day and night

This set up means that the globe is in exactly the same position as the Earth you're standing on – so that areas lit by sunlight on the model globe are areas of day on the whole Earth, while areas in shadow are in darkness. The edge of the shadow is dawn on the western side and dusk on the eastern side.

In Photo A, the image was taken at 1100 GMT when the Sun was not overhead, showing that it was day over most of the globe (lit by sunlight), but South America in the shade was still dark (night time), with dawn approaching.

Photo B was taken at noon (1200 GMT), when the whole of the globe seen in the photograph was in 'daylight'. Photo C was taken at 1700 GMT showing that night had come to the eastern part of Africa, since it was in shadow. Dusk was approaching western Africa and Europe.





When set up, use the globe to ask your pupils to point out where it is daytime on the globe (and the real Earth), where it is night-time, and where on Earth people will be watching sunrise and sunset. If you can revisit the globe at intervals during the day, the pupils can see the changes as the Earth spins under the Sun, and be reminded that Earth rotates once every 24 hours.

Using the globe to teach the seasons

The seasons are caused by:

a) more heat reaching the Earth' surface in the equatorial regions than at the poles and
b) Earth's tilted axis causing, in the summer, the Sun to be overhead at the tropics whilst one of the poles is in darkness and the other is lit.

You can show this on your globe because:

a) after the globe has been in the Sun for a few minutes, you can clearly feel with your hand that the equatorial regions are warmer than the lit pole;
b) if it is summer when you have set up your demonstration, one pole is lit whilst the other is in darkness.

Photo D was taken at 1100 GMT in the UK in late April (at the same time as Photo A, but from a different side). It shows that the North polar regions are lit during the day (while the South polar regions are in shadow – see Photo A). The equatorial regions felt warmer than the North polar region, because sunlight was more concentrated where the Sun was nearer to being overhead.

Use the globe to ask your pupils how they can tell from the globe which season it is. Invite them to feel the globe and to spot and explain the warmest and coolest parts.

Photos: Chris King.

The back up

Title: Earth on Earth

Subtitle: Using a globe in the sunshine to show how day/night and the seasons work

Topic: A model globe is fixed in the same position, relative to the Sun, as the real Earth, allowing pupils to clearly see how day and night and the seasons work.

Age range of pupils: 9 – 16 years

Time needed to complete activity: 15 mins or longer if the globe is revisited at intervals during a sunny day.

Pupil learning outcomes: Pupils can use the 'globe in the sunshine' to:

- explain how the half of the Earth bathed in sunlight at any one time is experiencing day, whilst the other half is experiencing night;
- point out and explain the day/night dividing lines of dawn and dusk;
- show how equatorial regions are warmer (and feel warmer) than polar regions because the Sun is nearer to being overhead and so more concentrated;
- point out and explain how polar regions are lit in the summer but are in darkness in the winter.

Context:

A model Earth is carefully positioned in an open space outside in the sunshine in exactly the same position, relative to the Sun, as the Earth beneath. The sunlight falling on the globe lights one side (daylight) and leaves the other side in darkness (night-time). As the Earth spins beneath the Sun during the day (while the Sun appears to move across the sky), the boundaries between 'day' and 'night' (which are dusk and dawn) can be seen to move steadily across the Earth.

In the sequence of photos A, B and C, showing how the sunlit day and the night-time shadow move across the globe, extra clues to the time the photos were taken are given by the reflection of the Sun on the globe model (in the noon photo, B, reflecting directly towards the observer) and by the position of the shadow of the globe.

If the demonstration is carried out near the equinoxes (March and September) then the poles will form the dividing line between the lit and shadowed areas. However, if the demonstration is carried out nearer the solstices (June and December) one of the polar areas will clearly be lit during the 'day', whilst the other is in darkness.

Photo D can be seen to have been taken at neither the equinoxes nor the solstices, since only part of the polar region is lit by sunlight.

Following up the activity:

During the day/night demonstration, ask the pupils what people are likely to be doing in a country moving from shadow into sunlight (where day is dawning) or moving from sunlight into shadow (dusk).

During the seasons demonstration, ask where on Earth there is likely to be the greatest danger of sunburn (*where the Sun is highest overhead, giving the greatest 'dose' of ultraviolet radiation)*; when would be the best time to mount an expedition to one of the poles (*when it is in daylight most of the time)*; where there would be the greatest difference in temperature between summer and winter (*at the poles*).

Underlying principles:

- The model Earth responds in exactly the same way to sunlight as the real Earth.
- It is day when the Earth is in sunlight and night when it is not; the boundaries between the two mark dusk and dawn.
- The Sun's radiation is more concentrated near equatorial regions than near polar regions because the higher in the sky the Sun appears, the more intense the radiation.
- When we are experiencing summer, the pole tilted towards the Sun is experiencing daylight, and the pole tilted away from the Sun, darkness.

Thinking skill development:

Linking understanding of the model globe to the real globe requires bridging skills and elements of three dimensional thinking. Predictions based on the model require construction (pattern-seeking) skills. Explaining how the model reflects the real Earth needs bridging and metacognitive skills.

Resource list:

- a globe
- a stable support for the globe (eg a flowerpot)
- a rod (eg. a pencil) to mark one of the poles
- a magnetic compass (to align the pole with north or south, as appropriate)

Useful links:

Put 'day night animation' or 'seasons animation' into a search engine like Google™ to find relevant animations. Introduce the activity using the 'Screaming roller coaster' Earthlearningidea about the spinning Earth.

Source: This activity is based on a globe fixed in the Clore Garden of Science at the Weizmann Institute, Rehovot, Israel, shown in the photo below. The photo was taken in early afternoon during February.

Earthlearningidea	Strategies and skills developed
A screaming roller coaster: how fast am I travelling (due to Earth's spin and Earth's orbit)?	A quick 'starter' to remind pupils that the 'stable' Earth on which they live is in fact spinning in space (while orbiting the Sun).
Hot or not? Investigating how latitude affects the amount of solar radiation received	An activity to help pupils to visualise why solar radiation is more intense in equatorial regions than polar ones, involving abstract thinking to relate the activity to the Earth, together with construction and metacognition skills.
The seasons: an indoor demonstration of the seasons	An indoor activity to enable pupils to understand how the tilt of the Earth affects the seasons throughout the year, involving skills of construction and bridging to the real situation.
Earth on Earth: using a globe in the sunshine to show how day/night and the seasons work	A model Earth in the real sunlight brings the abstract nature of day/night and the seasons into a more concrete understanding, allowing the development of three dimensional skills and the use of construction, metacognition and bridging skills.