University of Southampton
School of Physics and Astronomy

PPARC
Supported by the Particle Physics & Astronomy Research Council

Helping Your Child with the *Earth in Space*

Introduction

In the *Earth in Space* section of the National Curriculum for Science the children will learn a number of basic ideas. These may seem obvious to us, but children need to use a lot of imagination to understand them. Any activities that demonstrate or reinforce these ideas will help the children develop the mental agility to deal with new ideas in the future.

This sheet points out mental blocks that children may have when learning about the *Earth in Space*. It also suggests 'Activities', opportunities for you to talk about things children notice around them at home or when they are out with the family. This will reinforce what they do at school and help them realise how their Science lessons relate to everyday life.

Useful Vocabulary

Sphere	planets are spherical (better than 'round')
Orbit	path followed by a planet travelling around the Sun; likewise, the Moon orbits the Earth
Rotate/spin	the Earth rotates/spins on its axis
Axis	line around which something rotates or spins; for the Earth, a line through the centre from North to South
Revolve	turn round; can mean 'spin/rotate' or 'orbit' (unfortunately)
Sunrise/sunset	Sun appears/disappears over the horizon
North South East West	children learn to use a compass

Basic Ideas

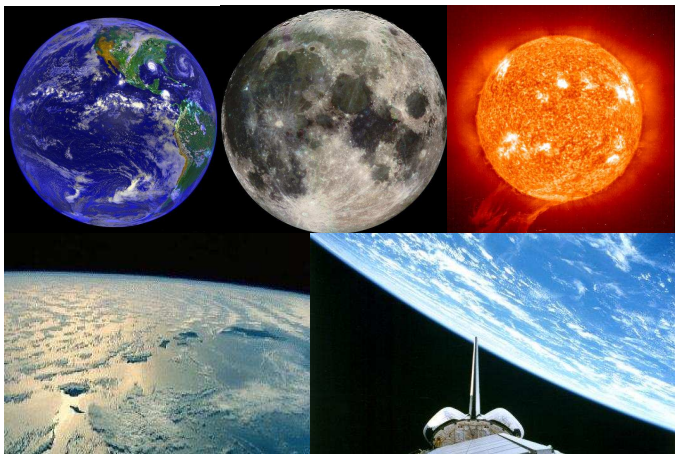
The Same Laws

The movements of the Earth, Moon and Sun are governed by the same laws of motion as objects in the everyday world around us.

Shapes

The Earth, Moon and Sun are spheres. This is not obvious just by looking at them from the ground. Evidence:

- ships disappearing over the horizon as they sail away
- people travelling round the world; astronauts orbiting the Earth
- images of the Earth, Moon and Sun from space

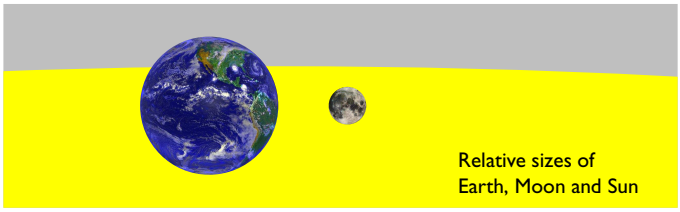


Sizes

The Sun and Moon are not as small as they look. They are not the same size as each other.

Relative sizes: Sun = beach ball, Earth = pea, Moon = pinhead.

This is particularly difficult. We can't provide direct evidence for the children. To understand this, the children have to be happy that things look smaller when they are further away. Then they may understand that the Sun appears tiny because it is so far away.



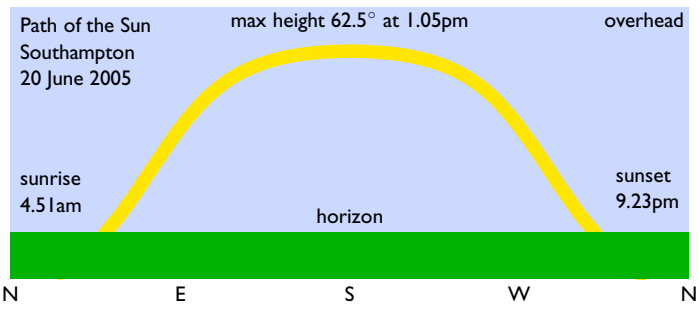
Important: never look directly at the Sun.

Activity: Point out how small something looks when it is very far away, when you are up a high tower or in a plane perhaps.

Activity: Set up a Sun, Earth and Moon arrangement using different sized balls then make them move round (spinning on their axes and orbiting).

Sun's Motion Across the Sky

The Sun rises in the east and sets in the west and it appears to move across the sky. However the Sun never moves: instead the Earth is spinning on its axis.



How can we prove this? We have to look for evidence.

Children need to be able to look at things from a different perspective to understand this.

Activity: Demonstrate this using torch and globe or even shine torch at child's face as child turns round. Child will notice that the light comes from a different direction (from their point of view) even though the torch has not moved.

Activity: Note where the Sun shines into the house at different times of day.

Activity: Look at sundials when out visiting old buildings.

Activity: Shadows — predict the direction of a tree's shadow at different times of day and the change in shadow length.

Prediction is a crucial part of science. It is important for children to work out in their heads what they think will happen. If things turn out to be different the children have to think through a new idea to explain what they see.

NB: some children use the word 'reflection' when talking about shadows. The word reflection should be used with images in mirrors but not for shadows.

Day and Night

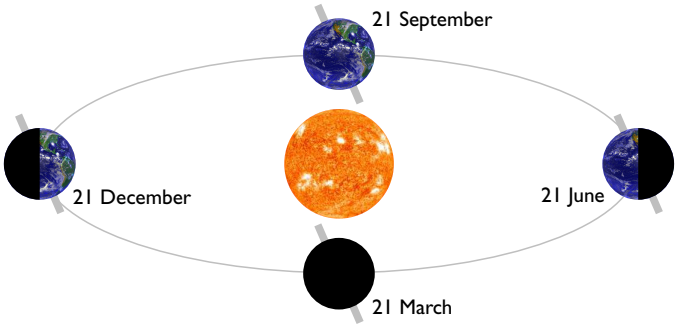
How do we get Day and Night and why are there more hours of daylight in summer?

Some children think we get night (dark) when the Sun goes behind a cloud. They need to see that, as the Earth spins on its axis, the side away from the Sun is in darkness.

It is difficult to explain why we have more daylight hours in summer: the reason is that the Earth's rotational axis is tilted with respect to the orbital plane. Children need to notice that days are longer in summer and shorter in winter but they don't have to explain it.

The Year

The Earth goes round the Sun once in 1 year. The best evidence is the seasons. The Sun also appears in the same position relative to distant stars after a year. Children need to be clear what a year is.



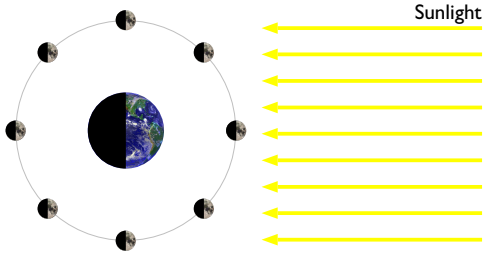
It's not true that we are further from the Sun in winter (in fact we are slightly closer, and in any case our winter is the Southern hemisphere's summer). This is a common mistake. We have to know that the North end of the Earth's axis is tilted away from the Sun to explain why it's colder in winter (this is the same reason that winter days are shorter). Children do not have to understand this at this age.

The Moon's Orbit

The Moon orbits the Earth once in 27.3 days (a lunar month).

Children often don't notice that the moon's appearance changes regularly (new moon, half moon and so on). Some think it goes through the whole sequence every night, others that its appearance changes randomly. The changing appearance of the moon is very difficult to understand. Children don't have to explain why its appearance changes at this age. They simply have to know that its appearance changes because it is orbiting the earth.

Earth and Moon seen from Galileo spaceprobe



3 7 11 15 19 23 27 1

Phases of the Moon for days in June 2005 (last image is for 1 July)

NB: even some adults think the moon really changes in size.

The Moon's Spin

The Moon rotates on its axis as it orbits the Earth so we only see one 'face'.

The 'far side of the Moon' and the 'dark side of the moon' are not the same thing.

Activity: Child has to walk round you but keep looking at you all the time. The only way they can do this is by 'spinning' on their axis.

Activity: Have a third person in a fixed position (the Sun) shine a torch on the child as they go around you. The 'far side' is the back of the child's head, but the 'dark side' is the part not lit up by the torch.

Other Observations

The moon doesn't seem to move as we travel along in the car. We can explain this because the Moon is so far away. If you watch things passing by from a car or a train you will notice that closer things whizz by faster. Distant objects move past very slowly. The moon is much further away than all these things so it hardly seems to go past at all.

Our calendar is based on the relative motion of the Earth, Moon and Sun.

Some Numbers

Earth's diameter	12,800 km
Moon's diameter	3,500 km
Sun's diameter	1,390,000 km
Earth-Sun distance	150,000,000 km
Moon-Earth distance	384,000 km

Web Resources

There is an enormous amount of astronomy material on the web. The site name may help give you an indication of the quality of the information. Sites ending in ac.uk are usually UK universities, edu are American (US) universities, while gov.uk, gov and mil are government or military organisations. You can find all sorts of things with a query to a search engine, but here are some to get you started:

http://www.hep.phys.soton.ac.uk/hycs/	Helping Your Child with Science: more copies of this leaflet and others
http://www.phys.soton.ac.uk/	School of Physics & Astronomy at the University of Southampton
http://photojournal.jpl.nasa.gov/	NASA Planetary Photojournal
http://aa.usno.navy.mil/	US Naval Observatory astronomical information
http://tycho.usno.navy.mil/vphase.html	Generates pictures showing the phase of the Moon on a date you specify (used to make the Moon phases picture above)
http://csep10.phys.utk.edu/	Online Journey Through Astronomy from the University of Tennessee, Knoxville
http://seds.lpl.arizona.edu/nineplanets/nineplanets/	Multimedia tour of the Solar System
http://www.heavens-above.com/	Starcharts and satellite information, customisable for your location

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