**National Curriculum Objectives:**
*(Statutory Requirements)*

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

**Experimental and investigative work focuses on:**

| **Planning an investigation:** | **Obtaining and evaluating evidence:** |
|---|---|
| • Pupils respond to suggestions and put forward their own ideas about how to find the answer to a question. (L3)<br>• They recognise why it is important to collect data to answer questions.(L3)<br>• Pupils recognise that scientific ideas are based on evidence. (L4)<br>• In their own investigative work, they decide on an appropriate approach to answer a question. (L4) | • Pupils use simple texts to find information. (L3)<br>• Pupils make observations and use a range of simple equipment to measure quantities (e.g. length, mass, volume). (L3)<br>• They record their observations and communicate them in a variety of ways, including graphs (L3)<br>• They provide explanations for observations and for simple patterns in recorded measurements (L3)<br>• Pupils select information from sources provided for them. (L4)<br>• Pupils make a series of observations and measurements that are adequate for the task. (L4)<br>• They record their observations, comparisons and measurements using tables and bar charts (L4)<br>• They use these graphs to point out and interpret patterns in their data (L4) |

***Key vocabulary:***
**Previously taught:** sun, light, dark, moon stars, day, night, shadows, axis, spin, rotate, transparent, translucent, opaque, direction, light travels

**New:** sphere, revolve, orbit, sunrise, sunset, position, relationship, Ptolemy, Copernicus, planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus), dwarf planet (pluto), moons

| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
|---|---|---|---|---|---|
| 1 | **LO: To show what I know about the Earth, sun and moon.** | Start this unit by finding out what the chn already know. Ask: *what would the Earth, sun and moon look like if you were travelling in outer space? What would it look like as viewed through the cockpit of a space ship?* **Title: what I know about the Earth, sun and moon.** Encourage the chn to draw what it would look like and to record their ideas/ knowledge about each. Discuss their ideas with a partner and consider the questions on the board. What shape is the Earth? Which is the biggest- the Earth, the sun or the moon? How do they move? Listen to the children's ideas as they discuss.<br><br>Ask children what they would like to find out in this unit (record and display).<br>**What I would like to learn about in this unit.** | Provide chn with pictures. How do they compare with their drawings? What does the Earth look like? Why? (Goldilocks Planet clip) What shape is the Earth? How do they know? Explain that these pictures are taken by powerful satellites and telescopes. But these have only become available in the last 50 years. What other evidence do they know about that would support the idea that the Earth is spherical.<br>(A large ship can be seen to disappear over the horizon gradually & if you then climb a high hill you can see it again! A ship can sail away, disappear and then turn round and reappear.)<br><br>**Q: Have people always thought that?** The Ancient Greeks realised Earth was round - different star constellations could be seen from different parts of the world, but the Mediaeval Church thought it was flat and sea farers would be nervous in uncharted waters in case they fell off the edge! (Watch- how do we know the Earth is spherical?)<br><br>**Q: What evidence were people using to make them think the Earth was flat?** (Direct evidence of the senses: the Earth looks flat, the Earth feels flat)<br>It was also a question of common sense – before Isaac Newton came along and explained about gravity to people, they wouldn't have accepted the Earth was a sphere, because they would have thought that the people on the other side of the planet (Australia) would have fallen off the world.<br><br>**Q: Were people using good scientific evidence to conclude the Earth was flat?** (They may say no – but remind them that we often tell them to use their senses | Discuss the term **Direct evidence** (see notes at end of planning)<br><br>Discuss the following four pieces of evidence:<br>1. A person saying 'from the surface of the Earth, the ground looks flat'<br>2. A person saying, if you watch ships sail out to sea, they seem to get lower and lower and then sink out of sight.<br>3. Travellers who set off in one direction by boat and keep going end up back where they started.<br>4. Photo of the Earth taken from space. | Pictures<br><br>Clear beakers of water |

| | | | | | |
|---|---|---|---|---|---|
| | | | in science, and that evidence of the senses is useful and necessary – we have to use our senses to make observations and collect data. There is nothing wrong with saying that the Earth **looks** flat – it does look flat! What is wrong is to jump to the conclusion that because it looks flat, it is flat.<br>Send the children to their tables to complete activity.<br><br>**Activity** (mixed ability groups):<br>One transparent cup on each table half-filled with water. Each child to have a go at putting a pencil in the water, and complete the questions on the sheet:<br>**1. What do you observe? How does the pencil look?** (bent where it enters the water)<br>**2. Does this mean the pencil really is bent?** (no)<br>**3. How do you know? What evidence can you give?** (take it out of the water, feel it) | | |
| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
| 2 | **L O:To understand the relative sizes of the Earth, Moon.**<br><br>*I know that the Earth, Sun and Moon are spherical and understand their relative sizes.* | Recap with the children the shapes of the earth, sun and moon. Can they identify objects in the room that are spherical?<br><br>**What are the relative sizes of the Earth, Sun and Moon?**<br>Show children the BBC video (see below).<br>http://www.bbc.co.uk/learningzone/clips/how-do-we-know-the-earth-is-spherical/2457.html<br>Get children to sit in a circle and put all the spherical objects in the middle. These will include various sized balls from PE cupboard, as well as an orange, a pea, a peppercorn and a tiny bead. Ask the children to choose the three that best represent the relative size of the Earth, Sun and Moon. [peppercorn = moon, pea = earth, large beach ball = sun]. Tell the children that this is still not quite accurate, but it gives them an idea. | Tell children that the practical difficulties of showing the Earth, Sun and Moon to scale is not a bad thing – it just shows them how huge the size and distance of the Sun is in relation to the Earth.<br><br>Children to draw this representation into their books.<br><br>Show the children an image of the Earth orbiting the sun from the mid 1800s (the Muggletonian Print). Tell the children that as more scientific evidence was gathered we learned that this depiction was not accurate. The size of the Earth relative to the Sun was much smaller and the distance between the two much greater. | Discuss actual sizes of the Earth, Sun & Moon. They are huge numbers! Sun diameter (what does 'diameter' mean for a 3D sphere?) = 1,392,530km, Earth diameter = 12,756km, Moon diameter = 3,476km. Distance of Earth from Sun = 152,000,000km, Moon from Earth | Balls of varying sizes, Post-its |

| | | | | | |
|---|---|---|---|---|---|
| | | In terms of distance, if you put the peppercorn about 25 cm from the pea, the beach ball needs to be about 93 metres away. | | = 384,622km.<br>If time, look at other facts about each.<br>Provide the chn with post-its.<br>Write facts that are true and that are false. Pass them to another table. Can they sort them into those that are true and those that are false? | |
| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
| 3 | **LO: To know that the earth rotates on its axis to create night and day.**<br>*I understand why our shadows change, and why we have day and night.*<br>*I understand why our shadows change, and why we have day and night.* | This needs to be started in the morning so Literacy will need to swap to the afternoon this week.<br><br>**Activity 1** (Inside)<br>**Q: Why do we have shadows?** (A shadow appears when an object blocks a light source such as the Sun.)<br>**Q: Do you have a shadow in the classroom? Why?** (Yes, anywhere there is a source of light, you will cast a shadow.)<br>**Q: If you are standing outside and the Sun is behind you, where will your shadow be?** (In front of you. Shadows always point away from the source of light which causes them). | **Activity 2** (Outside)<br>Go outside. Put children in pairs. One should stand with their feet together. One partner to draw around the other partner's feet, and then around their shadow. Write child's initials in feet. Then swap so both children have been drawn around. Then each child to measure the length of their shadow using a metre ruler. Explain how to record results rounded to nearest cm.<br><br>Use the shadows worksheet<br>Ask the children to predict what will happen to their shadows during the day, and why. Fill in prediction on the shadow worksheet.<br><br>Try to take measurements at 10 am(half way through first science session), 11am (this will be noon in BST. Chn stay outside at the end of break) and 2pm (after English). Get | Evaluate shadows investigation as a class.<br>**When were our shadows shortest?**<br>**When were they longest?**<br>**Why is this?** | Shadows worksheet<br><br>Chalk<br><br>Metre ruler |

| | | | | | |
|---|---|---|---|---|---|
| | | | children to observe what happens to their shadows and record the lengths in their results table on the shadows worksheet.<br><br>Children to graph their results. Model how to plot points on axes, and then join the points. Then children to complete a graph of the results of their shadow investigation. Children to use pre drawn axes on results sheet.<br><br>NOTE: If weather is bad, children to use websites to research the subject of shadows (see links) – but the activity should be completed when possible.<br><br>**Shadows website:**<br>http://www.schoolsobservatory.org.uk/astro/esm/shadows<br>http://www.childrensuniversity.manchester.ac.uk/interactives/science/earthandbeyond/shadows/<br><br>HA-Time zone question. | | |
| | | | | | |
| 4 | **LO: To know that the earth rotates on its axis to create night and day.**<br><br>*I understand why our shadows change, and why we have day and night.* | Ask the children to consider three explanations for the changing shape and position of the shadows:<br>1. The sun moves from one side of the sky to the other.<br>2. The Sun goes around the Earth<br>3. The Earth turns around so the Sun seems to move.<br><br>**Q: Is the direct evidence of the Sun and the shadows enough to tell us which explanation is right?**<br>Ask children to think if they've been in a car or a | **Activity 1 (Outside).**<br>Get everyone to link hands in a circle facing outwards. Then remove four children. Make them make a smaller circle, hands joined looking outwards. Tell the large circle it represents the Sun, and the small circle it represents the Earth. Tell children that the Sun is about 100 times the diameter of the Earth. So if the Earth's diameter is made from 4 children, how many children should be making the Sun? About 400 – put this number in the context of your school. [Make sure higher ability children understand that although the Sun is 100 times the diameter of the Earth, it is much bigger than that in terms of volume or mass] The Sun should stand still. The Earth | Where in the world is it the same time as in the UK? Despite being far away, South Africa has the same time as us because we both face the Sun at the same time. Show children Sunrise and sunset clip. | **Day and night website:**<br>http://www.childrensuniversity.manchester.ac.uk/interactives science/earthandbeyond/dayandnight<br>**BBC Clip:**<br>http://www. |

| | | | | | |
|---|---|---|---|---|---|
| | | train when the car or train next to them seems to move, and they thought it was theirs? This helps to show why the evidence from the senses can be explained in different ways – it can mean the vehicle you are in is moving past the other one – or that vehicle is passing yours. Similarly, the turning of the Earth means the Sun is facing different parts of the surface at different times which makes it seem to travel across the sky. | should rotate in its circle in an anticlockwise direction [NB – just rotating on its 'axis' – not orbiting the sun – that is happening in next session]. Tell the children this explains why the Sun looks like it moves across the sky. Repeat the activity a few times with other children experiencing the view from 'Earth'. Ask:<br>**Q: What causes day and night?**<br>**Q: Why is it dark at night?**<br>**Q: Is it night for the whole planet at the same time or different times?**<br>**Q: When it is noon in one part of the world, where will it be midnight?**<br>**Q: In what direction does the Sun appear to rise? Why?**<br>**Q: In what direction does the Sun appear to set? Why?**<br>The direction of sunrise and sunset is caused by the planet rotating in an anticlockwise direction.<br><br>**<u>Activity 2 (classroom)</u>**<br>Introduce the words: Rotation, Spin, Axis & discuss meaning. The scientific explanation for the Earth's movement is that 'it spins or rotates on its axis'.<br>**Q: How long does it take the Earth to rotate once?**<br>24 hours – which we call a day. Show the children the Day and Night website.<br><br>Show the children a globe and identify the North and South pole, and where its axis would be. Locate various continents on the globe.<br>Get a child to stand up to represent the sun.<br>Ask other children to identify where in the world it is day and night as you rotate the Earth on its axis – NB should rotate anticlockwise. Children should see that it is day in China before it is day in UK – this explains time difference between countries. Show children BBC clip. | | bbc.co.uk/learningzone/clips/day-and-night-on-earth/1874.html<br>**Sunrise and Sunset website:**<br>http://www.childrensuniversity.manchester.ac.uk/interactives/science/earthandbeyond/sunrisesunset |

| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
|---|---|---|---|---|---|
| 5<br><br>POS: Describe the movement of the Earth, and other planets, relative to the Sun in the solar system Describe the Sun, Earth and Moon as approximately spherical bodies | **LO: To know that the earth rotates on its axis at an angle and as it orbits the sun that is how we get seasons.**<br><br>**To know that an orbit around the sun takes 365 and a quarter days.**<br><br>*I can talk about the four seasons and describe why they happen each year.*<br><br>*I understand that the Earth orbits the Sun as it rotates on its own axis.* | Revise key points from previous two sessions. The Earth, Sun and Moon are roughly spherical, due to the distances involved, the Sun looks small but is actually 1 million times larger in volume than Earth (i.e. a million Earth's would fit inside the Sun if squashed together)! Remind chn that the Earth revolves once in 24 hours to create night and day & than the Sun's diameter is 108 times longer than the Earth's. See http://www.bbc.co.uk/learningzone/clips/how-big-is-the-sun-in-relation-to-earth/8950.html.<br>Remind chn that not only does the Earth rotate on its axis, but it also orbits the Sun once a year in an anticlockwise direction. Demonstrate this for chn using a large ball and a globe. One chd standing still holding the large ball while the smaller globe (Earth) starts to spin on its own axis. Place a figure on globe reinforcing the creation of night and day. With Earth still spinning ask the chd to orbit the Sun. Take a look at animated simulations of this such as the excellent BBC mini clip http://www.bbc.co.uk/schools/scienceclips/ages/9_10/earth_sun_moon.shtml. | Take a look at the UK daylight hours information.<br><br>Which months have the longest amount of daylight? Look at the four seasons of the year. What do we know about each? What annual events occur in them? Which is closest to their birthday for example? Draw out words Spring, Summer, Autumn and Winter - our seasons (in the UK – whereas in tropical countries there are only two seasons – dry and rainy). How do seasons differ? How long are the days? When do the longest & shortest days occur? What weather conditions do we associate with them? Ask a chd to hold a bright torch and start to spin the Earth with pencil through it on its 23.5 degree angle. Ask chn to notice how one hemisphere is always tilting towards the sun and therefore warmer. Meanwhile in the other hemisphere which leans away from the Sun, the angle means the Sun's rays are spread over a larger area and therefore it is cooler. Show this using a torch beam hitting the equator of a globe (circle of light) and then hitting an area nearer the poles – the light takes on a more oval shape & is more spread out. Then compare the beam falling on areas tilting towards & away from the Sun (use a felt tip pen to draw around the area of light in different 'seasons' to show this). Look at online version of this at http://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html (position observer at latitude of about 53°N) & watch the area of sunlight change shape through the year. Challenge chn to draw diagrams to show this. | Record data and results using scientific diagrams and labels and models<br>**Present findings in written form. MAIN outcome**<br><br>Able pupils to be able to explain why the day length is shorter. Can complete a line graph to show the comparison of temperature and hours of the day on a set of given axis | |

| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
|---|---|---|---|---|---|
| 6 | To investigate the Moon's | Show class James Nasmyth's drawing called 'Copernicus'. By prompting with questions, see if they can guess what the drawing shows. | Ask the children to record the facts about the Moon in their books ensure they include the following:<br>1. It is about a quarter of the size of Earth | Do the children understand what the moon is? Are | Netbooks<br>Image of James |

| | | | | | |
|---|---|---|---|---|---|
| | phases and orbit of the Earth | Explain that this is a drawing of a crater on the moon, observed through a telescope by James Nasmyth in the 1800s, who then drew with chalk what he saw.<br>**Q: What is the moon?**<br>Discuss, then show<br>http://www.bbc.co.uk/learningzone/clips/what-does-the-moon-look-like-why/8957.html<br><br>**Q: What is a month?**<br>Read and discuss the following:<br>The first calendar was probably made by the people of Mesopotamia (where Iran is now) about 6000 years ago. Calendars were needed to help farmers know when to plant their crops ready for the summer, and when to pick them before the winter came. They also needed to know when rain would be likely to fall, or rivers likely to flood. So they took a lot of interest in the changing seasons. They noticed that the seasons followed a regular pattern, or cycle: spring, summer, autumn, winter. We call this cycle one year.<br>The trouble is, seasons do not start and finish on one particular day each year. Spring arrives late some years, and summer may stretch on longer in some years than others. People needed some more accurate way in which to divide up the year. Some of the sky-watchers (astronomers) noticed that the Sun was not the only object that seemed to move across the sky. So did the moon. Also the moon changed its shape from a thin crescent like a thumbnail (called the New Moon) to a complete circle (full moon) and back again to a new moon, roughly every 28 nights. The astronomers noticed that this cycle happened between 12 and 13 times a year. That is why, to this day, we divide a year up into months (moons).<br>Because the Moon orbits the Earth, we call it a | 2. It is about 250,000 miles away in space<br>3. It orbits the Earth in the same direction as the Earth is spinning and takes about 28 days to complete its orbit.<br><br>**Q: What do we see when we look at the Moon each night for a month?** Show<br>http://www.bbc.co.uk/learningzone/clips/the-moon-and-its-orbit-around-the-earth/1596.html<br><br>**Activity** (Mixed Ability pairs):<br>Give children time to investigate the three websites below. Both involve the children using all of the knowledge they have gained so far in terms of orbits. This is a complex topic and research suggests that seeing it explained in a number of ways helps rather than hinders understanding.<br>http://www.bbc.co.uk/schools/ks2bitesize/science/physical_processes/earth_sun_moon/play.shtml<br>BBC game about orbit of earth and moon around sun. Interactive.<br>http://www.earthsunmoon.co.uk/<br>Good interactive website. Can be designed for 2 players/children. Games mixed with research<br>http://engineeringinteract.org/resources/astroadventure/astroadventurelink.htm<br>Astroadventure made by Cambridge University | they able to explain what a month is? | Nasmyth's Copernicus. |

| | | | | | |
|---|---|---|---|---|---|
| | | satellite of the Earth. Now humans have put lots of man-made satellites into space which orbit the Earth – so some people call the moon a 'natural satellite' | | | |
| Session | Learning Objectives | Introduction | Main activity | Application and review | Resources |
| 7 | To learn about our Solar System and man's journeys into space. | **Q: Do you think sending humans into space is a good idea? Why or why not?**<br>**Q: Do you think everyone agrees with you?**<br>**Q: What are the pros and cons for spending money on space exploration?**<br>Examples: Pros – technology developed for space travel has ended up benefiting life on earth such as earthquake prediction systems, robotic hands, toothpaste tubes, food packaging.<br>Cons – waste of money. Should be spent on hospitals/schools etc.<br>**Q: What challenges are faced by astronauts working in space, for example in the International Space Station?**<br>http://www.bbc.co.uk/learningzone/clips/weightlessness-in-space/1600.html<br>**Q: What difficulties did she face which we didn't think of?**<br>**Q: Who thinks they might like to be an astronaut? Why?**<br>http://www.bbc.co.uk/learningzone/clips/what-is-it-like-to-be-an-astronaut/5683.htm | Explain the main activity to the children.<br>Model brainstorming possible questions but leave room for the children to come up with their own.<br>In pairs, imagine that one of you is an astronaut who's just got back from a journey through our solar system. First as a pair brainstorm questions you might like to ask.<br><br>Model using the below websites to find the answers. Then children use the websites to find what the answers might be. Try to be as realistic as you can – and include as much scientific information as you can. Finally, put your questions and answers into a script for a radio show designed for kids about space.<br><br>Use website to research solar system:<br>http://www.spacekids.co.uk/solarsystem/<br>Use this website to research living on a space station:<br>http://www.esa.int/esaKIDSen/SEM52JWJD1E_LifeinSpace_0.html | Show the picture of the Orrery and discuss how it is a model to show the movement of the planets.<br>**Q: What do you notice? (Uranus is missing)**<br>**Q: Why would that be? (It had not been discovered yet)**<br>**Q: How many planets are there in our solar system?**<br>8 – Pluto was down-graded in 2006.<br>**Q: What are their names?**<br>Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune<br>Explain concept of a mnemonic to help remember the names.<br>Some fun ideas on Wikipedia including a | Orrery picture, netbooks, |

| | | | | | |
|---|---|---|---|---|---|
| | | | | physical one using fingers. http://en.wikipedia.org/wiki/Planetary_mnemonic As many pairs as possible to do their performance to the class. | |

Introduce the term **direct evidence**. It is similar to saying 'first impressions' – they need to understand that direct evidence can be misleading. The **direct evidence** of the beaker of water would suggest the pencil is bent. If we just accept that the pencil is bent because that it is how it looks, we would be wrong. We need to check more carefully, and look for other evidence to discover the real shape of the pencil. With the pencil, that is easy – you can just take it out of the water (this would be using more direct evidence). But that is difficult when we are talking about the shape of the planet we live on. Unless we can fly out into space and have a look, we have to accept other more indirect evidence.

Discuss the following four pieces of evidence:

1. A person saying 'from the surface of the Earth, the ground looks flat'
2. A person saying, if you watch ships sail out to sea, they seem to get lower and lower and then sink out of sight.
3. Travellers who set off in one direction by boat and keep going end up back where they started.
4. Photo of the Earth taken from space.

For each piece, ask some or all of the following questions:

**Q: How strong is the evidence? How direct?**

**Q: What does the evidence suggest?**

**Q: What is the most obvious conclusion it points to? Could the obvious conclusion be the wrong one?**